

!!!WARRANTY REVOCATION WARNING!!!

Without any prior notice to Roomba owners iRobot has (ca., 2006, Q4-2007, Q1) invoked a new policy regarding performance of "diagnostic" tests (those which are built-in to all Roomba firmware) without first discussing the need to do so with iRobot Customer Support. A Roomba with valid warranty stands to have its warranty revoked if an owner fails to heed the new policy.

There has been no formal release of the subject policy, however, a quasi-formal post, which also explains the Company's concerns, may be read via [this RoombaReview Sticky](#).

To proceed, you are doing so at your own risk. [Rev.\[10\]](#)

DISCLAIMER

When Roomba's wheels and / or brushes are driven, finger-tips, beards, and neck-ties or other garments are exposed to a hazardous situation. Notice that a Roomba in Diagnostics Mode is operating without the normal safety features that stop the motors when Disco is either lifted off the floor, or a stout article becomes wedged in a running mechanism. Not only must due care be exercised when using hands to reorient Roomba while its motors are powered, but if anything halts a running motor, for more than a second or two, there is great probability that the motor or its related electro-mechanical parts could be ruined! With that preamble said, be aware that this document has been prepared by Roomba-Discovery owners, none of whom are employed by iRobot; further the authors are not to be held responsible for personal, or material damage, nor for any inaccuracy within this document.

To proceed, you are doing so at your own risk; and, agree to the above disclaimer statement. [Rev.\[10\]](#)

===== DIAGNOSTIC-TESTS PROCEDURE

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Updated 070128, v.0.5

Editor's Note

A reminder: In version 0.4, **re-numbering of tests** had been done to get test-numbering to conform to Factory-Test numbers. That upgrade principally impacted original 'test' number five, which had been incorrectly considered to be a *motors'* test series. Within that old series, Test (5- c) may have

been referenced more times, in various posts, than any other test. That same information, and a little more, is contained in "Test-Nine".

SCOPE:

This procedure is applicable to the following Roomba Discovery models: #4100 Roomba Red, #4110 Roomba (a.k.a., "Sage"), #4210 Roomba Discovery, and #4220 Roomba Discovery-SE. Diagnostics tests herein apply only to the Roomba machine; not to the battery, nor directly to Roomba's accessories.

Model releases, such as the Pink Discovery, and the Scheduler, which followed the initial release of this procedure, may be expected to perform as indicated herein, but, none have specifically been tested by the authors. Scheduler Discovery owners have reported these diagnostics run just the same on those robots; just don't expect the scheduling function to be verified.

Roomba Discovery robots which have been OSMOed may yield unexpected test results. No OSMOed unit has been tested by the authors.

PRELIMINARY OPERATIONS AND BITS OF INFORMATION:

1) Detach Disco from the battery charger. Note: Diagnostic tests can be performed using a battery that is far less than fully charged, because all Roomba-functions are not powered simultaneously -- as they are when the robot performs floor-cleaning.

2) Choose an appropriate test area, or two. A table top on which Disco may be slid to the edge, to test wheel-drop switches and cliff-sensors, will work well during Tests 1 through 4. When Wheel-Motors are tested, beginning at Test-7, Disco should travel any allowed distances if done with Disco on the floor (you must chase it), or it may be carefully hand-held on one's lap if you don't want it to travel.

3) Pushing POWER will generally abort diagnostics and turn Disco OFF; or it may result in a flashing-RED POWER switch. (which, so far, has required a battery disconnect to escape).

4) **Pushing CLEAN, will increment (advance) to succeeding tests;** accompanied by suitable beep-counts.

5) Pushing SPOT will decrement (back up) from higher-numbered tests to lower-numbered tests.

Note: In each test the Dirt-Detect LED will repeatedly flash a sequence of long and short pulses of blue light to indicate the current test-number. That signaling (counting the test numbers in base-5) is the only function the Dirt-Detect LED plays in these Self-Tests. Long pulses (= five, base-ten) are roughly two to three seconds duration, while the short ones (= one) are about one second length.[Rev.\[9\]](#)

Note: Throughout tests seven to Test-14 the normally RED STATUS light can be expected to change color.[Rev.\[9\]](#)

Note: When any of Test-1 through Test-4 is first entered, the POWER button's color will be set to RED. Then, as designated actions and / or introduction of stimulus is applied, the diagnostic-mode firmware will decide whether the test has been passed. If it passes, the MCU, (Micro-Controller Unit), will switch the button's color to GREEN.[Rev.\[8\]](#)

However, owner-testers may not want to rely on that PASS indication, since trial runs through the tests show the color change to be sluggish, or not change at all. Generally, some other visible action has quickly proved proper operation, and there is little need to wait for the System to corroborate the PASS-condition.

PROCESS THE TESTS:

When ready to enter Disco's Diagnostic Mode, press the SPOT and CLEAN buttons simultaneously, and hold them down while momentarily pressing POWER, and *keep them down after releasing the POWER button*. Hold SPOT & CLEAN down until Roomba acknowledges (described next) your request.

"**Acknowledgement**" is an audible tone-set of five ascending *and* five descending notes.

Following the audible acknowledgement, and after you release the SPOT and CLEAN buttons, the robot will be in Test Zero.

Test-Zero: USER-INTERFACE LED's AUTO-CHECK

Discovery's panel lamps will repeatedly flash as follows:

1. POWER: GREEN, RED, dark,
2. STATUS: GREEN, RED, dark,
3. DIRT-DETECTOR: emits a short-blue flash then dark,
4. the cleaning-mode switch SPOT, flashes GREEN then goes dark,
5. the cleaning-mode switch CLEAN, flashes GREEN then goes dark, and
6. the cleaning-mode switch MAX (if present), flashes GREEN then goes dark,
7. all flashing in the stated sequence, repeating endlessly (almost).

This array of illumination is the test of all top-panel, User-Interface, LEDs. The flashing test-sequence will repeat until the test is indexed. Note that results will differ for Disco models lacking the "MAX" function. If any LED fails to emit the indicated color, there is an electronic fault in the system.

Test-One: BUMPER SENSORS (2 ea)

Depressing CLEAN, will index to the Bumper-Switch test. Indications from the robot will be as follows:

- A single beep, (^), will be sounded. Note: This is the higher tone of two used to quantify test-numbers via sounds. When test-numbers greater than five are reached, a low-tone is used to represent each tally of five high-tones. Starting in Test-6, each low-tone will be indicated by the underscore "_" character.
- POWER-button color will shift to a steady-ON, RED illumination,
- DIRT-DETECT will indicate the test-number by flashing a short pulse (• , a 'dit', if in Morse Code) of blue-light, which repeats at about three-second (3s) intervals.

Test the Bumper sensors (two slotted optical-switches, actually) by pushing on the Bumper's outer ends, and its middle, to make the SPOT and CLEAN buttons illuminate; a left-side-push should illuminate SPOT, a right-side-push should illuminate CLEAN, and a central-push should light both buttons. If the switches are functioning properly the MCU and firmware may acknowledge that by toggling the RED POWER-button to GREEN, after the two tests.

Test-Two: OUTER, CLIFF-SENSORS PAIR

Depress CLEAN again, to enter testing of outer Cliff-Sensors. Indications from the robot will be as follows:

- Two beeps will be sounded, (^^), to announce the test-number.
- POWER-button color will shift to a steady-ON, RED illumination,
- DIRT-DETECT will flash two short pulses (••) of blue-light, a sequence which then repeats at about three-second (3s) intervals.

Test the far left-, and far right-side Cliff Sensors by moving Disco's Bumper over a table edge, so the outer Cliff-sensor-detectors see no reflected light. That can be done one at a time. Make sure that the Spinning-Edge Brush has not stopped with an arm over the right-hand sensor-well; that may give a false indication. SPOT and CLEAN will change to GREEN when no return signal is detected. Place your hand under each outer sensor, and verify that the corresponding button (the one closest to your hand) goes dark.

If the sensors are functioning properly the MCU and firmware may acknowledge that by toggling the RED POWER-button to GREEN, after the two tests.

NOTE: A VWU's (Virtual Wall Unit) IR-beam (use the 0-3 ft range), when beamed into an *outer* Cliff-Sensor's well (at 25° to 30° to Disco's base, and aimed up and forward) will stimulate a detector and cause the pertinent button's LED to fluctuate. This type of examination originally revealed the detector to be mounted forward of the IR-emitter. Now, the utility of this stimulation would be to sort out which half of a sensor-module might need attention. This would be a quick means of checking the detector channel.

Use of a digital camera, at the same angle but aimed up and rearwards, can easily confirm whether the IR-LED part of an outer 'sensor module' is emitting.

Test-Three: INNER, CLIFF-SENSORS PAIR

Depress CLEAN again, to enter testing of inner Cliff-Sensors. Indications from the robot will be as follows:

- Three beeps will be sounded, (^ ^ ^), to announce the test-number.
- POWER-button color will shift to a steady-ON, RED illumination,
- DIRT-DETECT will flash three short pulses (•••) of blue-light, a sequence which then repeats at about three-second (3s) intervals.

When the Left-Inboard Sensor sees no reflected light, the SPOT button lights; and, for the Right-Inboard Cliff Sensor, it is the CLEAN button that reports a return signal. Generally, you can simply place your hand under the front, inner Cliff- Sensor openings to cause sensor radiance to be reflected back into the module's detector.

If the sensors are functioning properly the MCU and firmware may acknowledge that by toggling the RED POWER-button to GREEN, after the two tests.

Note: When trouble-shooting these front, inner-pair of Cliff-modules with a digital-camera, it may be useful to know the two LEDs are mounted close to each other, and straddling the center. They are aimed down and outboard, such that the right-side-LED beams down and to the right, and the left-side-LED beams down and to the left.

Test-Four: WHEEL-DROP SWITCHES (3 ea) and WALL-SENSOR (1 ea)

Depress CLEAN again, to enter Wheel-Drop sensor testing. Indications from the robot will be as follows:

- Four beeps will be sounded (^ ^ ^ ^).
- POWER-button color will shift to a steady-ON, RED illumination,
- DIRT-DETECT will flash four short pulses (••••) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

Tests 4-a and 4-b are simultaneously available – no incrementing switch operation is required between them.

Test-4.a: Wheel-Drop Check: If any wheel is allowed to extend (i.e., drop below full-up position by a set [by iRobot] amount), the SPOT button lights. Test each wheel's switch by holding two UP while manipulating the third one UP/DOWN.

Test-4.b: Wall-Sensor Check: By placing something reflective (e.g., a hand-sized piece of white paper) near the Wall-Sensor apertures on the right-hand side of the Bumper (and with the plane of the paper oriented roughly perpendicular to the drive-wheel axles), the CLEAN button should illuminate. Upon completion of 4.a and 4.b, the POWER LED should change to GREEN.

NOTE: The VWU beam (carefully aligned to the axis of the square, view-port) can also be used here to stimulate the wall-sensor's detector. The CLEAN-button LED will fluctuate with that sort of stimulus.

Test-Five: REMOTE-CONTROL RECEIVER

Depress CLEAN again, to enter Remote-Control-Receiver testing. Indications from the robot will be as follows:

- A single, lower tone will be sounded (_), to represent the decimal test-number "5".
- POWER-button color will shift to a steady-ON, RED illumination,
- DIRT-DETECT will flash one long pulse (—) of blue-light, a signal which then repeats at about four-second (4s) intervals.[Rev.\[9\]](#)

The Remote-Control Receiver system can be tested by illuminating the top-optic, mounted on Roomba's Bumper, with any one of three sources. When a Remote-Control unit or the Home-Base's beams (tractor or its top, repelling fan of IR radiance) stimulate the receiver, the CLEAN-button will light. Also, 'commands' sent by the 'Remote' will be processed normally by Disco, so the wrong button-press may set the machine OFF, or index it to a neighboring test! IOW, use the navigation, and PAUSE, (||), commands. When an ordinary VWU's stimulus illuminates the receiver, the SPOT-button will light. [Rev.\[8\]](#)

Don't depend on the robot to change the POWER switch's color to GREEN during this test sequence; even if all four stimuli are used.

Test-Six: BATTERY'S VOLTAGE-SENSOR AND TEMPERATURE-SENSOR

Depress CLEAN again, to enter Battery-parameter sensing checks. Indications from the robot will be as follows:

- A double-beep will be sounded; first a low tone, then a higher tone (_ ^).
- STATUS will be a steady GREEN,
- POWER-button color will shift to a steady-ON, RED illumination,
- SPOT-button will be a steady GREEN,
- CLEAN-button will be a steady GREEN,
- DIRT-DETECT will flash one long pulse and one short (— •) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

This is an "internal check" of the circuits that measure battery-voltage, battery-temperature, and total system current (referred to as...) "baseline-current". The latter must be the current drawn by the MCU and peripherals which are energized at this point in diagnostics-mode. While there is little possibility of presenting such data via the user-interface features in Disco's topside-panel of LEDs, we notice that PASS or FAIL states can be displayed. For example, both SPOT and CLEAN are lit GREEN upon entering this test with a healthy battery powering the robot. We find that CLEAN will go dark if we disrupt the battery's temperature connection to the robot. It is then possible to extend that sort of action to the battery-voltage assessment and claim that if we could somehow discharge the battery to a low enough level, the SPOT LED would go OFF -- signifying a battery with unacceptable charge level. With no addition information, we conclude the baseline-current data can only be sent out via the Serial Command Interface.[Rev.\[8\]](#)

If anyone has information that can be used to complete this section, please advise.

CAUTION: WITHIN THE NEXT FIVE TESTS, WHEELS & BRUSHES WILL BE DRIVEN, AND THERE IS NO SENSOR SALVATION TO PROTECT YOU, ROOMBA, OR HOUSEHOLD ITEMS THAT MAY GET CAUGHT UP IN THEM

WITH EXCEPTION OF TESTING DIRT-DETECTORS (TEST-12), THERE IS LITTLE UTILITY IN RUNNING ROOMBA ON THE FLOOR DURING THE FOLLOWING MOTOR AND MAIN-BRUSHES TESTS. IN FACT, IF YOU ARE UNABLE TO KEEP UP WITH THE ROBOT AND PROTECT IT FROM STOPPING AS IT HITS A

BARRIER, THERE IS A REAL THREAT OF DAMAGING A MOTOR, OR MOTOR-DRIVER'S CIRCUIT COMPONENT(S). IT IS, THEREFORE, RECOMMENDED THAT ROOMBA MECHANISMS NOT BE SUBJECTED TO MECHANICAL LOADS THAT ARE NOT WELL CONTROLLED BY THE TESTER. REFERENCES TO FLOOR-TESTING BEHAVIOURS HAVE BEEN RETAINED, BUT SHOULD BE VIEWED AS REFERENCE INFORMATION RATHER THAN AS TEST OPERATIONS. [Rev.\[10\]](#)

Test-Seven: LEFT-WHEEL MOTOR

Push CLEAN to check operation of the LEFT-Wheel. Disco, on the floor, will circle clockwise because the left-wheel is driving, and the right-wheel is not.

Indications from the robot in Test-7 will be as follows:

- A triple-beep will be sounded; two tones are used; one low, followed by two at a slightly higher pitch (_ ^ ^).
- STATUS will be a steady GREEN (unless an immediate overload is sensed),
- POWER-button color will be a steady-ON, RED illumination,
- DIRT-DETECT will flash one long pulse and two short (— ••) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

The left-wheel will be rotating at a moderate speed, which is approximately 65% of the wheel-speed you will see in Test-9. One might say: If the wheel drives Roomba at a reasonable speed, the test has passed; however, there is one subtlety to consider. If some part of the wheel-mechanism is binding sufficiently to trigger Disco's high-current (motor-current) limit, the STATUS color will shift from GREEN to RED as long as the overload continues. [Rev.\[8\]](#) The cause of such binding must be discovered and corrected.

Test-Eight: RIGHT-WHEEL MOTOR

Push CLEAN again to check operation of the RIGHT-Wheel. Disco, on the floor, will circle anti-clockwise because the right-wheel is driving, and the left-wheel is not.

Indications from the robot in Test-8 will be as follows:

- A quadruple-beep will be sounded; two tones are used; one low, followed by three at a slightly higher pitch (_ ^ ^ ^).
- STATUS will be a steady GREEN (unless an immediate overload is sensed),
- POWER-button color will be a steady-ON, RED illumination,
- DIRT-DETECT will flash one long pulse and three short (— •••) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

The right-wheel rotates at a moderate speed, which is approximately 65% of the wheel-speed you will see in Test-9. One might say: If the wheel drives Roomba at a reasonable speed, the test has passed; however, there is one subtlety to consider. If some part of the wheel-mechanism is binding sufficiently to trigger Disco's high-current (motor-current) limit, the STATUS color will shift from GREEN to RED as long as the overload continues. [Rev.\[8\]](#) The cause of such binding must be discovered and corrected.

Test-Nine: WHEELS DRIVE IN REVERSE DURING WHEEL-SPEED SENSOR CHECK

Note: This was test "(5-c)" in the prior version. This is **THE** important test if your Discovery is exhibiting the "Wheel-Centered Circle-Dance". When Roomba attempts to clean one of its wheel-tachometer optics, it halts the healthy wheel and then spins the duff-side's wheel forward and backward a few turns; and repeats that oscillation for six to eight times, then gives up. The action is not known for its success rate!

To enter Test-Nine, push CLEAN again. Indications from the robot at start of Test-9 will be as follows:

- Five-beeps will be sounded; two tones are used; one low, followed by four at a slightly higher pitch (_ ^ ^ ^ ^).
- STATUS will be a steady GREEN,
- POWER-button color will be a steady-ON, RED illumination,
- DIRT-DETECT will flash one long pulse and four short (— ••••) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

Test-9.a: Reverse Driving: Disco backs up **fast**, as both Wheels are driven in reverse! Note: Wheels do not rotate faster than this in any other powered wheel test; hence, this rate defines the 100% speed reference in these diagnostic tests.

In prior drive-wheel-tests, the wheel-assemblies have been verified to contain functional motors, functional gear-sets, and intact drive-belts; and their 'forward-paths' through their electronic-driver circuits (a.k.a., "H-bridges" -- one per wheel) have been verified operational. The only thing new for Test-9.a to check, is the 'reverse-path' through each H-bridge. If both wheels drive the robot in reverse, the circuit is validated. If a wheel fails to rotate, it means there is a fault on the main-PWB. Often, the failed part is a power transistor -- which a small percentage of owners have been able to diagnose and replace. Most everyone else, must depend on getting another Roomba!

Due to the higher rotation-rate, this test may reveal drive-belt slippage. Notice whether reverse-track deviates much from straight. Another possible fault which these wheel-tests can exhibit is a slow-turning motor, one being bogged down with sticky bearings. Here too, a very small percentage of owners have restored such an ailing motor to proper operation.

Test-9.b: Tachometer-Test: The Tachometer-Test consists of noting whether the SPOT & CLEAN button LEDs flicker at high-rate when the wheel-tachometer's are working properly. No additional button-pressing is required, just observe the SPOT & CLEAN buttons while wheels run in reverse. If the LED(s) in either panel-button remains a steady GREEN light, the nearest wheel to that steady-lit button has a tachometer problem. Problems have included the following:

- The tach's light-emitting-diode, LED, has a dirty lens, or is not emitting sufficient IR-radiance.
- The tach's photo-transistor, PT, detector has a dirty lens (the most common fault condition), or is photo-electrically unresponsive.
- If you do come into this test with a known broken drive-belt, one of the tach's beam-chopper blades may have stopped in the beam-path between the LED & PT. You may check its Tachometer 'pulse-generator' by manually rotating the wheel and noting whether the corresponding switch-button shows a fluttering, ON/OFF, LED output.

Illumination of SPOT is associated with the left wheel, and illumination of CLEAN with the right wheel assembly.

The STATUS LED turns RED to indicate a failure.

Test-Ten: FRONT-WHEEL ROTATION SENSOR

To enter Test-Ten, push CLEAN again; motors will stop. Indications from the robot while in this rotation-sensor check, will be as follows:

- Two low-pitch tones will be sounded (_ _).
- STATUS will be dark,
- POWER-button color will be a steady-ON, RED illumination,
- SPOT's LED may or may not be lit -- you will see below, it depend on the Front-Wheel's rotary position.
- DIRT-DETECT will flash one long and one short pulses (— —) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

The Front-Wheel's Rotation Sensor operation may be verified by manually rotating its wheel. During approximately three-tenths of a wheel-turn the SPOT switch will be lit GREEN, and the remainder of the turn,

SPOT will be dark. The "sensor" is a cam-operated, lever-actuated switch of the same type used for wheel-drop indication. [Rev.\[5\]](#), [Rev.\[6\]](#)

While doing that manual rotation, make certain the wheel spins freely on its bearings. When spun fast, it should complete a couple revolutions before stopping. If not freely spinning, look for wound on fibers which need to be cut / tweezed off the axle. CAUTION: DO NOT SPREAD THE WHEEL-FORK ARMS WHILE CLEANING. Spreading the fork can dismount the (hidden) switch-cam, thus disabling the rotation indicator sensor.

If you determine there is an internal fault with this rotation-sensor, you need to know that it is very difficult to disassemble the wheel to accomplish inspection and repair. The alternatives are to OSMO the robot (thus making it ignore the loss of rotation-data), or exchange it.

Test-10 is *THE* important test if your Discovery is exhibiting the "**Body-Centered Circle-Dance**". When the Front-Wheel is jammed with debris, and fails to rotate, Roomba will attempt to free the wheel by spinning itself CW and CCW, roughly about the center of the robot. As with the other Circle-Dance, this one is also oscillatory and is done by counter-rotating the drive wheels, a few turns, and in a repeating pattern. Not much is known relative to the success rate of this operation!

Note: If your Disco has had the OSMO treatment, we expect the Body-Centered CD will not be exhibited.

Test-Eleven: MAIN-BRUSHES MOTOR

To enter Test-Eleven, the Main-Brushes-Motor check, push CLEAN again. Indications from the robot at start of Test-11 will be as follows:

- Two low-pitch tones, and one higher will be sounded (_ _ ^).
- STATUS will be GREEN,
- POWER-button color will be a steady-ON, RED illumination,
- DIRT-DETECT will flash two long and one short pulses (— — •) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

Both main-brushes should be counter-rotating, and continue to do so while something (safe) is pressed against them, to simulate floor loading of the brushes.

It is important to mechanically load the brushes. If the square-drive couplings at the brushes' ends are worn round, the worn one(s) may fail to properly drive its brush, hence, the brush will stop as increasing load is applied. Another thing checked by loading is the motor's torque. A duff motor, in which one of its five armature-windings is 'open', may spin up without load, but when loaded it will easily slow, or halt.

Test-Twelve: DIRT-DETECTOR SYSTEMS

Note: In older versions, this was Test-(5-f) in which observation of wheel-driving and brush-turning was incorrectly emphasized; and *that* seemed like an odd thing to do because those features had just been individually tested! We now know this to be an opportunity to check the Dirt-Detector Subsystem(s).

To enter Test-Twelve, the Dirt-Detector Subsystem(s) check, push CLEAN again. Indications from the robot at start of Test-12 will be as follows:

- Two low-pitch tones, plus two higher-pitch tones will be sounded (_ _ ^ ^).
- STATUS will be dark,
- POWER-button color will be a steady-ON, RED illumination,
- DIRT-DETECT will flash two long and one short pulses (— — ••) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

Wheels and Main Brushes will be rotating during this test. Wheels rotate at a slow forward speed, a speed that is approximately 25% of the wheel-speed you saw in Test-9.

Since the Main-Brushes and both Drive-Wheels are driven, the test was apparently planned to be performed by arranging for Roomba to run over some testing grit (perhaps a small amount of kitty-litter) spread out on a floor.

When tested by that process, both SPOT-and CLEAN-buttons should light, to indicate proper operation. Alternatively, you may, with the brushes removed, tap on a dirt detector with a light-weight rod -- such as a capped ball-point pen. The individual stimuli will cause SPOT to briefly light in response to left-side dirt-detector stimulus, or CLEAN - for the right-side detector. [Rev.\[8\]](#)

FYI: The particle-sensor(s) are located just above the Main-Brushes. They are (or 'it is...', in newer Discoverys) the penny-size, brass, disc-shaped item(s).

Test-Thirteen: VACUUM-IMPELLER-MOTOR CHECK

To enter Test-Thirteen, the Impeller-Motor subsystem check, push CLEAN again. Indications from the robot at start of Test-13 will be as follows:

- Two low-tones and three high-tones will be sounded (_ _ ^ ^ ^).
- STATUS will be GREEN,
- POWER-button color will be a steady-ON, RED illumination,
- DIRT-DETECT will flash two long and three short pulses (— — •••) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

Vacuum impeller spins, and air-flow can be felt at Disco's rear.

It is rare for that not to happen; however, if there is no sound of a motor running, first look for a poor electrical connection of Bin-assembly to robot. The motor and its electronic driver are not known as failure points. If the motor runs but moves little air, the impeller may be debris-bound, or the motor-shaft bearing next to the impeller may need lubrication. Bearing "lubrication" is not feasible for most owners to accomplish. If debris is slowing the motor, partial Bin-disassembly and the use of forceps may cure the fault. If that was the problem, remember to not operate Roomba without its paper-filter installed!

Test-Fourteen: SPINNING-EDGE-BRUSH-MOTOR CHECK

To enter Test-Fourteen, the Edge-Brush-Motor subsystem check, push CLEAN again. Indications from the robot at start of Test-14 will be as follows:

- Two low-pitch, plus four higher-pitch tones will be sounded (_ _ ^ ^ ^ ^).
- STATUS will be GREEN,
- POWER-button color will be a steady-ON, RED illumination,
- DIRT-DETECT will flash two long and four short pulses (— — ••••) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

The Spinning Edge-Brush should rotate. The hand of rotation should be anti-clockwise when viewed from above Roomba. If this mechanism is running slower than nominal, or has indicated an over-current condition, the problem is usually fixed by dismounting the Edge-Brush then unwinding long hairs which have wrapped around the short section of round-shafting, located between the inner- end of the hexagonal adapter-shaft and the plastic gear-housing.

Test-Fourteen is the last test you will likely find useful to perform. You may simply set Disco OFF by pressing the Power button. You may, instead, run through the remaining seven steps to reach the turn-around point. If the latter is your choice, push CLEAN again, the motor will stop, and you will be paused at Test-15 (the DIRT-DETECT LED will be flashing three long (— — —), and the STATUS LED will be RED). Its still your choice to set power OFF at any time, or continue through what is now known to be tests of the robot's readiness to charge a battery. In this version of the Procedure, these final tests are far from completely defined.

SEVEN PARTIALLY UNDERSTOOD EXAMINATIONS

In previous versions of this procedure we had no clue about what was supposed to happen at each of the next seven stopping points. However, as a result of iRobot opening the Serial Command Interface to hackers, most of the 22 (0 to 21) diagnostic positions are well enough defined to permit their use, but the following seven test are not well enough understood to make them fully useful to the 'uninitiated' (us!).

The next six operations pertain to battery-charging, and are split into two, similar, sets. The first three, #15, #16, and #17, apply to battery-charging via the robot's right-rear, coaxial charging-jack; and the next three (#18, #19, and #20) work similarly, but with the Fast-Charger plus Home-Base combination applied to Discovery's underside-contacts.

NOTE: To get full benefit from these charging-tests, you should do them using a battery that has been discharged sufficiently to cause a Roomba to begin charging it. IOW, your Disco should have indicated that its battery needs charging.

In this version, we provide what is known about required actions and the robot's response at each step, but recognize there to be missing elements. These six tests may be viewed as 'coming attractions' -- perhaps someone will be stimulated to flesh them out fully and then share the information with us.

Test-Fifteen: CONNECT CHARGING P-S TO CHARGING-JACK, AND VERIFY VOLTAGE

[Rev.\[8\]](#)

It's likely that you have already pressed CLEAN to stop the Edge-Brush motor. If so, the robot is paused in Test 15. The audio announcement will have played, but the visible items in this status list may still be checked:

- Three low-pitch tones will have sounded (_ _ _), or be sounded if the Edge-Brush is still rotating, and CLEAN is pressed.
- STATUS will be RED,
- POWER-button color will be a steady-ON, RED illumination,
- SPOT will be dark,
- DIRT-DETECT will flash three long pulses (— — —) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

This step is a preparatory "PAUSE" followed by a "TEST". It first provides an opportunity to connect a charging power-supply (either the 7-hour wall-wart charger, or a Fast-Charger) to the robot under test. It then shows you if charging voltage has been sensed by the robot.

Do the charger set-up work now. [I like to de-power the charging power supply before mating its output connector to Disco's rear jack].

Then, upon powering the charging-supply, Disco's SPOT-button will light to confirm that an acceptable dc-voltage level is being presented to the robot. [As a side-test, if I then un-plug the source from the mains, SPOT should go dark, saying 'there is no charging voltage being detected inside the robot'; after that check, I re-connect the source to the mains so Disco is ready for Test-16.]

With an energized charger connected to the robot's rear jack, the SPOT LED will be ON, and that may be taken as an invitation to advance to the charging-sensor test, Test-16.

Test-Sixteen: VERIFY SENSING OF CHARGING-CURRENT LEVEL (REAR-JACK)

[Rev.\[8\]](#)

Step-15 is prerequisite to this test. Prior to pressing CLEAN, you must be ready to observe the light-pattern from the SPOT-LED since the pattern is displayed only once.

When ready to do Test-16, press CLEAN (you should then hear three low-pitch beeps, and one beep of higher-pitch (_ _ _ ^)).

We believe the following SPOT-LED activity indicates the robot has again sensed a useable charging voltage: IF, after the CLEAN-button press, SPOT's LED quickly cycles through OFF/ON/OFF/and ON, to then remain ON -- seems to be an indication of voltage-acceptance (since the same display occurs when no charging 'current' exists).

That 'report' is with a known functional charger, and a functional battery (no matter whether it needs charging, or not).

However, IF charging-current IS switched ON (because the battery needs some charge, and because Disco's charging-circuit is healthy), the STATUS-indicator will change as shown in the following list.

After allowing Test-16 to complete, the panel LED states will be these:

- STATUS will remain RED if no charging current has been switched through by the MCU, however, IF the battery requires charging, and the MCU commands charging to take place, GREEN will be indicated.
- POWER-button color will be a steady-ON, RED illumination,
- SPOT's LED will be steady GREEN,
- DIRT-DETECT will flash three long and one short pulses (— — — •) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

If STATUS has turned GREEN, the battery is actually under charge. You may verify that (if using a Fast-Charger) by remaining in Test-16 for, say, an hour, then, either: a) place your hand on Disco's top-cover (right on the Roomba logo) to feel how the warm battery has heated the case, or b) disconnect the FC, switch-OFF Disco, invert it and feel the warmth of the battery.

CAUTION: There has been no indication that the MCU will automatically stop high-rate charging, and drop into trickle-charging while in this self-test. Therefore, it may be wise to limit the total time spent in this test to that which inversely corresponds to the known state of charge in the battery, and which may be taking in *more* charge now. IOW, if the robot had indicated a re-charge was needed, then you could remain in Test-16 for a couple hours (given that a Fast-Charger is connected); but, OTOH, if Disco was taken fresh out of the completion of a charging situation -- the battery requires no additional charge -- the time spent in Test-16 should be minimized.

Test-Seventeen: VERIFY SENSING OF TRICKLE-CURRENT LEVEL (REAR JACK)

[Rev.\[8\]](#)

Step-15 is prerequisite to this test. Prior to pressing CLEAN, you must be ready to observe the light-pattern from the SPOT-LED since the pattern is displayed only once.

When ready to continue, press CLEAN (three low-pitch beeps, and two of higher-pitch will be sounded (_ _ _ ^ ^)).

We believe the following SPOT-LED activity indicates the robot continues to sense an acceptable trickle-charging voltage: IF, after the CLEAN-button press, SPOT's LED quickly goes OFF/ON/OFF and ON, to then remain ON -- seems to be an indication of voltage-acceptance (since the same display occurs when no charging 'current' exists).

That 'report' is with a known functional charger, and a functional battery that has been quickly transferred from a Rapid-Charger's trickle-charging.

After allowing Test-17 to complete, the panel LED states will be these:

- STATUS will be GREEN if the MCU senses the state of battery charge (battery-temperature may play a part too) is such that trickle-charging should begin, otherwise it will be RED,
- POWER-button color will be a steady-ON, RED illumination,
- SPOT's LED will be GREEN if trickle-charging-current is proper, but dark otherwise,
- DIRT-DETECT will flash three long and two short pulses (— — — ••) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

Test-Eighteen: SET UP HOME-BASE FOR CHARGING, AND VERIFY VOLTAGE

[Rev.\[8\]](#)

To enter step-Eighteen, a preparation pause and charging-voltage check, push CLEAN again. Indications from the robot at this time will be as follows:

- Three low-pitch beeps plus three of higher-pitch will be sounded (_ _ _ ^ ^ ^).
- STATUS will be RED,
- POWER-button color will be a steady-ON, RED illumination,
- DIRT-DETECT will flash three long and three short pulses (— — — •••) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

Operations are now paused to provide an opportunity to connect a Fast-Charger to a Home Base, (HB), to contact the robot-under-test to the HB's charging contacts, and to energize the charging system.

If interested in doing this test, and the next two, do that preparation. [I like to de-power the Fast-Charger, (FC), then manually manipulate Disco into an emulated docked-position -- docked as accurately as an automatic-docking does -- then re-connect the FC to 120VAC.

Upon powering the FC, Disco's SPOT-button will light to confirm that an acceptable level of dc-voltage is being presented to the robot. As a side-test, if I then un-plug the FC from the mains, SPOT should go dark, saying 'there is no charging voltage being detected inside the bot'; after that check, I re-power the FC to make the accessories ready for Test-19.]

Test-Nineteen: VERIFY SENSING OF CHARGING-CURRENT LEVEL (HOME BASE)

[Rev.\[8\]](#)

Step-18 is prerequisite to this test. Prior to pressing CLEAN, you must be ready to observe the light-pattern from the SPOT-LED since the pattern is displayed only once.

When ready to continue, press CLEAN (three low-pitch beeps, and four of higher-pitch will be sounded (_ _ _ ^ ^ ^ ^)).

We believe the following SPOT-LED activity indicates the robot has sensed a useable charging voltage: IF, after the CLEAN-button press, SPOT's LED quickly cycles through OFF/ON/OFF/and ON, to then remain ON -- seems to be an indication of voltage-acceptance (since the same display occurs when no charging 'current' exists).

That 'report' is with a known functional charger, functional Home-Base, and a functional battery (no matter whether it needs charging, or not).

After allowing Test-19 to complete, the panel LED states will be these:

- STATUS will remain RED if no charging current has been switched through by the MCU, however, IF the battery requires charging, and the MCU commands charging to take place, GREEN will be indicated.
- POWER-button color will be a steady-ON, RED illumination,
- SPOT-button color will be a steady-ON, GREEN illumination,
- DIRT-DETECT will flash three long and four short pulses (— — — ••••) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

If STATUS has turned GREEN, the battery is actually under charge. You may verify that by remaining in Test-19 for an hour, then, either: a) place your hand on Disco's top-cover (right on the Roomba logo) to feel how the warm battery has heated the case, or b) disconnect the FC, switch-OFF Disco, invert it and feel the warmth of the battery.

CAUTION: There has been no indication that the MCU will automatically stop high-rate charging, and drop into trickle-charging while in this self-test. Therefore, it may be wise to limit the total time spent in this test to that which inversely corresponds to the known state of charge in the battery, and which may be taking in *more* charge now. IOW, if the robot had indicated a re-charge was needed, then you could remain in Test-19 for a couple hours (given that a Fast-Charger is connected); but, OTOH, if Disco was taken fresh out of the completion of a charging situation -- the battery requires no additional charge -- the time spent in Test-19 should be minimized.

Test-Twenty: VERIFY SENSING OF TRICKLE-CURRENT LEVEL (HOME BASE)[Rev.\[8\]](#)

Step-18 is prerequisite to this test. Prior to pressing CLEAN, you must be ready to observe the light-pattern from the SPOT-LED since the pattern is displayed only once.

When ready to continue, press CLEAN (four low-pitch tones will be sounded (_ _ _ _)).

We believe the following SPOT-LED activity indicates the robot has sensed an acceptable charging voltage: IF, after the CLEAN-button press, SPOT's LED quickly cycles through OFF/ON/OFF/and ON, to then remain ON -- seems to be an indication of voltage-acceptance (since the same display occurs when no charging 'current' is switched ON).

That 'report' is with a known functional charger and functional Home-Base, and a functional battery that has been pulled from a Rapid-Charger's trickle-charging. We don't know, as yet, what indications might be given when the Discovery's systems fails to read an acceptable current.

After allowing Test-20 to complete, the panel LED states will be these:

- STATUS will be GREEN if the MCU senses the state of battery charge (battery- temperature may play a part too) is such that trickle-charging should begin, otherwise it will be RED.
- POWER-button color will be a steady-ON, RED illumination,
- SPOT's LED will be GREEN if trickle-charging-current is proper, but dark otherwise,
- DIRT-DETECT will flash four long pulses (— — — —) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

When finished checking battery-charging functions, it is preferable to disconnect the Fast Charger from AC-power, and then separate Roomba from its charging apparatus. Note that if an attempt is made to shut off Roomba power while the charging power supply is providing power to the system, the unit will not shut off. [Rev. \[9\]](#)

Test Twenty-One: BOOTLOADER CHECK

Press CLEAN and the robot will be doing the final test. As far as is known, this one is not an interactive operation. There will be no indications to suggest what may be going on. It must be assumed that the "bootloader" check is done internally, and one must sample the SCI data stream (a task that is not within the scope of this procedure) to see its status. Upon accessing this test position, the robot's audio-output and status of panel LEDs will be as follows:

- Four low-pitch and one higher-pitch tones will be sounded (_ _ _ _ ^),
- STATUS will be dark,
- POWER-button color will be a steady-ON, RED illumination,
- SPOT's LED will be steady ON,
- DIRT-DETECT will flash five long pulses (— — — — •) of blue-light, a sequence which then repeats at about four-second (4s) intervals.

As with the other incomplete 'tests', if anyone has information to share about this one, please advise.

One more press of CLEAN returns you to [Test-Zero!](#)

If POWER is pressed, Roomba-power will shut OFF, thus exiting Diagnostics Mode. NOTE: This "clean exit" is dependent on having been given the proper entry [acknowledgement](#), described upon entry into the 'Process the Tests' section. If the Power button is flashing-RED at this point, there is no escape other than to do a battery-disconnect.

===== **END OF DIAGNOSTICS** =====

REVISION HISTORY

- [1] 041122: In the Yahoo [RoombaUsers](#) Group message #5071, Trudy Hagain reported discovering how to access the diagnostics tests and listed many of them.
- [2] 041122: Barbara Needham provided updates to the list of Disco-Diagnostics -- resulting in the most complete Discovery Diagnostics Instructions to date (RoombaUsers message #5076).
- [3] 041122: Gordon transformed Trudy's and Barbara's diagnostic-test notes into more of a *procedure* format and posted the draft to the RoombaUsers members in message #5081.
- [4] 050117: Gordon was able to run diagnostics on a #4210-Discovery, and then correct some existing errors in the e-mail versions. That version was then transformed into an html-formatted Diagnostic Test Procedure. Version v.0.0 was up-loaded to the Yahoo Files directory, and its availability was announced in RoombaUsers message #6179.
- [5] 050118: Roger Crier described the Front-Wheel's rotation indicator (RoombaUsers message #6227). In a second message on the same date, Roger pointed out that diagnostics may be exited almost anytime by pressing POWER (RoombaUsers message #6234). The document was updated to v.0.1 to incorporate the new information.
- [6] 050615: Updated procedure to v.0.2, with minor corrections to text, and a minor technical adjustment (In v.0.1 the Front-Wheel's rotation indicator was stated to be ON (switch closed) for 90° of wheel rotation. It is ON for more like 115±15°). and then relocated the file to [Gordon's site](#), to bypass the member-requirement at the Yahoo site.
- [7] 060402: Updated procedure to v.0.3, by adding the following:
- a statement to indicate this procedure should work well with newer Discovery models (e.g., Pink, or Scheduler);
 - a qualifier regarding test results from an OSMO-treated Disco;
 - a hint to use a digital camera to test Cliff-LED's IR-emittance;
 - orientation information for LEDs and detectors in Cliff-modules;
 - comments about relative drive-wheel rotation rates in various wheel-tests;
 - more detail about the flashing of SPOT and CLEAN in test (5-c);
 - reasons which prevent SPOT and CLEAN to modulate during test (5-c); and
 - emphasis of the practice of applying mechanical loading to the main-brushes when their motor and drive-train are under test.
- [8] 060701: Updated procedure to v.0.4 to incorporate diagnostic discoveries found and fleshed out by Howard Busch, a [RoombaReview](#) member.
- Those "fleshed out" are Tests five, six and twelve; while those still under development are Tests-15 through -21.
 - Test-numbers were corrected in this version to correspond to the "factory test" numbering recently revealed in SCI data listings.
 - Fixed beep codes and dirt detect test number indicators. They are counting the test numbers in base-5. Both the beeps & Dirt-Detect indicate the same number.
 - Added PASS / FAIL indications which Discovery provides for many tests via its STATUS and / or SPOT LEDs.
 - In addition, the format of each test-module has been homogenized, and portions have been edited in an attempt to clarify.
- [9] 070114: Updated procedure to correct a few typos clarify a few statements.
- [10] 070128: Updated procedure to include the 'Warranty Revocation Warning', and to modify the DISCLAIMER to reflect a concern about overloading and causing unintended damage to a robot while it is in diagnostic test mode. A warning about applications of uncontrolled mechanical loads to running motors was inserted prior to the motors-testing section.
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