

Service  
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Philips Consumer Lifestyle

# Service Manual

## PRODUCT INFORMATION

- This product meets the requirements regarding interference suppression on radio and TV.
- After the product has been repaired, it should function properly and has to meet the safety requirements as officially laid down at this moment.

## TECHNICAL INFORMATION

- Colour : Oyster Metallic/Lime Yellow
- Power source : Lithium Ion Battery  
14.8 V / 2200 mAh
- Power Normal mode : 50 W  
Turbo mode : 65 W
- Charger AC / DC : 19 V DC / 3.16 A
- Charging time : 180 min
- Run time : 90 - 110 min
- Timer : 24 h
- Moving speed : 30 cm/sec
- Sensors : Bumper/lifting/Wheel Encoder/  
IR/gyro/camera
- Navigation method : Systematic mapping
- Remote control : Infrared Method
- Filter system : Mesh filter  
Exhaust filter  
Motor protection filter
- Dustbin capacity : 0.6 L
- Sound level : <73 dB
- Size : 345 x 104 mm
- Net weight : 6.8 Kg

## ACCESSORIES

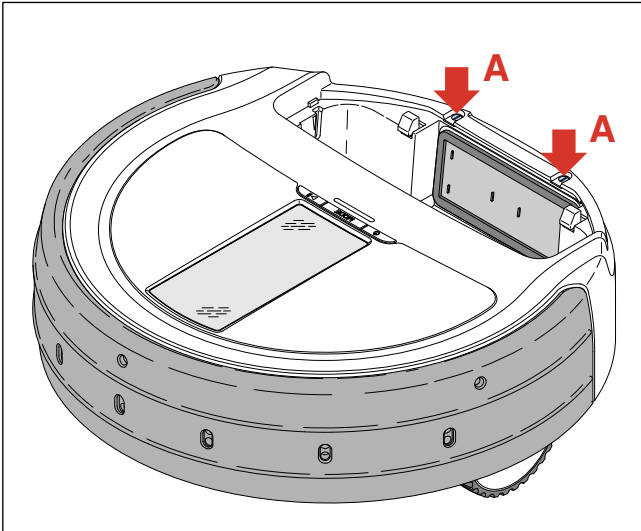
- Roller brush : 4222 459 48121
- Side brush set (L+R) : 4222 459 48131
- Lithium Ion battery : 4222 459 48141

## OPTIONAL (accessories)

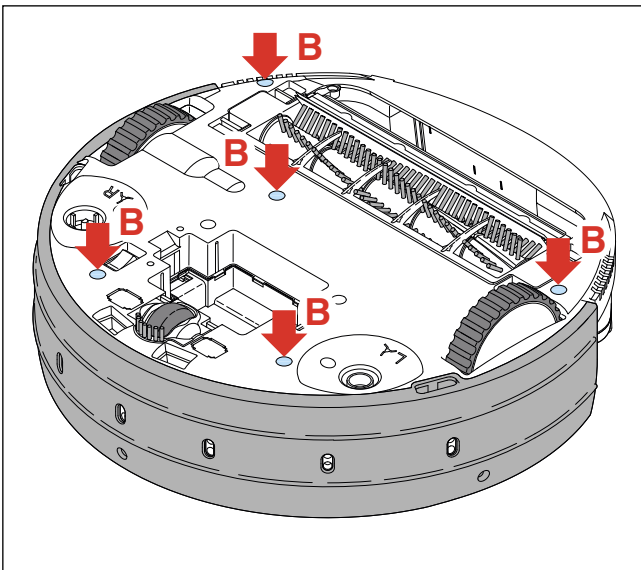
- No specific issues.

When the built-in diagnostics leads to the need to check the appliance internally, please follow below steps to bring the appliance to a service position.

- Before opening the appliance, first remove the dustbin cover (3) and dustbin assembly (5-8).
- Remove the two screws (A) in the top cover, see picture below:



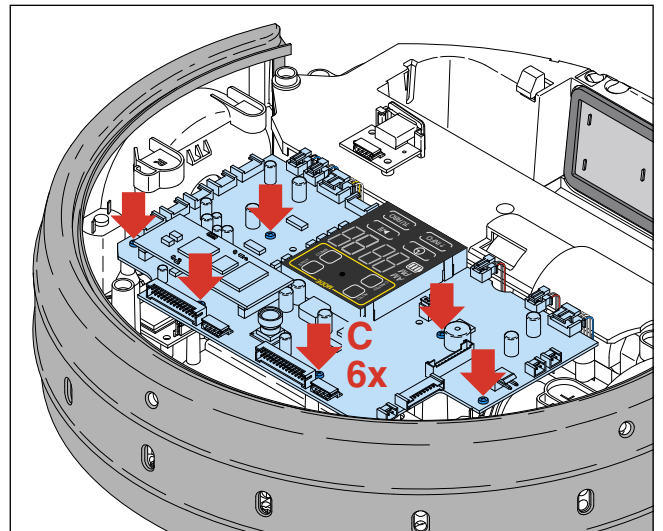
- Turn the appliance upside down on a clean protective mat or sheet to prevent scratches to the top cover.
- Switch the appliance off with the main switch at the bottom of the appliance.
- Remove the battery (12)!
- Remove the side brushes (11).
- Remove the 5 screws (B) as indicated in below picture (one screw is located underneath the QC sticker):



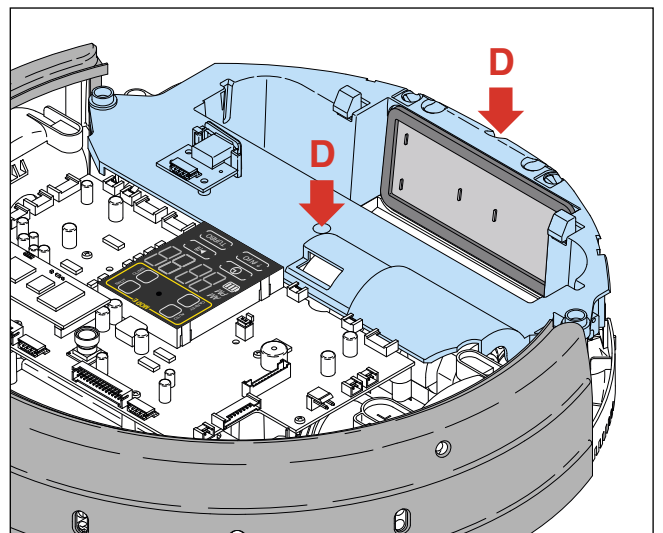
- Turn the appliance around again and remove the upper cover (18), take care of unplugging the button interface cable (20) from the main board! Do not forget to reconnect the interface cable to the main board when re-assembling the upper housing!

*Note: When there is no need to disassemble the bumper assy, please leave it in place as the wiring routing is quite complex, and would result in unnecessary time spent, as all mechanical components can be reached when only the main PCB is removed.*

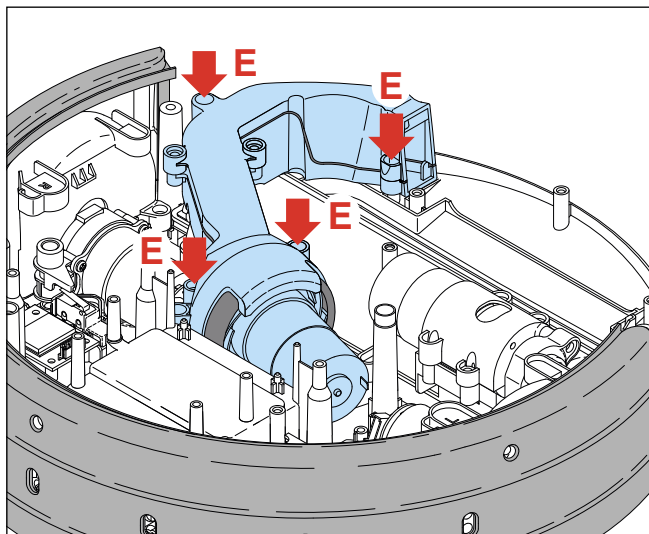
- Undo all connectors from the main board, apart from the connectors connecting to the bumper assy (J7, J11, J14 and J202). Unscrew the 6 screws (C) indicated in the picture below. You can now flip the main PCB (25) over, to the front, and access all internal components. Please mind the main PCB when servicing any part of the appliance, as it is a sensitive piece of electronics.



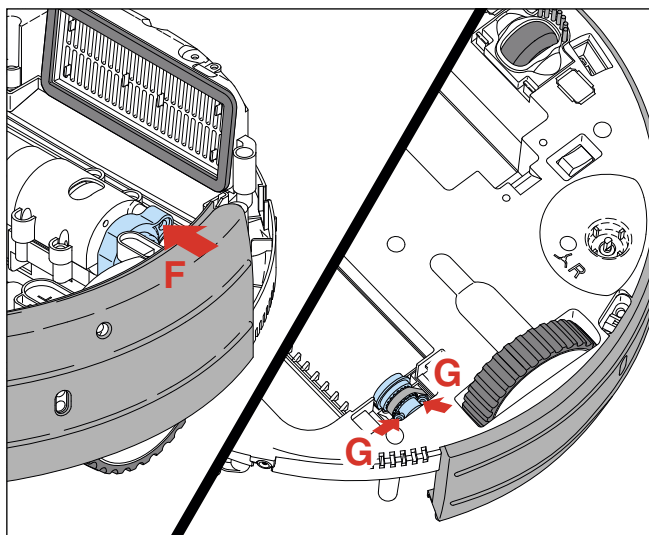
- When access to the Roller Brush motor (31) or Vacuum motor (26) is required, please remove the two screws (D) holding the Cover Middle assy (23) in place. And remove the Cover Middle assy, see picture below.



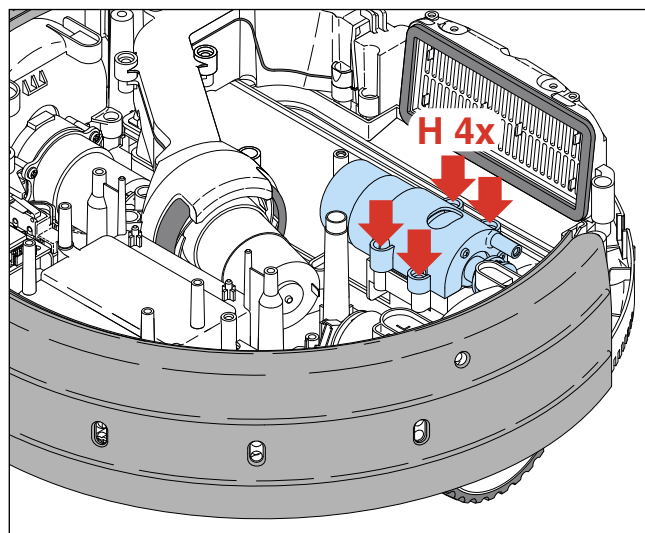
- To remove the Vacuum motor including suction tube remove the 4 screws (E) as indicated in the picture below. Be careful not to damage the Case Duct Filter (30).



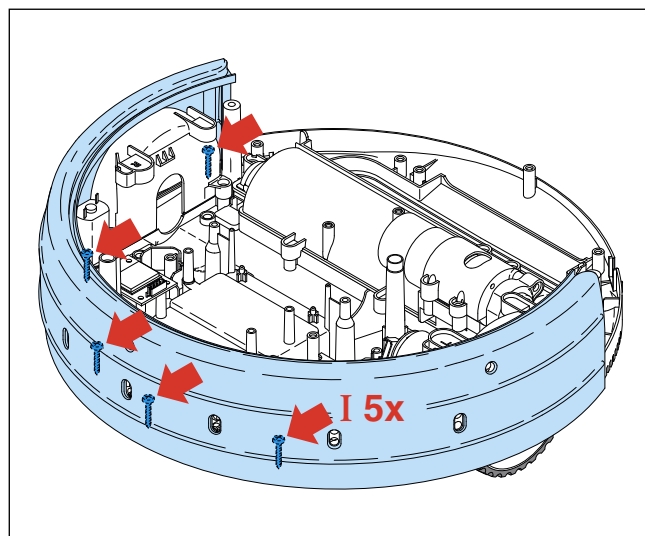
- To replace the brush belt (36), unscrew the screw (F) holding the protective cap covering the brush belt in place. You should be able to unscrew screw F without removing the Bumper assy. Turn the appliance upside down, remove the Brush retainer (17) and Roller Brush (16), unscrew the two screws (G) holding the Pulley Main Brush assy (38) in place. You can now remove the brush pulley and brush belt.



- To remove the Brush Motor assy (31) unscrew the screw (F) holding the protective cap covering the brush belt in place. Unscrew the four screws (H) holding the Brush Motor assy in place. By lifting the back side of the Brush Motor assy you slacken the tension on the Brush Belt, and you can slide the Brush Motor assy out. Make sure that you transfer both halves of the motor pulley and the C-clip to the new motor correctly, noting the original orientation (Motor, toothless part, toothed part, C-clip).



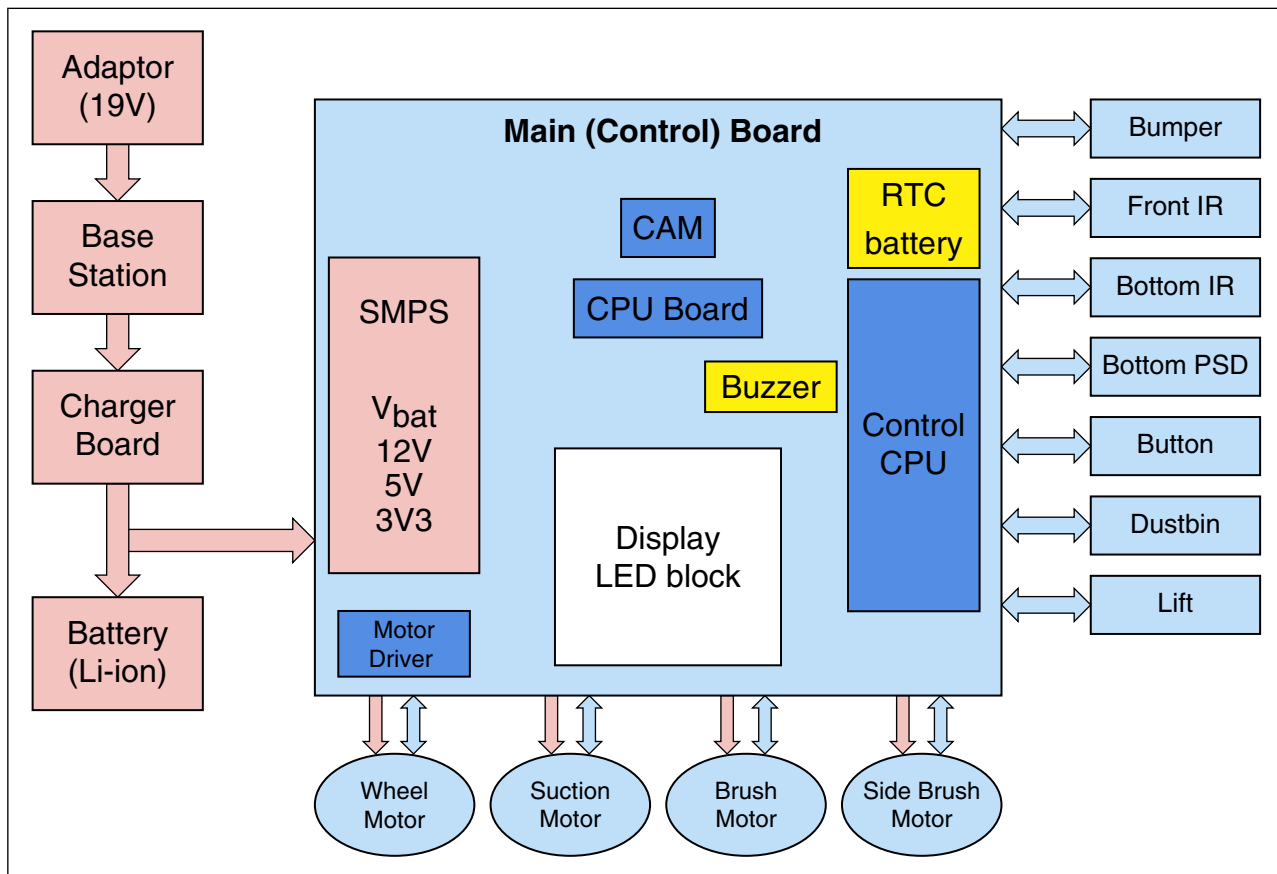
- To remove the Bumper assy, first undo the four remaining connectors from the main PCB (J7, J11, J14 and J202) put the main PCB aside. Unscrew the 5 screws (I) holding the bumper assy in place, as indicated in below picture. When removing the Bumper assy, take special notice of the correct wiring of the different sensors, as the alignment of the sensors is critical to the functioning of the appliance.



- To remove either of the two main driven wheel assy's, unscrew the two screws (J) holding the assy in place, and remove the wheel assy. The protective plastic cap, sliding axles and spring may become displaced, as they are not (permanently) fixed to the assy. Please notice the location of the spring around the front sliding axle, when reinstalling the wheel assy. Always check the correct position of the wheel assy with respect to the Lifting Sensor assy (33) on either side, make sure, when extended, it actuates the switch.
- When the repair is finished, check whether all functions of the appliance work properly by running the built-in diagnostics, confirming the functionality of all sensors and motors. When everything works ok, perform a Sensor Calibration and perform a quick functional test.

System configuration:

HomeRun Block diagram



- The main board consists of the Power supply, CPU-board, Real Time Clock, Motor drivers, Display and Camera unit and thus is controlling the whole system with regard to input/output processing, motor operation and others.
- The charging board charges the battery with the electrical source supplied from the 19 V mains adaptor and also gives input to the control board regarding battery condition.
- The User interface board contains the interface buttons. It also contains the Remote control reception device.
- 6 motors are used in the Robot body:  
2 wheel motors, 1 main brush motor, 2 side brush motors and 1 vacuum motor.

#### Sensors

- The **Bumper sensor** exists of an outer carbon rubber that makes contact with an inner patterned film when colliding. It is divided in 6 different contact areas, four at the front and two at the front upper side.
- The **Front IR sensors** are placed to detect obstructions without contacting, in addition to above bumper sensor. A total of 7 IR sensors are mounted for this function.
- The **Ground Detection IR sensors** are placed in the bottom to detect there is a "precipice"
- **Wheel Lift Detection sensors** are located on both wheels to detect if a wheel is raised.
- A **Dustbin Detection sensor** is mounted to detect dustbin is in place.
- A **Camera unit** at the top cover is used for mapping the room by means of the sealing/wall structure.
- A **Passive Encoder** is attached to the front wheel to measure the travel distance.
- A **Gyro sensor** is mounted to measure the rotation angle.

## Software upgrade

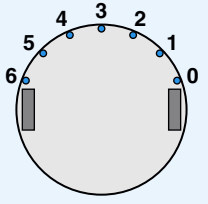
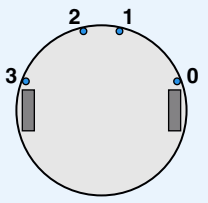
- The firmware and application software can be upgraded via a USB port situated under the dust container cover using a USB-flash drive.
- Check [www.philips.com/support](http://www.philips.com/support) or [www.atyourservice.ce.philips.com](http://www.atyourservice.ce.philips.com) regularly for updates. There you can also find the instructions how to upload the new software to the robot and the issues it will solve!
- Diagnostics and troubleshooting
- Display Error codes:

Error code	Error description	Presumption cause	Possible solution
E0	Rechargeable Battery is empty	Battery was discharged completely	Charge the battery
		Battery or Main board failure	Replace the Battery/Main board
E1	Wheel lifted	Movement of wheel is not smooth	Replace the wheel module
E2	Floor detection error	Ground blocked with dirt sensor	Clean the ground sensor
		Ground sensor defect	Replace ground sensor
E3	Dust container error	Dustbin detection sensor defect	Replace the Cover middle assy
E4	Wheel motor overload	Wheel blocked with dirt/hair	Remove the dirt/hair
		Gearbox or motor defect	Replace the wheel/motor/gear assy
		Driver or overload circuit defect	Replace the main board
E5	Brush motor overload	Brush blocked with dirt/hair	Remove the dirt/hair
		Brush motor/gear defect	Replace brush motor
		Driver or overload circuit defect	Replace main board
E6	Suction motor overload	Clogged filter	Clean the motor filter
		Suction motor defect	Replace suction motor incl. air tube
		Driver or overload circuit defect	Replace main board
E7	Inner system error	Software error	Reset with main on/off switch, check for firmware upgrades
E8	Dust stuck on front wheel	Dirt/hair in wheel case	Remove the front wheel and clean it

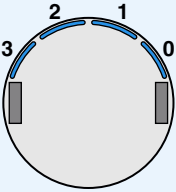
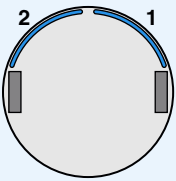
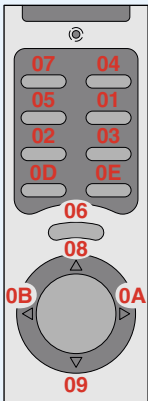
## Built-in Self Diagnostics program

- At the ready status (power and display is on), press both [MODE] and [start ►] button simultaneously for 3 seconds to start the self diagnose program. As soon as the program starts vEr will appear in the display. When pressing the [MODE] button the diagnose item will change order and pressing the [start ►] button it starts execution of the selected item.

- Below diagnose items are available:

Quick start guide diagnose program						
Press [MODE] and [►] button for 3 seconds						
Step	Display	Test item	Displays after execution	Action	Possible deviation	Possible cause of deviation
1	vEr	Application version	Application version	Check version	Older version	Not upgraded
2	FuEr	Firmware version	Firmware version	Check version	Older version	Not upgraded
3	HuEr	Hardware version	Hardware version	Check version	N.A.	N.A
4	An	Gyrosensor	0-359 degrees	Turn appliance around	No reaction/wrong reading	Gyrosensor board or CPU board faulty
5	PE	Frontwheel encoder	Travel distance in mm	Manually turn front wheel	No reaction when turning the wheel	Encoder defect Wheel Magnetic faulty
6	rUn	Wheel motors	Fo→bA→Fo etc.	Moves 4sec forward/ 4 sec backwards etc.	Does not move, move straight/only <b>one</b> wheel moves	Driver defect/Wheel motor defect
7	brU	Brush motors	brU	Main brush and sidebrushes rotate	One of the brushes does not rotate	Motor defect/main brush belt broken
8	vAC	Vacuum motor	vAC	Vacuum motor on	Vacuum motor does not rotate	Vacuum motor defect
9	PSdC	Drop-off sensor calibration	See Chapter "Calibration of PSD Drop-off sensors" !			
10	PSdr	Drop-off sensor readings	See Chapter "Calibration of PSD Drop-off sensors" !			
11	FrIr	Front IR sensors	Blocking each separate sensor (10 cm distance) should result in a change of the display. 	Check each of the 6 separate front IR sensors by blocking them by hand.	No reaction to <b>one</b> sensor/no reaction at all	Defect sensor/defect main board
12	boIr	Bottom IR sensors	Blocking each sensor (4 cm distance) should result in a change of the display. 	Check each of the 4 separate bottom IR sensors by blocking them by hand.	No reaction to <b>one</b> sensor/no reaction at all	Defect IR sensor/ defect main board



Step	Display	Test item	Displays after execution	Action	Possible deviation	Possible cause of deviation
13	bU	Front bumper sensors	<p>Push the 4 bumper areas as indicated below, this should result in a change of the display.</p> 	Check each of the 4 separate front bumper sensors by pushing them by hand.	No reaction to <b>one</b> sensor/no reaction at all	Defect bumper sensor/defect main board
14	tbU	Upper bumper sensors	<p>Push the 2 bumper areas at the top of the appliance as indicated below, this should result in a change of the display.</p> 	Check each of the 2 separate top bumper sensors by pushing them by hand.	No reaction to <b>one</b> sensor/no reaction at all	Defect bumper sensor/defect main board
15	doIr	Docking IR sensor	<p>Left two digits reflect the reception of the IR signal from the docking station for the two IR sensors at the left and right side. Right two digits deflect the reception of the middle sensor.</p>	Turn the appliance in front of the docking station and rotate it to check reception of the two sensors.	No reaction to <b>one</b> sensor/no reaction at all/no reading at all	IR sensor defect/docking station transmitter defect
16	rE	Remote control IR sensor	<p>Each button of the remote control reflects a Hexadecimal code on the display.</p> 	Push each button of the remote control and check the display for the correct code.	No reaction to <b>one</b> button/no reaction at all	Remote control defect/battery of the remote empty/remote receiver defect
17	dUSt	Dustbin detection sensor	<p>When detecting the dustbin "1" is displayed. If dustbin is not present "0" is displayed.</p>	Remove and place the dustbin.	No reaction	Dustbin detector defect/dustbin somehow does not actuate the detector
18	tACt	Wheel lift sensors	<p>Last two digits reflect the condition of the two wheel lift sensors: Wheel lifted will result in "1"</p>	Lift the robot at both sides separately to check the sensors.	No reaction to lifting <b>one</b> of the wheels/both of the wheels	Wheel lift sensor defect/Mechanical defect

Step	Display	Test item	Displays after execution	Action	Possible deviation	Possible cause of deviation
19	CHAr	Battery charging condition	"07" for not charging, "01" for charging and "00" for fully charged. The left digit of the display shows the availability of the charger: "0" charger not present, "1" charger present.	Connect the charger to the charging jack and check if appliance switches to the correct condition.	No reaction connecting the charger	19 V charger defect/ charging board defect
20	bAtt	Battery voltage	Battery voltage in tenths of volts	Check battery voltage (also during charging)	Battery voltage low and does not rise during charging	Battery defect/charger defect
21	rtC	Real Time Clock	0-599	Check counter 0-599 in 59,9 seconds	No counting	CPU board defect
22	boLE	Bottom IR sensor threshold	50	<b>Factory setting, do not change unless official notification of change is released!!</b>		
23	FrLE	Front IR sensor threshold	100	<b>Factory setting, do not change unless official notification of change is released!!</b>		
24	Led	Display test	All digits	Check all digits are lit	Digits that are not lit	Defect main board



## Troubleshooter:

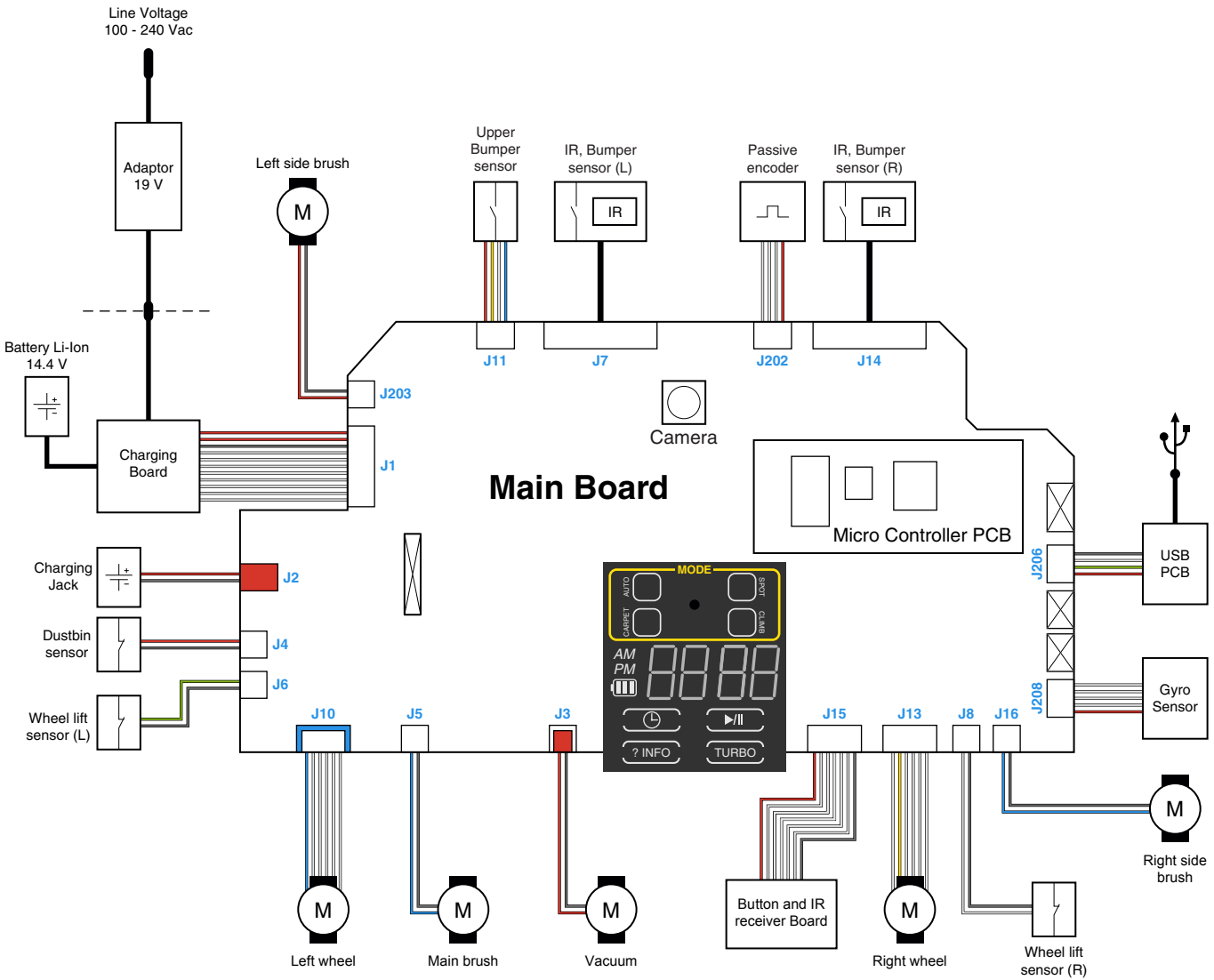
Troubleshooting tips when after Self Diagnosis the root cause is still inconclusive.

Symptom	Problem Area	Problem Area
1. The robot keeps colliding with objects in the room, and doesn't try to avoid them after collision. Also, during movement, the robot regularly touches obstacles with its bumper.	a. The mounting of the IR sensors in the bumper may be faulty or incorrect. b. The assembly of the Bumper Sensors (Stretched Film type) may be at fault.	<ul style="list-style-type: none"> <li>Please check the mounting of the IR sensors and the functionality of the IR Bumper Sensors using the built-in diagnostics. Replace the Bumper assy if necessary.</li> </ul>
2. During operation the robot stops with error message E2.	a. Foreign objects or dust/debris block the opening of the Ground Detection Sensors. b. The Ground Detection Sensors may be faulty.	<ul style="list-style-type: none"> <li>When the unit is still not operating as it should after cleaning of the Ground Detection Sensor, first replace the Bumper assy, when that doesn't solve the problem, replace the Main PCB.</li> </ul>
3. The robot falls down a step or the stairs.	a. Foreign objects or dust/debris block the opening of the Ground Detection Sensors. b. The Ground Detection Sensors may be faulty. c. The Wheel Lift Detection Sensor(s) may be faulty.	<ul style="list-style-type: none"> <li>When the unit is still not operating as it should, after cleaning of the Ground Detection Sensor, first replace the Bumper assy, when that doesn't solve the problem, replace the Main PCB.</li> </ul>
4. The robot moves at an unusual high pace.	a. The Front Wheel Encoder may be faulty.	<ul style="list-style-type: none"> <li>Check the connection to the Front Wheel Encoder.</li> <li>Check if on the Front Wheel assy the encoder actuator is still present and intact.</li> <li>Replace the Encoder PCB.</li> </ul>
5. The robot doesn't move, only rotates on its original location or deviates from a straight line unexpectedly.	a. The Wheel motor operation may be hindered by foreign materials. b. The Wheel motor(s) may be faulty.	<ul style="list-style-type: none"> <li>Clean any foreign materials from the Wheel assy(s).</li> <li>Replace the Wheel assy if necessary.</li> </ul>
6. The Roller Brush doesn't operate well, all other operation is ok.	a. Foreign objects block the Roller Brush. b. Gearbox failure of the Brush Motor.	<ul style="list-style-type: none"> <li>Clean the Roller Brush.</li> <li>When the Roller Brush still doesn't operate well, replace the Brush Motor assy.</li> </ul>
7. The movement pattern of the robot is irregular in the Spot Cleaning mode.	a. Regularity of the cleaning pattern is hard to maintain on carpet. b. The regularity of the cleaning pattern is hard to maintain when there are too much obstacles in the robot's way. c. The floor or the wheels of the robot may have become slippery, the friction between the wheels of the robot and the floor has become too low.	<ul style="list-style-type: none"> <li>Clean the wheels of the robot.</li> <li>Dry the floor / let the floor dry.</li> <li>Store the obstacles off the floor.</li> </ul>
8. When pressing the power button to operate the appliance, it immediately turns off.	a. The battery power may be low. b. The power cut-off protection may have been activated because of an overload to one of the motors.	<ul style="list-style-type: none"> <li>Make sure the battery is (fully) charged, when the battery power or its capacity remains low, check in order, the battery, the DC jack and the Charging PCB. Replace if necessary.</li> <li>Check all the motors by using the built-in diagnostics, replace any faulty motor assy.</li> </ul>
9. The robot will not power on.	a. The battery is fully discharged or faulty. b. The DC jack or Charging PCB may be faulty	<ul style="list-style-type: none"> <li>Make sure the battery is fully charged, when the battery power or its capacity remains low, check, in order, the battery, the DC jack, the Charging PCB and Main PCB. Replace if necessary.</li> </ul>

Symptom	Problem Area	Problem Area
10. Shortly after operation started the robot stops with error messages E4, E5 or E6 frequently.	a. Foreign objects block the Wheel Motor(s), Roller Brush Motor or the Suction Motor is clogged. b. The Main PCB may be faulty. c. One of the Motors may be faulty.	<ul style="list-style-type: none"> <li>• Check the motors for clogging or foreign objects.</li> <li>• Check whether all motors are fully functional by using the built-in diagnostics. Replace if necessary.</li> <li>• Replace the Main PCB.</li> </ul>
11. The wheels of the robot continue rotating even though robot is being raised from the floor.	a. The Wheel Lift Detection Sensors or its assembly may be faulty. b. The Ground Detection Sensors may be faulty.	<ul style="list-style-type: none"> <li>• Check the Wheel Lift Detection Sensor's functionality by using the built-in diagnostics, replace any of the Wheel assy if necessary.</li> <li>• Check the Ground Detection Sensors functionality, replace the Bumper assy if necessary.</li> </ul>

### Calibration of Ground Detection Sensors

1. Put the robot on a flat white surface (for instance a piece of white paper).
2. Enter the diagnostic mode by pressing both [MODE] and [start ►] button simultaneously for 3 seconds and scroll to PsdC with the [MODE] button.
3. Push [start ►] on the remote controller.
4. The turbo-LED lights up during the calibration process.
5. After calibration is finished check the calibration by scrolling to the next step Psdr with the mode button.
6. Push [start ►] on the remote controller.
7. The left two digits show the left side calibration result and the right two digits the right, each should show a number between 75-85.
8. If (one of) the results is out of range, please repeat step1-7 (be sure the surface is flat!).



Pos	Service code	Description
1	4222 459 48161	Remote control assy
2	4222 459 48151	Docking station assy
3	4222 459 48171	Dustcontainer cover assy
4	4222 459 48231	Cleaning tool
5	4222 459 48271	Filter holder
6	4222 459 48261	Exhaust filter
7	4222 459 48251	Inlet filter mesh
8	4222 459 48241	Dustbin assy
9	4222 459 48191	Adapter 19 V
10	4222 459 48201	Mains cord WE
11	4222 459 48131	Side brush set (left and right)
12	4222 459 48141	Rechargeable Li-Ion battery
13	4222 459 48211	Front wheel assy
14	4222 459 48471	Front wheel cover
15	4222 459 48281	Motor protection filter
16	4222 459 48121	Roller brush
17	4222 459 48221	Brush retainer
18	4222 459 48311	Top cover assy
19	4222 459 48511	Bumper sensor assy
20	4222 459 48301	Interface PCB cable set
21	4222 459 48291	Interface PCB
22	4222 459 48501	USB PCB assy
23	4222 459 48321	Cover middle assy
24	4222 459 52781	Main PCB + CPU PCB
26	4222 459 48351	Suctionmotor incl. air tube assy
27	4222 459 48481	PCB Gyrosensor
28	4222 459 48411	Charger PCB
29	4222 459 48521	Power switch assy
30	4222 459 48531	Case duct filter
31	4222 459 48381	Brush motor assy
32	4222 459 48441	Right wheel incl. motor/gear
33	4222 459 48451	Lifting sensor assy
34	4222 459 48461	Side brush motor assy Right
35	4222 459 48491	Encoder PCB assy
36	4222 459 48401	Brush belt
37	4222 459 48371	Brush shield
38	4222 459 48391	Pulley main brush assy
39	4222 459 48431	Left wheel incl. motor/gear
40	4222 459 48831	Side brush motor assy Left
41	4222 459 52341	Front Wheel Bearing
42	4222 459 52351	Roller Brush Bearing

