iRobot®

Roomba Discovery Series Service Manual

Published August 31 2006

Roomba Scheduler

Roomba Discovery SE

Roomba Discovery

Roomba Sage

Roomba Red

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Roomba Service Process

The Roomba Service Manual will guide a technician through the Roomba Service Procedure. The steps that involve record keeping will enable iRobot to better track and support product improvements. iRobot requires the data to be sent to them in a standardized manner but it is up to every Service Center to decide how detailed they require their record keeping to be.
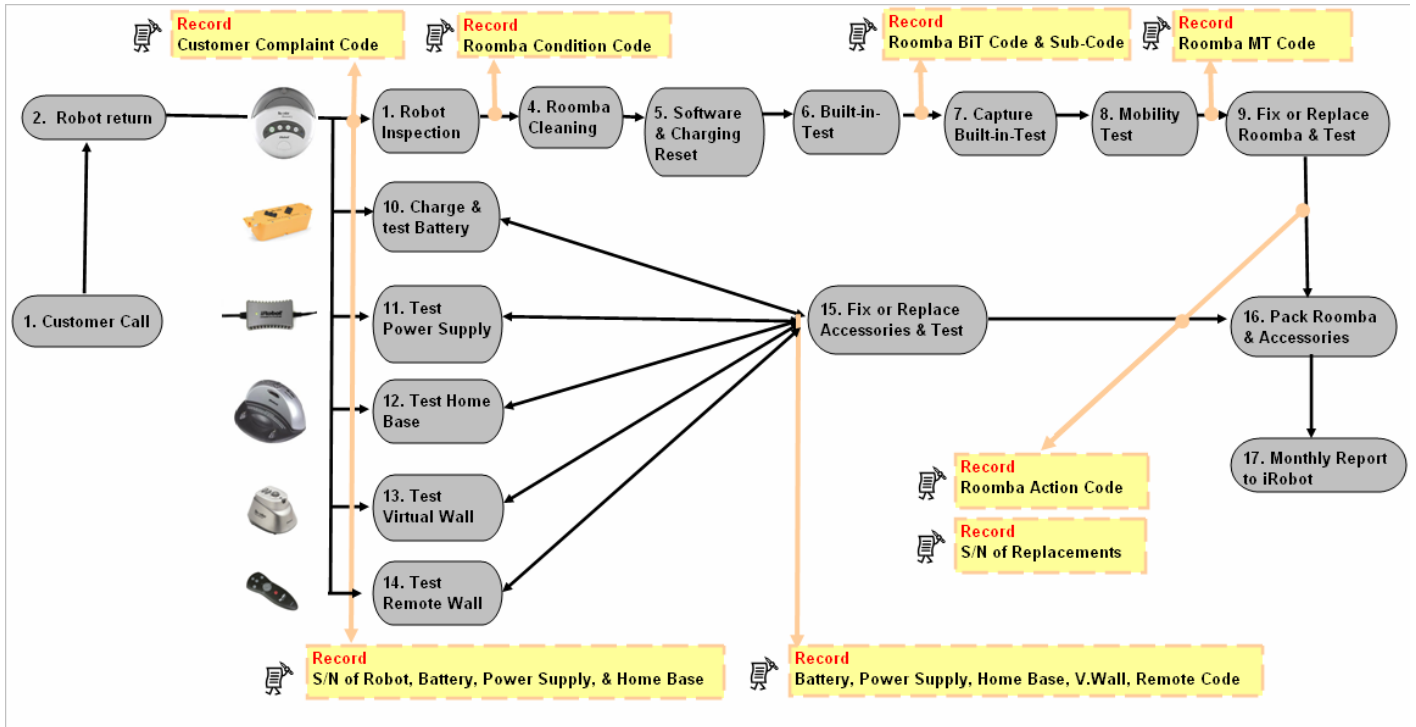
Record Keeping

01: Customer Call

Depending on the sophistication of the Customer Service Representation at the service centers, Roomba issues can be diagnosed over the phone by guiding a user through a troubleshooting process. For example, Appendix A walks through the charging troubleshooting. At a minimum, iRobot recommends that the customer be asked to perform routine Roomba maintenance steps to resolve the Roomba issue. Only if these steps fail to resolve the issue should a customer send the Roomba to a service center.

A) Customer should clean Roomba
     i.   Clean the cliff sensors under the bumper with compressed air.①
     ii. Remove any hair or obstruction from the three wheels.②
     iii. Remove any hair or obstruction from the brushes and bearings.③
     iv. Clean electrical contacts on Roomba and Home Base with alcohol pad or eraser.④
     v. Clean out the vacuum bin and vacuum filter. ⑤
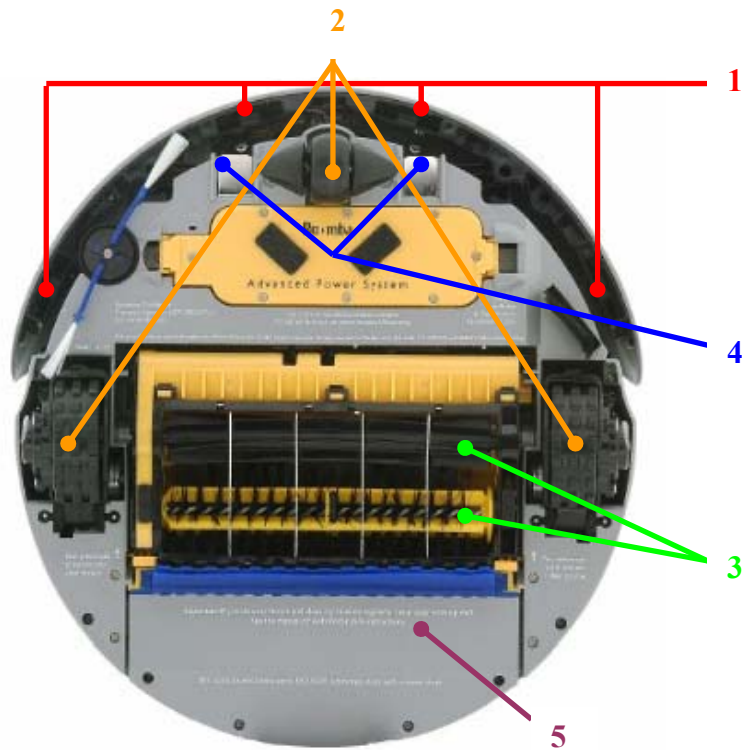
B) Customer should reset Roomba's charging system by removing the battery, pressing the Roomba power button for at least 5 seconds and reinserting the battery into the Roomba
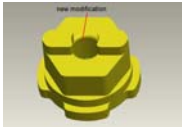
C) Customer should fully charge the battery overnight in the Roomba.

02: Roomba Return Procedure

If the initial maintenance steps did not solve the issue, a customer should proceed to return the Roomba, battery and all accessories to a service center. The customer should add documentation that provides the date, their name, address, a reference number and a description of the complaint.

In order to avoid receiving a depleted battery, ask the customer to remove battery from the Roomba and place it separately in the box.

03: Incoming Roomba Inspection

	Unpack the Roomba return.	
	Record serial number of the Roomba, Battery, Power Supply and Home Base.	Appendix B
	Record the date and 'Customer Complaint Code'.	Appendix C
	Remove the vacuum bin and turn the Roomba on its back on a flat surface.	
	Perform a general outer visual inspection of the Roomba condition. Look at the wear on the chassis, caster & drive wheels.	
	Inspect the brushes: o Remove the brush guard o Manually turn the bristle brush. The flexible brush should counter rotate? o Remove the brushes and check that both yellow brush bearings are present. Consider replacing old bearings with the new holed bearing style.[1] o Inspect the square ends of both brushes. Inspect the output gears on the side gearbox. to see if o **Record** the 'Robot Condition Code'. Is the brush new, lightly soiled or dirty condition.	
	Inspect the drive wheels: o Inspect the front wheel and drive wheels. Turn the wheels.	

---

[1] Holed bearings allow captured dirt and hair to escape the cleaning assembly..

	Reinsert all Roomba components (bearings, brushes, wire guard, side brush and vacuum bin). Insert *approved* charged battery in the Roomba and run the Roomba on 'Clean'. Does the Roomba end immediately with an error code? If not, continue.	Appendix D

04: Roomba Cleaning

	Remove and empty the vacuum bin and vacuum filter.	
	Inspect the filter for punctures and replace if punctured.	
	Clean the main brush, flexible brush and bearings from hair and dirt.	
	Clean drive wheel bearings.	

	Clean the wheel axles from hair using tweezers.
	  o Front caster
	  o Drive Wheels	

	Remove and clean under the side brush of hair and dirt.	

	Clean the sensors with compressed air.
	  o Cliff sensors
	  o Wall sensor
	  o Bumper sensors	

	Clean the cleaning assembly with compressed air.	
	Clean the electrical contacts on Roomba with alcohol pad.	

05: Roomba Software & Charging Reset

	Insert an *approved* charged battery in the Roomba and download the latest software (if outdated).	Appendix E
	Reset Roomba's charging system by removing the battery and pressing the power button for at least 5 seconds.	

06: Roomba Diagnostics: Built-in-Test (BiT)

	Insert an *approved* charged battery in the Roomba.	
	Insert an *approved* main bristle brush and flexible brush.	
	Verify the vacuum bin is inserted in the Roomba.	
	Use *approved* Power Supply, Home Base, Virtual Wall and Remote.	
	Perform BiT steps. Take note of the button & speaker performance.	Appendix F
📝	**Record** the 'Robot BiT Code' and 'Robot BiT Sub-Code'. Refer to main issue that caused return. Take special notice of the button & speaker performance.	Appendix C

07: Capture Built-in-Test Data

📝	Use **"iRobot Factory Test Client Version 1.1**" software to **download** the BiT output.	Appendix F

08: Roomba Diagnostics: Mobility Test

	Perform the Mobility Test.	Appendix H
📝	**Record** the "Robot MT Code'.	Appendix C

09: Fix or Replace Roomba

	Disassemble Roomba and clean Roomba with compressed air.	Appendix M
	Repair parts using Built-in-test Fix.	Service Procedure (pg 16)
	Check pcb connections.	Appendix I
	Retest the BiT and MT and continue fixing until 100% pass.	
📝	**Record** 'Action Code'.	Appendix C

10: Test Battery

	Fully charge the returned Battery in an *approved*Roomba.	

	Perform Battery test
	   o Battery Voltage
	   o Battery Voltage Drop with a 5 ohm load
	   o Thermistor value
		Appendix J
		
		Troubleshoot Battery (pg 35)

	[Note: If only battery voltage was low, attempt an uninterrupted 72 hour charge and repeat test. If the voltage drop failed, replace battery.]	
	When battery PASSES the test do a Roomba run time on a hard floor. Run time should be over 60 minutes. If runtime is less than 60 minutes, try a 72 hour charge again and see if run time improves. If no, replace battery.	
	Record the 'Battery Code'.	Appendix C

11: Test Power Supply

	Test returned Power Supply
	   o Output current at 90 VAC and 240 VAC
	   o Output current at 60 VAC
	   o Solid green light under load
		Appendix K
		
		Troubleshoot Power Supply (pg36)

	[Note: If the power supply light is off or blinking while charging, replace the Power Supply, Home Base and the Roomba's main pcb. The pcb in the Home Base and Roomba may have been damaged.]	
	Record the 'Power Supply Code'.	Appendix C

12: Test Home Base (if applicable)

	Test returned Home Base with a power supply
	   o Clean Home Base (electrical contacts and IR emitter)
	   o Check if power and dock LEDs are 'on' when charging
	   o Visually inspect contact springs
		Troubleshoot Home Base (pg 39)

	Test Home Base Mobility
	   o Perform Home Base avoidance (Fig 5 in Appendix H)
	   o Perform the manual dock (Fig 7 in Appendix H)
		Appendix H

📝	**Record** the 'Power Supply Code'	Appendix C

13: Test Virtual Wall (if applicable)

	Test returned Virtual Wall with charged batteries
	    o Clean Virtual Wall (IR emitter)
	    o Check power light (if blinking then batteries are low)
	    o Check Virtual mobility (Fig 4 in Appendix H)
		Troubleshoot Virtual Wall (pg 43)

📝	**Record** the 'Virtual Wall Code'	Appendix C

14: Test Remote (if applicable)

	Test returned Remote with charged batteries
	    o Clean Remote (IR emitter)
	    o Check power light (if blinking then batteries are low)
	    o Verify all command buttons function with a Roomba
		Troubleshoot Remote (pg 44)

📝	**Record** the 'Remote Code'	Appendix C

15: Replace Faulty Accessories

	Replace faulty accessories	
📝	**Record** the 'Action Item Code'.	Appendix C

16: Pack & Record the Serial Numbers

	Wrap Battery so no electrical contact is made with the Roomba in order to avoid creating a deeply discharged battery.	
📝	**Record** the serial number of all replacement parts.	Appendix B

![iRobot logo]

17: Monthly Data Report to iRobot

📜	Send monthly report to iRobot (tgiesecke@irobot.com) 1. A zipped up file of monthly Built-in-Test output files. The zip file should have a name format of **YYYYMM_RoombaBiT_##.csv** where ## is the name of the service center. Save the file as a CSV (comma delimited). 2. The detailed Record Sheet which captures all the service codes of each serviced Roomba.	Appendix C

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Roomba Vacuuming Robot

Roomba Terminology
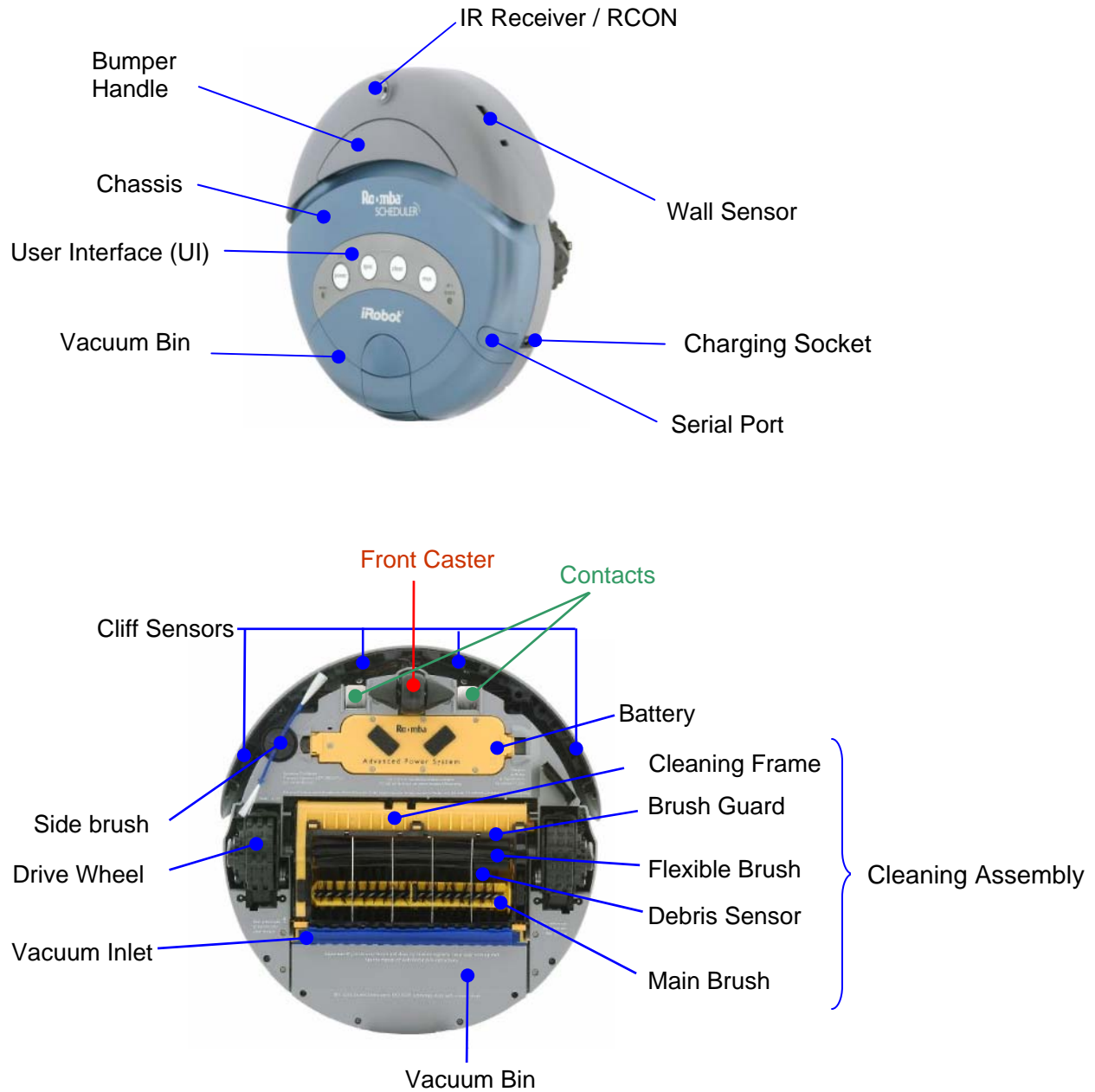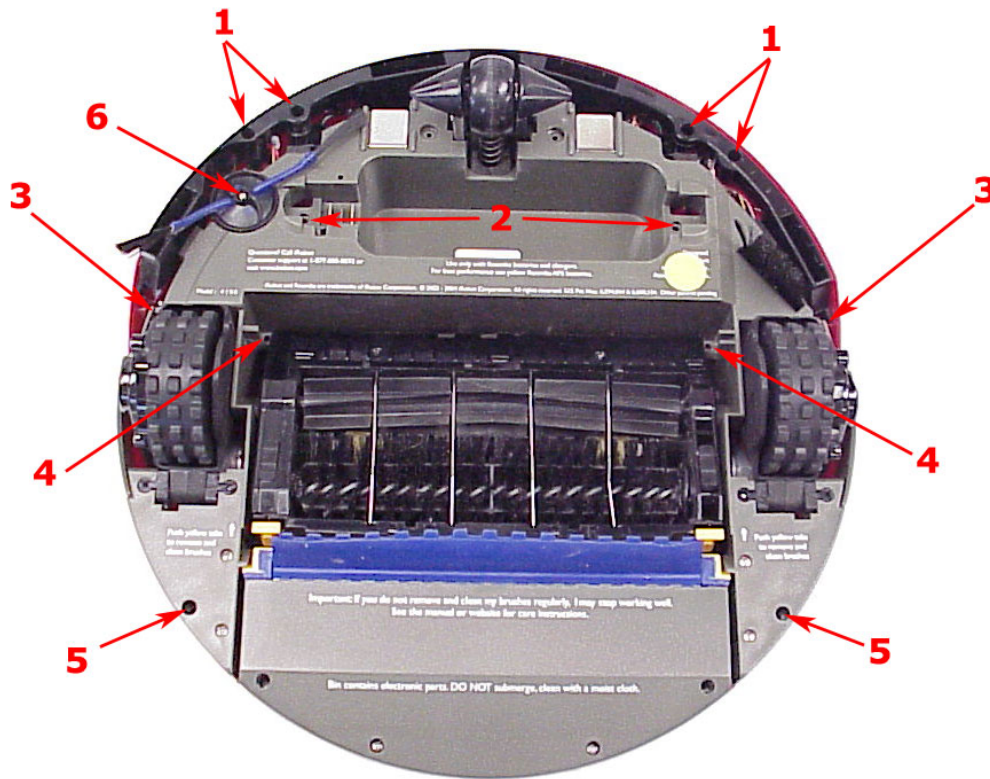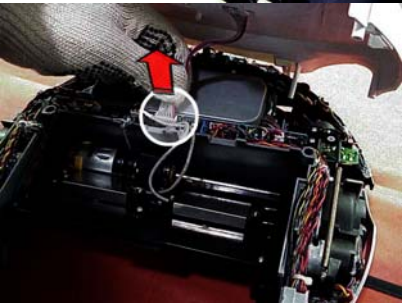
IR Receiver / RCON

Bumper
Handle

Chassis

User Interface (UI)

Vacuum Bin

Wall Sensor

Charging Socket

Serial Port

Front Caster

Contacts

Cliff Sensors

Side brush

Drive Wheel

Vacuum Inlet

Battery

Cleaning Frame

Brush Guard

Flexible Brush

Debris Sensor

Main Brush

Cleaning Assembly

Vacuum Bin

Roomba Chassis Disassembly Procedure

- o Remove Vacuum Bin
- o Unscrew bumper screws (1)
- o Unscrew chassis screws (2,3,4,5)
- o Unscrew side brush if necessary (6)

14
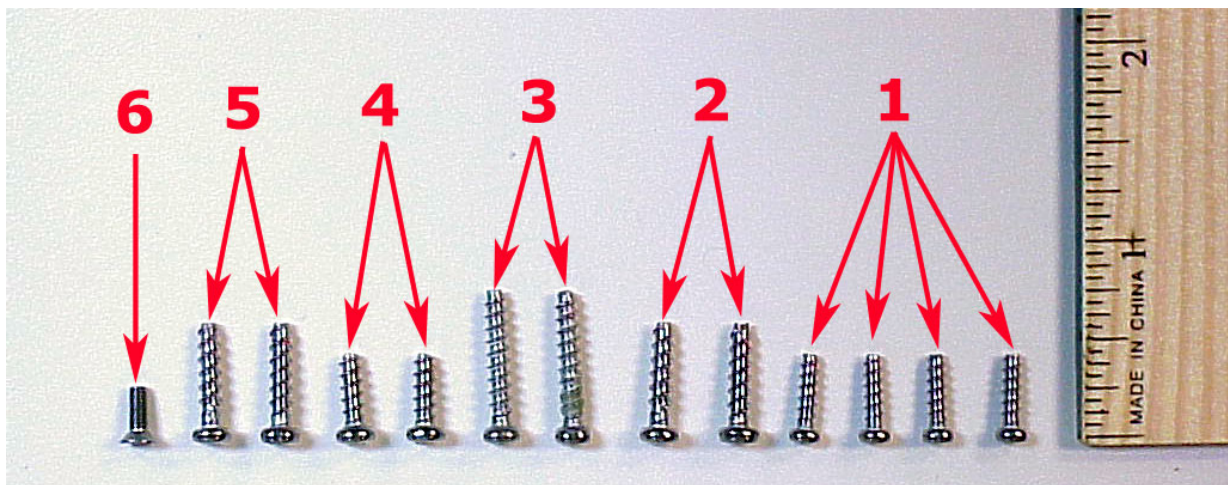
1	Lift outer bumper slowly (it is attached by a connector)	
2	Angle the bumper outward and carefully disconnect connector from outer bumper	
3	Lift top shell slowly (it is attached by a connector). Carefully disconnect the connector from Roomba.	
4	Clean off the internal dirt with compressed air.	

Go to Appendix M for details on how to remove the Cleaning Frame, PCB, Inner Bumper, Diver Wheels and Front Caster.

Roomba Electrical Inter-Relationships

Roomba electrical design is proprietary. However for servicing it is important to know that the following sensors are in series:

1. Right front cliff sensor, Right outer cliff sensor, Right wall sensor
2. Left front cliff sensor, Left outer cliff sensor
3. Right bumper sensor, Right wheel sensor, Left bumper sensor, Left wheel sensor.

Service Procedure (based on Built-in-Test Failures)

Every Roomba return is required to undergo a Built-in-Test (BiT) and a Mobility Test (MT) which will then dictate how to best service the Roomba. iRobot requires that only the initial BiT output file be recorded and sent back to iRobot on a monthly basis. However, a service technician will repeat the BiT numerous times during the servicing of a Roomba. A Roomba can only be returned to the customer after both the BiT and MT pass 100%.
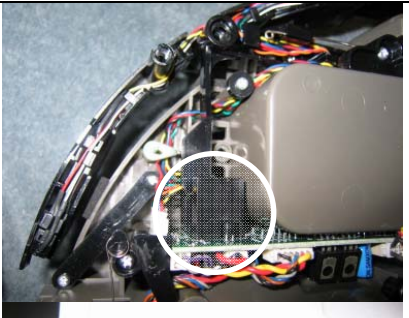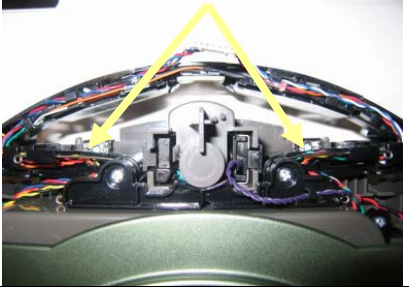
The following Service Procedure is based on failed BiT steps or specific Roomba symptoms. We provide basic steps on how to attempt to repair the component but as a last resort, a replacement part is suggested.

```
┌─────────────────────────────────────┐
│          BiT Repair Steps           │
└─────────────────────────────────────┘
                   │
                   ▼
┌─────────────────────────────────────┐
│     Replacement Part (if needed)    │
└─────────────────────────────────────┘
                   │
                   ▼
       ┌─────────────────────────┐
       │   Quality Check (QC)    │
       └─────────────────────────┘
```

Failed BiT 0 - Panel LEDS

<table>
<tr>
<td rowspan="3">BiT REPAIR STEPS</td>
<td>Roomba Symptom: Roomba lights do not turn on.</td>
<td></td>
</tr>
<tr>
<td>→ Connect an *approved* top shell to Roomba and redo BiT step. If BiT step passes, Roomba is working and we should now inspect the failed top shell.

→ Inspect wiring and soldering under the failed top shell. Are any pcb wires broken or disconnected?</td>
<td></td>
</tr>
<tr>
<td>→ If buttons are not working or intermittent and the Roomba is a Discovery, SE or Scheduler, open the user interface panel. Clean the pcb under the snap dome with alcohol and reapply tape to seal switch from dirt.</td>
<td></td>
</tr>
<tr>
<td>REPLACEMENT PART</td>
<td>Top Cover/Shell</td>
<td></td>
</tr>
<tr>
<td>QC</td>
<td>o   Inspect the wiring into the user panel and add hot glue if it is needed for strain relief.

o   <u>Ensure BiT passes.</u></td>
<td></td>
</tr>
</table>
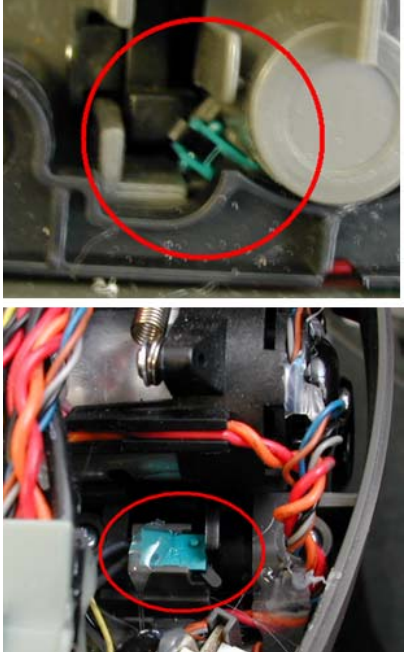
Failed BiT 1 – Bumpers

	Roomba Symptom: Roomba may back up and circle with no error code.	
BiT REPAIR STEPS	→ Clean area where bumper arms meet the IR sensor housing on pcb with compressed air. If test still fails remove arms (see Appendix M) and wipe sensors in housing with alcohol. → Make sure the front caster is properly inserted and that the connectors are secure. → Inspect the bumper springs and ensure they spring back and that there are no wires or obstructions as they compress. → Check for broken bumper arms.	
REPLACEMENT PART	**Main PCB**	
	Inner Bumper Module	
QC	o When reattaching the outer bumper verify that wires are not being pinched and that the springs are free to compress. o Ensure BiT passes.	

Failed BiT 2 or 3 – Outer & Inner Cliff Sensors

	Roomba Symptom: Roomba does not see cliffs or
	  o Does not run, says "ehh"
	  o Backs up in circular arcs
	  o Stops with "uh-oh and 5 beeps"	

BiT REPAIR STEPS	→ Clean the sensors with compressed air. → Is the side brush blocking the outer sensor? Rotate the side brush arms away from the cliff sensor opening. → Remove the outer bumper and inspect the cliff sensor wiring.	4 InfraRed floor sensors
REPLACEMENT PART	**Inner Bumper Module**	
QC	o When attaching the inner and outer bumper verify that the wires are well routed and not being pinched. o Verify that the bumper can be compressed and released freely on both sides o <u>Ensure BiT passes.</u>	

Failed BiT 4 – Wheel Drop

<table>
<tr>
<td rowspan="4">BiT REPAIR STEPS</td>
<td>Roomba Symptom: Roomba has triangular wiggle behavior at startup or stops with "uh-oh and 6 or 9 beeps".</td>
<td></td>
</tr>
<tr>
<td>→ Inspect the failed wheel switch and toggle it. If the switch arm is worn or broken, then replace the switch.

→ Clean the switch with a drop of alcohol and dry switch with compressed air.

→ If switch is loose from its mounting support, reattach it with hot glue.</td>
<td>
</td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">REPLACEMENT PART</td>
<td>Fixed Front Caster Module</td>
<td></td>
</tr>
<tr>
<td>Speaker/Wheel Drop Switch</td>
<td></td>
</tr>
</table>

	Wheel Drop Switch	
	Outer Bumper Assembly	
QC	o If replacing switch, verify the wires are well routed and will not be pinched during reassembly. o Ensure BiT passes.	

Failed BiT 4 – Wall Sensor

BiT REPAIR STEPS	Roomba Symptom: Roomba does not run parallel to the walls on its right side.	
	→ Clean the wall sensor with compressed air → Perform a wall follow test (see Figure 2 in Appendix H) → Attach an *approved* outer bumper and retest to rule out pcb failures.	 1 InfraRed wall sensor
	Outer Bumper Assembly	
QC	o Ensure BiT and MT passes.	

Failed BiT 5 – RCON / IR Receiver
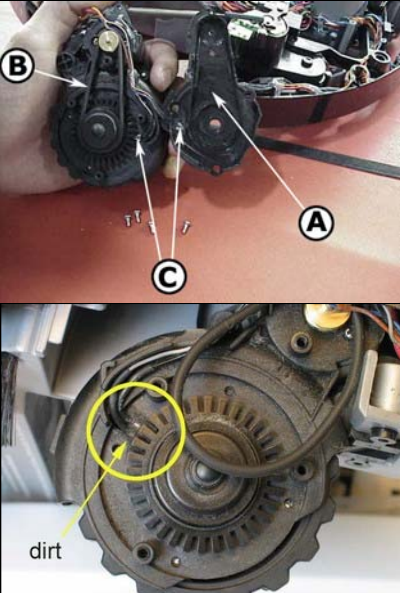
BiT REPAIR STEPS	Roomba Symptom: Crosses Virtual Wall beams, hits accessories, and does not respond to the Remote.	
	→ Wipe the RCON on top of bumper. Retest. → Detach outer bumper and inspect wiring under the bumper. → Plug in an *approved* outer bumper and retest with accessories to rule out pcb failures.	
REPLACEMENT PART	**Outer Bumper Assembly**	
QC	o Ensure BiT passes.	

Failed BiT 6 – Battery Sensor

BiT REPAIR STEPS	Roomba Symptom: Roomba does not charge	
	→ Clean the electrical contacts on the Roomba (in the battery well) with an alcohol pad. → Remove the outer bumper and inspect for any broken wires leading from the electrical contacts to the pcb.	

REPLACEMENT PART	**Battery**	
QC	o <u>Ensure BiT passes.</u>	

Failed BiT 7, 8 or 9 – Drive Wheels & Encoders
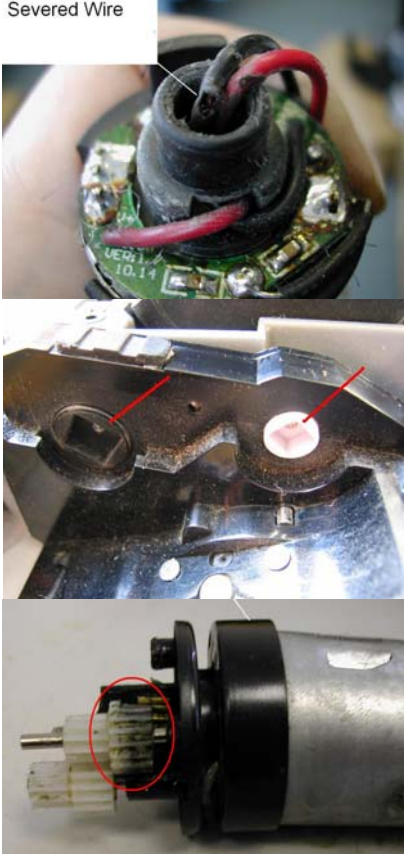
	Roomba Symptom: o Roomba spins both forward and backward in circles and may end in "uh-oh and 4 beeps". o Wheels may not turn or sound loud.	
BiT REPAIR STEPS	If the wheel tests fail or sound bad: → Put the Roomba on its back and manually turn the wheel. Is there an obstruction? Is the axle and bearing centered? → Open wheel cover and clean under the cove with compressed air, including wiping the encoder sensors with alcohol. (A,B,C) → Inspect the drive belt and exchange it if it is very worn or slipping. → If the motor is dead, attach a new wheel assembly into pcb and repeat test. If it works, the pcb is good and the wheel needs to be replaced.	
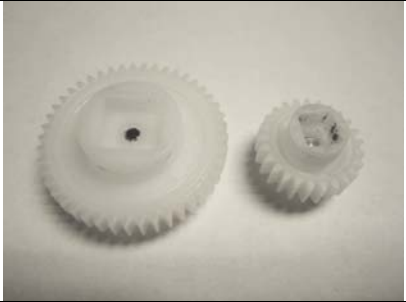
REPLACEMENT PART	**Drive Belt**	
	Right/Left Wheel Assembly	
QC	o <u>Ensure BiT passes.</u> o Verify wires are well routed and not pinched by the wheel cover. o Verify the wheel supports are screwed in.	

Failed BiT 10 – Stasis (front wheel)

BiT REPAIR STEPS	Roomba Symptom: 　o　Roomba will take longer to get unstuck. 　o　Roomba will abruptly interrupt its cleaning path with a quick panic spin (left or right spin)	
	If the <u>fixed</u> caster stasis fails, the mechanical switch may have failed: →Manually spin the wheel and verify that there is no hair in the axle and that it can spin fairly freely. →Replace caster module if cleaning did not help.	
	If the <u>swivel</u> caster stasis fails, the optical switch may have failed: → Remove the black/white wheel and clean the wheel with alcohol and remove hair from the axle. →Wipe the optical stasis window in the chassis above the wheel (see picture) using a lint free cloth. (see picture)	
REPLACEMENT PART	**Fixed Front Caster Module**	
	Swivel optical stasis	
QC	o　<u>Ensure BiT passes.</u>	

Failed BiT 11 – Main Brush

<table>
<tr>
<td rowspan="2">BiT REPAIR STEPS</td>
<td>
Roomba Symptom:

o Roomba does not clean or

o Brushes do not spin or sound loud

o Roomba ends with error "uh-oh and 1 beep".
</td>
<td></td>
</tr>
<tr>
<td>
If the main brush test fails or sounds loud:

→ If the brush motor is not running, try connecting an *approved* cleaning assembly to pcb main brush connector and run test. If test passes, then the Roomba pcb is good and we need to inspect the returned cleaning assembly.

→ Inspect brush motor power wires for breaks (see picture 1)

→ Inspect the output gear into brushes. Is the gear worn out? (see picture 2)

→ If there is a ratcheting and grinding sound, inspect the brush gear box and side gear box for missing gear teeth. (see picture 3)
</td>
<td>
Severed Wire

</td>
</tr>
<tr>
<td>REPLACEMENT PART</td>
<td>

Main Brush Assembly

</td>
<td>

</td>
</tr>
</table>

![iRobot logo]

Output Gears	
Brush Motor, Gearbox, Shaft	
QC	o <u>Ensure BiT passes with returned or replaced brushes</u> o Verify the string is attached to the chassis

Failed BiT 12 – Debris Sensor

BiT REPAIR STEPS	Roomba Symptom: Roomba's blue light never comes on in a dirty environment.	
	→ Verify the debris sensor is not covered in dirt. → If it test still fails replace main brush assembly.	
REPLACEMENT PART	**Main Brush Assembly**	

QC	o <u>Ensure BiT passes.</u> o If replacing Main Brush Assembly with a single debris sensor version, it will not run with software older than 2005-10-04-**1308**. o Verify string is attached to the chassis	
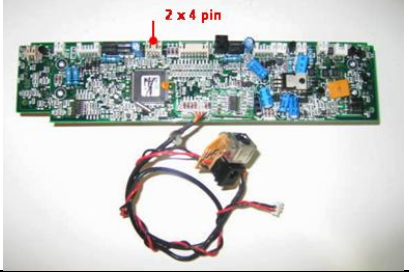
Failed BiT 13 – Vacuum

TROUBLESHOOTING	Roomba Symptom: o Roomba does not clean or o Roomba ends with error "uh-oh and 3 beeps" or o Vacuum Bin sounds loud.	
	If the vacuum test fails or sounds loud: →Verify the vacuum is unobstructed. Take out grill, spin impeller and shake out any dirt. Inspect the filter to make sure it is not punctured and letting particles into the impeller. →Verify the vacuum contacts are clean. →If sounds loud or is dead replace unit	
REPLACEMENT PART	**Bin Motor Assembly**	
QC	o <u>Ensure BiT passes.</u>	
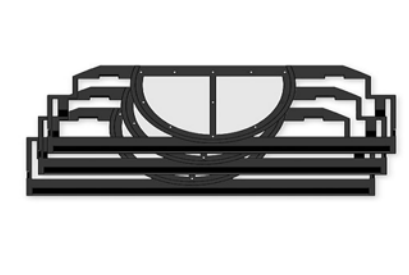
Failed BiT 14 – Side Brush

<table>
<tr>
<td rowspan="2">TROUBLESHOOTING</td>
<td>Roomba Symptom:

Roomba side brush does not turn or is loud
Roomba ends with "uh-oh and 2 beeps".

</td>
<td></td>
</tr>
<tr>
<td>→ Verify the side brush has been cleaned.

→ Attach an *approved* side brush into the pcb and retest. If test passes, then the Roomba pcb is good and we need to inspect returned side brush.

→ If the motor dead, replace unit. If it fails despite cleaning, replace side brush module.</td>
<td>

clogged sidebrush caused assembly to overcurrent</td>
</tr>
<tr>
<td>REPLACEMENT PART</td>
<td align="center">Side Brush Module</td>
<td></td>
</tr>
<tr>
<td>QC</td>
<td><u>Ensure BiT passes.</u></td>
<td></td>
</tr>
</table>

Failed BiT 15-20 – Charging

<table>
<tr>
<td rowspan="3">TROUBLESHOOTING</td>
<td>Roomba Symptom: Roomba is not charging.</td>
<td></td>
</tr>
<tr>
<td>If the internal charging fails (steps 15-17):

→ Verify the Power Supply and Home Base are working and *approved*
→ Verify Power Supply is correctly plugged into the Roomba.
→ If step still fails, replace pcb.</td>
<td></td>
</tr>
<tr>
<td>If the external charging fails (steps 18-20):

→ Verify the Roomba is properly docked on the Home Base and both lights are on the Home Base. Clean contacts on the Roomba if it is not docking.
→ If step still fails, replace pcb.</td>
<td></td>
</tr>
<tr>
<td>REPLACEMENT PART</td>
<td align="center">Main PCB</td>
<td></td>
</tr>
<tr>
<td>QC</td>
<td>o   <u>Ensure BiT passes.</u></td>
<td></td>
</tr>
</table>

Precautionary Replacements

Precautionary replacements	Speaker → Replace if it failed to work.	
	Brush Bearing → A holed bearing will protect the cleaning assembly best as it allows dirt to from failing by allowing dirt not to compact in the bearing and stress the cleaning frame.	
	Side Brush → A white bristle brush is transparent to IR and will not trigger false cliffs which could be a reason for customer return.	
	Filter → If filter is punctured it could allow dirt to enter vacuum assembly. Replace immediately.	

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Charging Accessories

Battery

Power Supply

Home Base

Rapid Charger

Roomba Battery

Batteries are made of 12 NiMH (nickel metal hydride) cells. It has a thermistor to measure battery temperature and a +ve and –ve contact.

Skid pads

thermistor

-ve contact

+ve contact
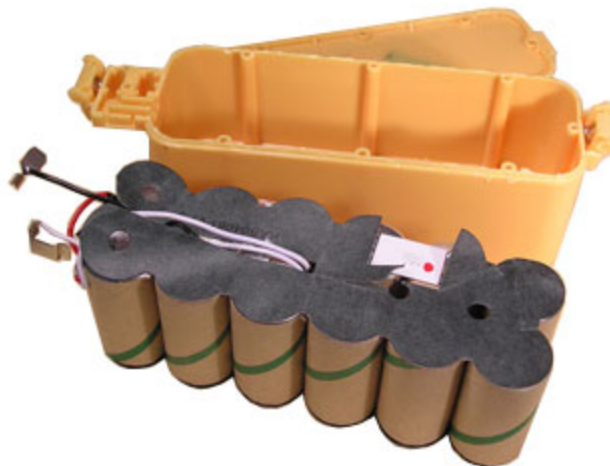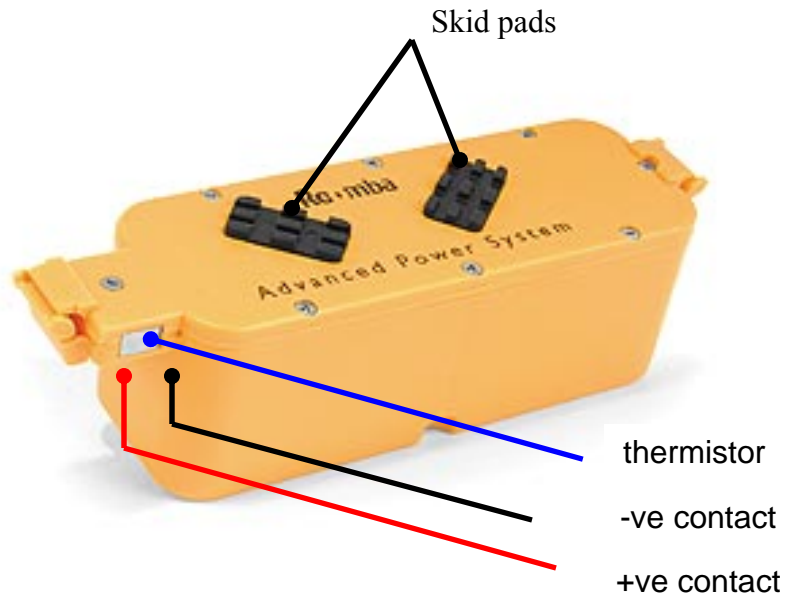
Battery Types

	Yellow APS Battery	Black Battery

• 3000 mAH • ~500 cycle life • 110 min runtime (hard floor) • 55 min runtime (medium pile carpet)	• not in production • 2600 mAH

Battery Insertion Technique

- Hold the Battery with the Roomba logo facing up and place Battery over the battery well.
- Lower the Battery slowly and then release it so that it drops in to the battery well.
- Press each Battery edge so that the latch engages and secures the Battery into the Roomba.
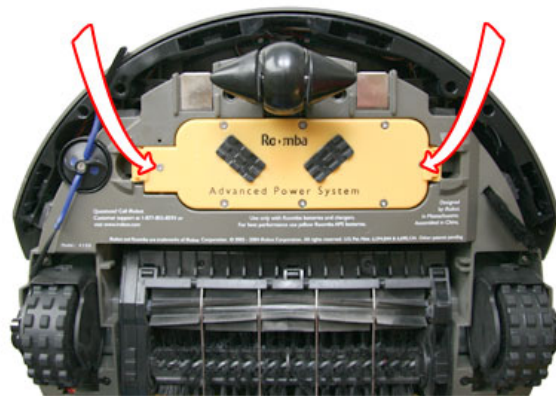
General Battery Maintenance Tips

- Keep the battery charging at all times unless in use.
- If Roomba is not going to be used for an extended period of time, charge battery first and then take battery out of Roomba and store separately in a cool place away from sourced of heat or direct sunlight. If it is not charged first it will deep discharge while in storage.
- Occasionally reset the charging system in the Roomba (remove battery and hold down the "power" button for at least 5 seconds and install battery), charge and run a "max" cycle without the Home Base present.

Battery Troubleshooting

- Batteries will deeply discharge when left in the Roomba unplugged. Roomba sleep current (when not running and left unplugged) is about 7 mA which slowly drains the battery.
- Batteries also naturally degrade over years. They should never be stored in a hot environment.
- Roomba can inaccurately calculate the battery charge capacity and not fully charge the battery. Charging systems can be reset by taking the battery out, pressing the Roomba power button for at least five seconds and reinserting the battery.
- Verify that the Battery tested was charged in a Roomba. This is because a Rapid Charger does not have the sophisticated software of a Roomba which dictates a proper charging cycle based on the battery voltage.
- The Battery latch may not be engaging well in the Roomba. Latches have been improved and can be distinguished below.

Old latch Design		No notch
New latch Design		Notched

Roomba Power Supply

Roomba's are charged by either a Universal (100-240V) or Domestic (120V) Power Supply. The Power Supply steps the voltage down to 22VDC and 1.25A. The <u>power</u> light on the Power Supply is an indication that it is plugged in and operating properly.

Power Supply Generations

Generation 1	Generation 1A	Generation 2
	(implemented ~Jan. 2005)	(implemented ~July 2006)
Date code starts with 04 or 05	**'P' branded in the plastic**	**Date code starts with A**

Power Supply Troubleshooting

- Is the light solid green while charging? If not try another wall socket.
- Generation 1 and 1A : If the power light is off or flashing, discard both the Home Base and the Power Supply and replace the main pcb on the Roomba.[2]
- Generation 2: If the power light is flashing or off, replace the Power Supply.

---

[2]A flashing Power Supply and Home Base can destroy the Roomba pcb.

Roomba Home Base

The Roomba Home Base is a self-charging station where the Roomba (through a sophisticated infrared tracking mechanism) can drive back to at the end of a clean cycle or when its battery is low. After docking itself, the Roomba will recharge its battery. The charging sequence takes about three hours with the fast APS power supply (grey) and six hours with the slow power supply (black).

The power light on the Home Base tells you that it is plugged in and operating properly. This light must be on and solid green for Roomba to charge. The dock light on the Home Base tells you that Roomba is successfully docked and charging.

Power Light

Docked Light

IR Force Field

IR Docking Beams

Electrical Plug

Electrical Contacts
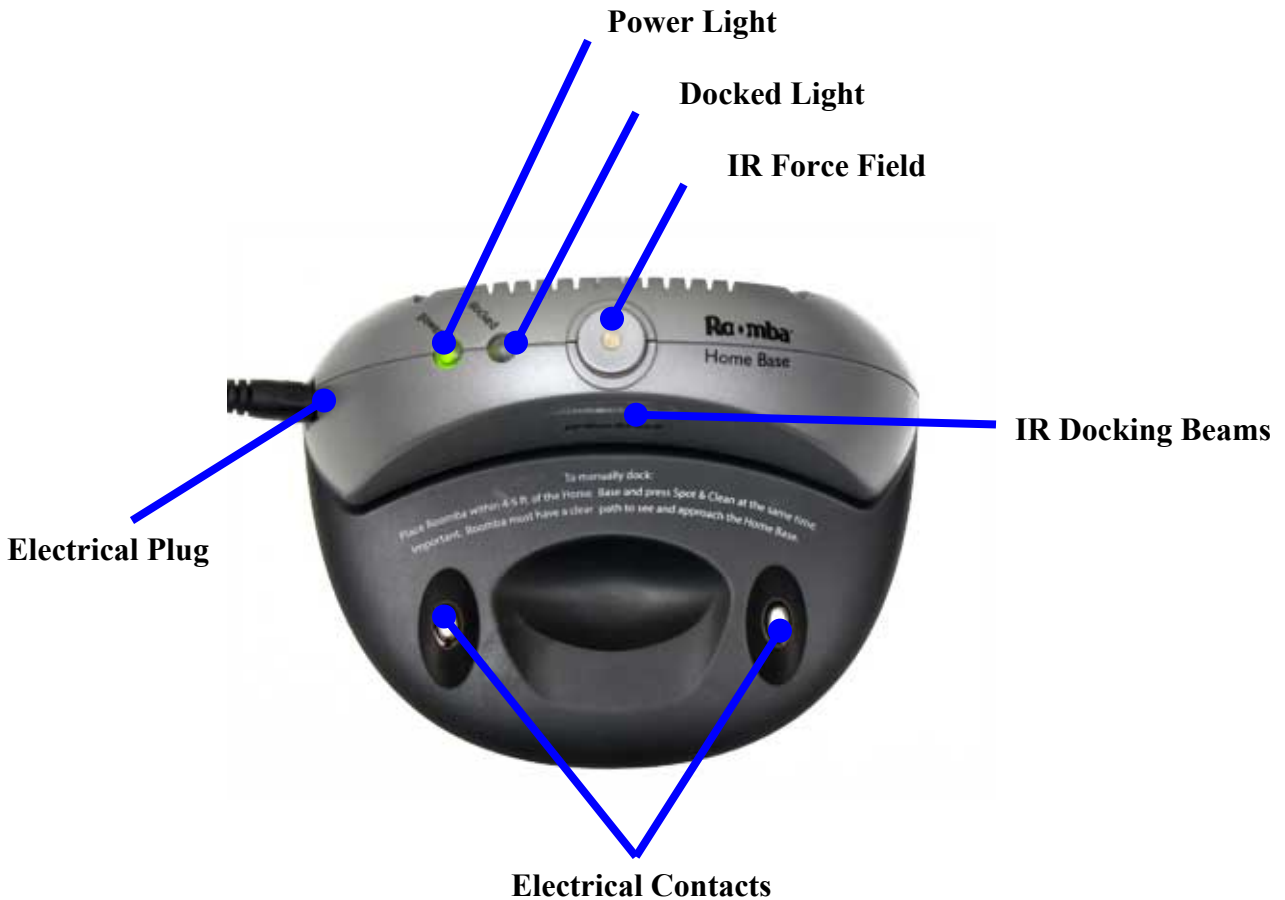
Manual Docking

To manually test the ability of the Roomba to dock successfully on the Home Base:
1. Verify that the Home Base is plugged in and that the power light is on.
1. Place the Home Base in a relatively open and flat area without any obstacles.
2. Remove any Virtual Walls closer than 8 ft (2.4 meters) from the Home Base.
3. Place Roomba about 3 ft (1 m) in front of the Home Base and press "Spot" and "Clean" buttons simultaneously. Roomba should drive back to the Home Base and it may take a few attempts.
4. Once the Roomba is on the Home Base verify the two green lights on the Home Base are lit and solid. If not, clean the electrical contacts under the Roomba and on the Home Base and repeat these instructions.

Force field diameter
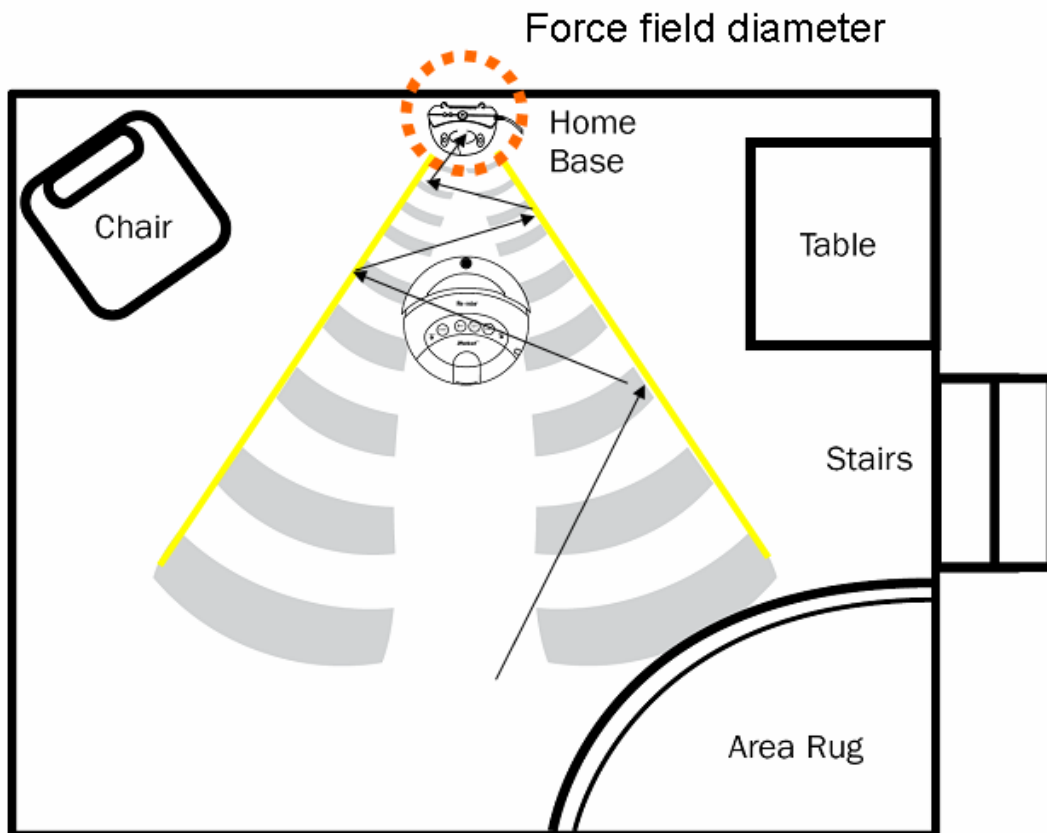
Home Base Generations

A modified Home Base was necessary to compliment the Roomba swivel caster design. The modifications are listed below.

1. Unpainted
2. Softer depression
3. Extended base plate
4. Unweighted
5. Elastomer foot

Home Base Troubleshooting

- The power light on the Home Base must be on and solid green while charging. If not, check the connection and the charging brick. [Note: If flashing replace the Home Base, power supply and Roomba pcb.[3]]
- The dock light on the Home Base must be on and solid green while charging. If the dock light is not on, try cleaning the contacts on the Home Base and under the Roomba if this is the case.
- Inspect the integrity of the spring contacts
- Wipe the IR lens from dust
- Verify that the swivel caster Roomba is paired up with the new extended Home Base. The new extended Home Base is compatible with fixed caster Roombas.
- Perform the Mobility Test (see Figure 5-7 in Appendix H). This will test docking abilities and Home base avoidance.

---

[3] A flashing Power Supply and Home Base can destroy the Roomba pcb.

Rapid Charger

[Note: No longer in production]

Power LED

The Rapid Charger was designed to charge the 2600 mAH black Battery in 2.5 hrs. Although the Rapid Charger can be used for the 3000 mAH yellow Battery, iRobot recommend that all batteries be charged in a Roomba. This is to make use of the Roomba charging sequence that initially measures the battery voltage and then proceeds with a proper charging mode.

Roomba Accessories

Virtual Wall

Remote
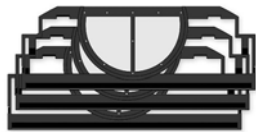
Filters

Bristle Brush

Flexible Brush

Side Brush

![iRobot logo]

Roomba Virtual Wall

The Virtual Wall emits an invisible, infrared beam up to 13 feet (~4 meters) long that Roomba regards as a barrier and will not cross. The beam is keyhole shaped and can get up to 3 feet wide (~1 meter). To avoid IR interference, do not place the Virtual Wall within 8 feet (2.4 meters) from a Home Base.When turned on, the standard Virtual Wall Unit will turn off automatically after approximately 2 hours. The batteries last about 140 hrs of operations.

Strength Setting

IR Emitter/Force Field

IR wall beam emitter

Power Button
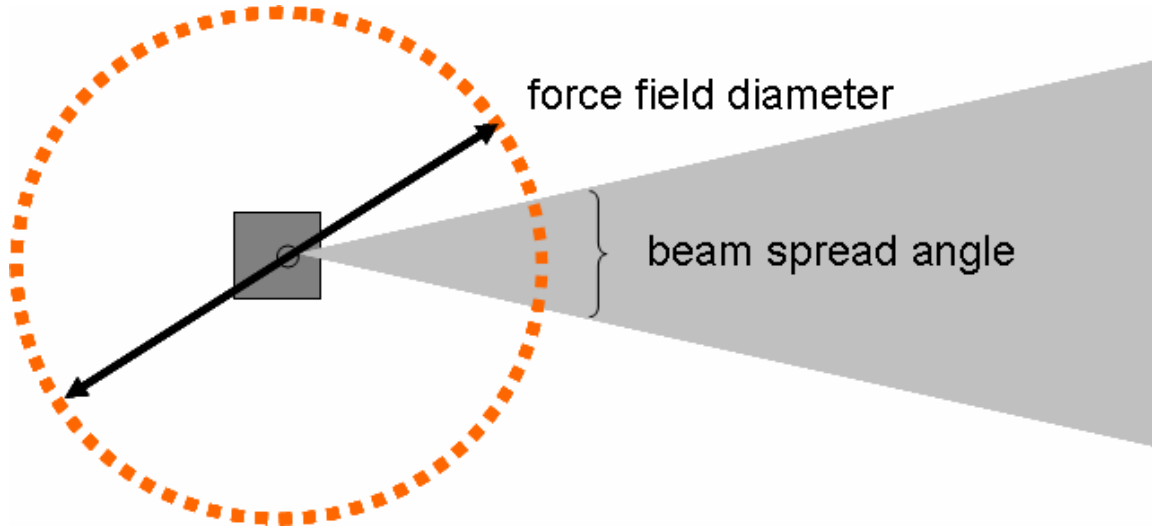
Top view of Virtual Wall and beam spread

Virtual Wall Generations

Silver Virtual Wall	Slim Virtual Wall	Scheduler Virtual Wall
Beam Angle : 24 deg **Diameter : 0.8 m**	**Beam Angle : 27 deg** **Diameter : 0.6 m**	**Beam Angle : 27 deg** **Diameter : 0.6 m**

Virtual Wall Troubleshooting

- If you press power and the light does not go on or flashes, check the batteries and the virtual battery door. If the Roomba goes through the beam, wipe the Virtual Wall eye (RCON) on top of the unit.
- Use a Roomba and the Virtual Wall to perform the Mobility Test (see Figure 4 in Appendix H). This will test Virtual Wall beam avoidance.

Roomba Remote

The Roomba Remote enables you to perform a variety of tasks with your Roomba without touching the robot. It is compatible with all new Roomba models (except Roomba Original).
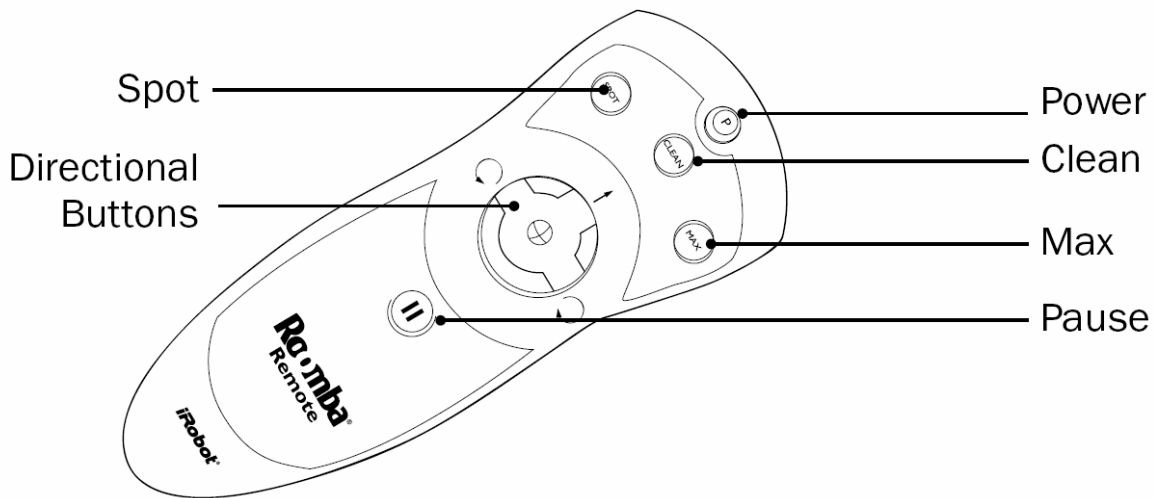
Remote Troubleshooting

- The light above the buttons comes on when a button is depressed. If not, replace the batteries.
- If the light is on but it does not communicate with the Roomba then :
  - Wipe the Remote's IR emitter (located on the front edge of the Remote) and the Roomba's IR receiver.
  - Check that there is a direct line of sight from the remote to Roomba, and that the Remote is pointed at Roomba. Try using the remote from several different heights and distances from Roomba.
  - Confirm that Roomba is not inside a Virtual Wall and do not try to drive the Roomba through the virtual wall beam and keep in mind that Virtual Wall beams can reflect off some surfaces.
  - Roomba Remote also will not work if within 8 feet (~2.4 meters) of the Roomba Home Base (if applicable). The Roomba Home Base creates Infrared (IR) frequency that overrides the frequency of the Roomba Remote.
  - It is possible that the remote is interfering with another IR device like a remote control for a television.
  - Confirm the front of the Roomba is not over a step or in front of an obstacle. The Roomba should be emitting a low beep sound in this scenario.
  - Try using the Roomba Remote in different lighting conditions. Certain halogen lights or powerful florescent lights can interfere with the Roomba Remote's functioning.

Roomba Filter

Roomba's filter is designed to keep Roomba's vacuuming system clear of debris. For maximum vacuum power, the filter should be cleaned and inspected after every use. If desired, the filter can be hand washed with soap and water but needs to be thoroughly dried before use. If punctured, replace the filter.
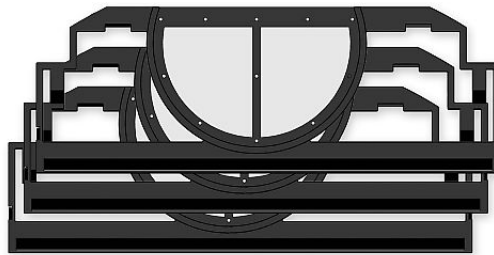
Filter Troubleshooting

- Inspect the filter and if punctured, replace the filter.

Bristle, Flexible and Side Brush

Roomba's brushes pick up debris from floors and direct it towards into the vacuum bin. For maximum Roomba life, the brushes should be cleaned and inspected after every use.

Brush Troubleshooting

- Remove and clean the brushes and inspect for tears
- Inspect the brush bearings and verify they are not molten and spin freely in the axle.
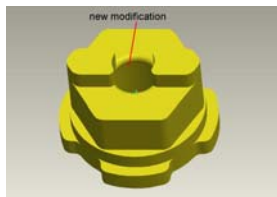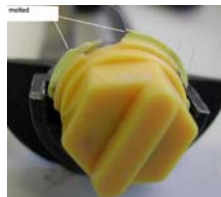
- Inspect the brush square ends
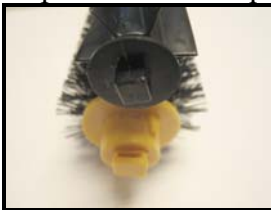
- Inspect the side brush arms and bristles

Appendices

Appendix A: Charging Troubleshooting Flowchart
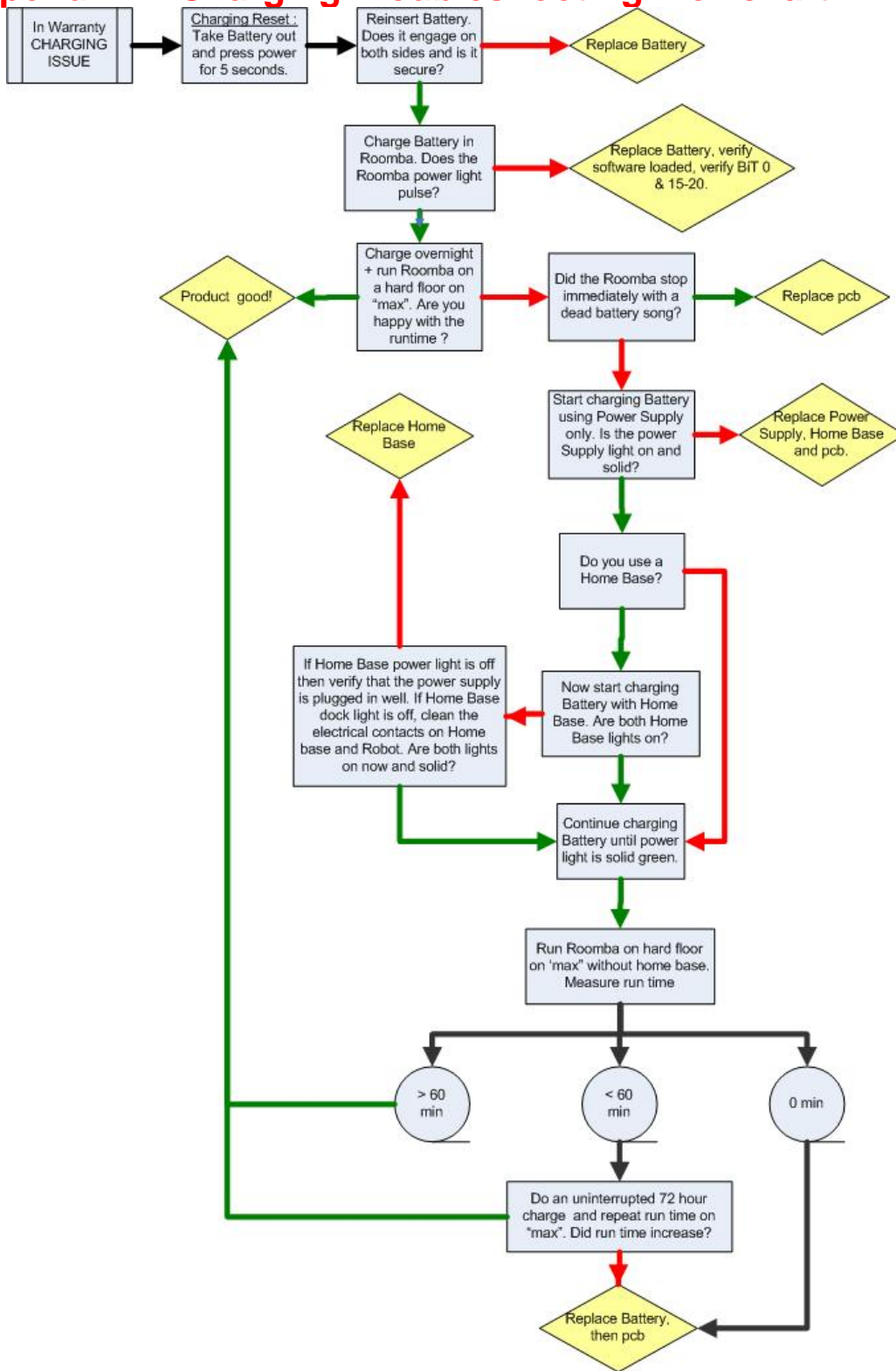
Appendix B: Serial Number Format

Robot ASCII Serial Number Format

(ASCII sticker in battery well)

model				year		month		day		cpu-type	sequence			
L	L	L	L	Y	Y	m	m	d	d	c	s	s	s	s

LLLL	Model number
YY	Year (since 2000) this robot was manufactured
mm	Month this robot was manufactured
dd	Day of the month this robot was manufactured
c	CPU type: E or EA if E128 chip, empty if DG256 chip
ssss	Order that robot was made on date of manufacture

Robot Barcode Serial Number Format

(barcode sticker in battery well)

manufacturer ID		status	model					year		month		day		revision		sequence				
M	M	U	L	L	L	L	L	Y	Y	m	m	d	d	R	R	s	s	s	s	s

MM	Manufacturer ID: 'JE' = Jetta, 'PR' = PRC
U	Status - 'N' = new, 'R' = remanufactured
LLLLL	Model number (00000 - 09999)
YY	Year (since 2000) this robot was manufactured
mm	Month this robot was manufactured
dd	Day of the month this robot was manufactured
RR	Model revision for this robot

- 01 indicates DG256 chip
- 02 indicates E128 chip
- 03 indicates OSMO Software Code 1707 and E128 chip
- 04 indicates OSMO Software Code 1308 and E128 chip

sssss	Order that robot was made on date of manufacture

Battery Serial Number Format

(ASCII debossed in plastic)

- o   YYMMDD XXX

Power Supply Serial Number Format

(ASCII number on sticker)

050525
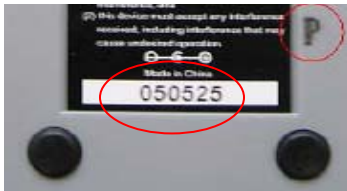
- o   YYMMDD or AYYMMDD
- o   The P on the plastic indicates it has been reworked. If "P" exists on the plastic, then add this to the end of the serial number.

Home Base Serial Number Format

(ASCII debossed in plastic)

YYMMDD

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Appendix C: Roomba Code List

Record Sheet Example

Service Center Name :	iRobot Burlington
Year :	2006
Month :	July

Complaint Date YYYYMMDD	Customer Complaint Code	Incoming Serial Number				Failure - Root Cause							Corr. Action Code 1	Corr. Action Code 2	Corr. Action Code 3	Replacement Serial Number			
		Roomba S/N	Battery S/N	Power Supply S/N	Home Base S/N	Roomba Condition Code	Main Roomba BiT Code	Main Roomba BiT sub-Code	Battery Code	Power Supply Code	Home Base Code	Virtual Wall Code				Roomba S/N	Battery S/N	Power Supply S/N	Home Base S/N
20060823	C02	050418EA	4.1E+07	050429P	41222	RC04-(Brus	RB02-(BiT0) sp	F1-mechanical	B00-Batte	PS00-PASS	HB04-Home	VW00-PASS	AA04-re	AA10-rep	AA23-re	-	-	-	62000

Code List

Customer Complaint Code	Robot Condition Code	Roomba BiT Code
CC00-Complaint NONE	RC00-Condition NEW	RB00-BiT PASS
CC01-(Cleaning) Brush Assembly	RC01-(Brush) lightly soiled	RB01-(BiT0) user interface / buttons
CC02-(Cleaning) Vacuum Assembly	RC02-(Brush) dirty	RB02-(BiT0) speaker
CC03-(Cleaning) Side Brush Assembly	RC03-Condition - OTHER	RB03-(BiT0) chassis
CC04-(Charging) Robot & Battery		RB04-(BiT1) bumper
CC05-(Charging) Accessory		RB05-(BiT2,3) cliff sensors
CC06-(Mobility) Drive Wheels		RB06-(BiT4) wheel switch or wall sensor
CC07-(Mobility) Caster Wheel		RB07-(BiT5) robot eye / RCON
CC08-(Mobility) Circle Dance		RB08-(BiT7-9) drive wheels/encoders
CC09-(Mobility) Robot		RB09-(BiT10) front caster
CC10-(Mobility) Accessory		RB10-(BiT11) cleaning frame
CC11-(General) Robot		RB11-(BiT12) debris sensor
CC12-(General) User Interface		RB12-(BiT13) vacuum bin
CC13-(General) Accessory		RB13-(BiT14) side brush
CC14-(Error) ehh		RB14-(BiT15-17) internal charging
CC15-(Error) dead battery song		RB15-(BiT18-20) external charging
CC16-(Error) uh-oh & no beeps		RB16-BiT- OTHER
CC17-(Error) uh-oh & 1 beep		**Roomba BiT Sub-Code**
CC18-(Error) uh-oh & 2 beep		F0-BiT PASS
CC19-(Error) uh-oh & 3 beeps		F1-mechanical issue
CC20-(Error) uh-oh & 4 beeps		F2-electrical issue
CC21-(Error) uh-oh & 5 beeps		F3-manufacturing/workmanship issue
CC22-(Error) uh-oh & 6 beeps		F4-missing components
CC23-(Error) uh-oh & 9 beeps		F5-environmental (dirt, hair)
CC24-(Error) uh-oh & 10 beeps		F6-unknown
CC25-Complaint - OTHER		

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Roomba MT Code	Battery Code	Power Supply Code
RM00- MT PASS	B00- PASS	PS00-PASS
RM01-fails initial spiral	B01-voltage low	PS01-voltage low
RM02-fails to wall follow	B02-voltage high	PS02-voltage high
RM03-fails cliff	B03-voltage drop fail	PS03-current low
RM04-fails to dock	B04-low run time	PS04-current high
RM05-fails rod transition	B05-thermistor	PS05-does not shut off
RM06-fails with home base	B06-contacts	PS06-LED blinking/off
RM07-fails with virtual wall	B07-latch	PS07-cord
RM08- MT-OTHER	B08-OTHER	PS08-OTHER

Home Base Code	Virtual Wall Code	Corrective Action Code
HB00- PASS	VW00-PASS	AA00-NO ACTION NEEDED
HB01-IR beams (won't dock)	VW01-IR Beams (crosses v.w	AA01-replace upper shell
HB02-force field (hits base)	VW02-force field (hits v.wall)	AA02-replace outer bumper
HB03-LED (power)	VW03-LED (power)	AA03-replace inner bumper
HB04-contacts (charging)	VW04-OTHER	AA04-replace speaker
HB05- OTHER		AA05-replace wheel drop switch
		AA06-replace wheel drive belt
		AA07-replace drive wheel
		AA08-replace front caster
		AA09-replace brush motor assembly
		AA10-replace cleaning frame
		AA11-replace output gears to brushes
		AA12-replace vacuum bin motor
		AA13-replace vacuum bin
		AA14-replace side brush motor
		AA15-replace side brush
		AA16-replace main pcb
		AA17-replace bristle brush
		AA18-replace flexible brush
		AA19-replace wire guard
		AA20-replace brush bearing
		AA21-replace filter
		AA22-replace power supply
		AA23-replace home base
		AA24-replace battery
		AA25-replace robot
		AA25-Cleaning alone fixed issue
		AA26-OTHER

Appendix D: Roomba Error Codes

Roomba Says	What It Means	What You Should Do
Plays 4-note song as power button blinks RED	The battery is low and needs recharging	• Connect Roomba to the Power Supply or Home Base and recharge the battery.
"Ehh"	Cliff sensors are dirty or need repair	• Pick up the Roomba and turn it over. • Check for any debris underneath the front bumper and around the cliff sensors. • Wipe the sensors with a lint-free cloth or use compressed air to clean them out.
No beeps	A wheel is stuck or off the ground	• Lift the Roomba and place it down again. • Press 'Clean' to restart the cycle.
"Uh-oh" + 1 beep	Roomba's main brushes are stalled	• Pick up the Roomba and turn it over and remove the wire guard. • Look for something blocking the brushes; you may need to remove and reinstall the brushes to remove the obstruction.
"Uh-oh" + 2 beeps	Roomba's side brush is stalled	• Pick up the Roomba and turn it over. • Look for something wrapped around the side brush. • Remove the side brush with a screw driver and check obstructions. • Replace the side brush, place Roomba in the center of the Roomba and press 'Clean' to resume cleaning
"Uh-oh" + 3 beeps	Roomba's vacuum is stalled	• Remove and empty the dirt bin. • Use a flat head screwdriver to remove the grill at the back of the debris bin. • Spin the vacuum impeller around, shaking out any debris that may be stuck. • Replace the grill and the dust bin.
"Uh-oh" + 4 beeps	Roomba's drive motor is stalled	• Your Roomba may be stuck, or something may be caught in a wheel. • If it's stuck, place it in the center of the room and press 'Clean'. • If it isn't stuck, pick up your Roomba and turn it over and look for something wrapped around the wheels. Push them in and out and verify they rotate freely. Place Roomba in the middle of the room, press 'Clean' and it should resume cleaning.
"Uh-oh" + 5 beeps	Roomba's cliff sensors are obstructed	• Pick up the Roomba and turn it over. • Check for any debris that might be caught underneath the front bumper, around the cliff sensors. • Wipe the sensors with a lint-free cloth or use compressed air to clean them out.
"Uh-oh" + 6 beeps	Roomba's wheel drop sensors are overloaded	• Pick up your Roomba, put it in the middle of the room, power it OFF and then ON again. • Select the cleaning cycle you prefer and let it go to work.
"Uh-oh" + 9 beeps	Roomba's wheel drop sensors have failed at startup	• Your Roomba probably needs to be serviced; please contact Customer Support.
"Uh-oh" + 10 beeps	Roomba's bumper is not registering obstacles	• If Roomba travels for a long distance without bumping into anything (which would be unusual), it might think it's stuck and can't move; press 'Clean' again and it should resume cleaning.

Appendix E: Roomba Software & OSMO
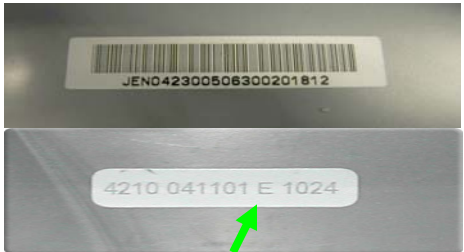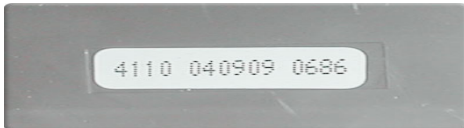
Roomba

Roomba's software is continuously being updated and implemented in newest Roombas. When a Roomba is serviced it is best practice to update the Roomba with the latest software code.

Software Date Tag	Features	Robot Production Implementation	OSMO version
2005-08-11-**1707**	circle dance mode, deeply discharged mode	**23 August 2005**	Version 1
2005-10-04-**1308**	Hacker code, code for single debris	**24 October 2005**	Version 2
2006-08-14-**1814**	BiT improvements, Single Button Roomba code	**29 August 2006**	Version 3

OSMO

Roomba's have been manufactured with two different chips (E128 and DG256), and so there are two software release to match the different chips. The OSMO Teal is used for E128 chips and the OSMO Purple is used for DG256 chip. Determine the Roomba chip type from Roomba's serial number and then use the proper OSMO. Using the wrong OSMO does not harm the Roomba, it just does not download software. Also, OSMO can only replace older software on the Roomba.

OSMO TEAL (E128)		
	- **Roomba's with barcodes.** -**Roomba's with serial number with letter E or EA**	
OSMO PURPLE (DG256)		
	- **Roomba's with serial number and <u>no</u> letter**	

To determine OSMO software version, inspect the OSMO date code.

OSMO Date Code	OSMO Date Code	OSMO Version #
	JEN1387Xyymmdd<u>01</u>xxxxxx JEN1387Xyymmdd<u>02</u>xxxxxx JEN1387Xyymmdd<u>03</u>xxxxxx	Version 1 (-1707) Version 2 (-1308) Version 3 (-1814)

OSMO Download procedure

The iRobot Osmo is a device that attaches to Roomba's serial port and automatically updates Roomba's software. To update Roomba's software:

1 Remove Roomba's serial port cover. If needed, use a coin or small screwdriver to remove the cover.
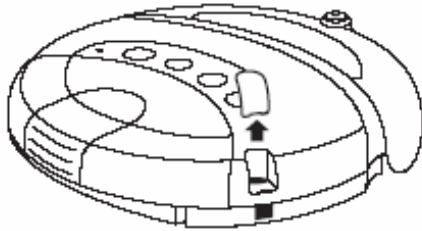
2 Power on Roomba.

3 Plug Osmo into Roomba's serial port. Osmo's LED will turn on when fully inserted.
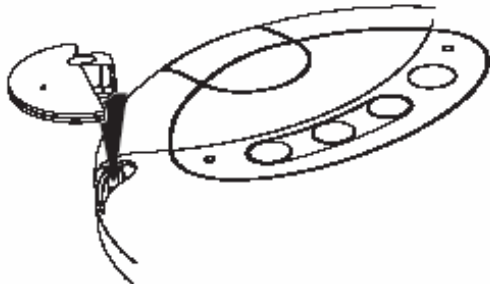
4 The software update takes approximately 90 seconds. During the update, Roomba's status light will flash and Osmo's LED will remain on.

5 Roomba's software update is complete when its status light stops flashing.

Note:
Do not remove Osmo until Roomba's status light stops flashing. If Osmo is removed during download, Roomba will not operate and the status light will be red. To resolve the problem, simply re-insert Osmo and complete the update.

If you have any questions about using your iRobot Osmo, please contact our Customer Support Representatives at: 1.877.855.8593.

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Appendix F: Roomba Built-in-Test Procedure

Put Roomba into built-in-test mode:

1. Power Roomba OFF by pressing the POWER button.

2. Hold down the SPOT and CLEAN buttons.

3. Power Roomba ON by pressing the POWER button.

4. Keep holding down the SPOT and CLEAN buttons for about 0.5 SECONDS until you hear a series of ASCE NDING BEEPS and the user panel LEDs start flashing.

For **<u>AUTO-ADVANCE</u>** mode:

5. Release the SPOT and CLEAN buttons.

For **<u>MANUAL-ADVANCE</u>** mode:

6. Continue holding down the SPOT and CLEAN buttons for a total of 3 SECONDS until you hear a second series of DESCENDING BEEPS.

7. Release the SPOT and CLEAN.

The built-in-test will now be in test number 0.

BUILT-IN-TEST NUMBER 0 tests the user panel LEDs.

1. Check that all of the user panel LEDs are flashing as follows:

    a. SPOT LED ON

    b. CLEAN LED ON

    c. MAX LED ON (for 3 button units)

    d. POWER LED GREEN

    e. POWER LED RED

    f. STATUS LED GREEN

    g. STATUS LED RED

    h. DIRT ALERT LED BLUE

2. Even in AUTO-ADVANCE mode, you must manually advance to the main test by pressing the CLEAN button.

In the MAIN BUILT-IN-TEST (all test numbers except 0):

- Each TEST NUMBER has multiple SUB-TESTS.

- The SPOT and CLEAN LEDs indicate when the sensors are activated.

- The STATUS LED indicates whether the current draw is within correct range where appropriate.

- Current measurements are taken in 0.5 second readings. During current readings, ALL LEDS ARE OFF.

- The DIRT ALERT LED will flash to indicate that the test is advancing to the next test number.

- The robot will BEEP when advancing to the next built-in-test number. Test numbers are indicated by a pattern of long and short beeps, where one long beep is equal to five short beeps. For example, test 11 is indicated by long-long-short.

AUTO-ADVANCE mode is designed to be used on the assembly line. In this mode, the robot internally decides PASS/FAIL for each test number. The test advances automatically so each sensor or actuator is tested only once.

In **AUTO-ADVANCE** mode:

- Activate the sensors for each sub-test IN ORDER as described in the chart below.

- When all sub-tests in a test number have PASSED, the built-in-test will AUTO-ADVANCE to the next test number.

- If a test does not pass, you can press the CLEAN button to MANUALLY ADVANCE to the next test number to continue the built-in-test.

- The test number checks may check multiple conditions other than those which turn on the LEDs. Therefore the test number may FAIL even though the sensors that turn on the LEDs seem to be working. In particular, the CURRENT DRAW of each actuator must be within acceptable limits for the test to pass.

- The POWER LED will be RED until all sub-tests in a test number are passed, then it will turn GREEN for a moment before advancing to the next test number.

- When you get to the last test number, either by AUTO- or MANUALLY advancing:
  - If all tests PASSED:
    - The POWER LED will BLINK FAST GREEN.
    - The robot can be powered off using the power button and will operate NORMALLY.

- o If any test FAILED:
  - The POWER LED will BLINK FAST RED.
  - The robot CANNOT be powered off and will not respond to any buttons until the BATTERY IS REMOVED.

MANUAL-ADVANCE mode is designed to be used for debugging particular sensors or actuators. In this mode, the robot DOES NOT decide PASS/FAIL for each test number. The test does not automatically advance, so sensors or actuators can be tested as many times as needed.

In **MANUAL-ADVANCE** mode:

- Use the CLEAN button to MANUALLY ADVANCE to the next built-in-test number.
- Use the SPOT button to go back to the previous built-in-test number.
- The POWER LED will always be GREEN.
- There is no pass or fail. If you advance past the last test number, the test number will wrap around to the first test.

The following chart describes how to use each built-in-test number. To PASS the built-in-test in AUTO-ADVANCE mode, the user must perform the actions EXACTLY AS DESCRIBED.

	Test Name	Tester Action	Robot Action	Spot LED (Left)	Clean LED (Right)	Status LED
0	Panel LEDs	Check correct flashing of LEDs. Press CLEAN to advance to the first test.				
1	Bumpers	Press and release left bumper. Press and release right bumper.		Left bumper pressed.	Right bumper pressed.	
2	Outer Cliff Sensors	Briefly lift robot's left side to simulate cliff-left. Briefly lift robot's right side to simulate cliff-right.		Cliff-left detected.	Cliff-right detected.	
3	Inner Cliff Sensors	Briefly lift robot's left side to simulate cliff-front-left. Briefly lift robot's right side to simulate cliff-front-right.		Cliff-front-left detected.	Cliff-front-right detected.	
4	Wheel Drop / Wall Sensor	Briefly lift robot to cause a wheel drop on left wheel, then right wheel, then front caster. Briefly simulate a wall.		Wheel drop detected.	Wall detected.	

5	Rcon IR Receiver	Point a virtual wall at the rcon IR receiver. Then point the virtual wall away or turn it off. Point a remote control at the rcon IR receiver and briefly press any button except Power.		Virtual-wall signal at rcon IR receiver.	Remote signal at rcon IR receiver	
6	Battery Sensors	No user action.		Battery voltage between 12 and 18 V.	Thermistor present.	Baseline current OK.
7	Left Wheel	Verify the wheels are in the air and unobstructed. Wait until STATUS LED is green. Then briefly stall left wheel.	Left wheel turns in forward direction	Left wheel over current stall.		Left motor current and encoder speed OK.
8	Right Wheel	Verify the wheels are in the air and unobstructed. Wait until STATUS LED is green. Then briefly stall right wheel.	Right wheel turns in forward direction.		Right wheel over current stall.	Right motor current and encoder speed OK.
9	Wheel Encoders	Verify the wheels are in the air and unobstructed.	Drive wheels turn in backward direction.	Left wheel encoder signal.	Right wheel encoder signal.	Motor current and encoder speed OK.
10	Stasis	Turn the front caster.		Stasis signal (caster rotation switch).		
11	Main Brush	Verify the brush is unobstructed. Wait until STATUS LED is green. Then briefly stall the main brush.	Main brush turns on.	Brush over current stall.		Brush current OK.
12	Debris	Briefly place robot in debris pile on left side. Briefly place robot in debris pile on right side.	Main brush turns on.	Debris detected on left side.	Debris detected on right side.	
13	Vacuum	Verify the vacuum is unobstructed. Wait until STATUS LED is green. Then briefly stall the vacuum motor.	Vacuum turns on.	Vacuum stall.		Vacuum current OK.
14	Side Brush	Verify the side brush is unobstructed. Wait until STATUS LED is green. Then briefly stall the side brush motor.	Side brush turns on.	Side brush stall.		Side brush current OK.

15	Plug-in Charger Precharge	Plug in the plug-in charger.		Plug-in charger available.		Pre-charge current OK.
16	Plug-in Charger On			Plug-in charger available.		Charge current OK.
17	Plug-in Charger Trickle			Plug-in charger available.		Trickle current OK.
18	Home Base / Wall-Mount Charger Precharge	Remove the plug-in charger. Place Robot in dock or wall mount charger.		Home Base / Wall-Mount charger available.		Pre-charge current OK.
19	Home Base / Wall-Mount Charger On			Home Base / Wall-Mount charger available.		Charge current OK.
20	Home Base / Wall-Mount Charger Trickle			Home Base / Wall-Mount charger available.		Trickle current OK.
21	Built-in-test Complete					

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Built-in-Test Data Capture Procedure

iRobot Data Capture

o Run the **"iRobot Roomba Factory-Test-Client Version 1.1"** software (2006-02007-1059).
o Bring the Roomba and *approved* accessories to the computer.
o Manually enter the Roomba's Serial Number or press "quit" to exit program
o Manually enter the Roomba's source. Is it from a customer (c), retailer (r) or unknown (u)?
o Ignore the Mobility test but to move on manually enter either 'p' or 'f'.
o Insert a charged battery in the Roomba. Complete a Built-in-Test on the Roomba and the power light will be flashing GREEN (it passed) or RED (if failed). Do not remove the battery as this will erase the test information.
o Connect the Roomba serial port, to the serial level shifter box, to a COM port of a computer.

o Press 'Max' or 'Clean' or 'Spot' to capture the data.
o Disconnect the Roomba.
o You can continue to the next robot and the text file will just get appended as more outputs are added.

Alternative Data Capture

When the built-in-test is completed the Roomba's power light will be flashing GREEN (it passed) or RED (if failed). Do not remove the battery as this will erase the test information.

o Plug in the serial adapter from the robot into COM2 of the PC.
o Open HyperTerminal
   ▪ -- (In Windows) START ->Programs -> Accessories -> Communications -> HyperTerminal   …or…
   ▪ (In Windows) START->RUN and enter HYPERTRM.EXE
o Name the connection (anything)
o Choose COM1 or COM2 depending on where you attached the adapter.
o Select bits per second and change to "57600"and under flow control select "none" (leave all other settings alone).
o In "HyperTerminal" go to TRANSFER -> CAPTURE TEST -> START
o Press MAX on the Roomba
o In "HyperTerminal" go to TRANSFER -> CAPTURE TEST -> STOP

Built-in-Test Output File (using iRobot Roomba Factory-Test-Client Version 1.1)

Software date tag

```
SUMMARY: START
SUMMARY: TIMESTAMP Fri Jun 30 07:09:35 2006
SUMMARY: DATE-TAG 2005-10-04-1308-L
SUMMARY: (baseline-current-ok?) PASS   mA -91  min -202  max -13  mV 15279  degrees-C 20
SUMMARY: (left-drive-current-ok?) PASS   mA -176  min -326  max -117  mV 15251  degrees-C 20
SUMMARY: (left-drive-stall-current-ok?) PASS   mA -586  min -749  max -397  mV 15168  degrees-C 20
SUMMARY: (right-drive-current-ok?) PASS   mA -176  min -326  max -117  mV 15251  degrees-C 20
SUMMARY: (right-drive-stall-current-ok?) PASS mA -553  min -749  max -397  mV 15140  degrees-C 20
SUMMARY: (brush-current-ok?) PASS   mA -352  min -566  max -208  mV 15196  degrees-C 20
SUMMARY: (brush-stall-current-ok?) PASS   mA -1387  min -1901  max -1302  mV 14917  degrees-C 21
SUMMARY: (side-brush-current-ok?) PASS   mA -104  min -247  max -52  mV 15251  degrees-C 20
SUMMARY: (side-brush-stall-current-ok?) PASS   mA -130  min -423  max -98  mV 15224  degrees-C 20
SUMMARY: (vacuum-current-ok?) PASS   mA -254  min -352  max -176  mV 15196  degrees-C 20
SUMMARY: (vacuum-stall-current-ok?) PASS   mA -384  min -423  max -299  mV 15140  degrees-C 20
SUMMARY: (int-charging-recovery-current-ok?) PASS mA 286  min 241 max 358  mV 15335 degrees-C 20
SUMMARY: (int-charging-current-ok?) PASS   mA 1283  min 397  max 1602  mV 15725  degrees-C 20
SUMMARY: (int-charging-trickle-current-ok?) PASS mA 52  min 33  max 72  mV 15391  degrees-C 20
SUMMARY: (ext-charging-recovery-current-ok?)PASS mA 293  min 241 max 358 mV 15418 degrees-C 20
SUMMARY: (ext-charging-current-ok?) PASS   mA 1152  min 397  max 1602  mV 15669  degrees-C 20
SUMMARY: (ext-charging-trickle-current-ok?) PASS mA 46  min 33  max 72  mV 15391  degrees-C 20
SUMMARY: (bump-left?) PASS
SUMMARY: (bump-right?) PASS
SUMMARY: (cliff-left?) PASS
SUMMARY: (cliff-right?) PASS
SUMMARY: (cliff-front-left?) PASS
SUMMARY: (cliff-front-right?) PASS
SUMMARY: (wheel-drop?) PASS
SUMMARY: (wall?) PASS
SUMMARY: (rcon?) PASS
SUMMARY: (any-remote-opcode?) PASS
SUMMARY: (battery-voltage-ok?) PASS
SUMMARY: (battery-temperature-ok?) PASS
SUMMARY: left-wheel-stall PASS
SUMMARY: (drive-speed-ok? left forward) PASS
SUMMARY: (drive-speed-ok? right stopped) PASS
SUMMARY: right-wheel-stall PASS
SUMMARY: (drive-speed-ok? right forward) PASS
SUMMARY: (drive-speed-ok? left stopped) PASS
SUMMARY: (drive-speed-ok? left reverse) PASS
SUMMARY: (drive-speed-ok? right reverse) PASS
SUMMARY: (stasis?) PASS
SUMMARY: brush-motor-stall PASS
SUMMARY: (debris-left?) PASS
SUMMARY: vacuum-motor-stall PASS
SUMMARY: side-brush-motor-stall PASS
SUMMARY: (int-charger-available?) PASS
SUMMARY: (ext-charger-available?) PASS
SUMMARY: (bootloader-ok?) PASS
SUMMARY: END
```

Either PASS, FAIL or UNTESTED

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Appendix G: Roomba Built-in-Test Limits

The following are the limits used to PASS or FAIL a Built-in-Test.

Tested in BiT #	Description	MIN	MAX
6	Battery Voltage	12V	18V
6	Battery Temperature (C)	5°C	60°C
7,8,11,13,14	Baseline Current	-202 mA	-13 mA
7	Left Drive Current	-326 mA	-117 mA
7	Left Drive Stall Current	-749 mA	-397 mA
8	Right Drive Current	-326 mA	-117 mA
8	Right Drive Stall Current	-749 mA	-397 mA
11	Brush Current	-566 mA	-208 mA
11	Brush Stall Current	-1901 mA	-1302 mA
13	Side Brush Current	-247 mA	-52 mA
13	Side Brush Stall Current	-423 mA	-98 mA
14	Vacuum Current	-352 mA	-176 mA
14	Vacuum Stall Current	-423 mA	-299 mA
~~15~~	~~Internal Charging Prep Current~~	~~32 mA~~	~~71 mA~~
15	Internal Charging Recovery Current	241 mA	358 mA
16	Internal Charging Current	397 mA	1602 mA
17	Internal Charging Trickle Current	33 mA	72 mA
~~18~~	~~External Charging Prep Current~~	~~32 mA~~	~~71 mA~~
18	External Charging Recovery Current	241 mA	358 mA
19	External Charging Current	397 mA	1602 mA
20	External Charging Trickle Current	33 mA	72 mA

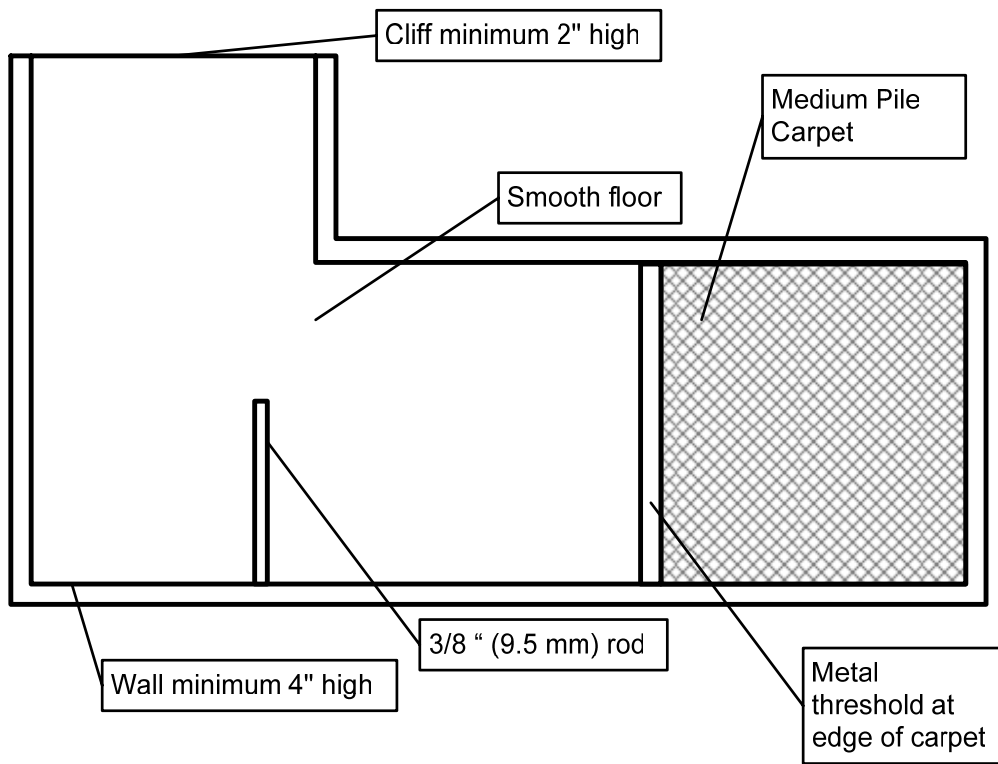# Appendix H: Roomba Mobility Test Procedure
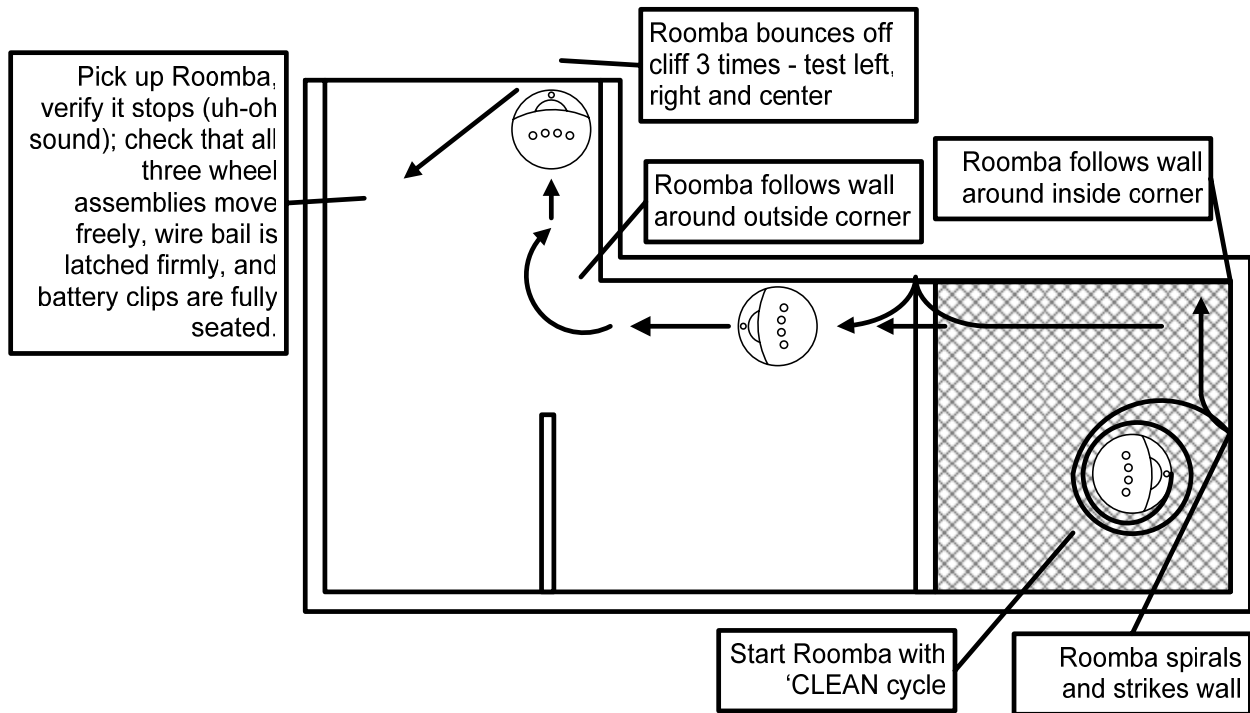

Figure 1 - Parts of the Test Table

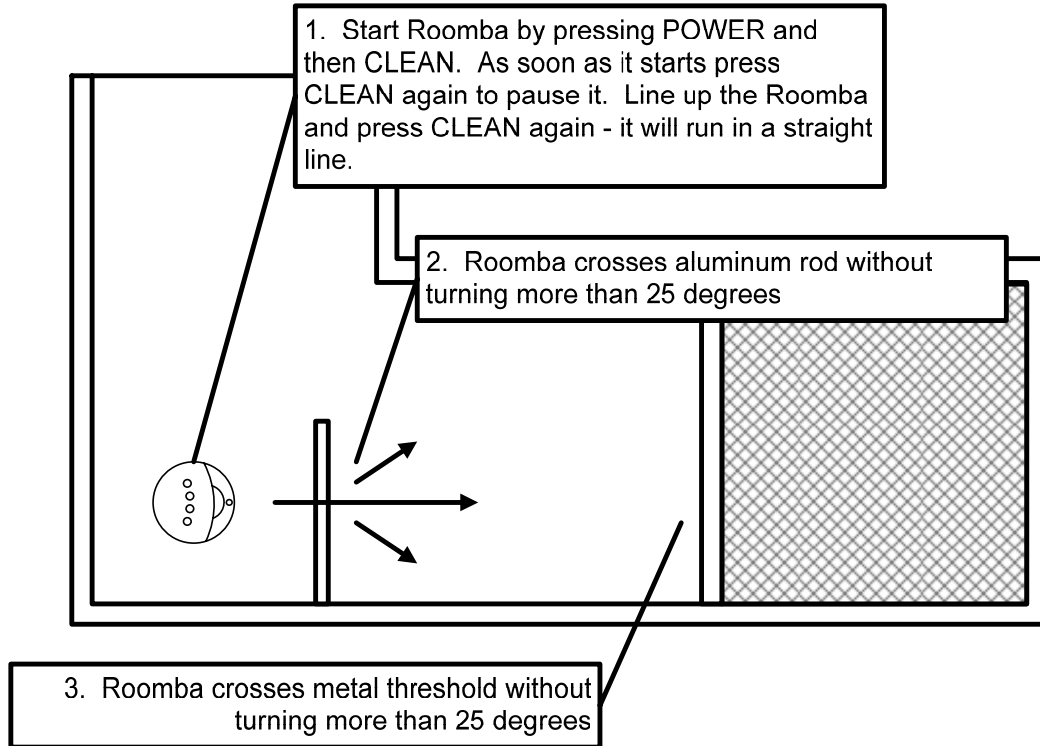**Figure 2 - Spiral, Wall Following, and Cliff Test**

1. Start Roomba by pressing POWER and then CLEAN. As soon as it starts press CLEAN again to pause it. Line up the Roomba and press CLEAN again - it will run in a straight line.

2. Roomba crosses aluminum rod without turning more than 25 degrees

3. Roomba crosses metal threshold without turning more than 25 degrees

Figure 3 - Threshold Crossing Test

1. Start Roomba by pressing POWER and then CLEAN. As soon as it starts press CLEAN again to pause it. Line up the Roomba and press CLEAN again - it will run in a straight line.

48"

3. Roomba should immediately turn away from the beam.

2. Place a VWU (set to M) 48" behind the Roomba and turn it ON.
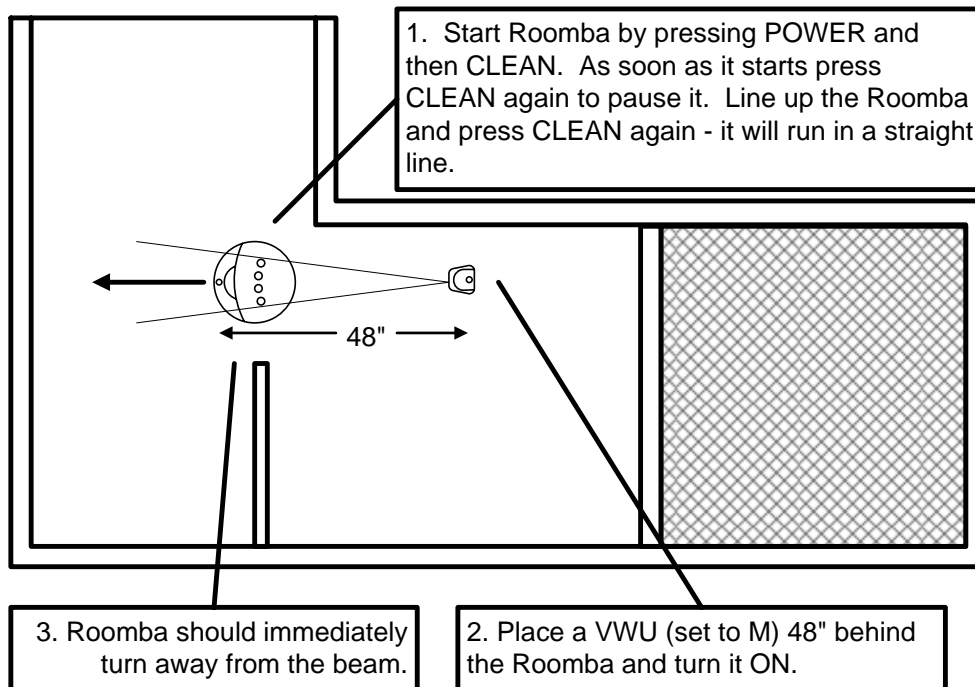
Figure 4 - Virtual Wall (VWU) Reception Test

Note: If Roomba strikes opposite wall then larger table must be used.

3. Roomba does not strike DoC

2. Roomba follows wall

4. Roomba follows wall

1. Start Roomba 1" from wall
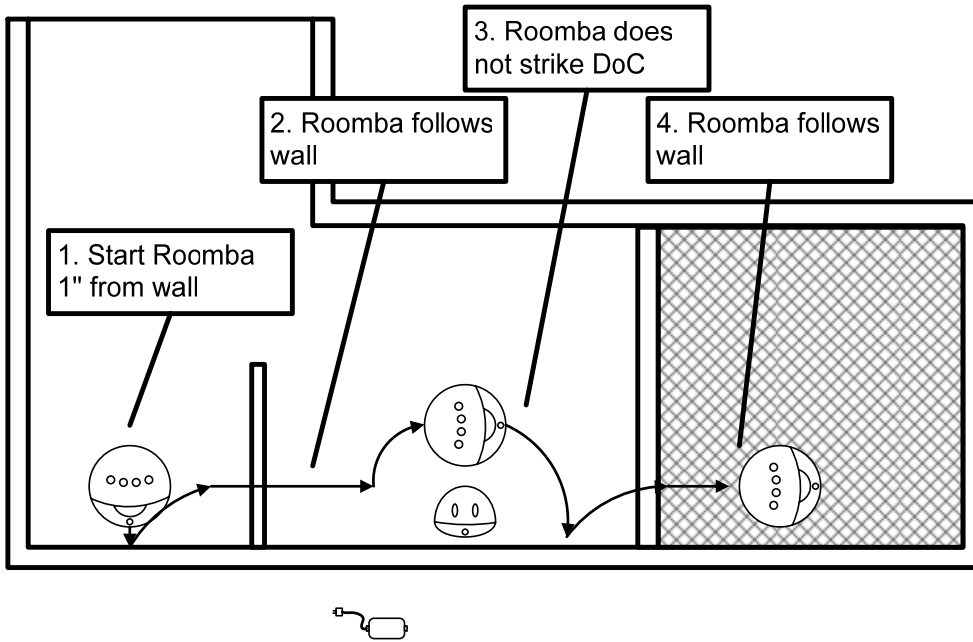
Figure 5 - Home Base Force Field Test

1. Start the Roomba by pressing CLEAN and SPOT at the same time

3. Ammeter indicates full charging current of 1.00 to 1.45 A

2. Roomba follows the docking beams and docks correctly the first time

No more than 60"
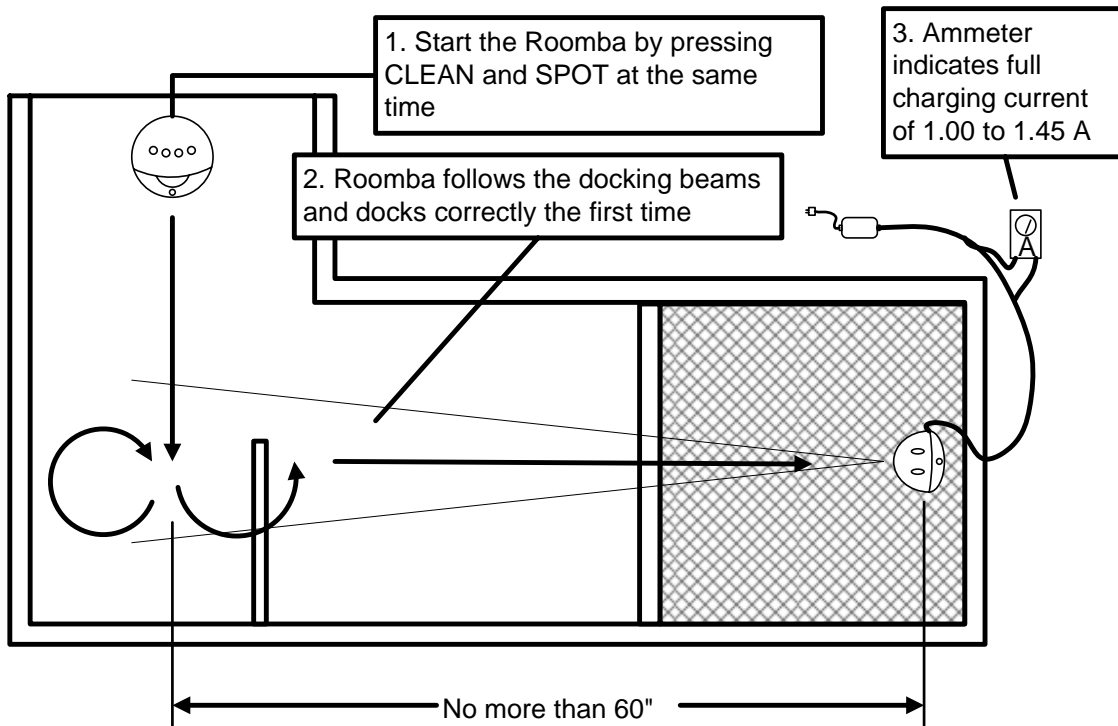
Figure 6 - Docking on Carpet Test
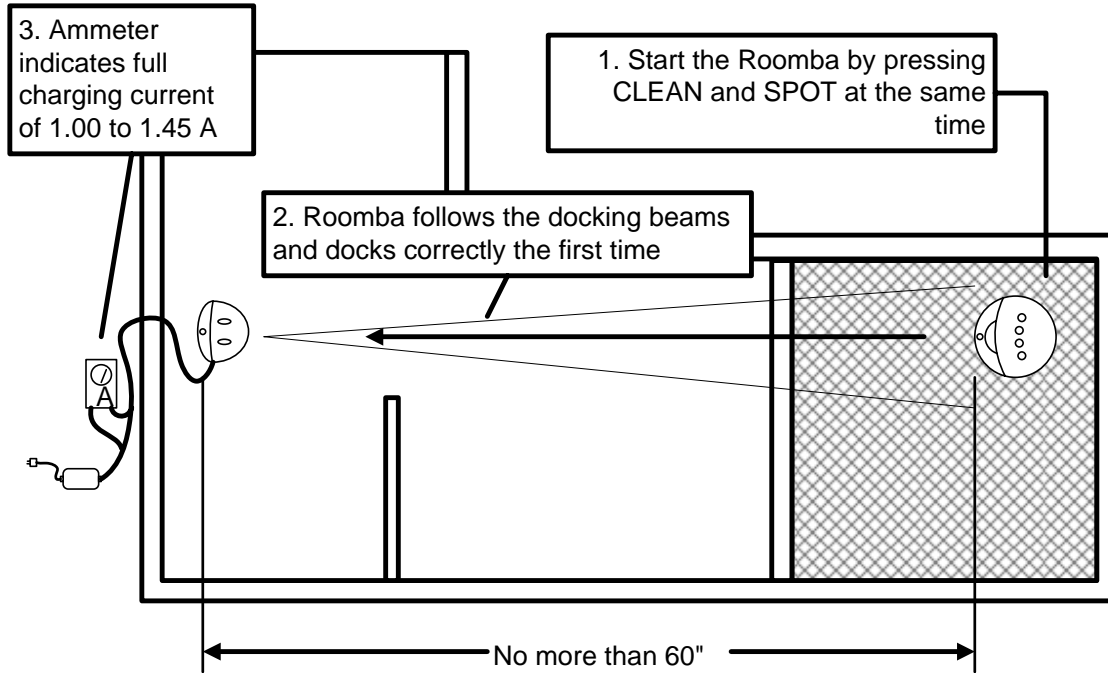
Figure 7 - Docking on Smooth Floor Test

Mobility Table Construction Specifications (in mm)
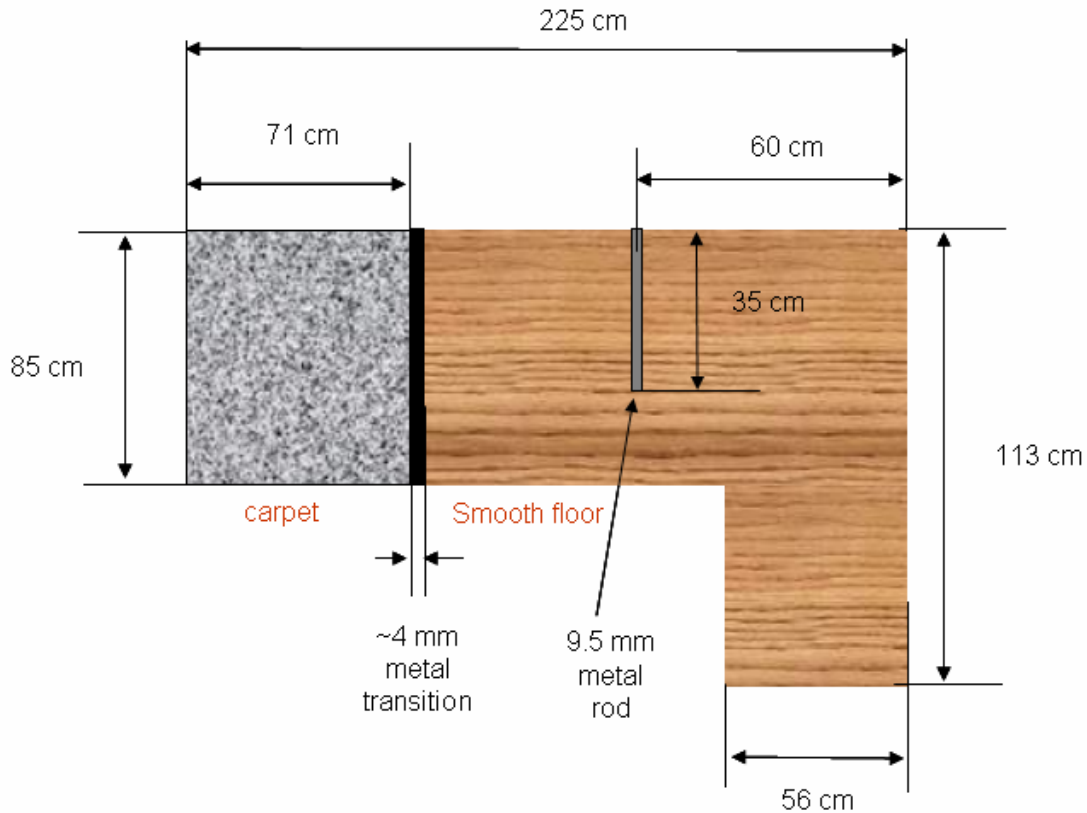
Appendix I: PCB Connector Designation

Side 1
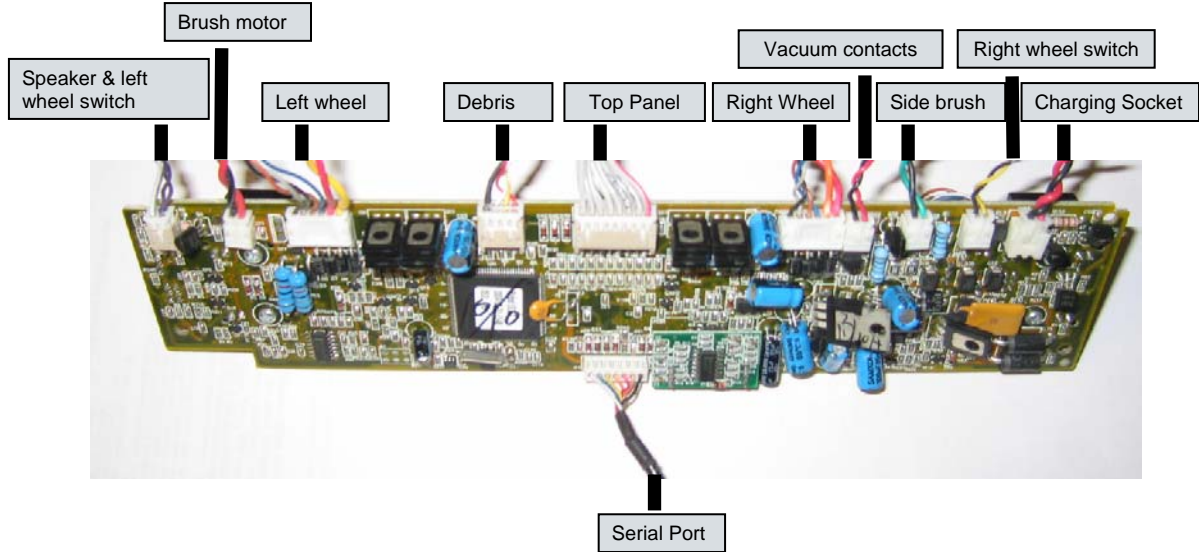
Side 2
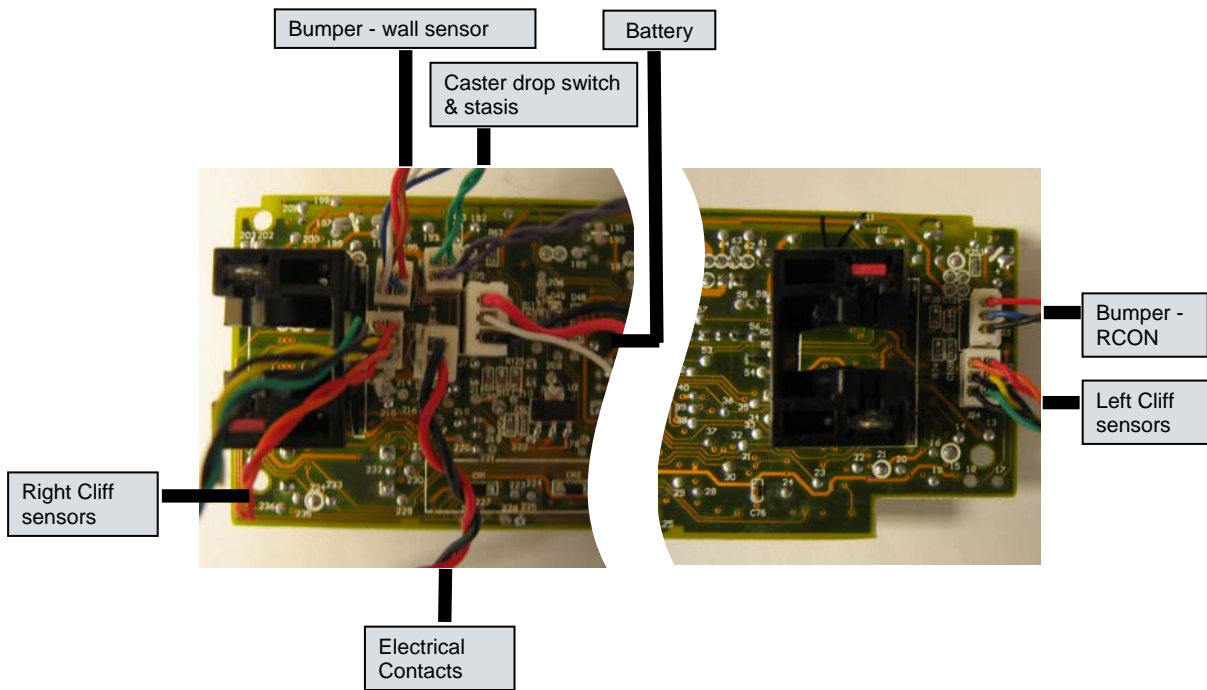
Appendix J: Battery Test Procedure

Using Battery Voltage Tester	
Objective :	To measure voltage across a Roomba battery, to measure voltage across a 5-Ohm resistor, and to measure the thermistor resistance.
Equipment :	Battery Voltage Tester, Multimeter, and <u>fully</u> charged battery under test.

Method	
1.	Fully charge battery with Roomba and latest software.
2.	To measure voltage across the battery, set the multimeter to measure DC VOLTAGE (**V**), and plug the multimeter terminals to the positive (+) and negative (-) terminals of the charge barge. **Failure if** reading is not between 15.5 – 18V.
3.	To measure the voltage across a 5 Ω resistor, follow step 1 (set the multimeter to measure DC VOLTAGE), and press the 5-Ohm resistor push button (<u>Caution:</u> Do not press button for more than a few seconds to avoid overheating of the load. **Failure if** voltage drop is more than 2 Volts.
4.	To measure the thermistor resistance value (thermistor contact to ground contact), set the multimeter to measure RESISTANCE (**Ω**), and plug the multimeter terminals to the thermistor terminal and the negative (-) terminal. **Failure if** not within specs in table below.

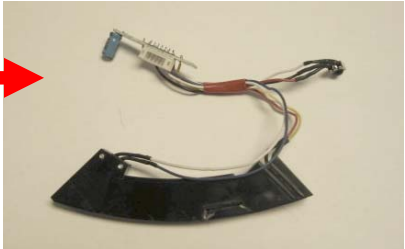| Ambient Room Temp	Thermistor Min (K Ohm)	Thermistor Max (K Ohm)
10 to 17 C	12.0	21.8
18 to 25 C	8.5	15.5
26 to 33 C	6.0	11.0
34 to 41 C	4.3	7.8

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Appendix K: Power Supply Test Procedure

For 1.25A FAST Power Supply	
Equipment:	AC Voltmeter, DC voltmeter, ammeter, variable voltage AC supply, power resistor (18 ohm 50 W for 1.25 A charging brick).
Method	
1.	Plug power supply into variable voltage AC supply with AC voltmeter connected across AC supply. Connect resistive load across output of power supply, with DC ammeter connected in series to measure current supplied to load. Connect DC voltmeter across resistive load and ammeter, so ammeter voltage drop is included in voltage reading.
2.	Set AC supply voltage for 90 VAC. **Failure if** DC output voltage < 20 VDC or > 24 VDC; DC output current <1.0 A or > 1.45 A.
3.	Set AC supply voltage for 240 VAC. **Failure if** DC output voltage < 20 VDC or > 24 VDC; DC output current <1.0 A or > 1.45 A.
4.	Disconnect power supply from AC supply. Set AC supply voltage for 60 VAC. Reconnect power supply to AC supply. **Failure if** output current isn't zero (power supply should shut down)

| For 600mA SLOW Power Supply	
Equipment:	AC Voltmeter, DC voltmeter, ammeter, variable voltage AC supply, power resistor (37 ohm 25 W for 600 mA power supply).
Method	
1.	Plug power supply into variable voltage AC supply with AC voltmeter connected across AC supply. Connect resistive load across output of power supply, with DC ammeter connected in series to measure current supplied to load. Connect DC voltmeter across resistive load and ammeter, so ammeter voltage drop is included in voltage reading.
2.	Set AC supply voltage for 90 VAC. **Failure if** DC output voltage < 20 VDC or > 24 VDC; DC output current <1.0 A or > 1.45 A.
3.	Set AC supply voltage for 240 VAC. **Failure if** DC output voltage < 20 VDC or > 24 VDC; DC output current <1.0 A or > 1.45 A.
4.	Disconnect power supply from AC supply. Set AC supply voltage for 60 VAC. Reconnect power supply to AC supply. **Failure if** output current isn't zero (power supply should shut down)

Appendix L: Built-in-Test Toolbox kits

These stripped down versions make it easier to attach and perform Built-in-Tests while fixing Roombas.

	Source	Toolbox version
Bumper connector		
UI Connector		

Appendix M: Disassembly Procedure
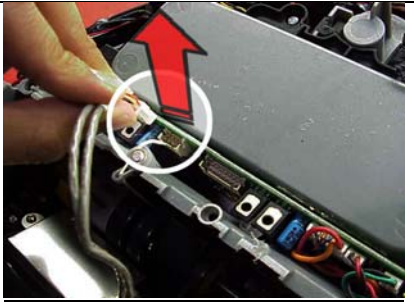
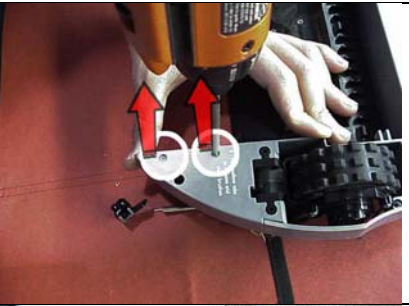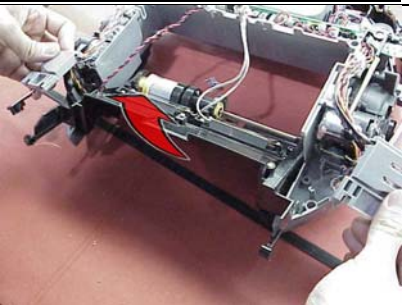## *Roomba Chassis Disassembly Procedure*
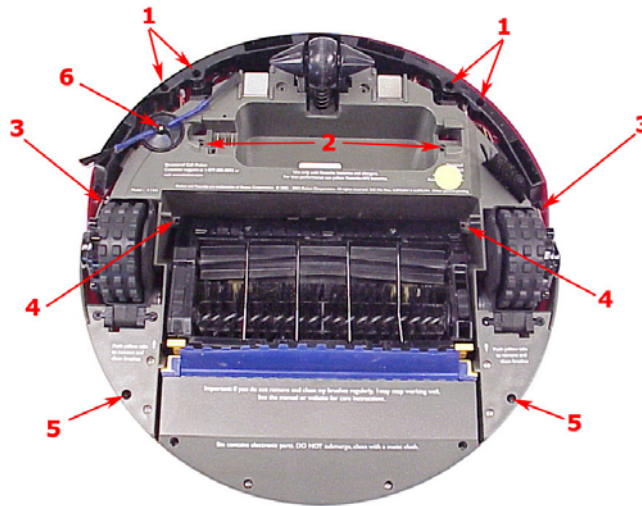
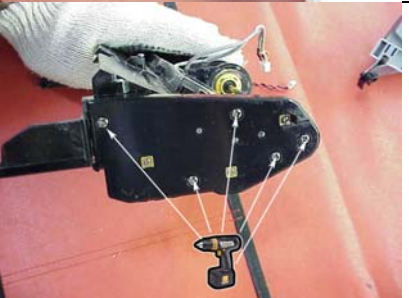
- o Remove Vacuum Bin
- o Unscrew bumper screws (1)
- o Unscrew chassis screws (2,3,4,5)
- o Unscrew side brush if necessary (6)
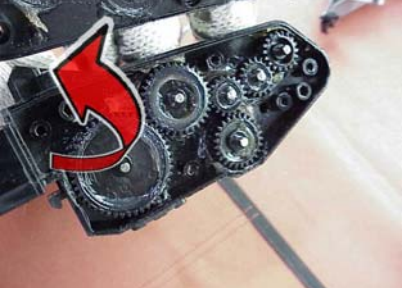
1	Lift outer bumper slowly as it is attached by the connector	
2	Angle the bumper outward and carefully disconnect connector from outer bumper	

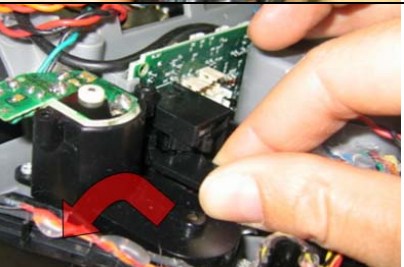| 3	Lift top shell slowly as it is attached by a connector. Carefully disconnect the connector from Roomba.	
4	Clean off the internal dirt with compressed air.	

Roomba Cleaning Frame Disassembly Procedure

1	Unscrew string mount and keep the string attached to the holder. Disconnect the string mount from the chassis.	
2	Disconnect debris sensor connector (gray wires)	
3	Disconnect brush motor connector (red/black wires)	

4	Feed brush motor connector under the wire router (unscrew the wire router if you have problems releasing the wires).	
5	Remove the (4) screws below the drive wheels (secures side holders for the cleaning frame pivot arms).	
6	Lift two side holders from the main body	
7	Remove cleaning frame assembly.	
8	Drive the (5) screws to open the side gearbox (if necessary).	
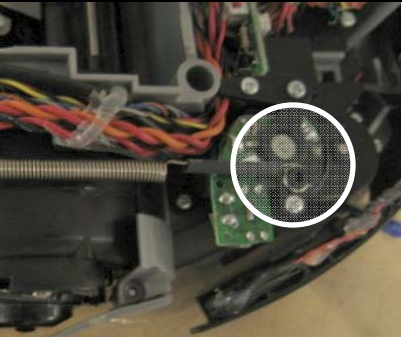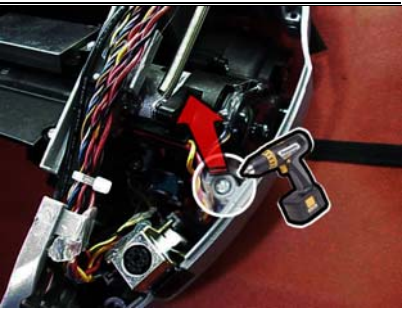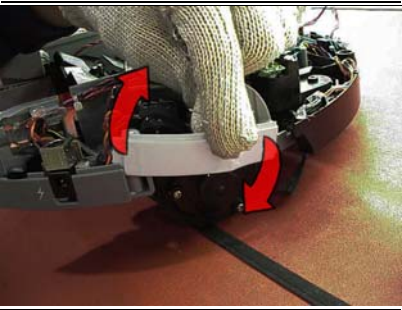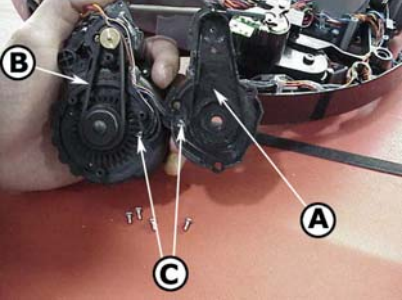
9	Lift the side gear box cover to inspect gears. Clear of hair and apply lubricant grease if necessary.	

Roomba Main PCB & Inner Bumper Removal Procedure

1	Unscrew the mounts (4) holding down the pcb on the edges.	
2	Detach all the connectors attached to the pcb.	
3	Swing the inner bumper arm towards the pcb and outwards to disengage it.	
4	Swing the bumper arm towards the pcb and outwards to disengage it. Allow the pcb to lift to avoid hitting the side brush gearbox housing.	
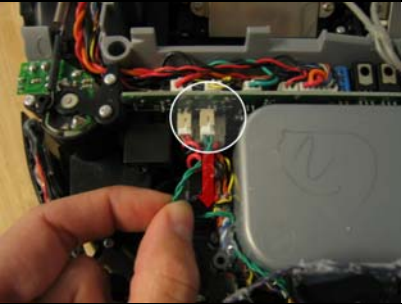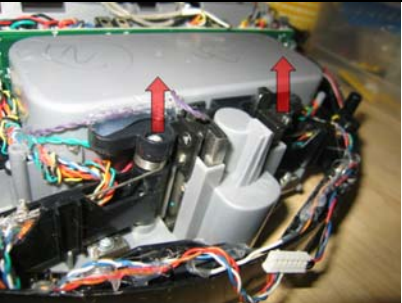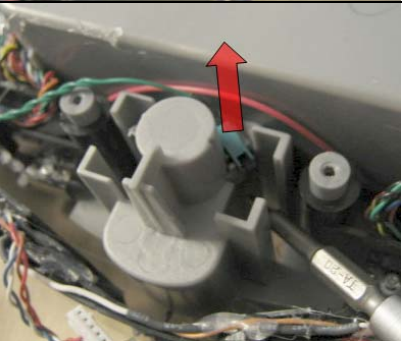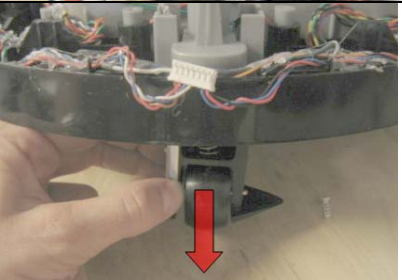
5	Lift the pcb out of the chassis. Slide the charging plug out and release the wire from the wire routing features.	
6	To remove the inner bumper, lift the bumper vertically up.	

Roomba Wheel Disassembly Procedure

1	Release the wheel spring.	
2	Unscrew (2) wheel support screws.	
3	For certain models remove the chassis bridge. Twist wheel out of the chassis but do not detach wires and connectors for general wheel maintenance.	
4	Unscrew (4) wheel cover screws.	
5	Carefully lift wheel cover (A), Inspect drive belt (B), Clean wheel encoders sensors (C) with alcohol pad.	

6	Verify the belt is not worn or broken and replace if needed.	
7	Close the wheel cover and verify it is correctly aligned and snapped into place. Guide wires through wire tabs and verify the sensor wires are NOT pinched.	
8	Inspect the wheel supports and replace if bent or deformed.	
9	Replacing the wheel and route wires so that they won't get pinched by chassis. Replace glue and zip ties if necessary.	

![iRobot]
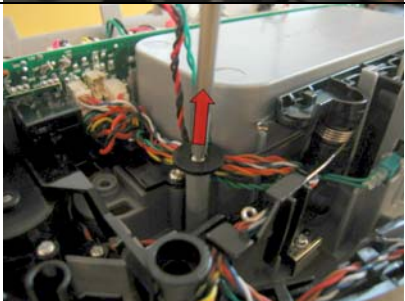
Roomba Fixed Caster Removal Procedure
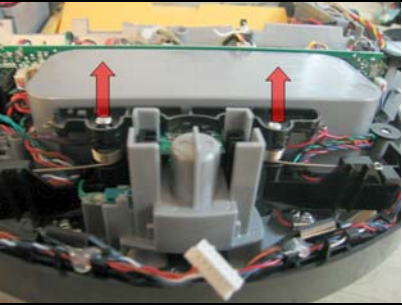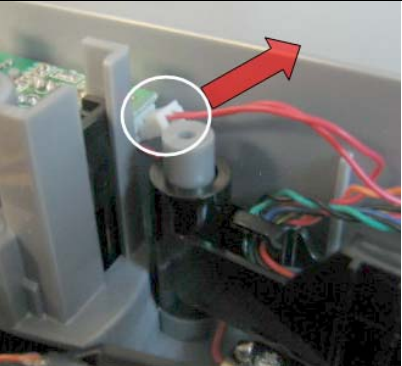
1	Disconnect the caster connector (green/purple) and guide the wires out of the wire tabs.	
2	Unscrew the spring cover and remove it. Release and remove the springs (2) underneath.	
3	Remove triangular screws (4) and caster guides that hold in the caster.	
4	Remove drop switch from its mount.	
5	Remove caster.	

Roomba Swivel Caster Removal Procedure

1	Squeeze in the caster guide rails and pull the caster assembly out of the chassis.	
2	To remove the wheel, place flat head screwdriver under wheel and twist up.	

Roomba Swivel Optical Stasis & Switch Removal Procedure

1	Disconnect the optical stasis & switch connector (red/black/green).	
2	Unscrew wire router and release optical stasis & switch wire from the bundle.	

3	Remove caster drop switch from the chassis.	
4	Unscrew the spring cover and remove it. Release and remove the springs underneath.	
5	Disconnect the optical connector.	
6	Remove screw that holds down optical pcb	
7	Lift board off the chassis.	

Appendix N: User Interface

User Interface : POWER Light
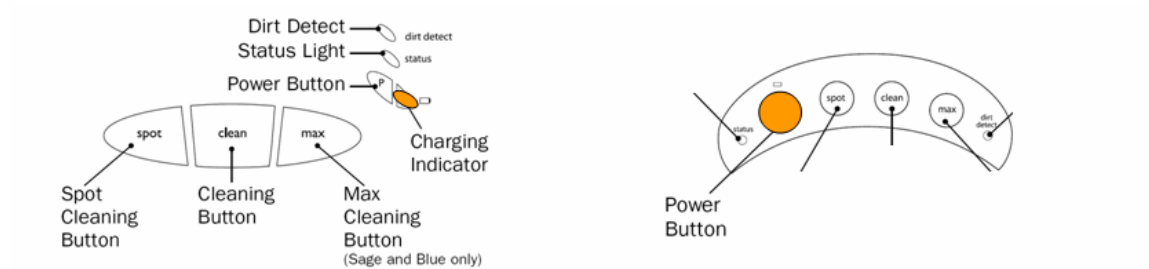
While charging :

No Light	GREEN	AMBER (can look RED)	RED
Battery failure or if only depleted the lights will turn on after a few minutes.	Solid green when finished charging.	Pulsing amber when charging battery.	Flashes red if charging brick has failed (pulsing green light on brick)

While starting, cleaning or stopped :

	Battery charged	Battery partially discharged	Battery discharged

User Interface : STATUS Light

Turned on or stopped :

GREEN	AMBER (can look RED)	RED
Clean cycle completed. Stays green until turned off or a new cycle started.	Gets stuck in the middle of a cleaning cycle and has to stop. Usually followed by an error code. Stays yellow until turned off or clean cycle resumed or restarted.	--Blinks red (twice a second) if no software installed. --Slow blinking (every 3 seconds) if it has a schedule and the robot is not running.

Battery indicator :

	Has a low battery during a 'max' cycle. Usually followed by the dead battery song.	Has a low battery during a 'clean' or 'spot' cycle. Usually followed by the dead battery song.

User Interface : DIRT Detect

[When Roomba$_2$ detects a certain level of dirt, it will go into DIRT ALERT mode. In DIRT ALERT mode it will spiral back and forth to try to clean up all of the dirt it can detect.]

No Light	Light BLUE (in DIRT DETECT)
During normal operation and no dirt is detected.	Solid blue when in DIRT DETECT mode (due to sensors reporting dirt). It uses continuous dirt detect feedback to turn into the dirt.
When Roomba$_2$ has a broken dirt sensor.	Blinks slowly and ignores dirt sensor and enters normal cleaning behavior when in DIRT DETECT OVERRIDE mode. This happens when the sensor is overloaded or malfunctioning. Examples are : -a continuous dirt signal for 40 seconds due to electronic malfunction. -a high frequency signal due to a loose debris sensor. -a high dose of dirt in a very dirty room.

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Appendix O: Roomba Engineering Changes

Gearbox Housing	2004-11-07	Change outboard housing from POM to GF NYLON which has a higher melting temperature.
Serial Port Housing	2004-11-15	Bevel the metal housing to reduce shorting between the hot tab of the charging jack and the ground casing of the serial port.
Side Brush	2004-12-03	Change black bristles to white bristles which are transparent to IR
Vacuum Impeller	2004-12-12	Better balance impeller by increasing gates in mold and thereby improve the flow of plastic.
Flapper Rod	2005-01-17	To strengthen rod and reduce bouncing internal shaft changed to stronger steel.
Vacuum Bin Contacts	2005-01-22	Corrosion and pitting of the vacuum bin contacts due to contamination and vibration cause the contacts to fail. Change the vacuum bin contacts to Nickel plated Beryllium.
Wheel Encoder Tab	2005-02-22	Add a tab to the hub behind the encoder that seals area from external dirt.
Ziptie	2005-04-11	Secure anti tassel halves of main brush with a ziptie. This stiffens main brush and reduces bouncing.
IR Blocker	2005-04-11	The plastic formulation of the bumper in 41xx is transparent to IR. Add black plastic part which is impermeable to IR.
Bearing hole	2005-04-28	Hair and dust builds up in the yellow bearing can lead to bearing pushing out and melting and even cracking cleaning frame. Extend axial bore through bushing for hair extrusion.
Main brush motor	2005-05-07	Change motor wire to one with higher temperature winding.
Rewiring	2005-05-09	Use less hot glue and improve wire routing on bumper, chassis and cleaning frame
Brush Gearbox	2005-05-24	Reduce housing / output shaft clearance on main brush gear box by : • Deepen hole in output gear to accommodate shaft an extra 1.5 mm • Lengthen pin in gearbox tat holds output gear • Shorten Shaft
Wheel Housing bowed	2005-05-29	Bowed housings allow more clearance between the o-ring and cover. This prevents the o-ring from chaffing against the cover and allowing the o-ring dust to contaminate the wheel encoder.

Home Base Feet	2005-06-08	Enlarge diameter and height of the four elastomeric feet at screws to increase traction on smooth floors. Home Base does not slide when robot docking.
Wheel Hole	2005-06-23	Close axle hole to reduce migration of dust under wheel cover.
Caster Material	2005-06-24	Change front caster material from Acetal to Nylon 801 (also black). This material is more abrasion resistant and withstands life tests. Long term fix is to design a swivel caster (in progress).
Motor Power Wire	2005-07-27	Main brush motor revolves in mounting brackets and this causes fatigue on the power wire. More flexible wire chosen.
ESD protection	2005-08-05	ESD entering the robot via the charging port may damage these FETS and cause the robot lose the ability to control the charging of its' battery. Protective components added to board.
Wire Bail	2005-08-19	We have seen a few cases of abraded wires. To avoid wires dragging on floor, wire profile is reduced so it does not protrude.
Software 1707	2005-08-23	1. Solve circle dance (dirty wheel encoders) with open loop mode. When in this mode may arc and have a different velocity. 2. Recondition batteries with deeply discharged battery charging. If battery ever under 10.8 V it will go into a 16 hour charge
String	2005-08-29	If string breaks the cleaning head cannot be regulated and more drag is experienced on carpet. Immerse string in silicon oil to strengthen string.
O-ring	2005-10-10	Change material of o-ring from compression molded CR to injection molded CR-B9. CR-B9 has improved abrasion resistance and injection molding has better repeatable consistency in the molded product.
Software 1308	2005-10-24	1. Single Debris Mode 2. SCI Mode
Brush motor outboard housing	2005-10-25	Change outboard housing to Grilon T300 GMH (equivalent to Nylatron). Inboard pivot bushing remains GF Nylon.
Wheel cover	2006-04-18	Seal wheel assembly by adding ribs along the cover to better seal the wheel compartment. Also extend the bosses to avoid vertical gaps where dirt can infiltrate.
Frog –grease	2006-05-18	Add damping grease to motor brackets to dampen cleaning head oscillations.
Debris Connector	2006-05-31	Return to a 2x4 connector configuration from the single debris sensor to the main pcb

Swivel Caster	2006-06-24	New caster swivels 360 degrees. Stasis detection is optical. Wheel is also removable.
Home Base	2006-06-15	New extended home base to compliment swivel caster. Also eliminated weights and paint
Slim Virtual Wall	2006-06-28	Results in smaller packaging
Seal Gearbox	2006-07-13	Seals gearbox from dirt infiltration
Main brush with End caps	2006-08-14	Reduces amount of hair and dirt entering side gearbox and yellow bearings.
Software 1814	2006-08-29	1. BiT improvements 2. Single Button Roomba Code (for new product Dirt Dog)

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Appendix P: GLOSSARY

approved	o a component that is considered functional and used to verify faulty components during Built-in-Test
APS	o Advanced Power System
BiT	o Built-in-Test
Chassis	o The plastic frame of the Roomba
Circle Dance	o The Roomba symptom where robot circles continuously. This can be caused by dirty encoders, broken drive belts, broken wheel IR, clogged bumper IR as so forth.
Cleaning Frame Assembly	o The cleaning assembly includes the pivoting self adjusting frame that supports the brushes, brush guard, brush motor and gearbox.
Debris	o Dirt that is being picked up by the Roomba
Discovery Series	o Roomba 2 Series that includes the Roomba Red, Sage, Discovery, Discovery SE and Scheduler
Encoder	o A sensor that relays information to the pcb
Force Field	o An IR avoidance beam that ensures the Roomba does not bump into it. Force field used in the Home Base and Virtual Wall
Home Base	o The Roomba self charging station
Infra Red (IR)	o A wave of light with wavelengths greater than those of visible light.
Light Emitting Diode (LED)	o Semiconductor light source that emits visible light or invisible infrared radiation.
Mobility	o Capable of moving or being moved readily
Original Series	o Roomba 1 Series that includes the Roomba Original, Pro and Pro Elite
Over-currents	o Exceeds the current limits for the motors.
PCB	o Printed circuit board
Pile	o The visible surface of a carpet consisting of yarn tufts in a loop, cut or cut/uncut configuration.
RCON	o Room confinement (reference to the IR receiver eye on the top of the outer bumper)
Stasis	o Refers to things that are not moving or changing
User Interface (UI)	o The physical means and method of interaction between users and products
Virtual	o Not physical