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S model Service Guide

- Read this manual carefully before appeal to service the robot.
- It is very important to read and follow all warning and safety instructions written in the Operating and Safety Manual.
- All maintenance procedures and troubleshooting must be carried out exactly as given in this manual.

This book was carefully prepared. However, F. Robotics Acquisitions Ltd. will not bear any responsibility for any errors, mistakes or misunderstandings. F. Robotics Acquisitions Ltd. shall not bear responsibility for any damage resulting from faulty instructions in this manual.

F. Robotics Acquisitions Ltd. reserves the right to introduce changes in the product and/or to this manual without any prior notice.

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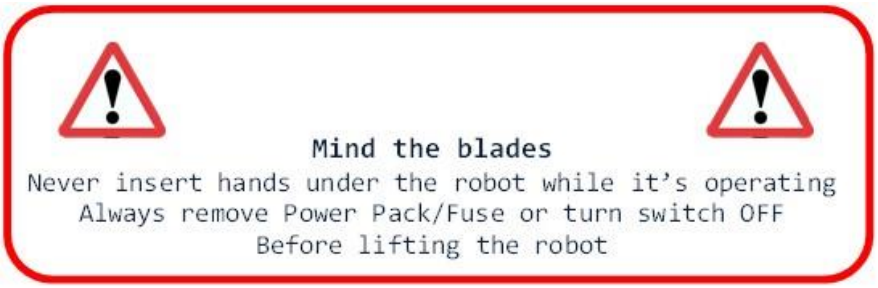

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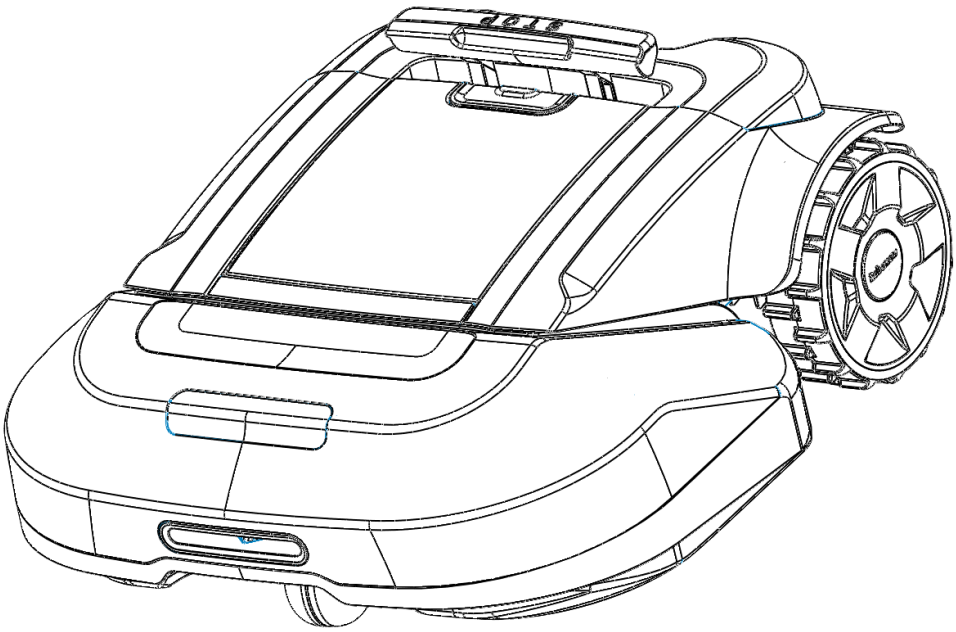
1. S Model Layout & Spare Parts Numbers

This chapter illustrating the RS robot layout, how it is constructed, part numbers and identification of parts.

IMPORTANT NOTE! This manual contains a lot of referring to Right and Left components. Right & Left sides defined as the right hand side and left hand side of the robot while standing behind it, and able to see its operating panel.

Failure to understand these definitions may result in mis-analysis or wrong repair.



1.1 S Model External & Internal views

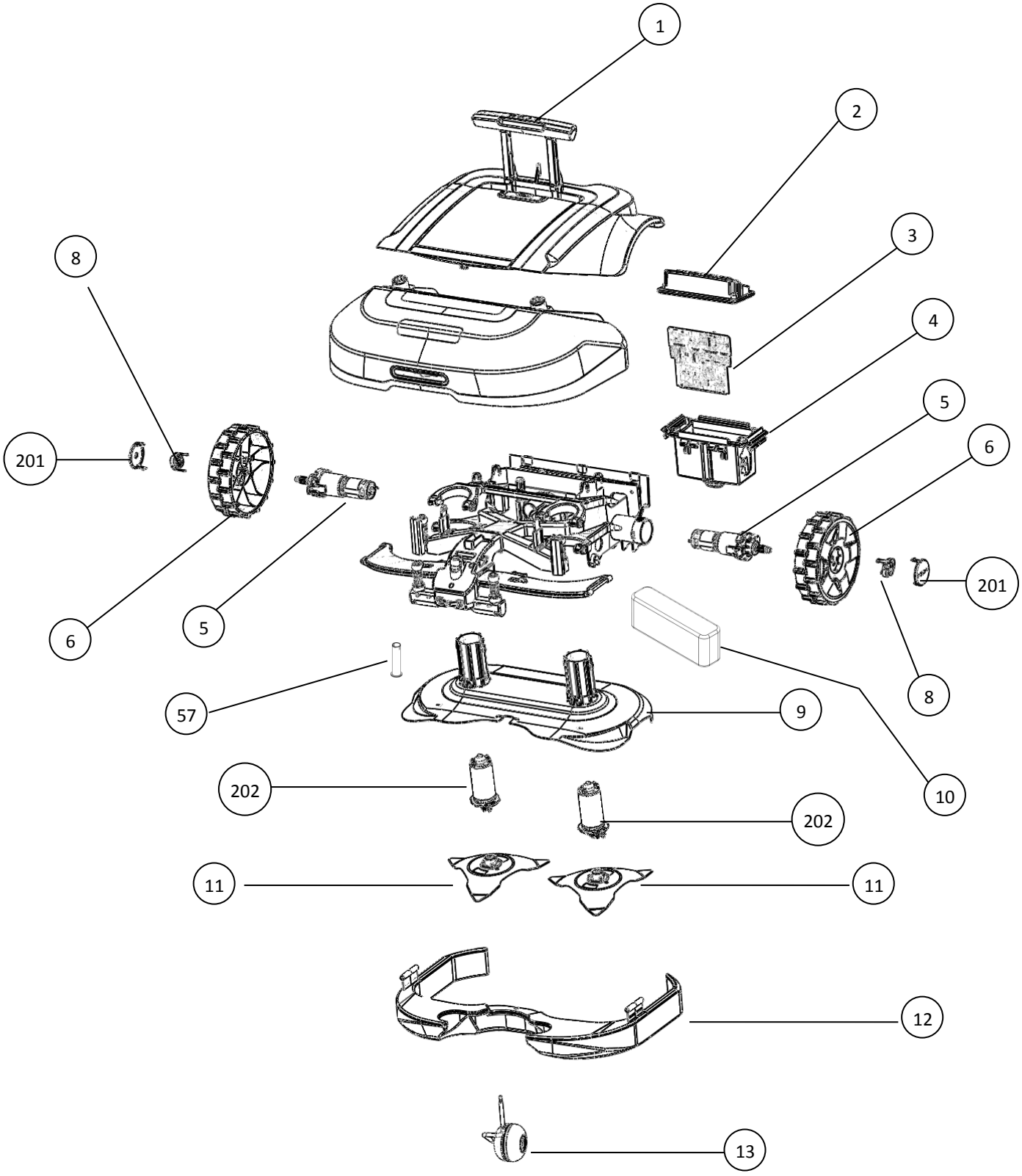


Figure 1 RS Exploaded View

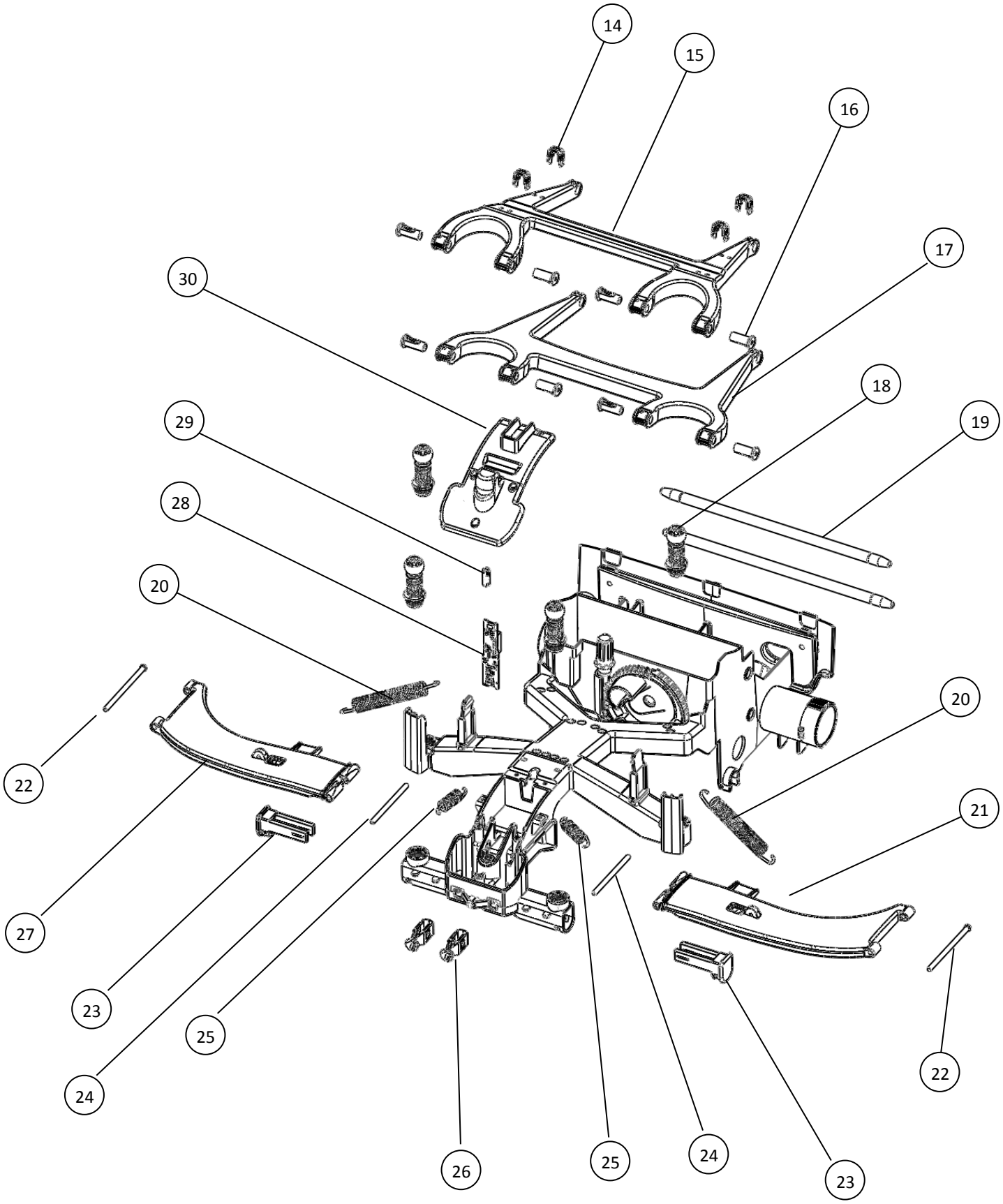


Figure 1.1 RS Exploaded View

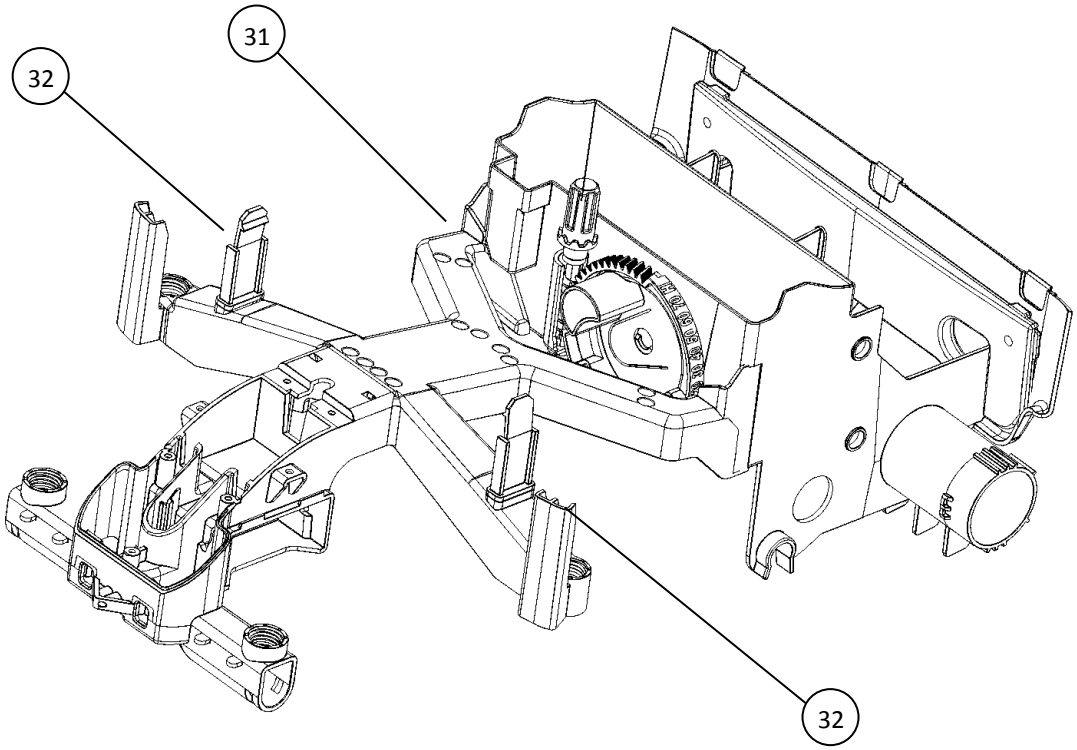


Figure 1.2 Chassis assy

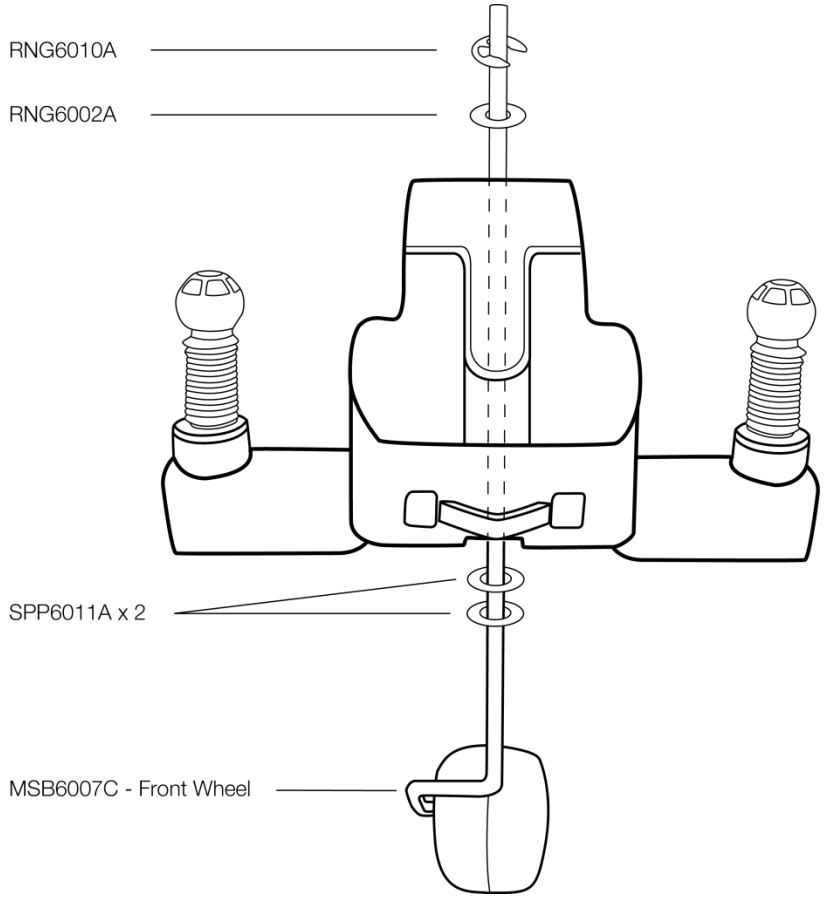


Figure 1.3 Front Wheel & Washers & Snap ring

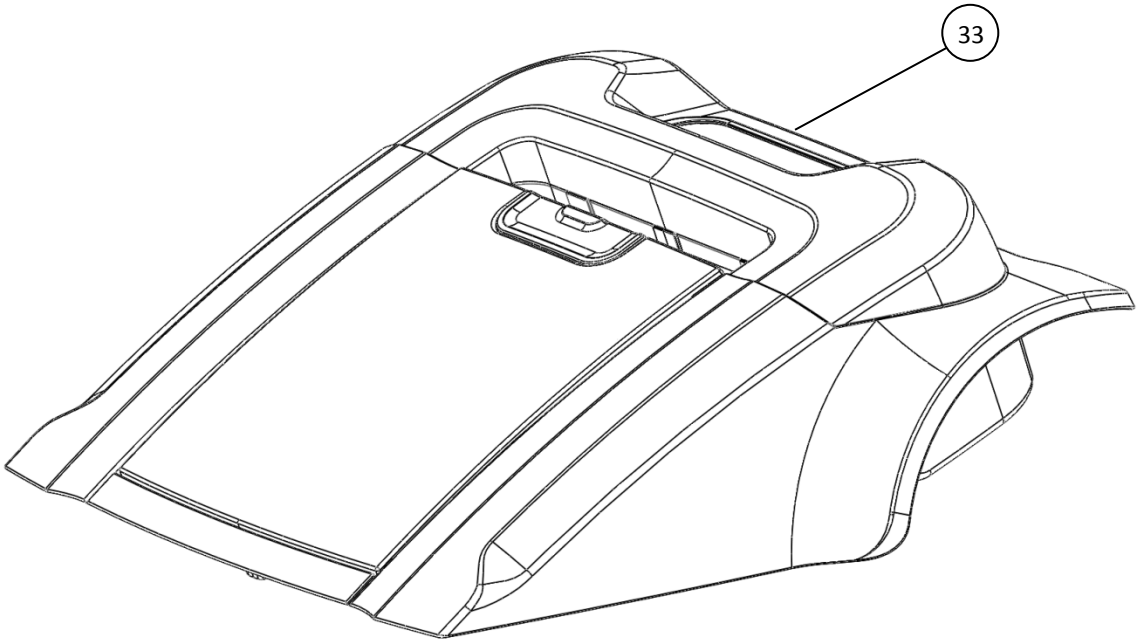


Figure 1.4 Cover assy

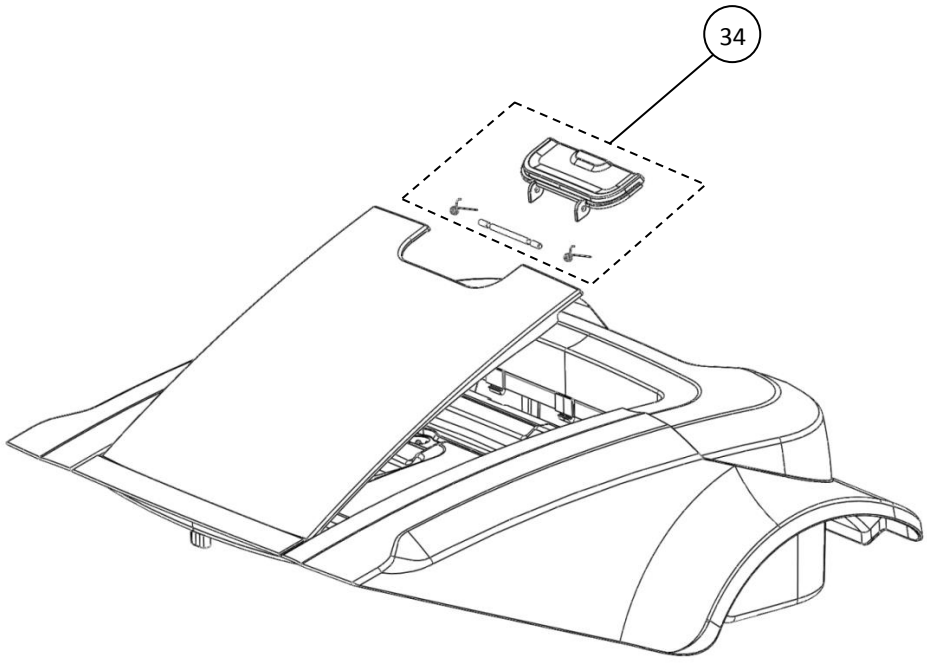


Figure 1.5 Door Shutter

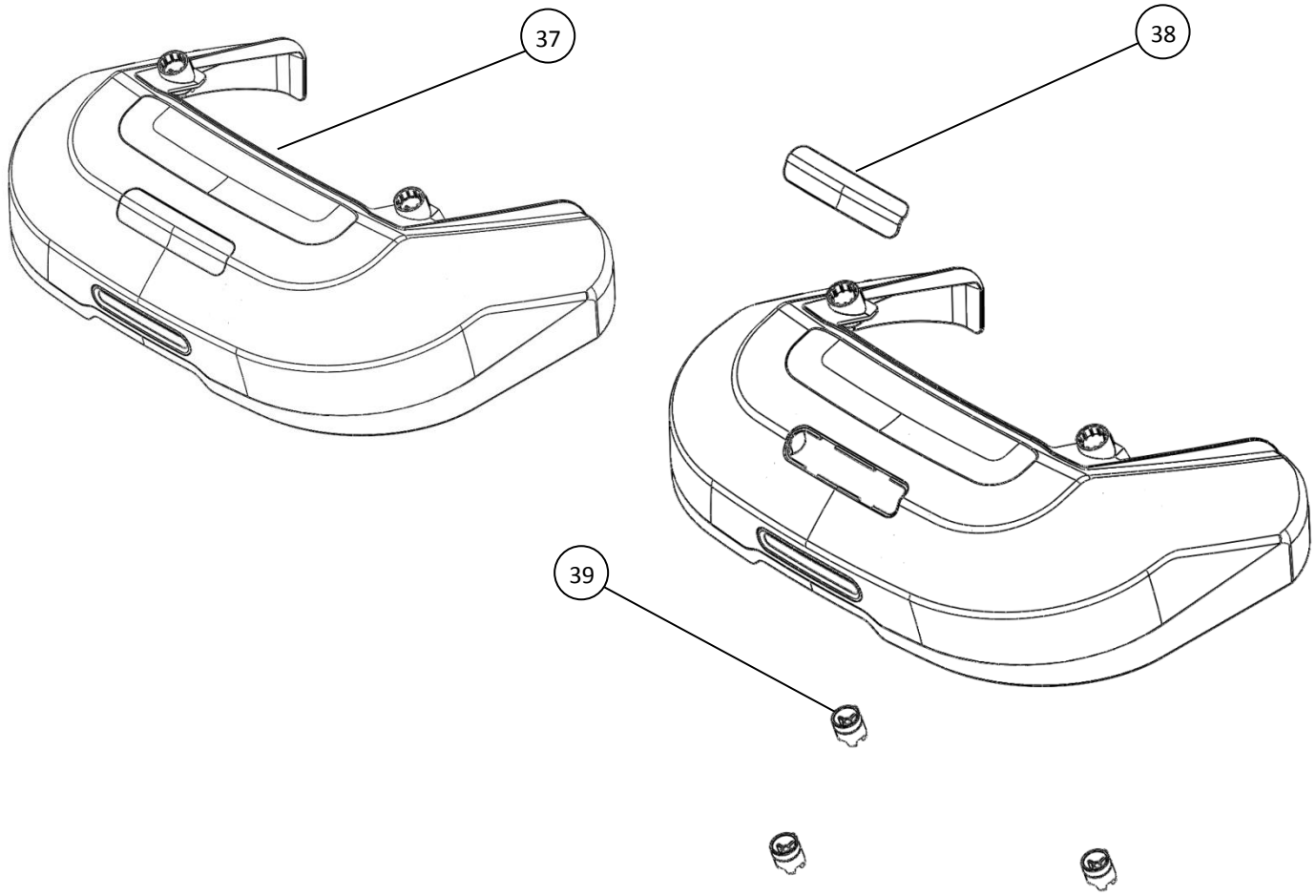


Figure 1.6 Bumper Exploded View

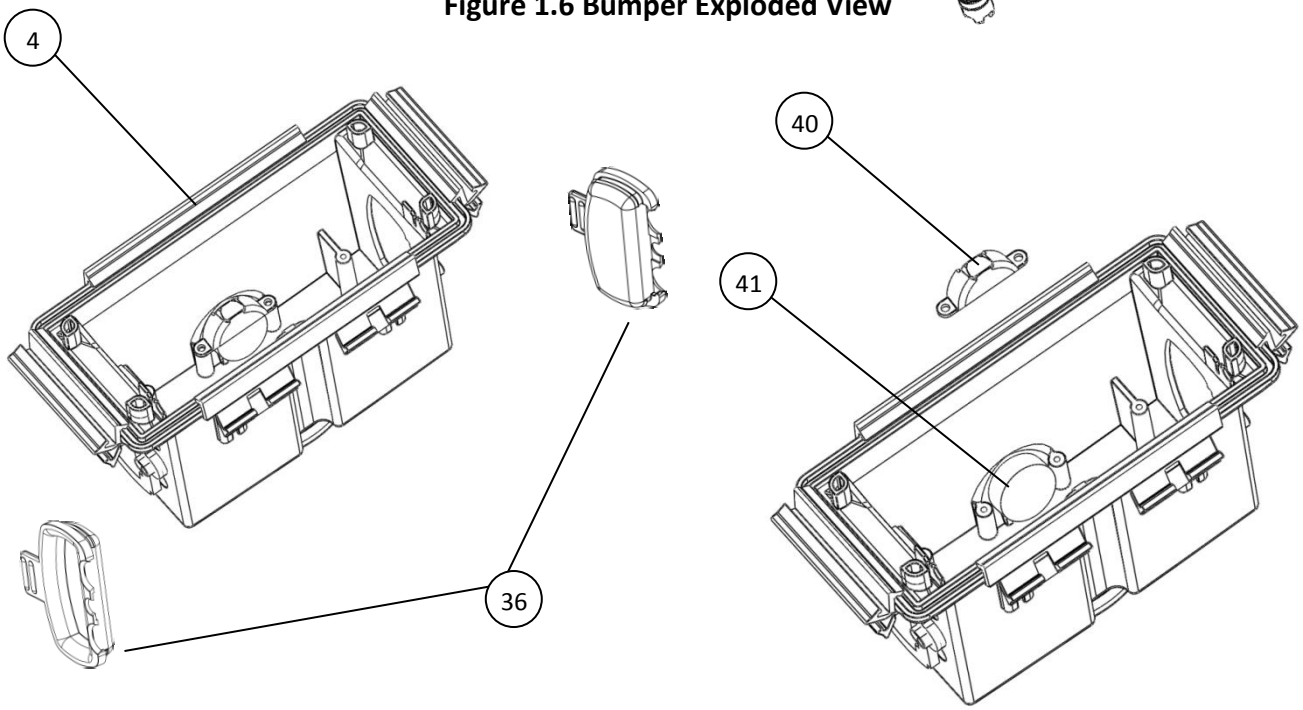


Figure 1.7 C Box Exploded View

1.2 Base Station & Power Box

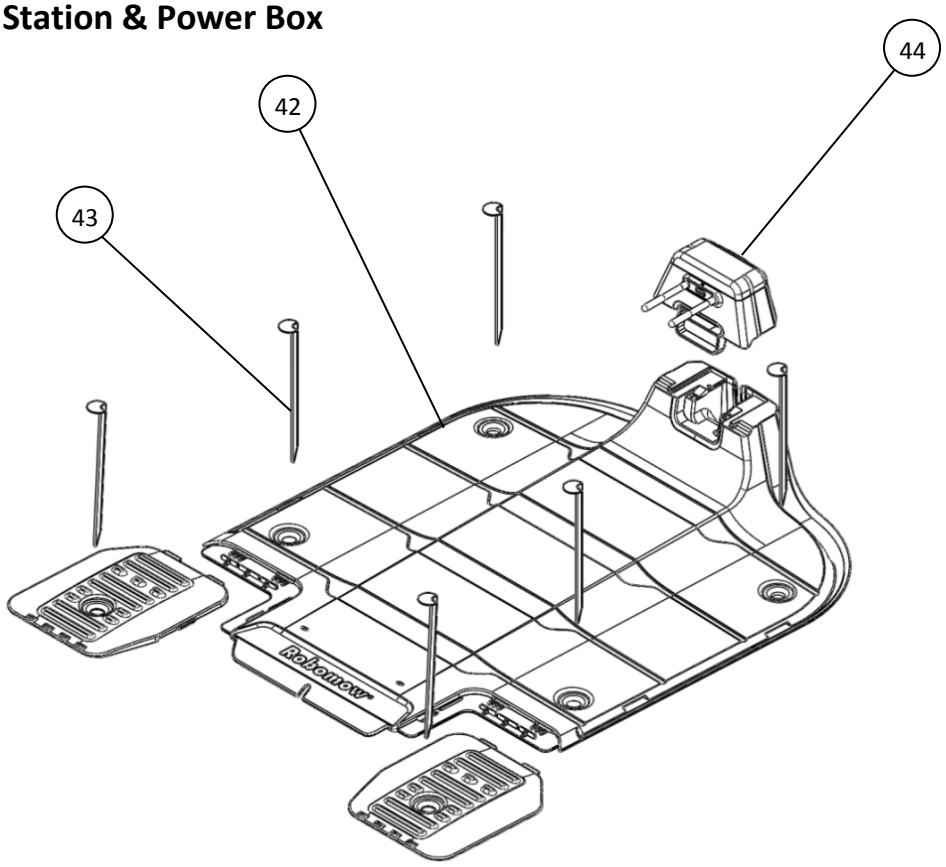


Figure 1.8 Base Station

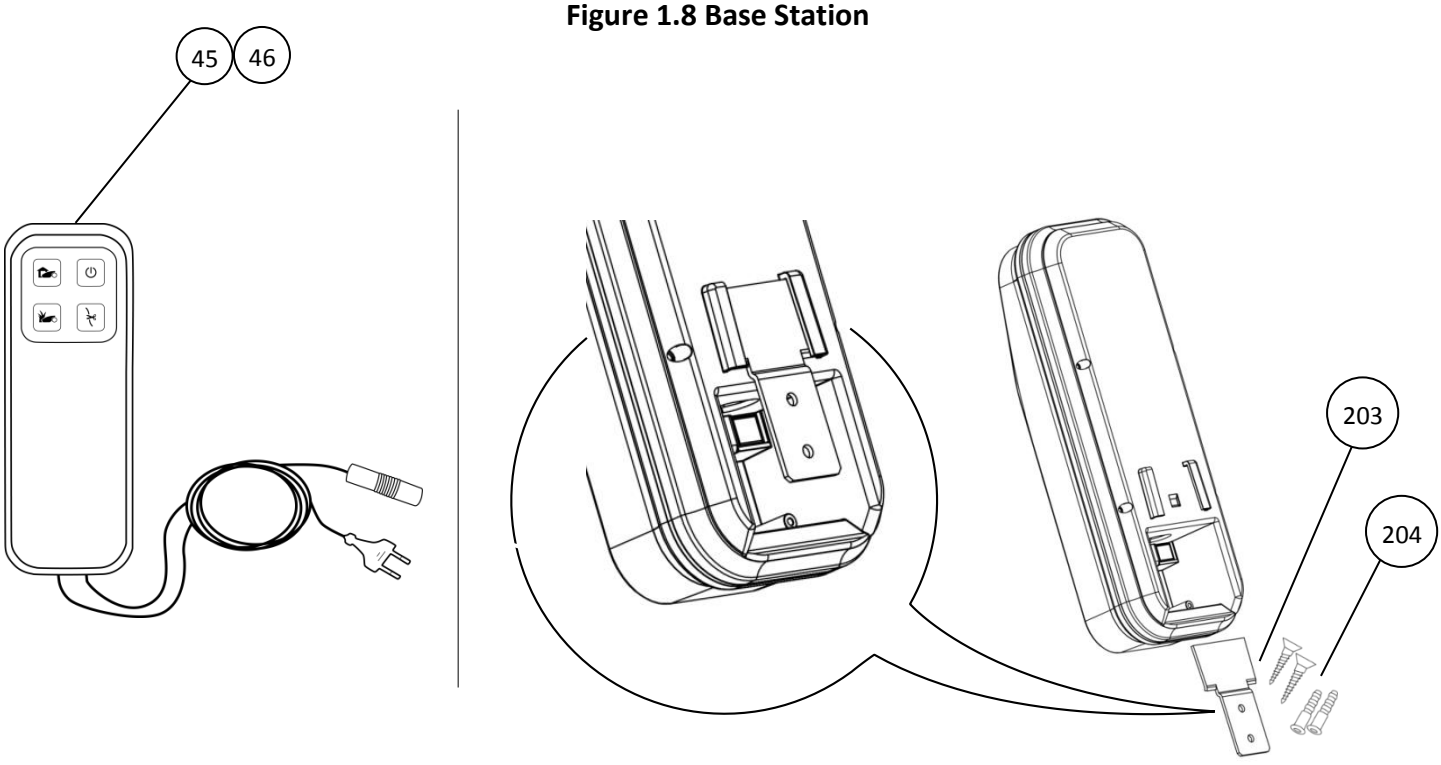


Figure 1.9 Power Box

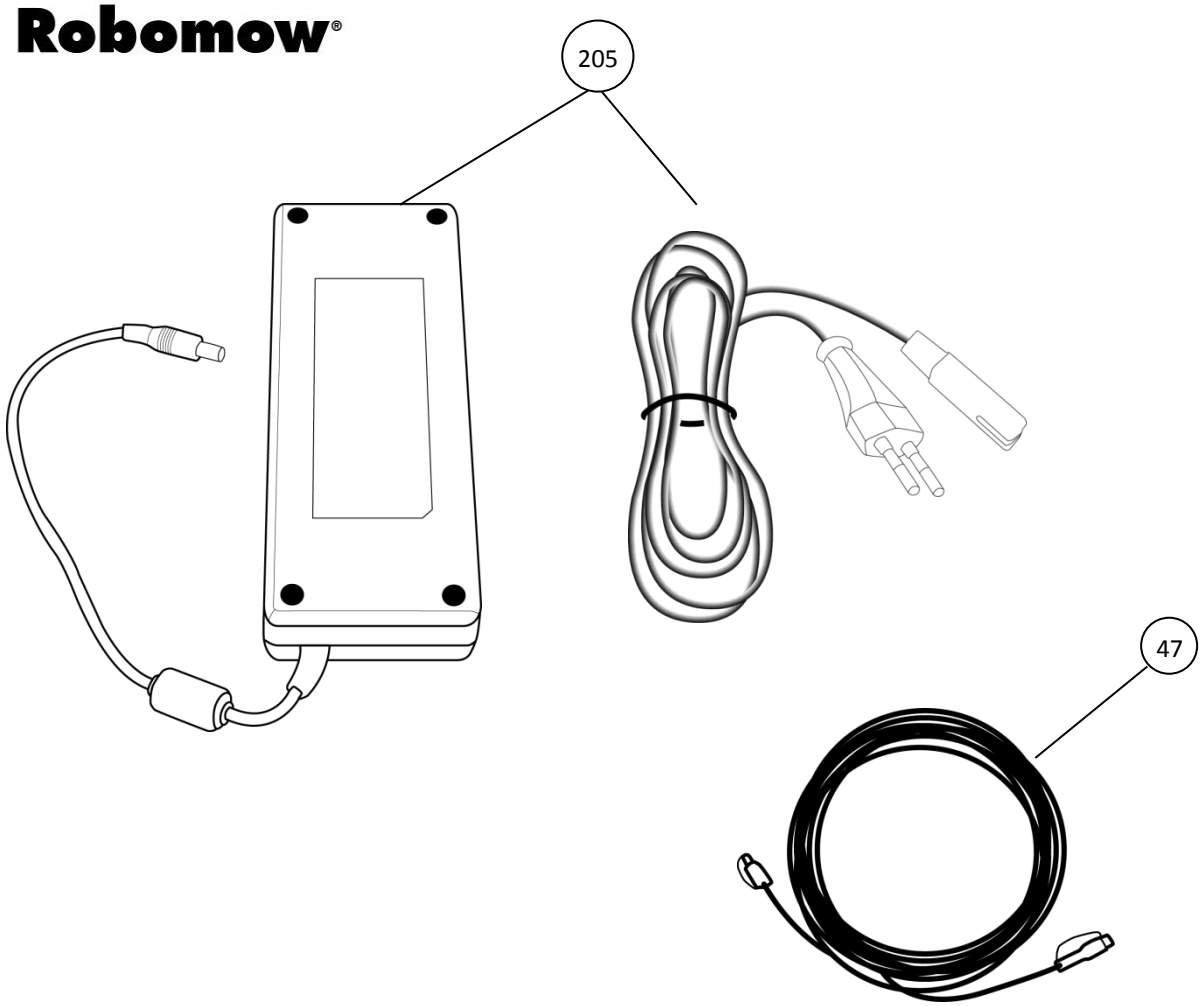


Figure 1.10 Power Supply & Cables

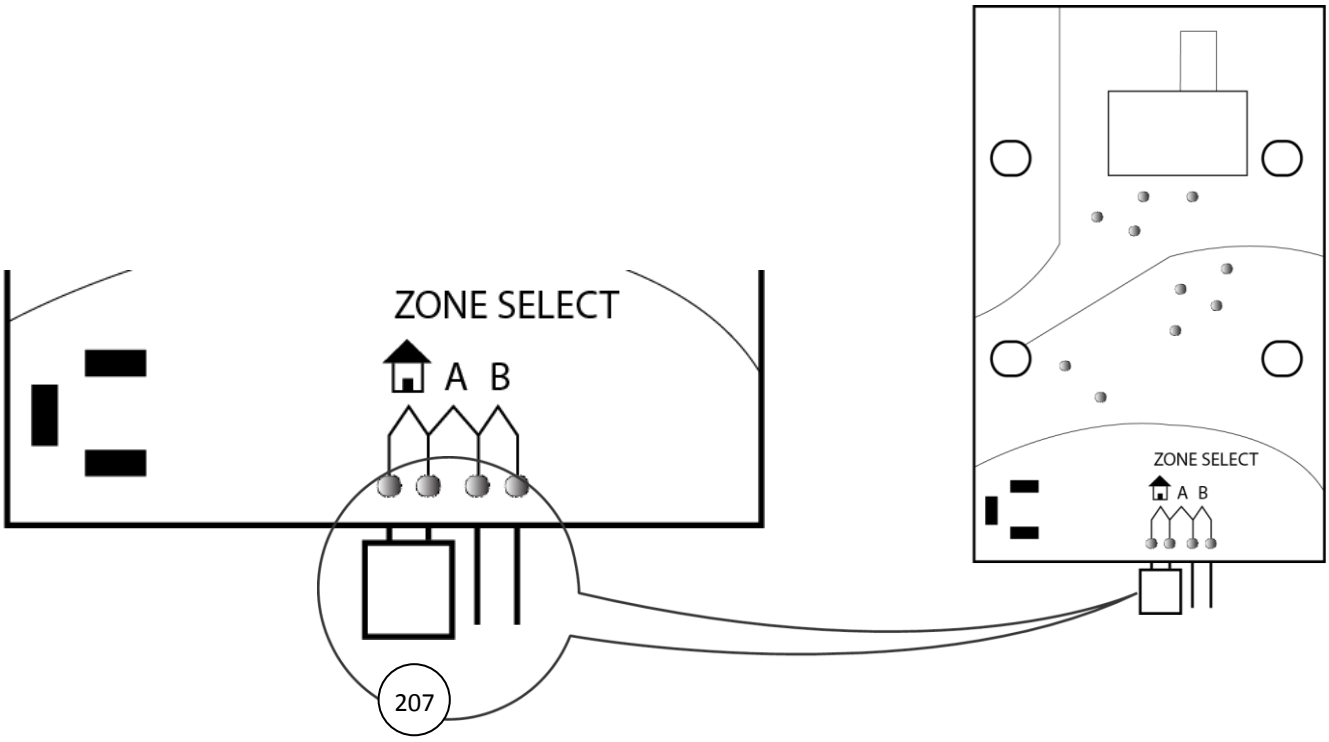
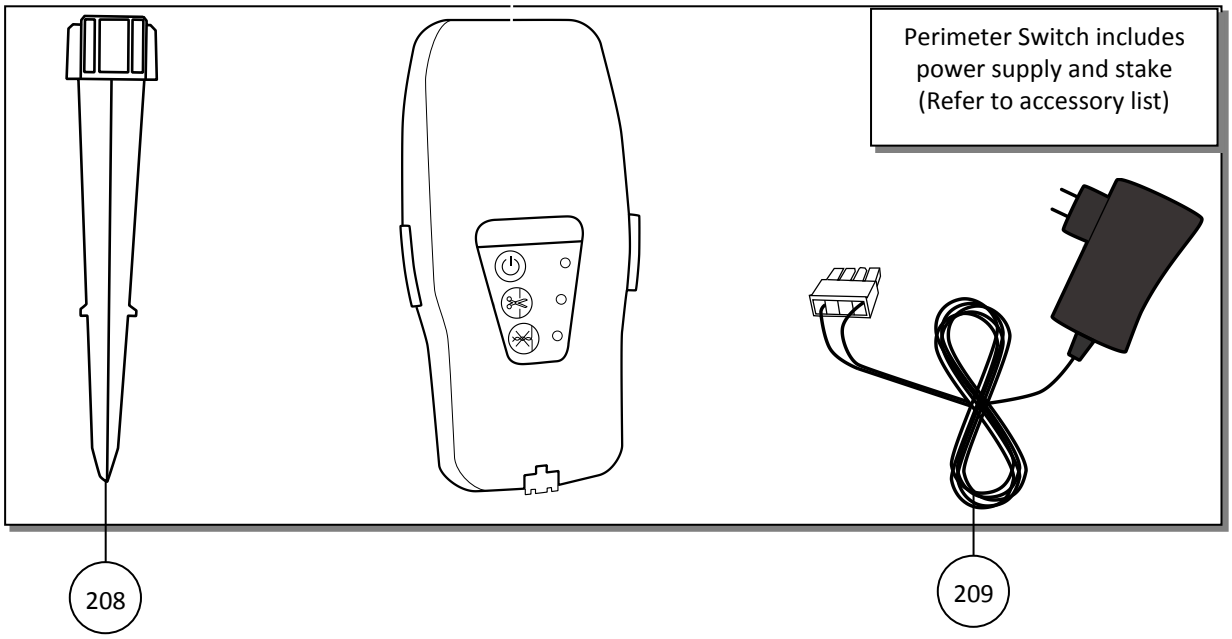
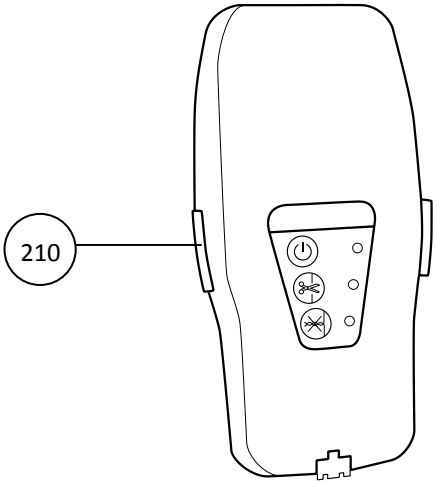
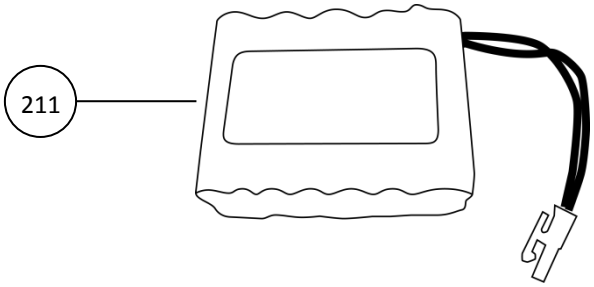


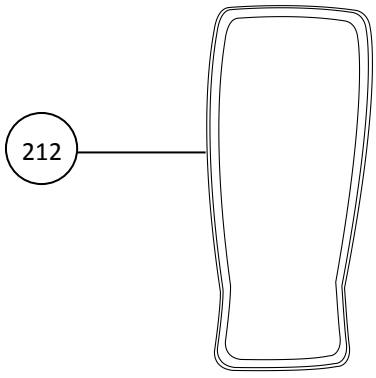
Figure 1.11 Zone Select (In Power Box)

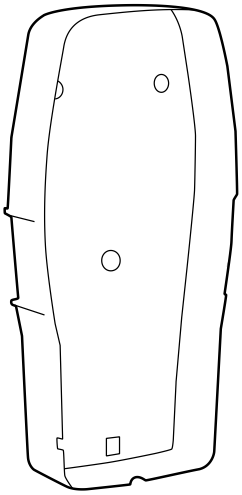
1.3 Perimeter Switch

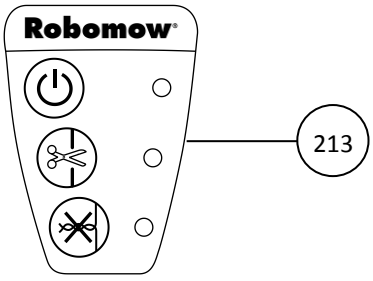












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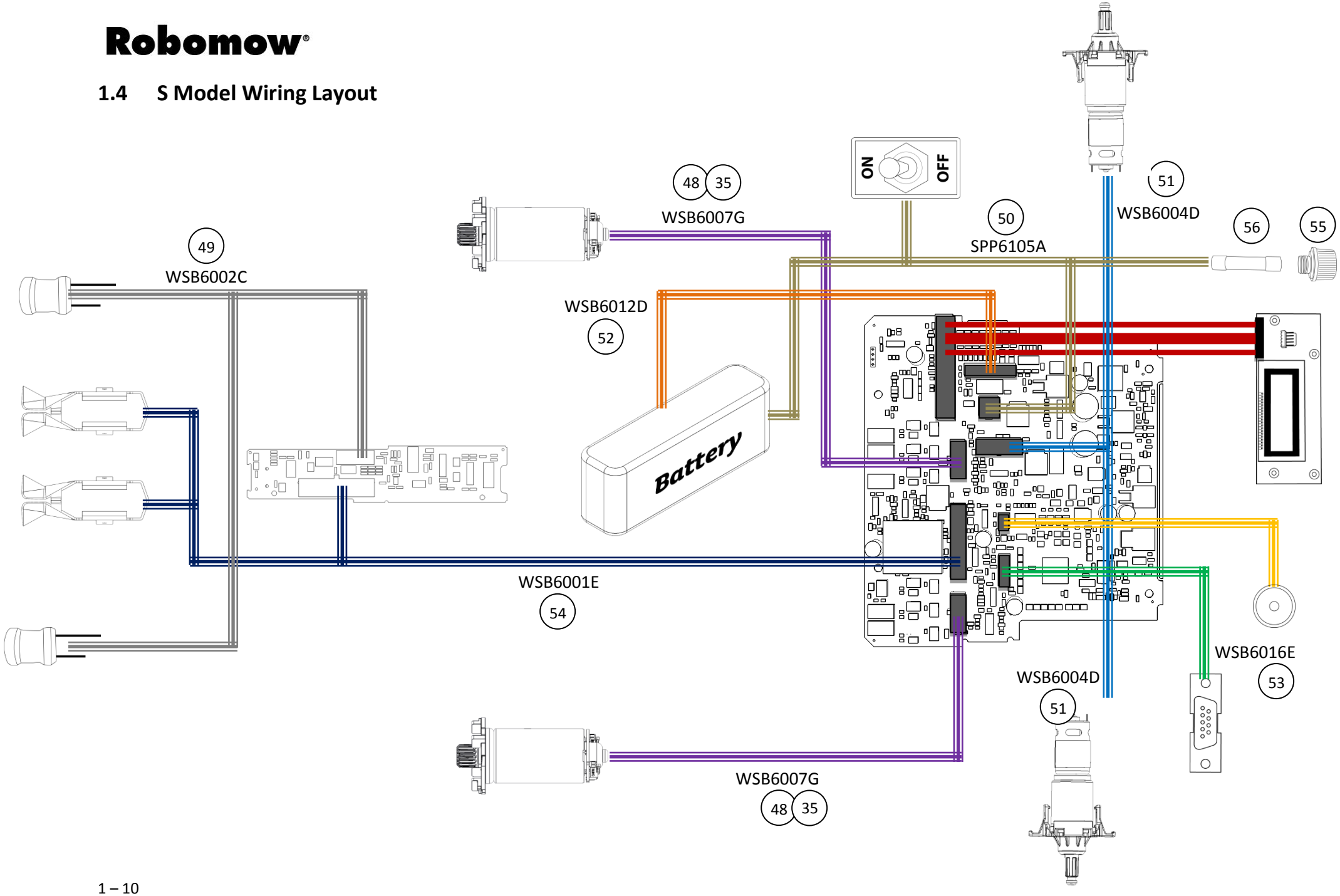
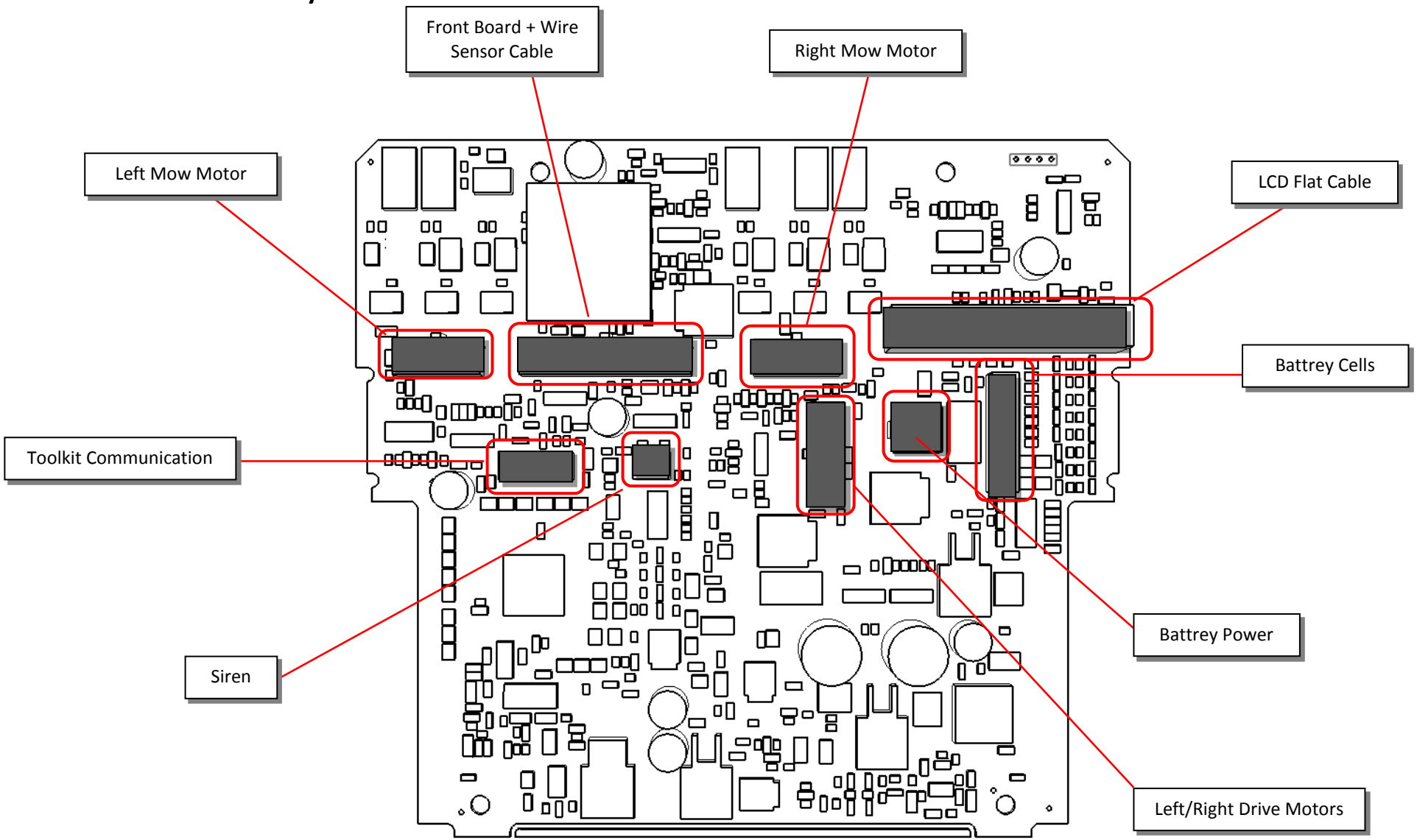
1.4 S Model Wiring Layout



1.5 Main Board Connectivity



1.6 Screws, Circlip & Washers Identification

#	P/N	Description	Where Used	Total Qty in use
1	SCR5009A	Screw KA40x20 WN 1411 ZP	Floater Assembly	24
2	SCR6000A	SCREW+"DIBEL"X2 KIT	Bracket to mount the P.Box	1
3	SCR6005A	TORX WN1451 K40 L12	C-Box	2
4	SCR6008A	EJOT WN 1452 K30 L-45mm	Power Box, cover	4
5	SCR6009A	EJOT WN 1452 K30 L-12mm	Bumper Assembly & LCD Panel Assembly	6
6	SCR6010A	EJOT WN 1452 K30 L-6 mm	Power Box, Electronic Board	4
7	SCR6012A	TOREXS M5 10mm - color grey	Mowing Motor Assembly	4
8	RNG6010A	Snap ring for 6mm shaft	Front Wheel	1
9	GEN6038A	5 mm Star lock	Shaft of Left & Right wing to floater	2
10	RNG0002A	Exter.zeger ring D12 DIN 471 BLK	Parallel shafts locker	4
11	RNG6002A	M6 DIN 125A steel	Front Wheel	1
12	RNG6007B	DIN988 8X14X1mm	Front Wheel	2

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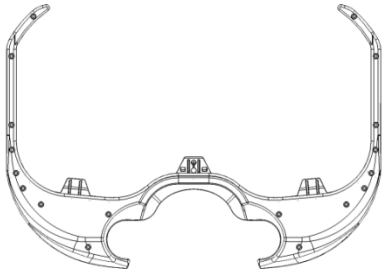
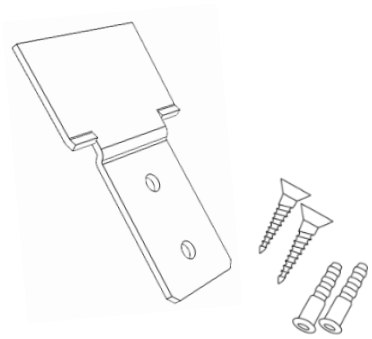
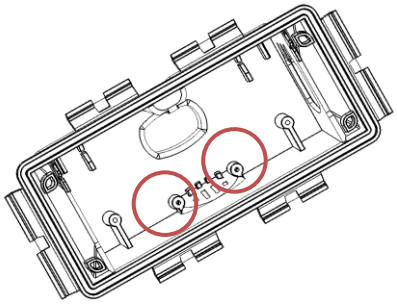
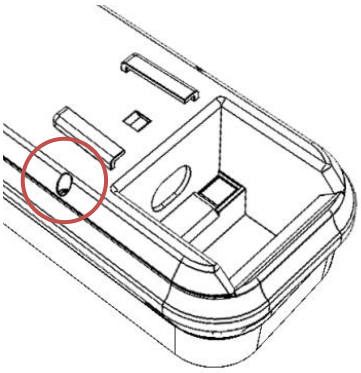
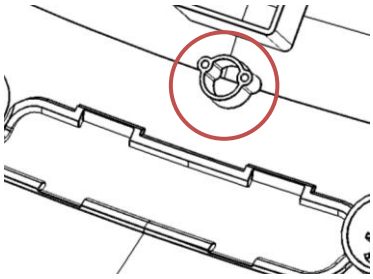
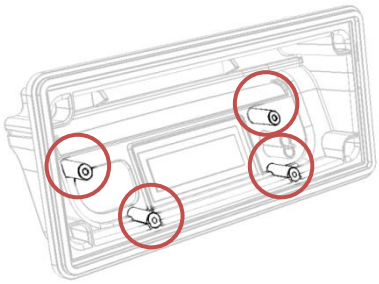
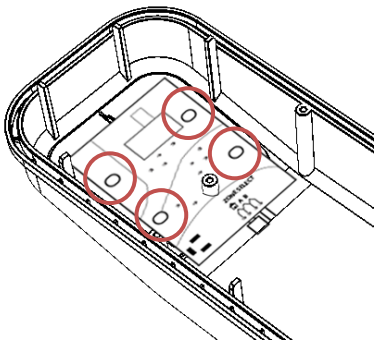
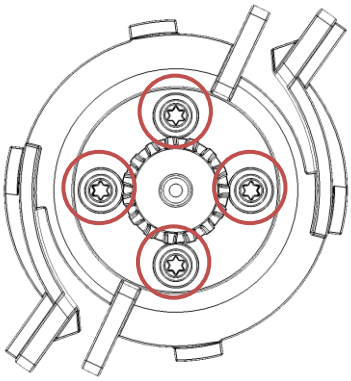
1 	**2** 	**3** 
4 	**5**  **Bumper**	 **LCD Panel**
6 	**7** 	

1.7 Spare Parts List

Spare Parts List is available in Excel format named “Master Spare Parts List”.

This file contains a lot of information about Robomow spare parts such as, in which model every item is valid, pictures, Standard warranty repair time, APL (assembled Parts List) which is a list that describes the items that contain an assembled part, and more.

For more information, refer to the “RS_RC Master Spare Parts List”.

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2. Menu Items

Table 2.1 below shows a list of shortcut buttons to a few common service menu screens.

Function	Button Combination						
Factory Default Software	STOP			↩			More than 4 Sec
Factory Default Main Board	STOP	▲	▼				More than 4 Sec
Factory Default Out Of the Box	STOP		▼				More than 4 Sec
Service Menu: Service Settings Information Tests Calibrations		▲	▼	↩			More than 2 Sec
Reset					GO		More than 2 Sec
Language Selection			▼	↩			More than 3 Sec
Bluetooth Remote Control Pairing (Robot in Idle mode)		▲	▼				More than 2 Sec

Table 2.1

NOTE: Shortcuts are not active when Anti-Theft is armed

This chapter describes the menu screens under Service menu. The access to the service menu is protected by a 'Service Code', which can be a fixed 'Master Code', or a temporary code.

The Master code is to be used ONLY by an authorized technician, and it is: **897**.

DO NOT share this code with a non authorized Robomow technician!

The temporary code is to be used by anyone else who may need an access to one of the Service menus. The temporary code list is available in paragraph 2.5 of this manual.

Figure 2.1 describes the highest service menu screens.

Under the Service menu, there are 4 sub menus: Information, Settings, Tests & Calibrations

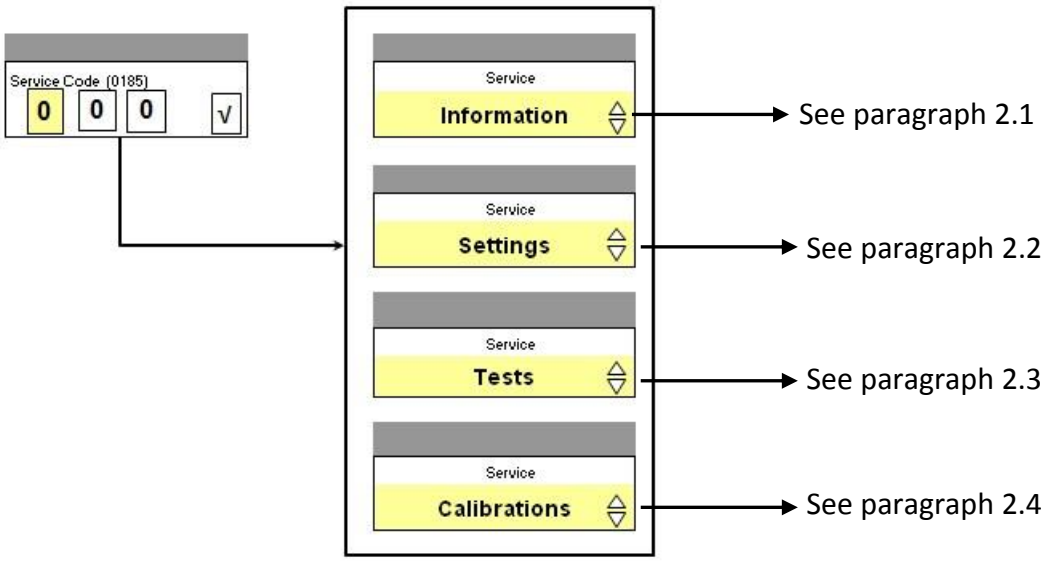
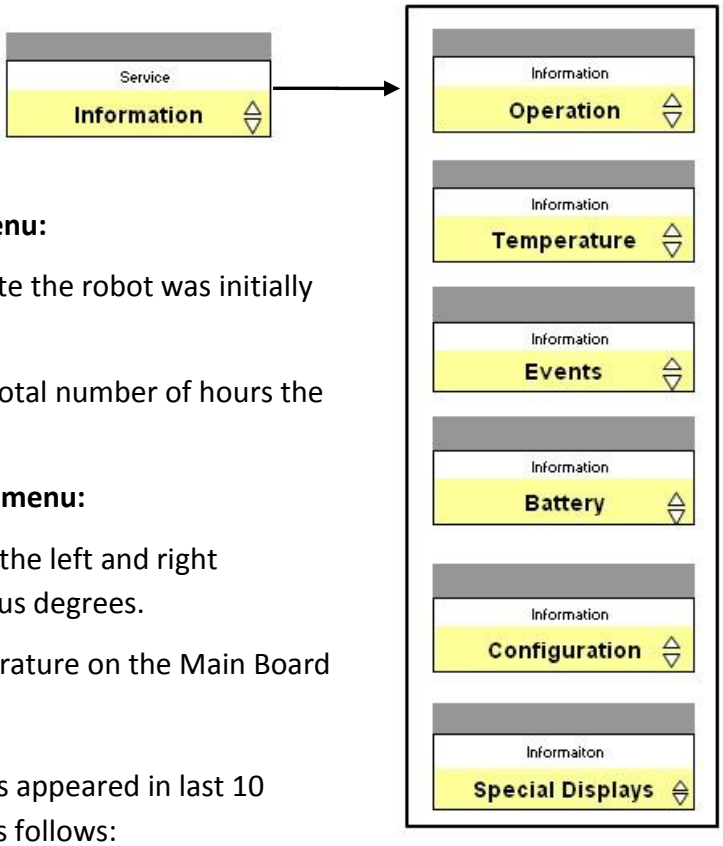


Figure 2.1



2.1 Information Menu

2.1.1 Information → Operation menu:

First date screen displays the first date the robot was initially operated since purchased.

The **total Hours screen** displays the total number of hours the robot wars working since first used.

2.1.2 Information → Temperature menu:

The **mowing Motors screen** displays the left and right mowing motors temperature in Celsius degrees.

Ambience screen displays the temperature on the Main Board

2.1.3 Information → Events menu:

The **history screen** displays the errors appeared in last 10 operations. Data format presented as follows:

Figure 2.2

'a' stands for am, 'p' stands for pm (in case US time format is activated)

M for Main zone;

1/2/3/4 for SubZone1/2/3/4 (If enabled)

A/B for ZoneA/B (Separated zones – If enabled)

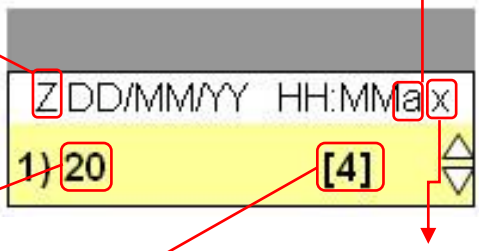


Figure 2.3

Error code

Number of times this error code happened since the robot initially started in day 1

1: Robot did not start operation

2: Robot started operation but did not return back to station

3: Robot started and returned to station without complete operation cycle successfully

4. Charging problem

Reset screen: Reset all history events.

2.1.4 Information → Battery menu:

Voltage screen displays the voltage of the battery pack.

Temperature screen displays the temperature surrounding inside the battery pack in Celsius degrees.

Run Time screen displays the last 10 battery run time. Run time defines as the time the robot start its operation until start searching the base.

Data format presented as follows:

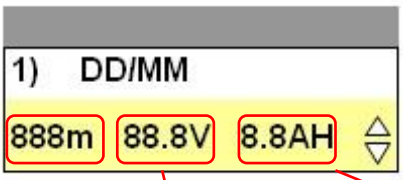


Figure 2.4

Total minutes of operation

Battery voltage in starting point

Battery capacity in starting point

2.1.5 Information → Configuration menu:

Software screen displays the current software burned on the Main Board.

Main Board screen opens sub menu of **Part number** screen and **Serial Number** screen.

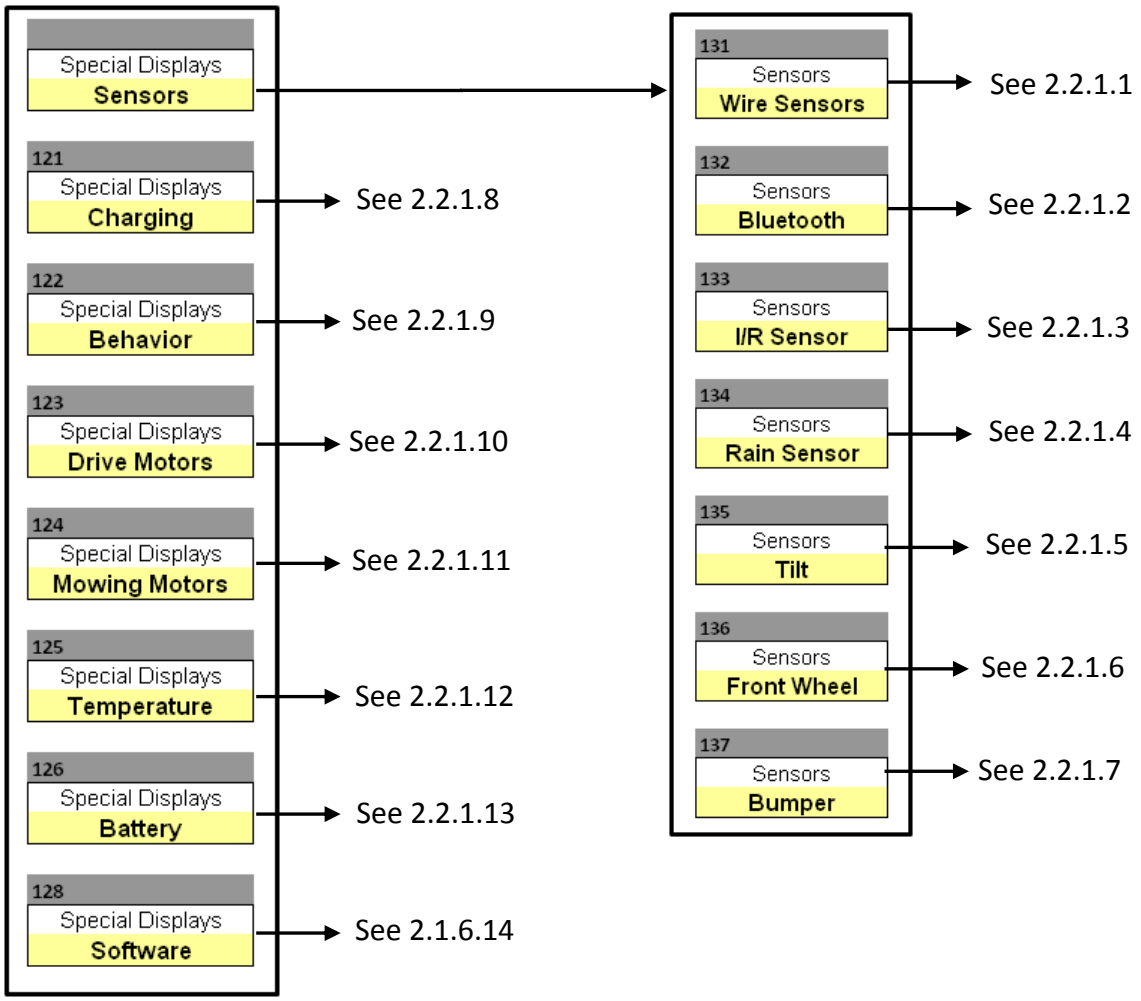
Station screen displays the Station version installed in each zone enabled in the lawn

Mower S/N displays the mower's serial number

RS Model Number

Software ID	Model
1	Premium RS612
2	Premium RS622
3	Premium RS630
4	MS1000
5	MS1800
6	TS1000
7	TS1800
8	R.S.1000
9	R.S.1800
10	R.S.3000
11	LK 1800
12	LK 3000
13	RS650
14	Premium RS612 2015
15	Premium RS630 2015
16	MS1000 2015
17	MS1800 2015
18	MS1000 2016
19	RS615
20	RS625
21	RS635
22	MS1500
23	MS2500
24	MS3500

2.2 Special Display Menu:



After a specific display is selected, use the ⮌ button to toggle between user menus and special display screen that was selected.

Press **STOP** button (carrying handle) to go out of the Special Display menus.

Note: Some of the parameters presented in this document, indicate as **'R&D use only'**. These parameters are used by the manufacturer for development and debug purposes, and are not require at the Service level by Robomow service provider. Hence these parameters will not be detail describe.

2.2.1.1 Wire Sensors screen – 13 1

Upon entering into 'Wire Sensors' screen, the following will be displayed on the robot's LCD:

1) Left amplitude	2) Left in/out count	3) Left gain	4) Wire sensors state
5) Right amplitude	6) Right in/out count	7) Right gain	8) Maximal wire gain
9) Left linear amplitude	10) Near wire edge amplitude	11) Near wire edge track number	12) Max linear amplitude

1) Left amplitude

Displays the strength (Amplitude) of the Left sensor signal. The closer the robot to the wire, the higher is the amplitude.

The minimum amplitude signal requires for operation is higher than 50.

2) Left in / out count

Signal value in & out the plot.

Expected left Wire sensor readings are:

Sensor IN	400 ± 5
Sensor OUT	200 ± 5

3) Left gain

Left sensor gain increases as the robot drives far from the wire. Gain interval is 0-7.

Robot close to the wire will get low gain ('0' very close to the wire), and higher as it get far from the wire ('7' would be in the middle of the plot).

4) Wire sensors state

Sensors in relation to the plot

0=Both in	1=Right out	2=Left out	3=Both out

5) Right amplitude

Displays the strength (Amplitude) of the Right sensor signal. The closer the robot to the wire, the higher the amplitude is.

The minimum amplitude signal requires for operation is higher than 50.

6) Right in / out count

Signal value in & out the plot.

Expected left Wire sensor readings are:

Sensor IN	400 ± 5
Sensor OUT	200 ± 5

7) Right gain

Right sensor gain is increased as the robot drives far from the wire. Gain interval is 0-7.

Robot close to the wire will get low gain ('0' very close to the wire), and higher as it get far from the wire ('7' would be in the middle of the plot).

8) Maximal wire gain

In Scan mode – 7

In Edge mode – 7

9) Left linear amplitude

Left wire linear amplitude. R&D use only

10) Near wire edge amplitude

Linear amplitude in the right sensor, during near wire edge drive. The robot chooses different value every operation

11) Near wire edge track number

The robot picks 1 out of 12 different distances to follow when performs 'Near wire following' drive.

This value represents the current track number the robot is performing in the current operation.

Track number is picked in randomly between 1 to 12 sigments.

12) Max linear amplitude

The maximal linear amplitude the robot detects in the current zone (for In-Motion-Scan behavior). R&D use only.

2.2.1.2 Bluetooth screen – 132

1) Bluetooth source device			

1) Bluetooth source device

Displays the source of the Bluetooth device.

0 = None	1 = Marker (Base Station)	2= Mobile app

Audio messages:

If mobile device application is detected, the buzzer will be activated every 1 second.

If a Base Station is detected, the buzzer will be activated

2.2.1.3 I/R Sensors screen – 133

Upon entering to 'I/R Sensor' screen, the following will be displayed on the robot's LCD:

1) Front IR base detect	2) Front IR remote control detect	3) Remote control buttons pressed	4) N/A
5) Rear IR base detect	6) Rear IR remote control detect		

When a docking station I/R signal is detected audio beeps will be heard.

1) Front IR base detect

   Base station is detected in front I/R sensor

2) Front I/R remote control detect

   Remote control is detected in front I/R sensor

3) Remote control buttons pressed

   Represents the buttons that are pressed in the remote control

4) N/A

5) Rear I/R base detect

   Base station is detected in rear I/R sensor

6) Rear I/R remote control detect

   Remote control is detected in rear I/R sensor

2.2.1.4 Rain Sensor screen – 134

Upon entering into 'Rain Sensor' screen, the following will be displayed on the robot's LCD:

1) Sensor reading	2) Sensor sensitivity	3) Sensor state	4) Sensor enable/disable
5) Rain detect during auto operation			

1) Rain sensor reading

   Displays the actual sensor reading

2) Rain sensor sensitivity

   Indicates the value in which below "rain" is detected. This value is adjustable through the Service' menu.

3) Sensor state

0 = Rain does not detected	1 = Rain is detected

4) Sensor enable/disable

0 = Rain sensor disabled	1 = Rain sensor enabled

5) Rain detect during auto operation

Indicates if rain is detected during automatic operation

0 = Rain does not detected	1 = Rain is detected

2.2.1.5 Tilt screen – 135

Upon entering into 'Tilt' screen, the following will be displayed on the robot's LCD:

1) Accelerometer X reading	2) Accelerometer Y reading	3) Horizontal tilt angle	4) Tilt state
5) Accelerometer Z reading	6 Detect time	7) Vertical tilt angle	8) Slope state
9) Robot heading direction	10) Drive tilt compensation enable		

1) Accelerometer X reading

X axis reading of the accelerometer component. if X reading is positive the actual reading will be displayed. If X reading is negative 1000 will be added to the absolute value of the reading

R&D use only

2) Accelerometer Y reading

Y axis reading of the accelerometer component. if Y reading is positive the actual reading will be displayed. If Y reading is negative 1000 will be added to the absolute value of the reading

R&D use only

3) Horizontal tilt angle

The measured horizontal tilt angle (front or rear sides are lifted). Values are in Degrees units.

(+) Value represents REAR robot is lifted

(-) Value represent FRONT robot is lifted

4) Tilt state

0=No detection	1=Detection

5) Accelerometer Z reading

Z axis reading of the accelerometer component. if Z reading is positive the actual reading will be displayed. If Z reading is negative 1000 will be added to the absolute value of the reading

R&D use only

6) Detect time [50 msec]

The time a tilt is detected in 50msec unit resolution; means 1 counter equals 50msec. The counter resets every operation start.

For example, if the value on the screen is 100, the actual time a tilt was detected is 50x100=5000 msec, which equals to 5 seconds.

7) Vertical tilt angle

The measured vertical tilt angle (robot's sides are lifted). Values are in Degrees.

(+) Value represents RIGHT robot is lifted

(-) Value represent LEFT robot is lifted

8) Slope state

Slope is detected when one side of the robot exceeded 30 angle degrees.

1=No Slope is detected	2= Slope is detected from the LEFT. (Left side is lifted higher than the right robot's side)	3= Slope is detected from the RIGHT. (Right side is lifted higher than the left robot's side)

9) Robot heading direction

Every time the robot start its operation, the first forward azimuth (direction), is set as 0 degree. Any change in this azimuth will change this value between 0-360 degrees.

10) Drive tilt compensation enable

Indicates if the drive compensation due to tilt/slope mechanism is enabled or disabled

0=No Tilt compensation	1=Tilt compensation

2.2.1.6 Front Wheel screen – 136

Upon entering into 'Front Wheel' screen, the following will be displayed on the robot's LCD:

1) Front wheel odometer ticks	2) Drop-off Detect time	3) Front wheel odometer failure	4) Drop-off state
5) Front wheel accumulated distance	6) Drive accumulated distance	7) Detect time	8) Drop-off A/D reading
9) Calibration idle reading	10) Calibration lift reading		

1) Front wheel odometer ticks

"Tick" defines as a counter of Front wheel rotations. One full wheel revolution equals to 4 ticks

2) Drop-off A/D reading

Analog to digital readings which the S/W detects as a Drop-off event.

One wheel revolution expected as: 230-255

3) Front wheel odometer failure

-1=Unknown	1=failure is detected	0=failure is not detected

R&D use only

4) Drop-off state

0=No Drop-off event	1=Drop-off event detected

5) Front wheel accumulated distance [10cm]

Front wheel accumulated distance in 10cm unit resolution; means 1 counter equals 10cm. The counter resets every operation start.

For example, if the value on the screen is 20, the actual distance the front wheel measured is 20x10=200cm, which equals to 2 meters. Forward & backward drive revolutions accumulated to a total added distance

6) Drive accumulated distance [10cm]

Drive wheel accumulated distance in 10cm unit resolution; means 1 counter equals 10cm. The counter resets every operation start.

For example, if the value on the screen is 50, the actual distance the Drive wheel measured is 50x10=500cm, which equals to 5 meters. Forward & backward drive revolutions accumulated to a total distance

7) Detect time [50 msec]

The time a Front wheel lifted is detected (Drop-off) in 50 msec unit resolution; means 1 counter equals 50 msec. The counter resets every operation start.

For example, if the value on the screen is 2,000, the actual time a Drop-off is detected is 50x2,000=100,000 , which equals to 100 seconds detection.

8) Drop-off A/D reading

The actual analog to digital reading the robot detects

9) Calibration idle reading

Drop-off reading that was learned during front wheel calibration in idle mode (wheel on the ground).

10) Calibration lift reading

Drop-off reading that was learned during front wheel calibration in lifted mode (front robot is lifted up and front wheel is in drop-off state).

2.2.1.7 Bumper screen – 137

Upon entering into 'Bumper' screen, the following will be displayed on the robot's LCD:

1) Left A/D reading	2) Left calibration idle	3) Left calibration press	4) Bumper state
5) Right A/D reading	6 Right calibration idle	7) Right calibration press	8) Detect time
9) Front press detect	10) Side press detect	11) Accelerated bumper detect	

1) Left A/D reading

Bumper sensor readings.

Expected values are:

Idle State (No press)	0 – 80
Press State	150 – 255

2) Left calibration idle

Value learned for left bumper in idle state during bumper calibration process.

3) Left calibration press

Value learned for left bumper in press state during bumper calibration process

4) Bumper state

0=No detection	1=Left detection	2=Right detection	3=Front detection

Note: Left & Right detection will be detected only if drive wheels are in motion.

5) Right A/D reading

Bumper sensor readings.

Expected values are:

Idle state (no press)	0 – 80
Press State	150 – 255

6) Right calibration idle

Value learned for right bumper in idle state during bumper calibration process.

7) Right calibration press

Value learned for right bumper in press state during bumper calibration process.

8) Detect time [50msec]

The time a bumper event is detected in 50msec unit resolution; means 1 counter equal to 50msec. The counter resets every operation start.

For example, if the value on the screen is 2,000, the actual time a bumper is detected is 50x2,000=10,000 , which equals to 10 seconds detection.

9) Front press detect threshold

Threshold value which is used for bumper front-press detection (being used during forward movements only).

Expected value is: 25

10) Side press detect threshold

Threshold value used for bumper side-press detection (being used during turn movements only).

Expected value is: 95

11) Accelerated bumper detect

R&D use only.

2.2.1.8 Charging screen – 12 1

Upon entering into 'Charging' screen, the following will be displayed on the robot's LCD:

1) Charging voltage	2) Battery Charging current	3) Charging power	4) Charging stage
5) Battery voltage	6) Battery cells balancing	7) Charger source	8) Charging time
9) Minimal cell voltage	10) Maximal cell voltage	11) Battery temperature	12) Cancel automatic departure reason (from Base Station)

1) Charging voltage [V]

The driven charging voltage the Power Box power supply

2) Battery Charging current [10mA]

Charging current in 10mAmp unit resolution; means 1 value equals to 10mAmp in real.

For example, if the value on the screen is 90, the actual current detected is 90x10=900mAmp, which equals to 0.9 Amp.

3) Charging Power

Charging PWM [%]. It is the charging power uses to control the required current.

4) Charging stage

Indicates the stage of the charging process at that time

4= Stage 1	5= Stage 2	6= Stage 3

5) Battery voltage [V]

Battery voltage measured on the connector. The units displays in Volts.

6) Battery cells balancing

Battery cells balancing in the current charging cycle

0 = Not balance yet	1 = Reached to balance state

7) Charger source

0 = Base Station	1 = Base Station Head (out of base station)	2= Unrecognized

8) Charging time [hours]

Total charging time.

This value is reset every new charging cycle

9) Minimal cell voltage

Minimal cell voltage in mV

R&D use only

10) Maximal cell voltage

Maximal cell voltage in mV

R&D use only

11) Battery temperature

Battery temperature in Celsius degrees.

No charging process if the temperature below 0 Celsius Degrees, or higher than 55 Degrees

12) Cancel automatic departure reason (from Docking Station)

Reason #	Description
0	None – Departure is not disabled
1	Battery is not in the required state
2	Robot is during inactive time
3	Required mow time is completed
4	Humidity/rain is detected
5	System switch is off
6	Demo mode is enabled
7	Departure is disabled due to miscellaneous reasons, until user interaction is detected
8	Multiple consecutive short operation times are detected
10	Program in the menu is set to OFF
11	Program on/off flag in the EEPROM is disabled
12	P.Box is in pause mode
13	All week days are set as inactive days
14	Automatic departure is disabled because winter charger is connected
15	Automatic departure is disabled because robot is in battery charge force
16	Automatic departure is disabled because robot is not on the Base Station
17	Automatic departure is disabled because of low ambience temperature
18	Automatic departure is disabled because robot missed the Sub Zone entry

2.2.1.9 Behavior screen – 122

Upon entering into 'Behavior' screen, the following will be displayed on the robot's LCD:

1) Scan type/Edge distance	2) Last termination event	3) Edge quarters	4) Docking station IR
5) Turn angle/Edge stop reason	6) Last leg distance	7) Corner leg number	8) Narrow passage leg number

1) Scan type/Edge distance

During Edge operation: The distance the robot follows the wire in meters. This value reset when 'Go' button is pressed.

During Scan operation:

1 = Random	2 = Parallel

2) Last termination event (which terminated the operation in the last scan session)

Number	Indicates
0	None
2	Success
3	Failure
4	Distance
5	Time
6	Wire
7	Bumper
8	Front wheel Dropoff
9	Front wheel slippage
10	Drive over current
11	Slope
12	Robot stuck
13	End of Edge
14	Lost the wire
15	Docking station detection

3) Edge quarters

Number of quarters (90°) calculated by the odometers.

Quarters are counted by automatic S/W decisions while following the wire.

Every 90° turn to the right counted as '+1', and to the left as '-1'. (Left means counter-clockwise when standing inside the lawn facing out).

4) Docking station IR

0	No Docking station IR signal detected
1	Docking station IR signal detected at the front
2	Docking station IR signal detected at the back
3	Docking station IR signals are detected at the front & back

5) Turn angle / Edge stop reason

During Scan operation: Displays the last turn angle in Degrees

During Edge operation: Displays the stop reason as describes in the below table

Edge stop reason #	Description
0	None
1	Docking station detected in a zone which a Base Station is not configured in
2	Minimal edge quarters count (-10)
3	Maximal edge quarters count (+10)
4	Required learned edge distance reached
5	Robot stuck in place detected
6	Front wheel drop-off detected
7	Robot reached required learned entry point
8	Drive over current detected
9	Wire is lost
10	Perimeter island detected
11	Docking station detected while searching for entry point

6) Last leg distance during scan [10cm]

The last drove leg distance in 10cm unit resolution; means 1 counter equals 10cm. The counter resets every operation start.

For example, if the value on the screen is 50, the actual distance the robot measured is 50x10=500cm, which equals 5 meters.

7) Corner leg number

Number of corner legs detected. R&D use only.

8) Narrow passage leg number

Number of narrow passage legs detected. R&D use only.

2.2.1.10 Drive Motors screen – 123

Upon entering to 'Drive motors' screen, the following will be displayed on the robot's LCD:

1) Left current	2) H/W over-current	3) Left S/W over-current	4) Over-current counter
5) Right current	6 Accumulated distance	7) Right S/W over-current	8) Total over-current events
9) Drive gear ratio	10) Motor max RPM		

1) Left current [10mA]

Displays the Left drive current detection in 10mA unit resolution; means 1 value equals 10mA in real. For example, if the value on the screen is 230, the actual current detected is 230x10=2,300mA, which equals to 2.3 Amp.

Expected values: In a new robot the readings should be 220-240 (+/-10%) for drive wheels lifted in the air (with no load).

Over current is detected when the current is higher than 2.0A for 3sec (default settings). Both threshold parameters (current & time) are adjustable through the 'Service' menu.

2) H/W Over current detection

Indicates if drive over-current is detected by the Hardware.

Expected values:

0 = No detection	1 = Over current detection

3) Left S/W over current detection

Indicate if Left drive over-current is detected by the Software. Expected values:

0 = No detection	1 = Over current detection

4) Over-current Counter

R&D use only

5) Right current [10mA]

Displays the Right drive current detection in 10mA unit resolution; means 1 value equals 10mA in real. For example, if the value on the screen is 230, the actual current detected is 230x10=2,300mA, which equals to 2.3 Amp.

Expected values: In a new robot the readings should be 220-240 (+/-10%) for drive wheels are lifted in the air (with no load).
Over current is detected when the current is higher than 2.0A for 3sec (default settings). Both threshold parameters are adjustable through the 'Service' menu.

6) Accumulated distance [10cm]

Displays the accumulated distance the drive motors drove in the in now running automatic operation.

Displays the values in 10cm unit resolution; means 1 value equals 10cm distance in real. For example, if the value on the screen is 100, the actual current detected is 100x10=1,000cm, which equals to 10 meters.

7) Right software over current

Indicates if Right drive over-current is detected by the Software. Expected values:

0 = No detection	1 = Over current detection

8) Total over current events

Whenever an over current event is detected by the robot, this counter increases in one. The counter will show the accumulated over current events in the now running automatic operation.

The counter is reset to '0' every new operation (Automatic departure or 'Go' button press).

9) Drive gear ratio

Indicates the revolutions number requires to the gear to complete one drive wheel revolution (round).

Expected values: For calibration code 400713, the ratio is 1:71 (the value on the screen will be 71)

10) Motor max RPM

Indicates the drive motors RPM in no load conditions, at 26V power supply.

Calibrated value

2.2.1.11 Mow motors screen – 124

Upon entering to 'Mow motors' screen, the following will be displayed on the robot's LCD:

1) Left current	2) Left RPM speed	3) Left temperature	4) Motors On/Off reason
5) Right current	6) Right RPM speed	7) Right temperature	8) Total over-current events
9) Power save mode	10) Over-current Count1	11) Over-current Count2	12)Power save high current time

1) Left current [10mA]

Left mow motor current in 10mA unit resolution; means 1 value equals 10mA in real.

For example, if the value on the screen is 80, the actual current detected is 80x10=800mA, which equals to 0.8 Amp.

Expected values in no load conditions: 600 – 850 mA

2) Left speed [RPM]

Left mow motor speed in RPM units

Expected values: In normal operation ~4000. In Eco mode ~3300

3) Left temperature [ºC]

Displays the Left mow motor temperature that is measured by the Thermistor placed inside the motor's shield.

4) Motors On/Off reason

#	Reason
1	Drop-off is detected – Mow motors are disabled
2	Bumper is detected – Mow motors are disabled
3	Tilt is detected – Mow motors are disabled
4	Handle is lifted – Mow motors are disabled
5	Stop button is pressed – Mow motors are disabled
6	Robot is charging – Mow motors are disabled
7	Robot is during docking station exit – Mow motors are disabled
8	Robot is approaching to an entry point – Mow motors are disabled
9	Robot is in reverse movement in automatic mode – Mow motors are disabled
10	Wire sensors are out for too long time – Mow motors are disabled
11	Zone distance learn is enabled – Mow motors are disabled
12	One time setup is running – Mow motors are disabled
13	BIT edge terminate test is active – Mow motors are disabled
14	Robot in demo mode – Mow motors are disabled
15	Mow motors are halted
16	Mow motors disabled from the Service menu (Settings)
17	No wire signal is detected during automatic operation – Mow motors are disabled
18	Battery capacity does not allow mowing – Mow motors are disabled
19	BIT 'Follow near wire' test is active – Mow motors are disabled
20	Manual mowing – Mow motors are 'on'
21	Automatic operation – Mow motors are 'on'
22	BIT mode – Mow motors are 'on'
23	Robot is searching the docking station – Mow motors are disabled
24	Mow motors are halted due to bumper/dropoff/tilt detection

5) Right current [10mA]

Right mow motor current in 10mA unit resolution; means 1 value equals 10mA in real.

For example, if the value on the screen is 80, the actual current detected is 80x10=800mA, which equals to 0.8 Amp.

Expected values in no load conditions: 600 – 850 mA

6) Right speed [RPM]

Left mow motor speed in RPM units

Expected values: In normal operation ~4000. In Eco mode ~3300

7) Right temperature [ºC]

Displays the Right mow motor temperature that is measured by the Thermistor placed inside the motor's shield.

8) Total over-current events

Whenever an over current event is detected by the robot, this counter increases in one. The counter will show the accumulated over current events in the now running automatic operation.

The counter is reset to '0' every new operation (Automatic departure or 'Go' button press).

9) Mow Power Save mode

1 = Normal	2 = Economic

Economic means Power Save mode is 'On'.

10) Over-Current counter 1

R&D use only

11) Over-Current counter 2

R&D use only

12) Power save high current time [Sec]

The accumulated time in seconds, which high mowing motors current (more than 2A) is detected during Eco mode, then the robot will stop the Eco mode and switch to normal mowing mode.

2.2.1.12 Temperature screen – 125

Upon entering to 'Temperature' screen, the following will be displayed on the robot's LCD:

1) Left Mow temperature	2) Right Mow temperature	3) Mainboard temperature	4) Battery temperature

1) Left mow Temperature [ºC]

   Displays the Left mow motor temperature that is measured by the Thermistor placed inside the motor's shield.

2) Right mow Temperature [ºC]

   Displays the Right mow motor temperature that is measured by the Thermistor placed inside the motor's shield.

3) Main Board Temperature [ºC]

   Displays the temperature that is measured by a Thermistor placed on the Main Board.

4) Battery Temperature [ºC]

   Displays the temperature that is measured by a Thermistor placed inside the Battery pack.

2.2.1.13 Battery screen – 126

Upon entering to 'Battery' screen, the following will be displayed on the robot's LCD:

1) Battery cell 1 volt	2) Battery cell 2 volt	3) Battery cell 3 volt	4) Battery cell 4 volt
5) Battery cell 5 volt	6) Battery cell 6 volt	7) Battery cell 7 volt	8) Battery cell 8 volt
9) Battery volt	10) Battery state	11) Battery capacity	12) System current consumption

1) Battery cell 1 volt [10mV]

   Displays the voltage inside cell #1 in 10mV unit resolution; mean 1 value equals 10mV in real. For example, if the value on the screen is 400, the actual current detected is 400x10=4,000mV, which equals to 4.0 Volt.

   Expected values: With a new battery, fully charged the readings should be 360 – 400

2) Battery cell 2 volt [10mV] – 8) Battery cell 8 volt [10mV]

   See "Battery cell 1 volt" above

3) Battery volt [10mV]

   Displays the battery voltage in 10mV unit resolution; means 1 value equals 10mV in real. For example, if the value on the screen is 2600, the actual current detected is 2,600x10=26,000mV, which equals to 26.0 Volt.

   Expected values: In a new fully charged battery the readings should be 2500-2650

4) Battery state

Displays the battery state

0 = Battery dead	1 = Low battery	2= Recharge battery	3 = Battery ready

5) Battery capacity [100mA/H]

Displays the battery capacity in 100mA/Hour unit resolution; means 1 value equals 100mA/H in real. For example, if the value on the screen is 12, the actual capacity is 12x100=1,200mA/H, which equals to 1.2 A/H.

The maximum capacity is 6 A/Hour

6) System current consumption [100mA]

Displays the entire system's current consumption in real time. The value is higher as more components are in action, meaning the minimal value will be seen in idle mode, and the maximal value will be reached when all components are in action (drive and mowing non ECO).

Values are in 100mA unit resolution; means 1 value equals 100mA in real. For example, if the value on the screen is 3, the actual current consumption is 3x100=300mA, which equals to 0.3A.

Robot in Idle mode should consume about 100mA (0.1A).

Values range can be 0 – 20A.

2.2.1.14 Software screen – 128

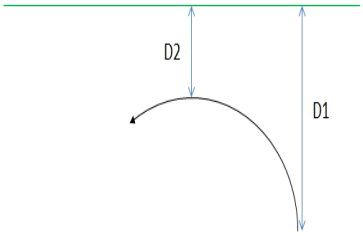
Debug tool, R&D use only.

2.3 Settings Menu

For default values, ranges and intervals refer to the “RS Service Interface” Excel sheet.

The table below describes the variables and short explanation of each of the menus under Settings.

Category	Sub category	Value	Value explanation
Base Station	--	Detect Distance	When a station is detected by the front I/R, while it drives Near Wire, the robot acquires the wire to drive on its maximum the “Detect Distance” value that was set. If no station was detected, the robot return to the drive Near Wire
	--	Telemetry On/Off	Enable/disable detection of the station & the Power box configuration by communicating with the robot
	--	Search Capacity	A minimum battery capacity which the robot will stop automatic operation and start searching the station for charging
		Search Voltage	A minimum battery cell voltage which the robot will stop automatic operation and start searching the station for charging
Operation	Narrow Passage	On/Off	Enable/disable narrow passage behavior
		Width	If the robot was enabled to Narrow Passage, and it drives 2 legs a distance below the settings here, the robot enters to Narrow Passage mode and changes its scanning mechanism to Parallel. See Figure 2.5 for Width definition.
		Length	If the robot runs in Narrow Passage mode, when it reaches to the passage corner, it will acquire the wire to follow it a distance that was set as length here. See Figure 2.5 for Legth definition.
	Subzone Passage	Length	Subzone Passage length. R&D use
	Back From Wire	On/Off	Enable/disable backing away from the wire during scan
		Distance	The distance that the robot will back away from the wire after reaching the edge during scan
	--	Slow Near Wire	Enables Near wire slow speed movement

Category	Sub category	Value	Value explanation
	--	Wire Gain Switch	Wire minimal invalid amplitude which below the robot will not start to work (All zones/subzones)
	In Motion Turn	On/Off	Enable/disable the 'in-motion' turn. When set to off, the 'in-place' turn is being used
	In Motion Scan	On/Off	Enable/Disable the 'in-motion' scan.
		Distance	Distance 1: Represent the distance from the wire it starts the 'in-motion turn' behavior (before reaching the wire). The bigger the value the closer to the wire the robot will start the behavior. Distance2: Represent the distance from the wire it tries to finish the 'in-motion turn' behavior 
		Max Wire Signal	Manually set the maximal wire amplitude in the garden (per zone). This value is learned automatically and should be overwritten only when problem is detected.
	Near Wire Follow	Distance	Distance to follow the wire while driving back to Base station
	Wire Follow Distance	Distance	Wire following distance limit in meters during scan
	Edge	On/Off	Indicates if edge is enabled during the program
		Edge Rescue	Enable/disable edge rescue during scan
		Turns	Set the left/right edge quarters threshold. Right turn threshold is used for island detection. Left turn threshold is used for telling the robot when to quit the wire follow during edge operation
	Tilt	Intensity	Tilt sensitivity(minimal)
	Stop time	Stop time	Safety sensor maximal detection time before system operation stop

Category	Sub category	Value	Value explanation
	Statistics	On/Off	Enable/disable operation data into the EEPROM, which will be available to be retrieved via SMS or Toolkit
	Temperature	Temp	The ambient temperature in which below the set point the robot will not automatic departure to operation. The ambient temperature is measured by: Thermistors on the Main Board, inside each of the mowing motors, and inside the battery pack. The lowest value from all three defined as the Ambience Temperature
		On/Off	
Mowing Motors	Eco Mode	On/Off – Operation	Enable/disable Eco mode operation
		On/Off – Edge	Turn mowing Eco mode during edge on/off
		On/Off – First Cycle	Turn On/Off the feature of forcing the robot to be in full mow power during the first cycle
		Speed --> On Speed	Mow motor RPM (Rounds Per Minutes) during ECO mode On
		Speed --> Off Speed	Mow motor RPM during ECO mode Off
		Sensitivity	The current threshold in which ECO mode On will be terminated
	Over Current	Sensitivity	The current threshold in which Over Current event is detected
		Time	The time the robot will allow to the O.C sensitivity value to be present before an O.C event is detected
	Stop Time	Time	The time for the mowing motors to resume operation after one of the Safety sensors in the robot is detected, and released. For example, if a bumper event is detected the mowing motors are stop immediately. Once the robot detects that it is OK to resume motors operation, it will count this “Stop time” and only then resume operation
	--	On/Off	Enable/disable mowing motors operation
	Direction	Left	Direction of the left mowing motor rotations

Category	Sub category	Value	Value explanation
		Right	Direction of the right mowing motor rotations
	Temperature	Left (On/Off)	Enable/Disable the contolling of the Thermistor to cancel an auto depart below 5 Deg
		Right (On/Off)	
Drive Motors	Over Current	Sensitivity	The current threshold in which Over Current event is detected
		Time	The time the robot will allow to the O.C sensitivity value to be presented before an O.C event is detected
Power Supply	--	Type	The maximal current driven out of the power supply while charging
	--	Source	Charging place
Battery	--	Type	Battery capacity used in this model
	Charging	Charging Current	The current that pushed to the battery during charging
		Capacity	Option to change the battery capacity manually
	--	Capacity	Manual setting of the battery capacity
	Current	Current 1	N/A
		Current 2	N/A
Factory Default	--	Main Board	Main board factory default. Calibrations require: Tilt, Front Wheel, Bumper, Wire, Language, Date, Time. Reset all settings to default. Need to update robot's S/N in "Change Mower S/N menu"
	--	Software	Software factory default. Calibrations require: Language, Date, Time, Reset all settings to default
	--	Out of the box	Out of the box factory default. Calibrations require: Language, Date, Time, Reset all settings to default + One time setup sequence
	--	Change Mower S/N	Modify mower S/N in case Main Board/Front Board/Wire Sensors replacement

Category	Sub category	Value	Value explanation
Bluetooth	--	On/Off	Enable/disable GSM module
		Serial Number	Activate the bluetooth command that saves the robot S/N to the RBLE
	--	Device Name	Activate the bluetooth command that sets the RBLE device name
		Service	Activate the bluetooth command that enters the RBLE into service mode , which means that RBLE will communicate with any mobile device in the area, and not only the one that was robot's owner mobile device.
Communications	--	Bluetoth	Set the robot to bluetooth communication To communicate with markers and the mobile app
		Serial Connector	Set the robot to serial connector communication. To communicate with the toolkit
Software version	--	Demo	Enables/disables demo version
Slippage	-- --	On/Off	Enable/disable the slippage mechanism
		Sensitivity 1	A distance which after elapse a Slippage event will be detected
		Sensitivity 2	Sensitivity of the front wheel odometer ticks detection.
Bumper	--	Sensitivity1	Threshold to detect front bumper event during scan & edge (except In-Place turns)
	--	Sensitivity2	Threshold to detect bumper event during In-Place turns
Tilt	--	Intensity	The intensity of the fix parameter for drive movements due to tilt angle for keeping straight drive in slopes
Floater	Floater Lift	On/Off	Enable/Disable the Floater Lifter
		Voltage	Controls the voltage used for holding the floater up
Lamp	--	On/Off	Enable/disable lamp

Figure 2.5 describes the Length and Width of Narrow Passage.

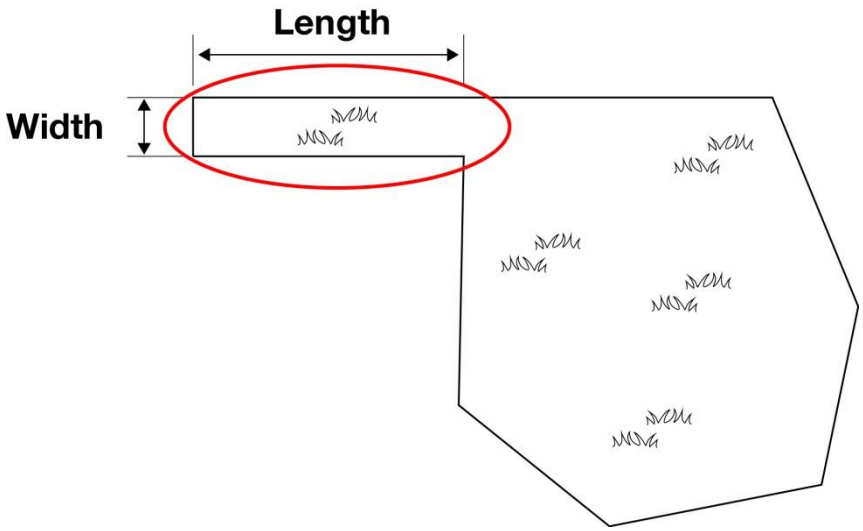


Figure 2.5

2.4 Tests Menu

2.4.1 Sensors Tests

2.4.1.1 Wire Sensors Test

This test contains 2 steps. The first step runs with wire signal turns On, and the second part runs with wire signal turns Off.

Step1 – Wire On test

Place the robot inside the plot, Wire signal is On, and start the test.

If the test passes then 'Passed' message will be displayed on the screen. If the test fails during Step1, failure number will be displayed on the screen. Enter failure number on the screen in the BIT Calculator to find out which failure(s) detected by the test, and refer to chapter 3 (Troubleshooting), paragraph 3.2 for detailed failure description.

Step2 – Wire Off test

Continue the test by switching the wire signal to Off (require to unplug the main outlet out of power to completely shut the Power Box Off), Then press 'Go' button.

During this test drive and mow motors are activated to check system noises, therefore perform it in places where there is no high grass around and a hard rigid surface is available.

If the test passes then 'Passed' message will be displayed on the screen. If the test fails during Step2, failure number will be displayed on the screen. Enter failure number on the screen in the BIT Calculator to find out which failure(s) detected by the test, and refer to chapter 3 (Troubleshooting), paragraph 3.2 for detailed failure description.

2.4.1.2 Bumper Test

The test starts with an internal test which if fails; a failure number will be displayed on the screen. Enter failure number on the screen in the BIT Calculator to find out which failure(s) detected by the test, and refer to chapter 3 (Troubleshooting), paragraph 3.2 for detailed failure description.

If the test passes then the following will be displayed on the robot's screen:

Sensor state	Display
Bumper not detected	-
Front bumper	^
Left bumper	<
Right bumper	>

2.4.1.3 Front Wheel / Drop-Off Test

The test starts with an internal test which if fails; a failure number will be displayed on the screen. Enter failure number on the screen in the BIT Calculator to find out which failure(s) detected by the test, and refer to chapter 3 (Troubleshooting), paragraph 3.2 for detailed failure description.

If test passes then the following will be displayed on the robot's screen:

Sensor state	Display
Drop Off not detected	-
Front Wheel lifted	*

2.4.1.4 Tilt Test

The test starts with an internal test which if fails; a failure number will be displayed on the screen. Enter failure number on the screen in the BIT Calculator to find out which failure(s) detected by the test, and refer to chapter 3 (Troubleshooting), paragraph 3.2 for detailed failure description.

If test passes then the following will be displayed on the robot's screen:

Sensor state	Display
Tilt not detected	-
Tilt is detected	*

2.4.1.5 Rain Sensor Test

The test starts with an internal test which if fails; a failure number will be displayed on the screen. Enter failure number on the screen in the BIT Calculator to find out which failure(s) detected by the test, and refer to chapter 3 (Troubleshooting), paragraph 3.2 for detailed failure description.

If test passes then the following will be displayed on the robot's screen:

Line 1:	- / *	
Line 2:	Value #1	Value #2

Legend:

'-' : Rain not detected

'*': Rain detected

'Value #1': Rain sensor actual reading

'Value #2': Rain detection threshold setting

2.4.1.6 I/R Test

When selecting this test, the following will be displayed on the robot's LCD

Line 1:	- / B	- / R
Line 2:	- / B	- / R

Legend:

Line 1: Signals detected at the robot's front I/R receiver

Line 2: Signals detected at the robot's rear I/R receiver

'-': No signal detect

'B': Base Station signal detect

'R': Remote signal detect

2.4.2 Drive Motors Test

Drive test should be performed when the robot's wheels are lifted in the air or on a clear surface to prevent drive over-current event to happen during the test.

If test fails, failure number will be displayed on the screen. Enter failure number on the screen in the BIT Calculator to find out which failure(s) detected by the test, and refer to chapter 3 (Troubleshooting), paragraph 3.2 for detailed failure description.

2.4.3 Mowing Motors Test

Mow test should be performed where no grass below the robot prevent mow over-current event to happen during the test

If test fails, failure number will be displayed on the screen. Enter failure number on the screen in the BIT Calculator to find out which failure(s) detected by the test, and refer to chapter 3 (Troubleshooting), paragraph 3.2 for detailed failure description.

2.4.4 Edge Termination Test

This test can be used for testing Edge mode in cases where the robot does not complete edge cycle successfully in the lawn, or if the robot does not return back to Base Station at the end of operation(s).

Start the test when the robot is on the base station. The robot then starts to perform an edge cycle and when the edge is completed the robot will display "Edge terminate" message in the first line on the robot's screen.

In the 2nd line of the screen a test result number will be displayed. Search the result # in chapter 3 (Troubleshooting), paragraph 3.3 for detailed results description.

2.4.5 Near Wire Follow Test

Drive the robot in the maximum distance set in Near Wire Follow Distance (set in the Service → Operation → Near Wire Follow → Distance).

This allows the user to test if the maximum distance that was set works fine all around the perimeter.

2.4.6 Buttons Test

This test is used for testing the buttons on the robot's front panel and the safety Stop bar.

Line 1:	G	C	U	D	S
Line 2:	- / *	- / *	- / *	- / *	- / *

Legend:

'G': Go button

'C': Cancel button

'U': Up button

'D': Down button

'S': Stop bar

'-' : No press detected

'*': Press detected

2.4.7 Battery Test

If test fails, a failure number will be displayed on the screen. Enter failure number on the screen in the BIT Calculator to find out which failure(s) detected by the test, and refer to chapter 3 (Troubleshooting), paragraph 3.2 for detailed failure description.

If test passes then the following will be displayed on the robot's screen:

Line 1:	Cell 1 voltage [mV]	Cell 2 voltage [mV]	Cell 3 voltage [mV]	Cell 4 voltage [mV]
Line 2:	Cell 5 voltage [mV]	Cell 6 voltage [mV]	Cell 7 voltage [mV]	Cell 8 voltage [mV]
Line 3:	Battery voltage in mV	System switch voltage in mV	Battery volt ground resistance fix in mV	Battery temperature in Celsius degrees

2.4.8 User Indicators Test

The test checks if all MMI (Man Machine Interface) items in the robot are operating well.

When the test is start, the robot will activate the following devices:

Lamp (illuminate)

Siren (beep)

LCD (Display: “If you can read, this LCD is OK”)

Press 'C' or 'STOP' button to terminate the test.

2.4.9 GSM Module Test

The test checks the functioning of the GSM module(Robot’s relevant parameters, GSM board, Sim Card and 3G connectivity).

2.4.10 Bluetooth Test

The test checks the Bluetooth device on the robot, when mobile application is detected the robot will sound a beep and the word “mobile device” will be displayed, when marker is detected the word “marker” will be displayed.

2.4.11 Floater Test

The test checks the floater.

“to lift up press up”

“to lower down press down”

Will be displayed on the screen.

User should check if the floater is lifted after Up button was pressed, and if it is down after down button was pressed.

2.4.12 Charge Current Test

R&D use only

2.5 Calibrations Menu

2.5.1 Wire Sensors Calibration

Start the calibration process by pressing 'Go' button, and follow the on-screen instructions.

IMPORTANT NOTE! When the robot instructs to switch the wire signal to OFF, unplug the main outlet cord from the power to completely shut the Power Box Off.

If the calibration process was finished successfully, "Passed" message will be displayed on the robot's screen. Press 'Go' button to acknowledge the message and move to the next operation require. Should the calibration failed, a "Failure #" message will be displayed on the robot's screen. Check failure number and possible resolution(s) in the "System Failure" table 3.2 shown in chapter 3 – Troubleshooting.

2.5.2 Drive Motors Calibration

Drive motor has a calibration code which is 6 digits number. For the time being, the code to be used in all RS models is: 400713.

When the new drive motor with a different code number will be valid, a list with all relevant calibration codes will be published.

2.5.3 Mowing Motors Calibraiton

Mow motor has a calibration code which is 5 digits number. Refer to the Product Line table to tell what robot model is being equipped with Brash mow motor and what model with Brushless mow motor.

Mow Motor	Calibration Label
Brush	25413
Brushless	46122

2.5.4 Tilt Calibration

Place the robot on a rigid, flat surface and start the calibration process by pressing 'Go' button, and follow the on-screen instructions.

If the calibration process was finished successfully, "Passed" message will be displayed on the robot's screen. Press 'Go' button to acknowledge the message and move to the next operation require. Should the calibration failed, a "Failure #" message will be displayed on the robot's screen. Check failure number and possible resolution(s) in the "System Failure" table 3.1 shown in chapter 3 – Troubleshooting.

2.5.5 Max Wire Signal Calibration

This calibration related to the “In-Motion-Scan”.

It celebrates the maximal linear wire amplitude, and done per zone.

Place the robot about ½ meters away from the wire, perpendicular to it (90 Deg) heading the wire. Select the zone to calibrate and press Go button. The robot will drive toward the wire, will stop when the two sensors are outside the lawn, and will drive backward slowly.

When the two wire sensors are back inside, the robot will stop and will remember the amplitude wire level exactly above the wire.

2.5.6 Bumper Calibration

Start the calibration process by pressing ‘Go’ button, and follow the on-screen instructions.

When instructed to push the bumper, press from the front, center, lower bumper area (below the charging contacts) toward backwards. The best practice to press the bumper right is holding the front wheel with two fingers and push with the thumb until the bumper reaches its end position backwards. Then press ‘Go’ button again to finish the calibration.

See Figure 2.6 for exact position where & how to push the bumper from.

Figure 2.6

If a calibration process was finished successfully, “Passed” message will be displayed on the robot’s screen. Press ‘Go’ button to acknowledge the message and move to the next operation require. Should the calibration failed, a “Failure #” message will be displayed on the robot’s screen. Check failure number and possible resolution(s) in the “System Failure” table 3.1 shown in chapter 3 – Troubleshooting.

2.5.7 Front Wheel Calibration

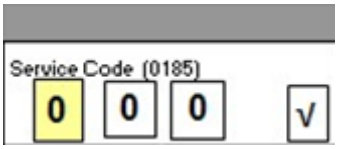
Start the calibration process by pressing ‘Go’ button, and follow the on-screen instructions.

When instructed to lift the robot, lift the front area not more than 5 cm to allow the front wheel generate Drop-off event. While the robot is lifted press ‘Go’ button.

If the calibration process was finished successfully, “Passed” message will be displayed on the robot’s screen. Press ‘Go’ button to acknowledge the message and move to the next operation require. Should the calibration failed, a “Failure #” message will be displayed on the robot’s screen. Check failure number and possible resolution(s) in the “System Failure” table 3.1 shown in chapter 3 – Troubleshooting.

2.6 Service menu: Temporary Code list

Temporary code is the code to type whenever a non-authorized person needs to have an access to one of the robot's service menus.



Ask the customer for the counter number in parentheses and check the temporary code in the below list.

IMPORTANT NOTE!

The number in the parentheses changes every 24 hours (as long as the robot is not in a sleep mode). Hence make sure the customer who gets temporary code knows that, and uses the code before the counter changes.

Counter	Temp. Password
0	000
1	001
2	006
3	015
4	028
5	045
6	066
7	091
8	120
9	153
10	190
11	231
12	276
13	325
14	378
15	435
16	496
17	561
18	630
19	703
20	780
21	861
22	946
23	036
24	129
25	226
26	327
27	432
28	541
29	654
30	771
31	892
32	018
33	147
34	280
35	417

Counter	Temp. Password
36	558
37	703
38	852
39	006
40	163
41	324
42	489
43	658
44	831
45	009
46	190
47	375
48	564
49	757
50	954
51	156
52	361
53	570
54	783
55	001
56	222
57	447
58	676
59	909
60	147
61	388
62	633
63	882
64	136
65	393
66	654
67	919
68	189
69	462
70	739
71	021

Counter	Temp. Password
72	306
73	595
74	888
75	186
76	487
77	792
78	102
79	415
80	732
81	054
82	379
83	708
84	042
85	379
86	720
87	066
88	415
89	768
90	126
91	487
92	852
93	222
94	595
95	972
96	354
97	739
98	129
99	522
100	919
101	321
102	726
103	136
104	549
105	966
106	388
107	813

Counter	Temp. Password
108	243
109	676
110	114
111	555
112	001
113	450
114	903
115	361
116	822
117	288
118	757
119	231
120	708
121	190
122	675
123	165
124	658
125	156
126	657
127	163
128	672
129	186
130	703
131	225
132	750
133	280
134	813
135	351
136	892
137	438
138	987
139	541
140	099
141	660
142	226
143	795

Service Temporary Code list (Continue):

Counter	Temp. Password
144	369
145	946
146	528
147	114
148	703
149	297
150	894
151	496
152	102
153	711
154	325
155	942
156	564
157	190
158	819
159	453
160	091
161	732
162	378
163	028
164	681
165	339
166	001
167	666
168	336
169	010
170	687
171	369
172	055
173	744
174	438
175	136
176	837
177	543
178	253
179	966

Counter	Temp. Password
180	684
181	406
182	132
183	861
184	595
185	333
186	075
187	820
188	570
189	324
190	082
191	843
192	609
193	379
194	153
195	930
196	712
197	498
198	288
199	082
200	879
201	681
202	487
203	297
204	111
205	928
206	750
207	576
208	406
209	240
210	078
211	919
212	765
213	615
214	469
215	327

Counter	Temp. Password
216	189
217	055
218	924
219	798
220	676
221	558
222	444
223	334
224	228
225	126
226	028
227	933
228	843
229	757
230	675
231	597
232	523
233	453
234	387
235	325
236	267
237	213
238	163
239	117
240	075
241	037
242	003
243	972
244	946
245	924
246	906
247	892
248	882
249	876
250	874
251	876

Counter	Temp. Password
252	882
253	892
254	906
255	924

3. Troubleshooting

RS model has three error list types: “Operation Stop Reason”, “System Failure”, and “BIT Failure”.

To find any error reason, refer to one of the below lists (depends what error message is displayed on the LCD), and connect the robot to the RS-Toolkit or check the relevant Special Display readings, to find odd values which can tell a hint of what is the source of the failure.

3.1 “Operation Stop Reason” list (Also known as “Last Stop Cause”):

Error messages and corrective actions table are published in the Operating & Safety manual. Error on the robot’s screen will not contain a number, but a short message. If the ↑ arrow button is then pressed, a number of the stop reason will be displayed. This number is what well known as “Last Stop Cause” number. Search the message/number displayed on the robot’s LCD in table 3.1 below to learn more about the failure(s) occurred.

Stop Reason Number	LCD Message	Description	Extra information
0	N/A		
1	No message	STOP button is pressed	
2	No wire signal	No wire signal is detected during automatic operation warming up phase	
3	Start inside/change wires in plot connector	Automatic operation was initiated by the user while robot is outside the plot	
4	Key pressed	Button constant press is detected during the automatic operation warming up phase.	Occurs only if operation was initiated by the user and not automatically.
5	Bumper pressed	Bumper is detected during the automatic operation warming up phase.	Occurs only if operation was initiated by the user and not automatically.
6	Front wheel prob.	Drop-off is detected during the automatic operation warming up phase.	Occurs only if operation was initiated by the user and not automatically.
7	Stuck in place/Cross outside	Consecutive turn movements are received without any heading movements	One of the following occurred: 1) More than 35 in place turns movement occurred without forward movements 2) more than 90 seconds have elapsed since the last time robot was moving in forward direction

Stop Reason Number	LCD Message	Description	Extra information
8	Stuck in place	Robot is performing forward legs without receiving any termination event	Robot performed more than 2 legs that ended due to distance limit (250 meter)
9	Check power	Robot got off the base station because charging voltage is not detected	If charging voltage is lost when robot is charging on the base station, then after 5 minutes (in case battery is in recharge state, or 60 minutes in all other cases), the robot will get off the base station and wait for wire signal detection which indicates power is back ON and the robot will return back to the base station
10	No message	Charging process is halted because no charging voltage is detected	If charging voltage is lost when robot is charging on the base station, then after 5 minutes (in case battery is in recharge state, or 60 minutes in all other cases), the robot will stop charging and display this error message
11	No message	The One Time Setup is now running, and the robot stop the automatic operation since either the base position test or the wire test stages ended	
12	No message	The One Time Setup is now running, and the robot stop the automatic operation in order to handle an obstacle event	
13	Drive overheat	Drive driver overheat is detected	
14	Base problem	Robot was charging in the base, and due to power break it disconnected from the base in order to display the problem and failed to connect to the base station for more than 3 times	
15	Recharge battery	Battery state indicates automatic operation cannot be performed	Occurs during the automatic operation warming up phase only if operation was initiated by the user and not automatically
16	Drive overheat	Drive driver overheat is detected	The robot tried to recover itself from this event without success, and too much time have elapsed, so the operation was terminated

Stop Reason Number	LCD Message	Description	Extra information
17	Recharge battery	Battery voltage indicates that a charging battery is require	
18	Recharge battery	Battery voltage indicates it is time to stop the automatic operation	
19	No message	Charging process is halted due to charger overheat is detected	
20	No message	Carrying handle is lifted during automatic operation	This will also be detected if stop button is partially pressed or pressed slowly
21	Handle lifted	Carrying handle is lifted during automatic operation warming up phase.	Occurs only if operation was initiated by the user and not automatically.
22	Start elsewhere	Drive over-current is detected during automatic operation	Occurs only if robot is during scan operation
23	Start elsewhere	Drive over-current is detected during manual operation	
24	Stuck in place	Multiple robot Slippage events are detected	More than 5 consecutive slippage events occurred
25	Switch off before lifting	Tilt is detected	Tilt is detected for more than 5 seconds
26	No message	System switch is switched off	
27	Mow overheat	Mow overheat is detected during automatic operation	
28	Check mow height	Mow over-current is detected during automatic operation	Occurs only if we are not in mow eco mode
29	Check mow height	Mow over-current is detected during remote control operation	
30	No wire signal	Wire signal is not detected during automatic operation	
31	Mow overheat	Mow overheat is detected during manual operation	
32	Cross outside	Wire escape is detected during automatic operation	
33	Front wheel prob.	Front wheel drop-off detected for a long time during automatic operation	Front wheel drop-off is detected for more than 15 seconds during scan Or Front wheel drop-off is detected for more than 35 sec during automatic operation (Edge/Scan)

Stop Reason Number	LCD Message	Description	Extra information
34	Inactive Time	Inactive time detected during automatic operation	Occurs only if operation was initiated automatically and not by the user.
35	Time Completed	The robot has reached the required mowing time in the current active zone	Occurs only if the following exists: - operation was initiated automatically and not by the user - The robot is not in a demo mode
36	Rain detected	Rain is detected during automatic operation	Occurs only if operation was initiated automatically and not by the user
37	No message	Robot is now in a BIT edge terminate test, and end of edge is detected	
38	No message	Remote control Safety button is pressed during automatic operation	
39	No message	Stop button is pressed during manual operation	
40	Rain detected	Docking station automatic departure is disabled due to rain detection	
41	No message	Front wheel drop-off was detected for too long during Automatic operation, hence the robot has stopped its operation and sent back to Base	Occurs only if a Base exists. This is due to the new safety standard requirements
42	Front wheel prob.	Front wheel drop-off was detected for too long during automatic operation, hence the robot has stopped its operation	Occurs only if Base does not exist. This is for the safety standard requirement
43	No message	Bumper was detected for too long during automatic operation, hence the robot has stopped its operation and sent back to Base	Occurs only if Base exists. This is for the safety standard requirement
44	Bumper pressed	Bumper was detected for too long during automatic operation, hence the robot has stopped its operation	Occurs only if Base does not exist. This is for the safety standard requirement
45	Drive overheat	Drive driver overheat is detected during automatic operation but, operation is not yet stopped and robot is trying to recover from it	

Stop Reason Number	LCD Message	Description	Extra information
46	Mow overheat	Mow overheat is detected during automatic operation, but operation is not yet stopped and robot is trying to recover from it	
47	No wire signal	No wire signal is detected during automatic operation, but operation is not yet stopped and robot is trying to recover from it	
48	N/A		
49	No message	Wrong menu place is detected during automatic operation	This error should not occur and was entered as a redundancy
50	Recharge battery	Battery discharge time limitation is detected which indicates that a charging battery is require	The operation time is limited according to the battery capacity in order to protect battery lifetime
51	Recharge battery	Battery discharge time limitation is detected during the automatic operation warming up phase.	Occurs only if operation was initiated by the user and not automatically. The operation time is limited according to the battery capacity in order to protect battery lifetime
52	Recharge battery	Battery discharge time limitation is detected which indicates that a charging battery is require	This occurs due to battery voltage drop monitor detection. this monitor searches for voltage drop in any one of the battery cells which indicates battery needs to be recharged
53	Recharge battery	Battery discharge time limitation is detected which indicates that a charging battery is require	
54	Recharge battery	User tries to send the robot to the base station but battery state does not allow it	
55	Recharge battery	Battery discharge time limitation is detected which indicates that a charging battery is require	
56	No message	The robot is during BIT Near wire test, and end of edge is detected	
57	No message	UP/DOWN/Cancel button is pressed during automatic operation – "panic" mode	One or more of the buttons were pressed for more than 300 ms

Stop Reason Number	LCD Message	Description	Extra information
58	Operation shorter than expected	Docking station automatic departure is disabled due to short time operation cycle detected	10 consecutive automatic operations with less then 15 minutes each were performed
59	Low Temperature	Docking station automatic departure is disabled due to low temperature	Occurs only if operation was not initiated by the user and was automatically initiated from the base station
60	Check mow	Mow over-current or Mow disconnection is detected during automatic operation warming up phase , while the robot is in the docking station	
61	Stuck In Place	Robot is stuck on the wire.	5 rescue behavior retries were performed but without success.
62	Bumper pressed	Automatic operation was stopped since bumper was detected for too long.	Occurs only if Base exists. This is for the safety standard requirement
63	Stuck In Place	robot is stuck in place without the ability to move the motors for more than 100 seconds.	this can accur for example due to bumper which is not released and robot constantly detects it
64	Stuck In Place	robot is trapped and performed more than 100 consecutive short legs (legs with distance shorter then 150cm)	such scenarios can happen for example when robot gets trapped in a certain area where it is surrounded by many obstacles
65	Floater Problem	floater motor driver problem is detected	
66	Base Problem	We reached maximal edge quarters while performing wire following	
67	No message	Docking station is detected during go to entry point process	During search for entry point the docking station is detected. This could indicate a problem since the docking station should not be detected when going to another subzone
68	No message	Battery overheat is detected during charging	Battery temperature is higher than 60 degrees
69	No message	Robot panel UP button is pressed during automatic operation – "panic" mode	UP button was pressed for more than 300 ms
70	No message	Robot panel DOWN button is pressed during automatic operation – "panic" mode	DOWN button was pressed for more than 300 ms

Stop Reason Number	LCD Message	Description	Extra information
71	No message	a command to stop the robot was received from the robomow mobile application	
72	Start elsewhere	Drive over-current is detected during automatic operation	Occurs only if robot is during scan operation after 5 drive overcurrent events are detected
73	No message	Charging operation was stopped in order to send a robot operation GSM message	
74	Drive overheat	Drive motor overheat is detected	we tried to recover from this state without success and too much time have elapsed and eventually we decided to terminate the operation
75	Drive overheat	Drive motor overheat is detected during automatic operation but operation is not yet stopped and robot is trying to recover from it.	
76	Rain detected	Rain is detected during automatic operation.	Occurs only if operation was initiated automatically and not by the user.
77	No message	Battery capacity timeout	battery is not being charged good and does not reach the required cells state also after charging for a long time (more than 30 hours).
200-255	Failure: #	Will be received when system failure is detected.	

3.2 “System Failure” list:

System Failure list will be used in case an error with number is displayed on the robot’s screen, after normal customer operation, such as manual or automatic operation attempt, but not procedures that are done via the Service Menu. Search the failure # in table 3.2 below to learn more about the failure(s) occurred.

NOTE: “Possible fault component(s)” column describes way of operation to appeal to a certain failure. Starts from the easiest solution up to the heaviest

Failure #	Failure Reason	Possible fault component(s)
201	Wire signal Off reading is higher than wire signal On reading	— Make sure the Power Box is completely out of power — When instructed to switch the signal to On, make sure the Power Box is back in power — Replace Power Box

Failure #	Failure Reason	Possible fault component(s)
		— Replace Front Board — Replace Main Board — Replace front board to Main Board braid

Failure #	Failure Reason	Possible fault component(s)
202	Either signal Off amplitude or signal On amplitude exceeded allowed tolerance	— Make sure the Power Box is completely out of power — When instructed to switch the signal to On, make sure the Power Box is back in power — Replace Power Box — Replace Front Board — Replace Main Board — Replace front board to Main Board braid
203	The robot is out of the lawn during wire calibration with signal On	— Repeat the calibration — Make sure the plot connector connections were not swapped
204	Wire sensors, In/Out calibration readings are invalid	— Check Power Box is in the power — Check for no error LED(s) illuminated on the Power box — Replace Power Box — Replace Front Board — Replace Main Board — Replace front board to Main Board braid
205	Drop-off lifted reading is equal or lower than Front wheel Drop-off idle reading	— Repeat the calibration — Check front wheel easily go up & down on its axle — Check the magnet installed on the upper axle area — Replace Front Board — Replace Main Board — Replace front board to Main Board braid
206	Difference readings between Drop-off lifted and Drop-off idle is too small	— Repeat the calibration — Check front wheel easily go up & down on its axle — Check the magnet installed on the upper axle area — Replace Front Board — Replace Main Board — Replace front board to Main Board braid
207	Bumper calibration results are not valid	— Make sure the bumper sits tight on its place — Repeat the calibration — Check that magnet on the Bumper is not damage — Replace Front Board
208	Difference readings between Bumper not pressed and Bumper pressed is too small	— Make sure the bumper sits tight on its place — Repeat the calibration — Check that magnet on the Bumper is not damage — Replace Front Board
209	N/A	

Failure #	Failure Reason	Possible fault component(s)
210	Bad battery voltage calibration	— Measure the battery output and calibrate the battery voltage (see Menu chapter 2, paragraph 2.5.6)
211	Battery cells connector is disconnected	— Make sure the connector is well connected — Replace Battery Pack — Observe all pins in the connector. For any doubt replace Battery to Main Board braid
212	N/A	
213	Mow left Thermistor is disconnected	— Swap left & right motors to analyze if the failure swapped direction too. If the problem swapped to the other side, replace mo motor — Check left mow motor connector and pins. For any doubt replace left mow motor braid
214	Mow right Thermistor is disconnected	— Swap right & left motors to analyze if the failure swapped direction too. If the problem swapped to the other side, replace mo motor — Check right mow motor connector and pins. For any doubt replace right mow motor braid
215	Mow motor is disconnected	— Check connectors and pins. — Replace mow motor — For any doubt replace right mow motor braid
216	Drive motors calibration failed because calibration values are invalid	— Compare calibration number on drive wheel with the value set in the robot — Replace drive motor
217	Drive motor is disconnected	— Check connectors and pins. — Replace drive motor — For any doubt replace drive motor to Main Board braid
218	Tilt calibration failed	— Repeat calibration. Make sure the surface is flat (no slop) — Replace Main Board
219	Tilt calibration failed due to accelerometer readings are out of allowed tolerance	— Repeat calibration. Make sure the surface is flat (no slop) — Replace Main Board
220	System configuration is invalid	This error indicate if a S/W was burned on a non matched Main Board — Burn the right S/W into the Flash — Replace Main Board, and re-burn the S/W
221	front wheel odometer reading is not in tolerance	
222	right drive motor is disconnected	
223	right mow motor is disconnected	

Failure #	Failure Reason	Possible fault component(s)
224	safety standard power up test failed	
225	accelerometer configuration failed	
226	wire reading indicates calibration failed because the difference between wire max signal threshold and wire amplitude set point is too big	
227	wire reading indicates calibration failed because the wire no signal gain is too small	

3.3 “BIT” (Build In Test):

BIT was developed for easy diagnosis proposes, in order to display errors occur during test procedures and internal .

This unique presentation allows display in a very simple way what error(s) are detected by the robot.

After a test is done (from the Service → Tests menus), if the test passed, Pass will be seen on the display. If a number will be seen, convert the error number on the screen to tell what failure(s) reason(s) were detected. The conversion is done via the “BIT error report” convertor in the Robomow Distributor website

NOTE! Each test that is done in the robot, part of the test is to check if during the last relevant calibration process there was an error that caused the calibration process to terminate with an error. If for example Wire test is being checked, the robot will display error code(s) related to the last Wire Sensors Calibration procedure, if the calibration failed back then.

3.4 RS Troubleshooting Guide

	Subject
1	**Setup Problems**
1.1	'Disconnected wire' warning (On the Power Box)
1.2	Wire too long warning (On the Power Box)
1.3	Power Box does not operate /dead
2	**Power & Charging**
2.1	Blank LCD
2.2	Short run time
2.3	Winter Charger problem
2.4	Robot found outside the lawn, on the edge (parallel to the wire up to 1 meter away), or on an island
2.5	Low Battery Checkup
2.6	Charging circuitry checkup
2.7	Robot would not start automatic mowing (Power related problems)
2.8	RS Power consumption
3	**Mowing**
3.1	'Check mow height' / 'Mow Over heat'
3.2	Poor quality of cut & Damage of lawn
4	**Automatic operation**
4.1	Many patches of uncut grass remain on the lawn
4.2	Robot ignores areas (Main & Sub Zones)
4.3	Stops with no message / Does not wake up
4.4	Cross Outside
4.5	'Stuck in place' message
4.6	The entire lawn is uncut / Robot would not auto depart to mow
4.7	Robot changes direction with no visible reason
4.8	Noises heard from various places in the robot
5	**Wire Sensors**
5.1	No Wire Signal message
5.2	Find disconnection in the wire installation loop

Troubleshooting procedures can be done by the customer, DCS, Dealer or RSS. Each diagnosis topic is classified by the appropriate Service Level depends the complicate level of the diagnosis and repair procedure.

	DCS and customer over emails & telephone
	Dealer / Service Dealer / RSS

1.1 'Disconnected wire' warning (On the Power Box) – 1 Beep and sound every 1 second

Q1. Check that all connections between the Power Box through the 20 meters extension cord, till the Base Station, are all connected well (Green Plot connector of the lawn is connected too)?

If **Yes** – Proceed to Q2

If **No** – Secure all connectors back in place and observe if the warning persists.

Q2. Make a small lawn loop using the second green plot connector that was supplied with the robot, see picture to the right. Does the warning still persist?

If **Yes** – Proceed to Q3

If **No** – Proceed to Q5

Q3. Take the Power Box and connect it directly to the Base Station Head (wire loop still connected). This will bypass the 20 meters extension cord.

Does the warning still persist?

If **Yes** – Proceed to Q4

If **No** – Replace the 20 meters extension cord

Q4. Disconnect the power plug that feeds the Base Station Head and connect it to the second power socket under the rubber hatch Head (wire loop still connected). See picture to the right.

Does the warning still persist?

If **Yes** – Replace Power Box and Base Station Head

If **No** – Replace Base Station Head

Q5. Check for disconnections in the wire loop buried in the lawn. You can use AM radio to search for disconnections more easily.

Could disconnection be found in the wire?

If **Yes** – Fix the wire using official splicing connectors, see picture to the right

If **No** – Check with Resistance meter (DVM) the resistance of the entire loop. The factor is about 1 Ω per 40 meters wire. Proceed to Q6

Q6. Does the resistance higher than 40 Ω?

If **Yes** – There is a disconnection somewhere in the wire loop

If **No** – Send the Power Box and Base Station Head to the repair station for analysis.

1.2 Wire too long warning (On the Power Box) – 3 Beeps and sound, 1 second silence

Q1. Is it a new installation or changes have been done in the lawn/installation cable lately?

If **Yes** – Make sure the installation was done according the written instructions in the Operating and Safety Manual

If **No** – Proceed to Q2

Q2. Make a small lawn loop using the second green plot connector that was supplied with the robot, see picture to the right. Does the warning still persist?

If **Yes** – Replace Power Box and Base Station Head

If **No** – Proceed to Q3

Q3. Wire used for the installation is the official wire supplied with robot?

If **Yes** – Proceed to Q4

If **No** – Use only the official wire packages for the installation

Q4. Disconnect the plot connector from the Base Station Head and check with Resistance meter (DVM) the resistance of the entire loop. The factor is about 1 Ω per 40 meters wire.

Does the resistance higher than 40 Ω ?

If **Yes** – Proceed to Q5

If **No** – Replace Power Box and Base Station Head

Q5. Check for disconnections in the wire installation loop buried in the lawn.

Go to chapter 10.3 “Find disconnection in the wire installation loop”.

1.3 Power Box does not operate /dead

Q1. Make sure the power cord to the Power box is connected well in to the Power Box assembly.

If **Yes** – Proceed to Q2

If **No** – Proceed to Q3

Q2. Disconnect Power Box from both sides, the outlet socket and the 20 meters extension cord. Connect the 220V power cord to a second power outlet (that you are sure is alive). Does the Power Box still dead?

If **Yes** – Replace Power Box

If **No** – Proceed to Q3

Q3. Take the Power Box and connect it directly to the Base Station Head. This will bypass the 20 meters extension cord.

Will the Power Box shut down?

If **Yes** –Replace the Base Station Head

If **No** – Replace the 20 meters extension cord

2.1 Blank LCD

Q1. Robot in the Base Station; Press 'GO' button few times and wait about 20 second. Does it start to mow?

If **Yes** – Most probably the LCD is faulty. Hence the robot needs to be brought to an authorized Service Station for repair.

If **No** – Proceed to Q2

Q2. Place the robot on the Base Station, change Safety Switch to Off and wait until the robot wakes up and change the switch to On. Then proceed to paragraph 5.3 (Stops with no message / Does not wake up)

2.2 Short Run Time

Q1. Did you observe this error more than once lately?

If **Yes** – Proceed to Q2

If **No** – Remove the fuse at the rear robot side for 10 seconds, and insert fuse back in place. The robot will now be charged a long charging session up to 16 hours.

Q2. Open Last Battery Run time (Service → Information → Battery → Run Time). Does the Run Time values, are met with the average mowing time shown in the table below?

Average operating hours per **<u>one operation</u>** should be:

S model

Area Range set by User	Average Working time per 1 mowing operation
0 – 50	22
50 – 100	45
100 – 150	67
150 – 200	89
200 – 250	111
250 – 300	134
300-3000	140

If **Yes** – Proceed to Q3

If **No** – Most probably the battery is weak. Need to replace the battery pack.

Q3. Does the mowing height set low while the lawn height is high?

If **Yes** – Increase mow height and let the robot complete full mowing cycle (2-3 days) to understand if the problem resolved or still existing.

If **No** – Proceed to Q4

Q4. Turn the Safety Switch to OFF, lift front robot area and check the following

- Debris are not stuck in the mowing deck
- Blades are not bent
- Too much mulches built up between mowing deck and blades
- Rotate blades (using long stick or gloves). See picture to the right

Did any of above mentioned items observed in the mowing deck?

If **Yes** – Make sure the mowing deck is clean and blades are in good condition.

If **No** – Proceed to Q5

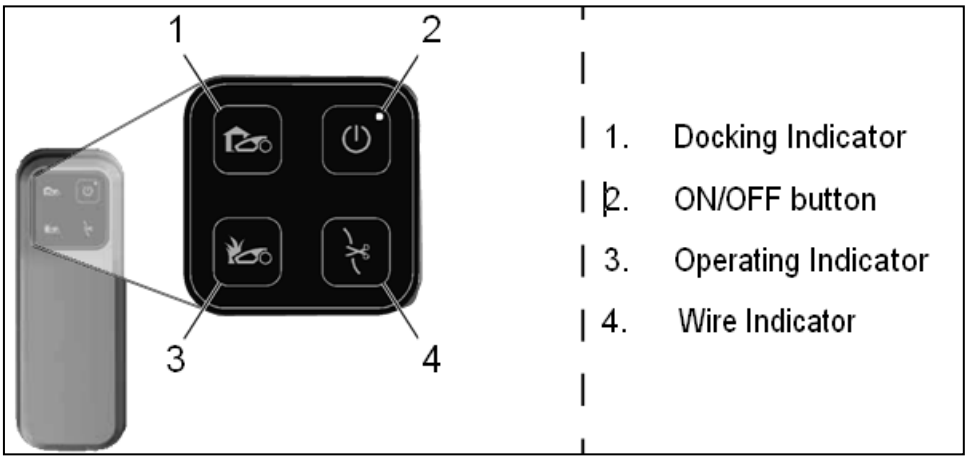
Q5. Turn the Safety Switch to ON, Enter Power Box to Pause mode (by pressing 2 seconds on the Pause button in the Power Box), place the robot on the Base Staiotn and let it charge 12 hours. Will a 'Ready' message be seen on the screen?

If **Yes** – The robot required a long charging session that happens once in a while. Let the robot continue work and contact Hot Line for further analysis.

If **No** – Need to replace the battery pack.

2.3 Winter Charging problem

Q1. Does the light bulbs (LEDs) on the Power Box showing the expected colors?



If **Yes** – Proceed to Q2

If **No** – Proceed to troubleshooting chapter 1.3 “Power Box does not operate”

Q2. Remove the charging adapter from the robot’s charging contacts. Wait few second and check robot screen. Does the screen show Zone Main or Zone A?

If **Yes** – Proceed to Q3

If **No** – Proceed to troubleshooting chapter 5.3 “Stop with no message”

Q3. Connect charging adapter back to the robot’s charging contacts. Wait 1 minute and check the robot screen. Make sure the Safety Switch is On. Does the screen show Home icon + Charging sign, or Home icon + “READY” ?

If **Yes** – This is the expected icons. Let the robot continue charging and if happen again, contact Hot Line for further analysis.

If **No** – The robot needs to be brought to an authorized Service Station for repair.

Q4. When the robot arrives the repair station, check the following:

NOTE: A Golden part(s) may be used for easy and fast diagnosis.

- Observe all above questions to make sure the customer did not miss something
- Charging Contacts and cable connector
- Front board
- Main Board

2.4 Robot found outside the lawn, on the edge (parallel to the wire up to 1 meter away), or on an island

Q1. Press "Go" button. Does the screen display an error message?

If **No** – Proceed to Q2

If **Yes** – If "Low Battery" is displayed – Go to Chapter 2.5 (**Low Battery checkup**)

For any other message – Check the error message in the Service Guide and act accordingly.

Q2. Does the robot wake up with set Time & Date request?

If **Yes** – Set time & date and Check the following:

A. Retrieve the last 10 events and send to Friendly Israel for analysis
B. Open Service → Information → Special Display → Battery screen. If at least one of the cells is below 2.7V – Charge the robot and let it work to observe recurrence of the failure.
C. Otherwise (all battery cells are higher than 2.7V), check visually the power connector to the battery that there are no burn signs and the connection is good between both sides.
D. If issues were NOT found in the battery connection, replace the battery and send to Friendly Israel the disassembled battery for analysis

If **No** (Robot do not wake up when pressing "Go" button) – Switch the Safety switch to Off, and Place the robot on the Base Station, wait 10 seconds, and proceed to Q3.

Q3. Does the robot wake up?

If **No** – Go to chapter 3 "**Charging circuitry checkup**"

If **Yes** – Change the Safety Switch back to On, charge the battery for 5 minutes, and proceed to Chapter 2 (**Low Battery checkup**)

2.5 Low Battery Checkup

Q1. Did you perform “Low Battery Checkup” lately?

If **Yes** – Proceed to Q2

If **No** – Proceed with paragraphs A-K below

A. Remove the robot Off the Base Station
B. Open Service → Information → Special Display → Charging Screen, and record the Charging Voltage in Table-1 below
C. Open Service → Information → Special Display → Battery screen. Record all 8 cell voltages in Table-1 below.
D. Retrieve the last 10 events (Service → Information → Events)
E. Push the robot on the Base Station, and wait until the Battery indicator is displayed on the LCD.
F. Open Service → Information → Special Display → Charging Screen, and record the Charging Voltage & Charging Current in Table-1 below
G. Charge the battery for one hour
H. Send the robot to a 'Near Wire Test' to observe it drives around the perimeter in Near Wire mode, and finds the Base Station to climb it back for charging without any issues.
   This is done through the Service Menu → Tests → Near Wire Follow test
I. If the 'Near Wire Follow' test passes OK, change the 'Search Capacity' to 2 AH. This is done through the Service Menu → Settings → Station → Search Capacity.
J. Change Battery Type to 5.5AH. This is done through Service → Settings → Battery → Battery Type
K. Send the entire information gathered up to now to Friendly Israel for further analysis, and let the robot run a few days with the new settings

		Value(s)	Expected values
B	Charging Voltage (#1)		15-17V
C	Cells voltages	(1)____ (2)____ (3)____ (4)____ (5)____ (6)____ (7)____ (8)____	2.7V – 3.6V
D	Last 10 events	1) ____ [__] 2) ____ [__] 3) ____ [__] 4) ____ [__] 5) ____ [__] 6) ____ [__] 7) ____ [__] 8) ____ [__] 9) ____ [__] 10) ____ [__]	
F	Charging Voltage (#1) Charging Current (#2)	_____V _____A	31-34V * 2.0-2.7A

Table 3.1

***** If the Charging Voltage is not between 31-34V, Proceed to Section 3 (Charging circuitry Checkup)


Q2. Did a Battery Pack replace lately?

If **No** – Replace Battery pack and send the Battery back to Friendly Israel for analysis.

If **Yes** – Collect the robot to the RSS (Regional Service Station), and record the following data:

A. Battery cells voltage (Service → Information → Special Display → Battery)
B. Open Speciual Display → Charging manu.
C. Connect the robot to the current measurement braid via a voltage-current measuring device, and connect the robot to a Base Station Head for charging (Winter Charging).
   When value #4 on the LCD turns 6 (Stage number 3), record value #2 (charging current), and the current the measuring device displays. At this stage it should be 70mA+/-30mA

LCD, Value #2	
Measuring device	

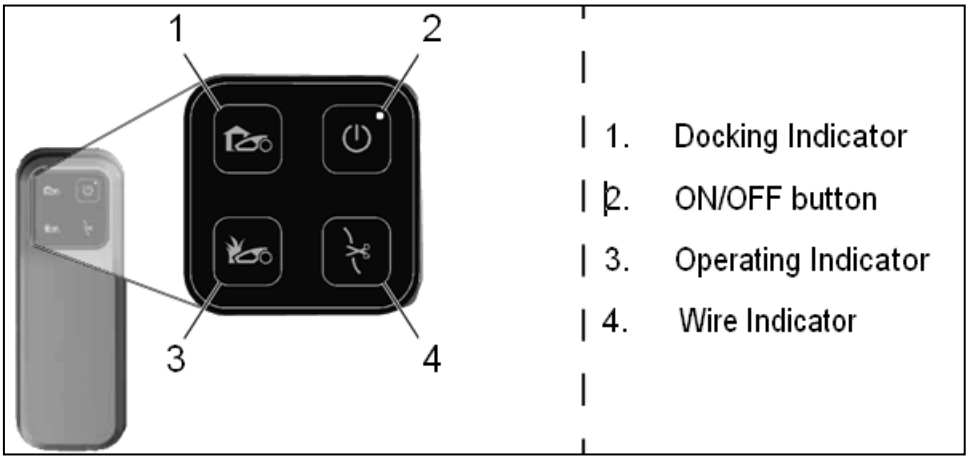
Connect to ‘A’ and COM ports, and put the position selector on Amp.
Important: Fail to do that will cause to the inner fuse inside the measuring device to burn

D. Record 3 hours of Charging log.
   Make Charge log recording:
   1. Place the robot on the Base Station for charging
   2. Launch RS Toolkit. Make sure you have a communication with the robot. In the upper menu bar, open Settings Troubleshooting settings Display Troubleshooting Set to Y
   3. Open the Troubleshooting tab. Click on <Debug Miscellaneous> button the P/W is 1234
   4. Check V to "Battery and Charging", and “Program”
   5. Press <OK>
   6. In the upper menu bar, open View Debug Window.
   7. After 12 hours of data collection, close the Debug window and the Toolkit application.
   8. Open path: C:\Friendly_Robotics\Projects\RS\RS_Toolkit\Files\Debug Window. The last file is the just created file.
   9. Send the file back to me for further analysis.

2.6 Charging circuitry checkup

Check the following in this order

1. Observe the Power Box visually to see if not blown , nor its color changed (dull) or other signs of over heat
2. Touch the Power Box to observe if it is overheated
3. Remove the robot off the Base Station, unplug the Power Box from its mains, and plug it back in. If the 'Docking Indicator' illuminated (solid) and/or the 'Operating Indicator' is repeatedly blinking for a pinch of a second, replace the Power Box
4. Place the robot back on the Base Station, and wait to see the 'Battery Charging' indicator on the robot's LCD. If it does not appear, bypass the 20 meter extension cord to connect the Power Box directly to the Base Station Head.
5. If no Battery Charging indicator is displayed on the robot's LCD, replace the Power Box. (If it helped, re-connect the 20 meter extension cord).
6. If neither replacing the Power box nor bypassing the 20 meter cord helped, replace the Base Station Head.



2.7 Robot would not start automatic mowing (already few days)

Q1. Check that the ON/Off (Pause) button on the Power Box is not pressed.
If the Pause button on the Power Box was activated, release the Pause button to allow the robot to start an automatic mowing.

If the Pause button on the Power Box was **not** pressed, check the display on the robot while on the Base Station. If a robot with a cross line is displayed, although the Pause button on the Power Box is **not** pressed, it means that there is a problem with the Telemetry (communication) between the Power Box and the robot.
In such case, set the Telemetry to 'Off' in the Service menu (Service → Settings → Station → Telemetry → On/Off) – this will disable the operation of the Pause button on the Power Box, but it will open a new menu at the user level (under Mower Options) called 'Program – On/Off' that allows the user to set the mowing schedule to 'Off'.

If both above observations found nothing, proceed to Q2.

Q2. Check that the Fuse is not burnt, the Safety Switch is On, and the 'Pause' button on Power Box is not illuminated.

All the above conditions are OK?

If **Yes** – Proceed to Q2

If **No** – Change /replace what's requires and let the robot charge to start mow.

Q3. Let the robot charge for 24 hours, and check Battery Capacity.

Open Service → Settings → Battery → Capacity.

Does the value higher than 5.0 AH?

If **Yes** – The robot should start mowing automatically. Check again Q1 above. If the unit has never left the Base Station automatically, perform S/W Factory Default

If **No** – Open Service → Information → Special Display → Charging menu, and perform the following:

A. Remove the robot from the Base Station, wait 60 seconds and take a photo of the LCD.
B. Push the robot manually on the base station, wait a few seconds and take a take a photo of the LCD.
C. Wait another 1 minute and a take a photo of the LCD.
D. Wait another 5 minute and a take a photo of the LCD.

Send all gathered data to Friendly Israel for further analysis.

2.8 RS Power Consumption

The robot consumes about 3 Ampere while it mows. If we consider 100 minutes (1.66 hours) of operating cycle, the total current we have to fill power back in the batteries will be 1.66h X 3 A which equals to ~ 5Ah.

The Power supply is 2.7A output, so to fully charge the battery from "recharge battery" status to fully charge will take:

5 Ah / 2.7A = **1.85 hours**.

After 1.85 hours the batteries will be full and the robot will keep the batteries in steady state to start operation any time. This has negligible power consumption, so it is not included in the total calculation.

NOTE: RS allows starting the next operation even if the battery is only 80% charged. This depends if the current cycle have not yet completed. But for the calculation, we will consider the batteries are being charged to full every charging cycle.

The Charging power consumption is measured by considering 1.85 hours of charging at 2.7A.

Assuming 220VAC in the outlet, the KW/h will be 220 X 2.7 = 594 W/h. In order to calculate charging costs per operation, we shall transform the units to KW/h.

594 W/h =**0.594 KW/h**.

To know how much would one operation cost in the electric monthly bill, we have to multiply "KW/h" times the "Charging time [hours]" times KW/h Cost.

Cost per operation = KW/h X Charging time [hours] X KW/h Cost

In courtiers that have more than one KW/h costs (depending the time of the year summer/winter, and the time of the day), make an average calculation, since nobody knows exactly when the robot was in charging.

For example let's assume **12 Euro Cent** for one KW/h, the calculation will be:

0.594 X 1.85 X 0.27 = **0.29 Euro** per one mowing operation.

3.1 "Check Mow Height" message

Q1. Is it the first cut of the season or the grass is very high?

If **Yes** – Lift mowing height level and let the robot to complete full cycle (2-3 days).

If **No**– Proceed to Q2.

Q2. Was there any change in the robot's Service Settings lately?

If **Yes** – Open Mowing Settings (Service → Settings → Mowing Motors) and check that all settings are in default values.

				Default Value
Mowing Motors	Eco Mode	On/Off	Enable/disable Eco mode operation	ON
		Speed --> On Speed	Mow motor RPM (Rounds Per Minutes) during ECO mode On	3300
		Speed --> Off Speed	Mow motor RPM during ECO mode Off	4000
		Sensitivity	The current threshold in which ECO mode On will be terminated	2 AMP
	Over Current	Sensitivity	The current threshold in which Over Current event is detected	5 AMP
		Time	The time the robot will allow to the O.C sensitivity value to be present before an O.C event is detected	1 SEC
	Stop Time	Time	The time for the mowing motors to **resume** operation after one of the Safety sensors in the robot is detected, and released. For example, if a bumper event is detected the mowing motors are stop immediately. Once the robot detects that it is OK to resume motors operation, it will count this "Stop time" and only then resume operation	1 SEC
	--	On/Off	Enable/disable mowing motors operation	ON
	Direction	Left	Direction of the left mowing motor rotations	CCW (Counterclockwise)
		Right	Direction of the right mowing motor rotations	CW (Clockwise)

If **No**– Proceed to Q3.

Q3. Turn the Safety Switch to OFF, remove the robot out of its Base Station and carefully check if the mowing blades are freely rotating. See below picture below.

If one or both blades are not rotating freely go to section 3.3 (Mowing motor(s) do not work).

Proceed to Q3.

Can you confirm the mowing deck is clean and the blades can rotate freely?

If **Yes** – Proceed to Q4.

If **No**– Clean the mowing deck and Proceed to Q4.

Q4. Place the robot in a place where there is no high level of grass, and run a 'Mowing test'.

The test was passed?

If **Yes** – Proceed to Q5.

If **No**– Proceed to Q6.

Q5. Place the robot in a place where there is no high level of grass, make sure the mowing height is in its fully upper position, and send the robot to mow. Will the robot stop with a mowing error message?

If **Yes** – Proceed to Q6.

If **No**– Let the robot work. Reduce mowing height gradually.

Q6. Lift the robot's wheels up in the air (inside a lawn, where you have signal). Open Special Display – Mowing Motors menu. (Service → Settings → Special Display). Send the robot to mow.

Will the mowing motor(s) indicate high current level in one of the motors? (Good values are 600-850 mA)

If **Yes** – Proceed to Q7.

If **No**– Let the robot work. Reduce mowing height gradually.

Q7. Swap two mowing motors and repeat Q6 above. Will the the high current level that was shown in step 6 is now moved to be present in the other motor side?

If **Yes** – Replace mowing motor (can be done by an end customer).

If **No** – The robot needs to be brought to repair by an authorized Service Station.

Q8. When the robot arrives the repair station, check the following:
NOTE: A Golden part(s) may be used for easy and fast diagnosis.

- Observe all above questions to make sure the customer did not miss something
- Check settings as mentioned in Q2 above
- Run Mow Test
- Replace one mowing motor and run Mowing Test again. If still fails, replace the 2nd mowing motor
- Main Board

3.2 Poor quality of cut & Damage of lawn

Q1. Is it the first cut of the season or the grass is very high?

If **Yes** – Lift mower height level and let the robot to complete full cycle (2-3 days).

If **No** – Proceed to Q2.

Q2. Are there wheels digging signs on the lawn?

If **Yes** – Proceed to Q3.
If **No** – Proceed to Q4.

Q3. Can the front wheel be rotate freely on its axle and against robot's chassis?

If **Yes** – Proceed to troubleshooting chapter 7.5 'Wheels track' or 7.6 'Maneuverability problems'.

If **No** – Try to release the wheel (There may be debris or mulches that eliminate the wheel to rotate freely). Proceed to Q4.

If this cannot be released, the robot needs to be brought to an authorized Service Station for further analysis.

Q4. Does one of the blades are worn or dull?

If **Yes** – Swap blades.

If **No** – Try to swap blades rotation side (via Service menu Service → Settings → Mowing Motors → Direction → Left/Right).

If it does not resolve the problem, the robot needs to be brought to repair by an authorized Service Station.

Q5. When the robot arrives the repair station, check the following:

NOTE: A Golden part(s) may be used for easy and fast diagnosis.

- Observe all above questions to make sure the customer did not miss something
- Set the mowing motors rotating direction back to default
- Mowing motors shaft are not bent
- Blade(s) status
- Check that the mowing deck sits OK

4.1 Many patches of uncut grass remain on the lawn

Q1. Is it a new installation or changes have been done in the lawn/installation cable lately?

If **Yes** – Proceed to Q2

If **No** – Proceed to Q3

Q2. Are you sure the installation done according the rules, and the lawn size settings (in the robot) are the actual dimensions?

If **Yes** – Proceed to Q3

If **No** – Recheck the wire installation and the robot's settings, if a wrong installation or settings were found, correct it and let the robot complete full mowing cycle (2-3 days) to understand if the coverage problem was solved or still existing.

Q3. Is it the first cut of the season or the grass is very high?

If **Yes** – Check mow height level is not too low and let the robot to complete full cycle (2-3 days).

If **No**– Proceed to Q4

Q4. Does it happen in a particular place or all around the lawn?

If **Yes** – Run the robot in the problematic area and observe if odd behavior can be seen. If needed open Service → Special Display → Behavior screen to learn more of what the robot detects in this particular place.

If **No** (All around the lawn) – Proceed to Q5.

Q5. Does the time of the year now is the peak season, so the grass is growing very fast?

If **Yes** – Increase the Intensity by few % (10% for instance), and check if this improves the coverage problem. Let the robot complete full mowing cycle (2-3 days) to understand if the coverage problem was solved or still existing.

If **No** – Increase the Interval and check if this improved the coverage problem. Let the robot complete full mowing cycle (2-3 days) to understand if the coverage problem was solved or still existing.

If all answers up to now were not solving the problem, proceed to Q6.

Q6. Retrieve data from the robot to be analyzed by trained technician.

Review the data retrieved and compare to expected values shown in the table below. If one or more of the values are out of range, act according the tips in the table below

	Where to find this screen	Expected values	Tips
Intensity	Operations → Intensity	Default value is 0%, which can be set between -50% to +50%	Increase the Intensity to let the robot more time to mow
Interval	Operations → Interval	Default value is "Twice a week" (84 hrs), which can be set to one of the below options: Every 2 days (48 hrs) – Twice a week (84 hrs) Once a week (168 hrs) Every 2 weeks (336 hrs)	Increase the Intensity to let the robot more time to mow
Last 10 Battery run time	Service → Information → Battery → Run Time	Check ALL the information shown on the screen, as it may tell a hint of the cause. Refer to the Service Interface or the Service Guide for more details about the data that is shown on that screen	Average operating hours per one operation should be: 0-50m²: 0.3Hr 50-100m²: 0.6Hr 100-150m²: 0.9Hr 150-200m²: 1.2Hr 200-3000m²: 1.5Hr
Last 10 Event List	Service → Information → Events → History	Check ALL the information shown on the screen, as it may tell a hint if there is a technical failure. Refer to the Service Interface and the Service Guide for more details about the data that is shown on that screen	Act according to the events recorded in the last operations
Mow height settings		Factory default is 50 mm height. 50mm is the mid level between the minimum (20 mm) and the maximum (80 mm)	Reduce the height by 10 mm each time

4.1 Robot ignores area (Main & Sub Zones)

Q1. Is it a new installation or changes have been done in the lawn/installation cable lately?

If **Yes** – Proceed to Q2

If **No** – Proceed to Q3

Q2. Are you sure the installation done according the rules, and the lawn size settings (in the robot) are the actual dimensions?

If **Yes** – Proceed to Q3

If **No** – Recheck the installation and the robot's settings, if a wrong installation or settings were found, correct it and let the robot complete full mowing cycle (2-3 days) to understand if the coverage problem was solved or still existing.

Q3. Are there obstacles on the lawn or on the edge that block the robot to complete mowing there?

If **Yes** – Remove the obstacle(s) that block the robot and let the robot complete full mowing cycle (2-3 days) to understand if the coverage problem was solved or still existing.

If **No** – Proceed to Q4

Q4. Place the robot on the Base Station, and send it to mow, starting with Edge mode. If the lawn contains Sub Zone(s), send the robot to mow in one of the Sub Zone(s).
Was the robot complete a full route and returned to Base Station before start to mow inside the lawn?

If **Yes** – Proceed to Q5

If **No** – Proceed to Chapter 4, paragraph 4.1 – Does not complete Edge

Q5. Place the robot in front of the uncutted area and send the robot to mow, omit the Edge to let the robot start mowing in Scan mode immediately.

Does the robot drive and mow in that area without problems?

If **Yes** – Let the robot complete the next few oprtations to understand if the problem was sporadic or recurrent.

If **No** – Ask the cutomer to take some pictures or scratch a drawing of the lawn, including how the wire set in the lawn, and send them to you so you may see the reason of the problem immediately.

4.3 Stops with no message

Q1. Was this phenomenon happened more than once?

If **Yes** – Proceed to Q2

If **No** – Let the robot continue work and if happen again, contact Hot Line for further analysis in accordance to this chapter.

Q2. Make sure the Safety Switch is set to 'ON', then press <Go> button.
Is the robot waking up?

If **Yes** – Proceed to Q5.

If **No** – Check if the fuse burnt, and proceed to Q3

Q3. Was the fuse burnt?

If **Yes** – Replace the fuse and check if it burns immediately again (This is a fast acting 20A/32V fuse which can be found in local electricity shops).

If the fuse burnt immediately – The robot needs to be brought to repair by an authorized Service Station.

If **No** – Insert the robot into the Base Station, turn the Safety Switch to 'Off' and wait few seconds until the screen turns 'On' with message "Switch On". Proceed to Q4

Q4. Is there a message on the screen "Switch On"?

If **Yes** – Let the battery be charged to full (it may take up to 24 hours), and observe if this phenomenon happen again. If it will happen again, contact Hot Line for further analysis.

If **No** – The robot needs to be brought to repair by an authorized Service Station.

Q5. Check the below parameters in the same order as written in the table. Once the root of the failure was found, stop checking the rest of the parameters in the list, and replace the faulty part.

Retrieve the Last 10 Events List as described below and compare to error list

Where to find this screen	Expected values	Tips
Service → Information → Events → History	Check ALL information shown on the screen, as it may tell a hint if there is a technical failure. Refer to the Service Interface and the Service Guide for more details about the data that is shown on that screen	Act according to the events list recorded at the last operations

	What to do/check	Expected results	Tips
1	Battery voltage	Fully charge battery: Battery Voltage = 28V Battery Capacity = 6 AH	Try to charge the battery to full, and run the robot to observe battery run time.
2	Check with “Gold” Battery Pack	LCD is On	Try to charge the battery to full, and run a robot to observe battery run time
3	Use “Gold” battery pack that you are sure is OK and charged. Disconnect all connectors on the Main Board, leaving only the Power and LCD cables connected. Check that the LCD is On. If LCD still Off, replace Main Board and check. If LCD still Off, replace LCD. When you have LCD On start connect the connectors one each in a time, while observing the LCD. Once the LCD turns Off (not because of going to sleep mode), you know that the last connection shorten the Main Board down. This component and/or its braid may be the fault reason. Replace the faulty item and check again	LCD stays On until finding the faulty component	It is recommended to connect a new component to be tested in a temporarily connection (e.g. Drive Motor), while it is not installed into the robot, but mounted outside. This will allow checking what the failed component is, without spending time for nothing.

4.4 "Cross Outside" message

Q1. Is it a new installation or changes have been made in the lawn/installation cable lately?

If **Yes** – Proceed to Q2

If **No** – Proceed to Q3

Q2. Are you sure the installation done according the rules of distance from cliff, corner, narrow path, adjacent lawn?

If **Yes** – Proceed to Q3

If **No** – Recheck the wire installation that was set according the installation rules written in the Operating and Safety manual, and correct where require.

Q3. Was the robot found out of the lawn?

If **Yes** – Proceed to Q4

If **No** – Proceed to Q5

Q4. Are there adjacent lawn(s) with robotic lawn mower (regardless what brand), or dog fence installation?

If **Yes** – Proceed to Q7

If **No** – Proceed to Q5

Q5. Does it happen in a place close to a corner/narrow pass?

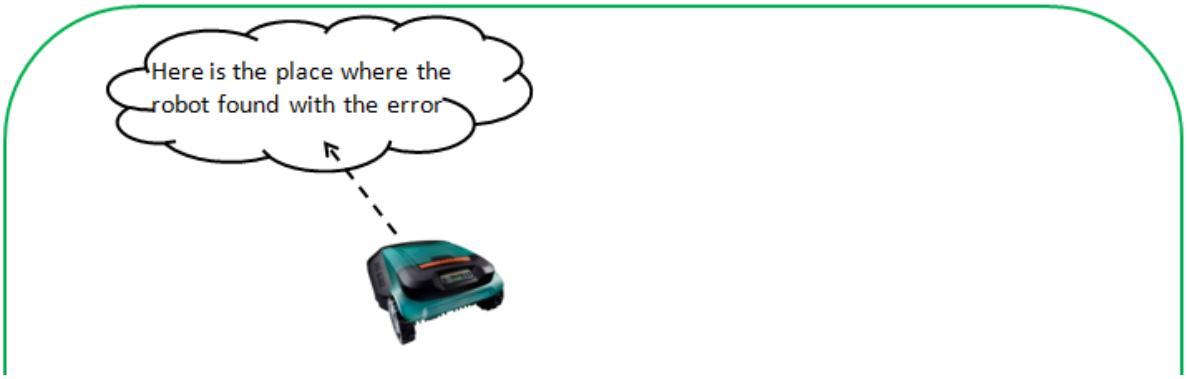
If **Yes** – Proceed to Q6

If **No** – Proceed to Q8

Q6. Place the robot inside the lawn, in a location that the robot faces toward the place it was found with the error, and send it back to the Base Station.
Did the robot cross the wire out?

If **Yes** – Recheck the wire installation that was set according the installation rules written in the Operating and Safety manual, and correct where require.

If **No** – Proceed to Q8



Q7. Ask your neighbor to plug out the mains to his/her robot (or dog fence) for one day, and operate Robomow in the closest zone to the adjacent lawn.
Did the robot cross the wire out?

If **Yes** – Proceed to Q8

If **No** – Contact Hot Line for further checks if this is an interference case

Q8. Are there high voltage cables or iron net buried in your lawn?

If **Yes** – Contact Hot Line for further checks if this is a robot issue or your lawn is not capable for robotic lawn mower

If **No** (Or not known) –The robot needs to be brought to a an authorized Service Station for further analysis

Q9. Run the robot at your Test Lawn and check Wire Sensors readings are stable.

If the robot behaves if no errors at your Test Lawn, most probably the problem is in the customer's lawn. Make sure to eliminate surrounding interferences at the customer's lawn.

4.6 "Stuck in Place" message

Q1. Are there wheels excavation signs on the lawn?

If **Yes** – Proceed to Q2

If **No** – Proceed to Q3

Q2. Does the path on the lawn enable smoothly maneuverability? (Holes, up/down hill, mud, high grass)

If **Yes** – Proceed to Q3

If **No** – Fix the path and check if it resolved the issue. If the error happens again right after the robot slip a bit (due to mud), increase the Slippage Sensitivity by 1 segment (Service → Settings → Slippage → Sensitivity).

Proceed to Q3

Q3. Can the front wheel be rotate freely on its axle and against robot's chassis?

If **Yes** – Proceed to Q4

If **No** – Try to release the wheel (There may be debris or mulches that eliminate the wheel to rotate freely).

If this cannot be released, the robot needs to be brought to a an authorized Service Station for further analysis.

Q4. Send the robot to work inside the lawn, where it has at least 5 meters to drive forward without hitting an obstacle or reaching a wire.

Will the robot drive straight more than 2 meters without changing direction?

If **Yes** – Proceed to Q5

If **No** – Open Service menu (Service → Information → Special Display → Behavior screen), and observe value #2 'Last Termination Event'. For more details see RS Service Guide, chapter 2.1.6.8.

Q5. Run the robot and watch it for about 30 minutes. Did you observe any odd behavior while it was working? (Changing direction in the middle of the lawn, stop driving forward with no visible reason, etc…)

If **Yes** – The robot needs to be brought to a an authorized Service Station for further analysis

If **No** – Let the robot continue to work, and if this error happens again, contact Hot Line for further analysis.

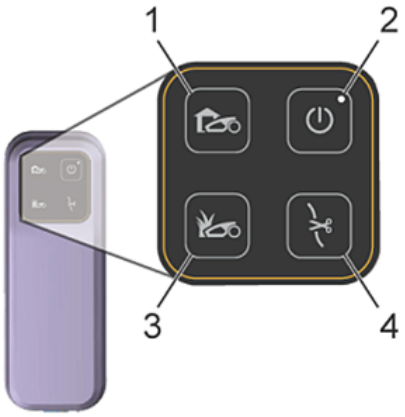
Q6. When the robot arrives to the repair station, check the following:
Connect the robot to the Toolkit and observe all robots' parameters. Especially observe the below parameters:

- Wire sensors in & out of lawn. Inside the lawn the values should be around 400 and outside should be 200
- Bumper readings in press and in idle modes. Front Bumper press should reflect as Front state. Idle mode should show Idle state

4.6 The entire (or most of the) lawn is uncut / Robot would not auto depart

Q1. Make sure the Power Box is connected to the Main Power. Check the Power Box display indicators #1 and #3 are functioning well. Check the indicator #2 is not switched to ON (red light will be displayed). See the explanation in the table below for each number.

1	**Docking Indicator**	Mower **is** in its Base Station.
2	**On/ Off Indicator**	Mowing Schedule is **Off.**
3	**Operating Indicator**	Mower **is not** in its Base Station.
4	**Wire Indicator** – Flashes and Beeps	The Perimeter Wire is cut, disconnected, or too long.
5	**All Indicator** Flash	Mower didn't return to the Base Station after 4 hrs of departure.
6	**All Indicator** Flash and Beeps	Theft detection



Does the indicator #2 is ON (red light will be displayed)?

If Yes- proceed to Q2.

If No- proceed to Q4.

Q2. Press two seconds on the Pause button to release the halt (red light will be disappeared). Wait until the robot will depart automatically out of the Base Station to mow.

Does the robot depart from the Base Station Automatically?

If **Yes** – Let the robot run a few days and observe good looking lawn

If **No** – Proceed to Q3 below

Q3. Does one of the other indicators indicate 4, 5 or 6?

If Yes- Go to sections 2.7 to find what may be wrong with the Power Box.

If No- Proceed to Q4 below.

Q4. Check that the Inactive was set correctly. Does it configured right?

If **Yes**- Proceed to Q5 below

If **No**- Correct the Inactive time accordingly

Q5. Does a Robomow App use by the customer?

If **Yes**- Check that the Automatic depart was not deactivated. Gray means automatic depart is set to Off.

If the auto departs button is active (yellow), proceed to Q6 below

If **No**- Proceed to Q6

Q6. Push the robot on the Base Station and wait a few minutes. Does the House icon is **NOT** seen on the left screen side of the display (only the battery icon is displayed)?

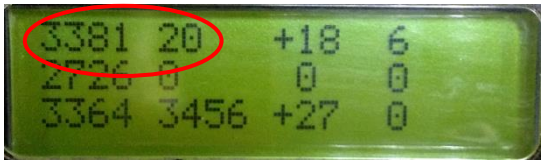
If Yes –It means the robot detects it is on the Base Station (which is true). Proceed to Q7 below

If No- It means the robot detects it is in Winter Charging mode (which is not the case). Proceed to Q8 below

Q7. Check Charging parameters in the Special Display on the robot.

Open Service menu → Information → Special Display → Charging.

The Charging voltage should be between 3200-3400 (32-34 V), and the current shall **not** show 0.



Does the charging voltage and current within range?

If **Yes** – Send the robot to a repair station along with the Power Box and the Base Station.

If **No** – Proceed to Q8 below

Q8. If both, Charging voltage & Charging current are out of range,

Yes – **Replace** the Base Station Adaptor

No – (Charging voltage in out of range, below than 31.5V, but the Charging current is not 0; **Replace** the Power Box

4.7 Robot changes direction with no visible reason

Q1. In the robot, go to Service → Information → Special Display → Behaviour screen

Press button to toggle between user menus and special display screen that was select. Send the robot to work in Scan mode (skip the Edge), and press again button to toggle back to the 'Behavior' screen while the robot mows for observation.

Check value #2 (upper line, second value from the left). While the robot changes direction in a place which it should not change (middle of the lawn), observe value #2 shown on the screen and look for its number in the below table. Check the number in the table below.

Value	Indication	Question	Answers & Actions
4	Distance	Did the robot drive 250 meters without reaching a wire or hitting an obstacle (bumper)	If **Yes** – This cannot happen is a real situation because the robot should reach a wire or hit an obstacle after few minutes of drive. If **No** – robot needs to be brought to repair by an authorized Service Station.
5	Time	N/A	N/A
6	Wire	Is there a wire on the ground where the robot now located?	If **Yes** – This is normal and should have been happening If **No** – Check the wire count in the Special Display → Wire Sensors → Values #2 and #6 (Left & Right count). If the values are 420-450 in the middle of the lawn while the robot mows, and the robot is 2014 configuration → Need to U/G to the latest publish S/W.
7	Bumper	Did the robot hit an obstacle?	If **Yes** – This is normal and should have happened If **No** – Perform Bumper calibration and run the robot again in Behavior mode. If this happen again, go to section 9.1 Bumper pressed
8	Drop Off	Did the front robot lift up?	If **Yes** – This is normal and should have happened If **No** – Perform Drop Off calibration and run the robot again in Behavior mode. If this happens again, go to section 8.1 "Front wheel problem"

Value	Indication	Question	Answers & Actions
9	Slippage	Can the front wheel be rotated freely on its axle and against the robot's chassis? 	If **Yes** – Go to section 8.2 "Slippage problems" If **No** – Clean the front wheel area to allow the wheel freely rotate, and run the robot again in Behavior mode. If this happen again, the robot needs to be brought to repair by an authorized Service Station.
10	Drive Over Current	Can you observe one (or two) drive wheels hard to rotate?	If **Yes** – Try to remove debris that is halting the wheel(s) to rotate, and run the robot again in Behavior mode. If this happen again, the robot needs to be brought to repair by an authorized Service Station If **No** – Robots from 2014 configuration, change Service Settings as follows: 1. Service→Settings→Drive Motors→Over Current→Sensitivity→ Change from 3A to 4A 2. Service→Settings→Drive Motors→Over Current→Time→ Change from 3Sec to 5Sec
11	Slop	Did the robot drive in a slope up or down hill larger than 30° Degrees?	If **Yes** – This is normal and should have happened. If **No** – Perform Tilit calibration and run the robot again in Behavior mode. If this happen again, the robot needs to be brought to repair by an authorized Service Station.
12	Robot stuck	Perform S/W factory default. Service → Settings → Factory Default → Software	Run the robot again in Behavior mode. If this happen again, the robot needs to be brought to repair by an authorized Service Station.
13	End of edge	Perform S/W factory default. Service → Settings → Factory Default → Software	Run the robot again in Behavior mode. If this happen again, The robot needs to be brought to repair by an authorized Service Station.
14	Lost the wire	Electricity power was always available?	If **Yes** – Perform S/W factory default. Service → Settings → Factory Default → Software. Run the robot again in Behavior mode. If this happen again, the robot needs to be brought to repair by an authorized Service Station. If **No** – This is normal and should have happened.

Value	Indication	Question	Answers & Actions
15	Docking Station detection	Did the robot meet the Base Station while the test ran?	If **Yes** – This is normal and should have happened. If **No** – Perform S/W factory default. Service → Settings → Factory Default → Software. Run the robot again in Behavior mode. If this happen again, the robot needs to be brought to repair by an authorized Service Station.

NOTE: If it was found that the robot needs to be brought to a Service Station due to failures number 12, 13, 14, and 15 (in the table above). When the robot arrives the Service Station, start with Factory erase (through Debug tab in the RS Toolkit), and run the robot to check if this error reconstructed. If it fails again on the same error, replace Main Board.

4.8 Noises heard from various places in the robot

Q1. Turn the Safety Switch to OFF, lift front robot area and check if there is any visible reason that can make the laud sound.

Possible reasons are:

- Debris stuck in the mowing deck
- Bent blade
- Too much mulches built up between mowing deck and blades
- Rotate blades (using long stick or gloves). See picture to the right

Q2. Press the bumper few times from verious directions. Are noised sound from the bumper?

If **Yes** – The robot needs to be brought to an authorized dealer shop for spraying lubricant spray on bumper springs. See picture to the right

If **No** – Proceed to Q3.

Q3. Turn both drive wheels manualy. Can laud noises be heard from one of them compared to the other one?

If **Yes** – Replace noise drive motor

If **No** – Proceed to Q4.

Q4. Rotate the front wheel on its axle and against robot's chassis. See picture down.

Can it turn and rotate freely?

(Do it with Front Wheel in its inner position and not outer position, like the robot is on the ground).

If **Yes** – Proceed to Q5

If **No** – Try to release the wheel (debris or mulches that eliminate the wheel to rotate freely).

If this cannot be released, the robot needs to be brought to a an authorized Service Station for further analysis

Q5. Place the robot inside the lawn and send it back to base (mow motors are not working). Can laud noises be heard from the robot?

If **Yes** – Make a short movie (smart phone, digital camera), and upload the movie to the Service Ticket opened in the ROSS (Robomow Online Support System).

If **No** – Proceed to Q6.

Q6. Send the robot to mow (mow motors are working). Can laud noises be heard from the robot?

If **Yes** – Remove **LEFT** blade (do that as instructed in the Operating and Safety manual), then send the robot to mow again. Proceed to Q7.

If **No** – Let the robot complete the next few oprtations to understand if the problem was sporadic or recurrent.

Q7. Was the laud noises reduced?

If **Yes** – Replace **LEFT** mowing blade and run the robot to observe if the noises are gone. If the noises are still being heard, replace **LEFT** mow motor.

If **No** – Put the **LEFT** blade back on the motor's pinion, and remove the **RIGHT** blade (do that as instructed in the Operating and Safety manual), then send the robot to mow again. Proceed to Q8.

Q8. Was the laud noises reduced?

If **Yes** – Replace **RIGHT** mowing blade and run the robot to observe if the noises are gone. If the noises are still being heard, replace **RIGHT** mow motor.

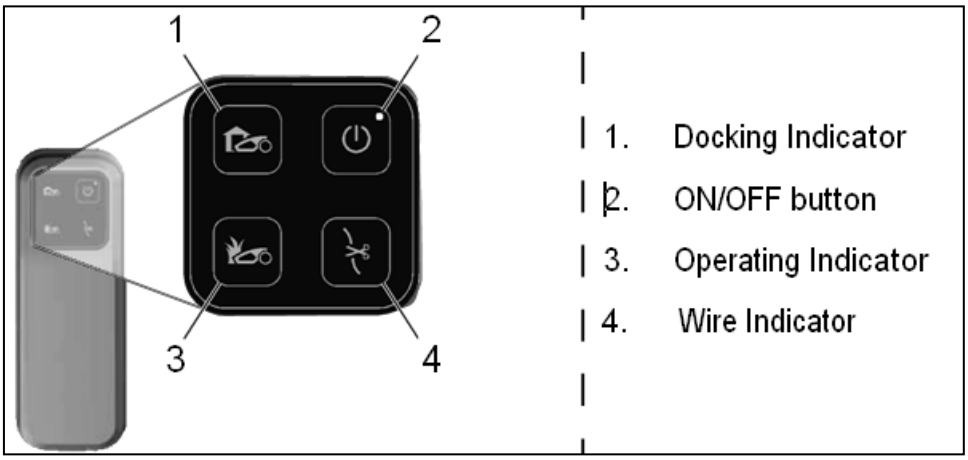
If **No** – Proceed to Q9.

Q9. If the robot still noise – The robot needs to be brought to repair by an authorized Service Station.

Q10. When the robot arrives to the repair station, observe the steps mentioned in this paragraph to make sure the customer did not miss something, and replace components that may cause to these noises.

5.1 No Wire Signal message

Q1. Are there any indicators bulbs (LEDs) on the Power Box display?



If **Yes** – Proceed to Q2

If **No** – Proceed to chapter 1.3 "Power Box does not operate/dead" in the troubleshooting chapter

Q2. Take the robot out of the Base station. Does the operating indicator on the Power Box (number 3 in the picture above) is illuminated?

If **Yes** – Proceed to Q3

If **No** – Proceed to troubleshooting chapter 1.3 “Power Box does not operate”

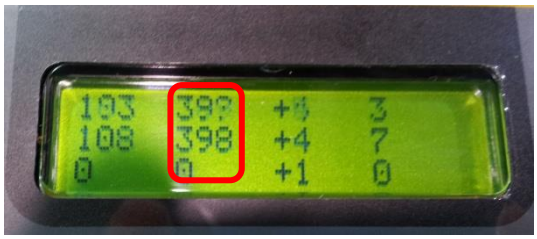
Q3. Does the "Wire indicator" (number 4 in the picture above) is illuminated on the Power Box too?

If **Yes** – Go to chapter 10.3 “Find disconnection in the wire installation loop”.

If **No** – Prepare a small wire loop of about 2 meter diameter (that can be rounded around the robot) and connect it to the Power Box using the second Plot connector that was supplied with the package (if there is no Plot connector available, use the one that connected to the wire installation in the lawn). Then proceed to Q4. See Plot connector picture to the right.

Q4. Go to ‘Special Display’ screen (on the robot: Service menu → Information → Special Display → Sensors → Wire Sensors), and check what values are seen on the screen in places 2 & 6. See picture below. The values should be 400 ± 5 while the robot is inside the plot and 200 ± 5 while the robot is outside the plot.

Does the value are as expected?



If **Yes** – And there are no disconnections in the wire installation loop, place the robot inside the lawn, Press ↩ button and send the robot to work. Press immediately ↩ again to watch the Special Display screen while the robot works. Observe values 2 & 6 especially if the robot stops with no visible reason.

If No – Proceed to Q5.

Q5. Are values 2 & 6 from two steps above showing value 0 (null)?

If **Yes** – Replace the Power Box

If **No** – The robot needs to be brought to an authorized Service Station for repair. Send the robot to repair along with the Power Box and the Base Station Head.

Q6. When the robot arrives the repair station, check the following:

NOTE: A Golden part(s) may be used for easy and fast diagnosis.

- Observe all above questions to make sure the customer did not miss something
- Front Board components and connectors
- Main Board
- Wire Sensors

5.2 Find disconnection in the wire installation loop

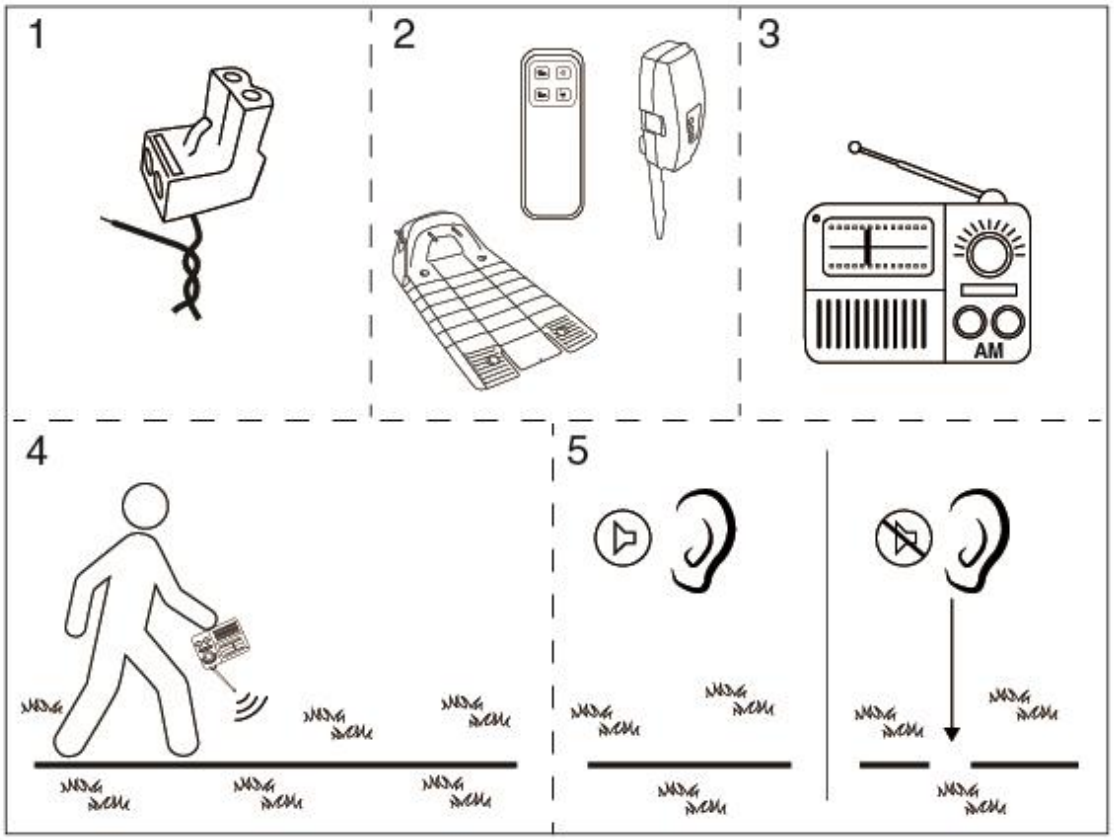
Searching broken wire using a radio AM:

In the link below you can watch how to search disconnection in the wire.

http://www.robomow.com/support/Movies/Find a wire break.rar

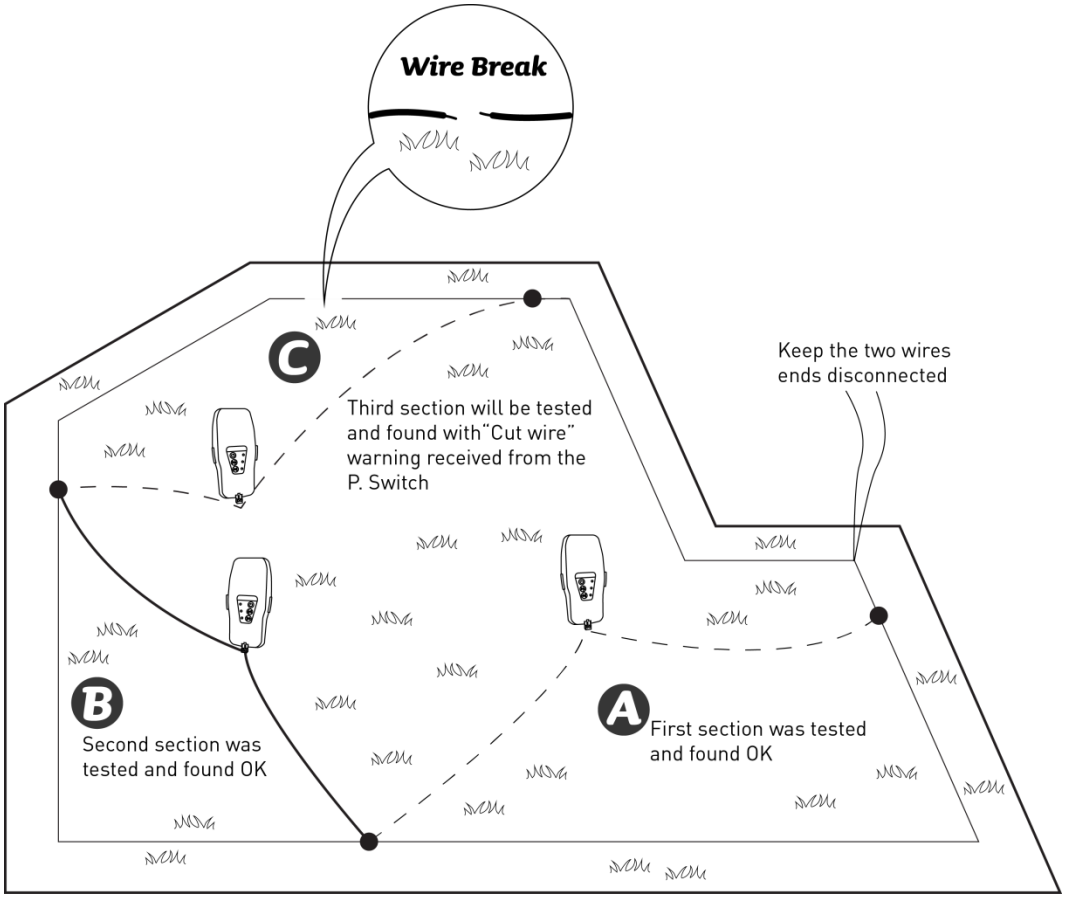
1. Disconnect one end of the perimeter wire from the Plot connector (green connector)
2. Make sure the Base Station Board / Perimeter Switch / Power Box is ON
3. Set the radio to AM frequency, that no broadcasting is detected, but only “white” noises are heard.
4. Start walking along the wire (the edge that still connected to the board, and not the edge that was disconnected out). Better to open the antenna and walk along the perimeter while the antenna is close to the ground.

   As long as the wire is not broken, there will be consecutive beep sounds, which will stop where the cut wire is.



Searching broken wire by small sectors

1. Prepare a Perimeter Switch with batteries and two wires; one is about 6 feet (2m), and a second 60 feet (20m) long. Strip back ¼ inch (6mm) of insulation from each wire end and connect the two wires to the p. switch via a plot connector (Green connector)
2. Disconnect the p. switch/Base Station/P.Box from the perimeter wire installation and leave two ends disconnected.
3. Decide how to split the entire lawn to few sectors, which each sector will be tested separately.
4. Strip ¼ inch (6mm) of insulation in two points to be sector tested, and connect the P.Switch.
5. Turn P. switch ON and check if the 'cut wire' indication is illuminated. If there is no indication (with sound), then the wire buried in the ground in this sector is OK.
6. Continue to move with the test equipment (p. switch + 2 wires) to the next perimeter wire sector to test until a 'Cut wire' indication will be found which will indicate that the broken wire is in this sector.
7. Once a broken sector was detected, it can be closely observed to find the cut or loose wire connections and repair it using a broken wire connector piece provided by Friendly Robotics.



Could disconnection be found in the wire?

If **Yes** – Fix the wire using official splicing connectors, see picture to the right

If **No** – Replace Power Box and Base Station Head