

# WonderBorg™

Build & Program Your Own Interactive Creature!

Instruction  
Manual

### A word from Tiger Electronics

Thank you for buying the WonderBorg. Please read this instruction manual carefully before using your Wonderborg, and always use the product as directed. We also recommend that you keep this instruction manual in a safe place.

### What is the WonderBorg?

The WonderBorg is a robot kit developed especially to let you experience the fun of creation. It's easy and fun to assemble the WonderBorg, even if you have no special knowledge of programming or mechanical engineering. Let the WonderBorg introduce you to the wonderful world of robots!

### Caution

#### Be sure to read this

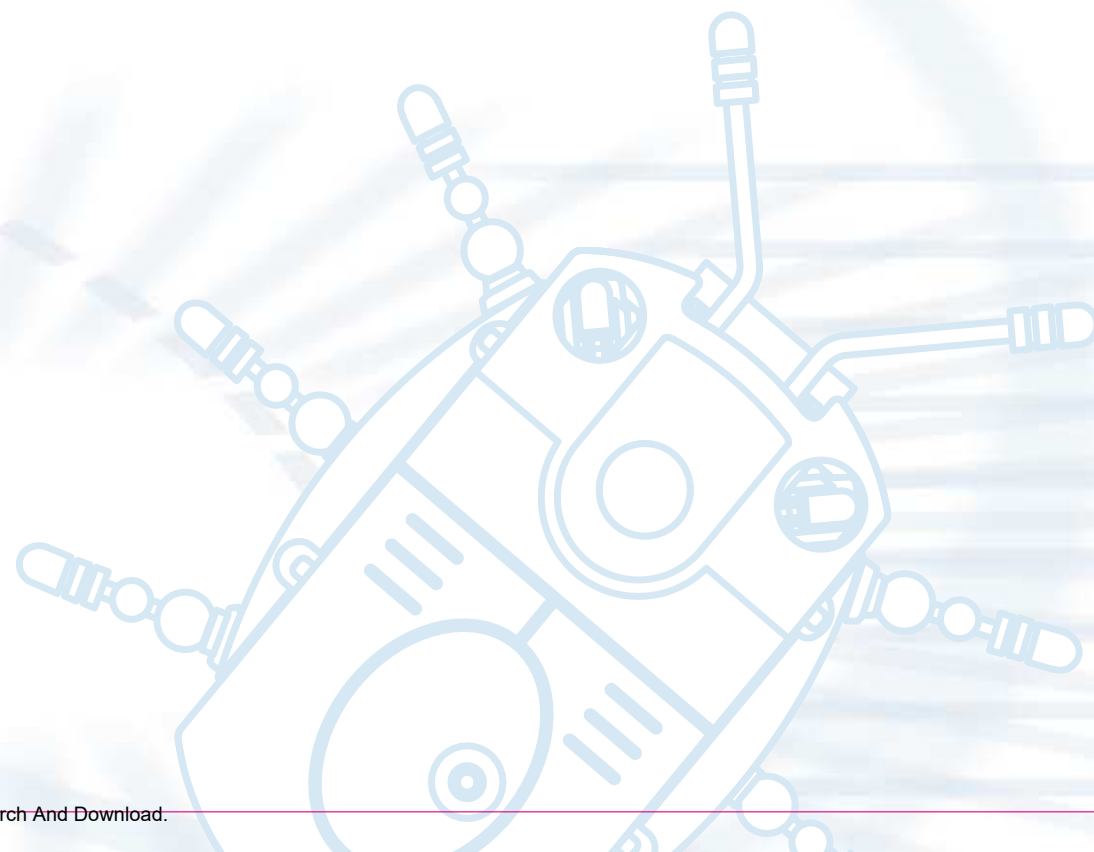
- Please be sure to read this instruction manual thoroughly before operating the WonderBorg.

#### Notes on Handling:

- Do not touch the terminals or allow them to get wet or dirty, as this could cause the product to malfunction.
- This product is a piece of precision machinery. Do not use or store it in extreme temperatures, or subject it to severe shocks. Under no circumstances should the electronic parts in this product be disassembled.

#### Notes on Use:

- This product is comprised of precision electronic parts. It should not be dropped, allowed to get wet or dirty, or disassembled. Avoid using or storing this product in environments where the temperature is very high or very low.
- Inevitably, some of the parts have sharp points and dangerous edges, so please take care when assembling the product.
- Attempting to operate the WonderBorg using an infrared remote control device for another appliance such as a TV set may cause this product to malfunction.
- Malfunctions may occur if the product is placed beside a window in direct sunlight, directly below a fluorescent light or other strong light source.
- If a malfunction occurs, switch the power OFF, then ON again.
- Do not place stickers over the transmitter and or the receiver as this could cause malfunctions.
- If any object gets in the way between the transmitter and receiver, the product will become unable to sense infrared, and will cease to function.
- When the batteries run low, malfunctions may occur. In this case, replace the batteries.
- This product uses reflective sensors, so the infrared sensor may be unable to function on dark-colored walls and floors. Please use the product on light-colored walls and floors.



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### Hardware Variations:

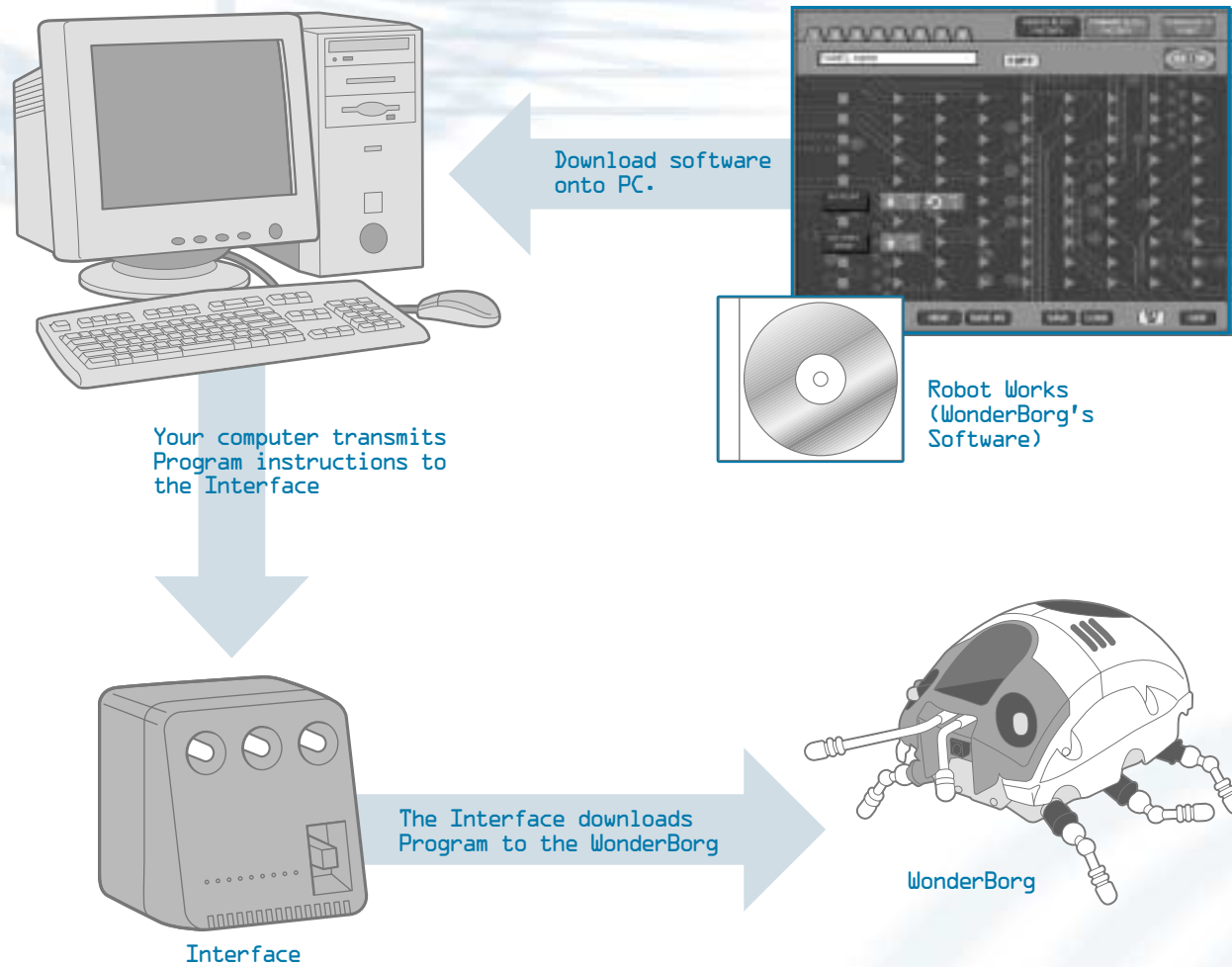
Advanced Fun with the WonderBorg

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### Configuration of the WonderBorg



### WonderBorg

The WonderBorg is a robot you assemble yourself. It has feet that can move backwards/ forwards and right / left, various sensors, and its own built-in computer. Its movements are controlled by programs you can create on your PC.

### Robot Works

Robot Works is the WonderBorg's own programming software. You install this software on your computer from the CD-ROM included. By simply lining up blocks on your computer screen, you can create your own programs for the WonderBorg.

### Interface

The Interface is the device that transmits your programs from the PC to the WonderBorg. It also sends infrared signals to the WonderBorg transmitting the information you designed in your program.

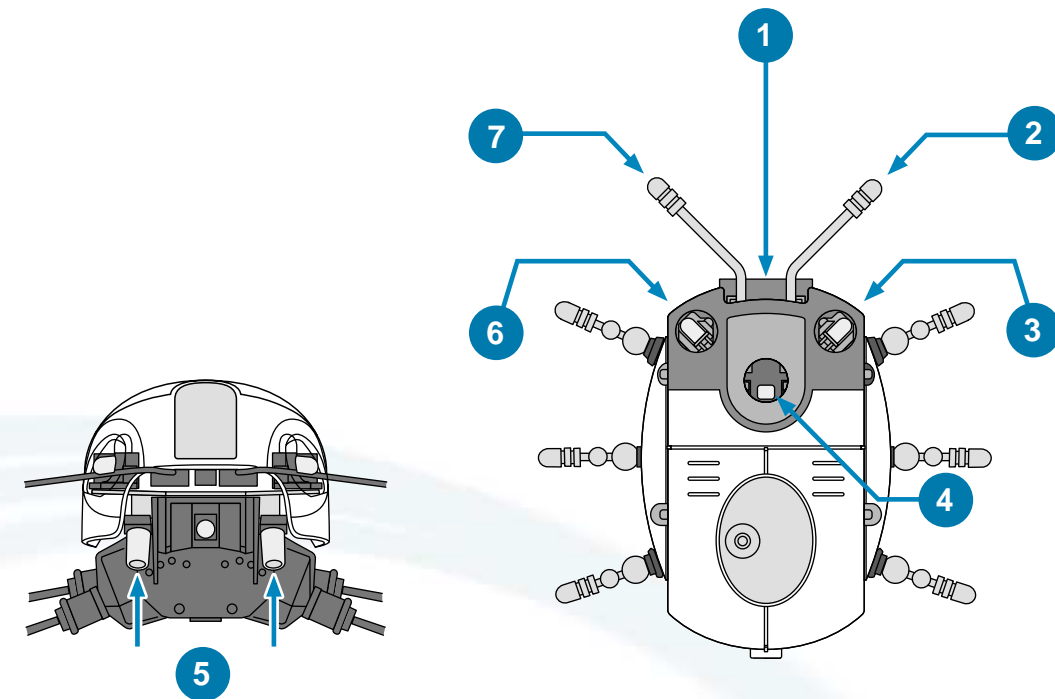


### The WonderBorg's Body

The computer determines how the WonderBorg reacts to information perceived by the sensors. The left and right legs are moved by their respective motors. When the legs on both sides move forward, the WonderBorg advances. When the legs on the right move forward and the legs on the left move backward, the WonderBorg turns to the left.

The various sensors are shown below

### WonderBorg's Sensors



1. Infrared signal receiver.: Distinguishes infrared signals coming from the Interface
2. Antenna (right): A sensor in the antenna socket enables the robot to react when the antenna touches something
3. Infrared LED (right): Used to detect objects up to 20cm away
4. Brightness sensor: Distinguishes between light and dark
5. Floor sensor: Used to decide whether the floor is there or not
6. Infrared LED (left)
7. Antenna (left)

\*Also has:  
 Internal clock sensor: Keeps track of passage of time  
 Step sensor: Counts how many steps the WonderBorg has walked

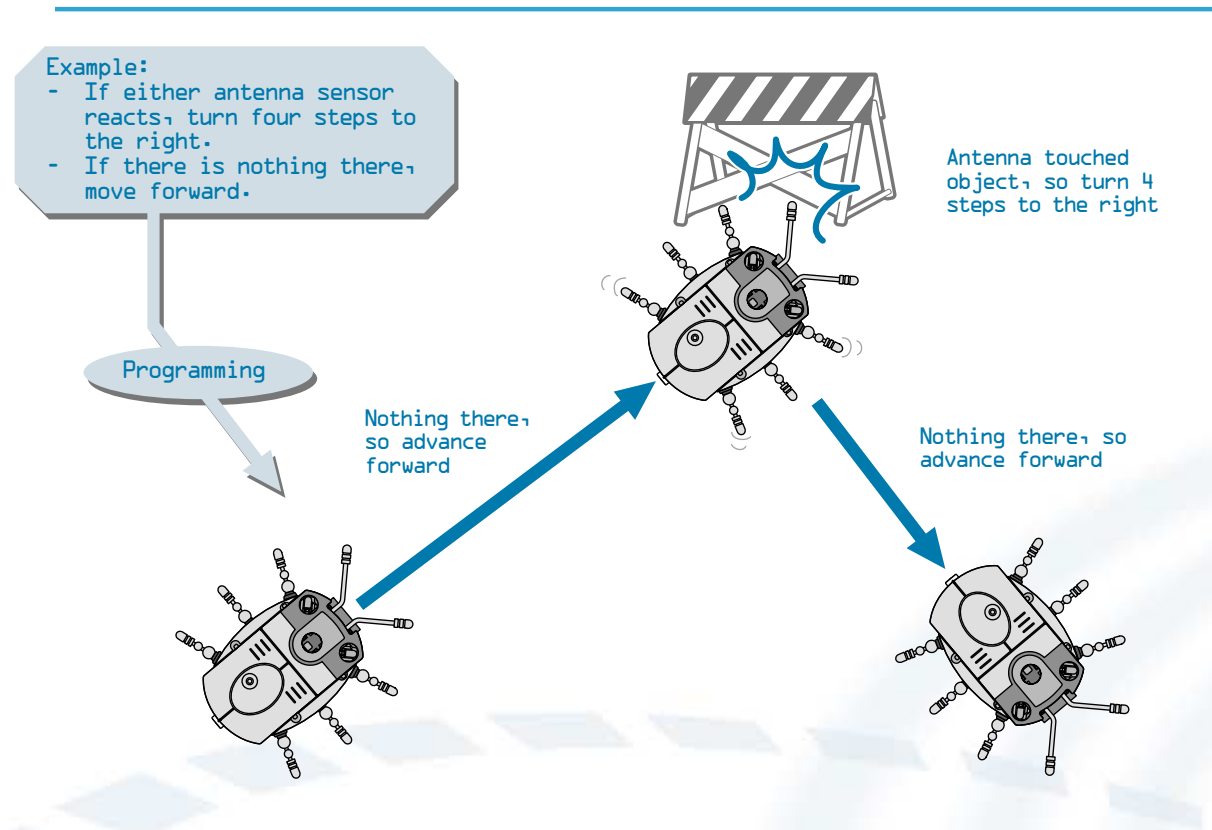
The computer links the sensors with the WonderBorg's movements (i.e. the working of the right and left motors) in accordance with the program written by the user.



### The WonderBorg's Intelligence (i.e. the Program)

The robot's sensors and its movements are linked together by the program, which could be called the WonderBorg's "intelligence".  
 For example, you could program the WonderBorg as follows: "if either antenna sensor reacts, turn four steps to the right" and "if there is nothing there, move forward (advanced)". In this case, the WonderBorg will change direction when it bumps into an obstacle, as shown in the illustration below. If none of the Sensors are activated, the WonderBorg will walk forward.

To make the WonderBorg Change direction when it bumps into an obstacle:



### How to Make the WonderBorg Work

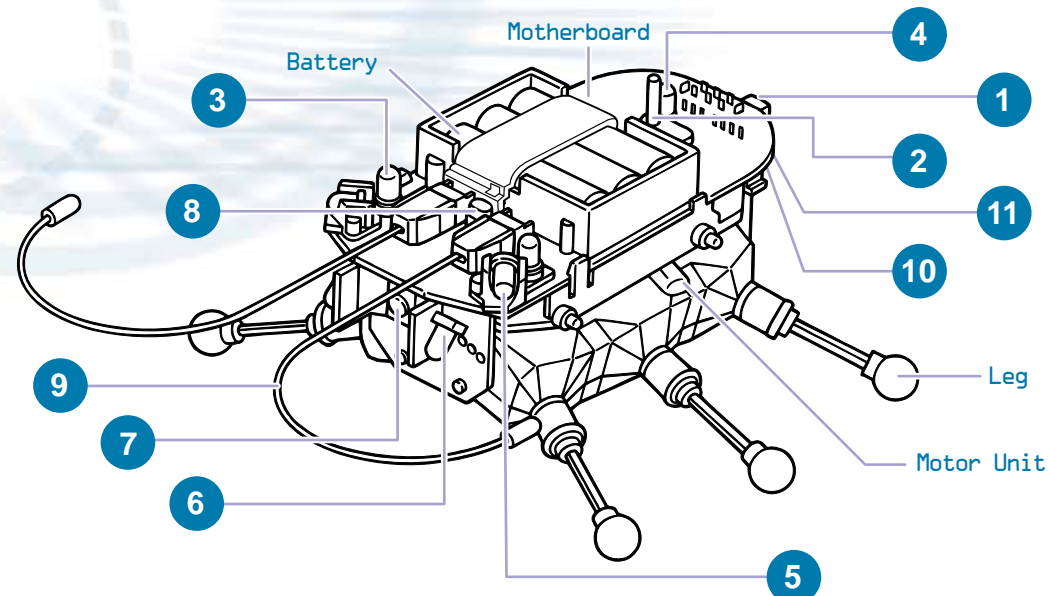
1. Assemble the WonderBorg
  2. Connect the Interface
  3. Install Robot Works on your PC
  4. Use Robot Works to create a program
  5. Transmit your program to the a WonderBorg
  6. The WonderBorg will move.
- See the "HARDWARE" section, starting on page 7, for instructions on assembling the WonderBorg. This section also contains a parts list for the WonderBorg kit, and gives the name and function for each part.
  - See the "SOFTWARE" section, starting on page 24, for instructions on installing Robot Works, connecting the Interface, transmitting programs to the WonderBorg, and making the WonderBorg move.



**AUTONOMOUS**  
**INFRARED RECEIVER**  
**PROGRAMMABLE**  
**CUSTOMIZE**



### Names of Parts



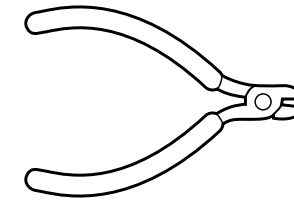
- 1. POWER switch**  
When this switch is turned ON, the WonderBorg enters standby mode. When the WonderBorg is not in use, this switch should be turned OFF.
- 2. START/STOP switch**  
If this switch is pressed once while the power is ON, the WonderBorg will start moving in accordance with the program. If the switch is pressed again, the WonderBorg will stop moving.
- 3. Eye (Red LED)**  
This LED is a Light-Emitting Diode. The eyes will flash when the WonderBorg detects the presence of a wall, or an infrared signal. The flashing of the eyes is controlled by Robot Works.
- 4. Green LED**  
This LED flashes while the program is being executed, and while the program is being halted. When the floor sensor is OFF, the green LED flashes rapidly. When the POWER switch is turned OFF, the green LED goes out.
- 5. Infrared LED 1**  
This LED sends out infrared rays. It is used to detect obstacles lying ahead and to send signals to other WonderBorgs.
- 6. Infrared LED 2**  
This LED sends out infrared rays to keep track of whether the floor is there or not.
- 7. Infrared Receiver**  
This is the sensor that receives infrared rays. It receives programs with infrared signals.
- 8. Light Sensor**  
This is the sensor that detects whether the WonderBorg's surroundings are light or dark.
- 9. Antennae**  
The socket of each of the antennae is a sensor. The WonderBorg can be programmed to react when one or both of its antennae touch something.
- 10. Connector**  
This connects the motors units and the motherboard.
- 11. Option Connector**  
This is an external input / output terminal. It can be used to add an extra sensor or other device.



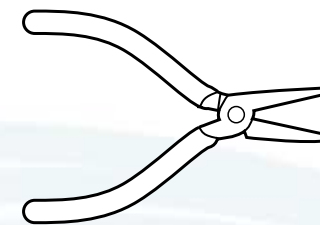
### Tools Required

Note: These tools are not supplied with this product.

#### Wire-cutters



#### Needle-nose pliers



#### Philips screwdriver

Note: This tool is used in the Hardware Variations section.



#### Others

AA alkaline battery: 2

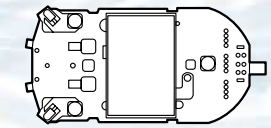
AAA alkaline battery: 3

Note: The AA and AAA batteries are not included with this product and must be purchased separately.

### List of Parts

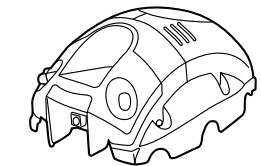
#### Electronic Parts

Motherboard: 1

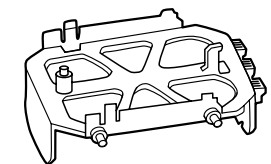


#### Plastic Parts

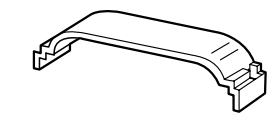
Body Shell: 1



Frame: 1

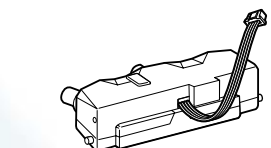


Battery Cover: 1



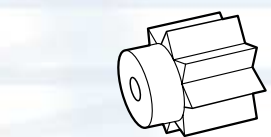
#### Motor Parts

Motor unit: 2

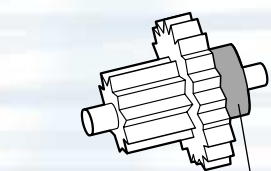


#### Replacement Gears

Pinion Gear 2 (white) (low-speed, high-torque type) 2



Gear Unit A-2 (low-speed, high-torque type) 2



Black ring

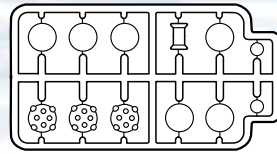


### List of Parts

#### Set of Rubber Parts (with runners)

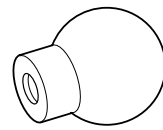
Set of Rubber parts:

2



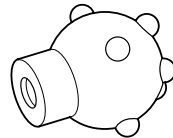
Foot A:

6



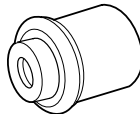
Foot B:

6



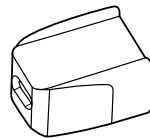
Leg Housing:

2



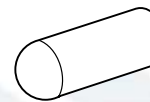
Antenna socket:

2



Antenna Protector:  
(2 are spares)

4



Plastic Antenna:

4



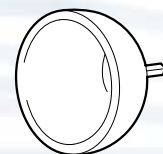
Plastic Leg:

8



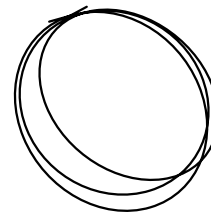
Tire Foot:

8

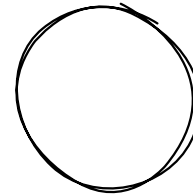


#### Other Parts

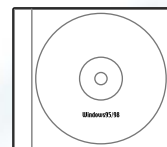
Special plastic leg wire (thick): 1



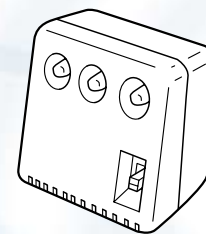
Special plastic antenna wire (thin): 1



Robot Works CD: 1

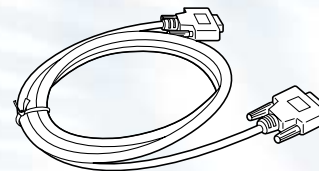


Interface: 1



Interface Cable

(RS-232C serial connection): 1



Sheet of decals: 1

Instruction Manual (this manual): 1

Test Field: 1

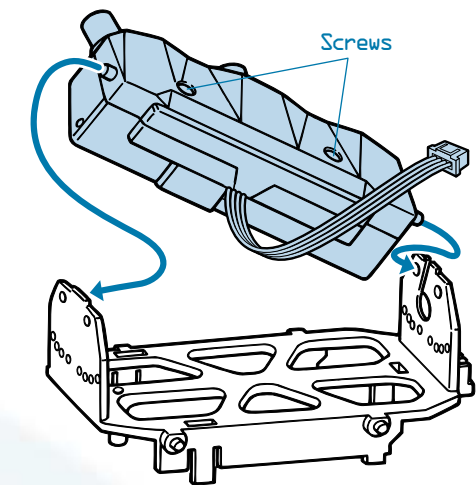
### The Basics

#### Assembling the Mechanism

##### 1-1

Using your fingers to open the frame slightly, take one of the motor units and slot the pins on its front and rear into the holes in the frame. The motor unit should be inserted so that the cable exit is facing the inside, and the screws are uppermost.

Note: Be careful to insert the motor unit the right way up.



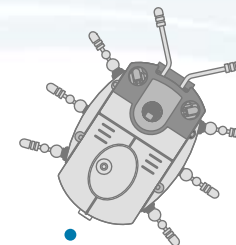
Now, at last, you are ready to start assembling the WonderBorg.

Please be sure to follow the instructions exactly.

You will need to be extremely careful, because you are going to assemble a set of precision electronic parts.

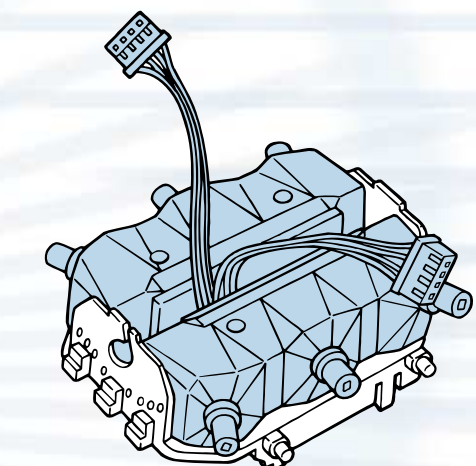
Be careful not to mix any of the parts which look similar to one another, such as the gears.

But don't worry too much, or it won't be any fun. Have fun assembling your WonderBorg - just take it nice and slow.



##### 1-2

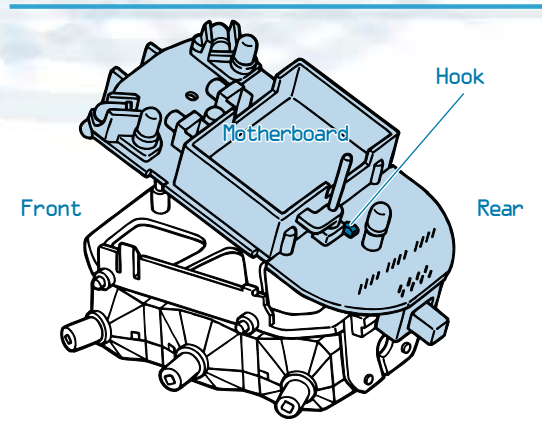
Insert the other motor unit in the same way. Make sure the cables are protruding, as shown in the diagram. The assembly of the WonderBorg mechanism is now complete.



### Installing the Motherboard

#### 2-1

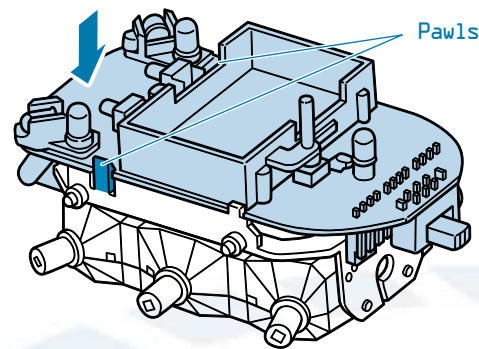
Slot the hook on the frame into the hole at the rear of the motherboard.



#### 2-2

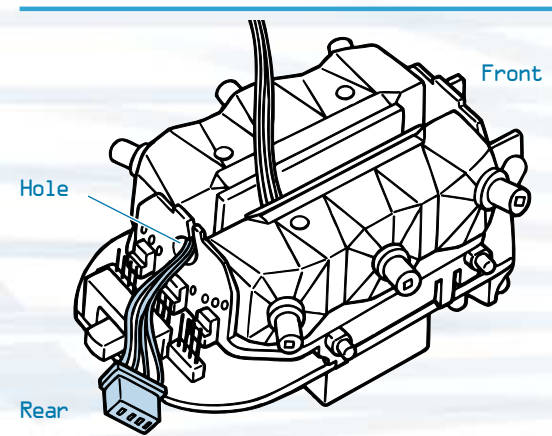
Press the motherboard down with your fingers until the pawls click into place, preventing the motherboard from being pulled off.

Push down into Place



#### 2-3

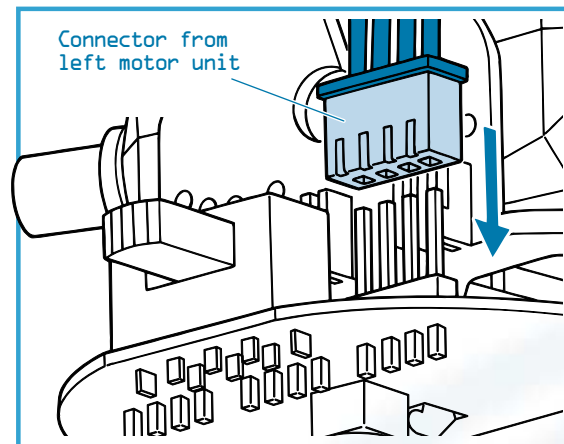
Pass the motor unit cables through the hole in the rear of the frame. Guide them through the hole one at a time.



#### 2-4

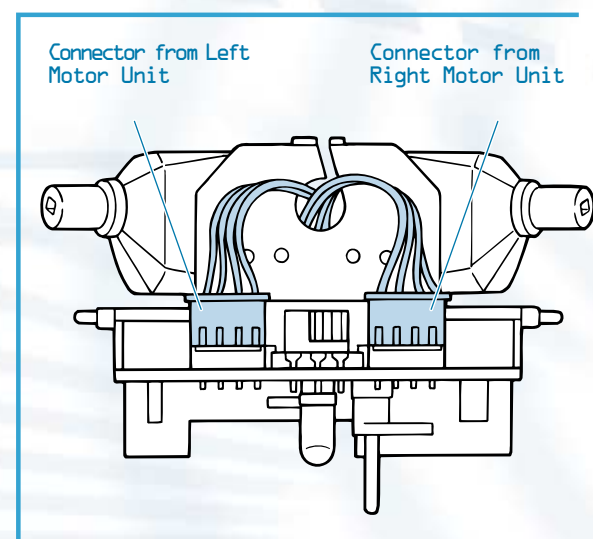
Plug the motor unit connectors onto the connectors on the rear underside of motherboard. The connector from the motor unit installed on the left should be plugged into the motherboard's left connector, and the connector from the right motor unit should be plugged into the motherboard's right connector. (Do not plug either into the motherboard's central connector.)

Note: Make sure the connectors are facing the same way, as in the diagram. The four pins of each motherboard connector should be inserted into the holes.



#### 2-5

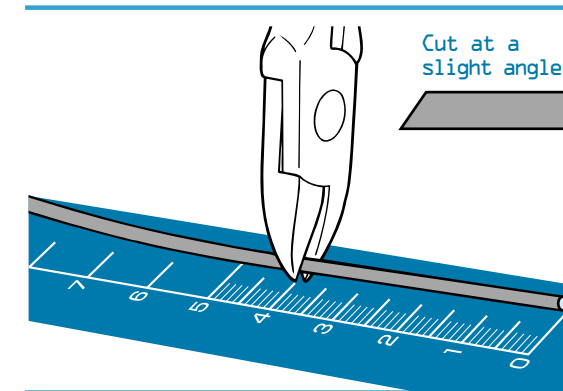
When both motor unit connectors are plugged into the motherboard, the installation of the motherboard is complete.



### Fitting the Legs

#### 3-1

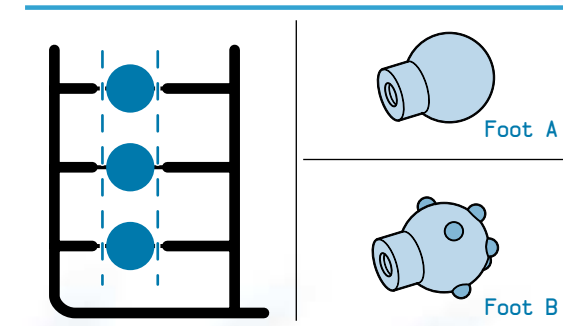
Using a pair of wire-cutters, cut the plastic-covered leg wire into lengths of about 4cm. Cut the segments at a slight angle, so that they will be easier to insert later. Cut six identical segments. Use the handy ruler on page 5b of this manual.



#### 3-2

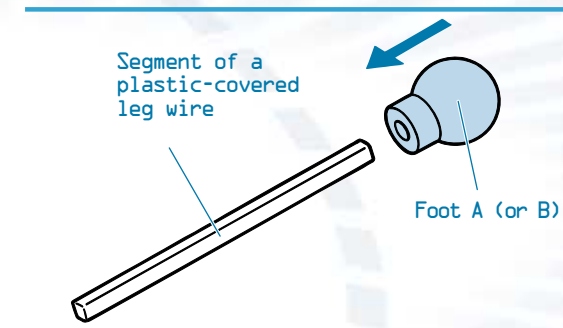
Using the wire-cutters, snip either "Foot A" or "Foot B" off the runners. When you do this, snip close to the foot. Snip out all six units.

Note: Foot A - These work best on flat, even surfaces.  
Note: Foot B - These provide a good grip on uneven surfaces.



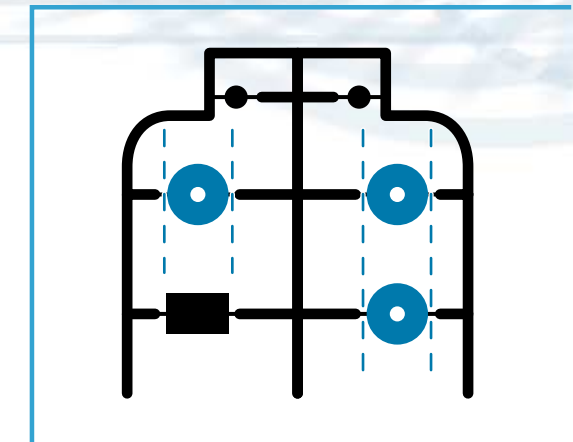
#### 3-3

Insert one end of a segment of plastic-covered leg wire into one of the Foot A or Foot B units, pushing it in as far as it will go. Do the same for all six units.



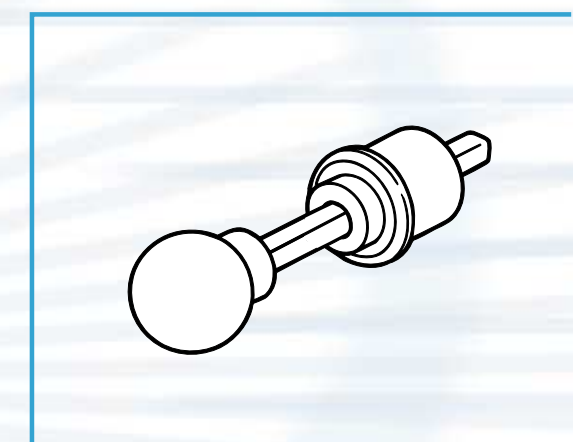
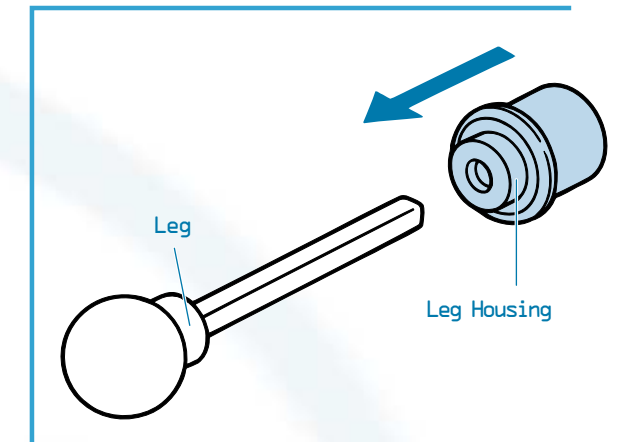
#### 3-4

Using the wire-cutters, snip out the six leg housings from the runner.



#### 3-5

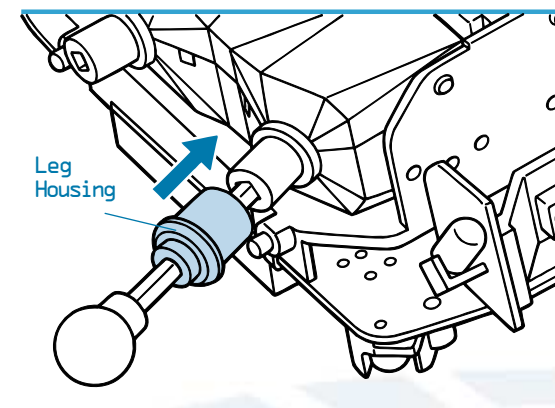
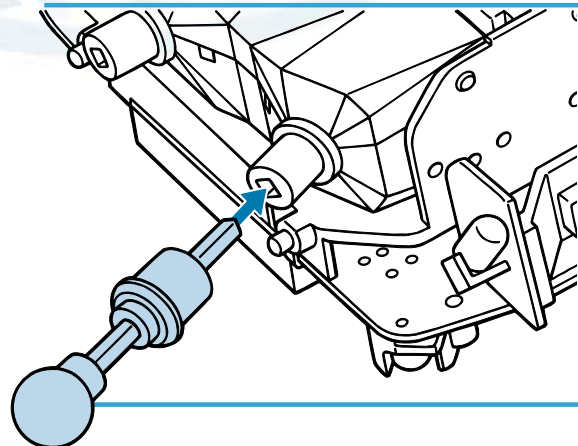
Insert one of the legs into a snipped-out leg housing. Do this for all six legs.



### Fitting the Legs

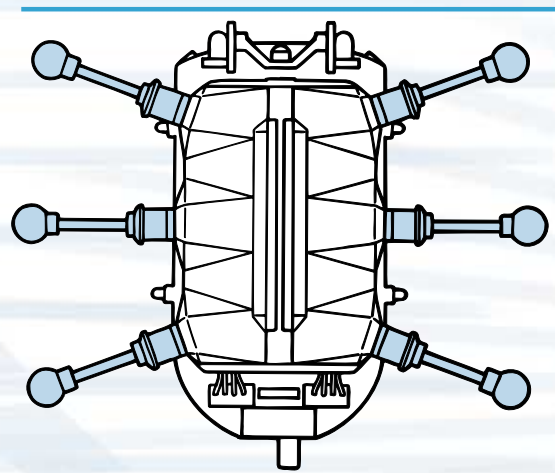
#### 3-6

Insert the legs into the sockets on the WonderBorg's body. Push each segment of plastic-covered leg wire into the socket as far as it will go. If you have difficulty inserting the wire, push it in from a slight angle.



#### 3-7

Fit all six legs in the same way. Fitting the legs is now complete.



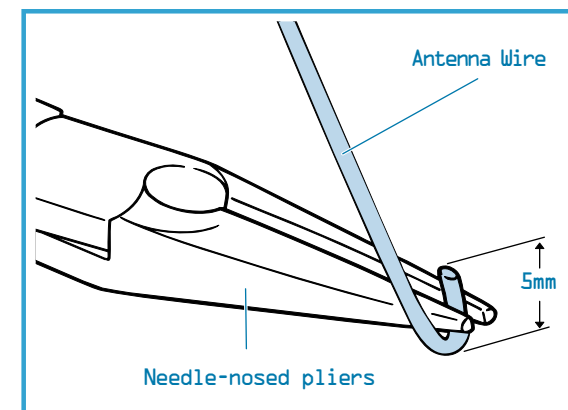
### Fitting the Antennae

#### 4-1

Using the wire-cutters, cut a length of about 15cm off the plastic-covered antenna wire (use the handy ruler on the page 5b of this manual).

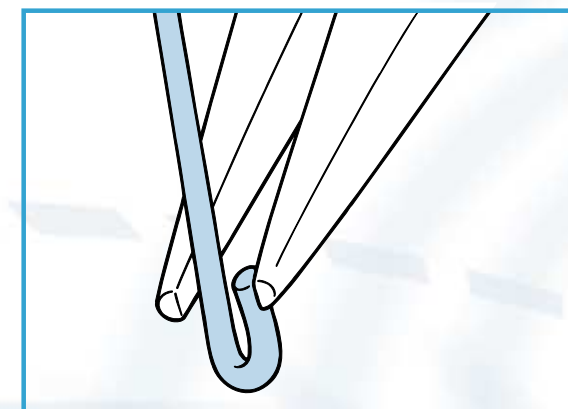
#### 4-2

Using the needle-nosed pliers, bend back the last 5mm or so of the wire.



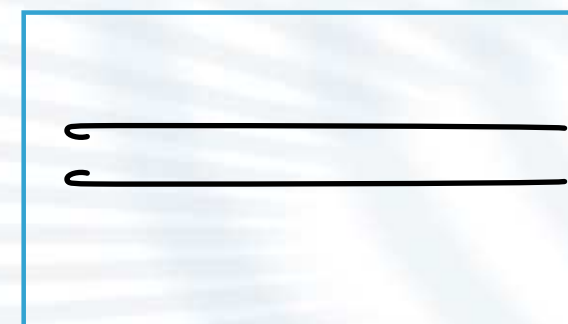
#### 4-3

Using the needle-nosed pliers, squeeze the bent end of the wire to sharpen the bend.



#### 4-4

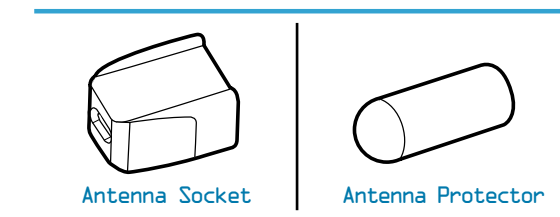
Do the same thing to another identical piece of wire.



### Fitting the Antennae

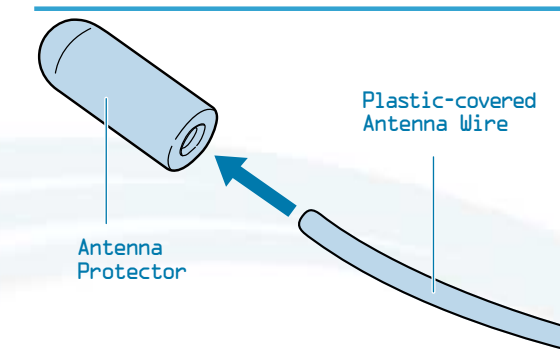
#### 4-5

Using the wire-cutters, snip two of the antenna sockets and two of the antenna protectors off the runner. (The other two antenna protectors are spares.)



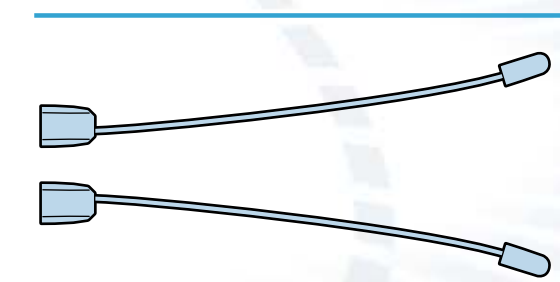
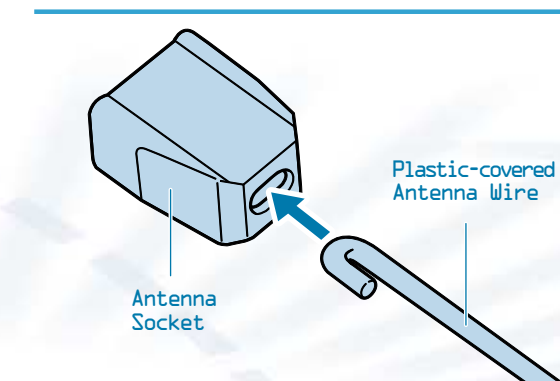
#### 4-6

Insert the end of one of the segments of plastic-covered antenna wire into an antenna protector as far as it will go. Do the same with the other one.



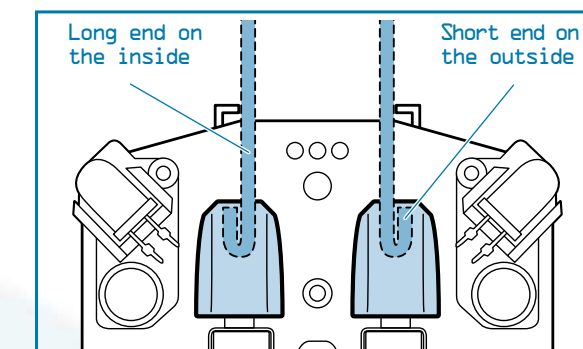
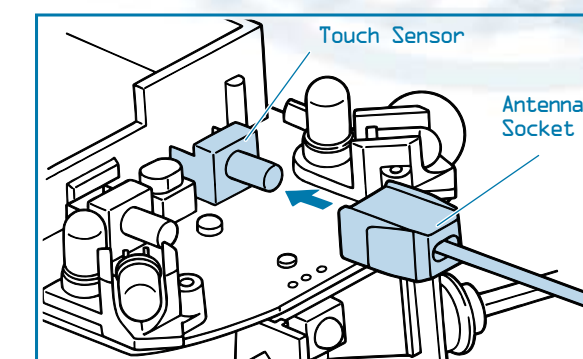
#### 4-7

Insert the bent end of one of the antennae into one of the antenna sockets, as far as it will go. Do the same with the other one.

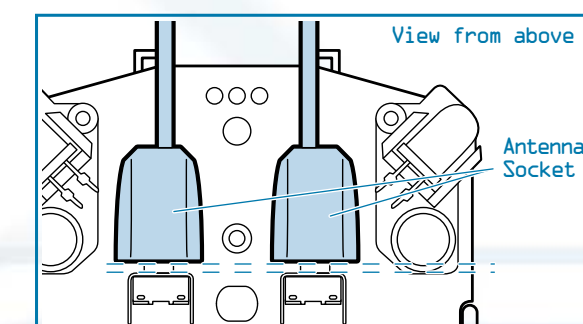


#### 4-8

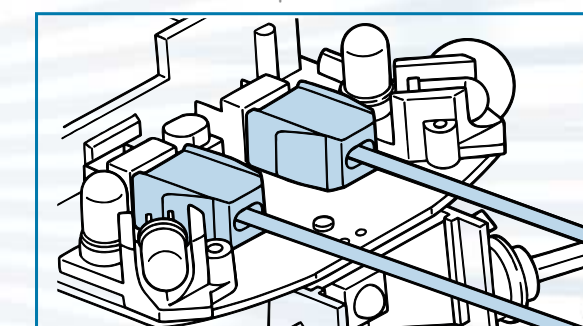
Plug one of the antenna sockets on to one of the motherboard's touch sensors, as shown in the diagram. When you do this, the cut end of the plastic-covered antenna wire should be facing outwards.



If you push the antenna socket too far in, the touch sensor may be unable to react. Leave a space of about 1 mm.



When both the left and right antenna sockets have been installed, the antenna installation is complete.



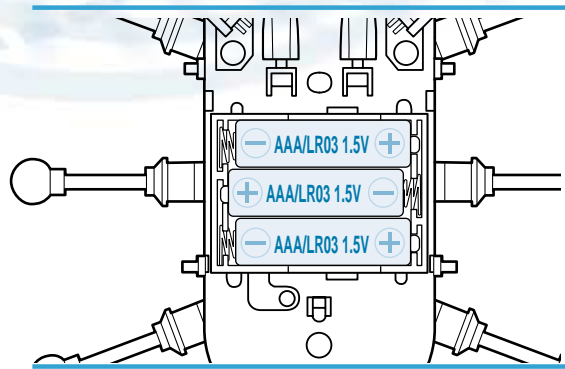
The WonderBorg's body is now complete.



### Bending the Legs and Antennae

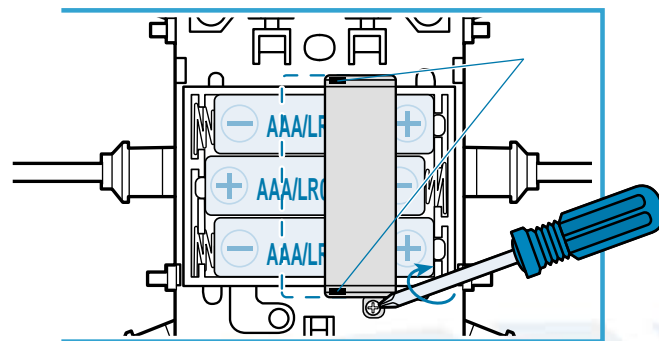
#### 5-1

Insert three AAA alkaline batteries (sold separately) in the WonderBorg, as shown in the diagram. Be careful to insert the batteries the right way.



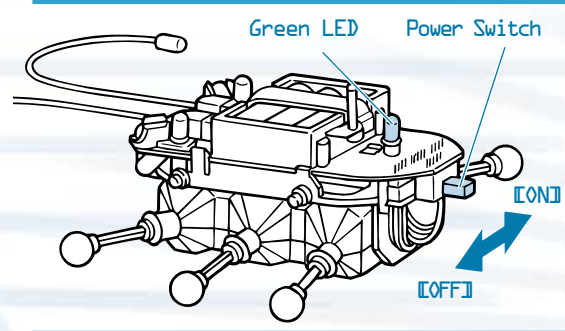
#### 5-2

Place the battery cover on top of the battery box. Be careful to position the battery cover with the holes positioned as shown in the diagram.



#### 5-3

Turn the WonderBorg's POWER switch ON. The WonderBorg's legs will move slightly, then stop immediately. The WonderBorg will make a beeping noise, and the green LED will light up.



If the WonderBorg does not work, check whether you have made a mistake in the assembly operation.

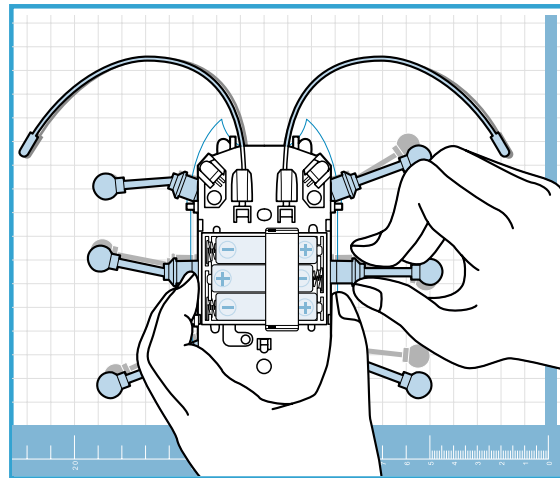
- Points to check:
- Are the connectors plugged in correctly?
  - Are the batteries inserted the right way?

#### 5-4

Turn the POWER switch ON.

#### 5-5

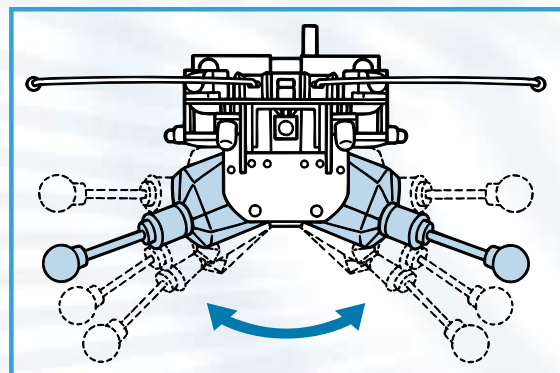
Place your WonderBorg on the leg and Antenna Bending Template on the page 5b of this manual. Bend the legs and antennae to match the illustration. They can be adjusted to any position. Once you have finished the adjustments, turn the power OFF.



The bending of the legs and antennae is now complete. Note: When the power is ON, the legs may move, so turn the power ON before adjusting them.

#### Extra Information

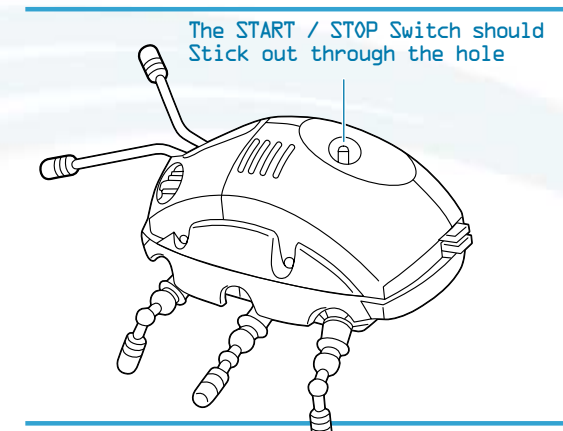
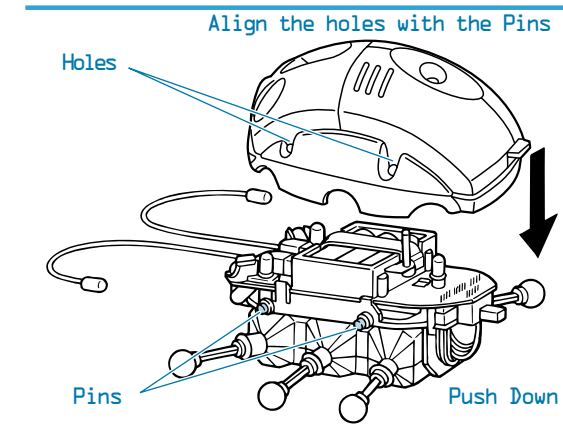
By changing the angle of the motor units, you can adjust the height of the WonderBorg. Note: If you adjust the angle of the motor units closer to the vertical direction (making the body higher), the WonderBorg will walk more smoothly over obstacles, but it will also be more prone to falling over. Likewise, if you adjust the angle of the motor units closer to the horizontal direction (making the body lower), the WonderBorg will be less prone to falling over, but it will also be less inclined to walk over obstacles. The angle is altered in four stages.



### Fitting the Body Shell

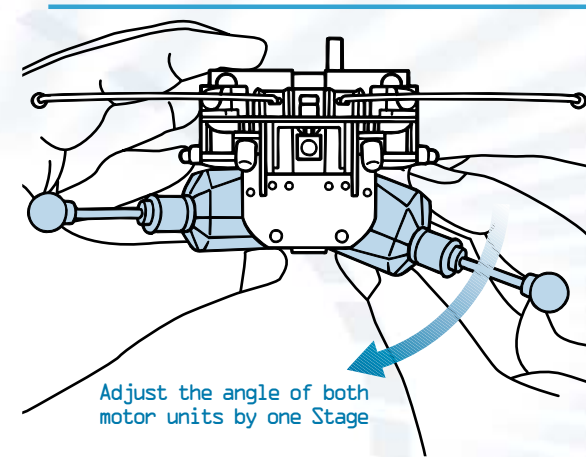
#### 6-1

Press the body shell down on to the WonderBorg's body so that the pins on the left and right side of the frame slot into the holes in the body shell. The START / STOP switch should protrude through the hole.

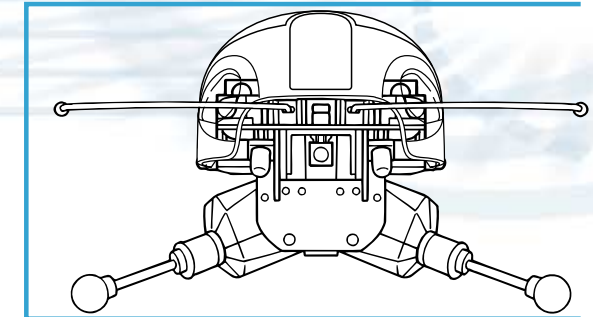


#### 6-2

Adjust the angle of the left and right motor units one stage away from the horizontal, so that they are slanted like the sides of the letter "A".



### Operational Testing

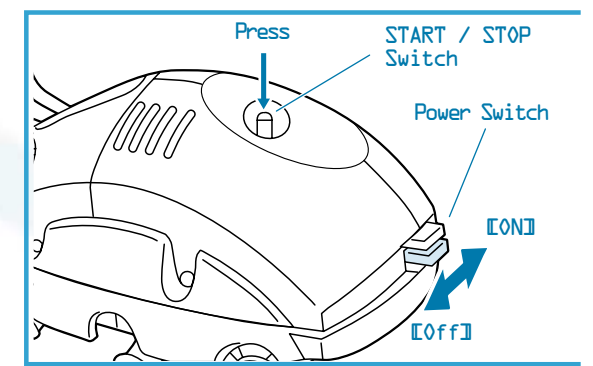


The WonderBorg is now complete. Next, carry out the following operational tests.

#### 7-1

Place the WonderBorg on the floor and turn the POWER switch ON. The legs should move slightly, then stop immediately. The WonderBorg should emit a beeping noise, and the green LED should light up.

#### 7-2



#### 7-3

The WonderBorg should emit a modulated beeping noise and start walking.

#### 7-4

The WonderBorg is pre-programmed with a test program (which is erased when you send it new data). Please check the following functions.

- Press right antenna: Rotates to the right
- Press left antenna: Rotates to the left
- Obstacle to right: Right eye LED flashes
- Obstacle to left: Left eye LED flashes

If the WonderBorg does not work correctly, check whether you have made a mistake in the assembly operation.

- Point to check:
- Are the connectors plugged in correctly?
  - Are the batteries inserted the right way?

#### 7-5

To halt the WonderBorg, press the START / STOP switch again.

#### 7-6

Turn the POWER switch OFF. The operational testing is now over.

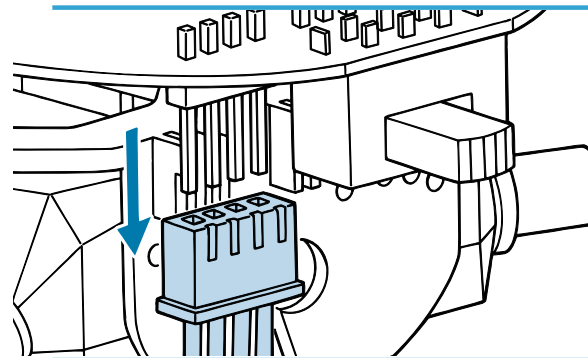
**Variation:** The operations described from this point on are variations. If you are interested, try them for yourself; however, they are not essential.

### Changing the Gears

By changing the gears on the motor units, you can determine whether to prioritize speed, or power.

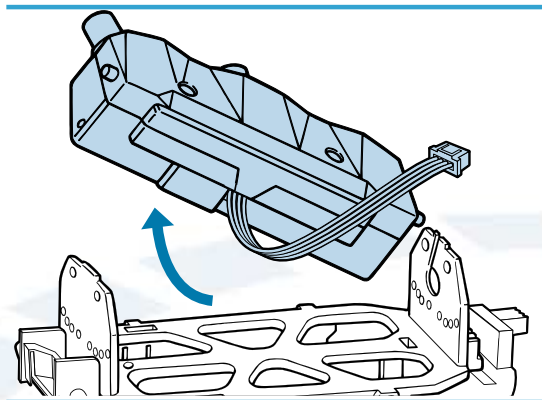
#### 8-1

Turn the POWER switch OFF, then unplug the motor unit connectors from the motherboard. When you do this, be careful not to bend the pins of the motherboard connectors.



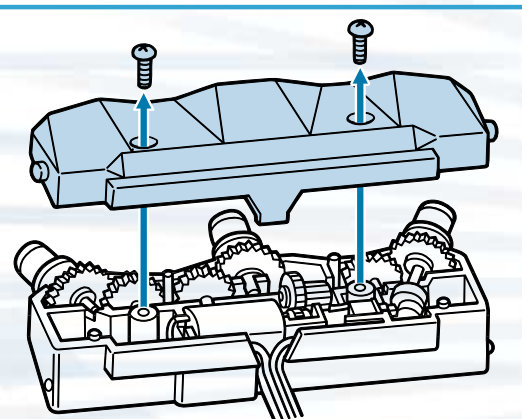
#### 8-2

Remove both motor boxes (including the cables) from the frame. It is easier if you remove the legs first.



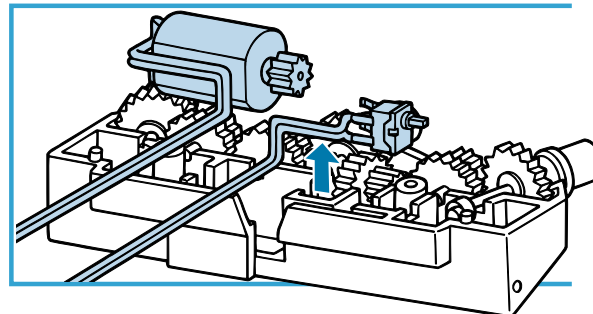
#### 8-3

Remove the screws and open the motor box.



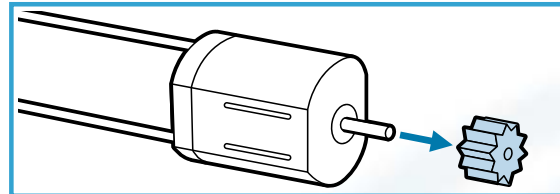
#### 8-4

Remove the motor switch from the gearbox (below).



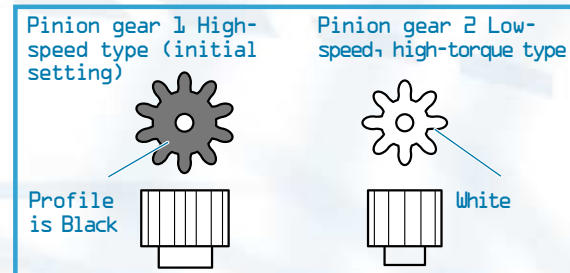
#### 8-5

Using needle-nosed pliers or any other suitable tool, remove the pinion gear from the motor. As you do so, be careful not to damage the teeth of the gear.



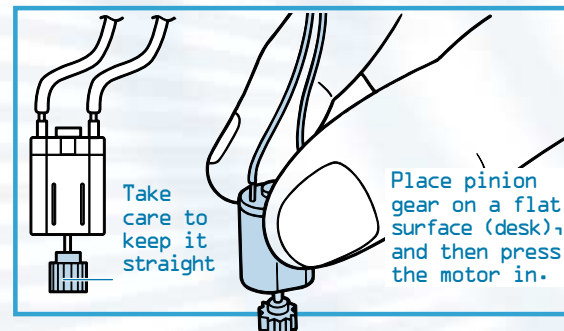
#### 8-6

Select a pinion gear. High-speed type (black): High speed, low power. Low-speed, high-torque type (white): Low speed, high power.



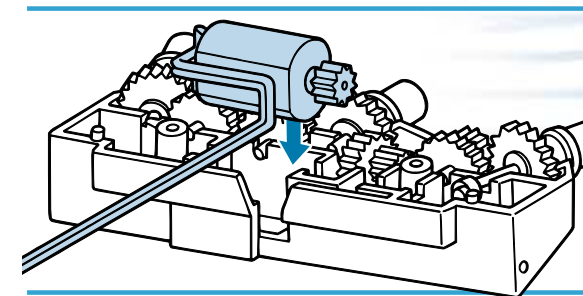
#### 8-7

Press the selected pinion gear on to the motor. Press firmly as far as it will go.



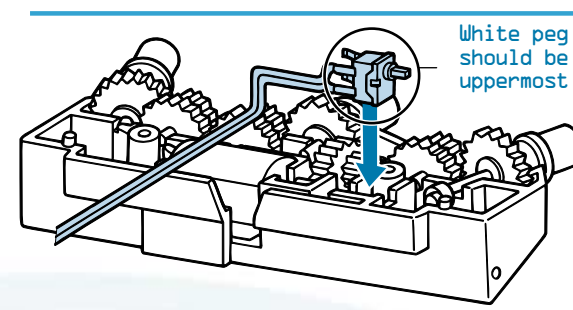
#### 8-8

Install the motor in the gearbox (below).

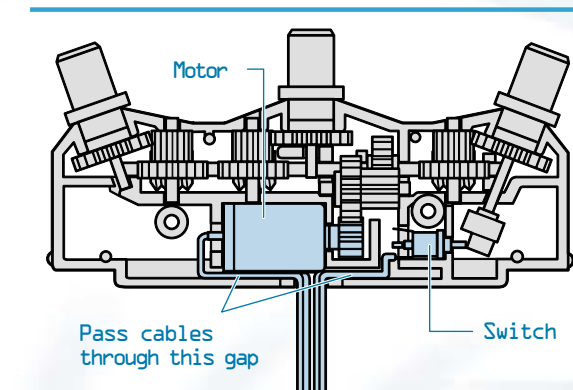


#### 8-9

Install the switch in the gearbox (below).

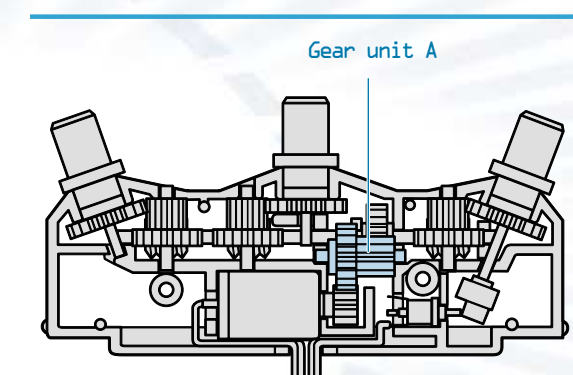


Pass the cables from the motor and the switch through the gap as shown in the diagram below.

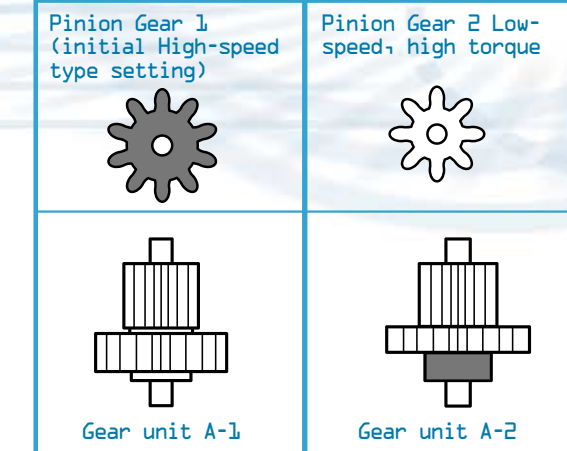


#### 8-10

Change gear unit A (hold it so that you can lift it from above).

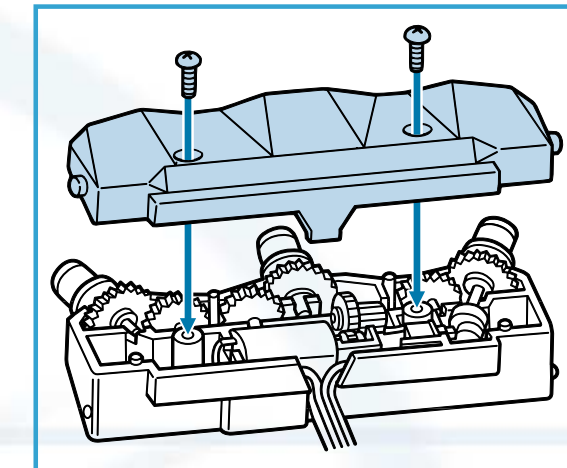


If you are using pinion gear 1, use Gear Unit A-1, and if you are using pinion gear 2, use Gear Unit 1-2.



#### 8-11

Secure the gearbox in position by fastening the screws, and re-assemble the motor unit. Fasten the screws firmly to eliminate any gear between the upper and lower parts of the gearbox. When you do this, be careful that the cables pass correctly through the gap, and are not caught between the parts of the gearbox. Use the same pinion gear, are gear unit A, for both motor units.

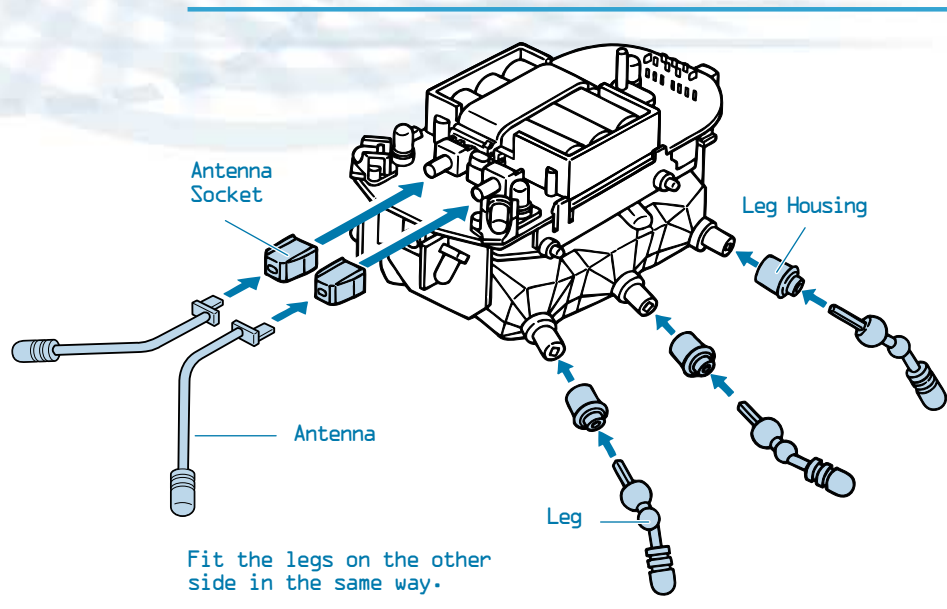


#### 8-12

Attach the motor units to the frame and attach the connectors to the motherboard explained on page 11. When you have done this, the replacement of the gears is complete.

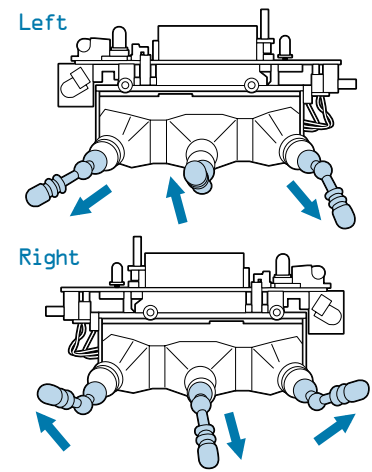
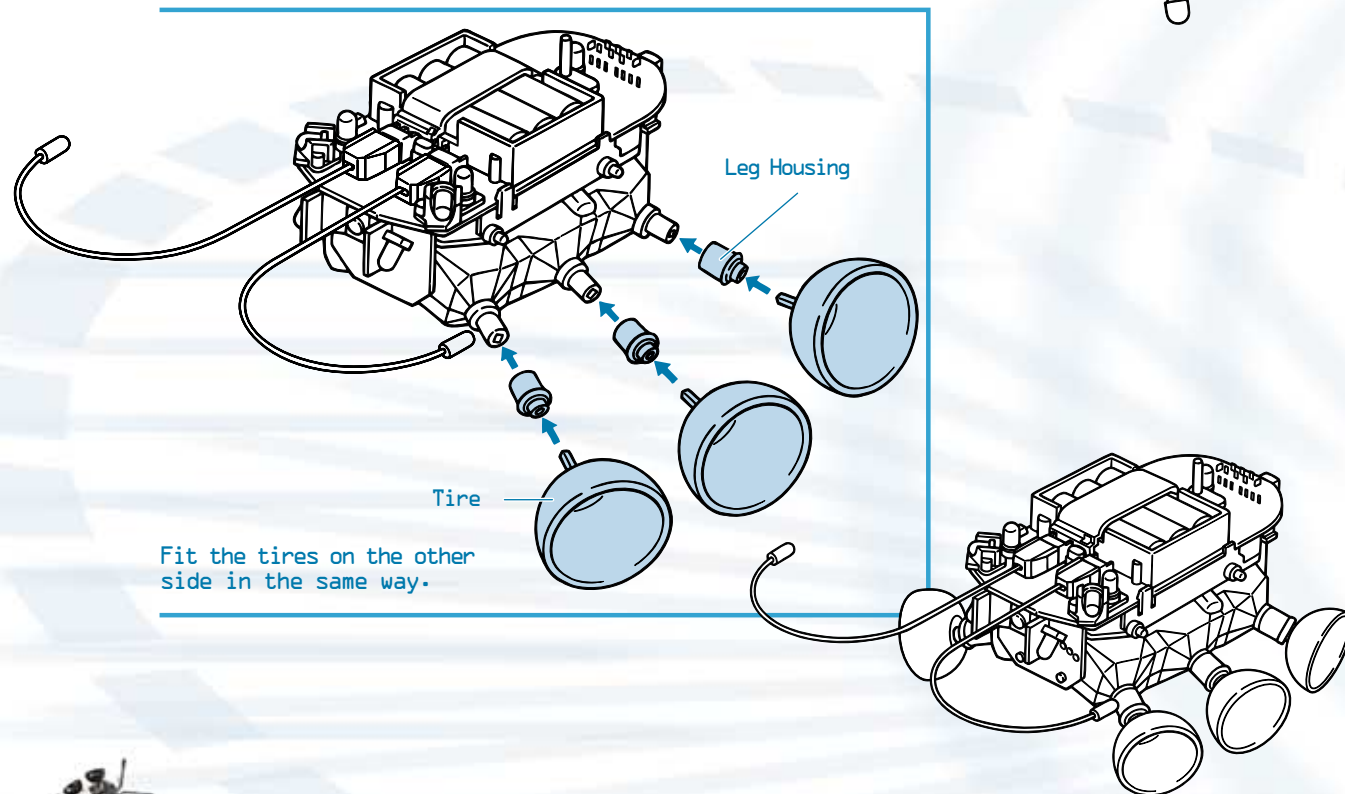
### Assembly Variations

#### 9-1 Fitting Plastic Leg and Antenna Parts



Use these parts if you prefer to make the assembly process as easy as possible.  
 Note: Turn the power ON before adjusting the angle of the legs.

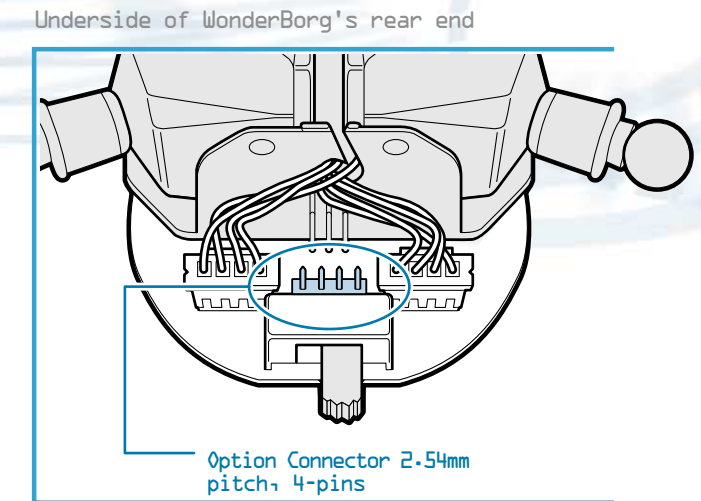
#### 9-2 Fitting the Tires



Fit each of the legs at the angle shown in the diagram

### The Option connector

The WonderBorg has an Option connector, allowing even more advanced remodeling. The Option connector is on the underside of the WonderBorg's rear end, and allows you to connect one external load such as a motor, or one external sensor such as a switch. To use this connector, you will need general knowledge of electrical circuits, a 2.54mm pitch, 4-pin connector (female) Morex type or other connector, and the ability to perform soldering. Care is needed when using the Option Connector: creating an inappropriate connection may damage the WonderBorg's circuits.



**Caution**  
 Option Connector 2.54mm pitch, 4-pins may have sharp points.

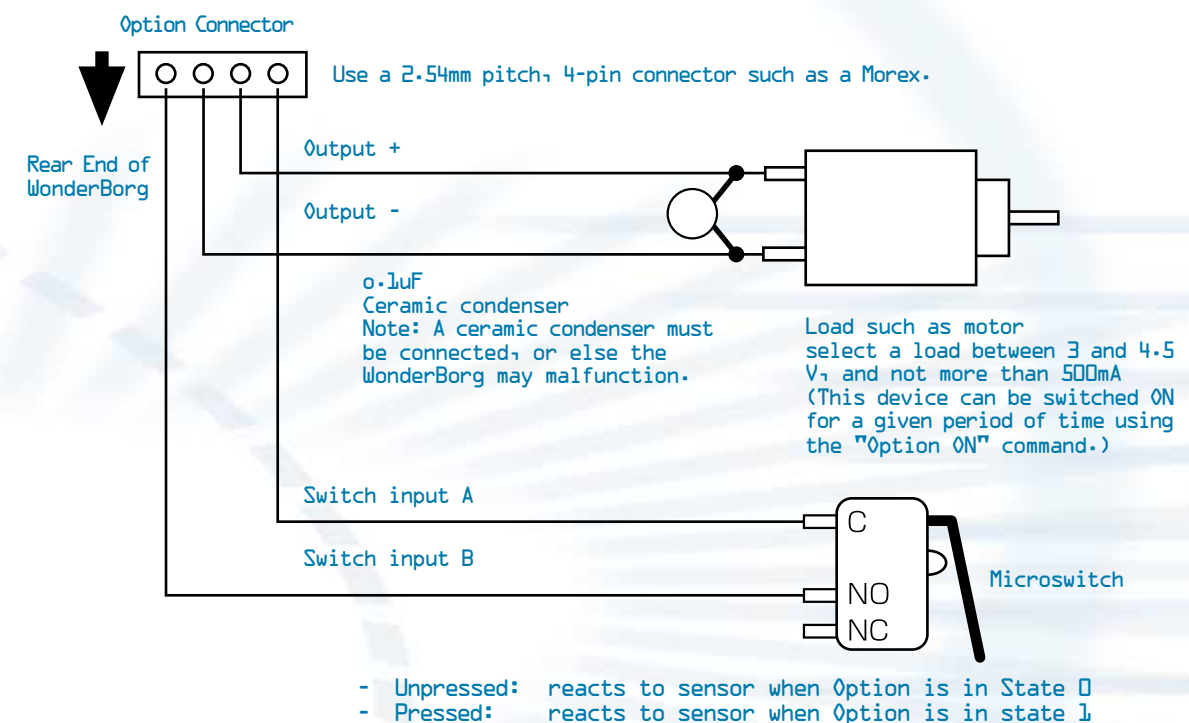
**Specifications**

**OUTPUT** Supply voltage: 4.5V, maximum supply current: 500mA, ON / OFF only  
 Out +: Current output connected to robot's battery +  
 Out -: Open corrector

**INPUT** Mechanical electrical contact points (switches, etc) short-circuit resistance: 1kΩ or lower  
 Switch input A: Microcomputer input, pulled high (100kΩ)  
 Switch input B: Connects to GND (robot's battery -)  
 This connector allows an additional motor to be added.

#### Pin Layout and Reference Circuit

**Caution**  
 If an inappropriate external circuit is connected to the Option Connector, this may result in damage to either or both the WonderBorg and the external circuit. Only connect an external circuit if you are fully aware of its specifications.



### Personalize your WonderBorg

Use the stickers / decals (included) to decorate the shell of your WonderBorg. Paint can also be used to customize the shell (paint sold separately).



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### Introduction

Have you assembled your WonderBorg?

The WonderBorg is not operated by remote control: it is an autonomous robot. In other words, it uses its own sensors to find out about its surroundings, and decides for itself how it should move. If you teach your WonderBorg what to do in a given situation, it will exhibit all sorts of behavior. This teaching process is called "programming the WonderBorg".

Ordinary programming requires specialist knowledge of computers, but this is not necessary to program the WonderBorg for PC. This is because you use special software called Robot Works, which allows you to create programs very easily using your computer's mouse. Read on, and learn how to program your own WonderBorg by following our practical guide.



Robot Works software is designed exclusively for Windows ME / 98 / 95. Robot Works uses your PC's external serial port, so have your PC manual in hand when you begin the setup operation.

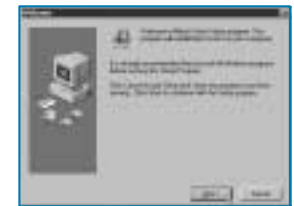
### System Requirements

- A DOS / V format PC.
- A PC running Windows ME / 98 / 95, and having a D-sub 90-pin serial connector. (If your PC has a different type of serial connector, you will need suitable adapter. Contact your PC's manufacturer for more information. The use of a USB-to-Serial adapter is not recommended.)
- The PC must be a Pentium 100MHz or higher, with at least 32MB of memory, 16-bit color capability or higher, and least 30MB of free disk space.
- A CD-ROM drive is also required, but only when installing the software.



### Installing the software

- To install Robot Works, you will need at least 30MB of free disk space.
- Load the Robot Works CD in your PC's CD-ROM drive.
- Go into "Robot Works CD" in "My Computer", and double-click the "works-setup" icon. This will activate the Installation Wizard.



- When the Installation Wizard starts up, click "Next". If you have any other programs open, close them and then restart the Installation Wizard.



- Specify where you want the software to be installed. Most people choose the default option and click "Next" (in this case, the software will be installed in the Program Files folder in the C drive.). If you want to install the software to another location, click "Browse". The directory selection screen will then appear. Specify the desired directory, then click "OK".
- It is now time to specify whether you want Robot Works to appear in the Start menu of in a particular program folder. Most people choose the default option and click "Next" (in this case, the software will be installed in the Robot "Works" folder.).



- If you want to change the name of the folder, enter the desired name in the topmost box, then click "Next".
- The screen asking you to confirm whether to go ahead with the installation will now appear. Most people choose the default option and click "Next". In this case, the installation will begin. If you want to change any detail of the installation, click on "Back" and re-set the item in question.
- The Robot Works installation status screen will now appear. When the progress meter reaches 100%, the installation is complete. When the screen tells you that the installation has been carried out successfully, click "finish". Robot Works is now installed.



- If you chose the relevant default option earlier, the Robot Works shortcut icon will now be present on the Desktop screen. To activate Robot Works, double-click this icon.

Note: If the Robot Works icon is not on the desktop screen, go into the Windows star menu, select "Programs", then select "Robot Works", then "Robot Works" again, to activate the program.

### Uninstalling Robot Works

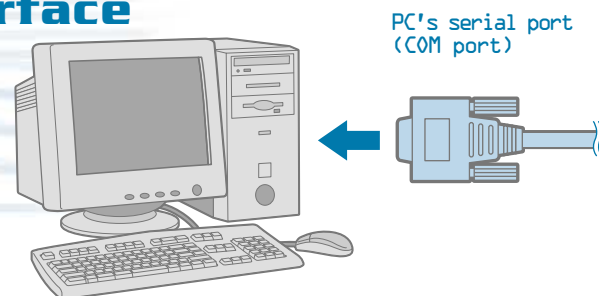
To uninstall Robot Works, go into "My Computer", select "Control Panel", select "Add / Remove Programs". When "Add / Remove Programs Properties" is displayed, Select : "Robot Works" from the list of applications, and click "Remove". Follow the on-screen instructions to remove the application.



### - Connecting the Interface

Caution: Be sure to switch the PC power OFF before starting this operation. Use only the Interface supplied with this product. Make sure that no other device is connected to the external serial port of your PC.

1. Connect the Interface to the PC's serial port (COM port) using the Interface Cable supplied with this product. Refer to your PC manual to avoid making a mistake. If your PC has more than one serial port, connect the Interface to COM1.



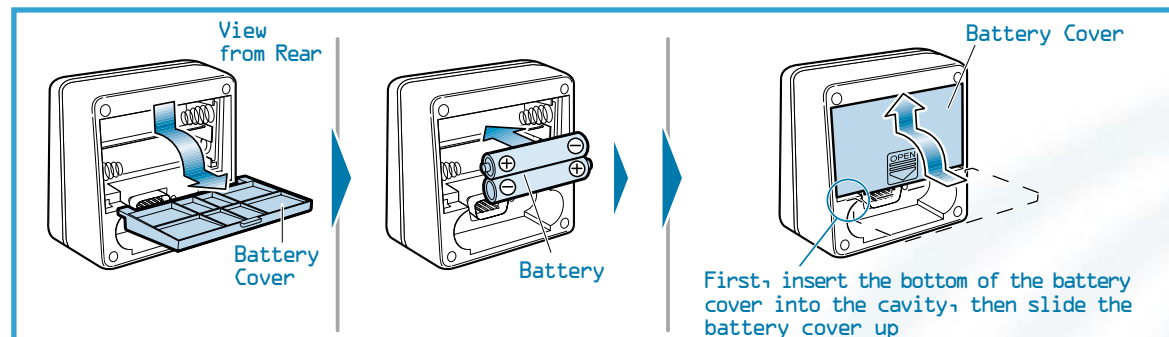
Note: If you own a palm pilot or similar device, you must temporarily disable it in order to attach the interface. These devices take control of the output port and will not allow the interface to connect. Simply click the mouse on your Hot Sync Manager icon (located on the bottom right corner of the screen), and click disable. Do the same to enable it when you are finished playing with the WonderBorg.

#### Caution

If you are using a notebook PC, for example, the serial port may be the wrong shape for the connector, and in this case you will need a serial port (COM port) adapter. Consult your PC manufacturer for more information. The use of a USB-to-Serial adapter is not recommended.

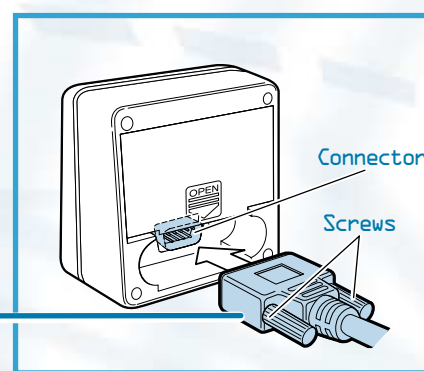
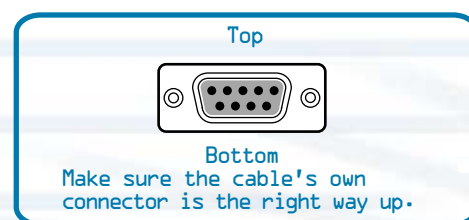
2. Remove the battery cover from the Interface supplied, and insert two AA alkaline batteries as shown in the diagram. Be careful not to insert the batteries the wrong way. Replace the battery cover, then turn the POWER switch ON. If the green lamp (labeled "POWER") on the front of the Interface lights up, it is connected correctly.

### Inserting the Batteries



3. Connect the supplied cable to the connector in the back of the Interface.

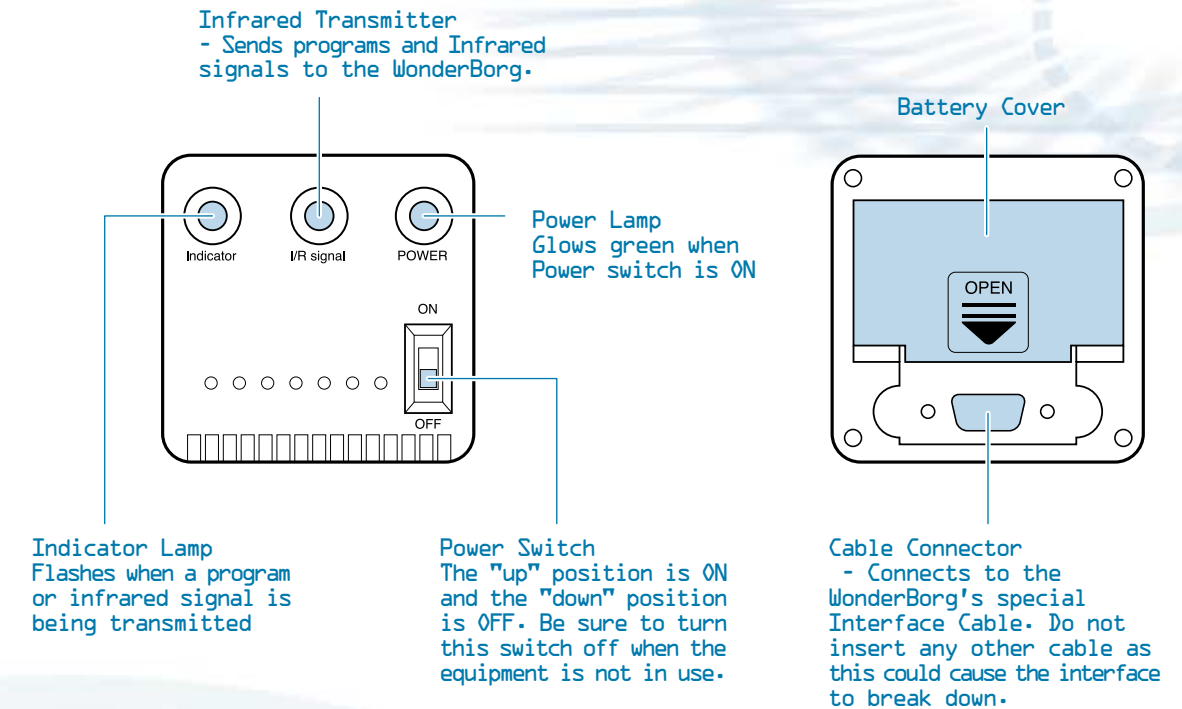
Note: Do not fasten the screws on the left and right sides of the connector.  
Note: Do not touch the terminal with your fingers



#### To Ensure Proper Function

- Do not mix old and new batteries.
- Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.
- Battery installation should be done by an adult.
- Non-rechargeable batteries are not to be recharged.
- Rechargeable batteries are to be removed from the toy before being charged (if removable).
- Rechargeable batteries are only to be charged under adult supervision (if removable).
- Only batteries of the same or equivalent type as recommended are to be used.
- Batteries are to be inserted with the correct polarity, and follow the toy and battery manufacturer's instructions.
- Exhausted batteries are to be removed from the toy.
- The supply terminals are not to be short-circuited.
- Do not dispose of batteries in fire as batteries may explode or leak.

### Names of Interface Parts and Their Function



### Points to note

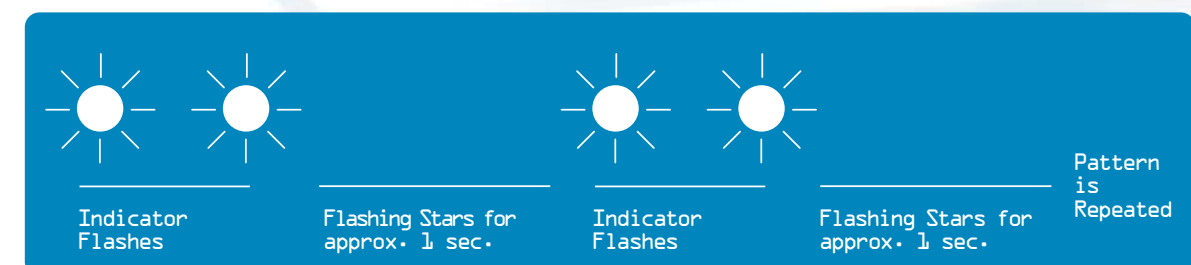
- The Interface is a piece of precision electronic equipment. Be careful not to drop it, allow it to get wet, or leave it inside a car during hot weather or anywhere else likely to become very hot, as this could cause it to break down.
- The only cable that should be inserted into the connector on the Interface is the special Interface Cable. Do not insert any other cable, or any small metal objects such as paperclips or pins.
- Do not touch the Interface Connector terminal with your fingers, or allow any metal objects to come in contact with it.
- The battery life is roughly 100 hours (using a commercially-available alkaline battery).
- If communications errors are becoming more frequent during program transmission (when a communications error occurs, the WonderBorg will emit a long beep), change the batteries. When you do so, replace both batteries with new ones, and make sure the batteries are inserted the correct way.

### Using the Interface as an Infrared Signal Transmitter

The Interface can be used to transmit infrared signals to the WonderBorg to guide it and perform other operations. To transmit an infrared signal, bring up the Settings screen in Robot Works, select the type of infrared signal you want to send, then click the START button on the screen.

### The flashing of the indicator lamp when an infrared signal is transmitted

When an infrared signal is transmitted, the indicator lamp on the Interface flashes (see chart below).



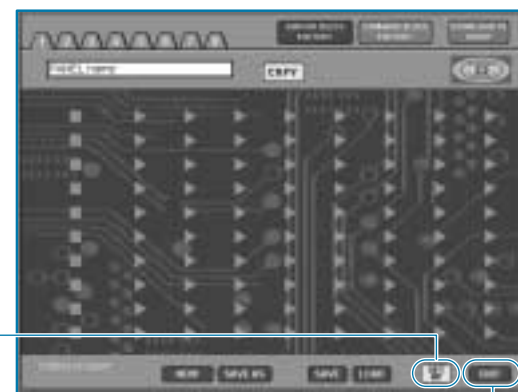
### Setting the serial Port

Before using Robots Works for the first time, you will need to set the serial port. This is done by opening Robots Works and following the procedure described below.

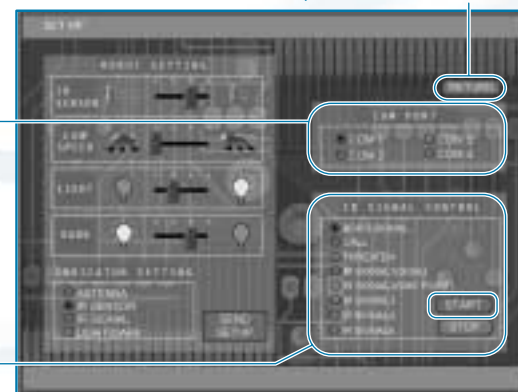
1. When you open Robot Works, the title screen will appear. If you left-click the "CLICK TO START" button, the panel screen will then appear.



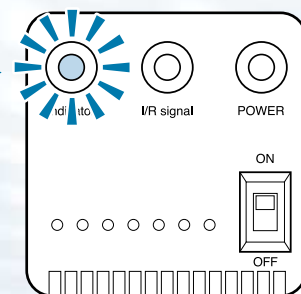
2. Click the "Set Up" button on the panel screen to bring up the settings screen.



3. Using the "Com Port" button on the Set Up screen, select the port to which the Interface is connected.



4. Turn the Interface's POWER switch ON, click "Borg Signal" on the "START" button. If all is in order, the red indicator lamp at the left on the Interface will start flashing.

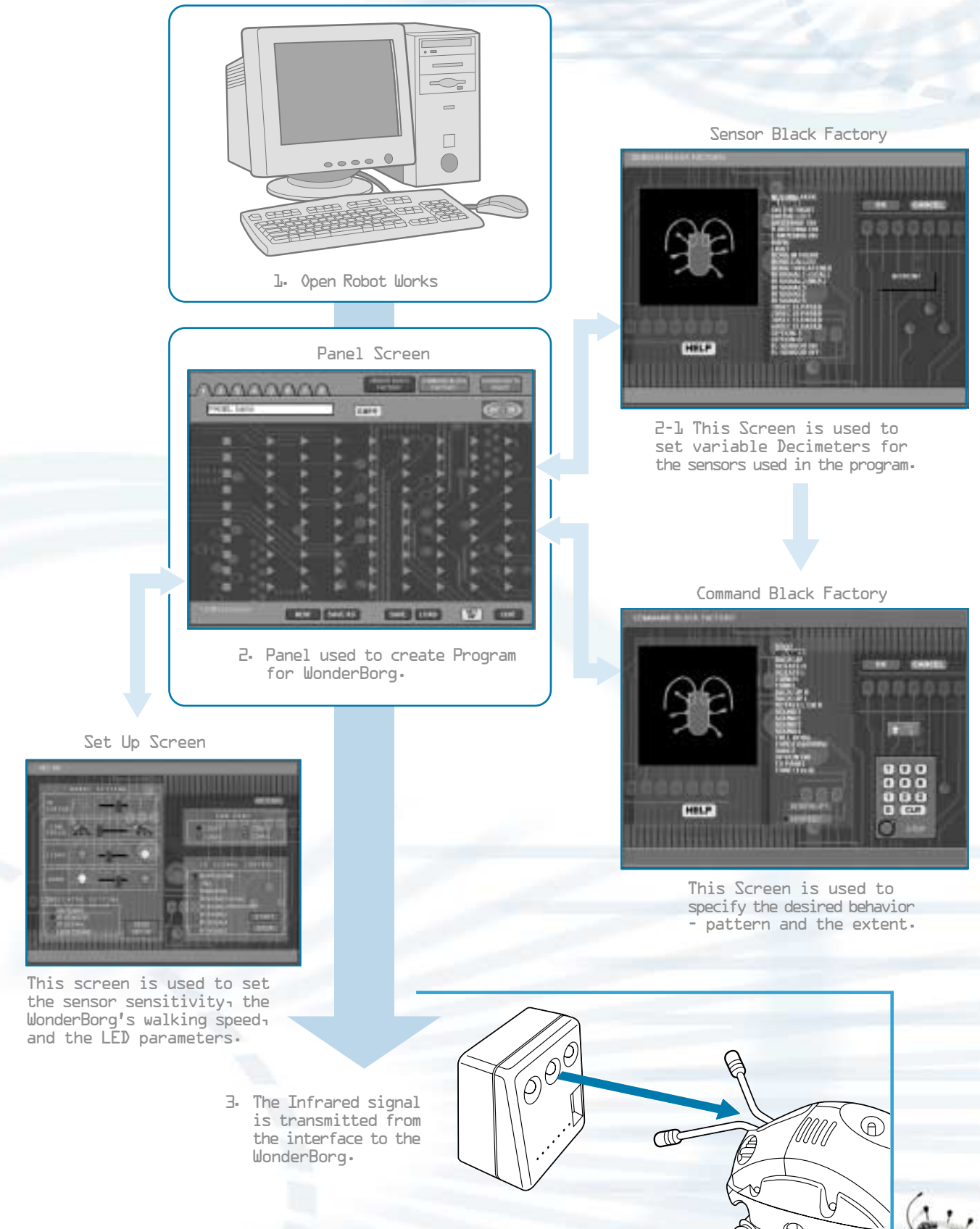


5. Click "STOP". The indicator lamp will stop flashing. Click "Return" to return to the panel screen, then click "Quit" to exit from Robot Works.

These settings only need to be specified the first time you use Robots Works. Your settings will be saved, so there is no need to repeat the above procedure on subsequent occasions.

### Overview of the Programming Operation

The main operating screens in Robot Works, and the way they relate to one another, are shown below.



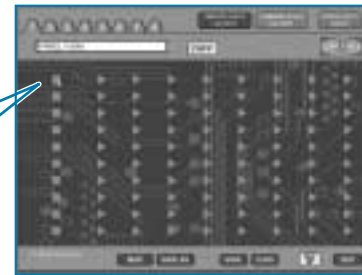
### Let's get started!

It's time to try programming your WonderBorg.

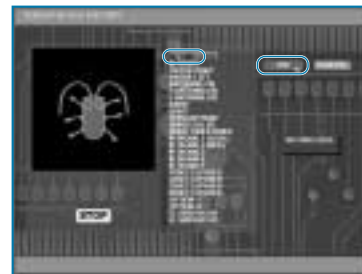
1. Open robots works, and click "CLICK TO START" on the title screen. The Panel Screen will then appear.



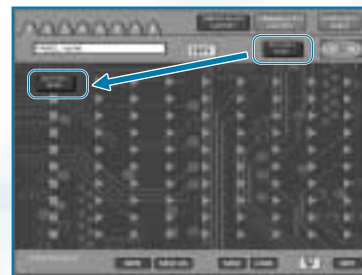
2. Left-click the blue square in the top left corner of the screen. The Sensor block Factory screen will then appear.



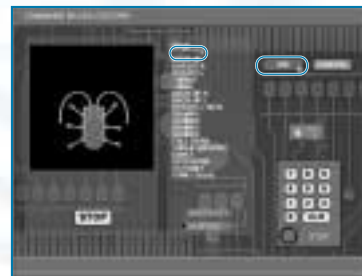
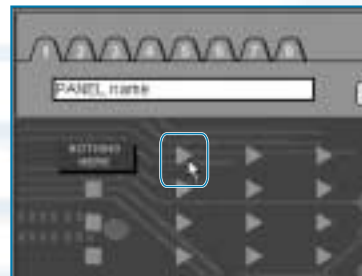
3. This screen is used to specify the sensor settings. On the list, select "Nothing Here", then click the "OK" button.



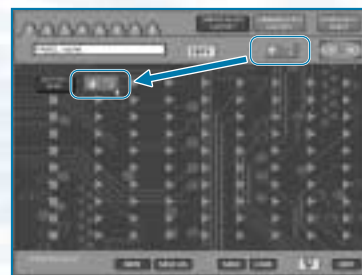
4. Go back to the Panel Screen. The "Nothing Here" block will be displayed on the panel. Drag this block and drop it on top of the blue square that you clicked earlier.



5. The next step is to specify a command. Left-click the pink triangle beside the "Nothing Here" Block. The Command Block Factory screen will now appear. On the list, select "Advance", then left-click the "OK" button.

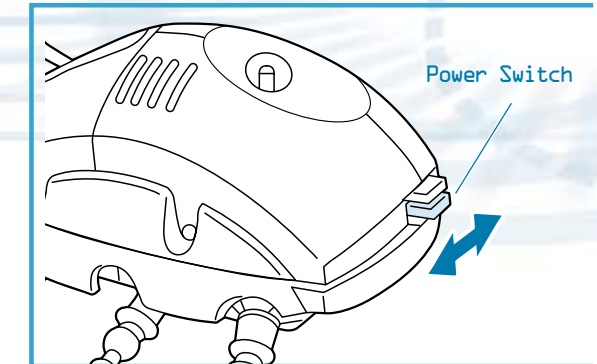


6. Go back to the Panel Screen. The "Advance" block will be displayed. Drag-and-drop this block to the right side of the "Nothing Here" block, using the same procedure as in step 4.

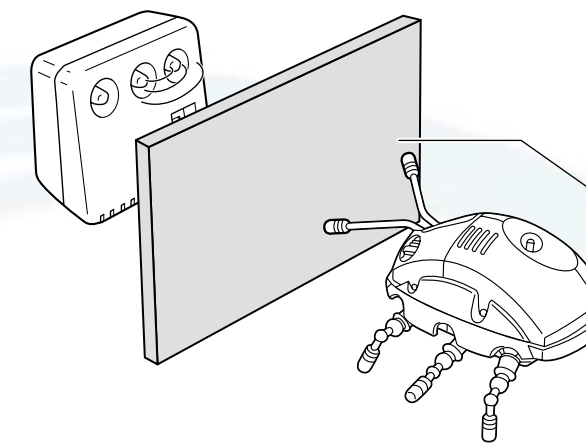
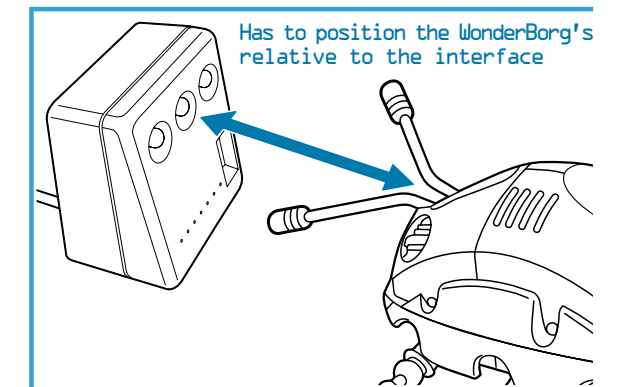


7. You have now created a program that says "When there is nothing there, the WonderBorg must move forward".

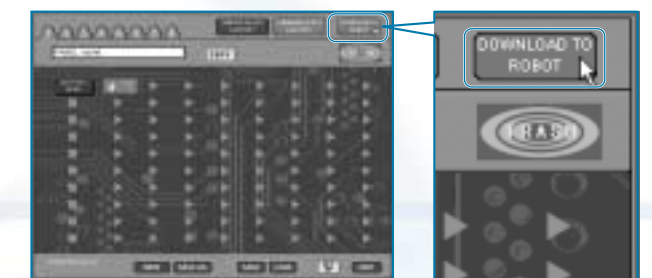
8. Turn the WonderBorg's POWER switch ON.



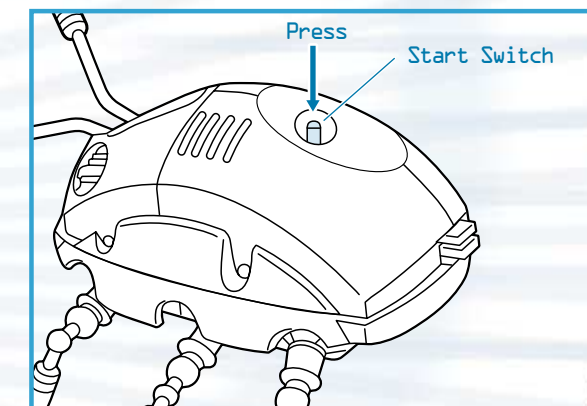
9. Position the Interface so that the transmitter is facing the WonderBorg's infrared receiver (the WonderBorg should be about 20cm away from the Interface). When you do this, make sure there is nothing in between the Interface and the WonderBorg (see the illustration below).



10. Left-click "Download to Robot" at the top of the Panel screen. Your program will now be transmitted. The WonderBorg's eyes will flash, and when it emits a short beep, the transmission is complete.



11. Press the WonderBorg's START / STOP switch once (causing the green LED to flash). If the WonderBorg now moves continuously forward, your program has been successfully transmitted. Press the START / STOP button again (the green Led will now go out) to bring the WonderBorg to a halt.





### How to Read the Screens

Operations are carried out using three basic screens: the Panel screen, the Sensor Block Factory screen, and the Command Block Factory screen. This section explains the role of each screen and how to switch between them.

When you open **Robot Works**, the title screen appears. Left clicking here will take you to the Panel screen.

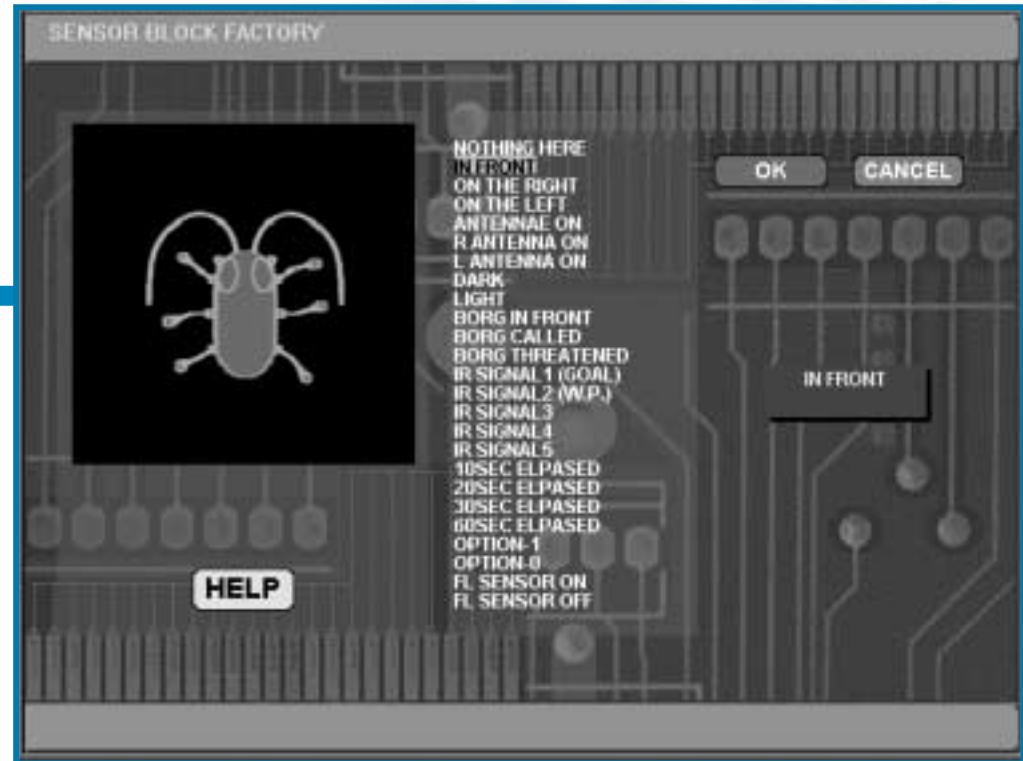


Go to Sensor Block Factory

Note: To go to the Sensor Block Factory, click one of the blue squares on the Panel Screen; to go to the command block factory, click one of the pink triangles.

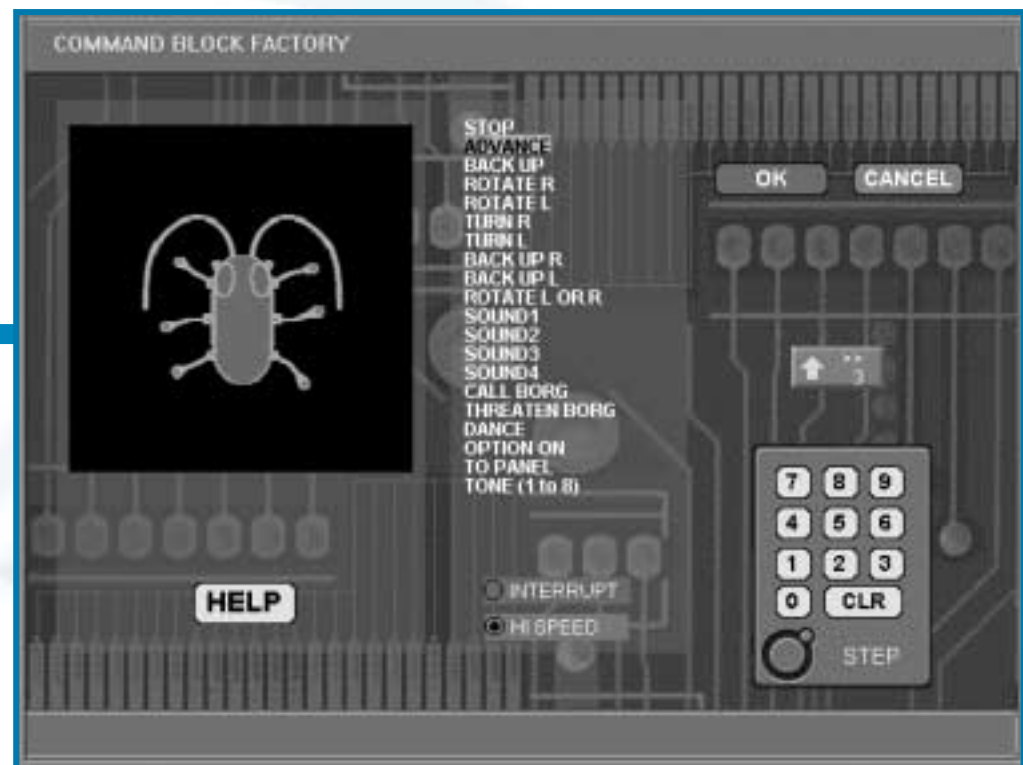
Go to Command Block Factory

The new block will appear here. Drag it over and drop it at the appropriate position on the panel.



### The Sensor Block Factory

This screen is used to create new sensor blocks on the Panel screen. A sensor block is a block specifying which sensor to use. It consists of yellow text on a blue block.



### The Command Block Factory

This screen is used to create new command blocks on the Panel screen. A command block is a block specifying which command to execute. The command consists of an icon and text on a red or green block.

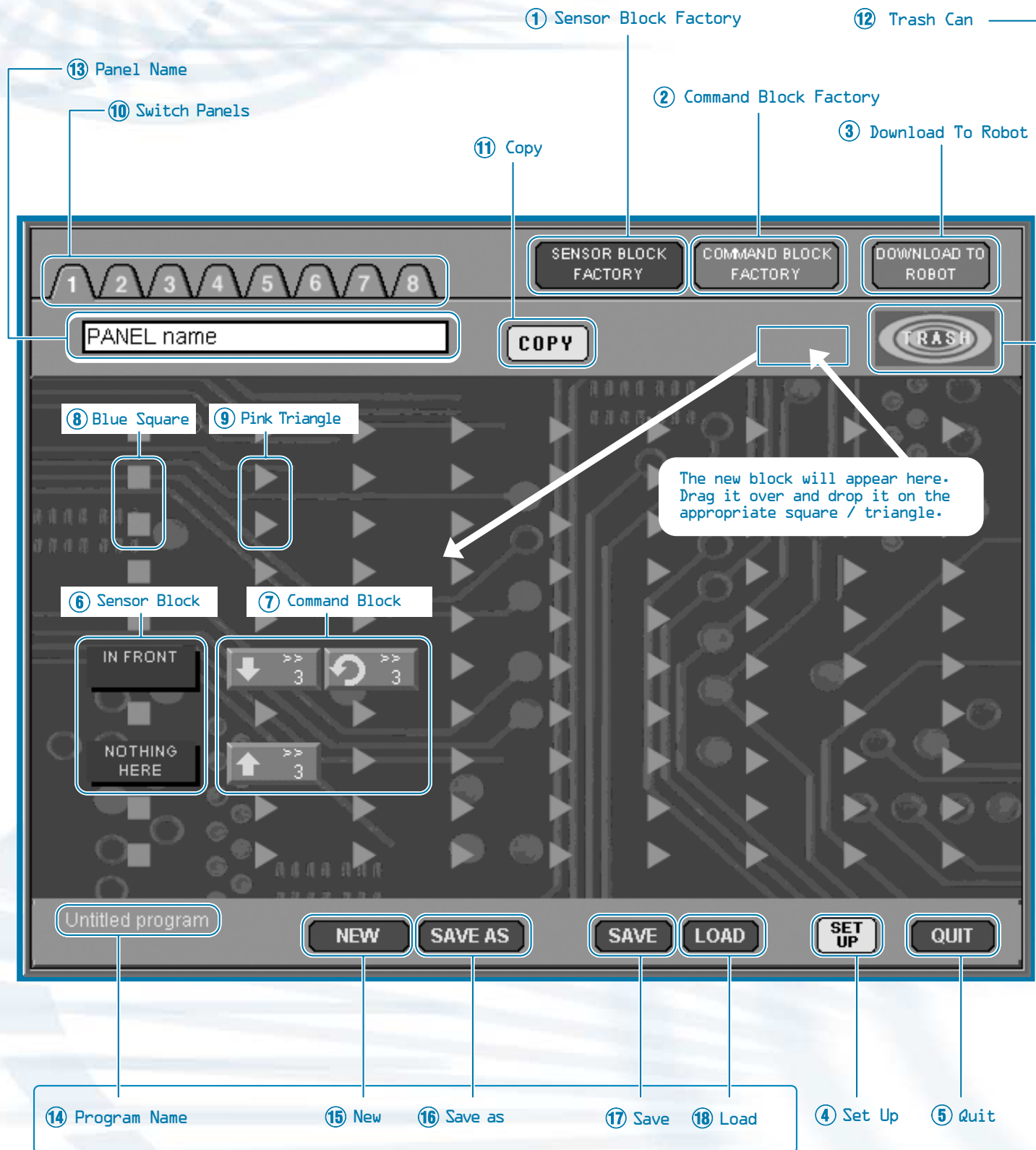
### The Panel Screen

This is the main screen used for programming the WonderBorg. Using the mouse to drag and drop blue sensor blocks and red and green command blocks, you can create a program very easily. (The illustration above shows a panel after a program has been input.)



### Names of Parts

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



### 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.



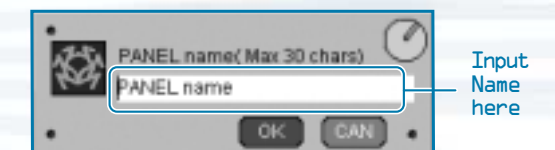
### 12. Trash Can:

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.

### 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 1 and command blocks as 2.

#### 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

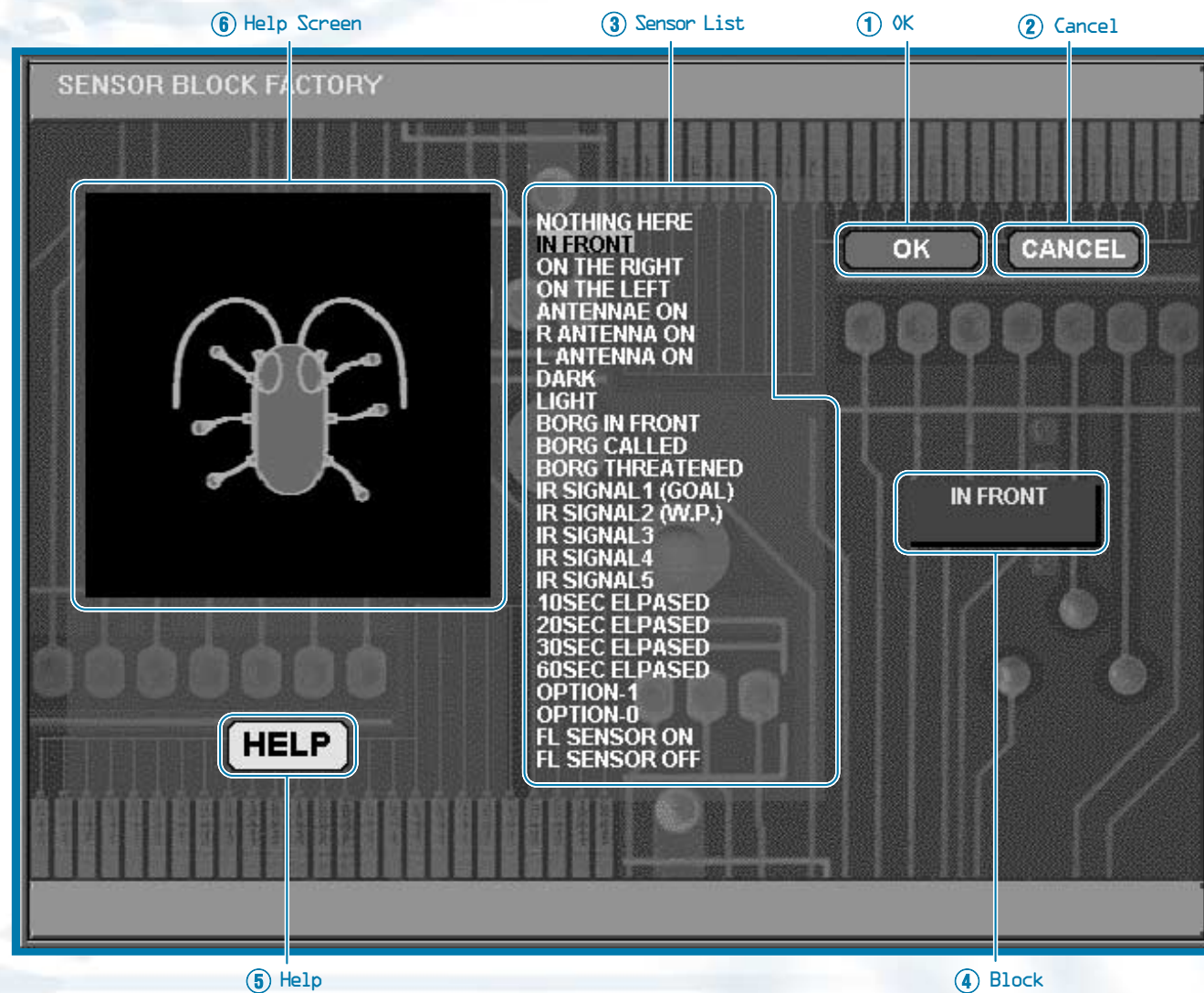
Within a program file, you can use the "Switch panel" command to switch to any given panel (use the number keys in the Command Block Factory to input the number of the desired panel) and make the robot execute the behavior-patterns specified by that panel. When the WonderBorg is activated, it always 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.

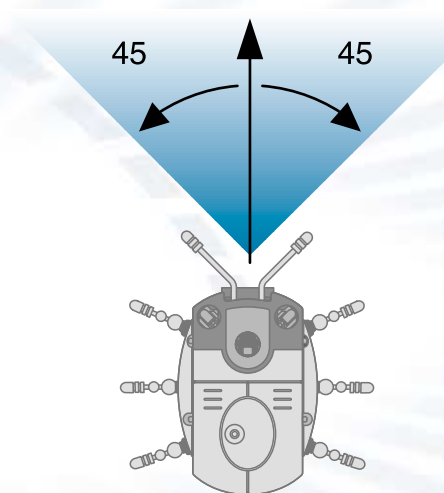
### How to Create a Sensor Block

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

Nothing Here	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.
Right antenna Left antenna Both antenna	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.
Infrared signal 1 (Guide to goal) Infrared signal 2 (Guide to another robot)	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.

### Area in which Robot can pick up infrared signals

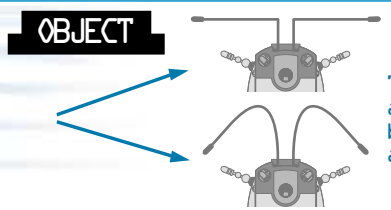
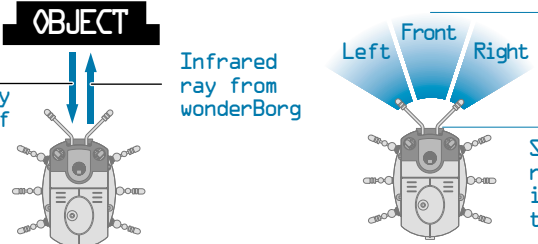
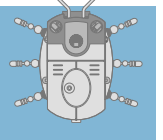
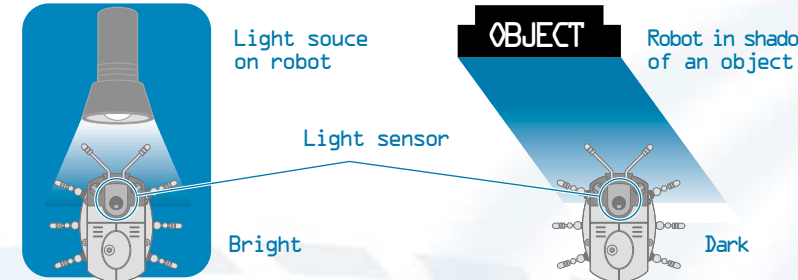
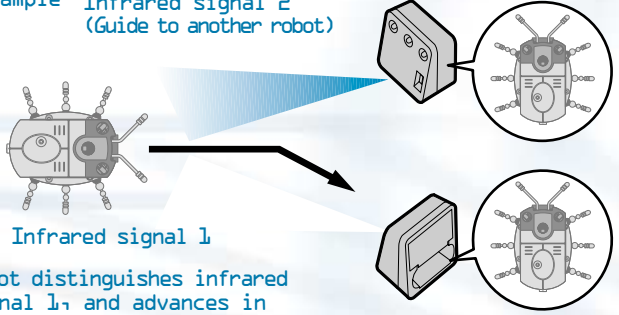



(Maximum) area in which robot will react to infrared signals. The robot will react to any infrared signal-emitting device in this area.

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

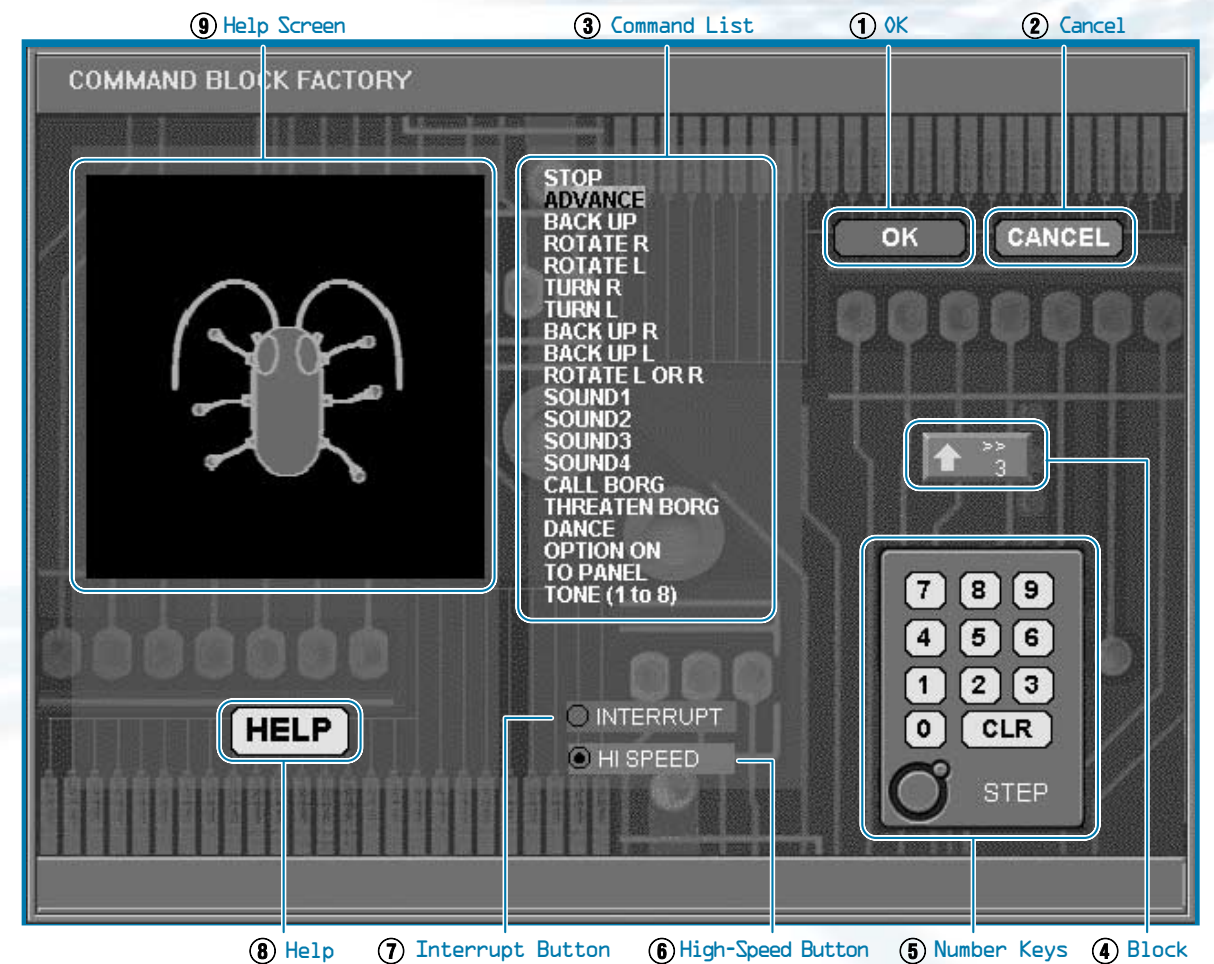
<b>Touch sensor</b> - Right sensor - Left antenna - Both antennae	 <p><b>OBJECT</b></p> <p>Sensor reacts when antenna touches something</p> <p>The wire antenna can be bent into any shape</p>
<b>Infrared sensors</b> - Something ahead to the right - Something ahead to the left - Something ahead	 <p><b>OBJECT</b></p> <p>Infrared ray reflects off obstacle</p> <p>Infrared ray from wonderBorg</p> <p>Left Front Right</p> <p>Approx. 10 cm</p> <p>Sensor may not react if robot is too close to obstacle.</p> <p>The Infrared ray emitted by WonderBorg bounces off obstacle &amp; is detected on way back</p> <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>
<b>Floor Sensor</b> - Floor sensor ON - Floor sensor OFF	 <p>Floor Sensor - senses status of floor in front of robot</p> <p>ON = Floor Present</p> <p>OFF = Floor is dark or absent</p> <p>Infrared ray emitted by WonderBorg is reflected back &amp; detected by the sensor when detected sensor is ON.</p> <p>Note: On certain floor surfaces, this sensor will not react. When it is off, the Green LED flashes faster.</p>
<b>Brightness sensor</b> - Light - Dark	 <p>Light source on robot</p> <p><b>OBJECT</b> Robot in shadow of an object</p> <p>Light sensor</p> <p>Bright</p> <p>Dark</p>
<b>Infrared signal sensor</b> - 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	 <p>Example Infrared signal 2 (Guide to another robot)</p> <p>Infrared signal 1</p> <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>
<b>Internal clock sensor</b> - 10 sec. elapsed - 20 sec. elapsed - 30 sec. elapsed	 <p><b>TIMER</b></p> <p>Usage Example</p> <ul style="list-style-type: none"> <li>- Make robot emit a cry once every 30 sec.</li> <li>- Sensor reacts every 30 sec., so robot can be made to give a cry at 30-second intervals.</li> <li>- Switch to another panel after 40 seconds.</li> <li>- 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.</li> </ul> <p>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).</p>
<b>Option</b>	<p>When an ON / OFF switch is fitted to the WonderBorg's Option Connector, this sensor will react by entering state 1 when the switch is ON, and state 0 when the switch is OFF.</p>

### 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. 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.  
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.
6. High-speed 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.
7. Interrupt button: 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.
8. 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").
9. Help screen: Screen area where the help animation is displayed.

### 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.



### 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 6 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	Motor or 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 8).	Panel no 1 to 8	✗	✗
	Tone (1 to 8)	Robot emits specified tone, which is one of the 8.	Tone no 1 to 8	✗	✗



### 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 red, other sensors will be ignored until this block's command has completed (e.g. until the robot has advanced 5 steps). When 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 "interruptable". 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....

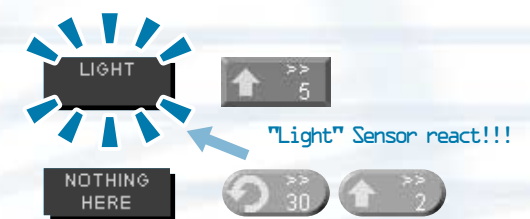


If the WonderBorg is programmed to rotate (30 Steps Left), then change position slightly (go 2 Steps forward)....

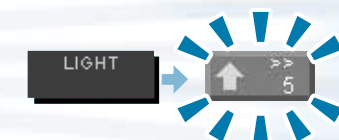
1. While the robot is rotating left (for instance, when it has walked 3 steps)....



2. IF "Light" Sensor reacts, robot does not have to rotate for remaining number of steps (nor does it have to take 2 steps forward in 2nd part of instruction). The "Light" sensor is higher up in the program than "Nothing Here". The first takes priority.



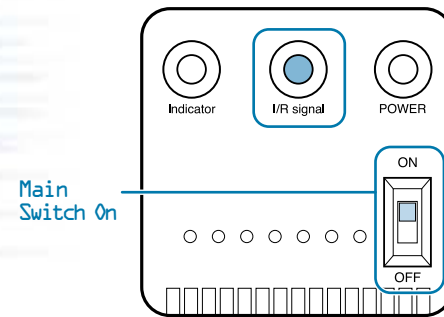
3. Robot immediately executes "Go Forward 5 Steps" command. ("Go Forward Command" overrides the other command.)



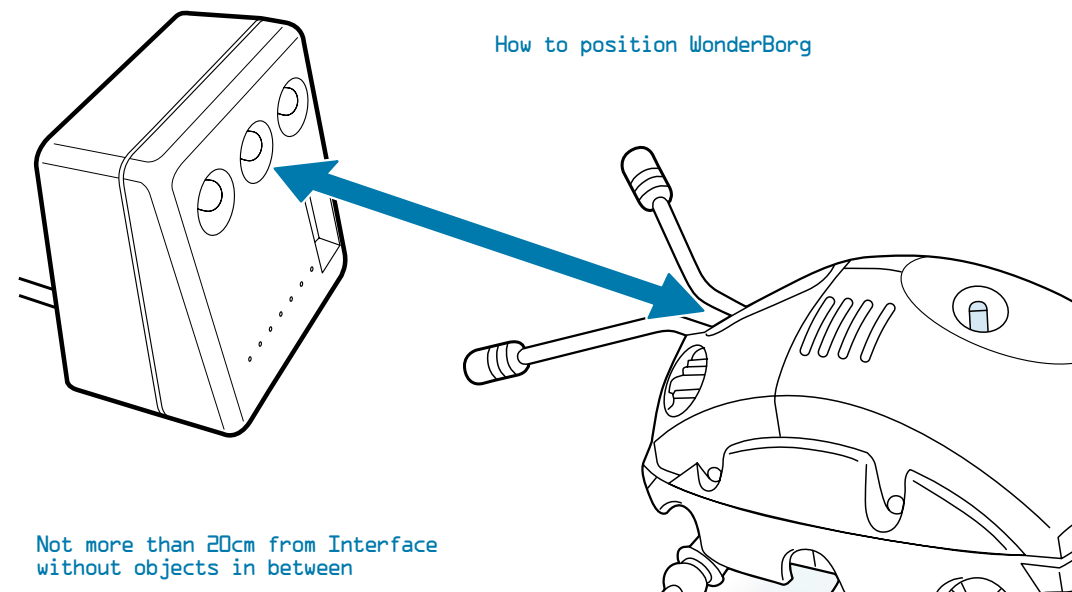
### Sending a Program to the WonderBorg

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.

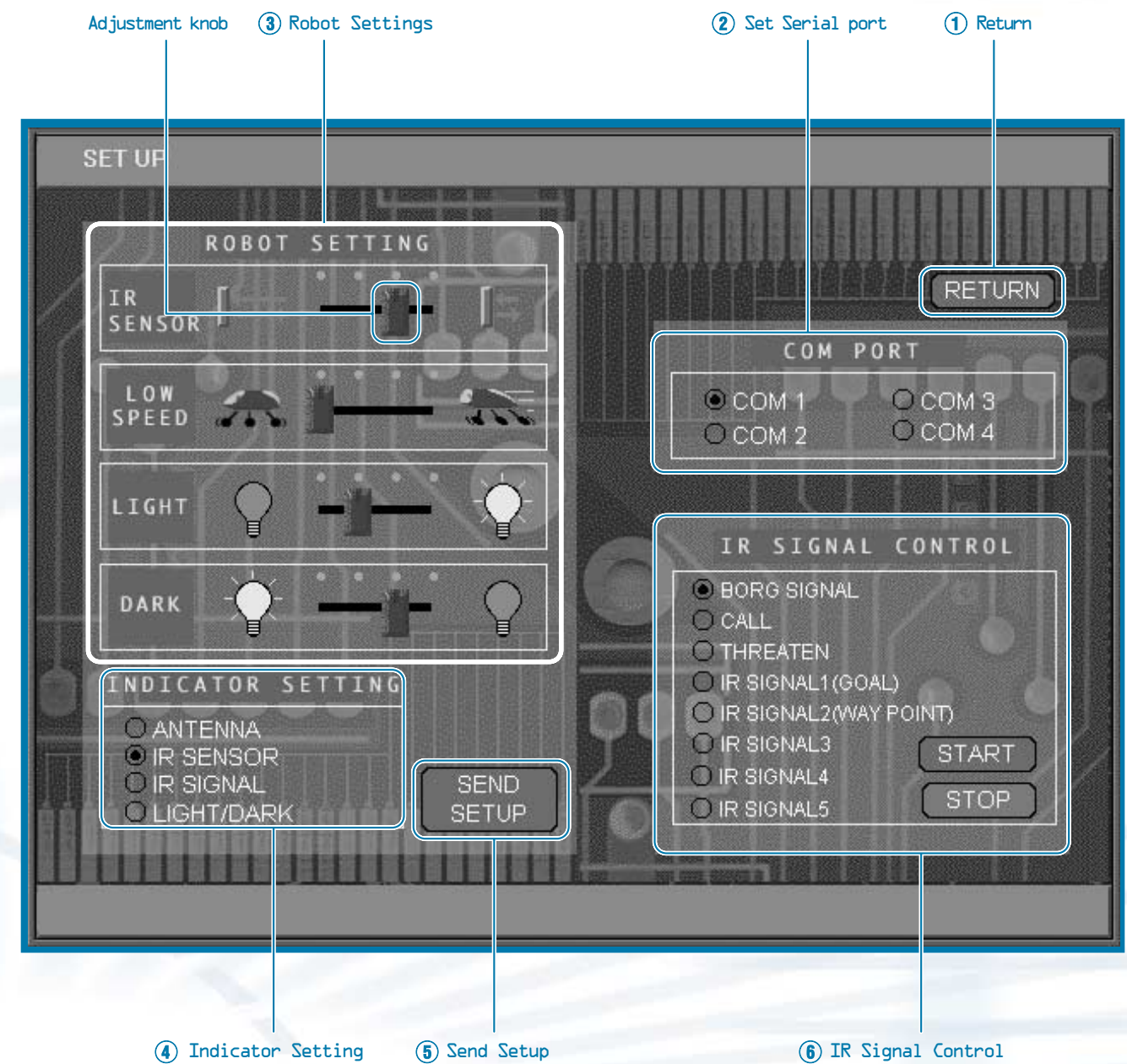


### The Set Up Screen

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

### Names of Parts

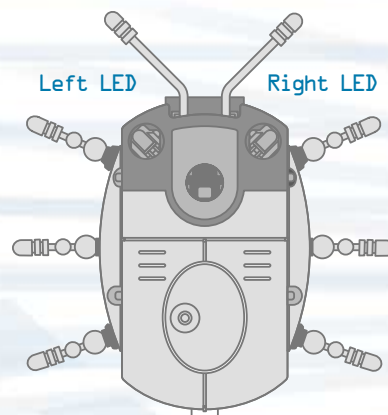
The names of the parts of the screen are shown below. The numbers correspond to the numbered descriptions on the following page.



- 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.

<b>Infrared sensor</b>	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.
<b>Low speed</b>	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.)
<b>Light sensor</b>	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.
<b>Dark sensor</b>	A "Dark" sensor block can be given any of four setting. 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.

	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 transmission 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 you PC, do not touch the connector terminal with your fingers or with any metal object.



### 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.

Panel 1

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.



#### 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.

Panel 1

Add this section to the program from Exercise 1

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

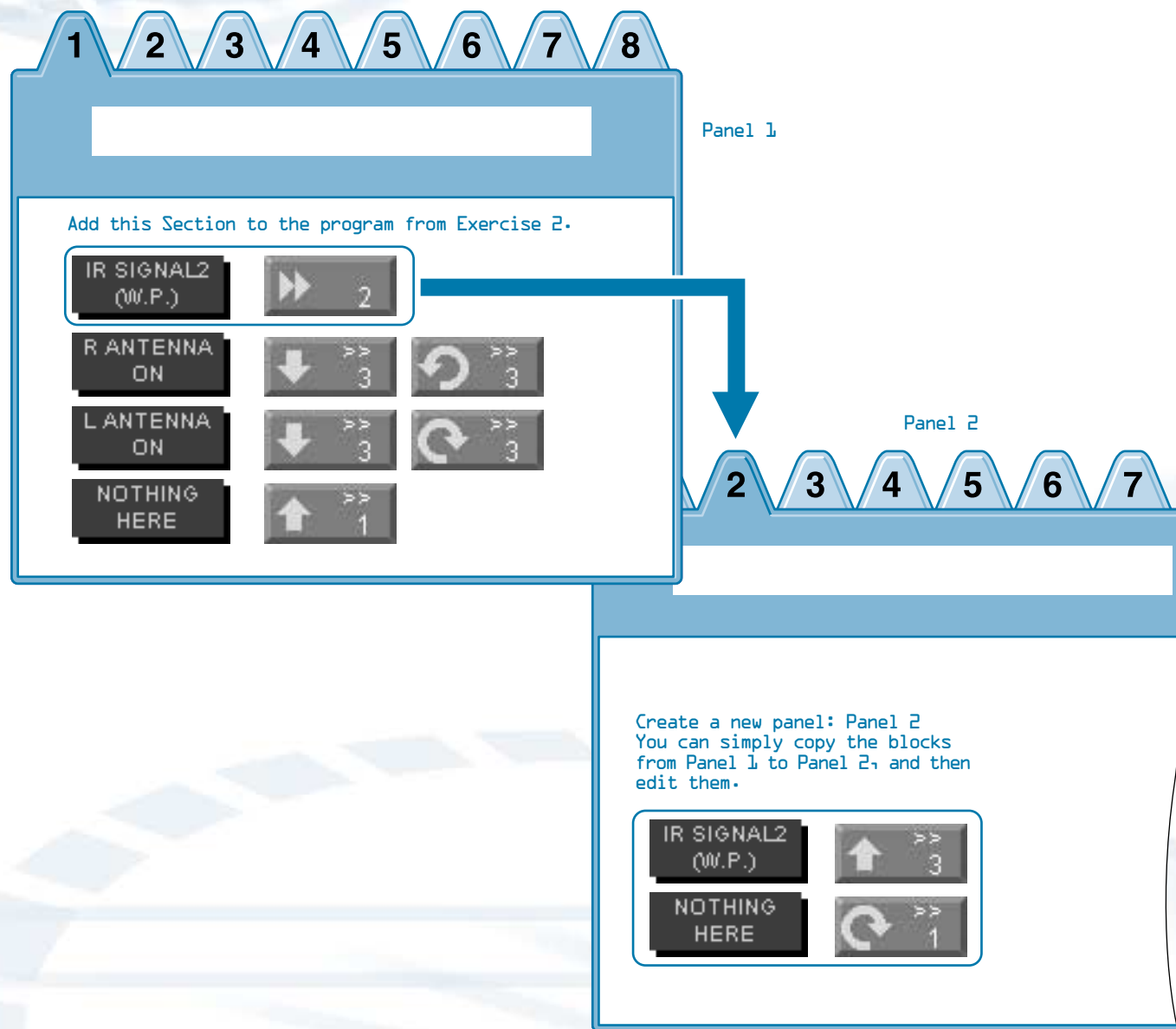
Although this program uses the touch sensors, the infrared sensors can also be used in the same way. Try replacing "right antenna" with "something on the right", and "left antenna" with "something on the left". Again, the numbers can be altered very easily just by double-clicking the appropriate block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



### Exercise 3: Modifying the Program so that the WonderBorg can Pick Up and Follow an Infrared Signal

In this exercise, we're going to modify the program from Exercise 2, so that if the robot detects an infrared signal, it will enter "Following mode (Panel 2)", and start following the infrared signal. This program uses 2 panels.

#### Program for Exercise 3



#### Panel 1

Panel 1 was created by taking the program from Exercise 2 and augmenting it with a line telling the robot what to do if it detects infrared signal 2 (Way Point). If it detects this particular infrared signal, it is instructed to switch to the program on Panel 2. As a result of the tests you carried out in Exercise 2, your blocks for evasive action may look different from those shown above, but you do not need to alter the figures all over again.

#### Panel 2

Panel 2 contains a program for "Following mode", where the robot will follow infrared signal 2 (Way Point). If it detects this particular infrared signal, it is instructed to move forward 3 steps. If there is no sensor reaction, it must then turn one step to the right. In this program, if the robot loses the infrared signal, it will turn round and round, while if it finds it, it will move forward.



### Testing

Before sending the program to the robot and having it executed we are going to prepare to transmit infrared signal 2 (Guide to another robot) from the interface.

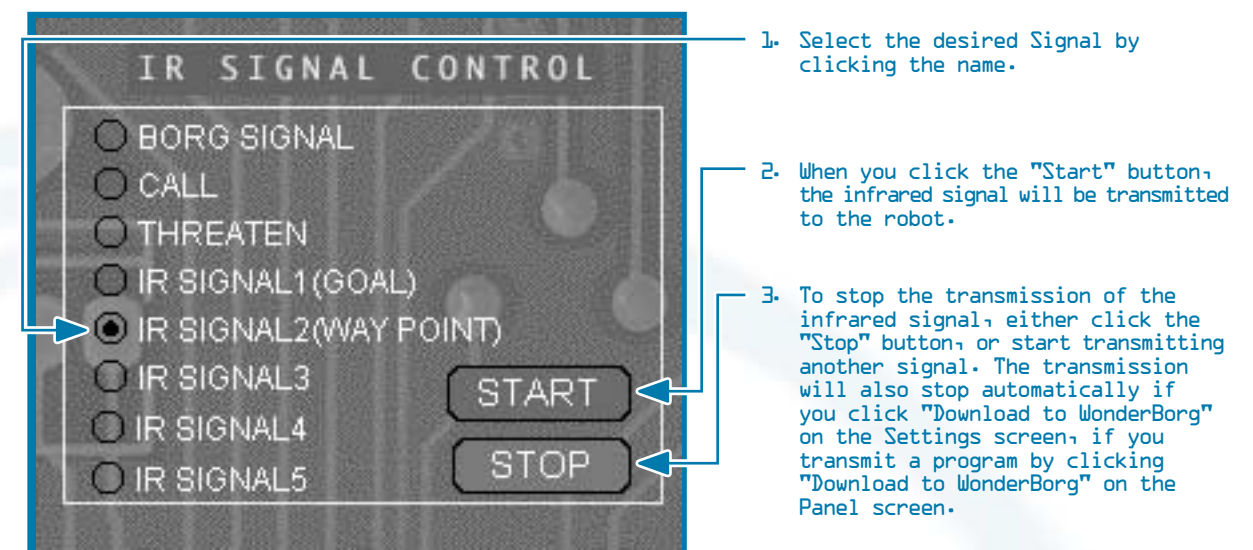


Click the "Set Up" button at the bottom right of the Panel screen, select "infrared signal 2 (Way Point)" from "IR Signal Control" menu on the Set UP screen, then click the "Start" button. The red indicator lamp on the Interface should flash for a short while, then the flashing will stop, and this pattern should be repeated continuously. If this happens, the infrared signal 2 is being transmitted from the interface.

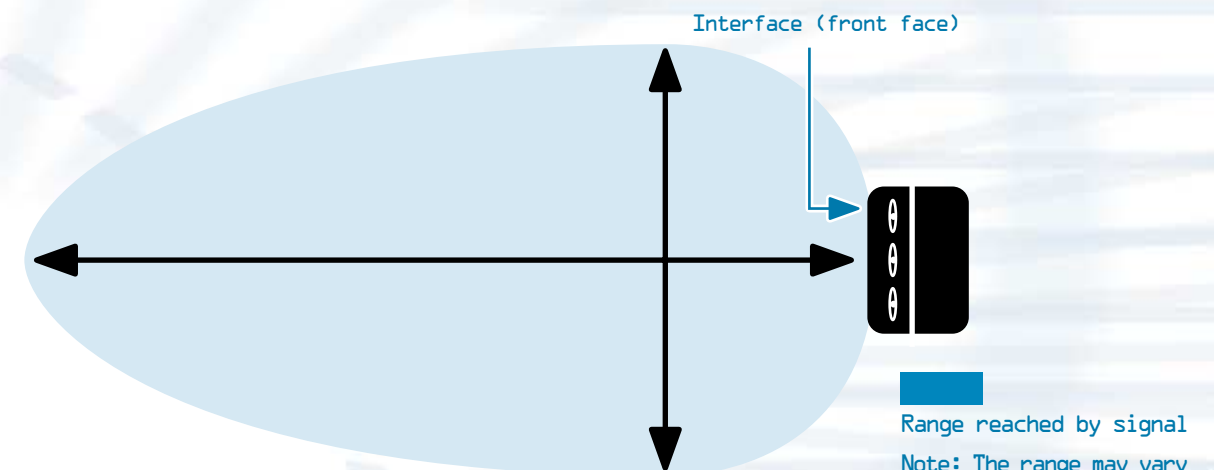
If necessary, you can unplug the cable from the Interface, and place the Interface some distance away from your PC. When you do this, do not switch the Interface's main switch OFF: the infrared signal will stop if you do so.

The range of the infrared signal is shown in the diagram below. Place the robot somewhere inside this range before starting the transmission. If the transmission does not work, move the robot a little closer to the Interface, then try again.

### How to Transmit an Infrared Signal



### The Ranged Reached by the Infrared Signal

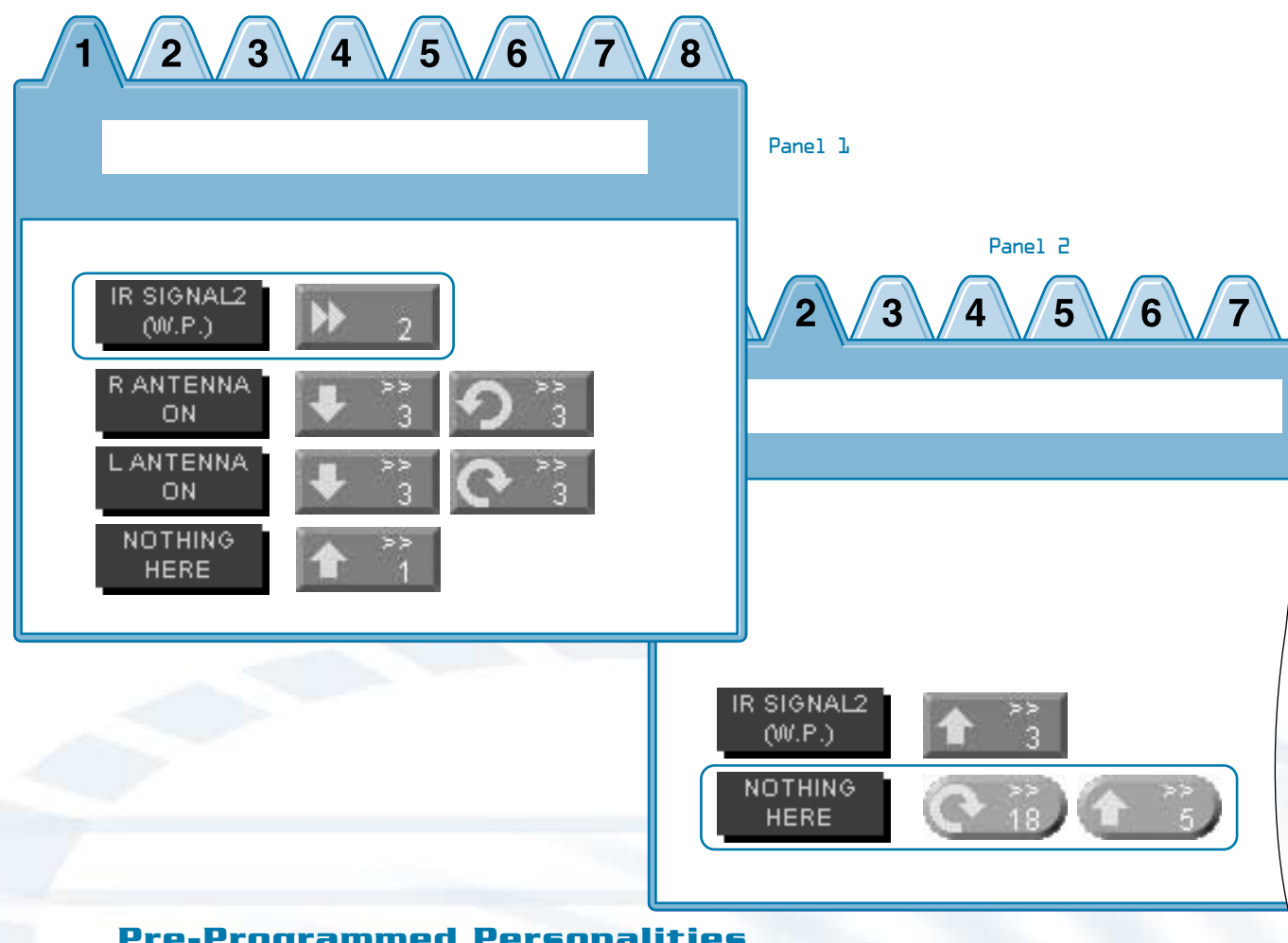


### Exercise 4: Modifying the Program to Make the WonderBorg Follow an infrared Signal Reliably

In this exercise, we are going to take the program on Panel 2 from Exercise 3, and modify it, using the "interrupt" function, so that the WonderBorg will follow infrared signal 2 (Way Point) more reliably.

With the program from Exercise 3, when the WonderBorg has detected infrared signal 2 (Way Point) and is walking towards the signal, if an empty can or other obstacle is placed between the robot and the Interface, blocking the signal, then the robot will lose the signal and end up turning round and round on the spot. With this new program, however, the robot moves forward a little each time it more or less completes a full turn if it loses the signal, it should be able to find it again.

In the new program on Panel 2, if there is no sensor reaction, the WonderBorg turns 18 steps to the right, and then goes 5 steps forward. This means that it is repeating a behavior pattern of scanning its surroundings, and then changing its position slightly. The blocks for these actions are green overridable blocks, so if the sensor for infrared signal 2 is triggered while the rotating, it will stop rotation and start walking forward.



### Pre-Programmed Personalities

As a user you may opt to use the three pre-programmed personalities included in the software. These are three completed programs that you can download to your WonderBorg. You may want to try these out initially to become more familiar with programming the WonderBorg.

The Adult personality is the most advanced pre-programmed personality. It uses the full range of its sensors.

The Baby personality does not use as many of its sensors as the adult. It hesitates and makes noises before it advances forward. The baby personality also dances around when it sees darkness (when you put your finger over the light sensor window).

The Dark personality is always looking for a fight. It will stay at a stand still and use a threatening tone to try and challenge other Borgs. It uses a wide range of its senses.

To access these personalities, open up the Robot Works program. Left mouse click on Load. Select the "Personality" folder. Pick which personality you wish to open, click on it and press open.



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## Troubleshooting

### Operating Problems

**- If the WonderBorg does not beep when the power is turned ON:**

Check that the motherboard and motor units are properly connected.

**- If nothing happens when the power is switched ON:**

If you have previously opened the motor unit to change the gears, check whether you have done this correctly. Check that the batteries have been inserted, and that they are the right way.

**- If the WonderBorg does not move correctly when you transmit a program:**

Check whether something is blocking the signal between the Interface transmitter and the WonderBorg's infrared receiver. Check that the interface and the robots are far enough apart.

**- If the WonderBorg makes a chirping noise while executing a program, and the stops moving:**

Check whether the robot's leg has been caught somehow. If any of its legs are interfered with while it is executing a program, the WonderBorg will chirp repeatedly.

**- If the WonderBorg's legs start trembling when the power is switched ON:**

This is not a fault: the WonderBorg is performing its initial operation check. Just leave it alone for a short while.

**- If the WonderBorg goes backward when the program says it should to forward:**

Check whether the motherboard and the motor units have been connected the wrong way.

**- If the WonderBorg does not walk properly:**

Check that the legs have been assembled correctly. To make the robot walk efficiently, the legs have to be assembled at the optimum angle. If you are using the legs made of plastic-covered wire, check that they are bent correctly.

**- If the WonderBorg starts executing the program, and then stops after a short while:**

check the batteries. When the batteries are low, the WonderBorg will sometimes come to a standstill when executing a movement at the "low speed" setting. If this is the problem, change the batteries.

**- If the Interface is not showing any reaction:**

Check that the cable is properly connected. Push it in as far as it will go. Is the port setting correct? Consult you PC manual and make sure the port selected is the one to which the Interface is connected. Is the interface switched ON? Check that the green indicator lamp is glowing. If the interface is switched ON but the green indicator lamp is not glowing, check that the batteries are inserted the right way. It can happen that a scrap of plastic from the battery wrapper has gotten stuck over a battery contact, so check for this too.

**- If an error message appears on your PC screen:**

An error message may appear if you select a port other than the one the Interface is connected to. In this case, the message will disappear when you click "OK" on the message dialog window, and you can then select the correct port. In this case, the cursor will turn in to an hourglass shape, but it will still work when you click it. Have you select the correct port? Consult your PC manual and select the port to which the interface is connected.

**- If your PC crashes:**

Restart your PC. Have you selected the correct port? Consult you PC manual and select the port to which the interface is connected.



### Problems with Program Transmission

**- If you transmit a program, and then find that the WonderBorg still behaves as it did before:**

The WonderBorg cannot receive a program while the green LED is flashing. Check that the WonderBorg and the Interface are facing one another, and are close enough. If they are too far apart, or if there is an object between them, it will not be possible to transmit the program. The WonderBorg's infrared receiver shouldn't be more than 20cm away from the Interface, and there should be nothing in the way between the two. Is someone using another WonderBorg close by? If so, this may make it impossible to transmit programs to your own WonderBorg. Are you using the robot in an extremely bright location? This can make it impossible to transmit programs to your WonderBorg.

- A. If the program is transmitted successfully: the WonderBorg gives a short beep.
- B. If the program is not updated: the WonderBorg gives a long beep
- C. If a faulty program has been received: the WonderBorg gives three long beeps.

### Problems with Sensors

**- If the touch sensors are not reacting properly:**

Check whether one of the sensors has come loose from the rubber socket holding it in place. You will need to remove the body shell. If you are using the antennae made of plastic-covered wire, check that they are bent correctly.

**- If the infrared sensors are not reacting properly:**

Go into the Set Up screen and adjust the sensitivity using the "Infrared sensors" gauge.

**- If the Light sensor is not reacting properly:**

Adjust the sensitivity using the "Light sensor" gauge on the Set Up screen. When programming, bear in mind that at certain levels of brightness, the WonderBorg cannot distinguish between "Light" and "Dark".

**- If the floor sensor' "OFF" reaction is triggered while the WonderBorg is walking:**

Check whether the WonderBorg's body is tilted because it has stepped up on some obstacle, or because of the way its legs are bent. Marked tilting of the body can sometimes make the floor sensors lose track of the floor. If the floor is black (or very dark in color), the floor sensors will be unable to detect the floor. (Hint: the speed of the flashing green LED indicates the type of floor surface (Light / Dark) as sensed by the WonderBorg - In addition, make good use of the Interrupt function)

**- If the floor sensors are not reacting properly:**

The performance of the floor sensors may vary slightly from one WonderBorg to another. Go into the Set Up screen and adjust the sensitivity, using the "infrared sensors" gauge. When programming, it should also be kept in mind that at certain "Floor status" settings, the robot may be unable to distinguish between "Floor sensor ON" and "Floor sensor OFF".

**- If the infrared sensors and the floor sensors are not working:**

If you are using the WonderBorg in a very light or brightly-lit location, the obstacle sensors and floor sensors may not react.

**- If the infrared sensors and the floor sensors have become less effective:**

Check the batteries: when the batteries run down, the sensors effective range shrinks. If this is the problem, change the batteries.

**- If the WonderBorg will no longer move forward (or carry out some other action in question) even though none of the sensors is reacting:**

Are the blocks "Nothing Here" and "Advance" (or the other action in question) waiting for a condition specified in a line higher up the panel? If sensor are reacting less effectively than before: Check whether you have set the number of steps in the command block to more than 2. While the WonderBorg is executing a command block, it cannot react to any other sensor block, so care is needed when the number of spaces in the command block is set to a number higher than 2 (i.e. when a single command block takes some time to execute). If you want a sensor with a higher priority to be able to take effect during the execution of a block involving more than 2 steps, you will need to specify the command block in question as "Interrupt". Again, if you want to speed up the reaction of the sensor even when the command block does not contain more than 2 steps, you should specify the command block as "Interrupt".



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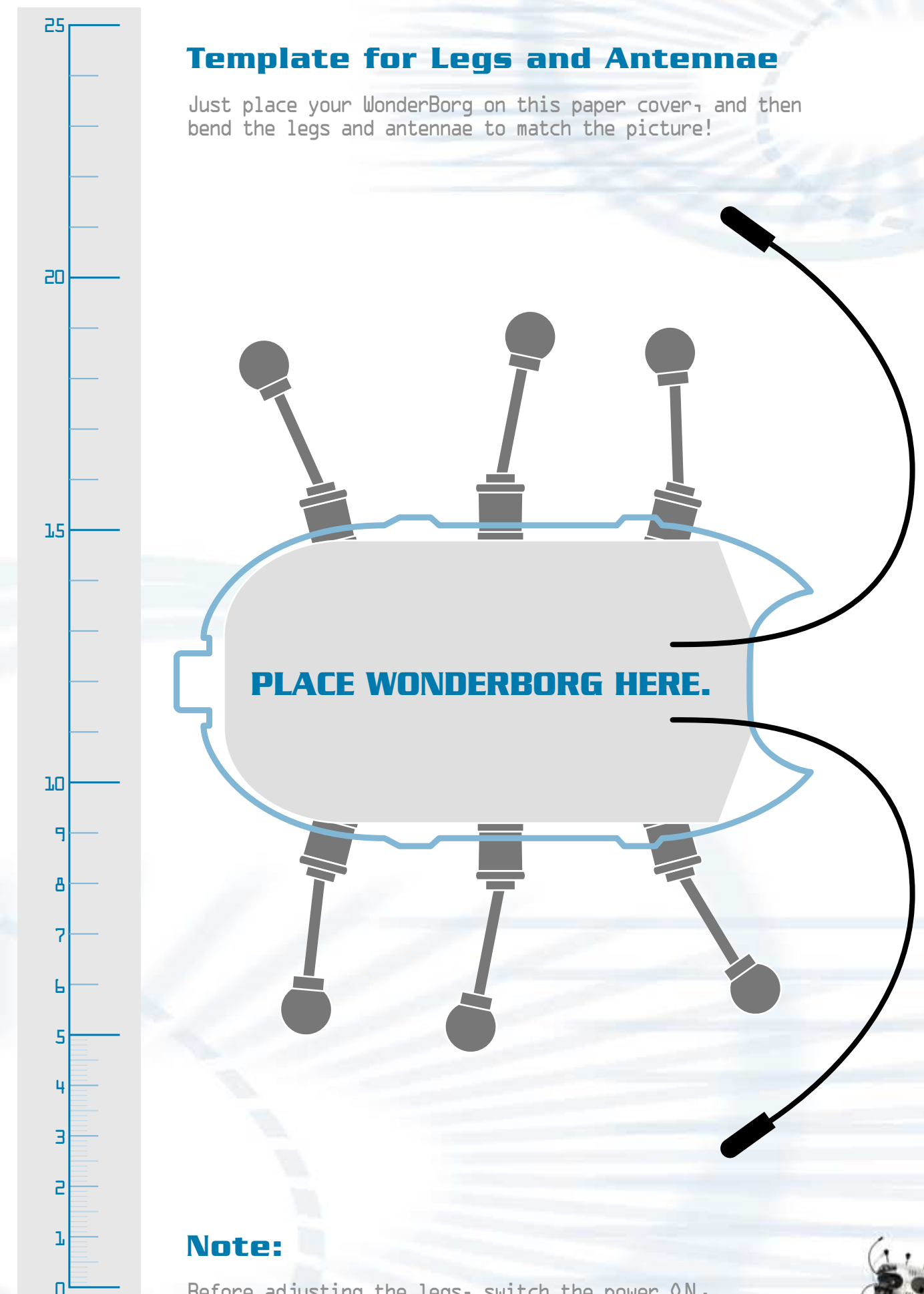
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## Template for Legs and Antennae

Just place your WonderBorg on this paper cover, and then bend the legs and antennae to match the picture!



### Note:

Before adjusting the legs, switch the power ON.



This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions :

(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio TV technician for help.



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