Robomower® Service Guide

- Read carefully and thoroughly all relevant sections before servicing Robomower.
- It is very important to read and follow all warning and safety instructions in this manual and in the Robomower Operating 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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Introduction

The purpose of this Service Guide is to allow trained and certified technicians to efficiently inspect, diagnose and repair the Robomower. If you have not completed training, please contact your manager or supervisor to arrange training completion.

The Service Guide is divided into various sections to allow access to information in an easy to use format. The sections in the beginning show the layout, wiring, parts and construction of the Robomower. Mid sections show diagnostic techniques and the last sections show repair and warranty procedures.

IMPORTANT: it is the policy of F. Robotics Acquisitions Ltd. that all agents, either directly appointed or appointed by a distributor, should always show a duty of care to customers. In most countries this is a legal requirement and. F. Robotics Acquisitions Ltd. policy is to always meet these standards and to surpass them wherever possible.

All units inspected by a technician MUST, as a minimum standard, pass the General Test prior to return to the customer.

Units which were actually repaired or had a certain part replaced, must go through specific testing, of that system, in line with the procedures set out in this Service Guide. The last part of each procedure has the appropriate test for that system.

In addition to testing a specific system or part, a General Test should always be undertaken to ensure no hidden problems are missed and, most importantly, to ensure that all safety systems are functioning.

If any doubt exists about diagnosis, repair, testing or any other technical aspect of the Robomower, always be sure to seek further advice from a qualified source.

Finally, if you have any suggestions for improvement of this guide, either in content, layout or additional material, please contact F. Robotics Acquisitions Ltd. through the correct channels and this will be considered for future updates.

1. Robomow Layout & Spare Parts

This first section is dedicated to the layout of the Robomow, how it is constructed, part numbers and identification of parts.

Important: Be sure to review section 1.1 (Orientation). It explains what is referred to as “right”, “left” etc. Failure to understand this can result in a mistake or problem in the analysis or repair of the product.

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1.1 Robomow layout and main components

1.1.1 Robomow top view

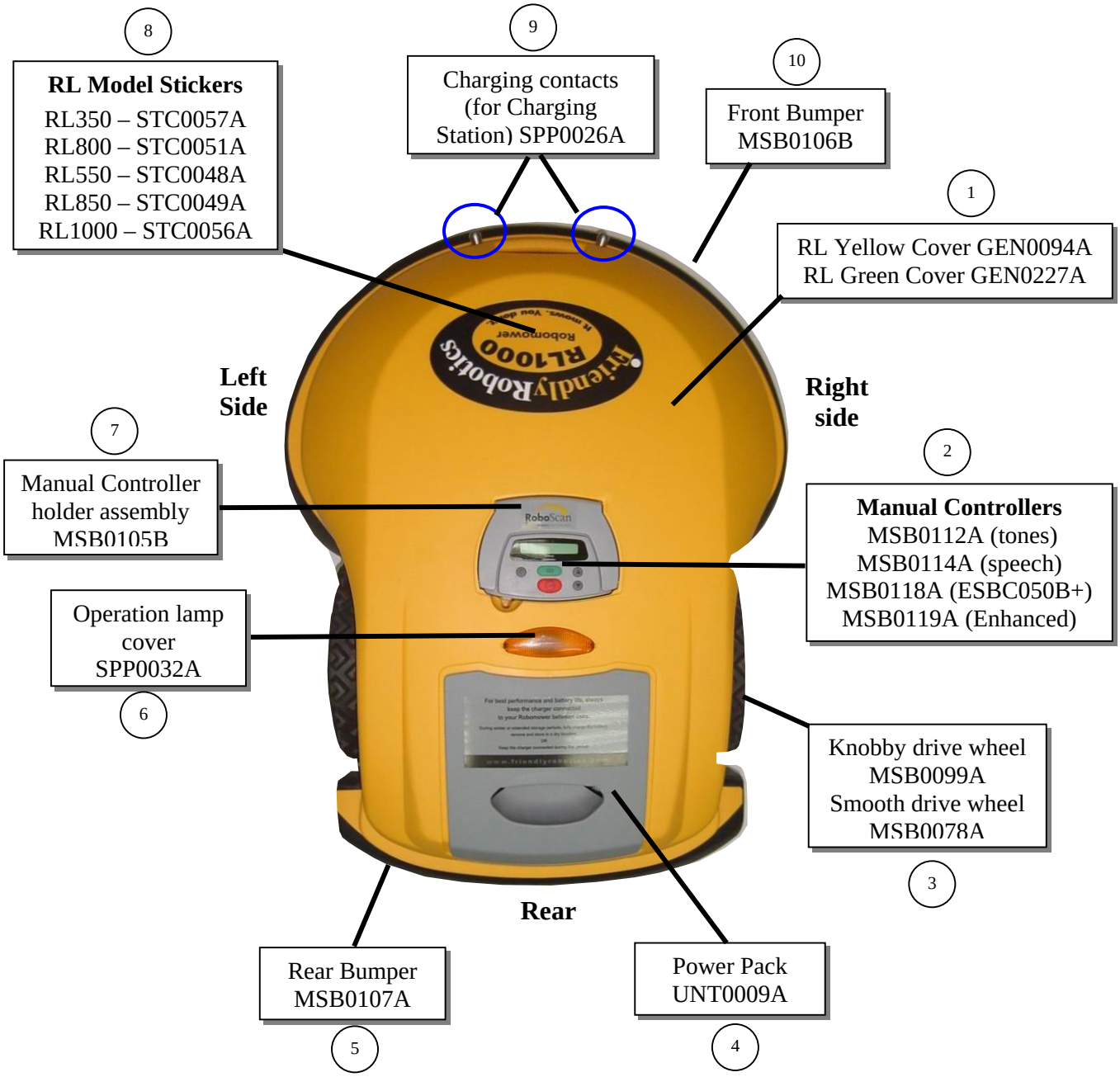

Figure 1.1.1 Top view

1.1.2 Robomow bottom view

Note: Mower sides are determined by its top view

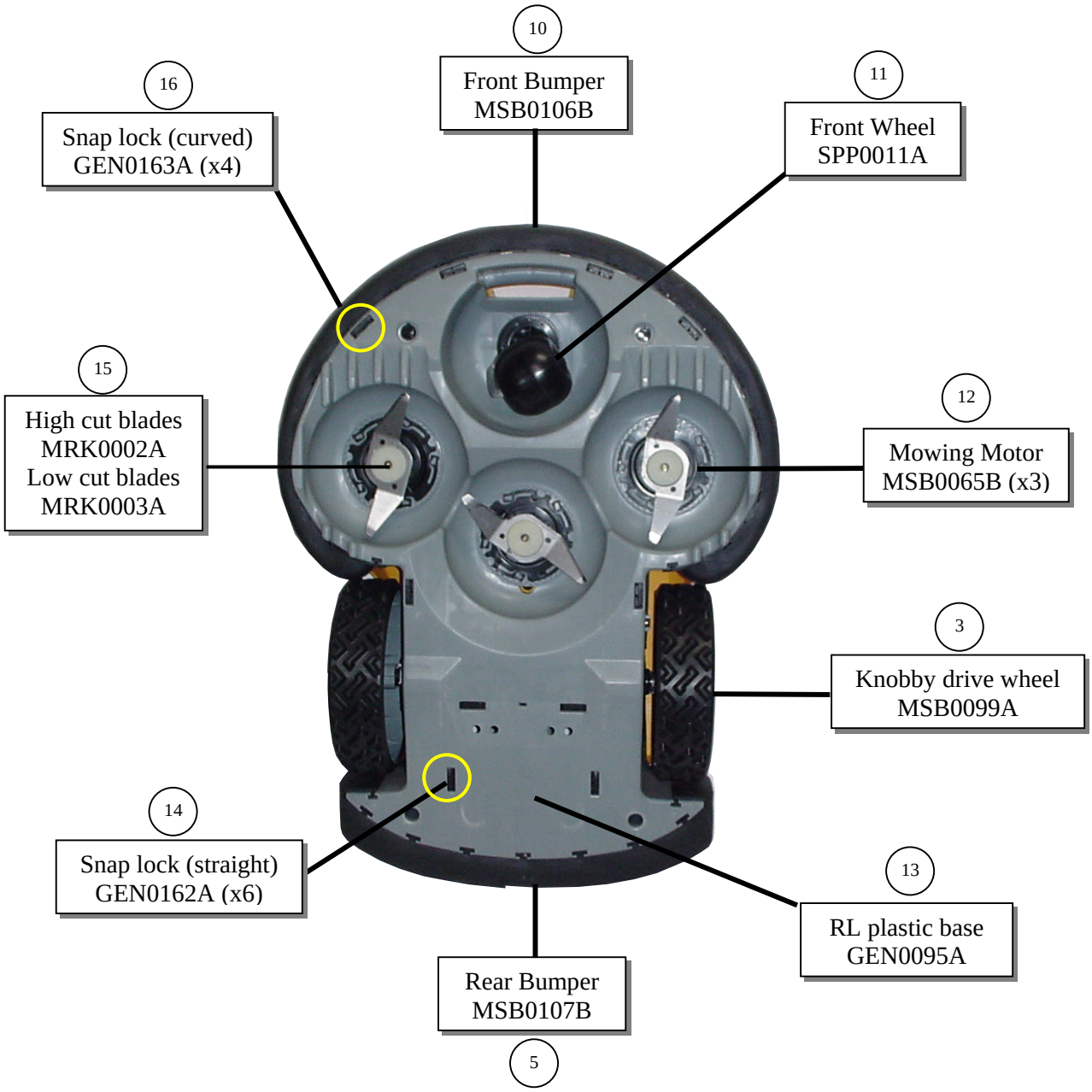

Figure 1.1.2 Bottom view

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1.1.3 Robomow internal views

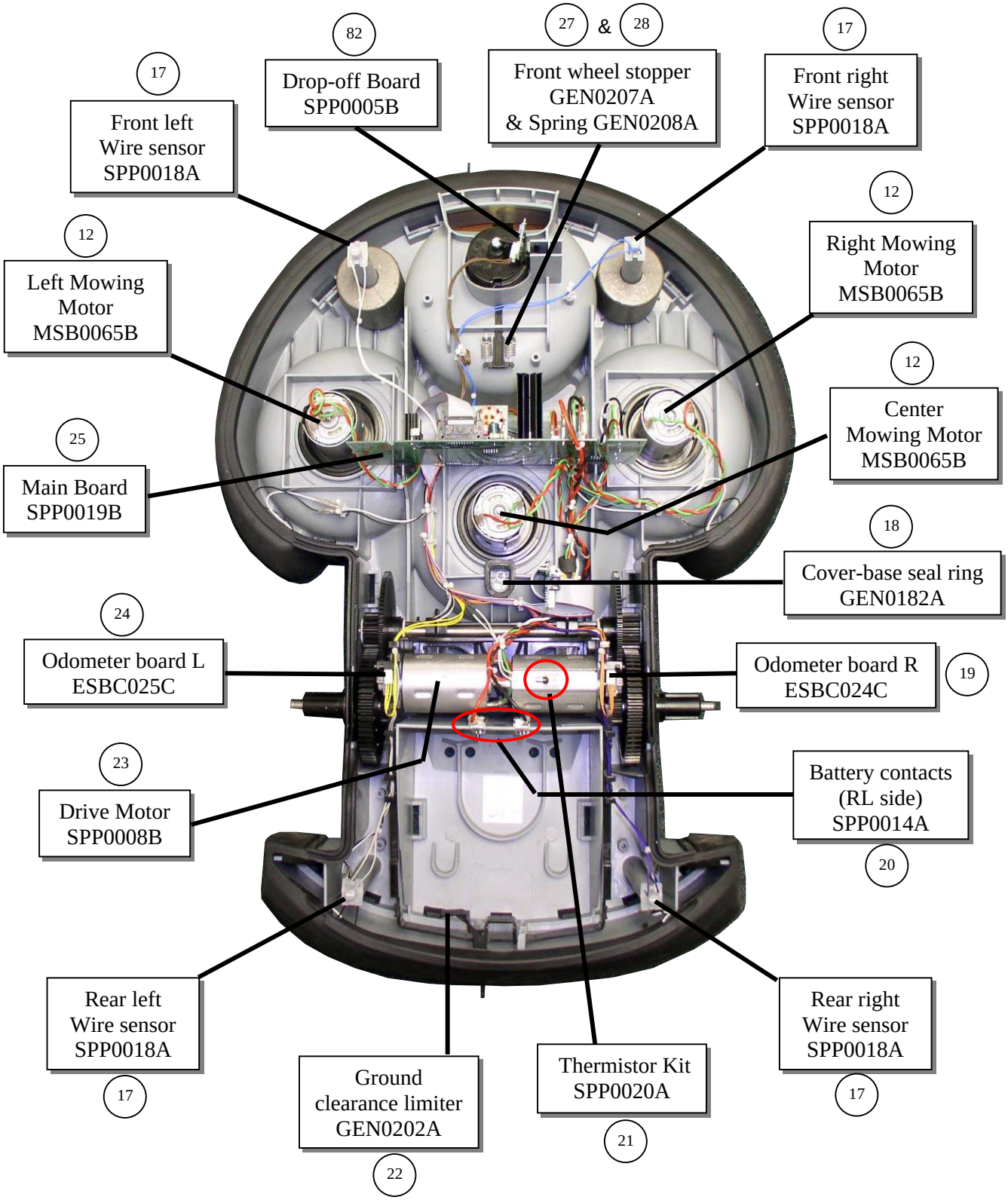


Figure 1.1.3 Internal view

1.1.4 Charging Station views

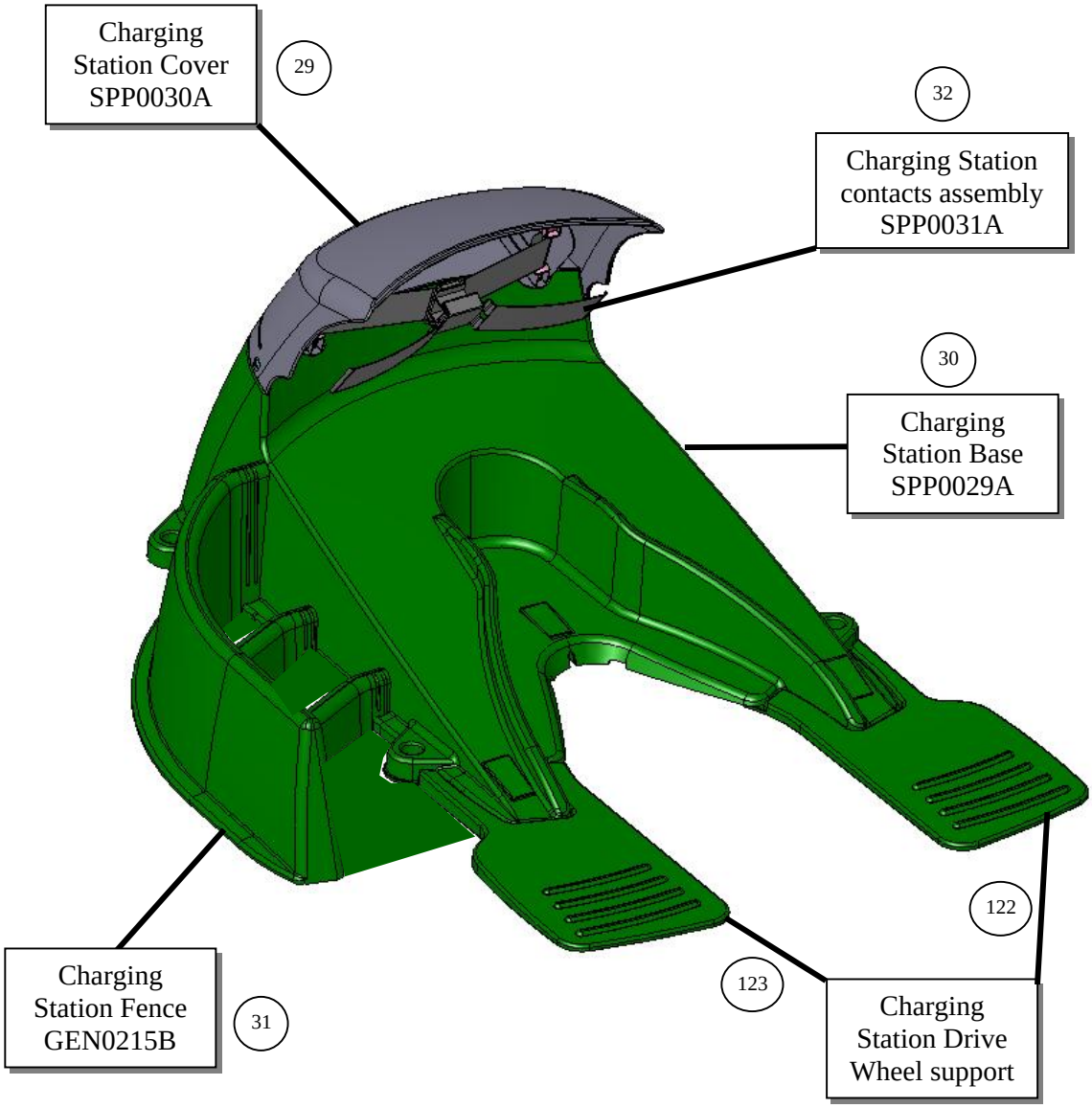
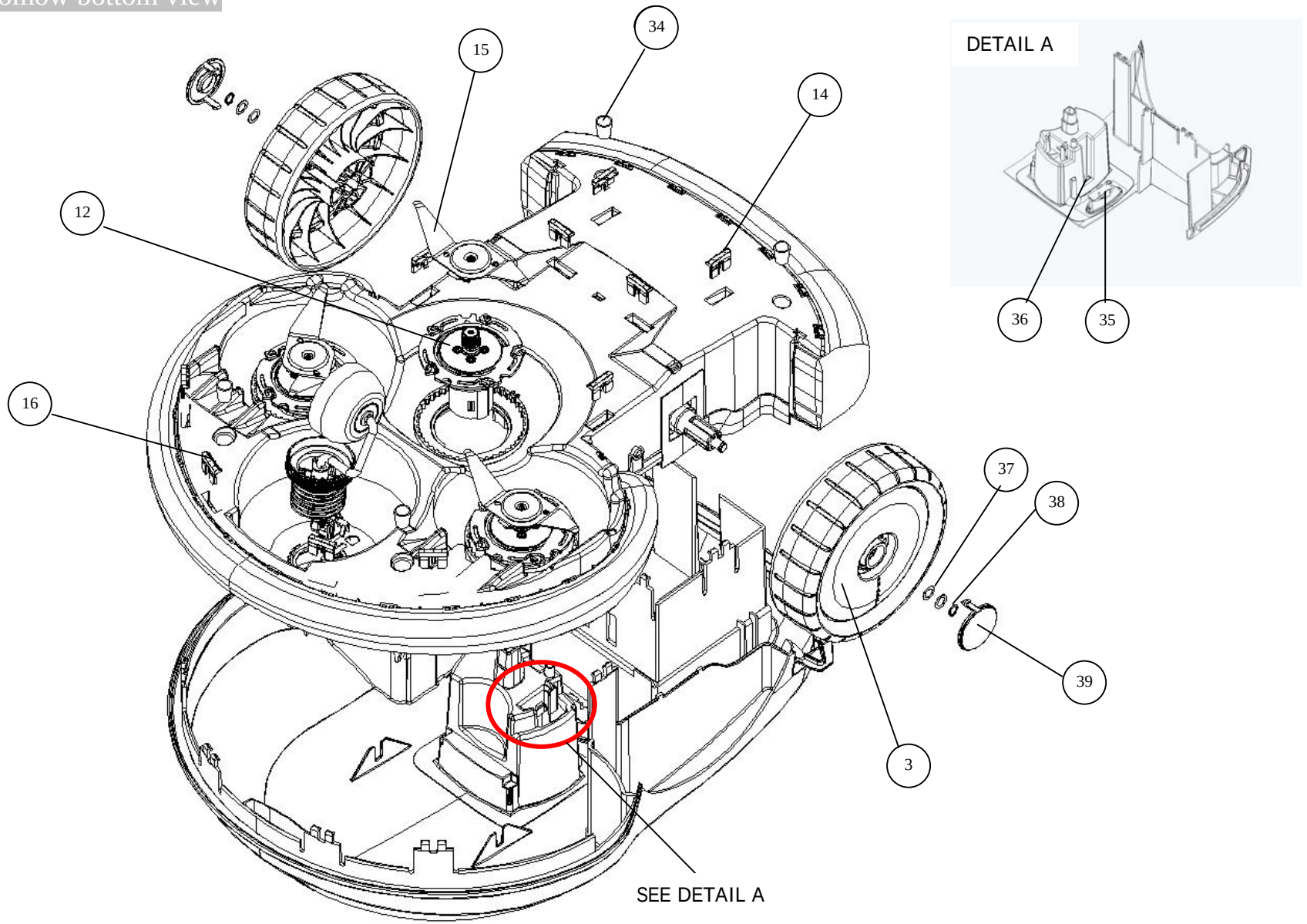


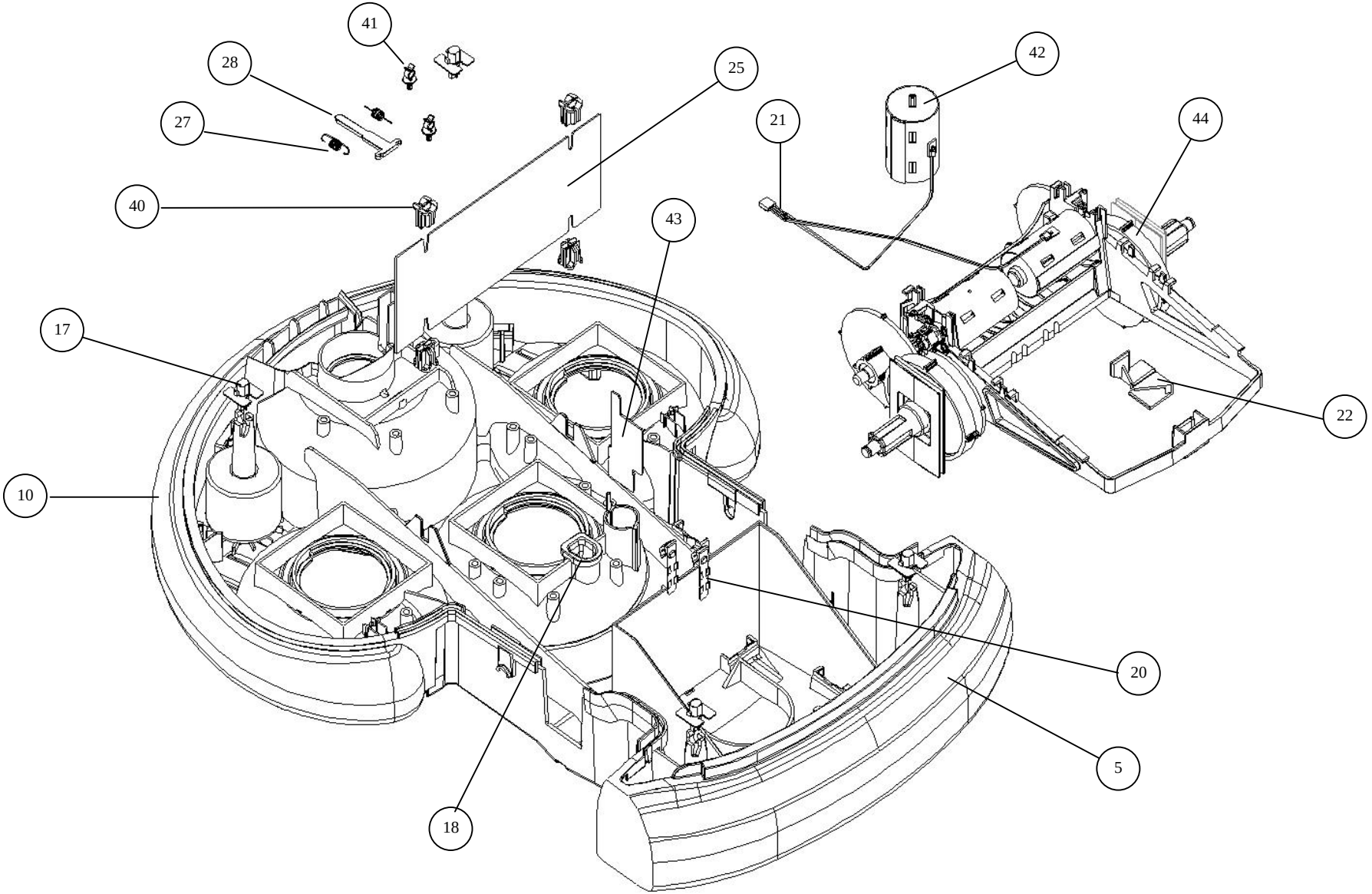
Figure 1.1.4 Charging Station view

1.2 IPL's / Exploded views

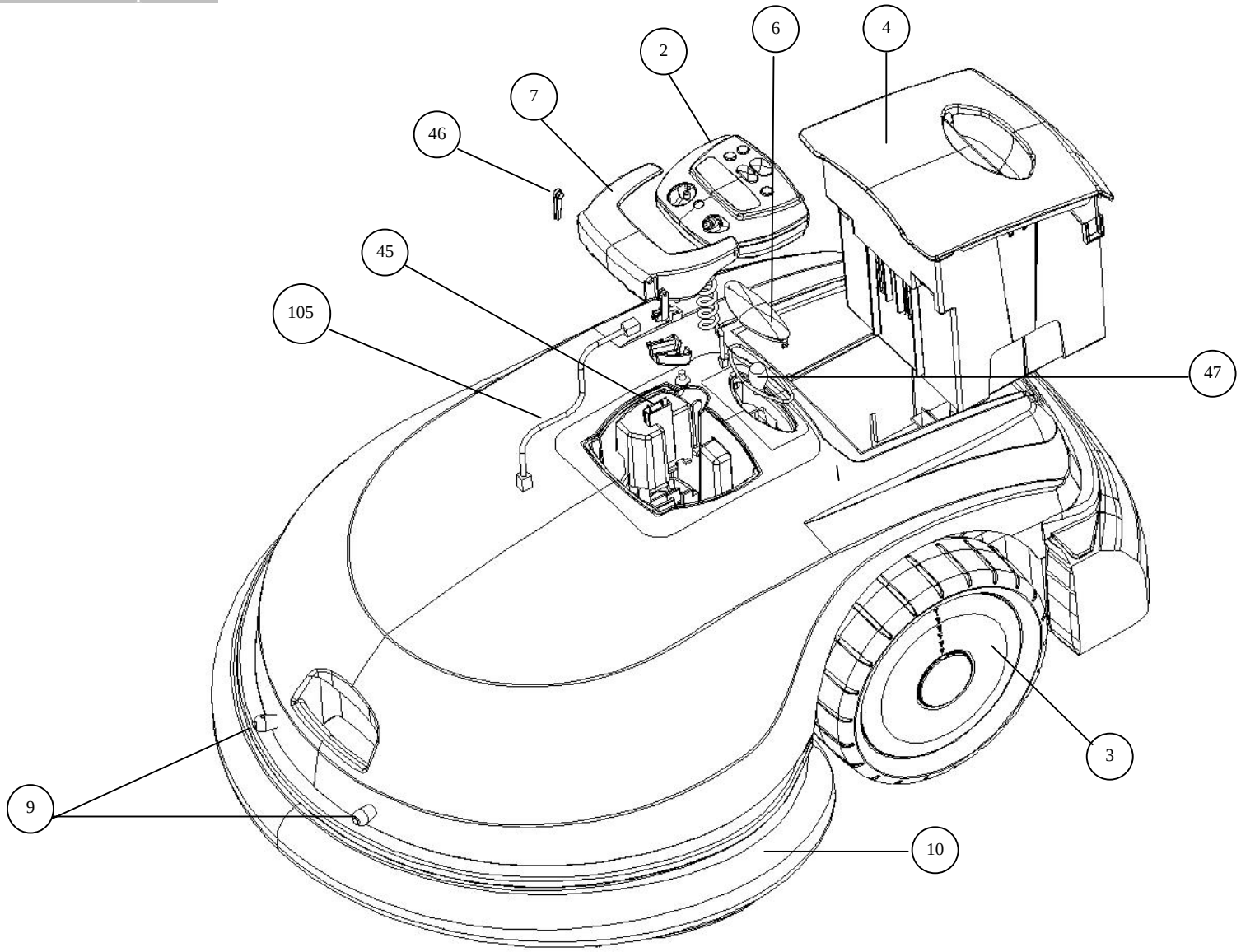
1.2.1 Robomow bottom view



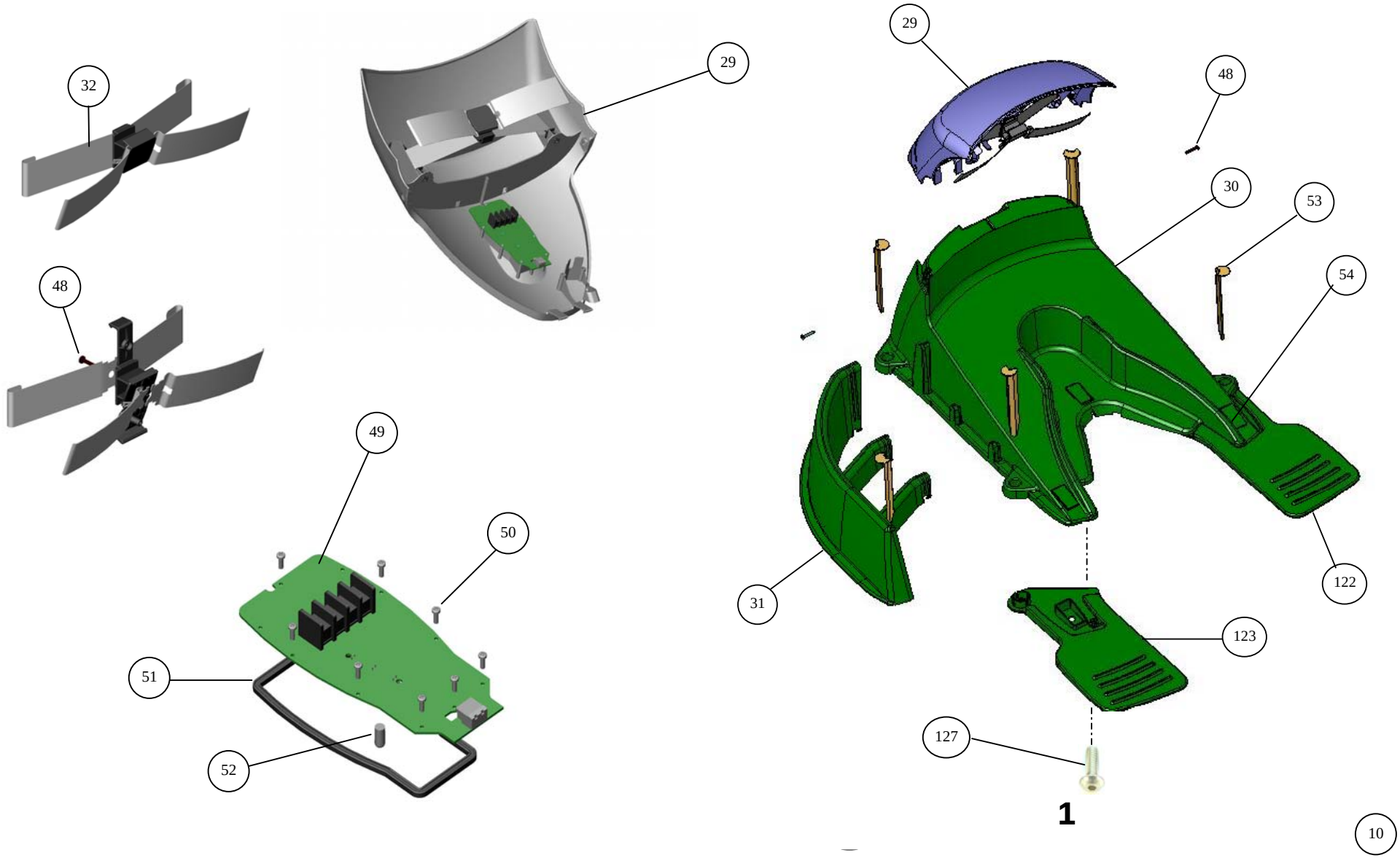
1.2.2 Base - top view



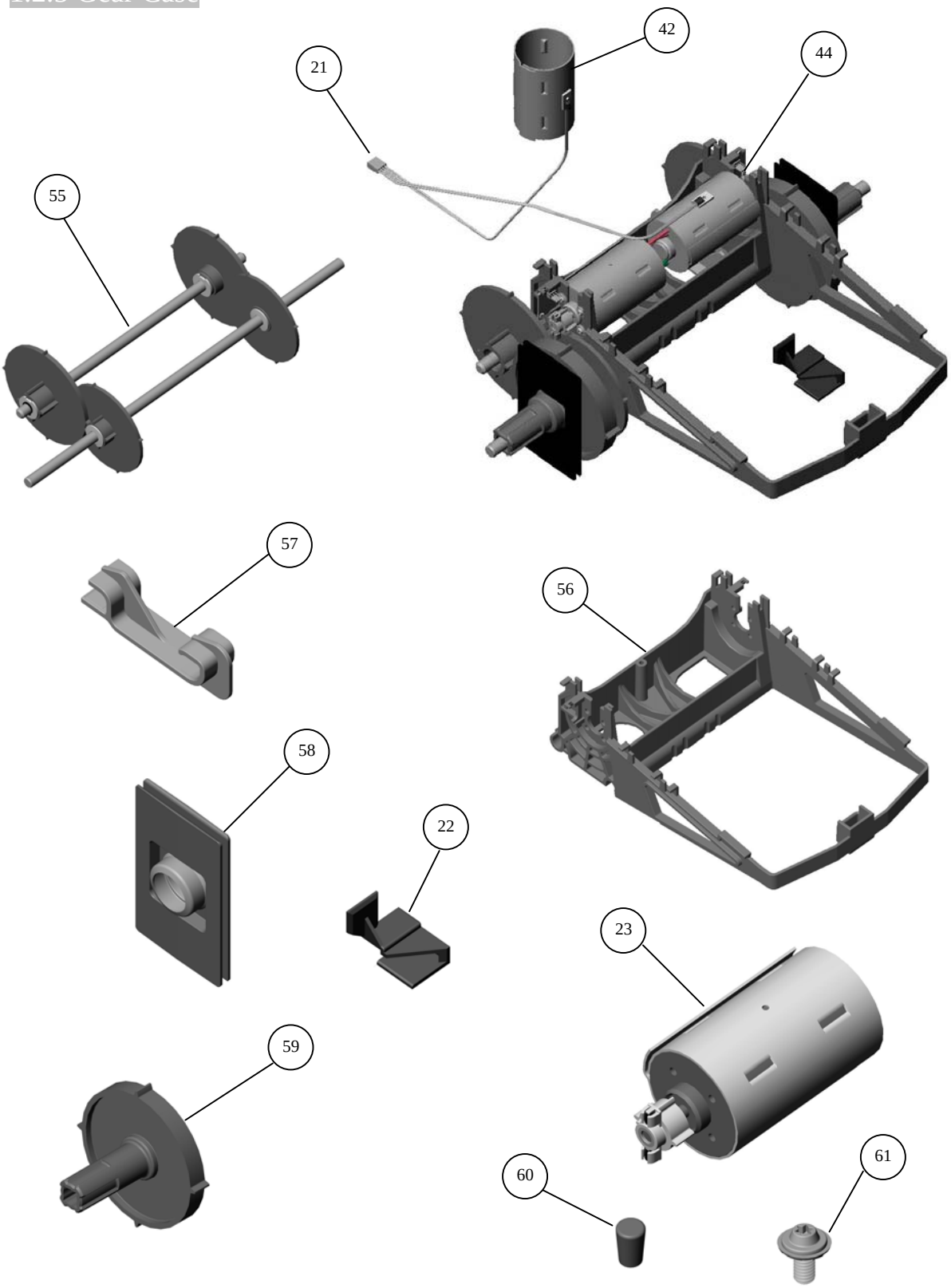
1.2.3 Cover – top view



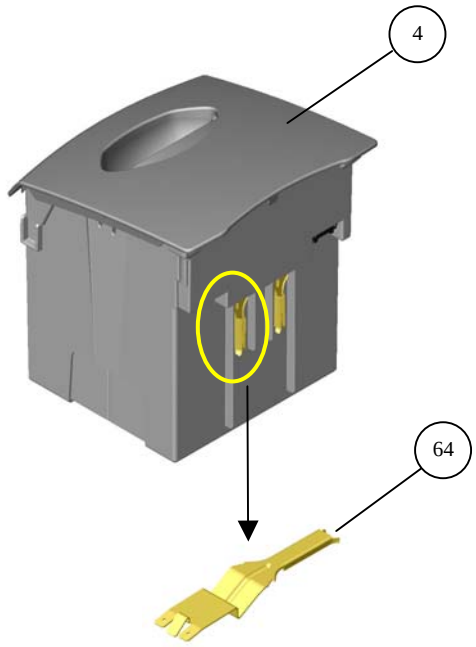
1.2.4 Charging Station

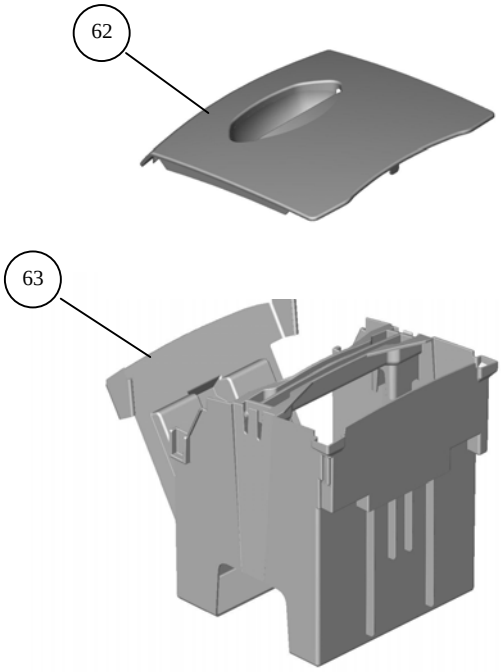


1.2.5 Gear Case



1.2.6 Power Pack & Power Supply





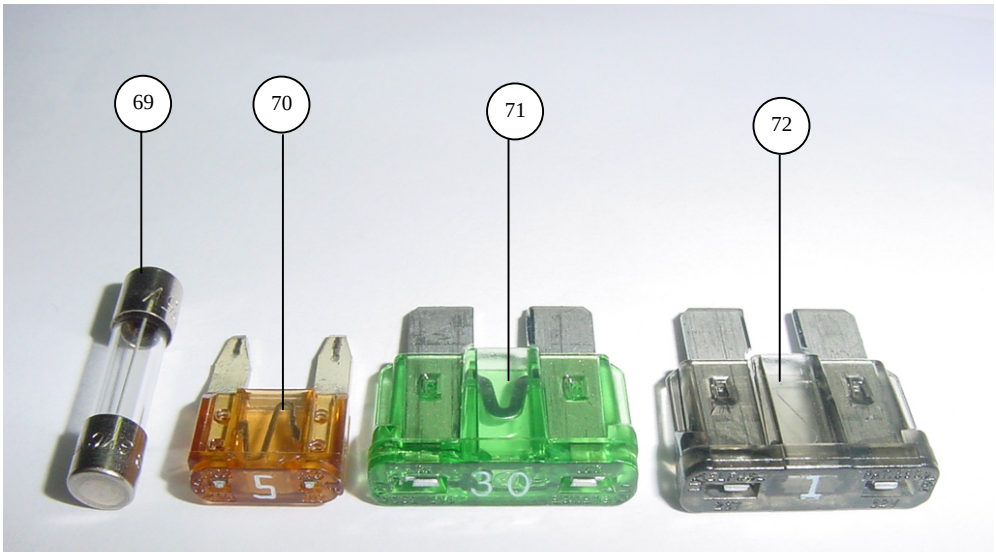
NOTE: for Power Pack wiring P/N's refer to 'Power Pack wiring diagram' (Section 1.5.2)

PWS0004A	230VAC Out Door Power Supply for RL1000 (EUR)
PWS0005A	115VAC Out Door Power Supply for RL1000 (US)
PWS0006A	230VAC Out Door Power Supply for RL1000 (UK)

PWS0001A	230VAC power supply-Europe
PWS0002A	230VAC power supply- UK
PWS0003A	115VAC power supply- US

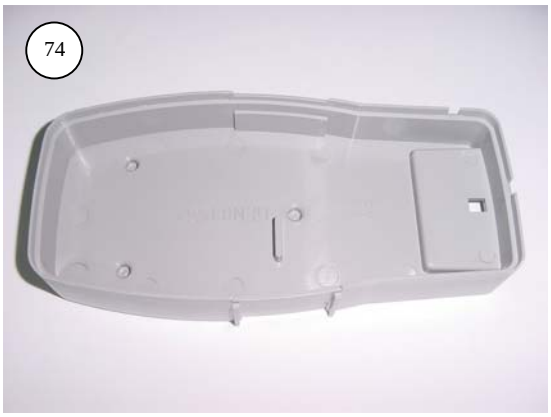
67	CBL0037A	External charger cord - UK
67	CBL0038A	External charger cord - US
67	CBL0039A	External charger cord - EUR
68	UNT0016A	Power Pack external charging adaptor

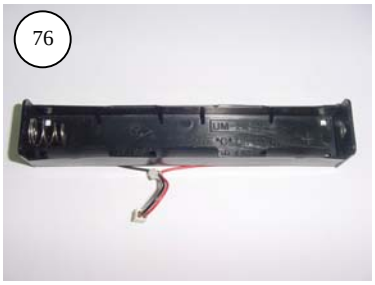
1.2.7 Fuses



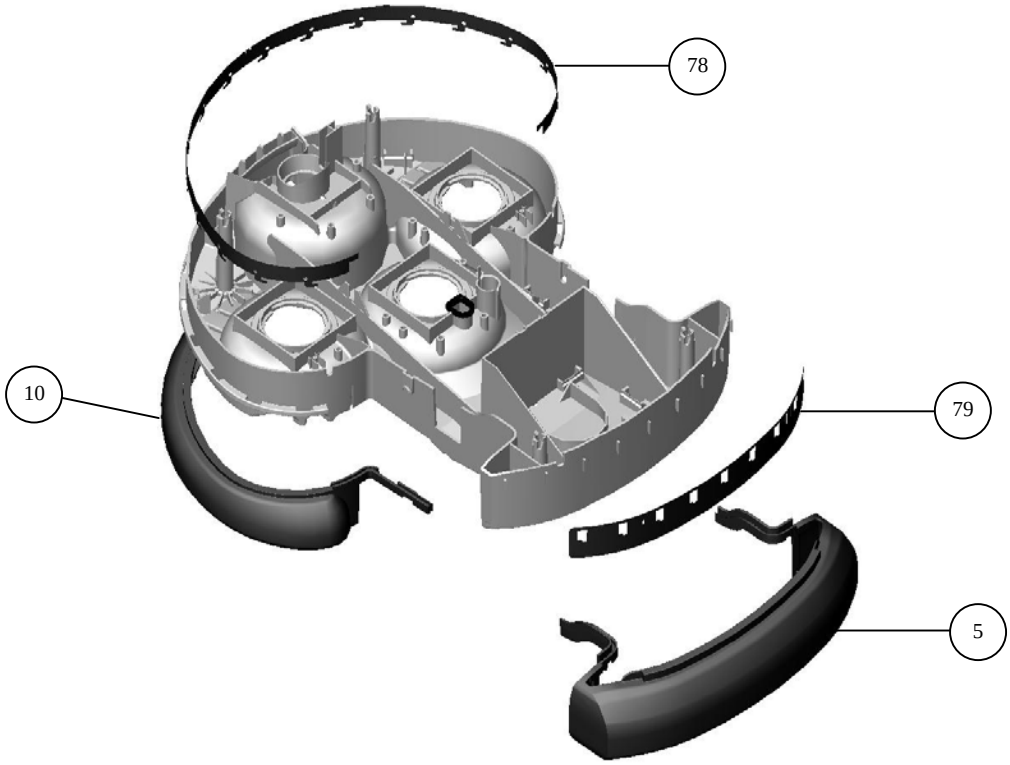
69	FUS0021A	Fuse 5x20 10A 125V (External Charger)
70	FUS0015A	Fuse mini blade 5A
71	FUS0003A	Fuse AT blade 30A 32V
72	FUS0012A	Fuse AT blade 1A 32V

1.2.8 Perimeter Switch

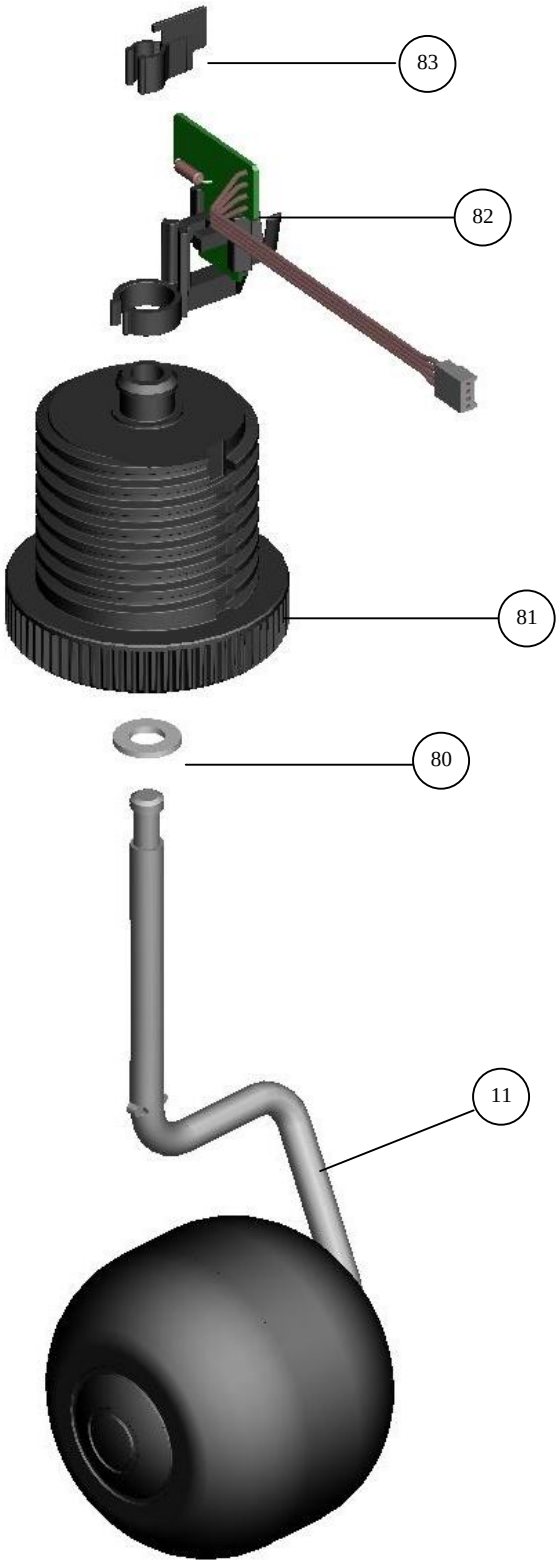




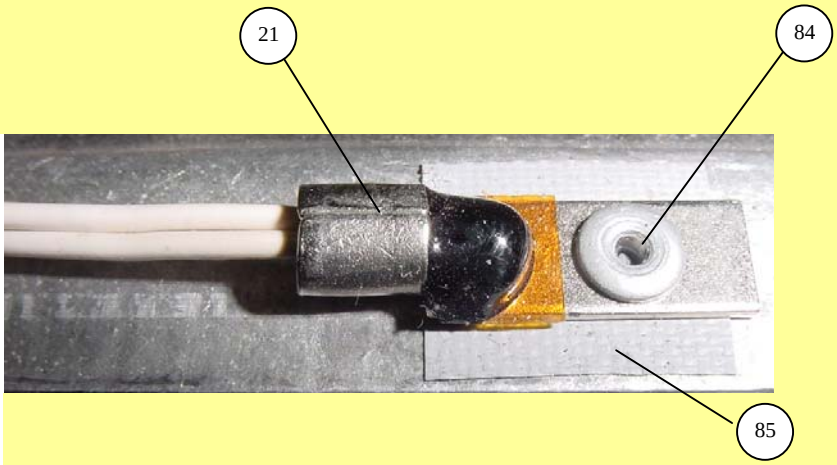
1.2.9 Bumpers



1.2.10 Front Wheel

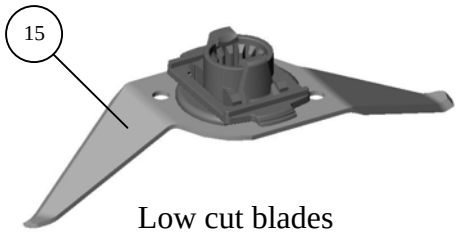


1.2.11 Thermistors

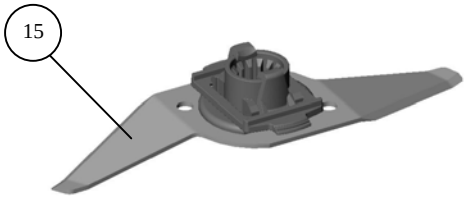


21	SPP0020A	Thermistors kit (Includes NIT0009A & HSN0003A)
84	NIT0009A	Pop rivet/D3.2x6
85	HSN0003A	Heat sink silicone insulator

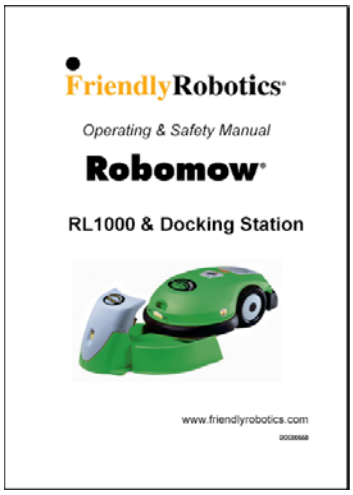
1.2.12 Add-On Items



Low cut blades



High cut blades



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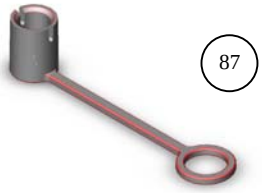
DOC0015D – RL Operating Manual (En)

DOC0076B – RL1000 (Standard Manual Con.) + Docking Manual



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GEN0211A	Charging plug rubber cover

26

GEN0210A	Charging socket rubber cover

88

TOL0001A	Mowing motor removal tool

1.2.13 Decals

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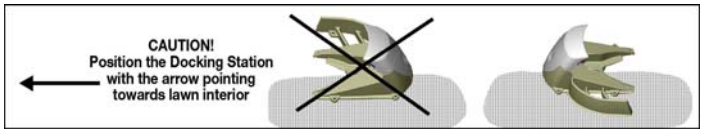
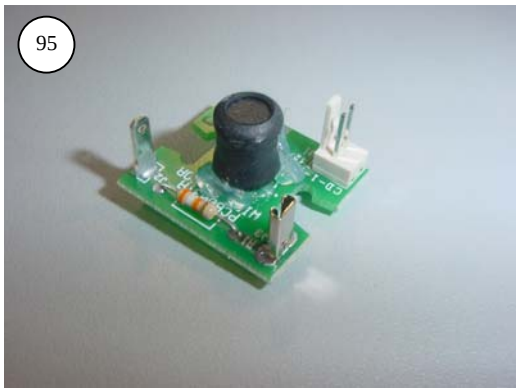


1.2.14 Old configuration spare parts

The parts below are available spare parts, which are not part of the ’05 configuration, but are still required to support the previous RL configurations.

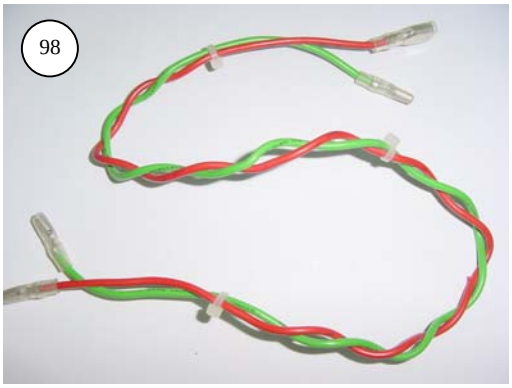
SPP0027A	Flash Software v 3.2a (Main Board ESB 0019)



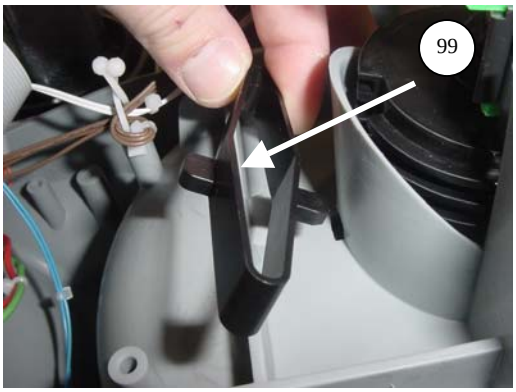
ESB0031A	Rear Right Wire Sensor Board

WSB0025B	Perimeter wire to perim. switch cable

GEN0148A	Navigator keypad



WSB0053A	Mowing motors cable



GEN0118A	Front Wheel Click Spring

1.3 Fuse location

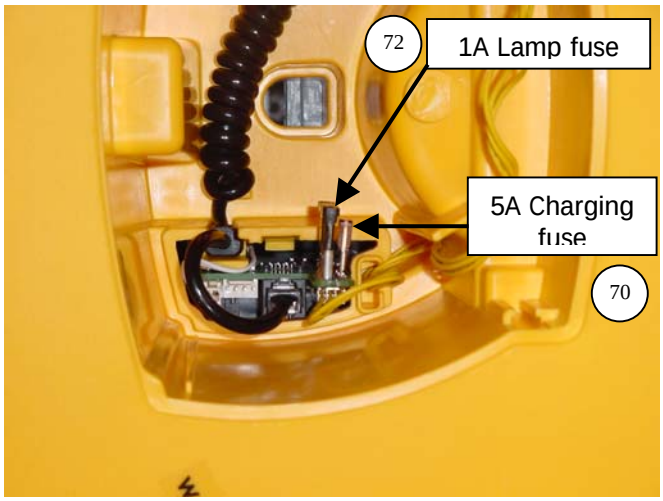


Figure 1.3.1 Robomow fuse location

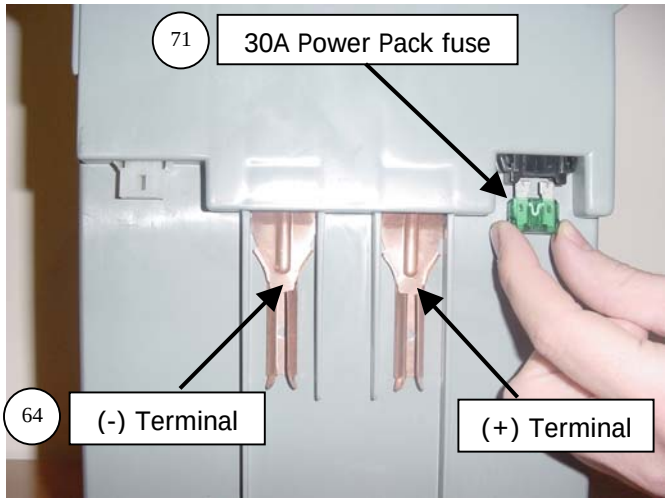
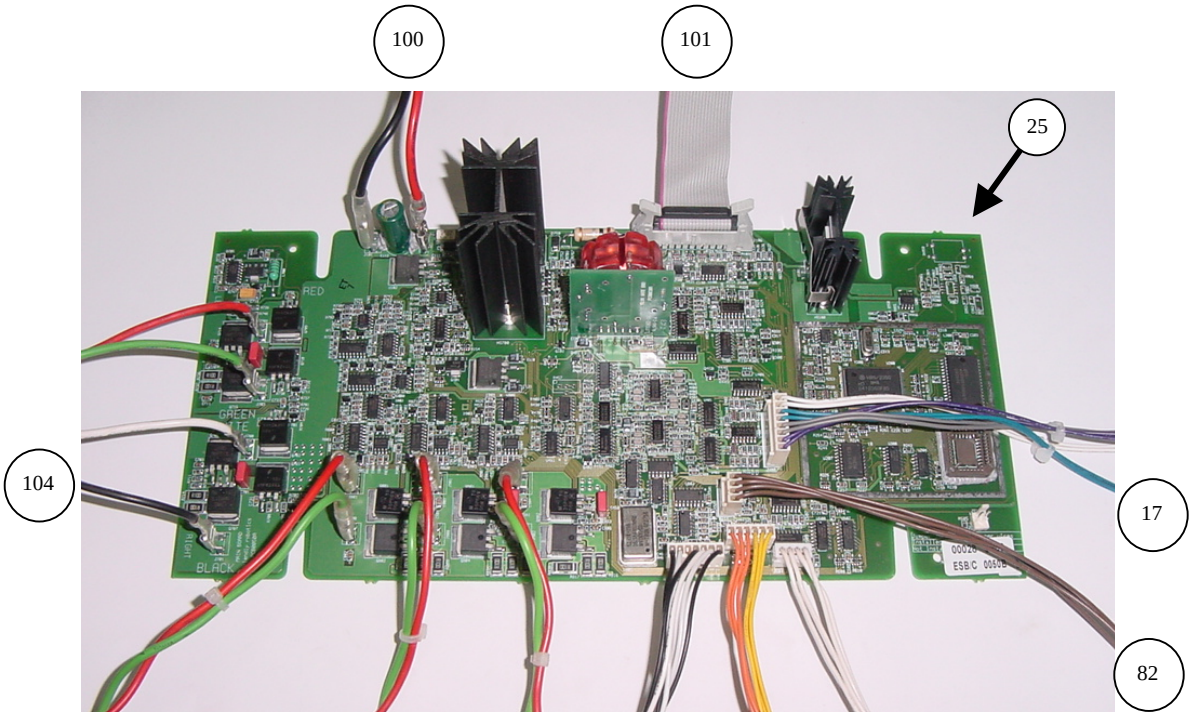


Figure 1.3.2 Power Pack fuse location

Figure 1.3.3 External Charger fuse location

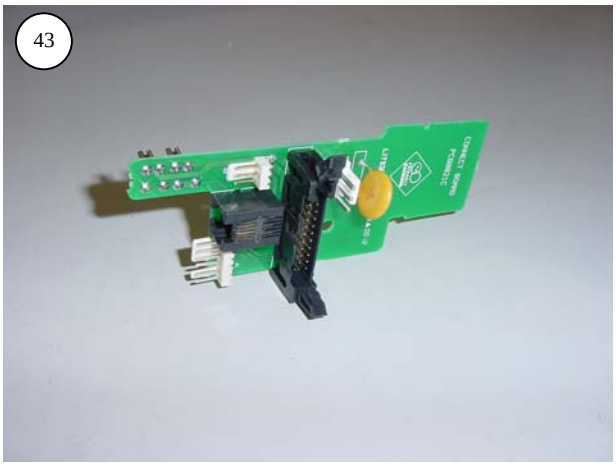
1.4 Board identification

1.4.1 Main Board

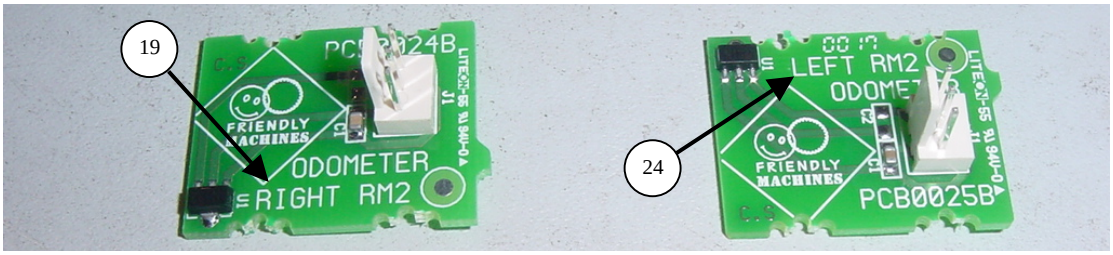


The Mowing motor cable is available as a separate part to support old configuration models.
12 - Soldered to the mowing motor
98 – Only cable

1.4.2 Connector Board



1.4.3 Odometer Board



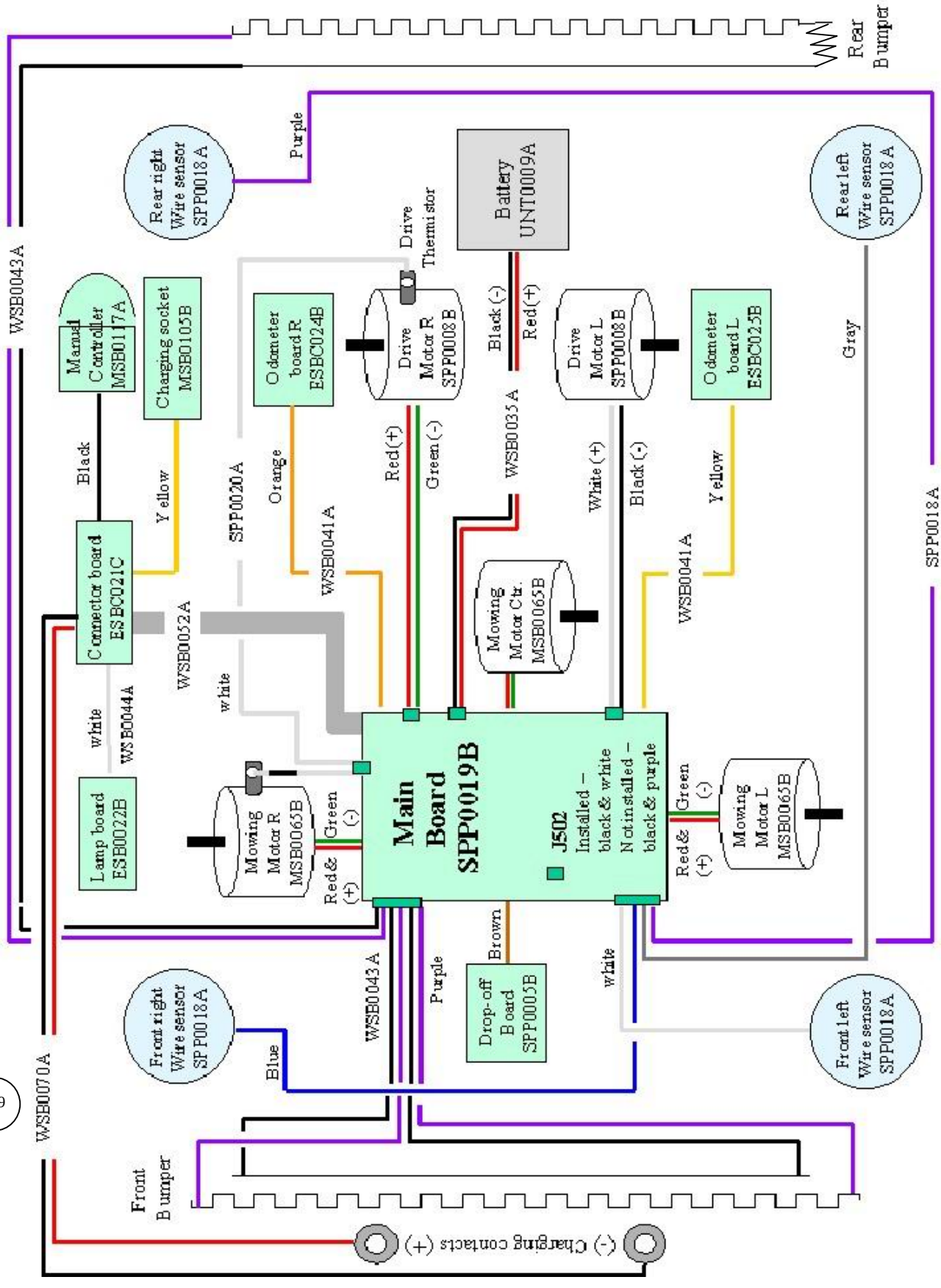
Right odometer board

Left odometer board

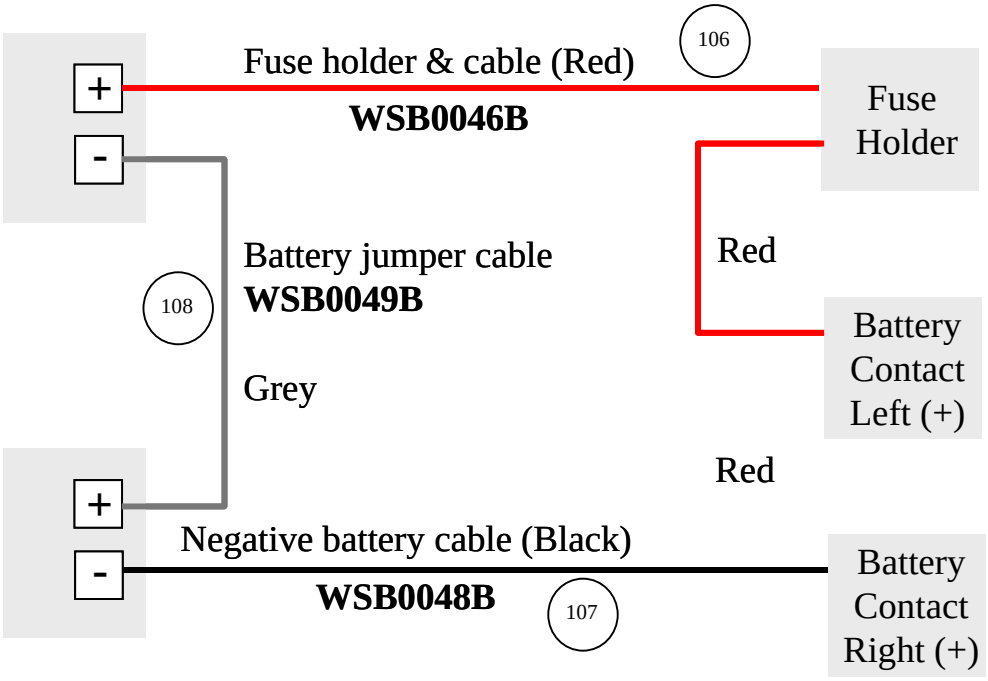
1.4.4 Drop-off Board

1.5 Wiring layout

1.5.1 Robomow schematic wiring diagram



1.5.2 Power Pack wiring diagram



1.6 Spare Parts List

1.6.1 Spare Parts – sorted by item number

#	Friendly P/N (2006)	Friendly P/N (2005)	Part Description	Appears in Exploded views No.	No. of parts
1	GEN0094A	GEN0094A	RL Yellow cover	1.1.1	1
1	GEN0227A	GEN0227A	RL Green cover	1.1.1	1
2	MSB0112A	MSB0112A	Manual controller- Europe (tones)	1.1.1 & 1.2.3	1
2	MSB0114A	MSB0114A	Manual Controller - US	1.1.1 & 1.2.3	1
2	MSB0118A	MSB0117A	Manual controller (ESBC050B and forwards)	1.1.1 & 1.2.3	1
2	MSB0119A	--------	Enhanced Manual Controller	1.1.1 & 1.2.3	1
3	MSB0078A	MSB0078A	Smooth drive wheel + bearing	1.1.1 & 1.2.1	2
3	MSB0099A	MSB0099A	Knobby drive wheel + bearing	1.1.2	2
4	UNT0009A	UNT0009A	Power Pack	1.1.1 & 1.2.6	1
5	MSB0107A	MSB0107A	Rear bumper assembly	1.2.8	1
6	SPP0032A	SPP0032A	operation lamp cover + seal	1.1.1 & 1.2.3	1
7	MSB0105B	MSB0105B	Man. cont. holder assembly (sp)	1.1.1 & 1.2.3	1
8	STC0048A	STC0048A	RL550 Sticker	1.1.1	1
8	STC0049A	STC0049A	RL850 Sticker	1.1.1	1
8	STC0051A	STC0051A	RL800 Sticker	1.1.1	1
8	STC0056A	STC0056A	RL1000 Sticker	1.1.1	1
8	STC0057A	STC0057A	RL350 Sticker	1.1.1	1
9	SPP0026A	SPP0026A	Charging contact (for Docking Station) + screws	1.1.1 & 1.2.3	1
10	MSB0106B	MSB0106B	Front bumper (one spring) assembly	1.2.8	1
11	SPP0011A	SPP0011A	Front wheel with axle	1.1.2 & 1.2.10	1
12	MSB0065B	MSB0065B	Mowing Unit + cable	1.2.1 & 1.1.3	3
13	GEN0095A	GEN0095A	RL plastic base	1.1.2	1
14	GEN0162A	GEN0162A	Snap lock (straight)	1.1.2	6
15	SPP0012A	SPP0012A	Single high cut blade	1.1.2 & 1.2.11	3
15	SPP0013A	SPP0013A	Single low cut blade	1.1.2 & 1.2.11	3
16	GEN0163A	GEN0163A	Snap lock (curved)	1.1.2	4
17	SPP0018A	SPP0018A	Wire Sensors x4 with cable (+DOC0057A)	1.1.3	1
18	GEN0182A	GEN0182A	Cover-base seal ring	1.2.2	1
19	ESBC024C	ESBC024B	Odometer Board R	1.1.3 & 1.4.3	1
20	SPP0014A	SPP0014A	Battery contacts assembly (RL side)	1.1.3 & 1.2.2	2
21	SPP0020A	SPP0020A	Thermistors kit	1.1.3 & 1.2.11	1
22	GEN0202A	GEN0202A	Ground clearance limiter	1.1.3 & 1.2.5	1
23	SPP0008B	SPP0008B	Drive motor replacement kit	1.1.3 & 1.2.5	2
24	ESBC025C	ESBC025B	Odometer Board L	1.1.3 & 1.4.3	1
25	SPP0019B	SPP0019B	Main Board (ESBC050B)	1.1.3 & 1.4.1	1
26	GEN0210A	GEN0210A	Charging socket rubber cover	1.2.12	1
27	GEN0208A	GEN0208A	Front Wheel stopper spring	1.2.2 & 1.1.3	2
28	GEN0207A	GEN0207A	Front Wheel stopper	1.2.2 & 1.1.3	1
29	SPP0030A	SPP0030A	Charging Station Cover (includes lexan, screws, sticker and push button)	1.2.4	1
30	SPP0029A	SPP0029A	Charging Station Base (Yellow)	1.2.4	1
30	SPP0039A	SPP0039A	Charging Station Base (Green)	1.2.4	1
31	GEN0215C	GEN0215B	Docking Station Fence (Green)	1.2.4	1
32	SPP0031A	SPP0031A	Docking Station Contacts Assembly	1.2.4	1
33	STC0054A	STC0054A	Charging station cover sticker	1.1.4	1
34	GEN0140A	GEN0140A	Sealing cup	1.2.1	4
35	ESB0022B	ESB0022B	Lamp Board	1.2.1	1
36	GEN0133A	GEN0133A	Magnet for Manual Controller	1.2.1	1
37	RNG0005A	RNG0005A	Spacer for Drive Wheel - D18*D12*0.5 DIN 988	1.2.1	2 to 8
38	RNG0002A	RNG0002A	Retaining ring for 12mm shaft (for Drive Wheel)	1.2.1	2

1.6.1 Spare Parts – sorted by item number (con.)

#	Friendly P/N (2006)	Friendly P/N (2005)	Part Description	Appears in Exploded views No.	No. of parts
39	GEN0104A	GEN0104A	Wheel Cup (gray)	1.2.1	2
39	GEN0201A	GEN0201A	Wheel Cup (black)	1.1.3 & 1.2.1	2
40	GEN0146A	GEN0146A	Main board rubber holder	1.2.2	4
41	CPS0007A	CPS0007A	Wire twist lock	1.2.2	
42	GEN0171A	GEN0171A	Motor shading	1.2.2	5
43	ESBC021C	ESBC021C	Connectors Board	1.2.2 & 1.4.2	1
44	SPP0004C	SPP0004B	Spare part gear case	1.2.2 & 1.2.5	1
45	GEN0142A	GEN0142A	Connector's cover	1.2.3	1
46	GEN0145A	GEN0145A	Pivot for manual controller's tray	1.2.3	2
47	LMP0004A	LMP0004A	Operating bulb bayonet 24v/4w	1.2.3	1
48	SCR0029A	SCR0029A	Screw DIN 7981C A2 4.2x25 (Docking Station)	1.2.4	5
49	SPP0028B	SPP0028A	Charging Station Board (includes screws, tact switch cover and push button)	1.2.4	1
50	SCR0027A	SCR0027A	Screw WN 1412 KA25x8 (Docking Board)	1.2.4	8
51	GEN0176A	GEN0176A	Docking Board seal	1.2.4	1
52	GEN0218A	GEN0218A	Push button for Docking Board	1.2.4	1
53	GEN0223A	GEN0223A	Fastening Stakes for the Charging Station	1.2.4	5
54	GEN0217B	GEN0217B	D. Station Connectors Cover (Green)	1.2.4	3
55	SPP0009B	SPP0009A	Gear Shafts replacement kit	1.2.5	1
56	SPP0015A	SPP0015A	Gear Frame (+ GEN0202A and DOC0056A)	1.2.5	1
57	GEN0122A	GEN0122A	Shafts clamp (gear)	1.2.5	2
58	MSB0077A	MSB0077A	Slider assembly	1.2.5	2
59	MSB0079A	MSB0079A	Gear spline + bearing	1.2.5	2
60	GEN0101A	GEN0101A	Odometer magnet	1.2.5	4
61	SCR0025A	SCR0025A	Screw for RL motors	1.2.5	8
62	GEN0132A	GEN0132A	Battery cover	1.2.6	1
63	GEN0131A	GEN0131A	Battery Case	1.2.6	1
64	GEN0130A	GEN0130A	Contact leaf-battery	1.2.6	2
65	PWS0004A	PWS0004A	230VAC Out Door Power Supply (EUR)	1.2.6	1
65	PWS0005A	PWS0005A	115VAC Out Door Power Supply (US)	1.2.6	1
65	PWS0006A	PWS0006A	230VAC Out Door Power Supply (UK)	1.2.6	1
66	PWS0001A	PWS0001A	230VAC power supply -Europe	1.2.6	1
66	PWS0002A	PWS0002A	230VAC power supply - UK	1.2.6	1
66	PWS0003A	PWS0003A	115VAC power supply - US	1.2.6	1
67	CBL0037A	CBL0037A	External charger cord - UK	1.2.6	1
67	CBL0038A	CBL0038A	External charger cord - US	1.2.6	1
67	CBL0039A	CBL0039A	External charger cord - EUR	1.2.6	1
68	UNT0016A	UNT0016A	Power Pack external charging adaptor	1.2.6	1
69	FUS0021A	FUS0021A	Fuse 5x20 10A 125V (External Charger)	1.2.7 & 1.3	1
70	FUS0015A	FUS0015A	Fuse mini blade 5A	1.2.7 & 1.3	1
71	FUS0003A	FUS0003A	Fuse AT blade 30A 32V	1.2.7 & 1.3	1
72	FUS0012A	FUS0012A	Fuse AT blade 1A 32V	1.2.7 & 1.3	1
73	MRK0025B	MRK0025B	5 hrs. Perimeter Switch	1.2.8	1
74	GEN0156A	GEN0156A	Perimeter switch back cover	1.2.8	1
75	GEN0175A	GEN0175A	Stake for perimeter switch	1.2.8	1
76	BAT0003A	BAT0003A	Battery holder for perim.switch with screws	1.2.8	1
77	CON0054A	CON0054A	Plot connector	1.2.8	1
78	MSB0090A	MSB0090A	Contact strip front assembly	1.2.8	1
79	MSB0091B	MSB0091B	Contact strip rear assembly	1.2.8	1
80	RNG0031A	RNG0030A	Washer M10x15 (BN 739)	1.2.10	1
81	GEN0117A	GEN0117A	Adjusting bolt	1.2.10	1
82	SPP0005B	SPP0005B	Drop off board + holder	1.2.10	1

1.6.1 Spare Parts – sorted by item number (con.)

#	Friendly P/N (2006)	Friendly P/N (2005)	Part Description	Appears in Exploded views No.	No. of parts
83	GEN0116A	GEN0116A	Drop off flag	1.2.10	1
84	NIT0009A	NIT0009A	Pop rivet/D3.2x6 (Thermistors)	1.2.11	2
85	HSN0003A	HSN0003A	Heat sink silicone insulator (Thermistors)	1.2.11	2
86	DOC0015D	DOC0015C	RL Operating Manual (En)	1.2.12	1
86	DOC0076B	DOC0076A	RL1000 + Docking Manual (En)	1.2.12	1
87	GEN0211A	GEN0211A	charging plug rubber cover	1.2.12	1
88	TOL0001A	TOL0001A	Mowing motor removal tool	1.1.12	1
89	STC0018A	STC0018A	Danger sticker	1.2.13	2
90	STC0022A	STC0022A	Front caution sticker	1.2.13	1
91	STC0012A	STC0012A	Rear warning sticker	1.2.13	1
92	STC0036B	STC0036B	Battery charging decal (En)	1.2.13	1
93	STC0055A	STC0055A	Charging Station fence sticker	1.2.13	1
94	SPP0027A	SPP0027A	Flash Software v3.2a+ (ESB0019C)	1.2.14	1
95	ESB0031A	ESB0031A	Rear Right Wire Sensor Board (old configuration)	1.2.14	1
96	WSB0025B	WSB0025B	Perim. wire to perim. switch cable	1.2.14	1
97	GEN0148A	GEN0148A	Navigator keypad	1.2.14	1
98	WSB0053A	WSB0053A	Mowing motors cable	1.2.14 & 1.4.1	3
99	GEN0118A	GEN0118A	Front Wheel Click Spring ('02 configuration)	1.2.14	1
100	WSB0035A	WSB0035A	Main board to battery cable	1.4.1 & 1.5.1	1
101	WSB0052A	WSB0052A	Flat cable	1.4.1 & 1.5.1	1
102	WSB0041A	WSB0041A	Odometers cable	1.4.1 & 1.5.1	1
103	WSB0043B	WSB0043B	Bumper cable	1.4.1 & 1.5.1	1
104	WSB0063A	WSB0063A	Drive motor + ferrite cable	1.4.1 & 1.5.1	1
105	WSB0044A	WSB0044A	Lamp board cable	1.2.3 & 1.5.1	1
106	WSB0046B	WSB0046A	Fuse holder battery pack cable	1.5.2	1
107	WSB0048B	WSB0048A	(-) spring battery cable	1.5.2	1
108	WSB0049B	WSB0049A	Battery jumper cable	1.5.2	1
109	WSB0070A	WSB0070A	Connector Board to charging contacts cable	1.5.1	1
110	DOC0008B	DOC0008B	RoboRuler	NA	1
111	DOC0051E	DOC0051D	RL Service Guide Hard Copy (En)	NA	
112	DOC0053C	DOC0053B	RL Service Guide CD (En)	NA	
113	DOC0065B	---------	RL Operating & Safety CD (En)	NA	
114	PRG0005A	PRG0005A	Flash Software v3.2i (Service version - 03 models)	NA	
115	SPP0033C	SPP0033B	Flash Software v3.2-06 + Operating Manual (En)	NA	
115	SPP0035C	SPP0035B	Flash Software v3.2-06 + Operating Manual (BLX)	NA	
115	SPP0036C	SPP0036B	Flash Software v3.2-06 + Operating Manual (DE)	NA	
115	SPP0040C	--------	Flash Software v3.2-06 + Operating Manual (IT)	NA	
115	SPP0041C	--------	Flash Software v3.2-06 + Operating Manual (DK)	NA	
115	SPP0101A	--------	Flash Software v4.1-06 + Operating Manual (En)	NA	
115	SPP0102A	--------	Flash Software v4.1-06 + Operating Manual (BLX)	NA	
115	SPP0103A	--------	Flash Software v4.1-06 + Operating Manual (DE)	NA	
115	SPP0104A	--------	Flash Software v4.1-06 + Operating Manual (IT)	NA	
115	SPP0105A	--------	Flash Software v4.1-06 + Operating Manual (DK)	NA	
116	CPS0013A	CPS0013A	Wire twist lock for bat. cable	NA	1
120	STC0052A	STC0052A	Theft Guard decal	NA	
121	GEN0067A	GEN0067A	Fast charger 115/230V (without cord)	1.2.6	
122	GEN0229A	--------	Charging Station right wheel support	1.1.4 & 1.2.4	1
123	GEN0230A	--------	Charging Station left wheel support	1.1.4 & 1.2.4	1
124	STC0058A	-------	Crossed-out wheeled bin		1
125	GEN0231A	--------	Gear frame support		
126	CPS0014A	--------	Plastic rivet (between cover and base)		
127	SCR0033A	--------	Screw for the Charging Station drive wheel supports	1.2.4	2

1.6.2 Spare Parts – sorted by Friendly part number

#	Friendly P/N (2006)	Friendly P/N (2005)	Part Description	Appears in Exploded views No.	No. of parts
76	BAT0003A	BAT0003A	Battery holder for perim.switch with screws	1.2.8	1
67	CBL0037A	CBL0037A	External charger cord - UK	1.2.6	1
67	CBL0038A	CBL0038A	External charger cord - US	1.2.6	1
67	CBL0039A	CBL0039A	External charger cord - EUR	1.2.6	1
77	CON0054A	CON0054A	Plot connector	1.2.8	1
41	CPS0007A	CPS0007A	Wire twist lock	1.2.2	
116	CPS0013A	CPS0013A	Wire twist lock for bat. cable	NA	1
126	CPS0014A	--------	Plastic rivet (between cover and base)		
110	DOC0008B	DOC0008B	RoboRuler	NA	1
86	DOC0015D	DOC0015C	RL Operating Manual (En)	1.2.12	1
111	DOC0051E	DOC0051D	RL Service Guide Hard Copy (En)	NA	
112	DOC0053C	DOC0053B	RL Service Guide CD (En)	NA	
113	DOC0065B	---------	RL Operating & Safety CD (En)	NA	
86	DOC0076B	DOC0076A	RL1000 + Docking Manual (En)	1.2.12	1
35	ESB0022B	ESB0022B	Lamp Board	1.2.1	1
95	ESB0031A	ESB0031A	Rear Right Wire Sensor Board (old configuration)	1.2.14	1
43	ESBC021C	ESBC021C	Connectors Board	1.2.2 & 1.4.2	1
19	ESBC024C	ESBC024B	Odometer Board R	1.1.3 & 1.4.3	1
24	ESBC025C	ESBC025B	Odometer Board L	1.1.3 & 1.4.3	1
71	FUS0003A	FUS0003A	Fuse AT blade 30A 32V	1.2.7 & 1.3	1
72	FUS0012A	FUS0012A	Fuse AT blade 1A 32V	1.2.7 & 1.3	1
70	FUS0015A	FUS0015A	Fuse mini blade 5A	1.2.7 & 1.3	1
69	FUS0021A	FUS0021A	Fuse 5x20 10A 125V (External Charger)	1.2.7 & 1.3	1
121	GEN0067A	GEN0067A	Fast charger 115/230V (without cord)	1.2.6	
1	GEN0094A	GEN0094A	RL Yellow cover	1.1.1	1
13	GEN0095A	GEN0095A	RL plastic base	1.1.2	1
60	GEN0101A	GEN0101A	Odometer magnet	1.2.5	4
39	GEN0104A	GEN0104A	Wheel Cup (gray)	1.2.1	2
83	GEN0116A	GEN0116A	Drop off flag	1.2.10	1
81	GEN0117A	GEN0117A	Adjusting bolt	1.2.10	1
99	GEN0118A	GEN0118A	Front Wheel Click Spring ('02 configuration)	1.2.14	1
57	GEN0122A	GEN0122A	Shafts clamp (gear)	1.2.5	2
64	GEN0130A	GEN0130A	Contact leaf-battery	1.2.6	2
63	GEN0131A	GEN0131A	Battery Case	1.2.6	1
62	GEN0132A	GEN0132A	Battery cover	1.2.6	1
36	GEN0133A	GEN0133A	Magnet for Manual Controller	1.2.1	1
34	GEN0140A	GEN0140A	Sealing cup	1.2.1	4
45	GEN0142A	GEN0142A	Connector's cover	1.2.3	1
46	GEN0145A	GEN0145A	Pivot for manual controller's tray	1.2.3	2
40	GEN0146A	GEN0146A	Main board rubber holder	1.2.2	4
97	GEN0148A	GEN0148A	Navigator keypad	1.2.14	1
74	GEN0156A	GEN0156A	Perimeter switch back cover	1.2.8	1
14	GEN0162A	GEN0162A	Snap lock (straight)	1.1.2	6
16	GEN0163A	GEN0163A	Snap lock (curved)	1.1.2	4
42	GEN0171A	GEN0171A	Motor shading	1.2.2	5
75	GEN0175A	GEN0175A	Stake for perimeter switch	1.2.8	1
51	GEN0176A	GEN0176A	Docking Board seal	1.2.4	1
18	GEN0182A	GEN0182A	Cover-base seal ring	1.2.2	1
39	GEN0201A	GEN0201A	Wheel Cup (black)	1.1.3 & 1.2.1	2
22	GEN0202A	GEN0202A	Ground clearance limiter	1.1.3 & 1.2.5	1
28	GEN0207A	GEN0207A	Front Wheel stopper	1.2.2 & 1.1.3	1
27	GEN0208A	GEN0208A	Front Wheel stopper spring	1.2.2 & 1.1.3	2
26	GEN0210A	GEN0210A	Charging socket rubber cover	1.2.12	1
87	GEN0211A	GEN0211A	Charging plug rubber cover	1.2.12	1

1.6.2 Spare Parts – sorted by Friendly part number (con.)

#	Friendly P/N (2006)	Friendly P/N (2005)	Part Description	Appears in Exploded views No.	No. of parts
31	GEN0215C	GEN0215B	Docking Station Fence (Green)	1.2.4	1
54	GEN0217B	GEN0217B	D. Station Connectors Cover (Green)	1.2.4	3
52	GEN0218A	GEN0218A	Push button for Docking Board	1.2.4	1
53	GEN0223A	GEN0223A	Fastening Stakes for the Charging Station	1.2.4	5
1	GEN0227A	GEN0227A	RL Green cover	1.1.1	1
122	GEN0229A	--------	Charging Station right wheel support	1.1.4 & 1.2.4	1
123	GEN0230A	--------	Charging Station left wheel support	1.1.4 & 1.2.4	1
125	GEN0231A	--------	Gear frame support		2
85	HSN0003A	HSN0003A	Heat sink silicone insulator (Thermistors)	1.2.11	2
47	LMP0004A	LMP0004A	Operating bulb bayonet 24v/4w	1.2.3	1
73	MRK0025B	MRK0025B	5 hrs. Perimeter Switch	1.2.8	1
12	MSB0065B	MSB0065B	Mowing Unit + cable	1.2.1 & 1.1.3	3
58	MSB0077A	MSB0077A	Slider assembly	1.2.5	2
3	MSB0078A	MSB0078A	Smooth drive wheel + bearing	1.1.1 & 1.2.1	2
59	MSB0079A	MSB0079A	Gear spline + bearing	1.2.5	2
78	MSB0090A	MSB0090A	Contact strip front assembly	1.2.8	1
79	MSB0091B	MSB0091B	Contact strip rear assembly	1.2.8	1
3	MSB0099A	MSB0099A	Knobby drive wheel + bearing	1.1.2	2
7	MSB0105B	MSB0105B	Man. cont. holder assembly (sp)	1.1.1 & 1.2.3	1
10	MSB0106B	MSB0106B	Front bumper (one spring) assembly	1.2.8	1
5	MSB0107A	MSB0107A	Rear bumper assembly	1.2.8	1
2	MSB0112A	MSB0112A	Manual controller- Europe (tones)	1.1.1 & 1.2.3	1
2	MSB0114A	MSB0114A	Manual Controller - US	1.1.1 & 1.2.3	1
2	MSB0118A	MSB0117A	Manual controller (ESBC050B and forwards)	1.1.1 & 1.2.3	1
2	MSB0119A	--------	Enhanced Manual Controller	1.1.1 & 1.2.3	1
84	NIT0009A	NIT0009A	Pop rivet/D3.2x6 (Thermistors)	1.2.11	2
114	PRG0005A	PRG0005A	Flash Software v3.2i (Service version - 03 models)	NA	
66	PWS0001A	PWS0001A	230VAC power supply -Europe	1.2.6	1
66	PWS0002A	PWS0002A	230VAC power supply - UK	1.2.6	1
66	PWS0003A	PWS0003A	115VAC power supply - US	1.2.6	1
65	PWS0004A	PWS0004A	230VAC Out Door Power Supply (EUR)	1.2.6	1
65	PWS0005A	PWS0005A	115VAC Out Door Power Supply (US)	1.2.6	1
65	PWS0006A	PWS0006A	230VAC Out Door Power Supply (UK)	1.2.6	1
38	RNG0002A	RNG0002A	Retaining ring for 12mm shaft (for Drive Wheel)	1.2.1	2
37	RNG0005A	RNG0005A	Spacer for Drive Wheel - D18*D12*0.5 DIN 988	1.2.1	2 to 8
80	RNG0031A	RNG0030A	Washer M10x15 (BN 739)	1.2.10	1
61	SCR0025A	SCR0025A	Screw for RL motors	1.2.5	8
50	SCR0027A	SCR0027A	Screw WN 1412 KA25x8 (Docking Board)	1.2.4	8
48	SCR0029A	SCR0029A	Screw DIN 7981C A2 4.2x25 (Docking Station)	1.2.4	5
127	SCR0033A	--------	Screw for the Charging Station drive wheel supports	1.2.4	2
44	SPP0004C	SPP0004B	Spare part gear case	1.2.2 & 1.2.5	1
82	SPP0005B	SPP0005B	Drop off board + holder + Cable	1.2.10	1
23	SPP0008B	SPP0008B	Drive motor replacement kit	1.1.3 & 1.2.5	2
55	SPP0009B	SPP0009A	Gear Shafts replacement kit	1.2.5	1
11	SPP0011A	SPP0011A	Front wheel with axle	1.1.2 & 1.2.10	1
15	SPP0012A	SPP0012A	Single high cut blade	1.1.2 & 1.2.11	3
15	SPP0013A	SPP0013A	Single low cut blade	1.1.2 & 1.2.11	3
20	SPP0014A	SPP0014A	Battery contacts assembly (RL side)	1.1.3 & 1.2.2	2
56	SPP0015A	SPP0015A	Gear Frame (+ GEN0202A and DOC0056A)	1.2.5	1
17	SPP0018A	SPP0018A	Wire Sensors x4 with cable (+DOC0057A)	1.1.3	1
25	SPP0019B	SPP0019B	Main Board (ESBC050B)	1.1.3 & 1.4.1	1
21	SPP0020A	SPP0020A	Thermistors kit	1.1.3 & 1.2.11	1
9	SPP0026A	SPP0026A	Charging contact (for Docking Station) + screws	1.1.1 & 1.2.3	1

1.6.2 Spare Parts – sorted by Friendly part number (con.)

#	Friendly P/N (2006)	Friendly P/N (2005)	Part Description	Appears in Exploded views No.	No. of parts
94	SPP0027A	SPP0027A	Flash Software v3.2a+ (ESB0019C)	1.2.14	1
49	SPP0028B	SPP0028A	Charging Station Board (includes screws, tact switch cover and push button)	1.2.4	1
30	SPP0029A	SPP0029A	Charging Station Base (Yellow)	1.2.4	1
29	SPP0030A	SPP0030A	Charging Station Cover (includes lexan, screws, sticker and push button)	1.2.4	1
32	SPP0031A	SPP0031A	Charging Station Contacts Assembly	1.2.4	1
6	SPP0032A	SPP0032A	operation lamp cover + seal	1.1.1 & 1.2.3	1
115	SPP0033C	SPP0033B	Flash Software v3.2-06 + Operating Manual (En)	NA	
115	SPP0035C	SPP0035B	Flash Software v3.2-06 + Operating Manual (BLX)	NA	
115	SPP0036C	SPP0036B	Flash Software v3.2-06 + Operating Manual (DE)	NA	
30	SPP0039A	SPP0039A	Charging Station Base (Green)	1.2.4	1
115	SPP0040C	--------	Flash Software v3.2-06 + Operating Manual (IT)	NA	
115	SPP0041C	--------	Flash Software v3.2-06 + Operating Manual (DK)	NA	
115	SPP0101A	--------	Flash Software v4.1-06 + Operating Manual (En)	NA	
115	SPP0102A	--------	Flash Software v4.1-06 + Operating Manual (BLX)	NA	
115	SPP0103A	--------	Flash Software v4.1-06 + Operating Manual (DE)	NA	
115	SPP0104A	--------	Flash Software v4.1-06 + Operating Manual (IT)	NA	
115	SPP0105A	--------	Flash Software v4.1-06 + Operating Manual (DK)	NA	
91	STC0012A	STC0012A	Rear warning sticker	1.2.13	1
89	STC0018A	STC0018A	Danger sticker	1.2.13	2
90	STC0022A	STC0022A	Front caution sticker	1.2.13	1
92	STC0036B	STC0036B	Battery charging decal (En)	1.2.13	1
8	STC0048A	STC0048A	RL550 Sticker	1.1.1	1
8	STC0049A	STC0049A	RL850 Sticker	1.1.1	1
8	STC0051A	STC0051A	RL800 Sticker	1.1.1	1
120	STC0052A	STC0052A	Theft Guard decal	NA	
33	STC0054A	STC0054A	Charging station cover sticker	1.1.4	1
93	STC0055A	STC0055A	Charging Station fence sticker	1.2.13	1
8	STC0056A	STC0056A	RL1000 Sticker	1.1.1	1
8	STC0057A	STC0057A	RL350 Sticker	1.1.1	1
124	STC0058A	-------	Crossed-out wheeled bin		1
88	TOL0001A	TOL0001A	Mowing motor removal tool	1.1.12	1
4	UNT0009A	UNT0009A	Power Pack	1.1.1 & 1.2.6	1
68	UNT0016A	UNT0016A	Power Pack external charging adaptor	1.2.6	1
96	WSB0025B	WSB0025B	Perim. wire to perim. switch cable	1.2.14	1
100	WSB0035A	WSB0035A	Main board to battery cable	1.4.1 & 1.5.1	1
102	WSB0041A	WSB0041A	Odometers cable	1.4.1 & 1.5.1	1
103	WSB0043B	WSB0043B	Bumper cable	1.4.1 & 1.5.1	1
105	WSB0044A	WSB0044A	Lamp board cable	1.2.3 & 1.5.1	1
106	WSB0046B	WSB0046A	Fuse holder battery pack cable	1.5.2	1
107	WSB0048B	WSB0048A	(-) spring battery cable	1.5.2	1
108	WSB0049B	WSB0049A	Battery jumper cable	1.5.2	1
101	WSB0052A	WSB0052A	Flat cable	1.4.1 & 1.5.1	1
98	WSB0053A	WSB0053A	Mowing motors cable	1.2.14 & 1.4.1	3
104	WSB0063A	WSB0063A	Drive motor + ferrite cable	1.4.1 & 1.5.1	1
109	WSB0070A	WSB0070A	Connector Board to charging contacts cable	1.5.1	1

1.7 Parts Compatibility Table

P/N	Description	Service Bulletin	Compatible with
GEN0094A	RL Cover	#RL0536-04	All models
GEN0118A	Front Wheel Click Spring	#RL0536-05	S/N IRL02340100 and older
GEN0148A	Navigator keypad	-----	S/N IRL02340100 and older (M. Controller without 'GO' printed on the green button)
GEN0182A	Cover-base seal ring	-----	S/N IRL03000000 and onwards
GEN0207A GEN0208A	Front Wheel stopper Front Wheel spring	#RL0536-05	S/N IRL03010000 and onwards
MSB0065B	Mowing Unit + cable	#RL0536-06	All models
MSB0106B	Front bumper (one spring) assembly	#RL0340-08	All models
MSB0112A MSB0114A	Manual controller (tones) M. Controller (US - speech)	#RL0456-09	All models
MSB0118A MSB0119A	Standard Manual controllers 05 Enhanced Manual Controller	#RL0536-09	Main Board ESBC050B and onwards
SPP0004B	Spare part gear case	#RL0536-02	All models
SPP0005B	Drop off board + holder + Cable	-----	All models
SPP0018A	Wire Sensors x4 with cable	#RL0536-03	All models
SPP0019B	Main Board	#RL0536-01	All models
SPP0020A	Thermistors kit	#RL0340-10	All models
SPP0027A	Flash Software v3.2a	#RL0536-11	Main Board ESB0019C
SPP0033B	Flash Software v3.2-06	#RL0536-11	Main Board ESBC050B
PRG0005A	Flash Software v3.2i	#RL0536-11	Main Board ESBC045B
WSB0053A	Mowing motors cable	-----	S/N beginning with IRL00…/IRL01…/IRL02…

Sample of ID decal (serial number) located at bottom of the Power Pack cavity:

Manufacture date:
Year – 2001
Week - 18

2. Menu Items

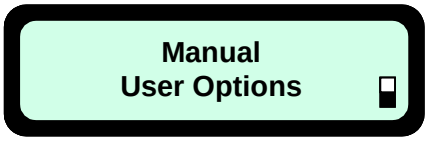
The menu items section gives an explanation and description of the options and messages displayed on the LCD Display.

Use this section to navigate around the menu and find the required option. Following is the layout of the menu as a whole. In section 2.2 you will find detailed explanations for each of the menu items.

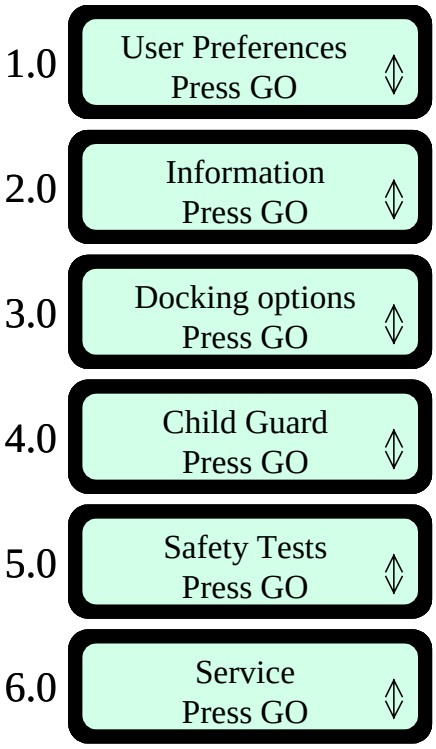
2.1 Menu Items Table

Note: the menus appeared in this manual are for RL1000 (S.W version 4.1-06). The 'Docking options' menu will not appear in other RL models.

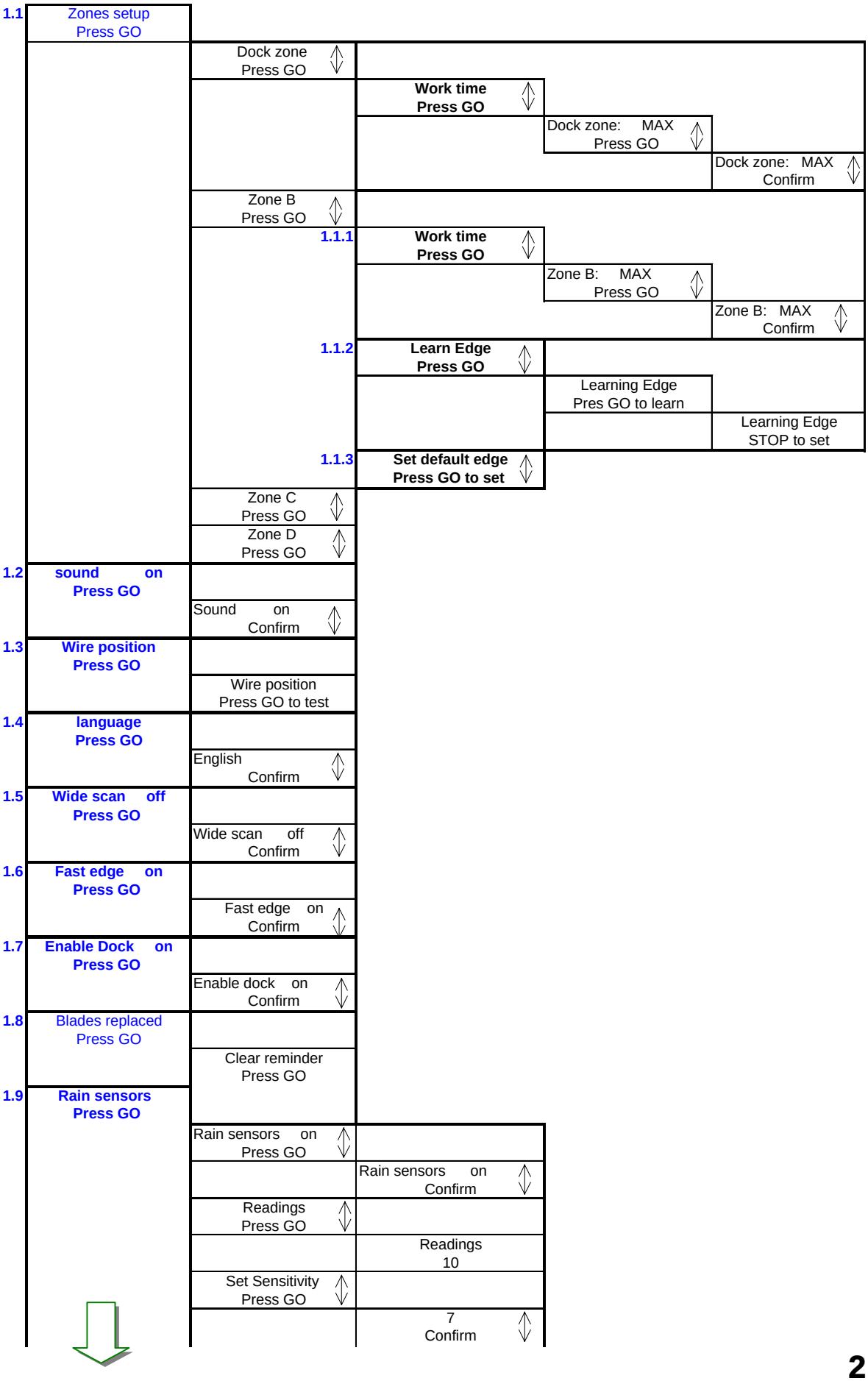
When the Manual Controller is out of its place the following display is appeared:

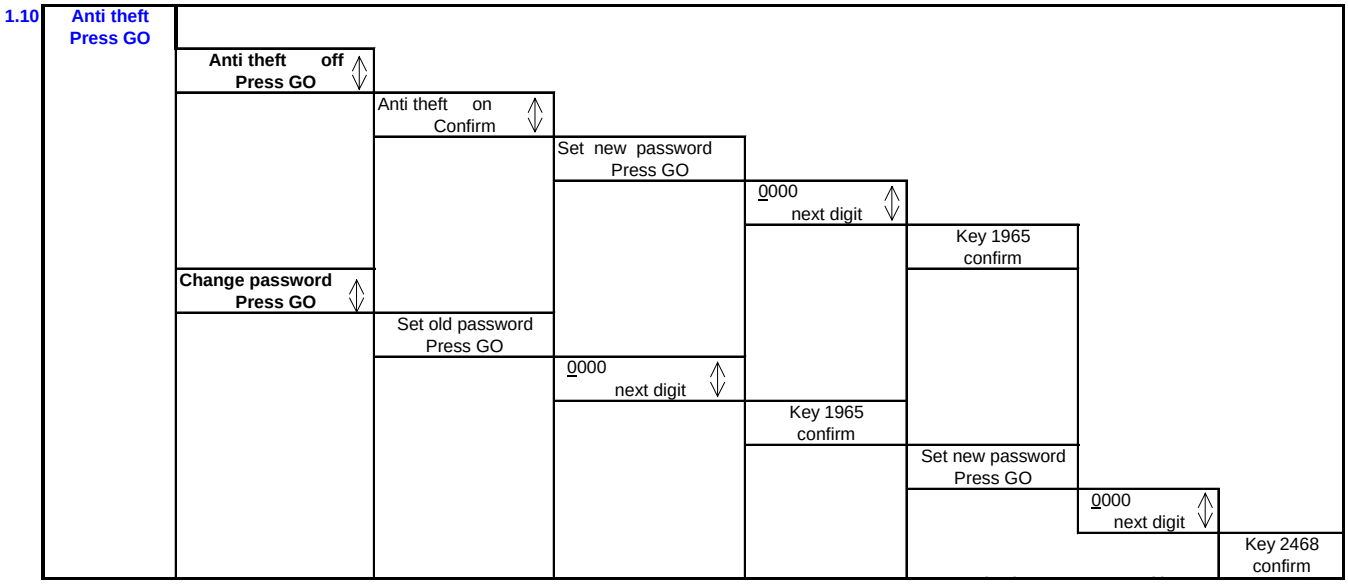


As pressing the 'GO' button when the Manual Controller in user's hand, the following menu items (under 'User Options') are available:



1.0 User Preferences:

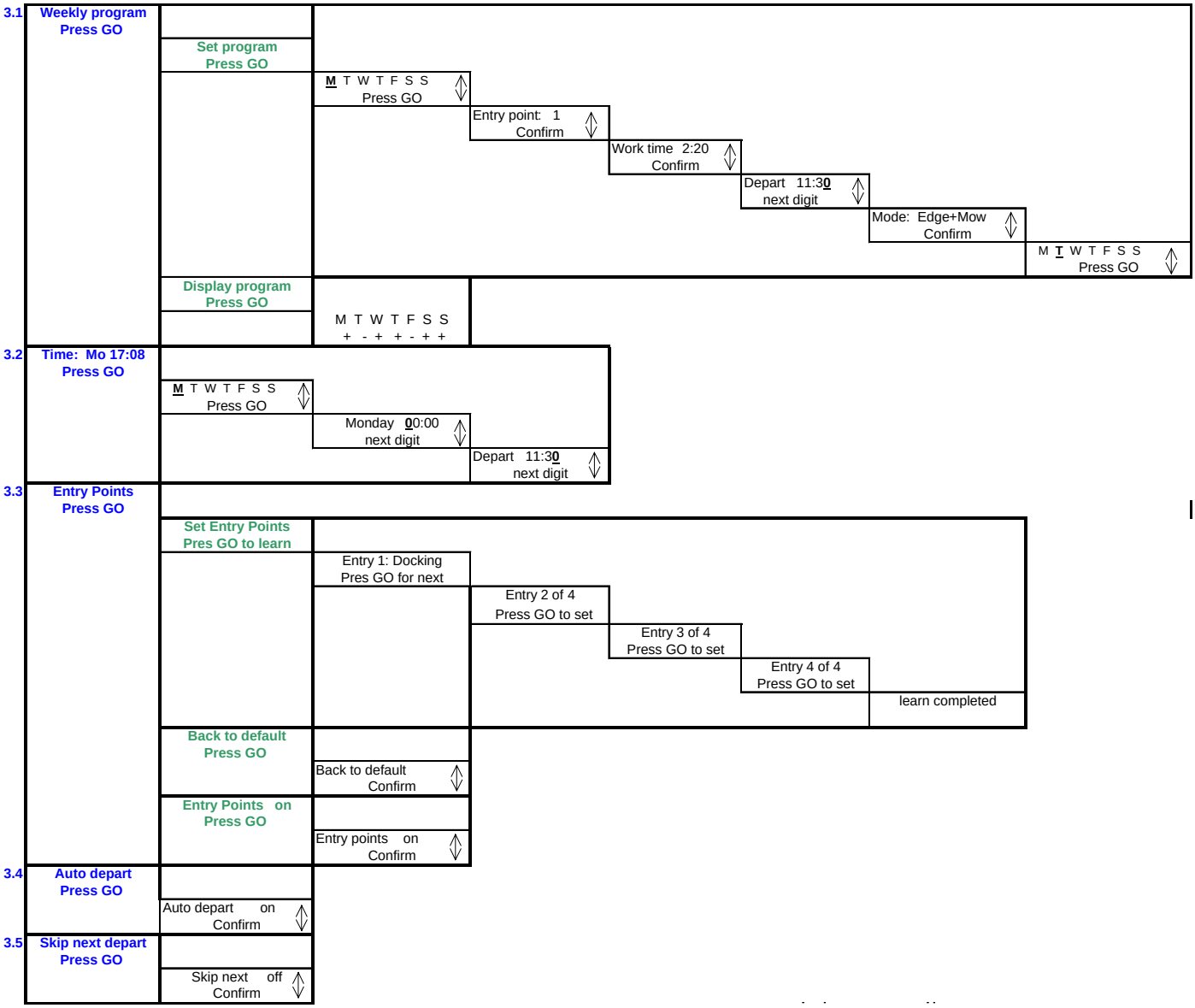




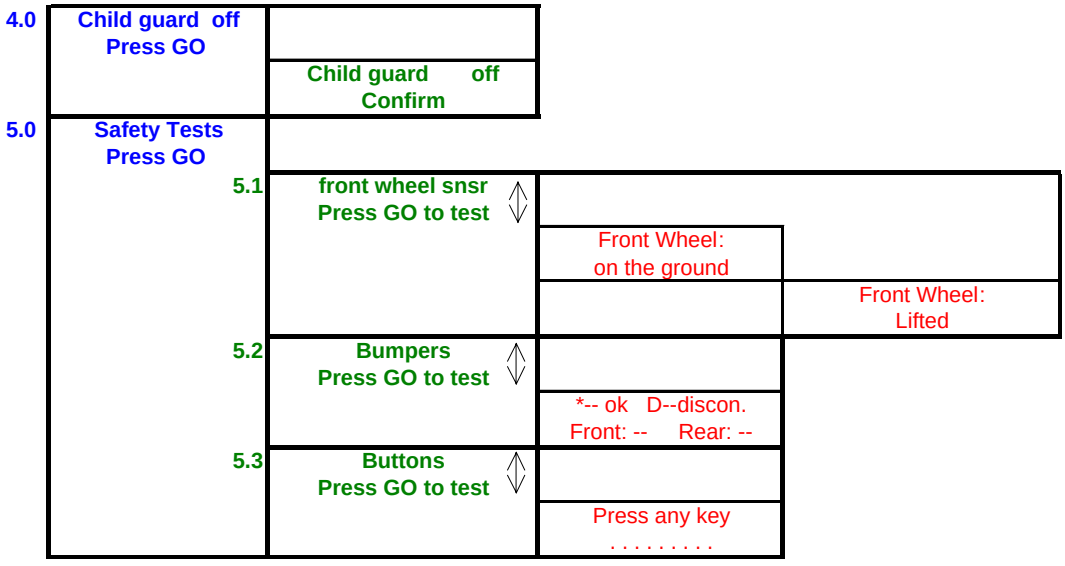
2.0 Information:

2.1	**Total Time** Press GO	**Total Time:** 196h34m
2.2	**Bat. run time** Press GO	**Battery run time** 2h25m 26.2V
2.3	**Battery Voltage** Press GO	**Battery Voltage:** 25.6 V
2.4	**Temperature** Press GO	**Temperature:** 25 C 77 F
2.5	**Main Board** Press GO	**Main Board:** ESBC050B
2.6	**Software version** Press GO	**S.W. version:** V4.1-05 30.10.04
2.7	**Charging Voltage** Press GO	**Charging Volt:** 31.2 V
2.8	**Charging temp.** Press GO	**Charging Temp.:** 50 C 122 F
2.9	**Last stop cause** Press GO	**Last stop cause:** 1. 143

3.0 Docking Options (RL1000 only):



4&5.Child Guard and Safety Tests items:



6. Service (Password required):

Password req. Press GO		
	_00000 (00) next digit ⇕	
		key 12321 Confirm

6.1 Calibrations
Press GO

6.1.1	Learn wire snsrs Press GO		
		wait… Confirm	
			was:x Now:x No:a confirm
6.1.2	Edge calibration Press GO		
		Edge calibration xxx done	
6.1.3	Set Country Press GO		
		USA Confirm ⇕	
6.1.4	DK calibration Press GO		
		activate motors Confirm	
			Done score DK problem failed! K = 18 xxx xx xxxx retry elsewhere

6.2 Tests
Press GO

6.2.1	Wire sensors Press GO to test			
		wait… advanced →		test passed confirm
			-aaa +bbb -ccc +ddd	
6.2.2	Rain sensor Press GO to test			
		Rain sensor 10 7 2		
6.2.3	Direction Keeper Press GO to test			
		wait… advanced →		test passed confirm
			1058943 +xxx 1974593 +yyy	
6.2.4	Drive motors Press GO to test			
		activate motors confirm		
				test passed advanced

Service (con.)

6.2.5	**Mowing motors Press GO to test**		
		activate motors confirm	
			test passed Confirm
6.2.6	**Thermistors Press GO to test**		
		Drive Pass	Mow Pass
6.2.7	**Docking tests Press GO**		
		Dock detection Press GO to test	
			Test results: 01 Press GO
6.2.8	**Edge tests Press GO**		
		Edge termination Press GO to test	
			Test results: 08 Press GO
6.2.9	**Bat. Maintenance Press GO**		
		Last bat. Volt: 25 ⇕	
		wrn. ignored 0	
		Poor storage 0	
		Reset Press GO ⇕	

Service (con.)

- 6.3 Settings — Press GO
  - 6.3.1 Docking options — Press GO
    - 6.3.1.1 Edge to dock off — Press GO
      - Edge to dock on — Confirm
    - 6.3.1.2 Docking search vlt. — Press GO
      - 22 — Confirm
    - 6.3.1.3 Dock bumper on — Press GO
      - Dock edge off — Confirm
    - 6.3.1.4 Islands on — Press GO
      - Islands off — Confirm
  - 6.3.2 Small wheels off — Press GO
    - Small Wheels on — Confirm
  - 6.3.3 Enable DK — Press GO
    - 6.3.3.1 Scan DK on — Press GO
      - Scan DK on — Confirm
    - 6.3.3.2 Edge DK on — Press GO
      - Edge DK on — Confirm
  - 6.3.4 Max leg distance — Press GO
    - Dock zone — Press GO
      - 0055M 0180F — confirm
    - Zone B — Press GO
    - Zone C — Press GO
    - Zone D — Press GO
  - 6.3.5 Thermistors — Press GO
    - Thermistors on — Confirm
  - 6.3.6 mowing on — Press GO
    - Mowing on — Confirm
  - 6.3.7 Drv. Overcurrent — Press GO
    - 50 — Confirm
  - 6.3.8 Mow Overcurrent — Press GO
    - 10 — Confirm
  - 6.3.9 Auto restart — Press GO
    - 6.3.9.1 Mow overload on — Press GO
      - Mow overload on — Confirm
    - 6.3.9.2 Drv overload on — Press GO
      - Drv overload on — Confirm
    - 6.3.9.3 Power break on — Press GO

2.2 Menu Items Explanation

They following section explain the different menu items appeared in section 2.1 above:

1.0 User Preferences

1.1 Zones Setup

Allows user to set the parameters that are specific per zone

1.1.1 **Work Time**

Allows the user the option of setting the operating time from the 'MAX' default setting to times ranging from 20 minutes up to 2:40 hours. This option is available for up to 4 different zones, Dock Zone, Zone B, C or D. Having four different zones can allow you to set operating time for several different zones that are of varying sizes, not requiring the same operating time for mowing.
Note: for Dock zone it is possible to set different work time per operation when setting the automatic weekly program.

1.1.2 **Learn Edge**

The default distance for edge mowing is approximately 1.5 to 2 rounds around the perimeter. This feature allows the user to learn a specific distance in each operating zone in order to cause the mower to cut the edge a specific distance, such as one full round. This can increase the efficiency by minimizing the time spent on edge mowing. In some rare cases, because of some unique geometry of the lawn, a mower may not complete edge under the normal default operation. This feature allows you to overcome the issue by learning the edge in that zone. It will remain as a learned distance until the edge is re-learned or the factory default edge is selected.

1.1.3 **Set Default Edge**

Returns the edge mowing distance back to the factory default in the zone selected.

1.2 Sound

The sound feature allows the user to disable all audio effects except those related with safety.

1.3 Wire Position

Allows user to test the wire position in 'Edge' mode while the mowing motors are switched off to prevent any damage to the perimeter wire after the initial setup of the wire is completed.

1.4 Language

Changes the LCD display on the Manual Controller to read in alternate languages.

1.5 Wide Scan

Wide scan is a second navigation method, where the angles between subsequent legs are increased. This method should be selected in lawns where the mower appears to be driving back and forth along the same path, not advancing to the left or right while mowing.

1.6 Fast Edge

Fast edge enables Robomow tracking the Perimeter Wire in faster drive speed. This option is enabled in Dock zone only. The fast speed has two speed levels, when the faster level is used when the mowing motors are witched off and Robomow tracks the Perimeter Wire in 'Searching dock' or 'Searching entry' modes.

1.7 Enable Dock

This option should be set to 'on' when using Docking Station to enable the Docking options to the user. If it set to 'off' the Docking menus are hidden.

1.8 Blades replaced

'Replace blades' message is displayed after every 200 hours of operation. The message is displayed upon 'GO' pressing for the next 10 hours of operation or till the user chooses the 'Blades replaced' option under the 'User preferences' menu.

1.9 Rain Sensor

The Rain sensor feature enables the mower to detect rain and to skip or stop the operation as the rain is detected. There are three options under the 'Rain sensor' menu:

- ***Rain sensor on/off*** - allows turning the rain sensor feature off to enable operation in rain and wet grass conditions.
- ***Reading*** – Shows the actual reading of the rain sensor.
- ***Set sensitivity*** – Enables to set the sensitivity of the rain sensor in which the mower will detect rain below the threshold set. The default sensitivity set in the factory is 4, it means that in any reading below 4 the mower will detect rain and will not operate.

1.10 Anti-theft

The anti-theft system provides the user a disabling function that will prevent anyone from using or driving the Robomow unless they have the valid code to enter. You will be prompted to enter a four-digit code of your choice to use as your personal security code. Use the scroll arrows in order to change each digit position to a different number and then press ***'GO'*** to move to the next digit to select. You will find a place to record your personal security code in Chapter 8 of this manual.

To change the password chooses the 'Change password' option under the 'Anti theft' menu. You will be promoted to enter your old password before setting the new one.

2.0 Information

2.1 Total time

A very important information menu item, this shows the total operating time of the mower. This is valuable information used for warranty and repair services. It can also indicate the usage model of the mower, for example using the mower on multiple properties instead of for homeowner use as it is designed. This number will only reset when a main board has been replaced. It is also a required line entry for a warranty claim.

2.2 Bat. run time

The left number indicates the last battery run time from GO pressing till 'Recharge battery' message is displayed and the right number indicates the battery voltage at the beginning of the operation (measured when the GO is pressed).

2.3 Battery voltage

Displays the current voltage of the power pack.

2.4 Temperature

Displays the ambience temperature in the mower.

2.5 Main Board

Main Board will display the version of CPU used in this particular mower. This is essentially an information menu, but can be used in the event an issue is found to only apply to one particular CPU.

2.6 Software version

Identifies the software version operating in this mower. An information menu, but can be important if a particular issue is found and it applies to only a specific version of software.

2.7 Charging voltage

Displays the charging voltage.

2.8 Charging temp.

Displays the charging temperature (measured on the Main Board).

2.9 Last stop cause

Displays the last 10 stop cause numbers (refer to Last Stop Cause Table in paragraph 5.7).

3.0 Docking Options (RL1000 only)

3.1 Weekly Program

3.1.1 Set Weekly Program

One of the advantages of having a docking station for the Robomow is the ability to set an automatic weekly program. The user can set the weekly program at the beginning of a season and not worry about mowing again all season long.
Four parameters are required to be selected: Day/s, Work time, hour/s, operating mode/s.
Select the day or days, the work time and the time in which you would like the mower to automatically depart and mow your lawn. Also select whether to have the edge mowed or not.
If 'Learn edge' is done, another option in the weekly program is available to the user – to set the 'Entry point' per specific day.
While the mower is docked, the next departure scheduled will be displayed at the top right corner of the LCD. It will display the day of the next departure, the time and mode.

3.1.2 Display Program

Select this option in order to view the weekly program. The days of the week will be displayed on the LCD (M, T, W, T, F, S, S) and a + or – under each letter. A '+' represents an active day, meaning that the mower will mow during that day, at the time scheduled.

3.2 Time

The first step before setting the weekly program is to set the current time: day of the week and time (hours & minutes). Note that the clock is on a 24-hour military time scale.
This feature is relevant only if a weekly program has been set.
While the mower is docked, the current time will be displayed at the top left corner of the LCD.
Note that whenever the power pack is removed from the mower, it is required to set the time.

3.3 Entry Points

'Entry point' is defined as the point, where the mower leaves the Edge and turn into the lawn to mow the inner area. In order to ensure better area coverage in mowing, the mower has default of three different entry points. The 'Entry points' option enable to set different entry points from those set by the factory to your lawn.

3.3.1 Set Entry Points

It is possible to set up to four points (includes the Docking Station itself, which is always defined as entry point number one and cannot be canceled).

3.3.2 Back to Default

Selecting 'Back to default' restores the factory default entry points – there is no distance in the memory and the mower should complete the lawn's edge at least once before it will use the default of 30% and 60% percentages of the perimeter as entry points.

3.3.3 Entry Points (on/off)

Allows user not to use the entry points. When setting the 'Entry points' to 'off' the mower will start the mowing of the inner area always from the Docking Station.

3.4 Auto Depart

Allows user to shut off the weekly program when setting the 'Auto depart' to 'off'.

3.5 Skip Next Depart

Allows user to skip the next scheduled operation.

4.0 Child Guard

Child Guard is an option that allows disabling operation of the buttons of the Manual Controller unless a pre-set two step button sequence is pressed first. While locked, the up arrow key and then the 'C' key must be pressed in order to un-lock the buttons for use. Once Child Guard is ON, the buttons will re-lock after about 60 seconds if none of the buttons were pressed. This is a very low-level safety feature intended to prevent button use or unintended operation by very young children. The factory default for this feature is OFF.

5.0 Safety Tests

The Safety Tests function provides a means for the customer to check the operation of the basic safety systems of the mower. It encompasses the front wheel sensor, the front and rear bumpers and the buttons on the Manual Controller. By entering this menu, the customer can select which system to test and following the screen prompts, test each of the systems.

6.0 Service

The Service menu, while accessed under the User Options screen, is not a customer menu option. It is only to be used by a trained service technician and requires a specific 5-digit code to be entered in order to access the sub-menus.

6.1 CALIBRATIONS

6.1.1 Learn Wire Sensors

'Learn wire sensors' is the process of teaching the wire sensors their position relative to the mower as well as to the signal of the perimeter wire. This process is used when the fault "Move From Wire" is displayed, the wire sensors have been replaced and when a main board has been replaced under a service repair.

6.1.2 Edge Calibration

Edge calibration is the process of defining how the mower will track the perimeter wire on edge mowing. This is pre-set from the factory to basically track on center. This process would generally be used only when a main board is replaced under a service repair or on replacement of the wire sensors.

6.1.3 Set Country

When a mower is first placed in operation, by default the customer is required to 'Set Country' prior to the mower operation. This setting helps define the area of the world in which the mower is operating in order to better define the magnetic field of the earth, which is used by the Robomow for navigation. This option would be used to change a country where the customer inadvertently selected the wrong country prior to the first operation or when a main board has been replaced under a service repair.

6.1.4 DK Calibration

When a mower is first placed in operation, by default the customer is required to perform DK (direction keeper) calibration' prior to the mower operation. DK calibration is the process of defining the detail level of magnetic north for the system. It is done at the users lawn and is only required to be done once. This option would be used if the mower has been moved to a new location over 160 km (100 miles) from the original location and when a main board has been replaced under a service repair.

6.2 TESTS

6.2.1 Wire Sensors

Wire sensors is a diagnostic process that tests the operation of the four wire sensors on the mower. It has two levels of testing, basic and advanced. Under the basic testing it is a 'pass-fail' test with a fault code listed for the failure message. The advanced testing shows the physical reading of each of the four wire sensors, which on occasion may be helpful, is troubleshooting. Typically, the basic test is sufficient.

6.2.2 Rain Sensor

Rain sensor is a diagnostics process that tests the reading of the rain sensor on the Manual Controller.
3 numbers are displayed in the test:

1) The left number is the rain sensor reading (the actual reading received from the rain sensor – it is updated every 5 seconds).
2) The middle number is the rain sensor sensitivity, which enables to set the sensitivity of the rain sensor in which the mower will detect rain below the threshold set. The default sensitivity set in the factory is 7, it means that in any reading below 7 the mower will detect rain and will not operate.
3) The right number is the rain sensor status when 0 means that rain sensor's existence is unknown, 1 means that rain sensor does not exist and 2 means that rain sensor exists.

6.2.3 Direction Keeper

Direction keeper is a diagnostic process used to test the DK system or on-board compass (called the flux gate). It has two levels of testing, basic and advanced. Under the basic testing it is a 'pass-fail' test with a fault code listed for the failure message. The advanced test will show the physical readings of the compass and is seldom used.

6.2.4 Drive Motors

Drive motors is the process of testing the drive motors and odometer system of the mower. It has two levels of testing, basic and advanced. The advanced testing is not functional in this system. Under the basic testing it is a 'pass-fail' test with a fault code listed for the failure message.

6.2.5 Mowing Motors

Mowing motors is the process of testing the mowing motor system of the mower. It has one basic level of testing. Under the basic testing it is a 'pass-fail' test with a fault code listed for the failure message.

6.2.6 Thermistors

Is used for testing the two Thermistors of the mower, one is located on the right Drive Motor and the other on the right Mowing Motor. When this test is selected, an automatic testing process will take place resulting in a 'Pass/Fail' message.

6.2.7 Docking

Dock Detection

Is used for testing the entry process of the mower to the Docking Station. After this test is selected, place the Manual Controller in its place and choose the 'Go to dock' option. An automatic testing process will take place resulting in number, which indicates the result of the test.

6.2.8 Edge

Edge Termination

Is used for testing the edge mode in case, which the mower does not complete the edge all around the perimeter or when the mower does not drive back to the Docking Station at the end of the operation. After this test is selected, operate the mower in Edge mode. At the end of the edge, the mower will display a 'Test result: X', which is the reason for Edge termination in this performed test.

6.2.9 Battery Maintenance

Battery maintenance is a multiple menu selection. It can provide valuable information of the customers' maintenance habits regarding the mower as well as help in identifying a faulty power pack.

Last Battery Voltage –the last measured voltage of the power pack will be displayed. This number is updated frequently when in charging mode and in automatic operation mode. If the mower was in deep sleep mode, the last recorded voltage prior to deep sleep will be recorded. This can be useful in determining charger operation by viewing the voltage over time. Additionally, it can be used to view voltage over time while in operation to understand a discharge rate to determine power pack condition.

Warning Ignored – the energy management system of the mower will alert both audibly and by displaying a text message prompting the user to connect the mower to the charger when not in use (if the customer has failed to do so). The warnings vary in frequency of time and loudness, depending on the time disconnected from the charger. This warning system will function for approximately 48 hours before shutting down and entering a deep sleep mode for energy conservation. This selection indicates how many times the customer has ignored the alert system and allowed the mower to enter the deep sleep mode. This can indicate poor maintenance by the customer and could cause diminished power pack performance and service life. While any number here is a cause for concern and illustrates the need to educate the user how to properly mainten the mower, a count of 2 or more is serious and can damage the power pack.

Poor Storage – poor storage counter indicates how many times the mower was put into operation where the power pack capacity was less than 80% of fully charged. This essentially indicates how often the mower was used prior to the power pack being fully re-charged, where the count will not start until there is a 20% capacity loss from fully charged. The 20% criteria is important, as many people will use the mower in several smaller areas in addition to the main area. A smaller area will discharge the power pack, but not to the 20% level, so we do not want to count such operations. A high count here, greater than 3 or 4 indicates that the user is not fully re-charging

the power pack. If a customer claims that that's his only solution to mow the entire lawn, it is recommended that they purchase an additional power pack and an external charger. Lastly, if the voltage of a power pack, when inserted, is less than 90% of the last measured voltage, that indicates that the power pack has not been fully charged at the end of the previous season, which is critical for good service life (winter/storage charging instructions are given in the operating & safety manual).

Reset – allows resetting all listed battery parameters back to zero when a new power pack has been put in service or possibly if a service repair was done, which may have affected the counters.

6.3 SETTINGS

6.3.1 Docking Options

6.3.1.1 **Edge to Dock**

Enable the mower to complete the edge operation from the Docking Station back to the Docking Station without any condition, otherwise there are few events that may cause the mower to leave the edge, such as distance limit or number of turns to the left.

6.3.1.2 Docking search vlt.

Option to increase the 'Searching dock' threshold voltage (22.5 and 23.0) in case, which the mower doesn't succeed to drive back to the Charging Station because of low battery voltage.

6.3.1.3 Dock bumper

Changing this option to 'off' will change the bumper behavior so it will make bypass in every bumper event during 'Edge' mode.

6.3.1.4 Islands

Setting this option to 'off' allow the mower to acquire the Perimeter Wire immediately as starting to search for the Charging Station with no need to converge to the end of the lawn.

6.3.2 Small Wheels

In some markets there are two types of wheels for different Robomow models. There are knobby wheels (as in all US models) and there are smaller diameter wheels without treads. If this setting is inadvertently selected, the mower will not navigate properly and will likely not drive in straight lines.
It is important to have the setting right according to the type of wheels.

6.3.3 Enable DK

Enable DK is a feature that is helpful when operating the mower in an area where magnetic interference is suspected in a certain lawn or when the Robomow is operated indoors, i.e. at an exhibition.
Indoors exhibitions are typically on concrete floors that contain a great deal of metals. This large amount of metal will skew the magnetic field causing the mower to run in curved lines rather than straight lines. Turning the 'Enable DK' feature off will allow the mower to navigate solely on wheel rotation measurement, thereby not using the magnetic field of the earth. This will allow for straight lines in a show environment. The default of this feature is always on.
Enable DK is divided into 2 modes: edge and scan and it is possible to disable the DK either in edge or scan. Disabling the DK in the 2 modes enables to operate the mower without compass at all (or when the compass is faulty).

6.3.4 Max leg distance

Enable to set the max distance between the perimeter wires in every zone.
There is a monitoring system that detects the wire sensors readings during operation. If the readings are not changed for some time (it depends on the distance between the wires), it means that the mower is probably stuck in place.
For example:
in lawn 10 by 30, the mower will not drive more than 10 meters with the same readings, but in lawn 40 by 90 it may drive for 60 meters with no changes in the wire sensors readings.
If during scanning it is found that the max leg distance set by the user is shorter than what does the mower calculate, then the S.W will update it.

6.3.5 Thermistors

Enable Thermistors is set to 'on' by default at the manufacturer. This option is used when replacing a Main Board in old configuration Robomow, which has no Thermistors – in such case there are two options:
1. Add Thermistors to the Robomow, as the new Main Board supports this option.
2. Set the 'Thermistors' option to 'off' if the Robomow does not have Thermistors.

6.3.6 Mowing

The mowing feature provides the ability to disable the operation of the mowing motors. All other aspects of the mower will perform normally, however the blades will not rotate. This feature is useful when testing the set up of the perimeter wire prior to having the wire fully pegged to the ground, preventing the risk of cutting it. Additionally, it is a feature that can be used when using the mower in exhibitions, for safety reasons.

6.3.7 Drv. Overcurrent

Option to set the drive over current (load) threshold in which the mower will change the drive direction.

6.3.8 Mow Overcurrent

Option to set the mow over current (load) threshold in which the mower will change direction to move from the area with high grass.

6.3.9 Auto Restart

This option enables to set the cases in which Robomow restarts the operation automatically within an hour after it has stopped during the operation.

6.3.9.1 Drive Overload

If the mower stops with the following 'Drive overload - cooling, wait…'(10 min above 100 or 1 sec above 105), it will stay awake for up to **60 minutes** with the displayed message and blinking operating light. If the mower cooled down to allowed temperature that enables the operation (Drive - **85 Celsius**), the mower will automatically renew the operation from the point he has stopped.

6.3.9.2 Drive Overload

If the mower stops with the following 'Mow overload - cooling, wait…'(10 min above 90 or 1 sec above 100), it will stay awake for up to **60 minutes** with the displayed message and blinking operating light. If the mower cooled down to allowed temperature that enables the operation (Mow - **80 Celsius**), the mower will automatically renew the operation from the point he has stopped.

6.3.9.3 Power Break

Electrical power interruption - In every signal interruption the RL1000 will stop with 'Waiting for signal…' message. If the signal comes back within 60 minutes from the stop, the mower will restart the operation automatically, otherwise it will stop with 'No wire signal – press GO'. The Operating Lamp is blinking all the time that the mower is waiting.

6.3.10 Special Display

Choosing the 'Special display' option enables to display the relevant parameters to tested process (such as temp, volt and sensor readings) and to perform detailed diagnostics. After a specific display is selected use the CANCEL ('C') button to toggle between normal and special display, and the STOP button to terminate the special display.

6.3.10.1 Charging display

In this display the LCD will display the following information:

1.Charging stage	2.Battery voltage	3.Charger voltage	4.Docking state
5.Charging time	6.Charging FET d2a	7.Charging FET temp.	8.Ambience temp.	9.Charging enable flag

1. Charging stage.
   The stage of the charging process.
2. Battery voltage.
   Battery voltage in volts.
3. Charger voltage.
   Charger voltage in volts.

4. Docking state.
   If the charging is done through the charging socket (placed in the Manual Controller Holder) then '00' is displayed in the docking state.

   If the charging is done through the Docking Station, one of the following numbers is displayed:

   01 - Charging through the docking station

   02 - Problem in charging through the docking station

   03 - Robomow is trying to reconnect to the docking station for recharging

   04 - Automatic departure time

   05 - The user initiated the departure time

   06 - Disconnected from charging in order to cool down because of overheat in the ambience-charging temp.

   07 - Disconnected from charging in order to cool down because of overheat in the charging FET temp.

   08 - Disconnected from charging in order to cool down because of overheat which is caused when battery voltage is too high during charging.

   09 - Disconnected from charging in order to heat up when needed

   10- Disconnect from charging in order to perform the 'Learn entry points' sequence

   11 - Disconnected from docking contacts

5. Charging time.
   Indicates the charging time in hours from the time the Robomow is connected to the Power Supply/Docking Station.

6. Charging FET d2a.

   Indicates the charging FET state (for minimal charging voltage value is 250 – stage 4 in the charging process, for maximal charging voltage value is 60 – stage 1 in the charging process)

   Definition: **FET** (Field-Effect Transistor) A transistor whose control, or gate, signal creates an electro-magnetic field, which turns the transistor ON or OFF.

7. Charging FET temperature.

   Indicates FET temperature (ºC) while in charging. If temperature > 125ºC then cooling is required.

8. Ambience temperature.

   Indicates the ambience temperature (ºC).

9. Charging enable flag.

   Indicates if charging is enabled.
   0 – Charging is disabled.
   1 – Charging is enabled.

6.3.10.2 Wire Sensors

In this display the LCD will display the following information:

1.Front left reading	**2.**Front right reading	**3.**Bit rate
4.Rear left reading	**5.**Rear right reading	**6.**Wire sensors state

1. Front left reading.
   Front left wire sensor reading.
2. Front right reading.
   Front right wire sensor reading.
3. Wire bit rate.
   Indicate the frequency of the wire signal (S.W units)
4. Rear left reading.
   Rear left wire sensor reading.
5. Rear right reading.
   Rear right wire sensor reading.
6. Wire sensors state.
   0 - all wire sensors are inside the garden
   1 - forward right sensor outside the garden
   2 - backward left sensor outside the garden
   4 - forward left sensor outside the garden
   5 - forward left and right sensors outside the garden
   6 - forward left and backward left sensors outside the garden
   7 - forward left forward right and backward left sensors outside the garden
   8 - backward right sensor outside the garden
   9 - forward right and backward right sensors outside the garden
   10 - backward left and right sensors outside the garden
   11 - backward left backward right and forward right sensors outside the garden
   13 - forward left forward right and backward right sensors outside the garden
   14 - backward left backward right and forward left sensors outside the garden
   15 - all wire sensors are outside the garden

6.3.10.3 Temperature

In this display the LCD will display the following information:

1.Mow temperature (ºC)	**2.**Right drive temperature (ºC)	**3.**Ambience temperature (ºC)
4.Mow temperature (A2D)	**5.**Right drive temperature (A2D)	**6.**Charging FET temperature (ºC)

1. Mow temperature (ºC).
   Mow temperature in ºC.
2. Right drive temperature (ºC).
   Right drive temperature in ºC.

3. Ambience temperature (ºC).
   Ambience temperature in ºC.
4. Mow temperature (a2d).
   Mow temperature in a2d.
   Otherwise - over current.
5. Right drive temperature (a2d).
   Right drive temperature in a2d.
6. Charging FET temperature (ºC).
   Charging FET temperature in ºC.

6.3.10.4 Edge

In this display the LCD will display the following information:

1.DK angle (degrees)	**2.**DK quarters	**3.**High edge speed
4.Moving toward DS	**5.**Wire sensors state	**6.**Dist from right turn (meters)

1. DK angle.
   DK angle in degrees.
2. DK quarters.
   DK quarters during edge.
3. High edge speed.
   Indicates if high speed during edge is enabled.
   0 – Disabled
   1 – Enabled
4. Moving towards ds.
   Indicates if we are moving towards the Charging Station.
   0 – No
   1 - Yes
5. Wire sensors state:
   0 - all wire sensors are inside the garden
   1 - forward right sensor outside the garden
   2 - backward left sensor outside the garden
   4 - forward left sensor outside the garden
   5 - forward left and right sensors outside the garden
   6 - forward left and backward left sensors outside the garden
   7 - forward left forward right and backward left sensors outside the garden
   8 - backward right sensor outside the garden
   9 - forward right and backward right sensors outside the garden
   10 - backward left and right sensors outside the garden
   11 - backward left backward right and forward right sensors outside the garden
   13 - forward left forward right and backward right sensors outside the garden
   14 - backward left backward right and forward left sensors outside the garden
   15 - all wire sensors are outside the garden
6. Distance from right turn in meters

6.3.10.5 Drive motors

In this display the LCD will display the following information:

1.Left drive current (A2D)	**2.**Right drive current (A2D)	**3.**Right drive temperature (ºC)
4.Over current counter	**5.**Hardware over current	**6.**Right drive temperature (A2D)

1. Left drive current.
   Left drive current in a2d.
2. Right drive current.
   Right drive current in a2d.
3. Right drive temperature (ºC).
   Right drive temperature in ºC.
4. Over current counter.
   Indicates if drive over current is detected either by Hardware current limiter or by Software current readings.
   0 – No over current
   Otherwise - over current.
5. Hardware over current.
   Indicates if drive over current is detected by Hardware current limiter.
   0 – Over current not detected.
   1 - Over current detected
6. Right drive temperature (a2d).
   Right drive temperature in a2d.

6.3.10.6 Mow motors

In this display the LCD will display the following information:

1.Left mow current (A2D)	**2.**Middle mow current (A2D)	**3.**Right mow current (A2D)
4.Over current counter	**5.**Hardware over current	**6.**Temperature (ºC). or over current event counter

1. Left mow current.
   Left mow current in a2d.
2. Middle mow current.
   Middle mow current in a2d.
3. Right mow current.
   Right mow current in a2d.
4. Over current counter.
   Indicates if mow over current is detected either by Hardware current limiter or by Software current readings.
   0 – No over current
   Otherwise - over current

5. Hardware over current.
   Indicates if mow over current is detected by Hardware current limiter.
   0 – Over current not detected.
   1 - Over current detected
6. Mow temperature (ºC) or over current event counter
   The display will switch every 3 seconds between:
   1) Mow temperature in ºC.
   2) Mow over current events counter.

If mowing motors are off the following information will be displayed:

1. '0' (A constant '0' will be displayed)
2. Should be '0', otherwise represents the mowing disable reason.
3. Operation state.
4. Last stop cause reason.
5. Current movement id.
6. Should be '0', otherwise represents the mowing disable reason.

6.3.11 Factory Defaults

Factory defaults will return all changeable settings back to the original factory setting. This can be helpful if the user has changed many settings, as it is faster than changing each item independently. After 'Factory defaults' is selected, the following procedures should be completed: 'Learn wire sensors', 'Edge Calibration', 'Set country' and 'DK Calibration'.

3. Troubleshooting

3.1 Error Messages

This is a comprehensive list of all error messages that may be displayed on the Robomow LCD. It lists the message, what it means and possible cause and corrective action required to solve the problem. In every case, which the mower stops it is recommended to see the '**Last stop cause**' number as it gives more information about the reason/cause of the stop (refer to paragraph 5).

Message Displayed	Probable Cause/Event	Corrective/User Action
Blocked path	- Bumper pressed during warm up. - Bumper pressed for >2 sec during manual mowing. - Bumper pressed while departing from the Docking Station - Bumper pressed when the mower turns into the lawn to mow the inner area	- Move mower away from obstacle pressing on bumper. - Manually drive mower away from obstacle.
Calibration Req.	- Displayed on first use only	- Follow prompts on LCD to calibrate mower
Charging Failure	- The charging process is not active	- Contact service provider
Check Mow Height	- Mowing motors have faced over-current for too long or some obstacle is stuck or wrapped around the blades. - Something is preventing a blade from rotating freely. Severe grass accumulation under the mowing deck; rope or similar object wrapped around mowing blade. - Object jammed under mower preventing blade from rotating.	**CAUTION** – Remove power pack before lifting the mower. - Inspect blades for foreign material or debris preventing rotation. - Clean out accumulated grass clippings using a wooden stick.
Check P. Switch	- Mower is trying to depart from Docking Station and the perimeter switch is not responding - There is a perimeter wire disconnection detected at departure time	- Turn on the perimeter switch and check for broken wire warning.
Check Power	- Power supply/charger is not plugged properly into the main power supply - Charging plug is not fully inserted into the charging socket of the mower - The charging process has stopped due to a temporary power loss.	- Disconnect the charging plug from the mower, confirm power supply is plugged into the main power receptacle and re-connect the plug to the mower to resume charging.
	- No power to receptacle or main power is shut off	- Turn power on to the main receptacle.
Docking problem	- The mower contacts do not touch the Docking Station contacts	- Make sure that both mower drive wheels are leveled with the Docking Station base (if necessary fill the area underneath the drive wheels with dirt)
	- The mower or Docking Station contacts are dirty	- Clean the contacts with a brush or piece of cloth
	- Charging is not detected, although there is physical contact between the mower and the Docking Station contacts (mower is found in the Docking Station entrance).	- Turn on the Perimeter Switch - Confirm a good connection of the cables to the Docking Station contacts. - Check the Charging fuse 5A (remove the plastic cover below the Manual Controller).
	- Mower does not reach the Docking Station within the time and distance limitations.	- Confirm the mower is operated in a docking zone. - Confirm the mower is not slipping or stuck on its way to the Docking Station.

Message Displayed	Probable Cause / Event	Corrective / User Action
Drive Overload Cooling, Wait…	- The drive motors have been working under a severe load for too long.	- There is no need to do anything – Robomow will renew automatically the operation after the drive motors will cool down to temperature that allows operation.
Drive problem	- Internal failure	- Contact service provider
Enter Code	- The theft guard system is activated	- Enter the correct 4-digit code. '***Theft Guard'*** can be deactivated under '***User Preferences'***. Contact your service provider for assistance in a lost code situation.
Front/Rear bumper disc.	- Internal bumper failure	- Contact service provider
Front/Rear bumper pressed	- Front or Rear Bumper is constantly being pressed	- Move mower away from object pressing against bumper.
Front Wheel Problem	- The Front Wheel has left the ground for more than 8 – 10 seconds.	**CAUTION** – Remove power pack before lifting the mower
		- The Robomow has driven onto an obstacle, raising the front end. Remove or exclude this object from the mowing area.
		- The Robomow is being used on a slope too steep for safe mowing. Exclude this from the mowing area.
		- High grass is preventing the front wheel from fully riding on the ground. Raise the cutting height.
		- The ground contains large holes or indentions where the front wheel can drop into when passing across. Fill these areas with dirt and level off.
High temp. Disc. charger	- Robomow is charged through the plug and ambience temperature is out of range (above 158ºF / 70ºC)	- Robomow charging is not allowed when the ambience temperature is raised above 158ºF / 70ºC; Disconnect the charger plug and wait until the temperature will go down or take the Robomow to be charged in a cooler place.
High temp. Waiting…	- Robomow is charged through the Docking Station and the ambience temperature is out of range (above 158ºF / 70ºC);	- Do not do anything, the charging is stopped and Robomow is waiting for temperature to change back to the allowed range; if temperature stays out of the range for more than 12 hours, the message is changed to 'High temp. Press GO'.
Keep charging if not used	- Message is displayed every time the charger plug is disconnected from the mower. - Displayed when the mower isn't in operation and not connected to the charger/Docking for a long time.	- Press any key to change the display back. - Send the mower back to the Docking Station for charging / connect the charging plug or continue in operation
Keys locked	- Child lock feature has been activated	- Press the **Up** ⇑ arrow key and then press the **'C'** button. Child lock can be deactivated under **User preferences**.

Message Displayed	Probable Cause / Event	Corrective / User Action
Low battery	- Mower is searching for the Docking Station but the battery voltage is too low to continue the searching process	- Drive the mower manually for charging in the Docking Station
Low temp. Disc. charger	- Robomow is charged through the plug and ambience temperature is out of range (below 32 ºF / 0 ºC); disconnect the charger plug from the Robomow.	- Robomow charging is not allowed when the ambience temperature is going down below 32ºF / 0ºC; Disconnect the charger plug and wait until the temperature will go down or take the Robomow to be charged in a warmer place.
Low temp. Waiting…	- Robomow is charged through the Docking Station and the ambience temperature is out of range (below 32ºF / 0ºC);	- Do not do anything, the charging is stopped and Robomow is waiting for temperature to change back to the allowed range; if temperature stays out of the range for more than 12 hours, the message is changed to 'Low temp. Press GO'.
Left/Mid/Right mow problem	Mowing motor is faulty or disconnected	Contact service provider
Move from Wire	- The Robomow is positioned too close or on top of the perimeter wire	- Move the Robomow approximately 6 – 10 feet (1.5 – 3m) away from the perimeter wire and start again.
Mowing Overload Cooling, Wait	- The mowing motors have been working under a severe load for too long of a time.	- There is no need to do anything – Robomow will renew automatically the operation after the mowing motors will cool down to temperature that allows operation.
No Wire Signal	- Perimeter Switch is not turned on or not connected to the zone intended to mow	- Make sure the Perimeter Switch is connected to the correct zone and is turned on
Rain detected Go to ignore (Enhanced Manual Controller only)	- Robomow detects rain upon GO pressing	- Do not operate Robomow in rainy weather and wet grass; If you choose to override, press the GO button; The overriding is valid for the current operation only
Ready Keep Charging	- The battery is fully charged	- Keep the charger (power supply) connected and operating
Recharge Battery	- The maximum operating time has been reached	- Connect the charger to the mower
Replace blades every 200 hours	- An automatic reminder to replace the blades is displayed every 200 hours	- Replace the blades and restart the counter of the blades replacement reminder by choosing the '**Blades replaced – Clear reminder'** option under the '**User Preferences'** menu
Replace lamp	- The Operating Lamp is burnt out	- Confirm the message and replace the Operating Bulb as soon as possible
Retry elsewhere	- Calibration failure from interference in the immediate area	- Move the Robomow 10-12 feet (3-4m) from this spot and attempt calibration again.
Set Country	- Displayed only on first use.	- Follow prompts on LCD screen to set country
Set Time	- Displayed every time the power pack is taken out of the mower (reset operation)	- Set real time clock (day and hour)
Skipped: Low bat	- Robomow has skipped the last depart due to low battery voltage	- Confirm there is enough time between the two adjacent departures so the battery can be charged prior the scheduled operation (min 16 hours between operations)
Skipped: Rain (Only Enhanced Manual Controller)	- Robomow has skipped the last depart due to rain detection	- It is not recommended to cut wet or damp grass, but if you choose to override the rain sensor, change the setting of the 'Rain sensor' to 'off' under the 'User preferences' menu.

Start Elsewhere	- An unknown fault has occurred and user help is required	- Manually drive the mower away from this particular area and restart operation
	- Wheel drive motors have been working under a severe load	- Check to insure the mower is not stuck, allowing the wheels to slip
Thermistors fail	- Faulty / disconnected Thermistors (overheat protection)	- Contact service provider
Time Completed	- The operating time set for that zone has been reached	- Connect to the charger if all mowing has been completed for the day.
Waiting for signal…	Robomow has stopped the operation in Dock zone, because there is no signal received from the Charging Station	- Check the power to the Charging Station. There is electrical power interruption. There is no need to do anything – Robomow will renew automatically the operation if the power will come back within an hour from the break.

3.2 Problem analysis flow charts

To use this section efficiently follow this procedure:

A. Using the Table of Contents, locate the sub-section for the area of the unit to be checked.

B. Identify the type of problem that you have, this is normally known, due to the symptom or Error message that was displayed prior to inspection of the unit.

C. In most sub-sections there is a choice of several start points, this is shown in the Table of Contents. Choose the start point and find the corresponding flow chart box.

D. Follow the flow chart instructions one step (box) at a time. Ensure that every thing is completed or that a clear answer is available before moving on to the next box.

E. When a box is reached suggesting various choices of action (shown by “bullet point” marking); always start at the top “bullet point” and only after this has been completed, move down to the next until a cure is found.

The “bullet points are designed so that the easiest and/or cheapest options are explored first, before moving on to progressively more expensive or more time consuming tasks.

Problem analysis flow charts – Table of Contents

3.2.1 Setup Problems

3.2.1.1

Wire disconnected indicator is blinking (P. Switch)

Do you have another zone with a perimeter wire set up?

NO

- Confirm wire is plugged in and wire leads are firmly attached
- Confirm good contacts between perimeter switch/docking board and perimeter wire
- Disconnect and connect the zone (plot) connector to the perimeter switch
- Open the 2 screws of the zone connector and confirm the wire ends and the connector are clean of corrosion/rust.

YES

Try the perimeter switch in another zone

- Disconnect the perimeter wire ends from the zone connector by opening the 2 screws
- Cut a short wire and strip 0.5cm of insulation from each wire end
- Insert one end into each hole of the connector and tighten the screws
- Press the 'ON' button of the p. switch

- **Note!**
  There is a Wire-Break Locator product that is designed to find breaks in the Perimeter Wire and it can be purchased directly from the company manufacture it.
  It is not a Friendly Robotics product and Friendly Robotics did not test it, thus there will not be any responsibility or support by Friendly to this product.
  For more details email to friendly@friendlyrobotics.co.il

'Wire disconnected' is still blinking?

NO

Perform initial search for the disconnected wire:

- Take out the two wire ends from the zone connector – confirm they are clean, reinsert and tighten the screws
- Try to remember if any work has been done since the last operation which could have caused a break in the wire
- Look for a damaged wire very close to the point where the mower stopped during operation
- Check the wires leading from the perimeter switch to the lawn
- Walk along the wire (including perimeter islands) and look closely for a cut in the wire or a loose connection.
- Check all wire connections carefully
- Make sure there are no wire splices made without standard wire connectors

Perform a secondary search for the disconnected wire by testing different lengths of the wire using the p. switch (See next page for secondary search).
It should be noted that it could be difficult to find a cut or loose connection in the wire using a visual method. A new setup should be considered as a solution at this stage.

YES

- Open the perimeter switch (old conf. with black wire only):
- Check connections and black wire leading from the p. switch to the connector
- Remove the black cable (WSB0025B) and connect the perimeter wire ends directly to the screws inside the p. switch – if it works you can continue in operation

Replace Perimeter Switch

3.2.1 Setup Problems (con.)

3.2.1.1

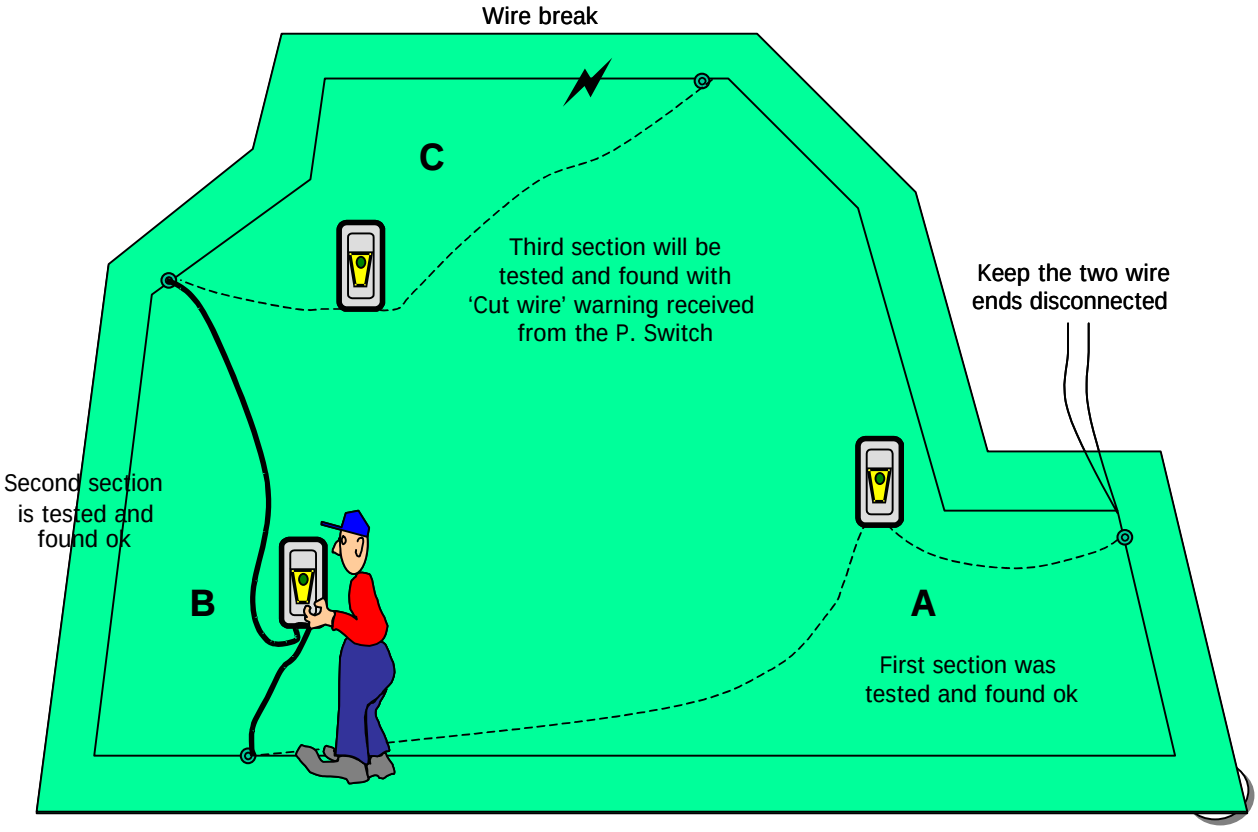
Secondary search for the disconnected wire

Is it a multiple zone set up?

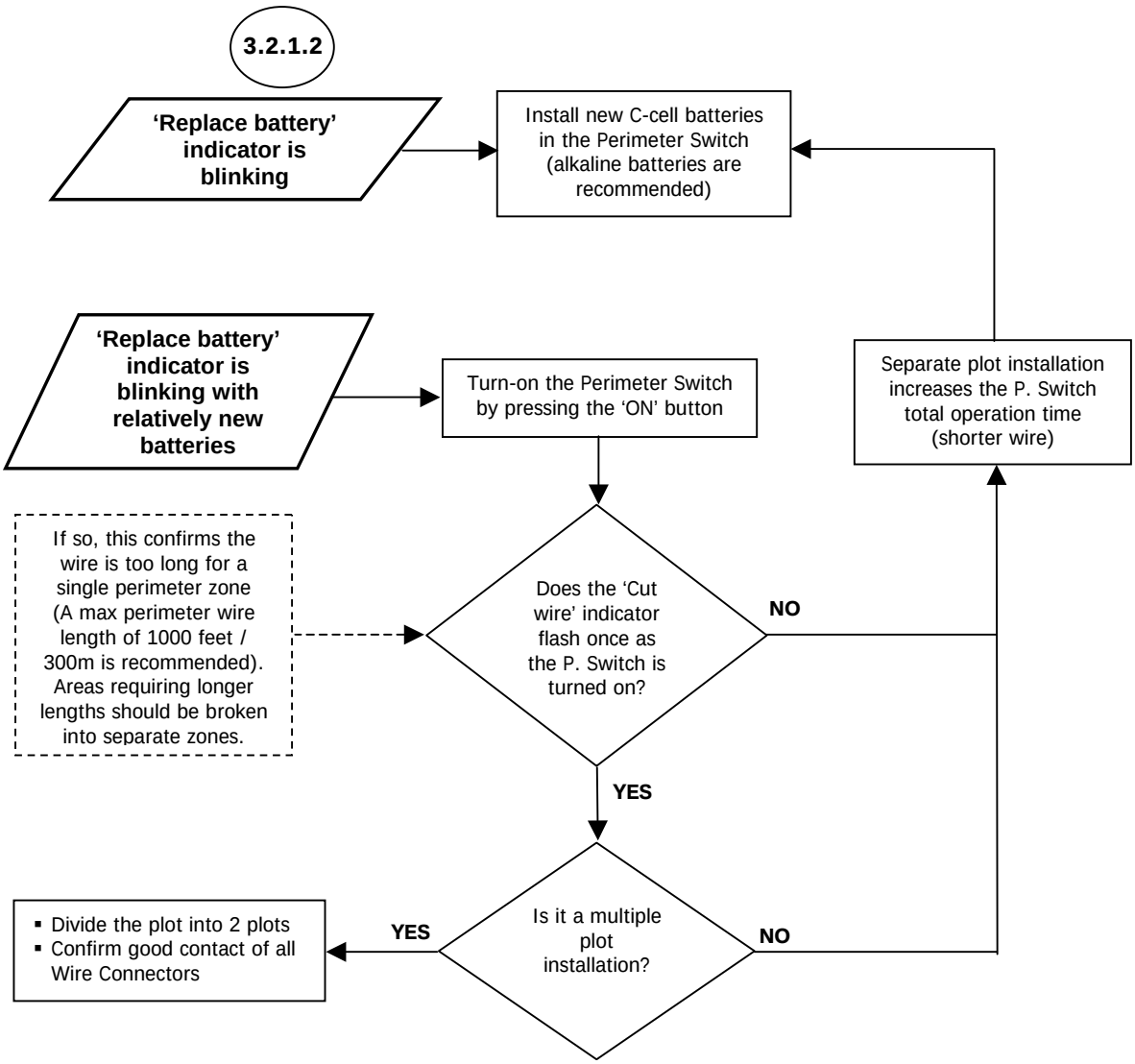
YES → Check each zone separately and find the problematic zone (by cutting the wires between the zones to separate them)

NO → Choose an area/wire to be tested (see detailed explanation below)

- Disconnect the p. switch from the perimeter wire installation (by opening the two screws) and leave the wire ends **disconnected**.
- Prepare two wires – about 6 feet (2m) and 60 feet (20m) long.
- Strip back ¼ inch (6mm) of insulation from each wire end and connect the two wires to the p. switch.
- Strip back 1 inch (2.5cm) of insulation from the other wire ends.
- Define the 2 points on the perimeter wire where you want to isolate it from the main installation in order to check the connection (the distance between these 2 points should exceed the longer wire which you prepared for the testing).
- Strip ¼ inch (6mm) of insulation at each point you want the additional wire connected in order to divide the zone.
- Twist the two ends of wires to the points you want to check on the perimeter wire.
- Turn on the p. switch and check for disconnection in the specific wire.
- If there is no indication of 'Cut wire', it means that the tested wire is ok.
- Continue to move with the test (p. switch + 2 wires) to the next perimeter wire section to be tested.
- When the p. switch indicates 'Cut wire', it means that the cut wire is within the tested wire.
- It is recommended to divide the suspected wire into 2 sections in order to minimize the wire length.
- When the problematic section is short enough, you can look closely to find the cut or loose wire connection and to repair it by standard wire connectors, or you can cut the wire and install a new wire.



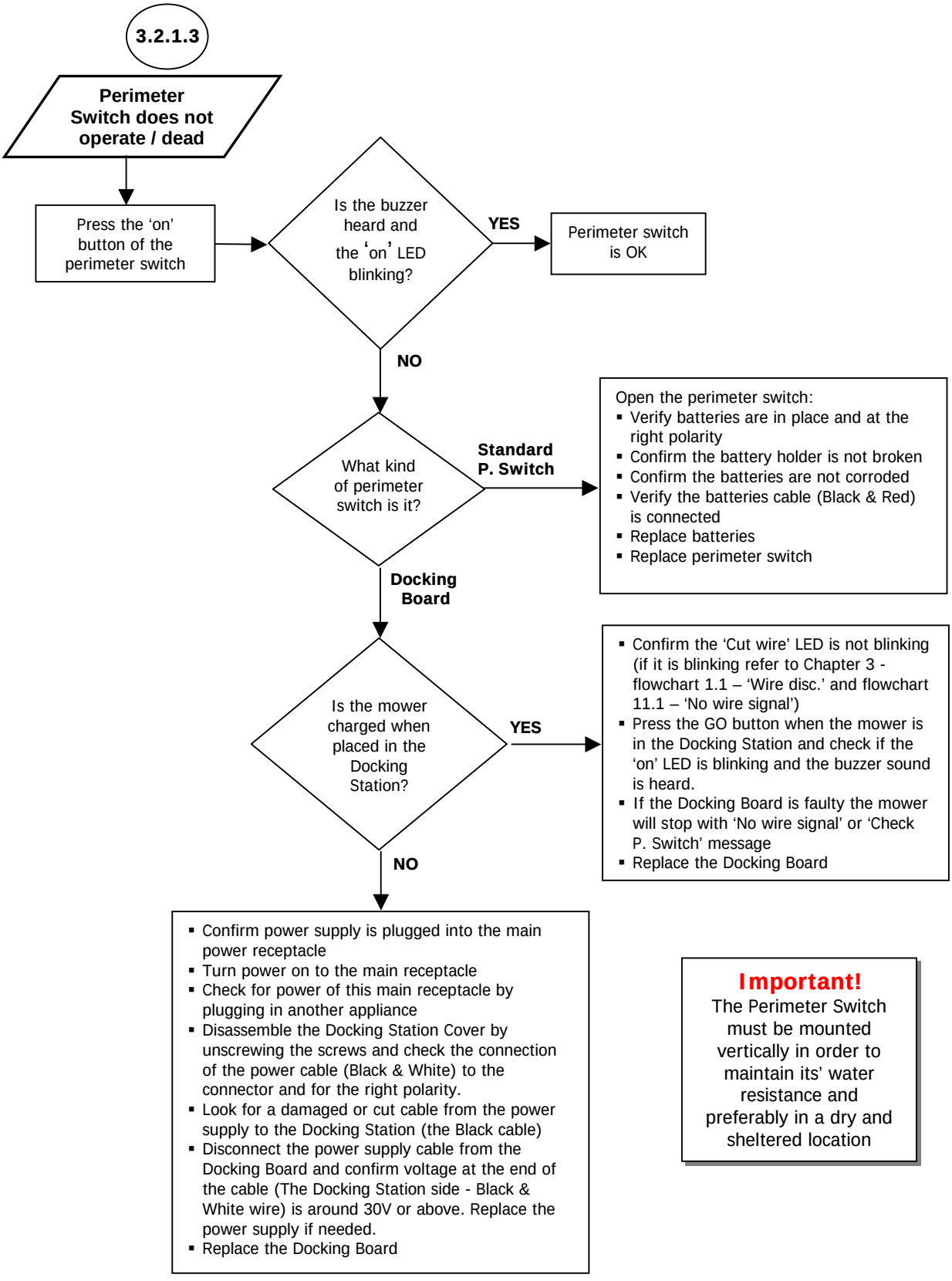
3.2.1 Setup Problems (con.)



If the Perimeter Wire needs to be spliced:
Use the connectors supplied in the box.
It is waterproof and gives a reliable electrical connection.

Important Information!
Twisted cables, or a screw terminal, insulated with insulation tape is not a satisfactory splice. Soil moisture will cause the conductors to oxidize and after a while result in broken circuit.

3.2.1 Setup Problems (con.)



Important!
The Perimeter Switch must be mounted vertically in order to maintain its' water resistance and preferably in a dry and sheltered location

3.2.2 Power & Charging Problems

Does not 'wake up' when 'GO' is pressed

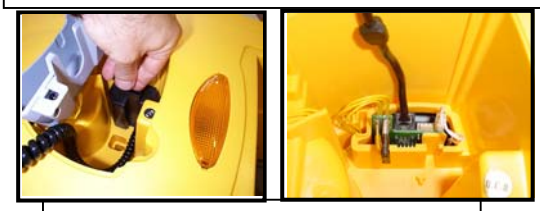
3.2.2.1

Remove power pack and re-insert after 10 seconds

Robomow awake? **YES** → OK

NO

- Confirm battery contacts on both sides (Bat. and Robomower) are not loose/damaged
- Check battery fuse (30A) is not blown (located in battery case)
- Check main fuse (1A) and charging fuse (5A) are not loose/blown/rusty (located on connector board (in manual controller pocket under black/gray cover)
- Confirm good contact between m. controller cable plug and socket on the connector board
- Open the power pack cover and check connections



Connector Cover removed, showing fuses

Voltage across power pack contacts is at least 14 volts? **YES** → Replace manual controller and re-test

Wakes up? **YES** → OK

NO → Remove Top Cover

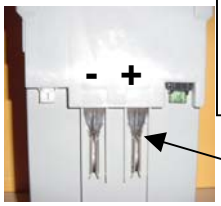
NO → Charge Power Pack outside mower, using an external charger

Is there a loose connection or signs of electrical failure found on any components? **YES** → Repair or replace as found

NO

- Replace Connector Board
- Replace Connector cable
- Replace main board and follow the instructions attached to the spare part board (Service Bulletin) – use the most updated S/W version flash and complete the following settings (under the 'Service' menu):
  - o 'Learn wire sensors' (Refer to chapter 5.3.3)
  - o 'Edge Calibration (Refer to chapter 5.3.2)
  - o 'Set country'
  - o 'DK Calibration' (Refer to chapter 5.3.1)

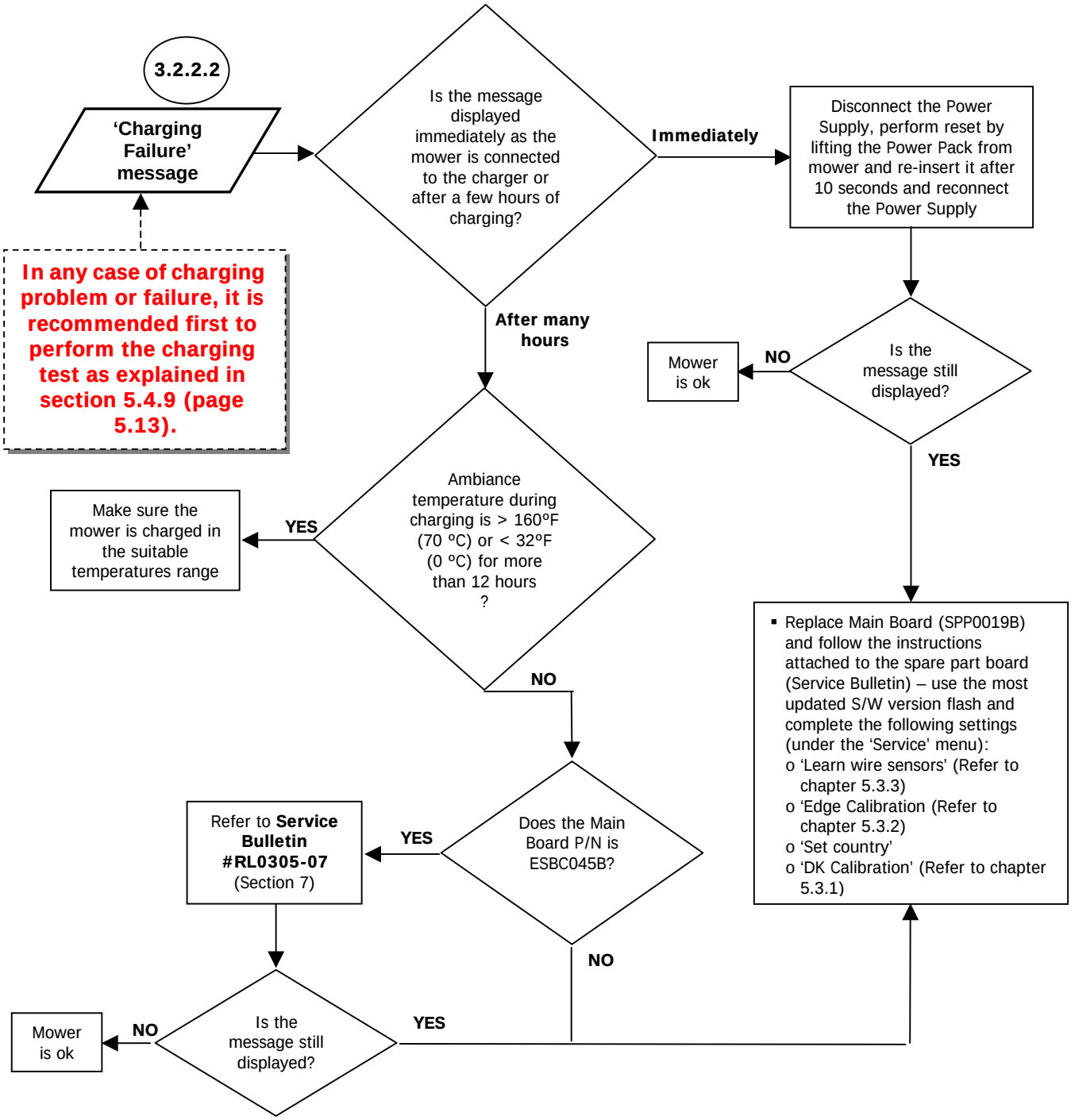
The Power Pack must have at least 14 volts for the Robomower to wake up. Connecting a standard 12 volt, 1-3 amp automotive type charger to the connectors on the outside of the power pack and charging for 12 hours will usually bring the voltage up to 14 volts, enough to wake up the mower. If so, allow the mower to fully charge the power pack on-board as normal. If it does not succeed, replace the power pack.
(The positive+ connector on the power pack is the connector closest to the 30-amp fuse).



+ Positive terminal

Confirm the user properly maintains battery by checking the parameters under 'Battery maintenance' menu (The 'Last Bat. Volt' parameter indicates the last measured voltage of the battery – it can show if the battery was charged at the end of the last operation)

3.2.2 Power & Charging Problems (con.)



3.2.2 Power & Charging Problems (con.)

'Check Power' message

3.2.2.3

Does the message appear during charging?

YES

- Confirm the Power Supply is plugged into the main power receptacle
- Check for power to this main receptacle by plugging in another appliance
- Confirm the Power Supply connector is fully inserted into the charging socket
- Check if the Power Supply plug is corroded/rusty

NO

Is it an RL1000 (charged through the Docking Station)?

YES

Perform reset by lifting the Power Pack from mower and re-insert it after 10 seconds (it will automatically inhibit the charging through the Manual Controller Holder Assembly)

NO

Is there corrosion/rust inside the Charging Socket?

YES

NO

Replace Manual Controller Holder Assembly (MSB0105B)

5 Amp charging fuse OK with tight and corrosion free contact?

NO

Replace fuse – clean contacts

YES

Yellow charge cable attached to connector on Connector Board?

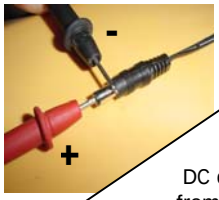
YES

NO

Attach connector

DC output from Power Supply at least 32 volts?

NO



YES

AC voltage from wall at least 110 (US)/ 220(EUR) volts?

YES

Replace Power Supply

NO

Use another outlet

YES

Remove Power Pack case, Connector Board cover and Charging fuse (5 Amp)

DC voltage greater than 32 volts?

YES

Remove Top Cover and check the Connector board and flat cable (connection, damage or signs of electrical failure and corrosion)

- Replace connector board (ESBC0021C)
- Replace flat cable (WSB0052A)
- Replace Main Board (SPP0019C)

NO

Replace Manual Controller Holder Assembly (MSB0105B)

\+ On the upper side of the charging fuse house (the small one)
\- On Power Pack contact (black)

3.2.2 Power & Charging Problems (con.)

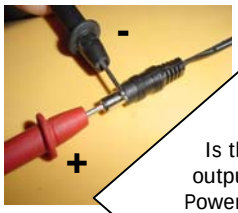
3.2.2.4

There is no Charging indication although the Power Supply is connected

In any case of charging problem or failure, it is recommended first to perform the charging test as explained in section 5.4.9 (page 5.13).

- Confirm the Power Supply is plugged into the Mains Supply
- Ensure the Mains Supply is turned on
- Test that the main socket is working by plugging another appliance

- Confirm the Power Supply connector is fully inserted into the charging socket
- Confirm that the charger plug is not corroded / rusty
- Unplug and plug the charger from the Robomower
- Confirm that there is no corrosion inside the charging socket
- Reset the Robomower by removing the Power Pack and re-inserting it



Is the DC output from Power Supply at least 32 volts?

NO

Is the AC voltage from wall at least 110 (US)/ 220(EUR) volts?

NO

Use another outlet

YES

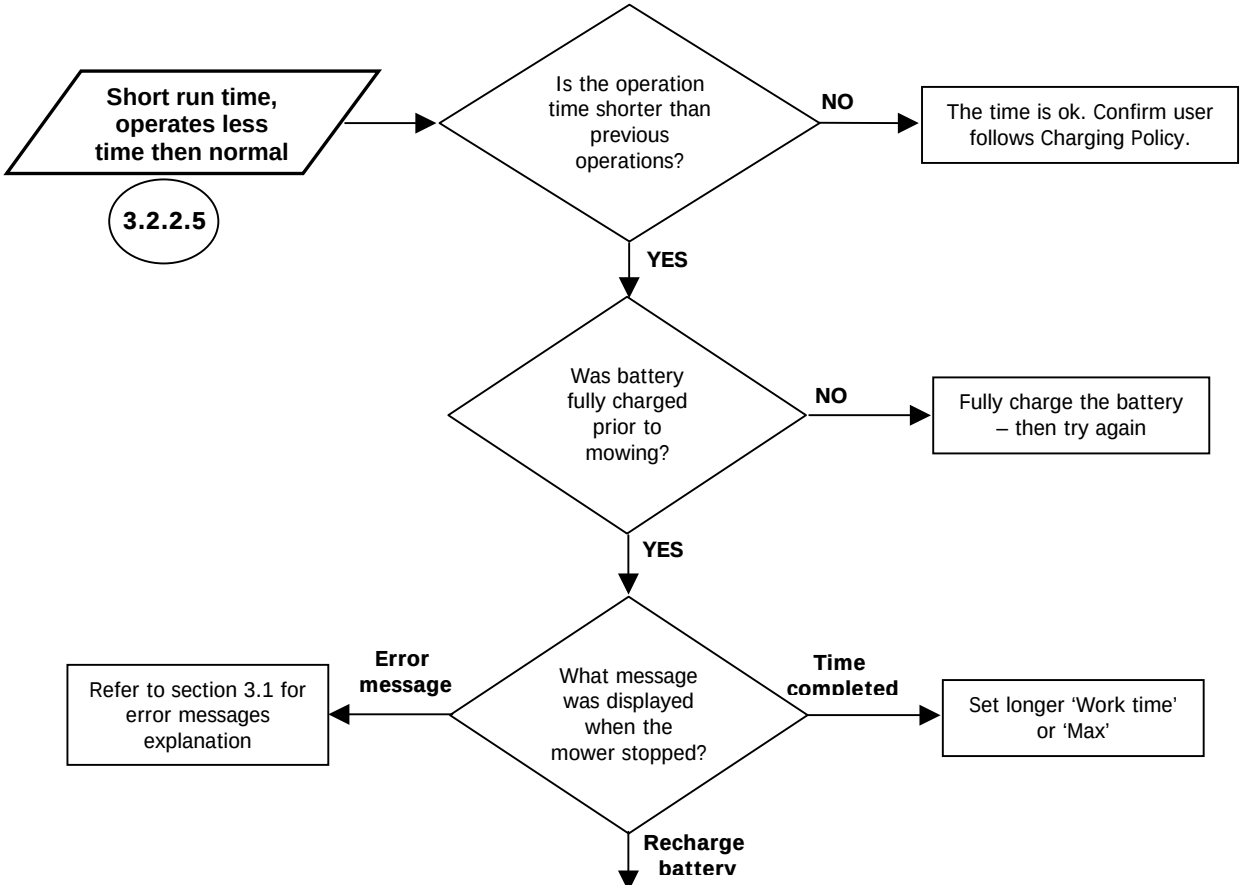
Replace power Supply
(US – PWS0003A)
(UK – PWS0002A)
(EUR – PWS0001A)

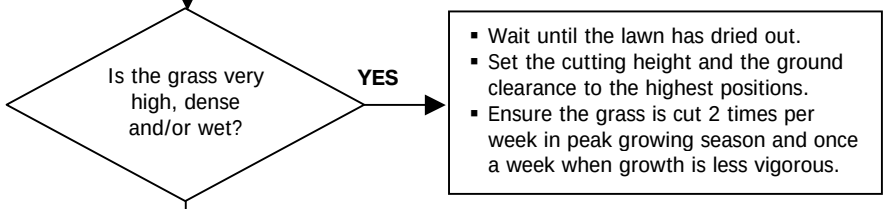
YES

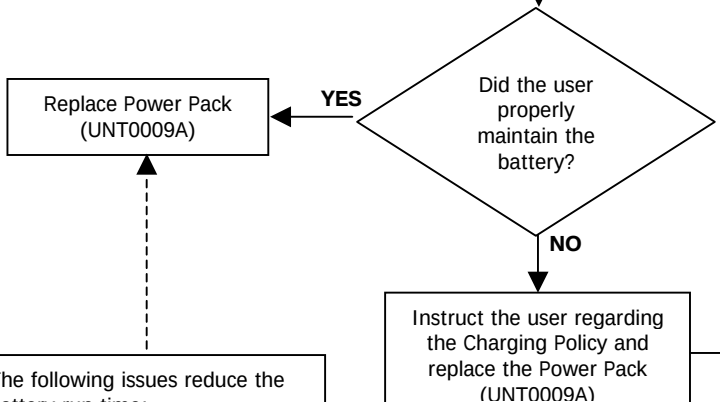
Replace Manual Controller Holder Assembly (MSB0105B)

- Replace connector board (ESBC0021C)
- Replace flat cable (WSB0052A)
- Replace Main Board (SPP0019C)

3.2.2 Power & Charging Problems (con.)







The following issues reduce the battery run time:
- Improper battery maintenance (does not follow the charging policy)
- More than 300 operation hours (The battery is coming to the end of its natural life)

Charging Policy

Between uses:
- The battery should always be kept in charging between uses during the mowing season.
- Mower should be operated only after 'Fully charged' or 'Ready' message is displayed.

During winter:
- Fully charged the battery, remove and store in a dry location.

Check the parameters under 'Battery maintenance' menu in the 'Service' (for more details see section 2.2 paragraph 5.14).
The battery warranty is valid only when following the charging policy.
In any case where the customer did not follow this policy the claim would be not accepted.

3.2.3 Mowing Problems

Important Safety Information!!!

PRIOR TO ANY OF THE ACTIONS SUGGESTED BELOW REMOVE THE POWER PACK.

Always wear thick protective gloves when handling or cleaning around the blades

3.2.3.1 **'Check mow height' message**

3.2.3.2 **Uncut lane left behind the Robomower**

3.2.3.3 **Mowing motors do not start but the Robomower moves on the lawn**

Loose branches, fruits, rope etc. on the lawn can block the blades operation

Lift the Robomow by the front handle and confirm nothing is blocking the blades

Confirm 'Mowing' is set to 'on' (under 'User Preferences' menu)

Does the message problem appear again?

NO → Robomow OK

YES → Adjust the ground clearance and cutting height to the highest position and retry

Robomow should be left to cool off till the 'Cooling, wait...' message is changing to 'Press GO' – then press the 'GO' button to continue the operation

'Mow overload – Cooling, wait...' message **3.2.3.4**

Clippings and debris in mowing deck

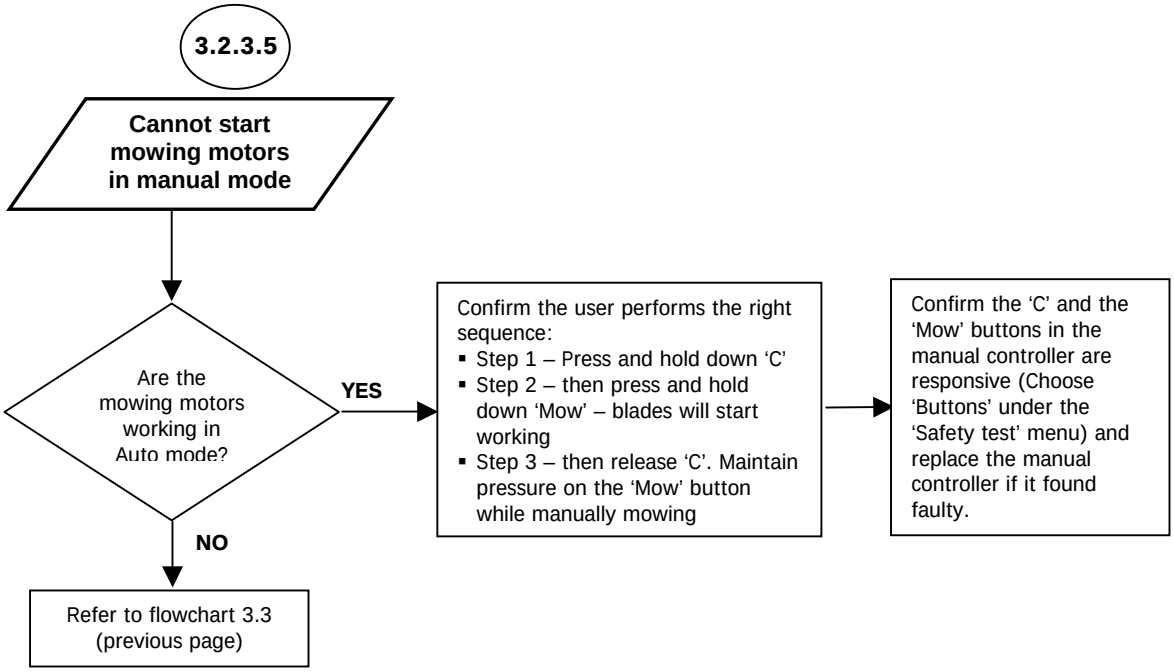
Is the mowing deck blocked with grass clippings and debris?

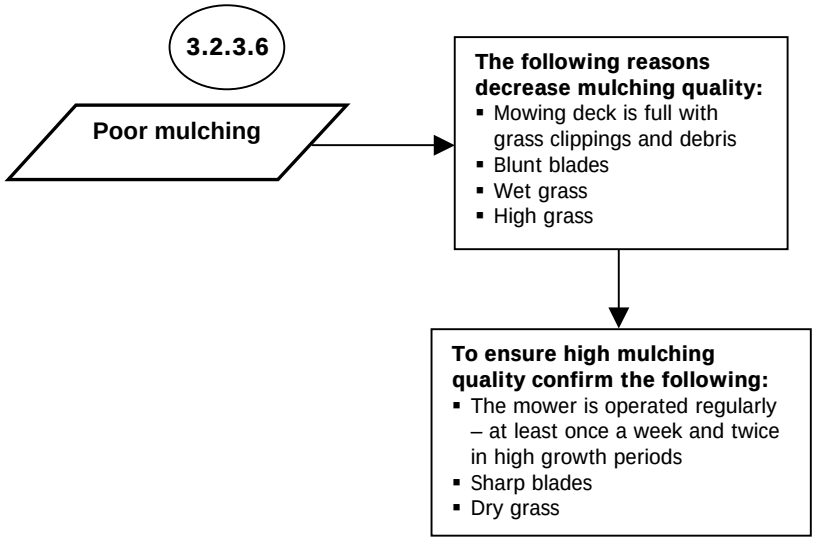
YES → Carefully remove the grass clippings and allow the lawn dry before commencing mowing

NO →

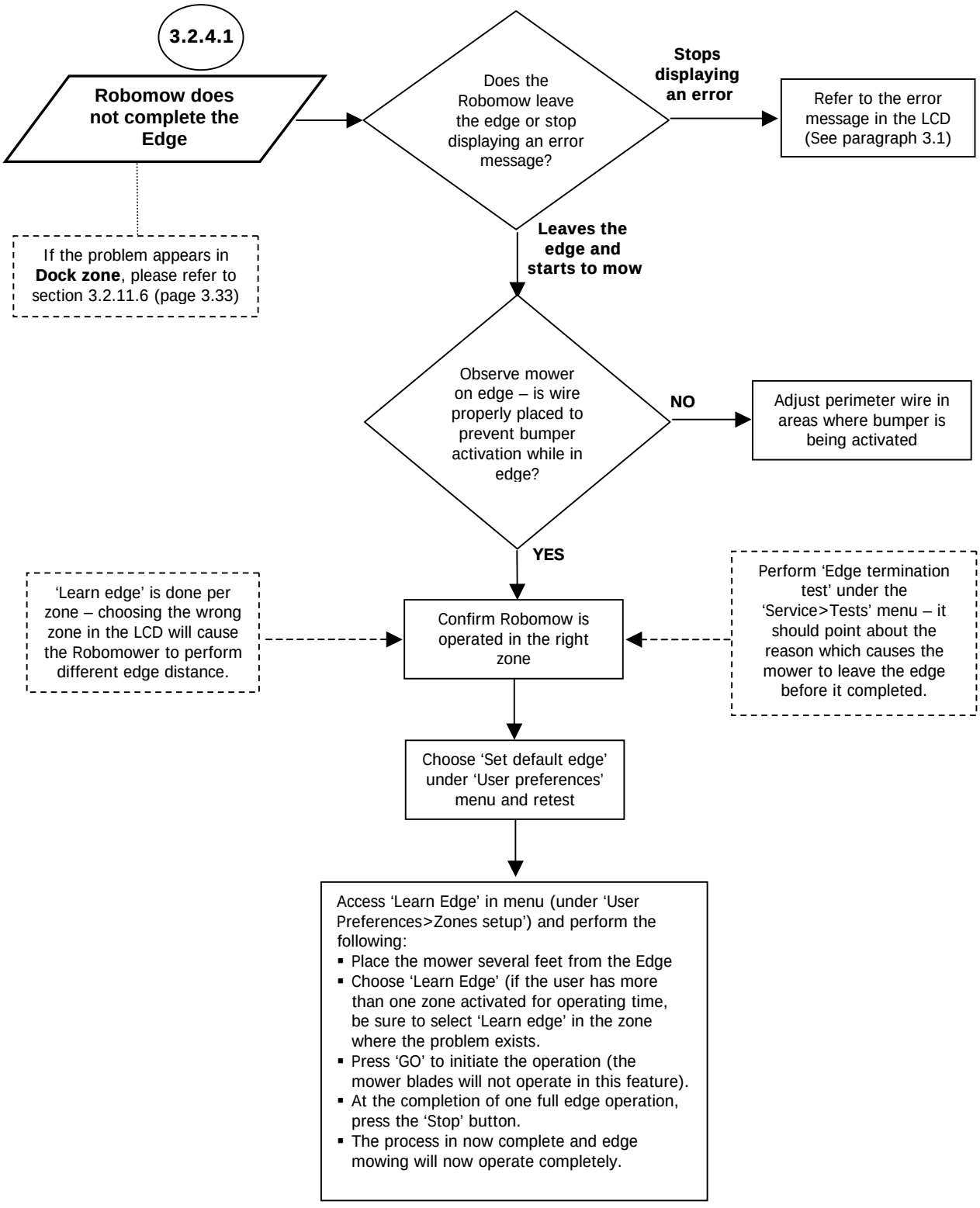
- Perform 'Thermistors test' under 'Service' menu (See section 5.3.9)
- Perform 'Mowing motors test' and refer to fault number.
- Try to rotate each blade (carefully, wearing a glove) and make sure all blades rotate easily and freely (Dull blades should be replaced – High cut blades – MRK0002A / Low cut blades – MRK0003A)
- Remove Top Cover and check tab connections on motors and on the Main Board
- Confirms the cables are not damaged
- Replace the Mowing Assembly (MSB0065B)
- Replace the Main Board (SPP0019B)

3.2.3 Mowing Problems (con.)

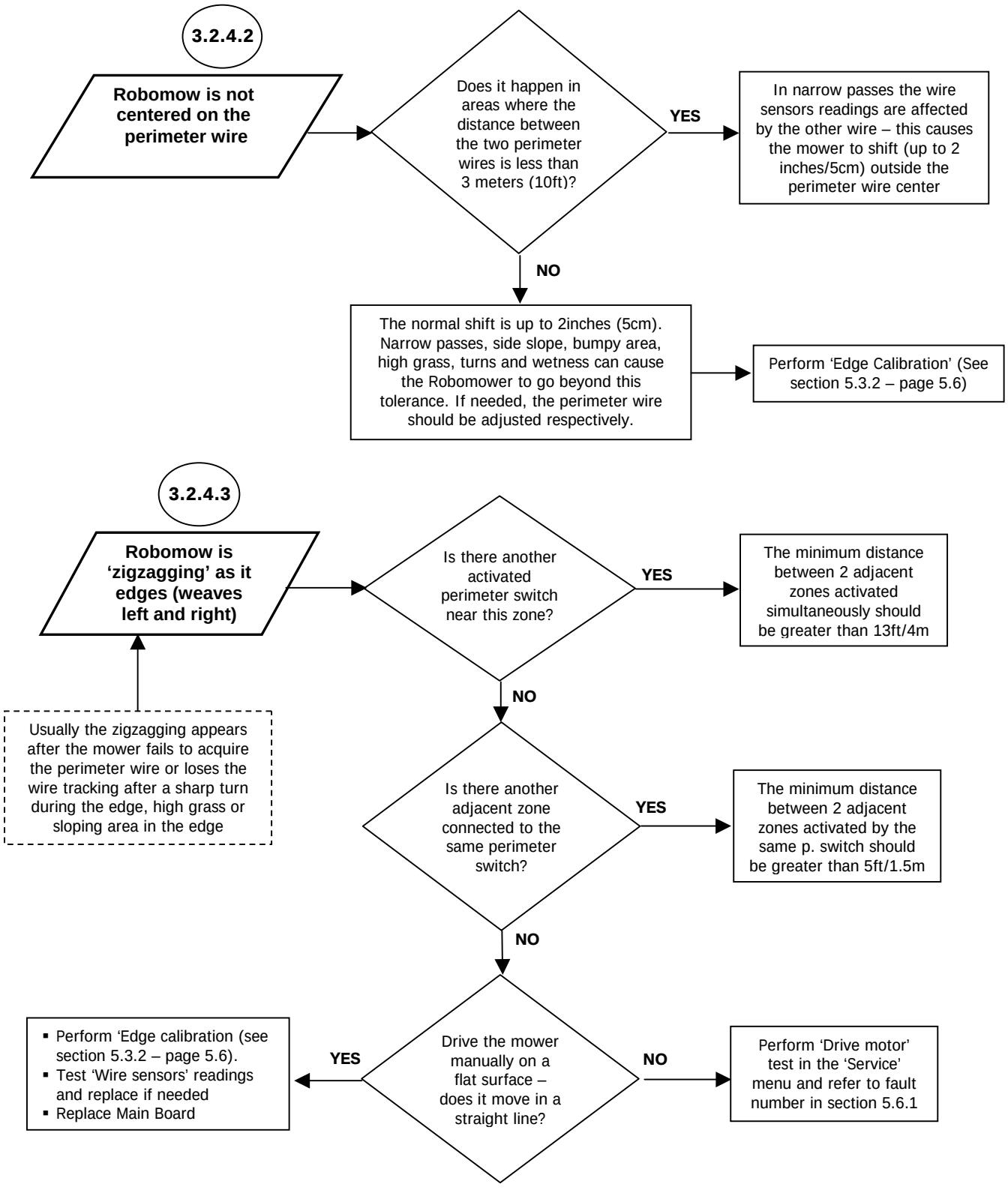




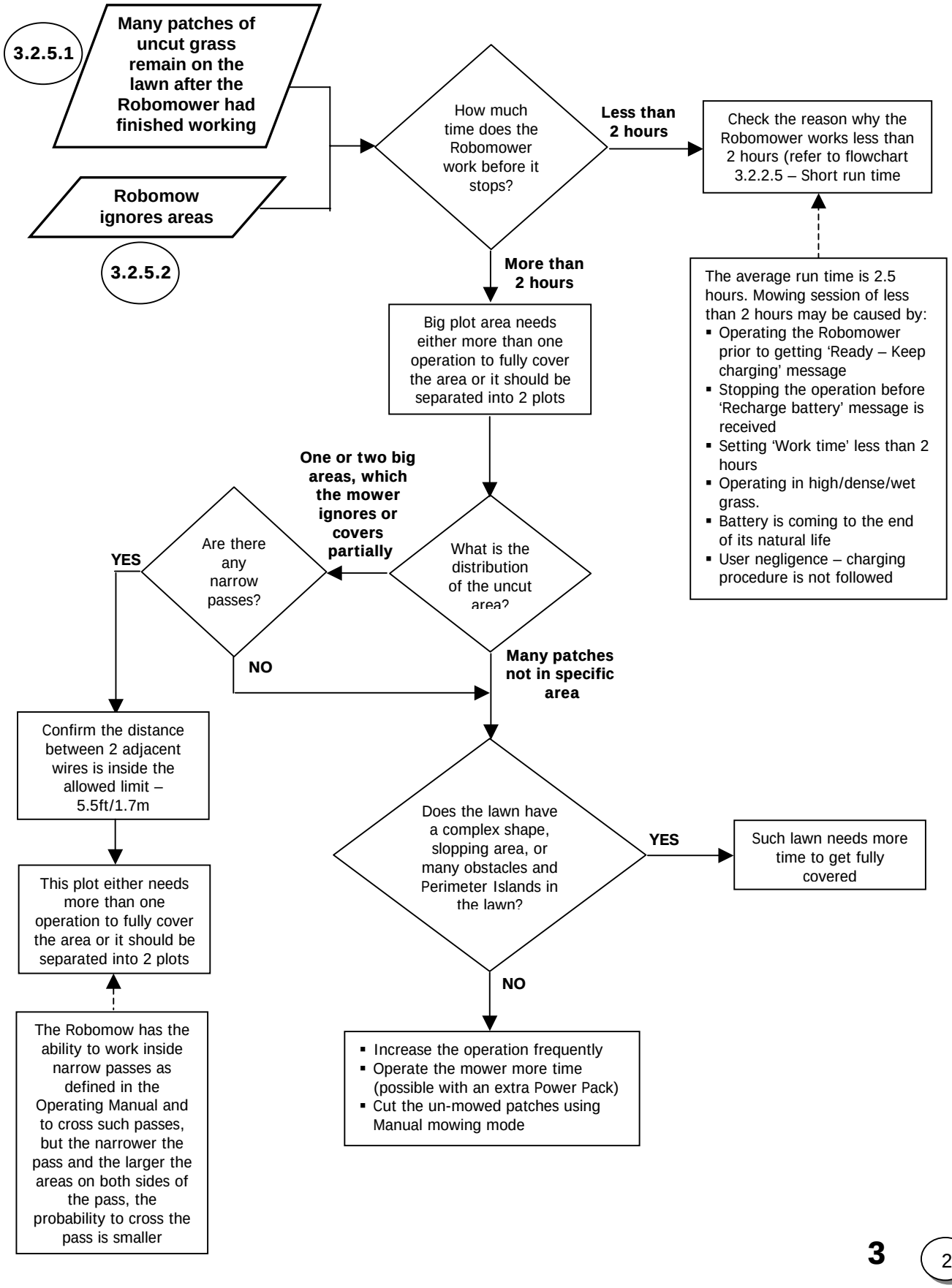
3.2.4 Edge Problems



3.2.4 Edge Problems (con.)



3.2.5 Automatic Mowing Problems



3.2.5 Automatic Mowing Problems (con.)

3.2.5.3

Robomow had stopped and is found with no error message

If the Manual Controller cord is misplaced in the cavity it may push the Manual Controller during operation and stop the automatic operation

What was the display in the LCD?

Blank LCD

The display is turned off automatically after 20 min. Remove the Manual Controller from its place or press the GO button to see the last message displayed

Manual User Option

Is the M. Controller in its place (flushed with the Top Cover surface)?

NO

Make sure that prior to inserting the Manual Controller to its place, the cord is stored well underneath.

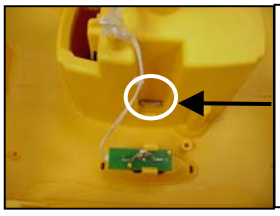
YES

Replace the M. Controller with a good one and view the display to see if it changes to Auto menu when it is flushed with the Top Cover

Is it changed?

NO

Remove the Top cover – confirm there is a magnet inside the cover



A magnet is located underneath the rectangular protrusion. Its function is to change between the Manual and the Auto modes

YES

The Manual Controller is faulty - Replace

Zone A / Dock zone

Is it a recurring problem?

YES

- Confirm The Manual Controller is placed well and flushed with the Top Cover.
- Confirm Power Pack contacts on both sides (bat. and RL) are not loose/damaged.
- Remove Connectors Board cover and confirm the fuses are not free to move and there is no corrosion on the fuse housing.
- Confirm good contact between M. Controller cord plug and socket on the Connector Board.
- Remove Power Pack cover and check for loose connections

NO

Confirm the Manual Controller is placed well and flushed with the Top Cover – short lifting of the Manual Controller while operating will cause the mower to stop.
Robomower is like a computer – in very rare cases it may shutdown automatically (reset)

3.2.5 Automatic Mowing Problems (con.)

Important Safety Information!!!

PRIOR TO ANY OF THE ACTIONS SUGGESTED BELOW

REMOVE THE POWER PACK.

Always wear thick protective gloves when handling or cleaning around the blades

3.2.5.4

Robomow keeps going back and forth on the same lines without advancing sideways

3.2.5.5

Poor direction keeping – Robomower does not move in straight lines

Confirm the Front Wheel turns freely both on the horizontal and vertical axes, clean out all grass clippings around the Front Wheel and recheck

'DK Calibration' should be carried out on a smooth and level area, away from metal objects and power lines

Confirm 'Set country' is set to your country and perform 'DK Calibration' (refer to section 5.3.4)

- Slopes greater than 15 degrees can be mowed using Manual mode
- Some natural 'drift' can occur and this is normal
- When Robomower is climbing a slope, especially when the grass is wet, the scan progress may be slower.

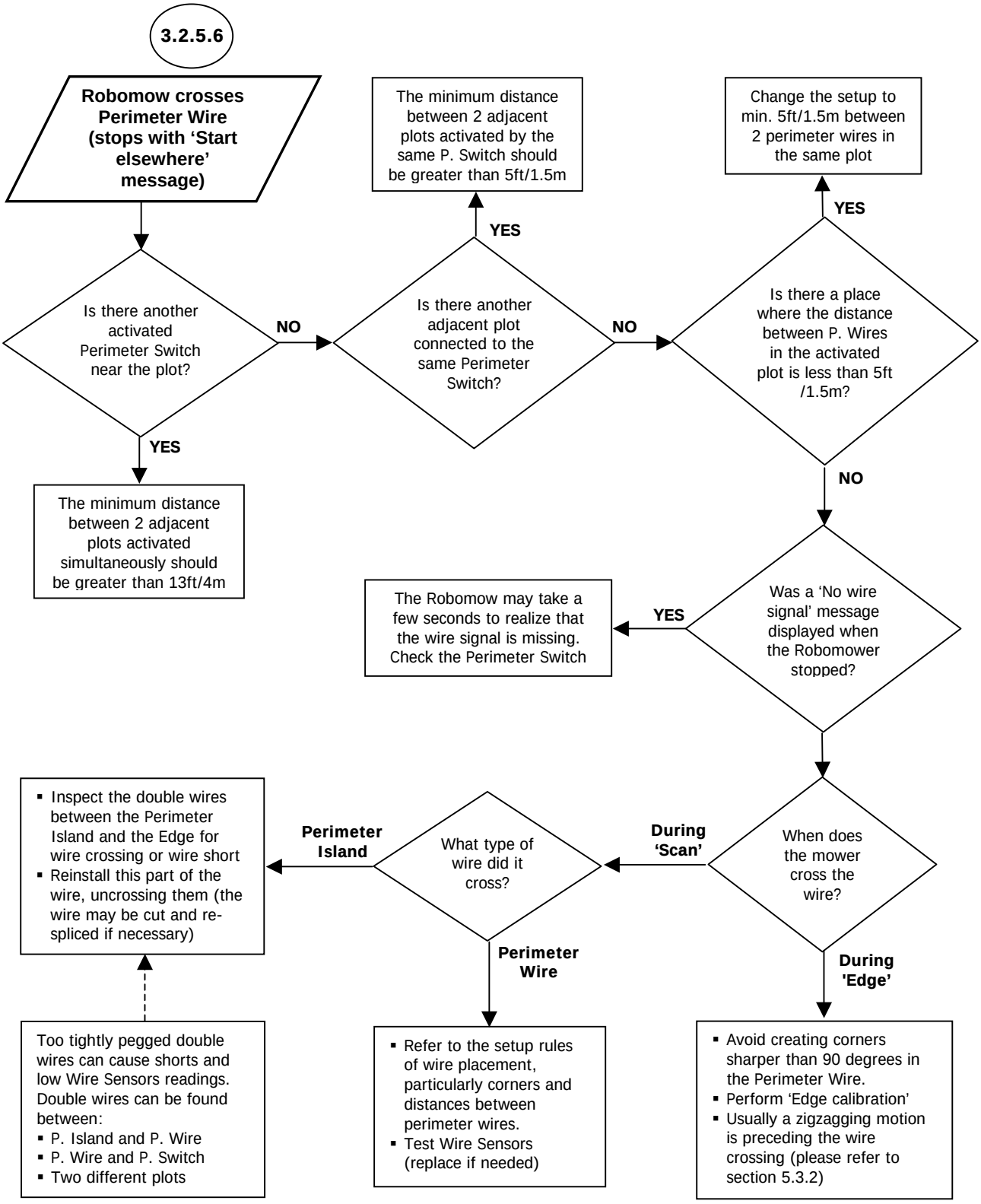
Confirm the slope is not more than 15 degrees

Knobby wheels (MSB0099A) can improve the ground holding of the mower especially in slopping area, bumpy area and wet grass

Set the 'Wide scan' option to 'on' under 'User preferences' menu. This will increase the angle between mowing lines.

Under 'Service menu:
- Check 'Drive motors'
- Check 'Direction keeper
- Refer to fault number in section 5.6)

3.2.5 Automatic Mowing Problems (con.)



3.2.6 Manual Controller Problems

3.2.6.1

One or more of the Manual Controller buttons do not respond

Is it a new Robomower or is it the first operation after an extended storage period (winter)?

NO → Check the suspected faulty button (Choose 'Buttons' under the 'Safety test' menu) and replace the Manual Controller if found faulty.

YES → Press the button, which does not respond several times continuously (up to 30 times)

Electrical equipment stored for a long period of time starts to oxidize. Few activations of the Manual Controller button are required to remove the oxidation from it.
The activations remove the oxidation and the button will function normally. This phenomenon is prevented when the Robomower is in use because the Manual Controller is constantly under voltage, which delays the oxidation process.

Does the button respond?

YES → The Manual Controller button is OK, continue operation

NO → Check the suspected faulty button (Choose 'Buttons' under the 'Safety test' menu) and replace the Manual Controller if found faulty.

3.2.6.2

Manual Controller display does not change to 'Zone A' / 'Dock zone' when placing it in its place

Is the M. Controller in its place (flushed with the Top Cover surface)?

NO → Make sure that prior to inserting the Manual Controller to its place, the cord is stored well underneath.

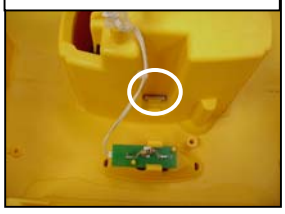
YES → Replace the M. Controller with a good one and view the display to see if it changes to Auto menu when it flushed with the Top Cover

Is it changed?

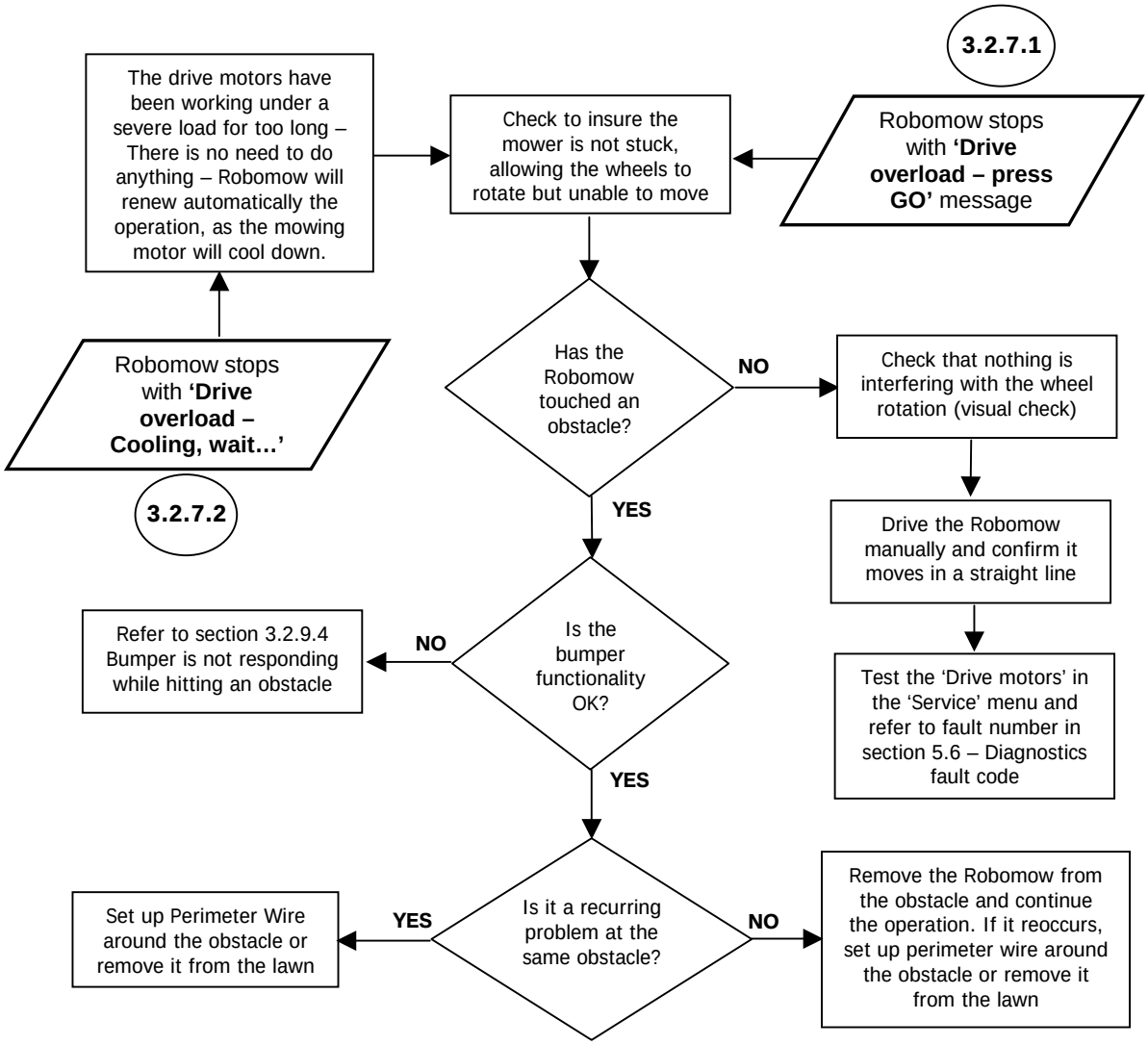
NO → Remove the Top cover – confirm there is a magnet inside the cover

YES → The Manual Controller is faulty - Replace

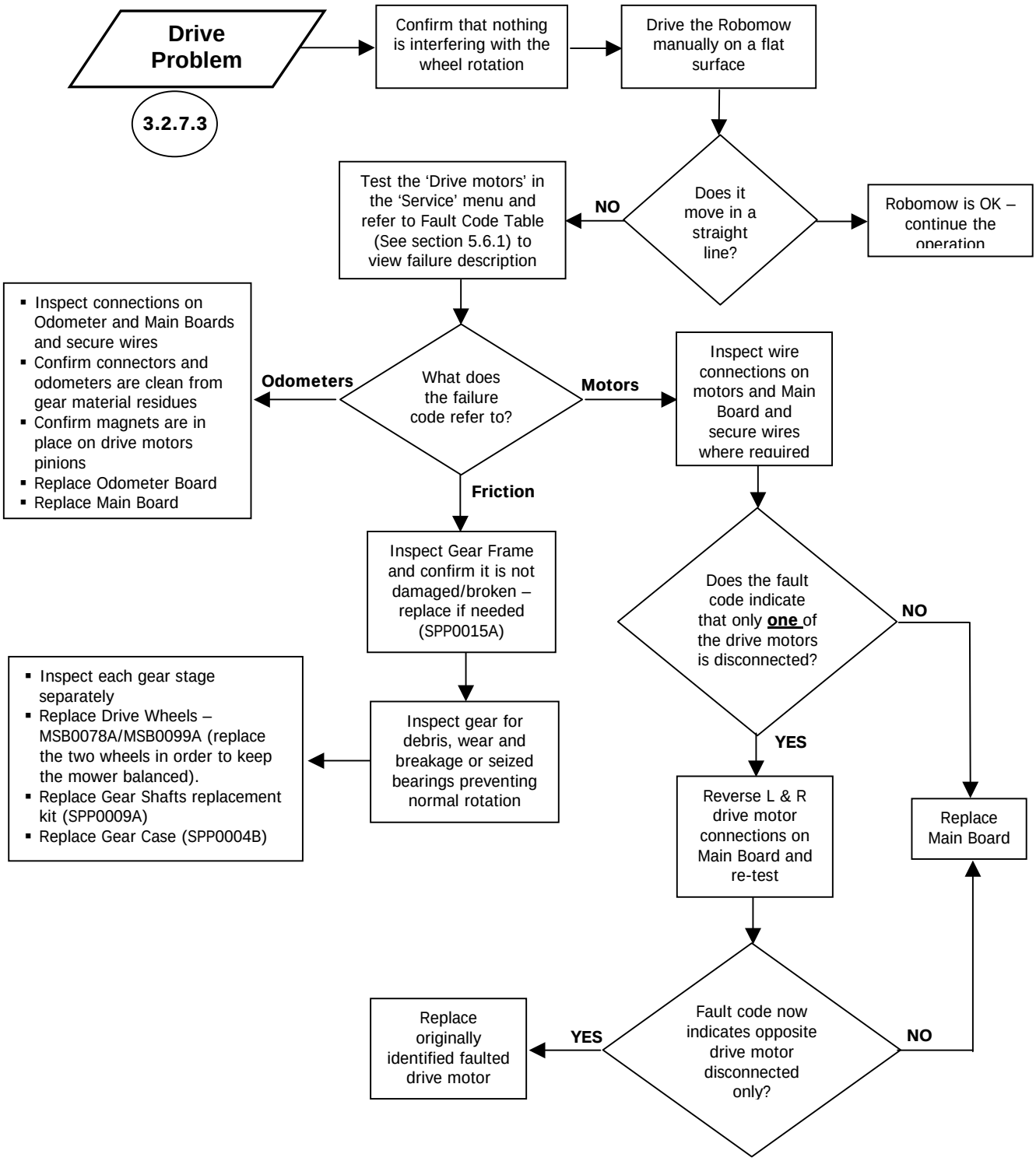
A magnet is located underneath the rectangular protrusion. Its function is to distinguish between the Manual and the Auto modes



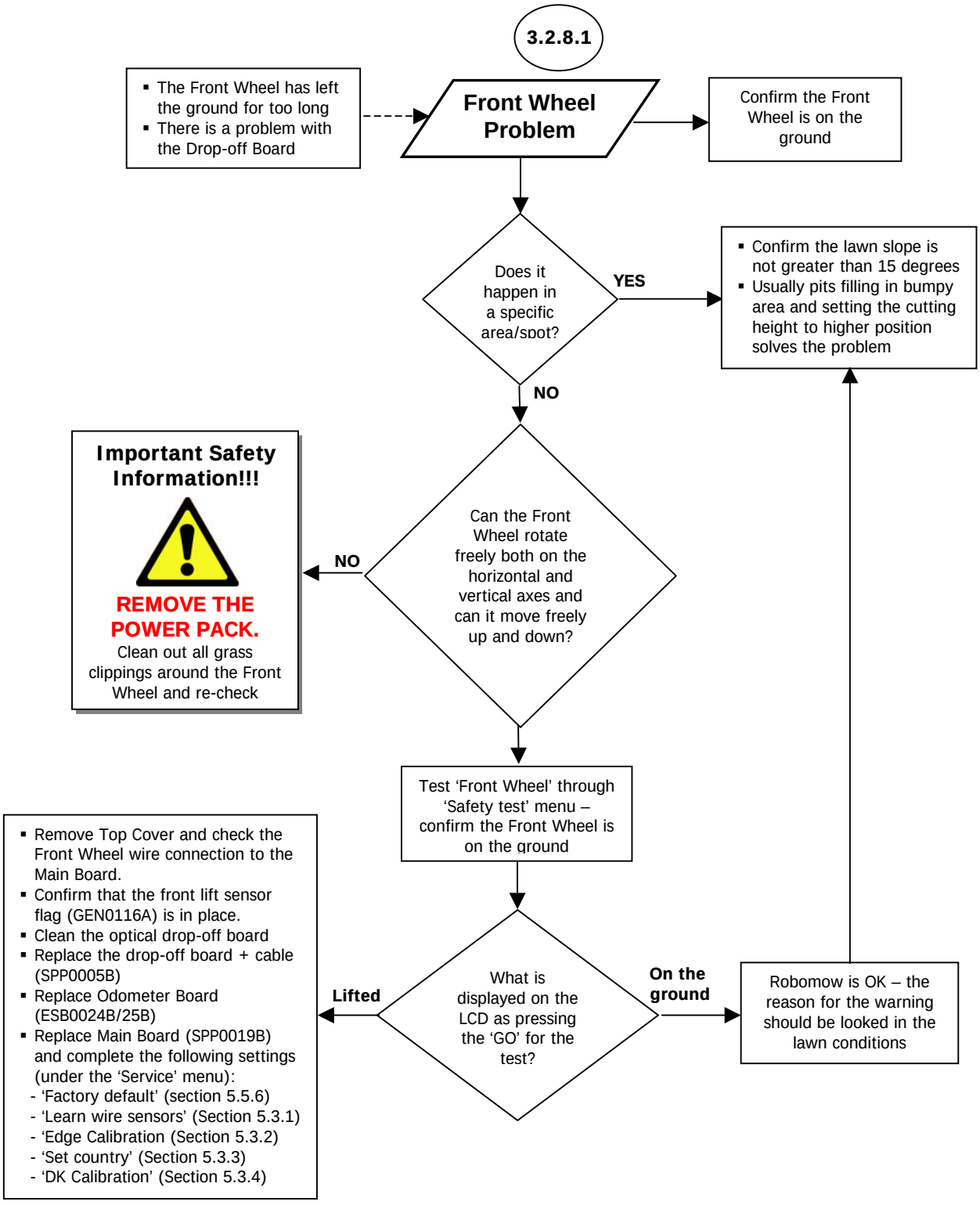
3.2.7 Drive Problems



3.2.7 Drive Problems (con.)



3.2.8 Front Wheel Problems



3.2.9 Bumpers Problems

Attention

Item pressed against the bumpers or Robomower positioned "standing" on any of the bumpers while in storage can change the shape of the bumper and cause problems to the touch sensor electronics

3.2.9.1

Front /Rear Bumper Pressed

Take the Power Pack out of the mower and re-insert

Is anything pushing against the bumper?

YES

Remove Robomow away from the object

NO

Test the 'Bumpers' through 'Safety test' menu – confirm a bumper is pressed

Press and squeeze the appropriate pressed bumper from bottom to top

Is any distortion of the bumper visible?

YES

Continue to press the bumper at the distorted area and leave it at room temp. for several hours

NO

Is 'Bumper pressed constantly displayed?

YES

Remove Top Cover:
- Confirm metal strip is in place
- Replace Bumper
- Replace Main Board (SPP0019B) and complete the following settings (under the 'Service' menu):
  - 'Factory default' (5.5.6)
  - 'Learn wire sensors' (5.3.1)
  - 'Edge Calibration' (5.3.2)
  - 'Set country' (5.3.3)
  - 'DK Calibration' (5.3.4)

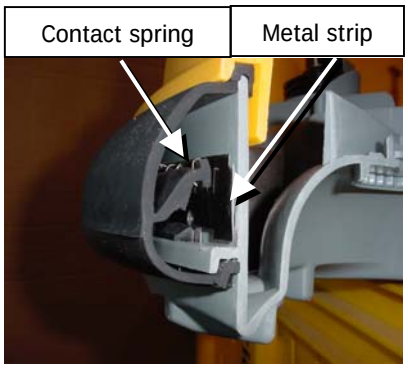
NO

Is only slight force required before a bumper pressed indication (*) appears?

NO

YES

Look for bumper deformation – this should be rectified by ensuring correct seating of bumper on the gray plastic base



3.2.9 Bumpers Problems (con.)

'Front /Rear Bumper disc.' message

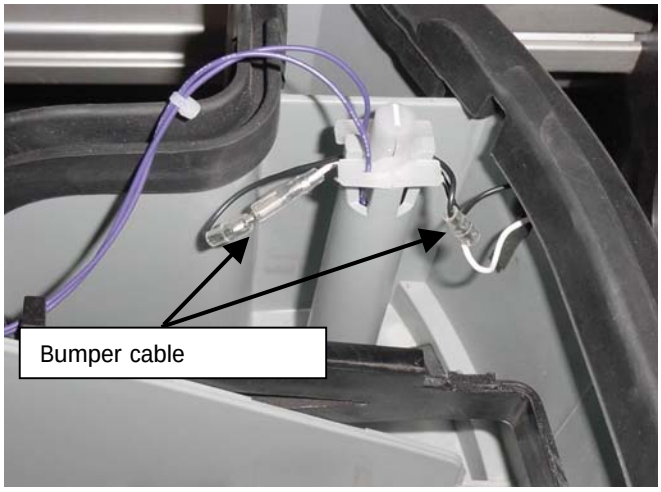
3.2.9.2

Take the Power Pack out of the mower and re-insert

Is the 'Bumper disc.' Message still displayed?

NO → Robomow OK

YES



Remove the Top Cover:
- Confirm jumper position on the Main Board (refer to Service Bulletin 'RL0536-01 Main Board'
- Look for disconnected connectors (between Main Board and Bumper
- Ensure connection of wires to bumper metal strip and to bumper spring.
- Confirm there is no disconnection in the soldering point between the white/purple wire to the inner bumper spring
- Confirm the Bumper cables (WSB0043A) are connected and there is no corrosion on the contacts (see the picture)
- Look for damaged wires
- Replace bumper wiring (WSB0043A)
- Replace Bumper (Front – MSB0106B Rear – MSB0107A)
- Replace Main Board (SPP0019B)

3.2.9.3

Bumper sounds without hitting an obstacle

Was the bumper sound heard and the mowing motors stopped while mowing manually?

NO → Press the 'GO' button for Automatic operation and confirm there is no bumper sound during operation

YES

Press and squeeze the bumper from bottom to top all around

Is the mowing system too noisy / vibrating?

NO
- Test the 'Bumpers' through 'Safety test' menu.

Remove the Top Cover:
- Look for bumper deformations – these should be rectified by ensuring correct seating of bumper on the gray plastic base.
- Confirm metal strip is in place
- Replace Bumper (Front – MSB0106B Rear – MSB0107A).
- Replace Main Board (SPP0019B) and complete the following settings (under the 'Service' menu):
  - 'Factory default' (Section 5.5.6)
  - 'Learn wire sensors' (Section 5.3.1)
  - 'Edge Calibration (Section 5.3.2)
  - 'Set country' (Section 5.3.3)
  - 'DK Calibration' (Section 5.3.4)

YES

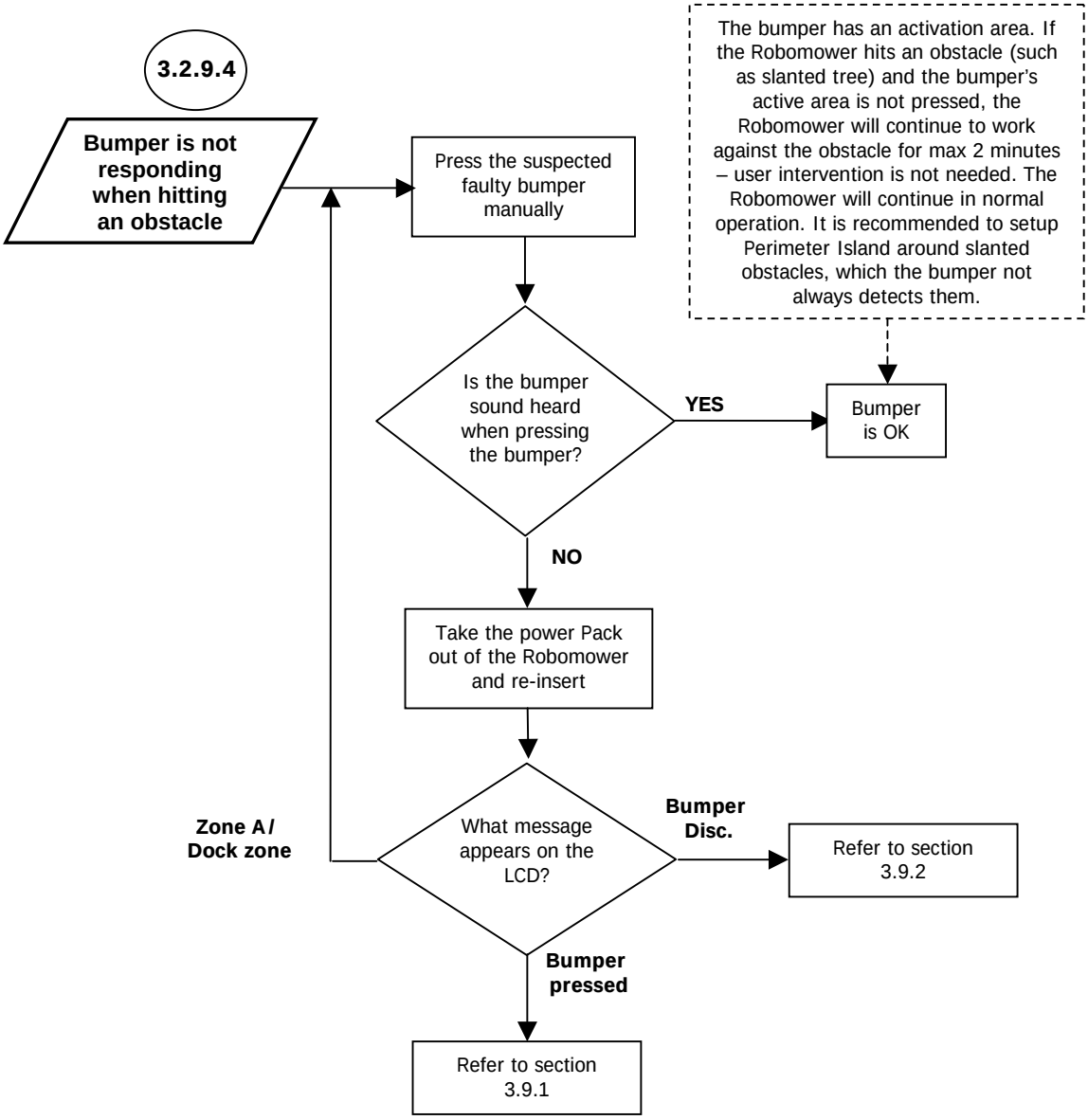
Refer to section 3.12.1 (Excessive noise)

Attention!

Item pressed against the bumpers or Robomower positioned "standing" on any of the bumpers while in storage can change the shape of the bumper and cause problems to the touch sensor electronics

Possible reasons for bumper false detections:
- Heavy wet / moisture
- Vibrating mowing system (damaged motor or unbalanced blades)
- Distorted bumper (improper storage)

3.2.9 Bumpers Problems (con.)



Recommendation

The Robomow is designed to easily work in the lawn with both types of obstacles, however, for the most gentle and silent operation, it is preferable to demarcate all fixed objects in and around the working area. If you are unsure about a particular obstacle, it is best to exclude it with the perimeter wire. It will have no effect on the efficiency of the mower and can later be removed if not needed.

3.2.10 Wire Sensors Problems

'No wire signal' message

3.2.10.1

Is the Perimeter Switch/Docking Board turned on?

NO → Turn on the Perimeter Switch by pressing the 'on' button

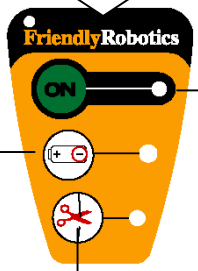
YES

Is any LED blinking on the Perimeter Switch?

NO → Refer to flowchart 3.1.3 – 'Perimeter Switch does not operate'

YES

Which LED on the P. Switch blinking?



Refer to flowchart 3.1.2 - Replace batteries – only for standard Perimeter Switch

Refer to flowchart 5.3.1 - Wire Disconnected

Has the message been received during operation or upon GO pressing?

Upon pressing GO → Move the Robomow towards the wire and press the GO again (Min. signal is needed to start the operation)

During operation → Confirm the plot is not too big (Robomower's distance from the nearest perimeter wire should be less than 50ft/15m when the wire sensors reading are above 10)

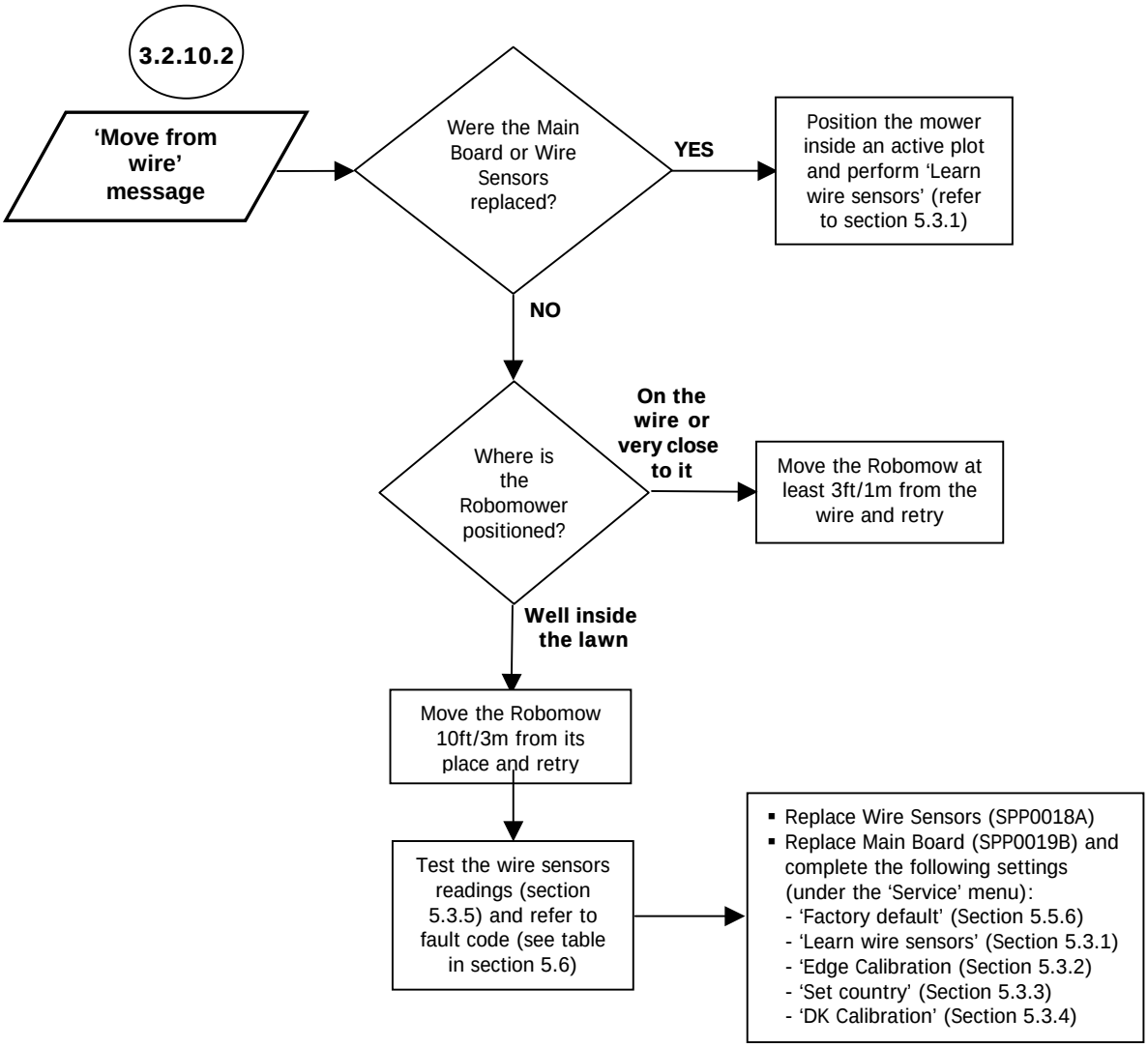
Test the wire sensors readings (see section 5.4.1)

Fail →
- Refer to fault code (see table 5.6)
- Replace Wire Sensors (SPP0018A)
- Replace Main Board (SPP0019B) and complete the following settings (under the 'Service' menu):
  - 'Factory default' (Section 5.5.6)
  - 'Learn wire sensors' (Section 5.3.1)
  - 'Edge Calibration (Section 5.3.2)
  - 'Set country' (Section 5.3.3)
  - 'DK Calibration' (Section 5.3.4)

Pass → Look for double wires, separate the wires and confirm the readings are OK

Too tightly pegged double wires can cause short and reduce wire sensors readings.
Double wires can be found between:
- Perimeter wire and Perimeter Islands
- Perimeter Wire and Perimeter Switch
- Two different plots

3.2.10 Wire Sensors Problems (con.)



3.2.11 Charging Station Problems

Problem Encountered	Probable Cause / Event	Corrective / User Action
Robomower does not leave the Charging Station for operation at the time set in the Weekly Program	- Confirm the time in the mower is set correctly (day and hour)	- Set the time (See paragraph 4.2 in the Operating and Safety Manual)
	- Low battery voltage	- Confirm there are minimum 16 hours of charging in the Docking Station before the next scheduled depart
	- 'Auto depart' is set to 'off' ('Manual depart' is displayed when the mower is in the Docking Station)	- Change the setting of the 'Auto depart' to 'on' (See paragraph 6.3 in the Operating and Safety Manual)

Robomower records the information and the reason in case it will not depart from the Docking Station.
Usually a '+' sign is appeared below the active day, but if from some reason the mower does not depart on time from the Docking Station, the '+' sign is changed with one of the following:

Character	Meaning
+	Active day
R	Skipped due to rain (Robomow did not departe from the Docking Station at the scheduled time due to rain detection)
r	Docked before time due to rain (Robomow did not complete the operation and drove back to the Docking Station due to rain detection during the operation)
B	Skipped due to low battery voltage (Robomow did not departe from the Docking Station at the scheduled time due to low battery voltage)
b	Docked before time due to low battery voltage (Robomow did not complete the operation and drove back to the Docking Station due to low battery voltage – relevant only when 'Working time' is set)
D	Skipped because there was no contact with Docking Station or there was no charging voltage (power break or mower which is placed out of the Docking Station) at the scheduled depart time
U	Skipped due to user choice (for example if the user chose the 'skip next depart' option or set the 'Auto depart' to 'off')
C	Skipped because there was no charging at the scheduled departs time, although there was voltage (usually when the Robomow is in the Docking Station, but the Manual Controller is not in its place).

Problem Encountered	Probable Cause / Event	Corrective / User Action
Robomower does not detect the Charging Station contacts and/or 'Front wheel problem' is displayed when the mower is in the Docking Station	**Perform *'Docking test'* (refer to section 5.4.7).** This test checks the detection of the Docking Station by the Robomower.	
	- Power supply/charger is not plugged into the main power supply	- Confirm power supply is plugged into the main power receptacle.
	- No power to receptacle or main power is shut off	- Check for power to this main receptacle by plugging in another appliance. - Turn power on to the main receptacle. - Disassemble the Docking Station Cover by unscrewing the screws and check the connection of the power cable (black) and the wire connector (green). - Confirm the 'ON' light is blinking in the Docking Station when switching on the green (ON) button.
	- Docking Station and/or Robomower have burnt signs or/and corrosion	- Periodically clean the Docking Station and the Robomower contacts using only a damp cloth. - Contact your service provider if the contact should be replaced
	- Poor or disconnection of the Docking Station wires (red and green) to the contacts	- Confirm good contacts in the tabs (end of the red and green wires) to the Docking Station contacts.

Follow the steps below:

1. If the mower doesn't detect the Charging Station, the failure may be found in one of the following:
   - Robomower
   - Charging Station
   - Power Supply

2. **Testing the Robomower:**
   - Connect the mower to a standard Power Supply (Indoor use only) through the charging socket (placed below the Manual Controller at the left side) and confirm 'Charging' is displayed for at least 1 minute.
   - Place the mower out of the Charging Station.
     Choose 'Charging voltage' under the 'Information' menu; it should be around 14.0 V.
     If the voltage is '0' check the following:
     - Connections between the Robomow contacts to Connector Board
     - Connector Board
     - Connection between Connector to Main Board
     - Main Board

     Take a metal ruler and make shortage between the contacts in the mower side.
     If the mower is good, then the voltage should drop down to zero.
     If the mower has problem (disconnection, burnt Fuse, faulty Manual Controller Holder Assembly…) then the charging voltage will stay the same (~14V).
     If the mower is good continue to the next step.

     Information:
     If you measure the voltage on the Charging Station contacts when the mower is out of the Charging Station, it should be zero.
     As you drive the mower to the Docking Station and it reaches the contacts, it will initiate the current consumption (because it detects the 14V from the mower side).

3. Drive the mower into the Charging Station and confirm it touches the Charging Station contacts.
   Leave the Manual Controller out of its place so the charging of the battery will not start.

Measure the voltage (using voltmeter) on the docking contacts while the mower contacts touch the docking contacts (should be around 36V).
If it is less then 36V continue to step 4.

4. Disassemble the docking cover (figure 3.2.11.1) and measure the voltage on the two cables of the Power Supply where they are connected to the Docking Board (at the points showed by the red arrows in figure 3.2.11.2). The voltage should be ~38V, if it is lower then the Power Supply is faulty.

Figure 3.2.11.1
Opening the screws to remove the cover

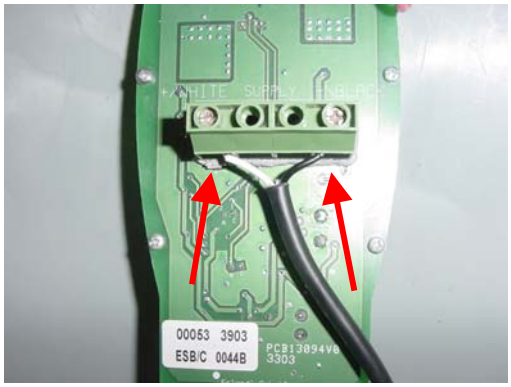


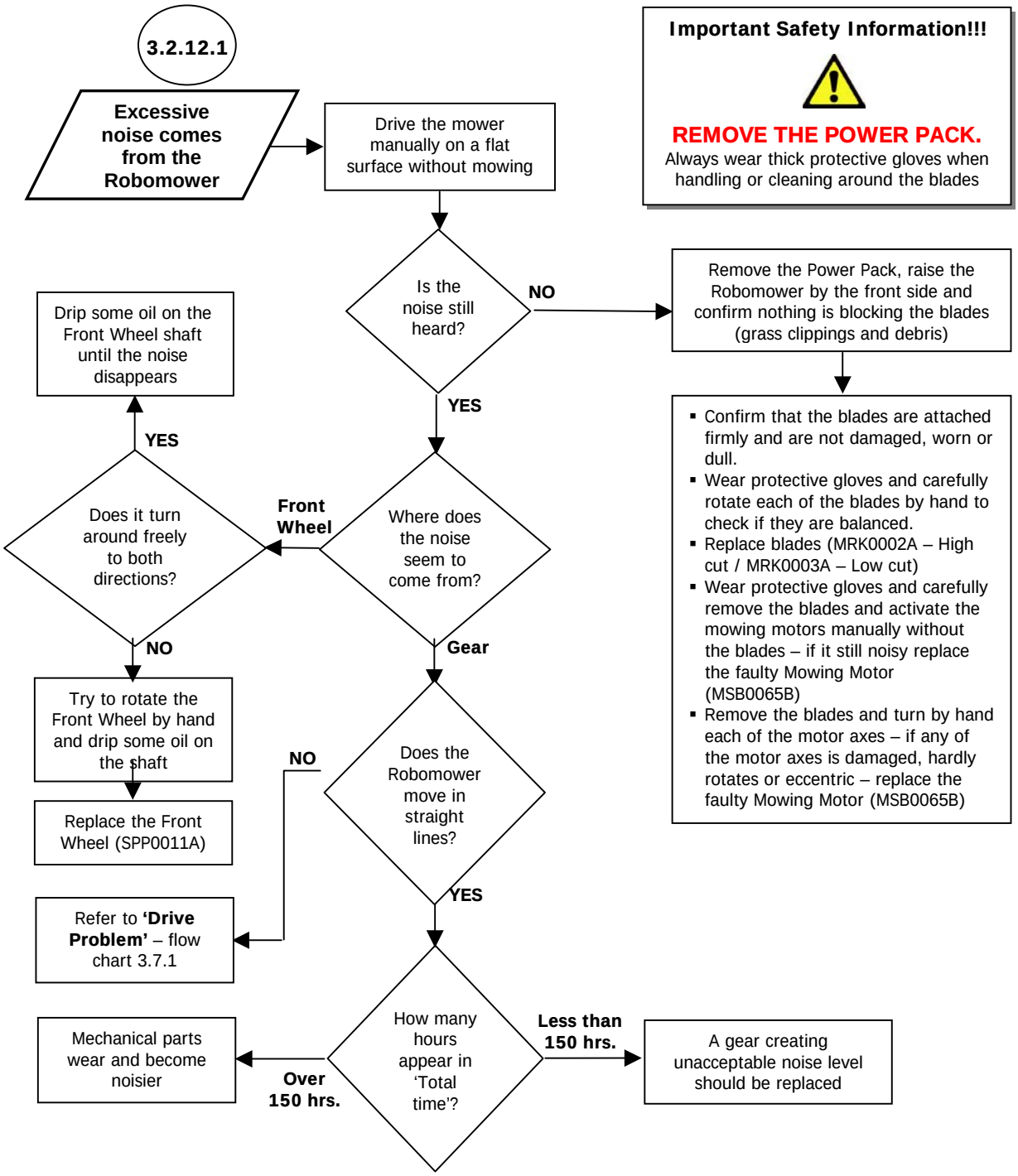
Figure 3.2.11.2
Power Supply cable screws

5. If the output voltage of the Power Supply is ~38V replace the Docking Board.

Problem Encountered	Probable Cause / Event	Corrective / User Action
Robomower reached the Charging Station when its contacts are above the Charging Station contacts	- Height difference between the Charging Station base and the lawn surface at the entrance to the Charging Station	- Confirm the ground before the Charging Station is leveled with the Charging Station base – if necessary fill the ground with dirt and level off
Robomower is operated in the zone with the Charging Station but stopped with 'Recharge battery' or 'time completed' message	- The Robomower was operated from the lawn (not from the Docking Station) when the main display showed 'Zone B' or any other zone but not 'Dock zone'	- When operating the Robomower from inside the lawn, confirm the main display on 'Dock zone'
Robomower is searching for the dock in zone with out Charging Station	- The Robomower was operated from the lawn in 'Mowing' (without 'Edge') when the main display showed 'Dock zone'	- When operating the Robomower from inside the lawn, confirm the main display on 'Dock zone'
Robomower does not complete the edge in plot with Charging Station	- Events such as distance limitation or number of quarters count by the compass during edge may cause the mower to terminate the perimeter wire - Perform 'Edge test' as explained in section 5.4.8. This test displays the reason for the edge termination by the mower. - You can always change the setting of 'Edge to dock' to 'on' ('Service' > 'Settings' menu). This option enables the mower to complete the edge from the Charging Station back to the Station, even if there are events during the edge, which should cause the mower to terminate the perimeter wire	

3.2.12 Excessive noise

Note: Excessive noise from the Robomow, which does not decrease the performances, is an aesthetic issue only.



4. Repair and Maintenance Procedures

The Repair and Maintenance Procedures Section is broadly divided into two areas, External and Internal. The External procedures include all those procedures that can be completed without the removal of the cover and conversely all Internal procedures require the removal of the cover of the unit.

Always follow procedures step by step and ensure good workshop practice by working in clean, dry conditions. Use only correct, well-maintained tools. At the top of each procedure, the tools required are listed, as well as the time needed to complete the procedure. The time stated tends to be generous, allowing time for diagnostics, reviewing the relevant procedures in the Service Guide and completing the General Test (See section 5.1) before the unit is sent back to the customer.

Always complete testing to ensure safety and proper operation of the unit. When completing work, always record the FCS (Friendly Coding System) code on any report or claims to Friendly Robotics (See section 6 – Procedures and Policies)

Table Of Contents

4.1 Robomow External procedures

4.1.1 Fuses replacement

Required tools:	None	Procedure duration:	5 minutes

Power Pack Fuse Replacement (30A) – FUS0003A

A. Remove the Power Pack from the Robomow.
B. Pull the burnt fuse directly downwards to extract.
C. Fully insert a new 30A fuse (FUS0003A).
D. Return the Power Pack and verify the Robomow is turning on.
E. Complete the **General Test** as outlined in **section 5.1.**

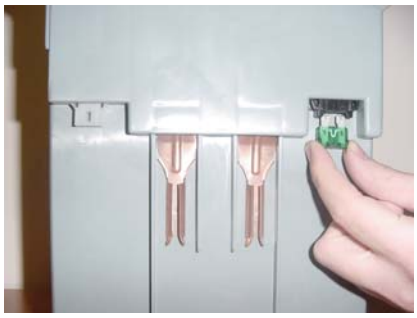


Figure 4.1.1.1
30A Power Pack fuse replacement

Required tools:	None	Procedure duration:	5 minutes

Charging Fuse Replacement (5A) – FUS0015A

A. Remove the Power Pack from the Robomow.
B. Lift the Manual Controller to an upright position, in its tray.
C. Squeeze the two tabs of the fuse cover, while pulling up the fuse cover (Figure 4.1.1.2)
D. Pull out the 5A fuse (the small one) - Figure 4.1.1.3 and replace it with a good one.
E. Replace the fuse cover – make sure it is securely in place.
F. Return the Power Pack and verify the Robomow is turning on.
F. Connect the Power Supply to the Robomow and verify it is getting into charging state.
G. Complete the **General Test** as outlined in **section 5.1.**

Figure 4.1.1.2
Fuse cover removal

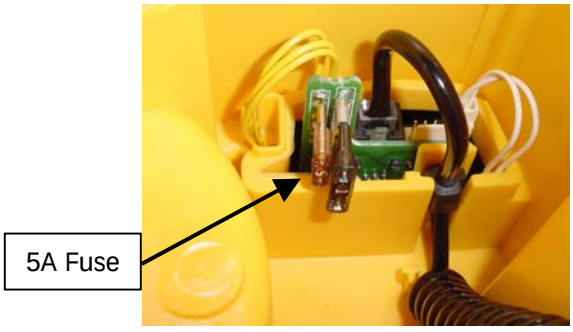


Figure 4.1.1.3
5A Charging fuse replacement

4.1.2 Operating lamp replacement (LMP0004A)

Required tools:	Flat screwdriver	Procedure duration:	5 minutes

A. Remove the Power Pack from the Robomow.

B. Insert the screwdriver into the notch of the lamp cover and lift, as illustrated in Figure 4.1.2.1. Be cautious not to pinch or damage the seal ring.

C. Repeat step B on the other side of the cover.

D. Gently re-insert the screwdriver under the seal ring and continue lifting the lamp cover, as illustrated in Figure 4.1.2.2

E. Remove the burnt lamp and replace with a new 24V 14W lamp (Figure 4.1.2.3).

F. Return the lamp cover and complete the **General Test** as outlined in **section 5.1.**

Figure 4.1.2.1
Initial lifting of the cover

Figure 4.1.2.2
Screwdriver under the seal ring

Figure 4.1.2.3
Operating lamp

4.1.3 Manual Controller (MSB0118A) Replacement

M. Con. Holder Assembly (MSB0105B) Replacement

Required tools:	None	Procedure duration:	5 minutes

A. Remove the Power Pack from the Robomow.

B. Lift the M. Con. Holder or the Manual Controller to an upright position, in its holder.

C. Grab the holder and pull it straight up, as illustrated in Figure 4.1.3.1

D. Once the two black pivots are released from the yellow cover place a finger on each one and pull the assembly completely out of its place, as illustrated in Figure 4.1.3.2

Figure 4.1.3.1
Holding the M. Controller for removal

Figure 4.1.3.2
Releasing the controller from its place

E. Squeeze the two tabs of the fuse cover, while pulling up the fuse cover (Figure 4.1.3.3).

F. To replace the **M. Controller holder assembly**, disconnect the yellow charging cable from the Connector Board (3 pins). Replace the defective M. Controller holder assembly with a new one and repeat previous steps in reverse order, ensuring correct routing of wires, as illustrated in Figure 4.1.3.4.

Figure 4.1.3.3
Releasing the fuse cover

Figure 4.1.3.4
Correct routing of wires

G. To replace the **Manual Controller,** release the cable's strain release and the plug from the socket by squeezing the latch, as illustrated in Figures 4.1.3.5 and 4.1.3.6.

H. Replace the defective Manual Controller with a new one and repeat previous steps in reverse order, ensuring correct routing of wires, as illustrated in Figure 4.1.3.4 above.

I. Complete the **General Test** as outlined in **section 5.1**

Figure 4.1.3.5

Figure 4.1.3.6

Releasing the cable's strain release and connection to the Connector Board

4.1.4 Front Wheel with axle replacement (SPP0011A)

Required tools:	Flat screwdriver	Procedure duration:	10 minutes

A. Remove the Power Pack from the Robomow.

B. Turn the Robomow on its back and place it on a soft surface to protect it from scratches.

C. Unscrew the front wheel, as illustrated in Figure 4.1.4.1 all the way until the highest mowing position.

D. Identify the front wheel spring/stopper and its latch that is preventing the complete removal of the front wheel. Insert a screwdriver into the notch and push backwards, as illustrated in Figure 4.1.4.2.

Figure 4.1.4.1
Unscrewing the Front Wheel

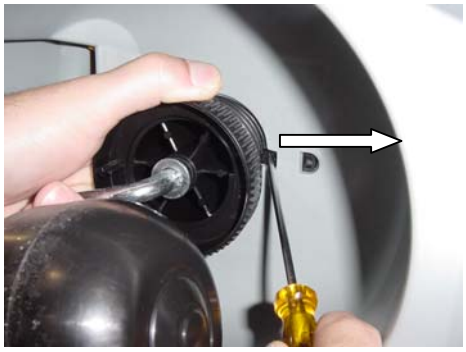


Figure 4.1.4.2
Retracting the front wheel spring/stopper for front wheel removal

E. While the stopper is in the retracted position, unscrew the front wheel completely and remove it slowly from its hole, taking care not to strain the wire connection (Figure 4.1.4.3)

F. Remove the Holder with the drop-off board by pulling hard on the holder (Figure 4.1.4.4).

Figure 4.1.4.3
Front Wheel removal from its cavity

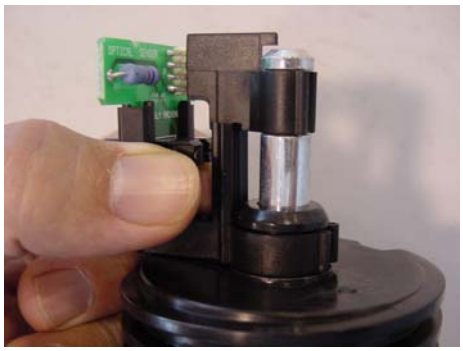


Figure 4.1.4.4
Removal of the drop-off board holder

G. Remove the flag from the metal shaft in a similar method – by pulling hard on the flag (Figure 4.1.4.5)

H. Replace the faulty part: either the egg wheel with shaft (SPP0011A), the adjusting plastic bolt (GEN0117A) or the flag (GEN0116A).

I. Return the adjusting bolt onto the shaft remembering to place the metal washer first.

J. Replace the flag to the metal shaft.

K. Replace the drop-off board holder. Perform this in two steps. First insert the holder onto the metal shaft while making sure the flag is placed correctly between the two parts of the optical sensor, as illustrated in Fig. 4.1.4.6; then press the holder firmly down until it will snap onto the plastic bolt.

Figure 4.1.4.5
Removal of the flag

Figure 4.1.4.6
Replacing the drop-off board holder

L. Insert the front wheel into its hole. Make sure the 'V' shape is inserted into the guide channel on the right side of the hole, as illustrated in figures 4.1.4.7 and 4.1.4.8 below.

Figure 4.1.4.7
Insertion of the 'V'

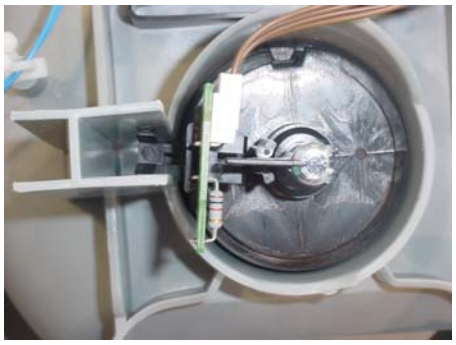


Figure 4.1.4.8
'V' located in guide channel – top view

M. Use the screwdriver as explained in step 'D' to overcome the blockage of the first thread.

N. Screw the Front Wheel into its place to the proper height position.

O. Turn the Robomow back on its wheels, insert the Power Pack and restart it.

P. Perform the 'Front wheel test' under the 'Safety tests' menu.

Q. Complete the **General Test** as outlined in **section 5.1.**

4.1.5 Drive wheel replacement

Required tools:	Flat screwdriver External circlip pliers	Procedure duration:	5 minutes

A. Remove the Power Pack from the Robomow.

B. Prop the Robomow on a stand so that the drive wheels will not be touching the ground.

C. There are two drive wheels types: smooth wheel and knobby wheel, as illustrated in Figure 4.1.5.1. Make sure to replace the faulty wheel with the same type wheel. Failure to do so will result in improper operation of the Robomow and might cause damage.

Figure 4.1.5.1
Knobby wheels versus Smooth wheels

D. Remove the Power Pack from the Robomow.

E. Identify the two notches on the wheel cup. Using flat screwdriver, remove the wheel cup, as illustrated in Figure 4.1.5.2.

F. Identify the circlip located under the wheel cup and use appropriate pliers to remove it from the shaft, as illustrated in Figure 4.1.5.3

Figure 4.1.5.2
Wheel cup removal

G. Remove the circlip and the spacer rings and store them. The number of spacer may vary between 1 and 4. When replacing a wheel make sure to replace the same number of spacer rings as was removed (Figure 4.1.5.3)

H. Pull the drive wheel off the spline, as illustrated in Figure 4.1.5.4.

Figure 4.1.5.3
Drive wheel circlip removal

Figure 4.1.5.4
Disassembled drive wheel

I. Replace the damaged wheel with a new one (it is recommended to replace both wheels in order to ensure the unit is balanced during the operation).

J. Push the new drive wheel over the shaft and the spline until it rests against the support in the spline.

K. Return the wheel cup.

L. Place the Robomow on the ground.

M. Complete the **General Test** as outlined in **section 5.1.**

4.1.6 Blades replacement

Required tools:	Protective gloves	Procedure duration:	5 minutes

NOTE: Blades are not under warranty

A. Remove the Power Pack from the Robomow.

B. Prop the Robomow on a stand or turn the Robomow on its back, placing it on a soft surface to protect it from scratches.

C. To remove blades, squeeze locking tabs on each side of the blade retainer, and then pull blade assembly off, away from mower. When reinstalling the blade, line up the mating splines and push until a firm click is heard, indicating a proper seating of the blade onto the shaft.

D. It is recommended to change all 3 blades at the same time.

NOTE: Blades sharpening is not recommended, as a good balance cannot be achieved.

4.1.7 Charging Station contacts (Robomow side) replacement

Required tools:	Pliers	Procedure duration:	10 minutes

A. Remove the Power Pack from the Robomow.

B. Identify the two contacts on the Robomow front cover and unscrew them by hand or using pliers, as illustrated in Figure 4.1.7.1 below.

C. After removing the contacts you will see the screw end (coming from the inner side of the Robomow, as illustrated in Figure 4.1.7.2.

Figure 4.1.7.1
Charging contacts (RL side)

Figure 4.1.7.2
Screw – after removing the contact

D. Replace the contact with a new one. Confirm the magnet and the rubber are inserted into the contact in the right order (first the magnet then the rubber), as illustrated in Figure 4.1.7.3 below.

E. Screw the 2 contacts back to their place tightly – cover the contact with a piece of cloth to protect it from scratches when using pliers.

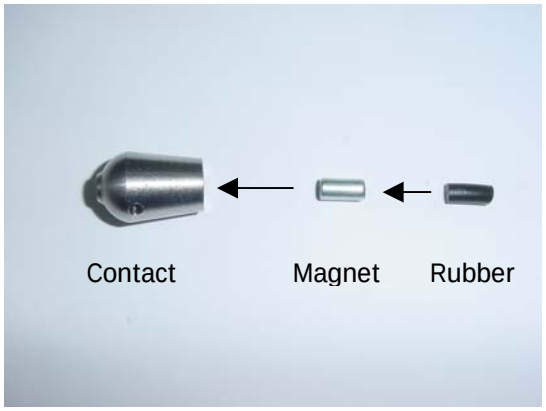


Figure 4.1.7.3
Insert the magnet and rubber
into the contact as shown in the Figure

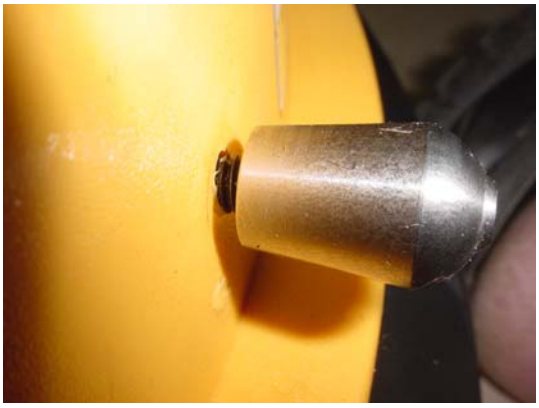


Figure 4.1.7.4
Screw the contact back to its place

4.2 Robomow Internal procedures

NOTE: The procedures duration appears at the top of each procedure and at the table in **section 6.1.3** are the net time required to perform the specific replacement. When calculating the total repair time, you should add 20 minutes to cover the time of the removing and returning the cover.

4.2.1 Removing the cover

Required tools:	Wide flat screwdriver	Procedure duration:	10 minutes

A. Remove the Power Pack from the Robomow.

B. Remove the fuse cover in the manual controller cavity (Figure 4.1.1.2).

C. Remove the Manual Controller and disconnect its cable (See 4.1.3).

D. Disconnect the charging cable from the connector board and remove the M. C. holder.

E. Disconnect the lamp cable from the connector board.

F. Remove the 5A and 1A fuses.

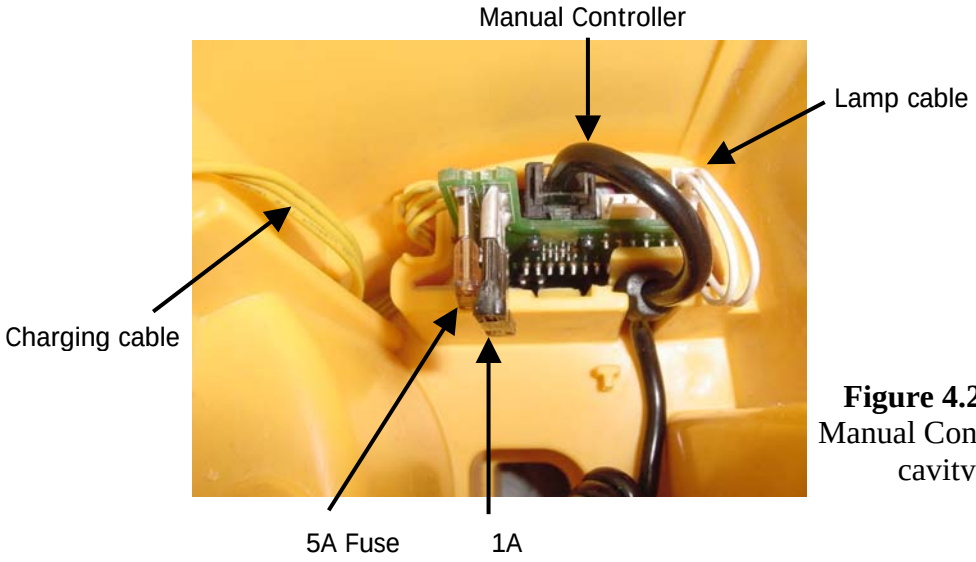


Figure 4.2.1.1
Manual Controller cavitv

G. Turn the Robomow on its back, placing it on a soft surface to protect it from scratches.

H. Identify the ten lockers that lock the cover to the base, they are distributed around the circumference of the Robomow.

I. Using a wide flat screwdriver pull the locker out of its cavity, as illustrated in Figure 4.2.1.2 below.

Figure 4.2.1.2
Removing locker

J. Repeat step I for the other nine lockers.

K. Turn the Robomow back on its wheels.

L. Grab the front lift handle in one hand and the bumper below it in another hand and jerk the two parts apart, as illustrated in Figure 4.2.1.3.

M. After the two parts are separated at the front, repeat the same step for the rear.

N. When the front and rear are completely separated, lift the cover evenly, as illustrated in Figure 4.2.1.4. Beware not to damage the connector board by watching inside the Manual Controller cavity well for clean separation.

O. Lift the cover all the way carefully as the charging contacts (RL1000 only) on the cover are still connected to the Connector Board.

P. Collect both main board rubber holders that support the main board to the cover and store them.

Figure 4.2.1.3
Separating the cover from the base

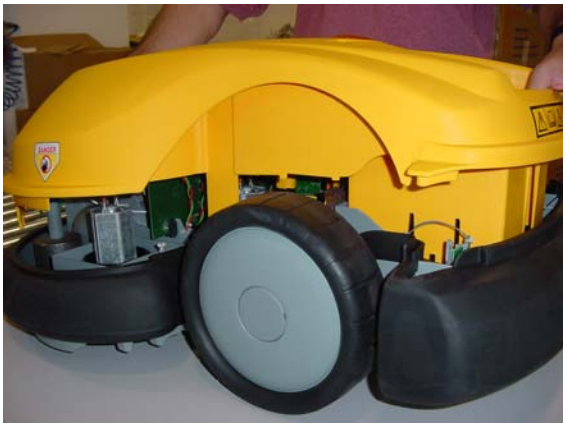


Figure 4.2.1.4
Lifting the cover of the base

4.2.2 Returning the cover

Required tools:	None	Procedure duration:	10 minutes

A. Make sure the main board is firmly pushed in its position at the base. Make sure the unit is clean inside and use air pressure to clean it, if necessary.

B. Place both main board rubber holders (marked in circle) on the main board and push them into place, as illustrated in Figure 4.2.2.1.

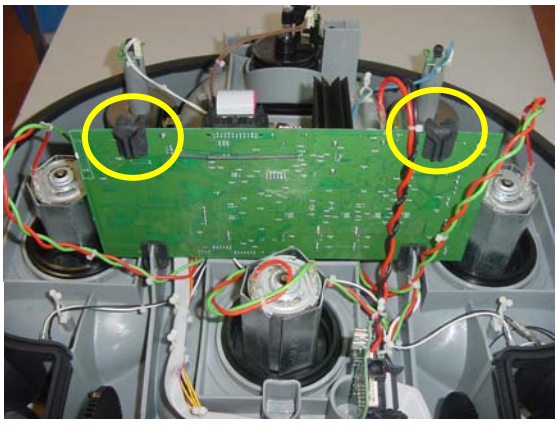


Figure 4.2.2.1
Main board and its rubber holders

C. Push both battery contacts to sit firmly in their place on the base, ensuring correct polarity – red lead (+) on the left side (See Figure 4.2.2.2)

D. Take the cover and place it gently over the base. Make sure the lamp cable is inserted into the manual controller cavity.

E. Confirm the bumper ears sit properly on the base, as illustrated in Figure 4.2.2.3.

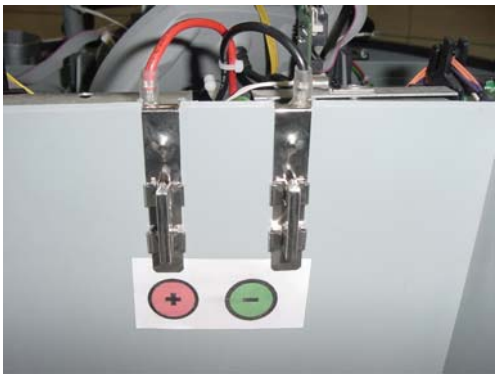


Figure 4.2.2.2
Battery contacts polarity

Figure 4.2.2.3
Bumper ears on the base

Align the cover relative to the base: the battery cavity in the cover should be inside the battery cavity in the base and all extended cover 'legs' should sit against their counterpart holes on the base. When replacing the cover, beware not to damage the connector board, by observing through the Manual Controller cavity.

F. Push the cover into place until all ten cover 'legs' are positioned as illustrated in Figure 4.2.2.4.

G. Turn the Robomow on its back.

H. Verify the bumper is in its place all around the Robomow and in particular around the drive wheels.

I. Collect the ten lockers. As illustrated in Figure 4.2.2.5 below, there are two types of lockers: four flat and six curved. The curved lockers have curved notches. The flat lockers fit in the holes around the battery cavity while the four curved lockers fit in the holes close the front bumper area.

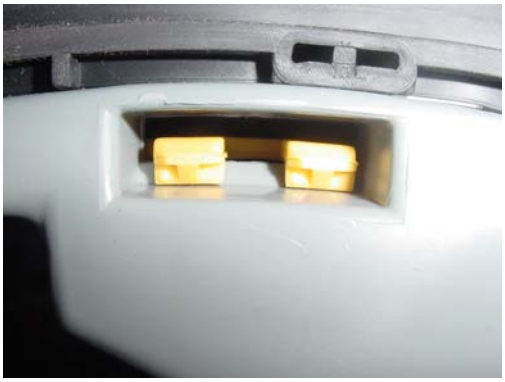


Figure 4.2.2.4
Proper position a cover 'leg' inside its hole

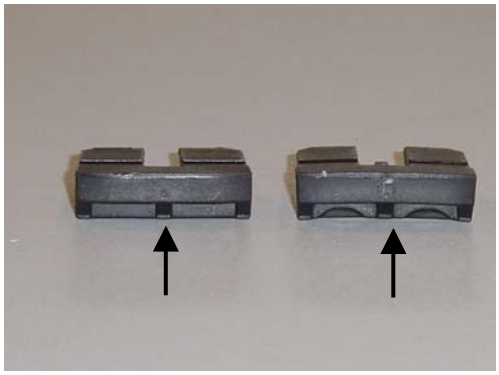


Figure 4.2.2.5
Curved and flat lockers

J. Insert the locker with the two large legs sliding down the side yellow legs of the cover.

Figure 4.2.2.6
Fitting a locker inside its cavity

K. Turn the Robomow back on its wheels.
L. Insert the 5A and 1A fuses into their right locations (see Figure 4.2.1.1)
M. Connect the lamp cable.
N. Insert the Manual Controller and its holder (See **Section 4.1.3**)
O. Connect the charging cable (3 pins yellow cable) and the manual controller plug.
P. Replace the fuse cover.

Figure 4.2.2.7
Fuse cover in its place

Q. Complete the **General Test** as outlined in **section 5.1**.

4.2.3 Main Board Replacement

Required tools:	Wide flat screwdriver Flash extracting tool	Procedure duration:	10 minutes

A. Remove the Power Pack from the Robomow.

B. Remove the cover, as outlined in **section 4.2.1**.

C. Disconnect all the cables leading to the main board.

D. Remove the main board from its seat in the base and store the four rubber holders.

E. Take the new main board from its packing and follow the instructions as defined in **Service Bulletin #RL0536-01 -Main Board Replacement** (**Section 7.1**)

F. Flash replacement instructions:

a. The first step is to fit the new board with the flash (S.W version) from the defected board or with new flash from the spare parts stock.

b. The flash is placed inside a socket and need to be extracted using the special flash extracting tool. Place the two leads of the tool at the diagonal corners of the socket with grooves, as illustrated in Figure 4.2.3.1.

c. Insert both leads of the extracting tool all the way into the groove.

d. Squeeze the sides of the tool, as illustrated in Figure 4.2.3.2.

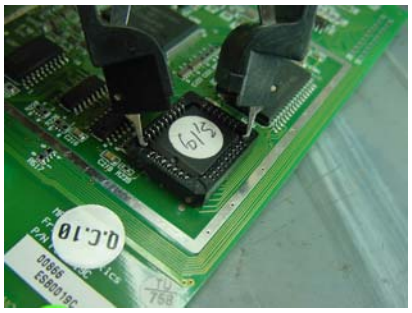


Figure 4.2.3.1
Positioning the extracting tool on the socket

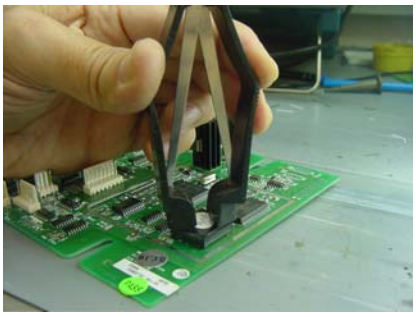


Figure 4.2.3.2
Squeezing the tool

e. The flash will pop out of the socket. Lift the flash off the board (Figure 4.2.3.3)

f. Identify the flat corner of the on the flash and the marking dot next to it, as illustrated in Figure 4.2.3.4.

Figure 4.2.3.3
Lifting the flash out of the socket

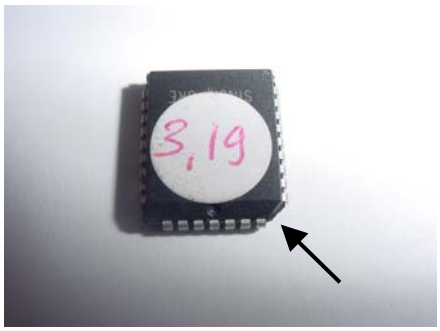


Figure 4.2.3.4
Orientation markings on the flash

g. Identify the flat inside corner and marking triangle next to it inside the socket, as illustrated in Figure 4.2.3.5.

h. Carefully and methodically place the flash over the socket cavity making sure the flat corners and marking dot/triangle are one above the other. Verify that every lead in the flash is sitting against a lead in the socket, as illustrated in Figure 4.2.3.6.

Figure 4.2.3.5
Orientation markings on the socket

Figure 4.2.3.6
Placement of the flash over the socket

i. Place your thump on the flash and press the flash so that it will be pushed horizontally and uniformly into the socket cavity, as illustrated in Figure 4.2.3.7.

j. Upon proper insertion, the flash should be inside the socket cavity, as illustrated in Figure 4.2.3.8.

Figure 4.2.3.7
Pressing the flash into the socket

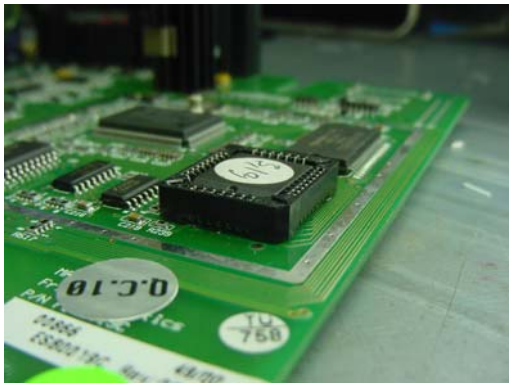


Figure 4.2.3.8
A flash properly inserted into
a socket cavity

G. Place the four rubber holders on the new main board and place it in its seat in the base.

H. Connect all the cables, as illustrated in Figure 4.2.3.9 on next page.

I. Perform basic test prior to closing the unit. Connect the Manual Controller and insert both fuses on the connector board. Insert the Power Pack and drive the unit around. Remove the Power Pack, the Manual Controller and both fuses.

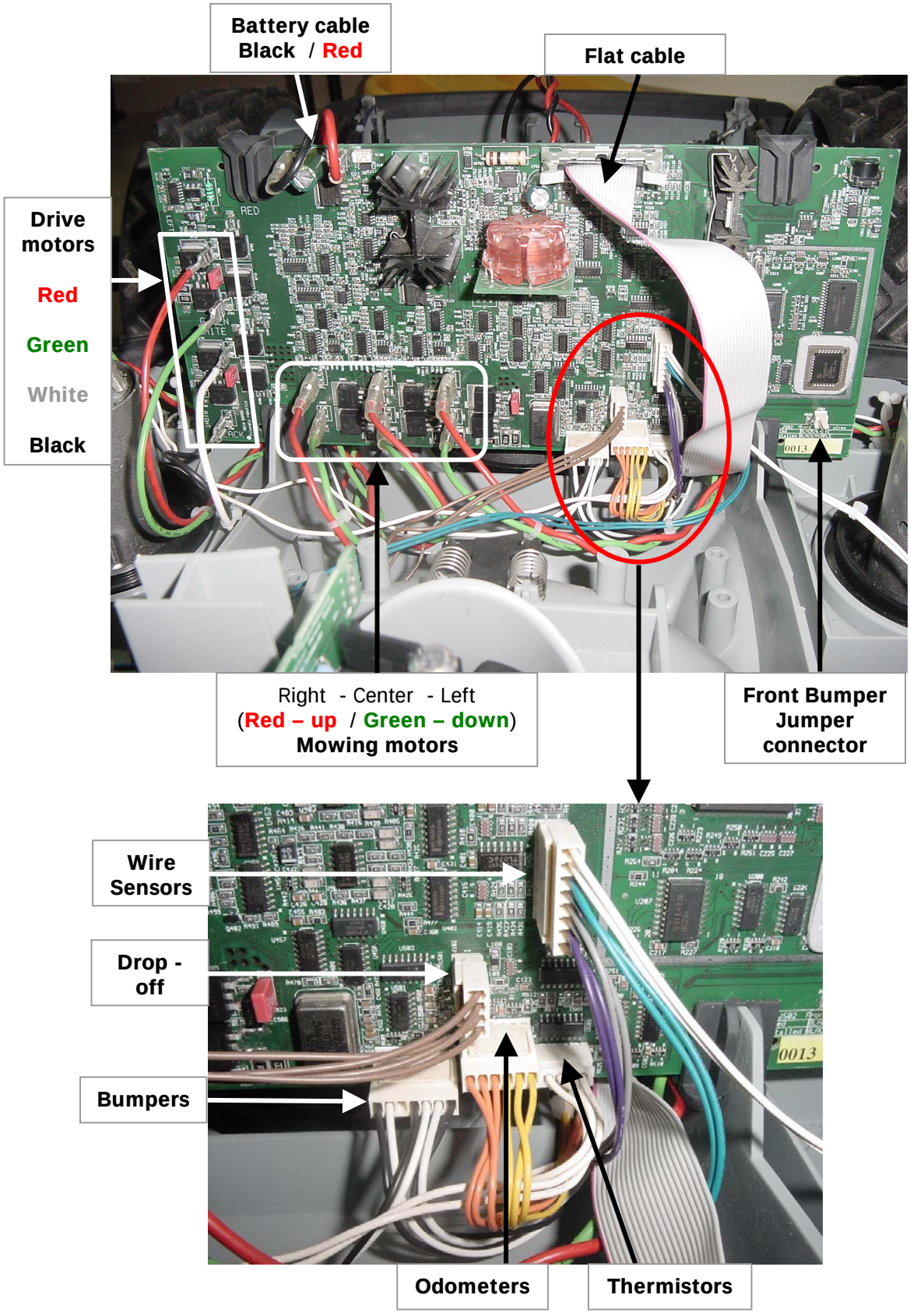


Figure 4.2.3.9
Cable connection to the Main Board

J. Replace the cover as outlined in **section 4.2.2.**

K. Place the unit inside the simulated garden, as explained in section 5.1 and turn the Perimeter Switch on.

L. Perform 'Factory defaults' under the 'Service'>'Settings' menu (section 5.5.6)

M. Perform the following under the 'Service'>'Calibration' menu:

i. 'Learn wire sensors' (section 5.3.1)
ii. 'Edge Calibration' (section 5.3.2)
iii. 'Set country' (section 5.3.3)
iv. 'D.K Calibration' (section 5.3.4)

N. Complete the **General Test** as outlined in **section 5.1**.

4.2.4 Other Board Replacement

4.2.4.1 Connector Board Replacement

Required tools:	Wide flat screwdriver	Procedure duration:	5 minutes

A. Remove the Power Pack from the Robomow.

B. Remove the cover, as outlined in section 4.2.1.

C. Remove the flat cable by pulling the two lever arms outwards.

D. Slide the Connector Board upwards to remove, as illustrated in Figure 4.2.4.1.1 below.

E. Take the new Connector Board and insert it into its positioning slots. Make sure it fits all the way into the slots.

F. Make sure both lever arms of the flat cable socket are extended outside. Take the flat cable connector and place it against the socket on the Connector Board. Make sure the protrusion on the connector is against the notch in the socket. Press the connector into place and both lever arms will close on the connector, as illustrated in Figure 4.2.4.1.2 below.

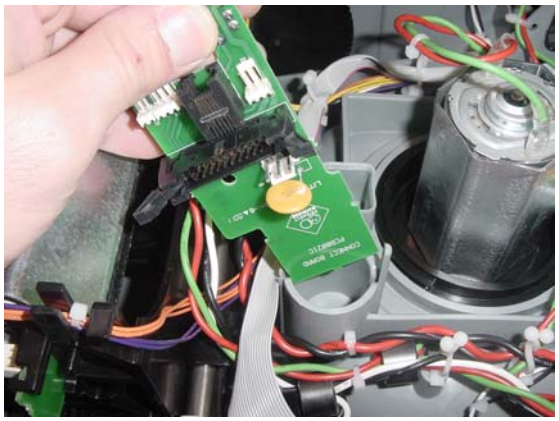


Figure 4.2.4.1
Connectors board replacement

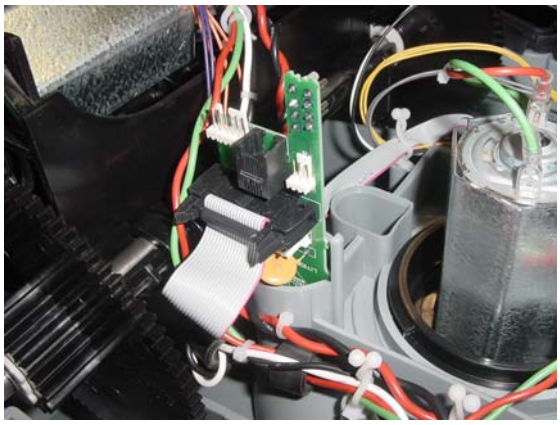


Figure 4.2.4.2
Connector Board in its proper position

G. Close the cover, as outlined in section 4.2.

H. Complete the **General Test** as outlined in **section 5.1**.

4.2.4.2 Drop-off Board Replacement

Required tools:	Wide flat screwdriver	Procedure duration:	15 minutes

A. Remove the Power Pack from the Robomow.

B. Remove the cover, as outlined in section 4.2.1.

C. Unscrew the Front Wheel all the way until the highest mowing position, ass illustrated in Figure 4.2.4.2.1.

D. Push the Front Wheel stopper/spring backwards (see Figure 4.2.4.2.2 below) to enable the complete removal of the front wheel.

Figure 4.2.4.2.1
Unscrewing the front wheel

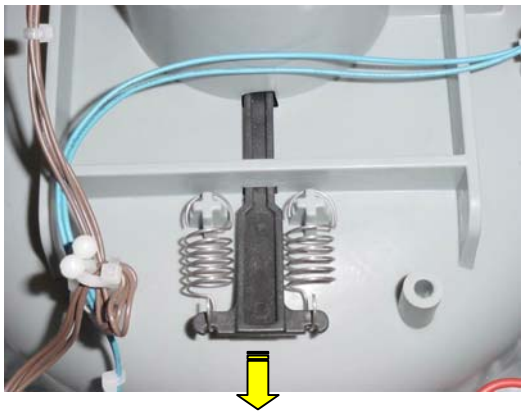


Figure 4.2.4.2.2
Retracting the stopper for front wheel removal

E. Remove the Holder of the Drop-off board by pulling hard on the holder, as illustrated in Figure 4.2.4.2.3 below until the holder is removed out of its place (Figure 4.2.4.2.4)

F. Replace the drop-off board with the holder and cable (one spare part - SPP0005B).

G. Replace the drop-off board holder. Perform this in two steps, first insert the holder onto the metal shaft while making sure the flag is placed correctly between the two parts of the optical sensor; than press the holder firmly down until it will snap onto the plastic bolt.

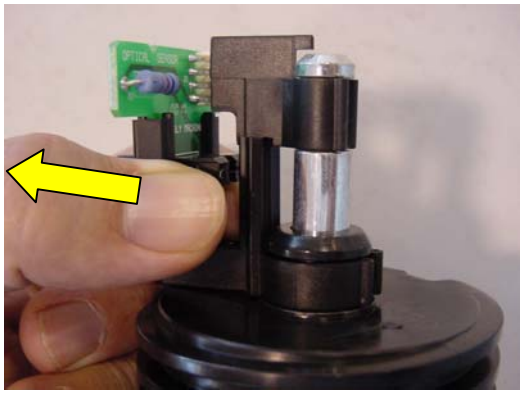


Figure 4.2.4.2.3
Removal of the drop-off board holder

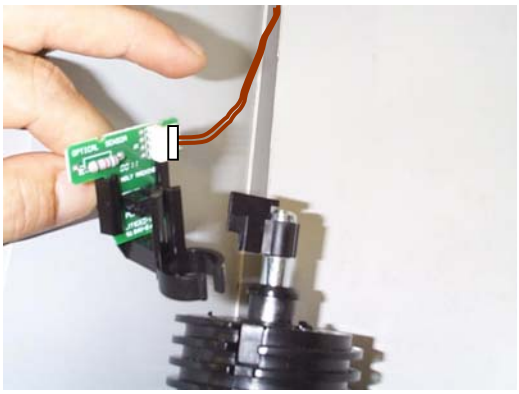


Figure 4.2.4.2.4
Drop-off holder is out of its place

H. Screw the front wheel into its place to the proper height position.
I. Connect the drop-off board cable to the Main Board.
J. Close the cover, as outlined in section 4.2.2.
K. Perform the 'Front wheel test' under the 'Safety tests' menu.
L. Complete the **General Test** as outlined in **section 5.1**.

4.2.4.3 Lamp Board Replacement

Required tools:	Wide flat screwdriver	Procedure duration:	5 minutes

A. Remove the Power Pack from the Robomow.
B. Remove the cover, as outlined in section 4.2.1.
C. Turn over the cover and place it on a protected surface so it will not be damaged or scratched.
D. Disconnect the lamp cable from the connector on the board, as illustrated in Figure 4.2.4.3.1 below)

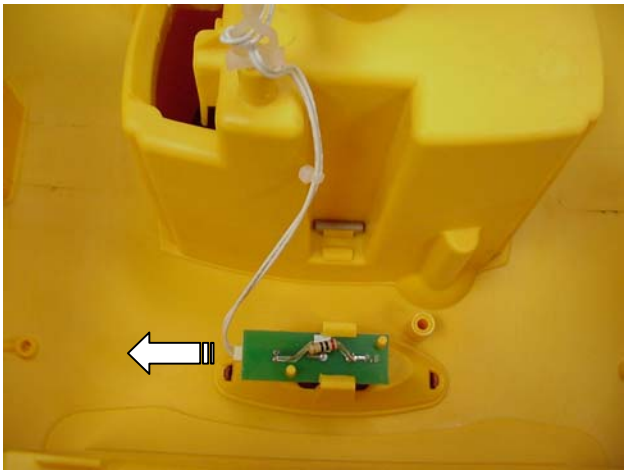


Figure 4.2.4.3.1
Disconnection of lamp cable

E. Careful not to distort them, push one of the two plastic retaining clips holding the board in its place and remove the board.
F. Replace the damaged board with a new one.
G. Make sure the plastic retaining clips are holding the board securely in place.
H. Connect the wire to the connector.
M. Replace the cover as outlined in section 4.2.2.
N. Complete the **General Test** as outlined in **section 5.1**.

4.2.5 Mowing Motor Replacement

Required tools:	Special tool for mowing motor removal (can be purchased from Friendly Robotics – TOL0001A)	Procedure duration:	10 minutes

NOTE: Read **Service Bulletin #RL0536-06** - Blade Motor Change (**Section 7.1**) before starting this procedure.

A. Remove the Power Pack from the Robomow.

B. Remove the cover, as outlined in **section 4.2.1**.

C. Disconnect the mowing motor from the Main Board.

D. Remove the mowing blade from the defected motor.

E. Clean the mowing deck from grass residues and dirt.

F. Take the mowing motor special tool provided by Friendly Robotics and identify its five pins and five holes in the mowing motor flange they will fit into (Figure 4.2.5.1).

G. Identify the placement hole in the special tool and the triangle mark on the mowing motor flange, as illustrated in Figure 4.2.5.2 below.

Figure 4.2.5.1
Special tool for mowing motor removal against the motor flange

Figure 4.2.5.2
Locating hole on the tool and triangle on the flange

H. Place the tool over the flange so the triangle mark on the mowing motor flange will be seen through the locating hole in the tool, as illustrated in Figure 4.2.5.3 below.

I. Unscrew the mowing unit with the special tool and remove it carefully through the hole, as illustrated in Figure 4.2.5.4 below.

Figure 4.2.5.3
Proper alignment of the mark and the hole

Figure 4.2.5.4
Mowing motor removal

J. Replace the defective mowing unit with a new one. Insert the mowing unit into its hole and connect the wires to the main board.

   NOTE: If a Thermistor is attached to the shield of the defective motor, remove the shield and replace it on the new motor.

K. Use the special tool to tighten the motor.

L. Attach the mowing blade to the new mowing unit. Make sure both sides of the blade are locked (clicked).

M. Return the cover as outlined in **section 4.2.2.**

N. Replace the cover as outlined in **section 4.2.2.**

O. Place the unit inside the simulated garden, as explained in section 5.1 and turn the Perimeter Switch on.

P. Perform **'D.K Calibration'** (section 5.3.4) under the 'Service' menu.

Q. Perform the '**Mowing motor test'** outlined in section 5.4.5.

R. Complete the **General Test** as outlined in **section 5.1**.

4.2.6 Gear Case Procedures

4.2.6.1 Gear Case Replacement

Required tools:	Wide flat screwdriver External circlip pliers	Procedure duration:	30 minutes

NOTE: Read **Service Bulletin #RL0536-02**- Gear Case/ Frame Modification (**Section 7.1**) before starting this procedure.

A. Remove the Power Pack from the Robomow.

B. Remove the drive wheels, as outlined in **section 4.1.5.**

C. Remove the cover, as outlined in **section 4.2.1**.

D. Disconnect the drive motor cables (4 cables: red, green, white and black) from the main board and take them out of the twisted wire holders (See Figure 4.2.6.1.1)

E. Disconnect the right odometer cable (orange) and left odometer cable (yellow) from the odometer boards. Remove both cables from their holders in the gear frame (See Figure 4.2.6.1.1).

F. Remove the rear-right wire sensor from its holder and the cable (purple) from its holders in the gear frame (See Figure 4.2.6.1.1).

G. Remove the rear left wire sensor from its holder and the cable (gray) from its holders in the gear frame (See Figure 4.2.6.1.1).

H. Disconnect the rear bumper cable (black & white or black & purple) from the connectors near the rear-left wire sensor. Remove both cables from their holders in the gear frame Remove the rear-right wire sensor from its holder and the cable (purple) from its holders in the gear frame (See Figure 4.2.6.1.1).

I. Disconnect the Thermistors connector from the Main Board.

J. Disconnect the right mowing motor from the Main Board and remove the right mowing motor shading.

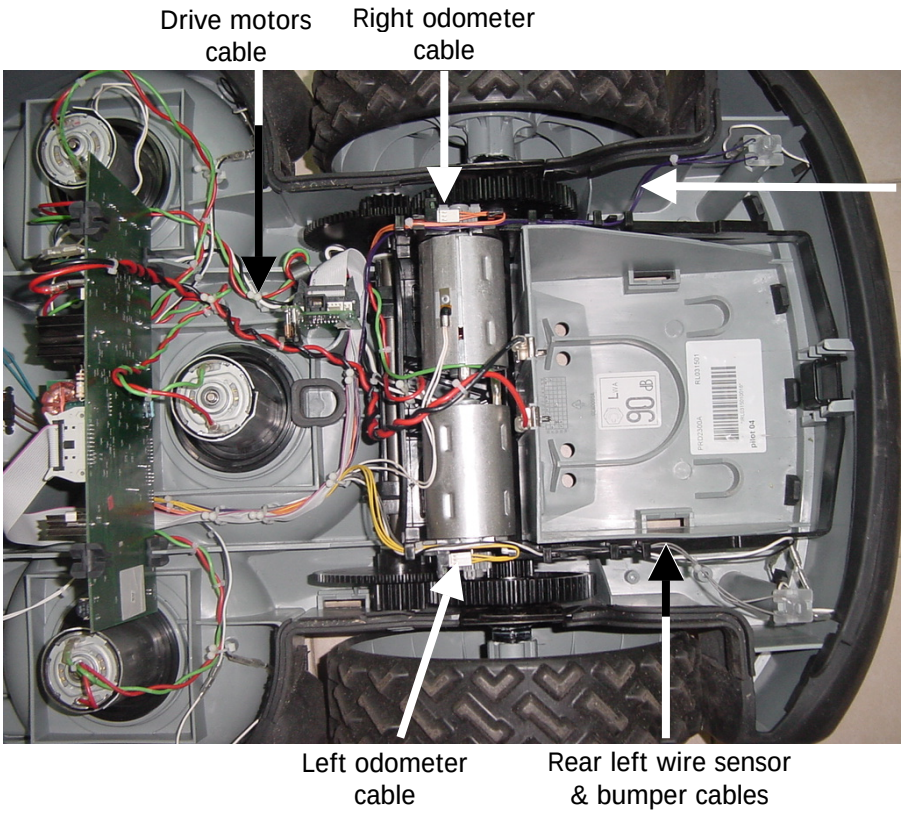


Figure 4.2.6.1.1
Cable around the gear case

K. Place the ground clearance adjustment lever on top of the rear bumper from the chassis.

L. Insert a wide flat screwdriver between the left base wall and the short shaft bushing and pry them apart, as illustrated in Figure 4.2.6.1.2. Lift the shaft out of the hole and place the end of the short shaft on the base wall, as illustrated in Figure 4.2.6.1.3.

Figure 4.2.6.1.2
Removing the short shaft out of its position

Figure 4.2.6.1.3
Short shaft on the base wall

M. Repeat step L for the right side of the short shaft.

N. Lift the gear case out of the base.

O. Take the new gear frame and position it around the battery cavity.

P. Insert the slider into the cavity of the base wall, as illustrated in Figure 4.2.6.1.4 below. Repeat this step for the other side of the unit.

Q. Straighten the slider and position it as illustrated in Figure 4.2.6.1.5 below.

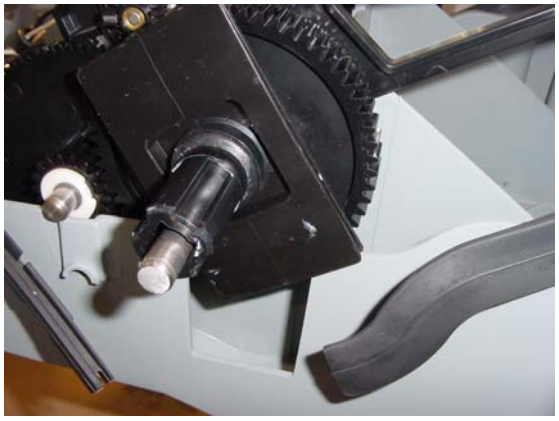


Figure 4.2.6.1.4
Inserting the slider into place

Figure 4.2.6.1.5
Slider in its insertion position

R. Using a wide flat screwdriver extend the base wall and insert the short shaft inside, as illustrated in Figure 4.2.6.1.6 below.

S. Slide the short shaft all the way until it locks into its hole. Repeat the step for the other side of the short shaft, as illustrated in Figure 4.2.6.1.7.

T. Replace the seal of the front bumper and the seal of the rear bumper so they will touch both sides of the slider, as illustrated in Figure 4.2.6.1.7.

Figure 4.2.6.1.6
Moving the base wall to allow short shaft insertion

Figure 4.2.6.1.7
Slider in its insertion position

U. Place the ground clearance adjustment handle to its middle position.

V. Repeat steps C to J in reverse order. Make sure the drive motor cables are connected to the main board in the proper order – from to bottom: red, green, white and black (the colors are printed on the board). Ensure that cable ties are placed tightly around the wires from the Wire Connectors.

W. Replace the cover as outlined in **section 4.2.2.**

X. Perform the '**Drive motor test'** outlined in **section 5.4.4**.

Y. Complete the **General Test** as outlined in **section 5.1**.

4.2.6.2 Drive motor magnet replacement

Required tools:	Wide flat screwdriver External circlip pliers	Procedure duration:	5 minutes

A. Remove the Power Pack from the Robomow.

B. Remove the drive wheels, as outlined in **section 4.1.5.**

C. Remove the cover, as outlined in **section 4.2.1**.

D. Identify the magnet located inside the grooves in the drive pinion, as illustrated in Figure 4.2.6.2.1 below.

E. The magnet is shaped as a cone, the narrow end is “North” and the wide end is “South”. Proper positioning of the magnets in the pinion is crucial to allow proper reading by the odometer. Both magnets – cones – should point at the same direction. When the notch is facing you. The cones should be pointing to your left, as illustrated in Figure 4.2.6.2.2.

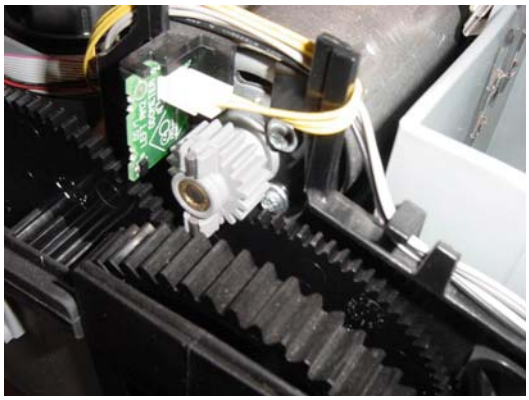


Figure 4.2.6.2.1
Drive pinion and its two magnets

Figure 4.2.6.2.2
Magnets orientation relative to the pinion

F. Once the magnet is placed in the proper orientation, firmly press it into place, it will click. After proper placement the pinion with the magnets should lock as illustrated in Figure 4.2.6.2.3 below.

G. If a magnet is placed in a reverse orientation it will not sit properly in its place and will protrude as illustrated in Figure 4.2.6.2.4.

Figure 4.2.6.2.1
Properly placed magnets

Figure 4.2.6.2.2
Improperly placed magnets

H. Return the drive wheels, as outlined in **section 4.1.5.**

I. Return the cover as outlined in **section 4.2.2.**

J. Perform the '**Drive motor test'** outlined in **section 5.4.4**.

K. Complete the **General Test** as outlined in **section 5.1**.

4.2.6.3 Odometer Board replacement

Required tools:	Wide flat screwdriver External circlip pliers Long nose pliers	Procedure duration:	10 minutes

A. Remove the cover, as outlined in **section 4.2.1**.

B. Remove the drive wheel next to the faulty odometer board that needs to be replaced, as outlined in **section 4.1.5.**

C. Identify the odometer board and disconnect the odometer cable from the board, as illustrated in Figure 4.2.6.3.1 below. Please note that there is a right odometer board and a left one, each has a unique part number.

D. Insert the flat screwdriver into the notch on the side of the odometer board facing the frame, as illustrated in Figure 4.2.6.3.2

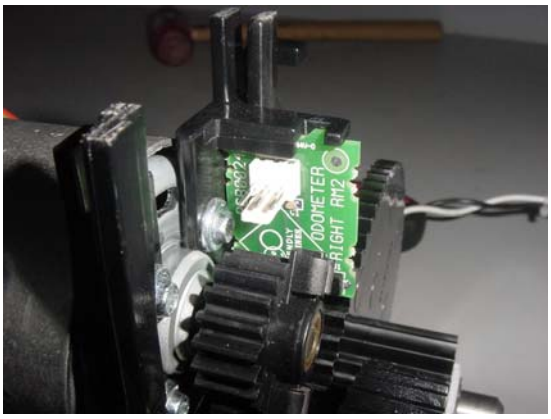


Figure 4.2.6.3.1
Right odometer board

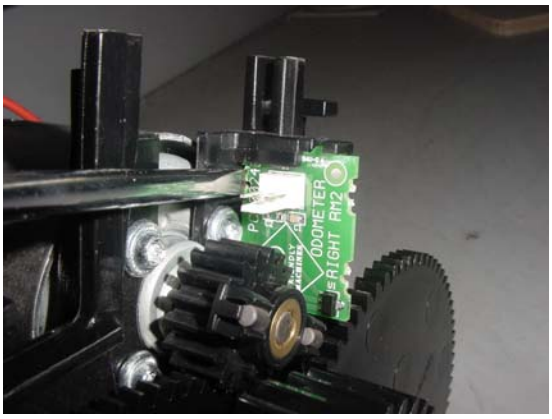


Figure 4.2.6.3.2
Placement of the flat screwdriver

E. Using the long nose pliers, grab the holding notch behind the board and lift slightly, just above the locking ramp in the board. Simultaneously apply pressure with the flat screwdriver to release the board, as illustrated in Figure 4.2.6.3.3.

F. Place the new board, in the same orientation, into the groove and press firmly so it will snap into place, as illustrated in Figure 4.2.6.3.4.

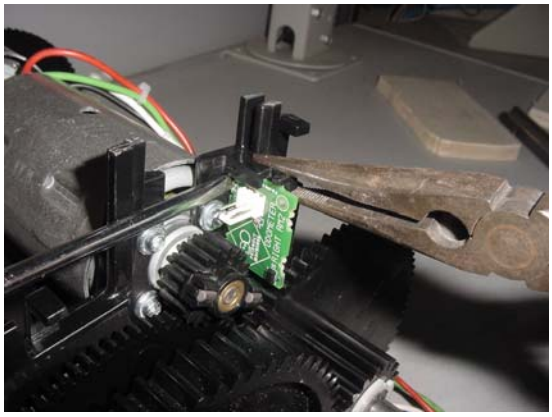


Figure 4.2.6.3.3
Releasing the board using
the screwdriver and the pliers

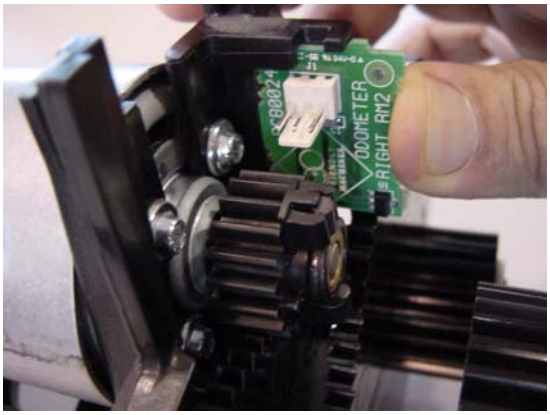


Figure 4.2.6.3.4
Insertion of a new odometer board

G. Connect the odometer cable.
H. Return the drive wheels, as outlined in **section 4.1.5.**
I. Return the cover as outlined in **section 4.2.2.**
J. Perform the '**Drive motor test'** outlined in **section 5.4.4**.
K. Complete the **General Test** as outlined in **section 5.1**.

4.2.6.4 Shafts replacement

Required tools:	Wide flat screwdriver Plastic hammer External circlip pliers Long nose pliers	Procedure duration:	45 minutes

A. Remove the cover, as outlined in **section 4.2.1**.
B. Remove the drive wheel, as outlined in **section 4.1.5.**
C. Remove the gear case, as outlined in **section 4.2.6.1**. Take the gear case out of the Robomow and place it on a flat clean surface, as illustrated in Figure 4.2.6.4.1.
D. Remove the spline and slider from both sides of the long shaft, as illustrated in Figure 4.2.6.4.2.
E. Remove both shaft holder clips by using a wide flat screwdriver. Insert the screwdriver between the clips and the gear frame, and twist the screwdriver 90 degrees, as illustrated in Figure 4.2.6.4.3.
F. After removing both clips, turn the gear case so the Drive Motors will face upward. Place the gear case on two wooden blocks, as illustrated in Figure 4.2.6.4.4. Use a plastic hammer and hit on each side of the long shaft so it will come out of the groove in the gearbox.

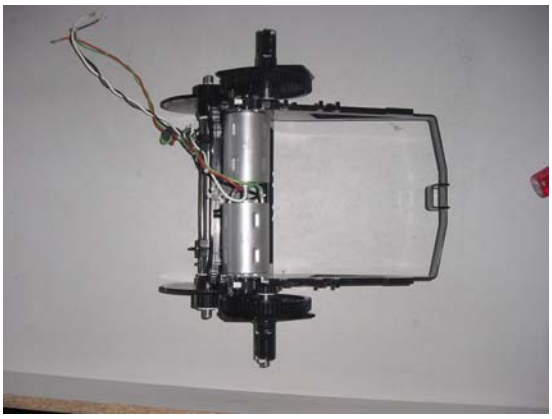


Figure 4.2.6.4.1
A complete gearbox out of the Robomow

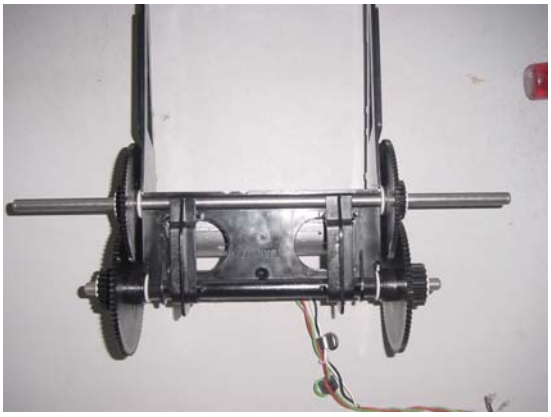


Figure 4.2.6.4.2
A gearbox without the spline and slider

Figure 4.2.6.4.3
Removing the shaft clips

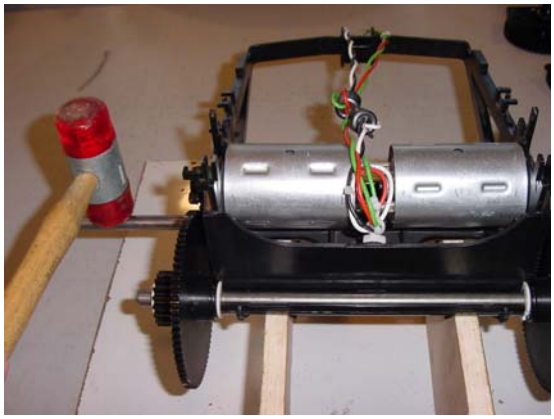


Figure 4.2.6.4.4
Extracting the long shaft out of a gearbox on supporting blocks

G. Turn the gearbox so the drive motors will face towards the table. Use a plastic hammer to hit on each side of the short shaft, as illustrated in Figure 4.2.6.3.5.

H. Discard of both shafts. Turn the gearbox again and place it on the wooden supports so the drive motors will face up. From the new shafts kit, take the short shaft and place it near the gear frame groove. The white bushings will sit against the frame, as illustrated in Figure 4.2.6.3.6.

I. Tap on both sides of the shaft with a plastic hammer until both bushings will “pass” the gear frame corner, as illustrated in Figure 4.2.6.3.7.

J. Hit both sides of the shaft with a plastic hammer until it will fully and firmly sit inside the gear frame groove, as illustrated in Figure 4.2.6.3.8.

Figure 4.2.6.4.5
Extracting the long shaft out of a gearbox

Figure 4.2.6.4.6
Short shaft placement in the gear frame groove

Figure 4.2.6.4.7
Short shaft placement

Figure 4.2.6.4.8
Short shaft placement

K. Take the long shaft, 2 gears and 4 rings and place them on the long shaft, 2 rings between the gears and 2 rings outside the gears, as illustrated in Figure 4.2.6.3.9.

L. Place the long shaft in its groove in the frame. Make sure both rings are outside the frame, as illustrated in Figure 4.2.6.3.10.

Figure 4.2.6.4.7
Long shaft composition

Figure 4.2.6.4.8
Long shaft placement in the gear frame

M. Center the new long shaft in its groove using a caliper. The measure from the shaft end to the gear is 101 mm, as illustrated in Figure 4.2.6.3.11.

N. Once the long shaft has been centered, use the plastic hammer to force the shaft into its groove, as illustrated in Figure 4.2.6.3.12.

Figure 4.2.6.4.11
Centering the long shaft

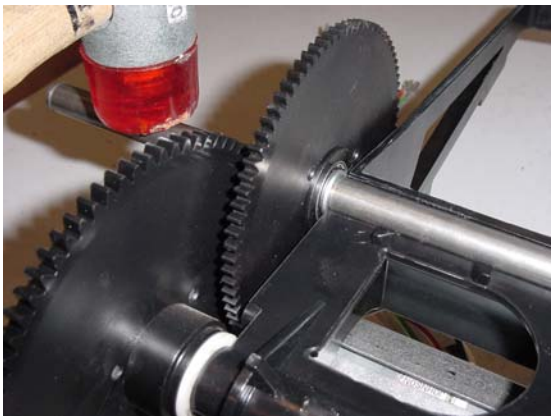


Figure 4.2.6.4.12
Inserting the long shaft into the groove

O. Take both clips and place them between the notches, as illustrated in Figure 4.2.6.3.13.

P. Use a plastic hammer to tap the clips into place, as illustrated in Figure 4.2.6.3.14.

Figure 4.2.6.4.13
Placement of the clips on the gear frame and shafts

Figure 4.2.6.4.14
Tapping of the clips into place

Q. Return the gear case, as explained in **section 4.2.6.1**.

R. Return the drive wheels, as outlined in **section 4.1.5.**

S. Return the cover as outlined in **section 4.2.2.**

T. Perform the '**Drive motor test'** outlined in **section 5.4.4**.

U. Complete the **General Test** as outlined in **section 5.1**.

4.2.6.5 Drive Motor replacement

Required tools:	Wide flat screwdriver External circlip pliers and TORX T-20	Procedure duration:	45 minutes

A. Remove the cover and both drive wheels, as outlined in **section 4.1.5.**

B. Remove the gearbox and both shafts, as outlined in **section 4.2.6.4**.

C. Identify the 4 screws that hold the drive motor to the gear frame, as shown in Figure 4.2.6.5.1.

D. Open the four screws using TORX T-20 tool, as illustrated in Figure 4.2.6.5.2.

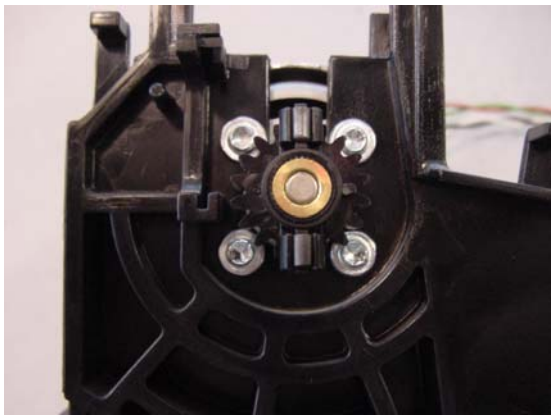


Figure 4.2.6.5.1
The 4 screws that hold the
Drive Motor to the gear frame

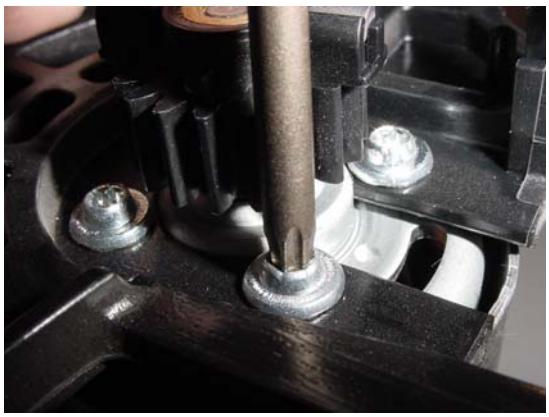


Figure 4.2.6.5.2
Using a TORX T-20 to open
the motor screws

E. Remove the defect motor by sliding the holding shoulders of the gear frame to the gap between the motor and the pinion, as illustrated in Figure 4.2.6.5.3.

F. Free the cables coming out of the motor by twisting open the twist lock on the gear frame and by cutting the wire strap tie between the two magnetic beads. Discard of the defected motor. Place the new motor into the gear frame; secure the wires through the twist lock and attach a strap between the two magnetic beads, as illustrated in Figure 4.2.6.5.4.

Figure 4.2.6.5.3
Removing the drive motor
from the gear frame

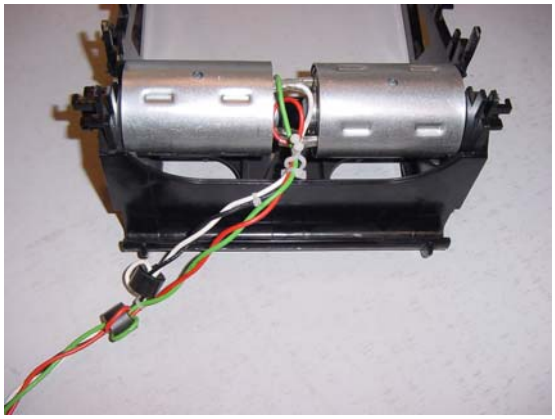


Figure 4.2.6.5.4
Placement of the new motor
and the cable attachment

G. Secure the motor to the gear frame using the four screws that used to hold the defected motor. Make sure to use only screws that were supplied by Friendly from the spare part list as the screws have a unique design. Apply 150 lb-in torques to tighten each screw.

H. Install both shafts, as was explained in **section 4.2.6.4**.

I. Return the gear case, as explained in **section 4.2.6.1**.

J. Return the drive wheels, as outlined in **section 4.1.5.**

K. Return the cover as outlined in **section 4.2.2.**

L. Perform the '**Drive motor test'** outlined in **section 5.4.4**.

M. Complete the **General Test** as outlined in **section 5.1**.

4.2.6.6 Gear frame replacement

Required tools:	Wide flat screwdriver External circlip pliers TORX T-20	Procedure duration:	60 minutes

NOTE: Read **Service Bulletin #RL0536-02**- Gear Case/ Frame Modification (**Section 7.1**) before starting this procedure.

A. Remove both drive wheels, open the cover, remove the gearbox and both shafts and remove both drive motors, as was explained in **section 4.2.6.5**.

B. Take the new gear frame and mount the drive motors and the shafts onto it: Place the gear in the unit, close the unit and place the drive wheels.

C. Return the cover as outlined in **section 4.2.2.**

D. Perform the '**Drive motor test'** outlined in **section 5.4.4**.

E. Complete the **General Test** as outlined in **section 5.1**.

IMPORTANT: If the Robomow was equipped with knobby drive wheels, place the ground clearance limiter, as shown in Figure 4.2.6.6.1 below.

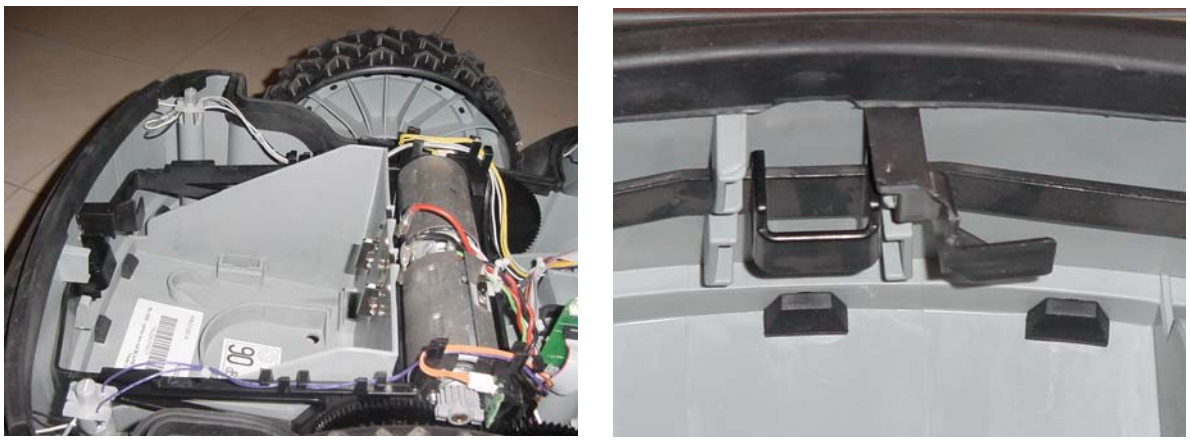


Figure 4.2.6.6.1
Ground clearance limiter

4.2.7 Wire Sensors replacement

Required tools:	Wide flat screwdriver	Procedure duration:	10 minutes

NOTE: When servicing Robomow with old configuration Wire Sensors (See Figure 4.2.7.1 below) **S/N IRL02340100 and below.** Read **Service Bulletin #RL0536-03**- Wire Sensors/Cable replacement (**Section 7.1**) before starting this procedure.

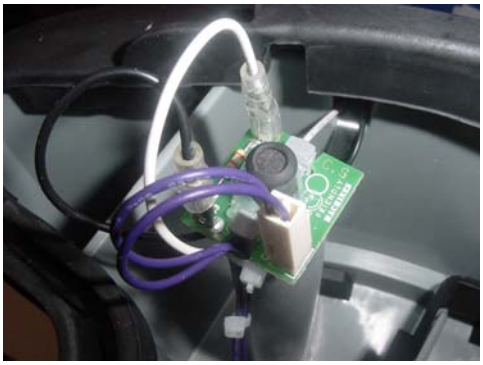


Figure 4.2.7.1
Old configuration Wire Sensors

A. Remove the Power Pack from the Robomow.

B. Remove the cover, as outlined in **section 4.2.1**.

C. Draw the gray plastic retaining clips holding the wire sensor plastic in its place, as illustrated in Figure 4.2.7.2 below.

D. Remove the wire sensor holder, as illustrated in Figure 4.2.7.3 below and repeat this step for all 4-wire sensors.

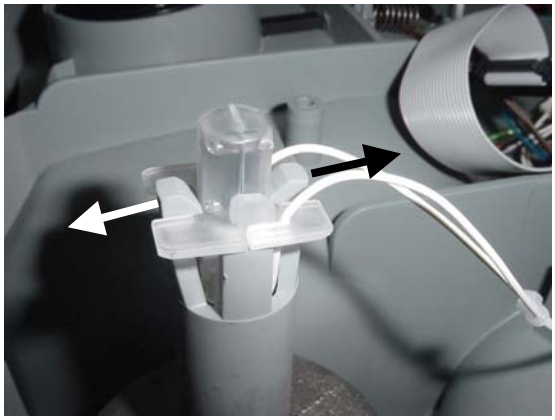


Figure 4.2.7.2
Drive pinion and its two magnets

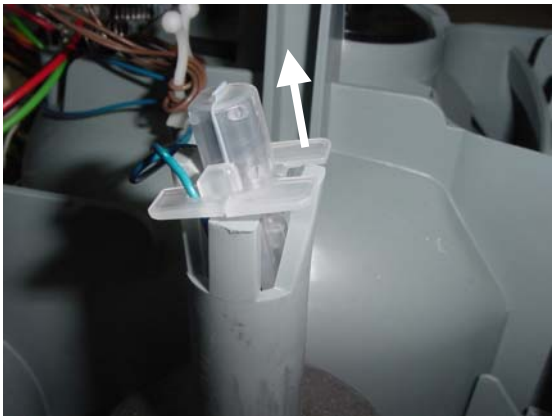


Figure 4.2.7.3
Magnets orientation relative to the pinion

E. Disconnect the wire sensors cable from the main board and remove the faulty wire sensors cable with the 4 sensors.

F. Take a new part, connect the cable to the main board and place each sensor close to its place (White – front left, Blue – front right, Gray – rear left, Purple – rear right).

G. Place each of the wire sensors holders in its place; making sure it is placed in the proper direction, as illustrated in Figure 4.2.7.4.

H. Verify that both gray plastic retaining clips are back in place and are holding the wire sensor holder, as illustrated in Figure 4.2.7.5.

Figure 4.2.7.4
Proper direction to place wire sensor holder

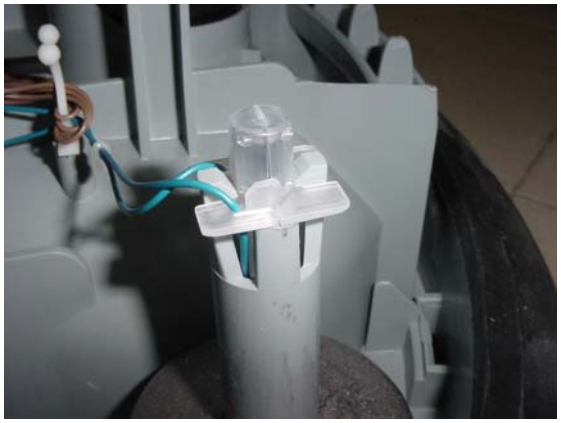


Figure 4.2.7.5
Proper position of wire sensor holder in its place

I. Return the cover as outlined in **section 4.2.2.**
J. Perform 'Learn wire sensors' (see **section 5.3.1**)
K. Perform 'Edge calibration' (see **section 5.3.2**)
L. Perform 'Wire sensors test, as outlined in' **section 5.4.1**.
M. Complete the **General Test** as outlined in **section 5.1**.

4.2.8 Power Pack contacts replacement

Required tools:	Wide flat screwdriver Tapered pliers	Procedure duration:	5 minutes

The Power Pack contact is made of 2 parts, as seen in Figure 4.2.8.1 below.
This design is made only for production purposes. The spare part and the replacement procedure are for replacing the 2 parts assembled.

Figure 4.2.8.1
Power Pack contact assembly

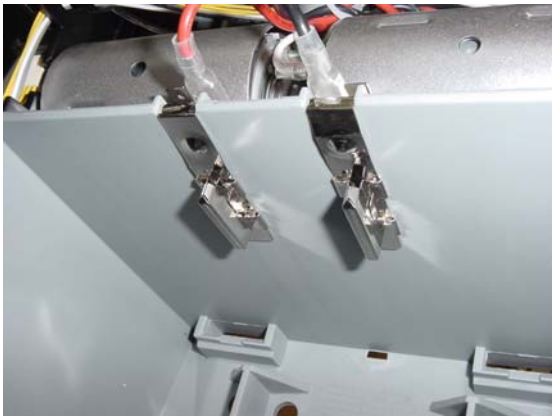


Figure 4.2.8.2
Power Pack contacts

A. Remove the Power Pack from the Robomow.

B. Remove the cover, as outlined in **section 4.2.1** and expose the power pack contacts, as illustrated in Figure 4.2.8.2.

C. Disconnect the damaged power pack contact from its lead and replace it with a new one. Ensure the leads are connected correctly – red wire on LH contact, black on RH.

D. Return the cover as outlined in **section 4.2.2.**

E. Test the functionality of the Robomow by replacing the Power Pack and observing that the unit "wakes up".

F. Complete the **General Test** as outlined in **section 5.1**.

4.2.9 Rear bumper replacement

Required tools:	Wide and long flat screwdriver Soap and water solution	Procedure duration:	30 minutes

A. Remove the Power Pack from the Robomow.

B. Remove the cover, as outlined in **section 4.2.1** and expose the rear bumper, as illustrated in Figure 4.2.9.1 below.

C. Disconnect both left and right bumper cables (white or purple) that are coming out of the rear bumper.

D. Peel off the "ears" that are touching the slider seal on both sides of the Robomow and expose the top edge of the gray plastic base in those areas.

E. Peel off the top edge of the bumper from the gray plastic base all the way around the bumper, as illustrated in Figure 4.2.9.2 below.

Figure 4.2.9.1
Rear bumper – assembled view

Figure 4.2.9.2
Peeled off bumper's top edge

F. In Figure 4.2.9.1 identify the protrusions that are holding the bottom edge of the bumper. Using the wide flat screwdriver, push down one side of the protrusion down, as illustrated in Figure 4.2.9.3.

Figure 4.2.9.3
Pushing the protrusion – 1st step

G. Push the second side of the protrusion, as illustrated in Figure 4.2.9.4.

H. Pull down the two 'T' holders located next to each of the drive wheels. The faulty bumper will become detached from the gray plastic base.

Figure 4.2.9.4
Pushing the protrusion – 2nd step

Bumper assembly

I. Support the Robomow on its side but be careful not to damage any of its exposed internal parts. Place the bumper on the Robomow, as illustrated in Figure 4.2.9.5.

J. Take the new rear bumper and apply the soap and water solution on all seven holding protrusions.

K. Insert the top of the 'T' holder into its place, as illustrated in Figure 4.2.9.6.

Figure 4.2.9.5
New bumper placement initial position

Figure 4.2.9.6
Insertion of the 'T' holder

L. Place both (white or purple) bumper cables above the upper edge of the bumper.

M. Identify the holding protrusion closest to the inserted 'T' holder, use your thumb and press it into its rectangular hole in the gray plastic base. At first press one side of the protrusion, as illustrated in Figure 4.2.9.7.

N. Once the first side of the protrusion is in the rectangular hole, press with your thumb the rest of the protrusion into the rectangular hole, as illustrated in Figure 4.2.9.8.

Figure 4.2.9.7
Thumb pressing on one side of the protrusion

Figure 4.2.9.8
Thumb pressing the entire protrusion

O. Move the other end of the bumper and insert the 'T' holder into its place as was explained in item K above. Make sure both bumper cables are still placed above the upper edge of the bumper.

P. Repeat steps M and N for the remaining six protrusions so the entire bottom edge of the bumper is securely placed.

Q. Verify that all the protrusions went actually all the way, as illustrated in Figure 4.2.9.9. On the left side is a properly seated protrusion and on the right side the protrusion requires additional pressing/manipulation. Make sure all the protrusions look like the one on the left.

R. Connect both bumper cables. Make sure both cables coming out of the bumper are going through the designated notch in the gray plastic base, as illustrated in Figure 4.2.9.10.

S. Replace the top edge of the bumper, above the 'T' holder areas, on the gray plastic base, as illustrated in Figure 4.2.9.10.

Figure 4.2.9.9
Proper and improper seating of the protrusion

Figure 4.2.9.10
1st stage top bumper edge placement

T. Stretch the bumper upwards all the way around, as illustrated in Figure 4.2.9.11.

U. Place the entire top bumper edge, including the “ears”, over the gray plastic base, as illustrated in Figure 4.2.9.12 below. Make sure the bumper cables, on both sides are not pinched and well connected to their tabs.

Figure 4.2.9.11
2nd stage top bumper edge placement

Figure 4.2.9.12
Properly seated bumper and wires

V. Return the cover as outlined in **section 4.2.2.**

W. Perform ‘Bumper test’ under the ‘Safety test’ menu.

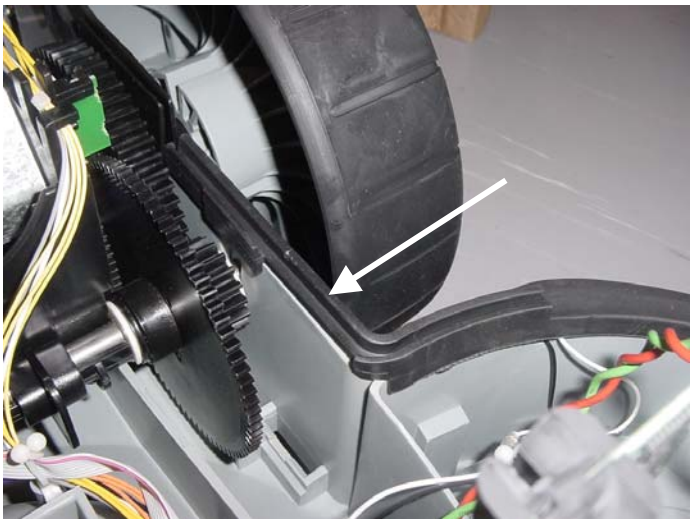
X. Complete the **General Test** as outlined in **section 5.1**.

4.2.10 Front bumper replacement

Required tools:	Wide and long flat screwdriver Soap and water solution	Procedure duration:	40 minutes

A. Remove the Power Pack from the Robomow.

B. Remove the cover, as outlined in **section 4.2.1** and expose the front bumper, as illustrated in Figure 4.2.10.1 below.



C. Disconnect both left and right bumper cables (white or purple) that are coming out of the front bumper.

D. Peel off the "ears" that touch the slider seal on both sides of the Robomow, as illustrated in Figure 4.2.10.2 below and the rest of the front bumper's top edge.

E. Identify the 'T' holder and the under side of the holding protrusion in the bottom side of the bumper, as illustrated in Figure 4.2.10.3 below.

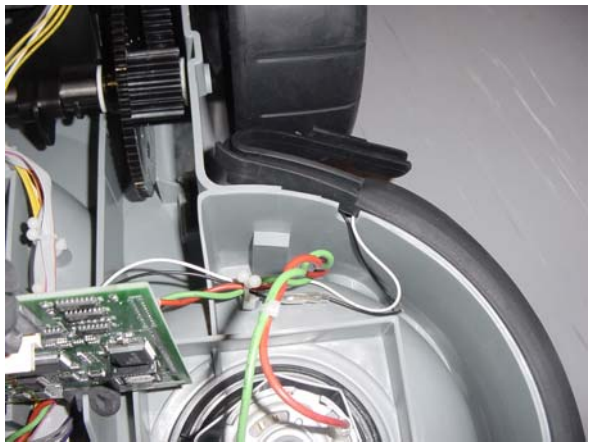


Figure 4.2.10.2
Peeled of front bumper's top edge

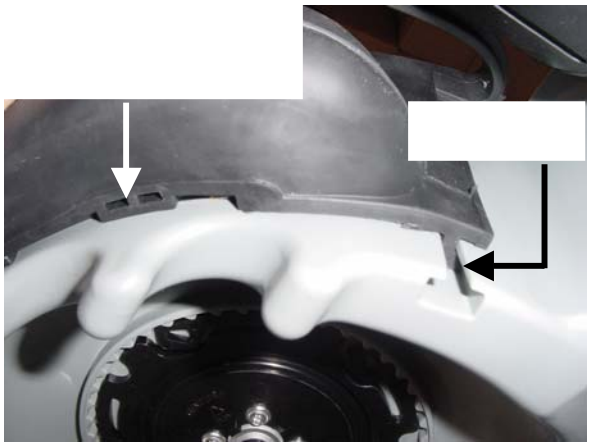


Figure 4.2.10.3
'T' holder and protrusion's under side

F. Using the wide flat screwdriver, push down one side of the protrusion, as illustrated in Figure 4.2.10.4.

G. Push the second side of the protrusion, as illustrated in Figure 4.2.10.5 below.

Figure 4.2.10.4
Pushing the protrusion – 1st step

Figure 4.2.10.5
Pushing the protrusion – 2nd step

H. Pull down on the two 'T' holders located on each side of the bumper, as illustrated in Figure 4.2.10.3. The faulty bumper will become detached from the gray plastic base.

Bumper assembly:

I. Support the Robomow on its rear bumper but be careful not to damage any of its exposed internal parts. Make sure the front metal strip is properly located all the way around, as illustrated in Figure 4.2.10.6.
J. Take the new front bumper and apply the soap and water solution on all holding protrusions. Place the new front bumper in its general location, as illustrated in Figure 4.2.10.7.

Figure 4.2.10.6
Properly located front metal strip

Figure 4.2.10.7
Placement of the front bumper in its general location

K. At first, insert the top 'T' holder into its place in one side, as illustrated in Figure 4.2.10.8. Repeat this step for the 'T' holder on the second side.

Figure 4.2.10.8
Insertion of the 'T' holder

L. Place both bumper cables above the upper edge of the bumper.

M. Make sure the bumper's rubber rib with the metal spring is not caught under the plastic rib that holds the metal strip, as illustrated in Figures 4.2.10.9 and 4.2.10.10

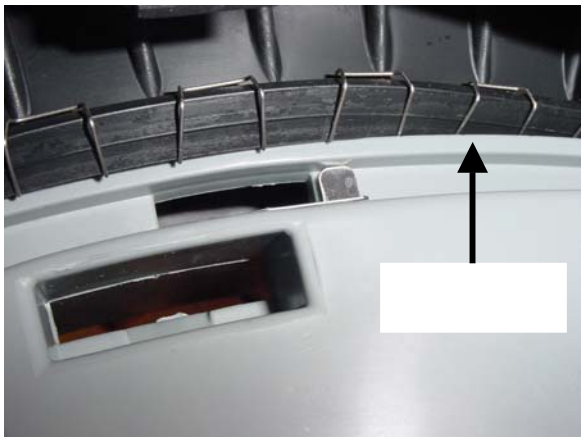


Figure 4.2.10.9
Improperly seated contact spring

Figure 4.2.10.10
Placement of the front bumper in

N. Identify the underside of the holding protrusions as illustrated in Figure 4.2.10.11. Use both of your thumbs and press it into its rectangular hole in the gray plastic base, as illustrated in Figure 4.2.10.11.

Figure 4.2.10.11
Thumb pressing of the protrusion

O. Repeat step N for all the protrusions along the entire length of the bottom edge of the front bumper.

P. Verify that all protrusions went all the way through the rectangular hole by pulling back on the bumper's top edge, as illustrated in Figure 4.2.10.12.

Q. Make sure the bumper cables are coming through the designated notch on both sides of the bumper, as illustrated in Figure 4.2.10.13. Connect both (white or purple) wires.

Figure 4.2.10.12
Properly seated front bumper holding protrusions

Figure 4.2.10.13
Properly routed front bumper cables

R. Return the top edge of the bumper "ears" on the gray plastic base, as was illustrated in Figure 4.2.10.1.
S. Place the entire top bumper edge over the gray plastic base. Make sure the cables, on both sides, are not pinched and well connected to their tabs.
T. Return the cover as outlined in **section 4.2.2.**
U. Perform 'Bumper test' under the 'Safety test' menu.
V. Complete the **General Test** as outlined in **section 5.1**.

4.2.11 Thermistors assembly/replacement

Required tools:	Wide flat screwdriver External circlip pliers + Driller	Procedure duration:	30 minutes

NOTE: Read **Service Bulletin #RL0340-10** - Thermistors Kit (SPP0020A) Installation Instructions (**Section 7.1**) before starting this procedure.

Before starting the assembly of Thermistor to the Robomow, confirm the Main Board has the connector to support the Thermistors connection.

A. Remove the Power Pack and the cover, as outlined in **section 4.2.1**.

B. Disconnect the Thermistors cable from the Main Board.

C. Drill the pop rivet, as illustrated in Figure 4.2.11.1, to release the Thermistor from the drive motor shading. Vacuum the area inside the Robomow and around the gearbox - make sure there are no metal residues from the drilling process.

D. Place the pad on the drive motor shading, as illustrated in Figures 4.2.11.2, on the same place exactly from where the faulty Thermistor was removed.

Figure 4.2.11.1
Drilling the pop rivet to remove the Thermistor

Figure 4.2.11.2
Placement of the pad

E. Insert the pop rivet to the special tool and place the end of the pop rivet into the hole in the Thermistor, as illustrated in Figure 4.2.11.3 below.

Figure 4.2.11.3
Preparing the Thermistor for assembly

F. The Thermistor cable color is white. There is one side with black marking on the white cable, as illustrated in Figure 4.2.11.4 below. Make sure the side with the black marking is attached to the right mowing motor.

G. Attach the pop rivet with the Thermistor to the motor shading, as illustrated in Figure 4.2.11.5.

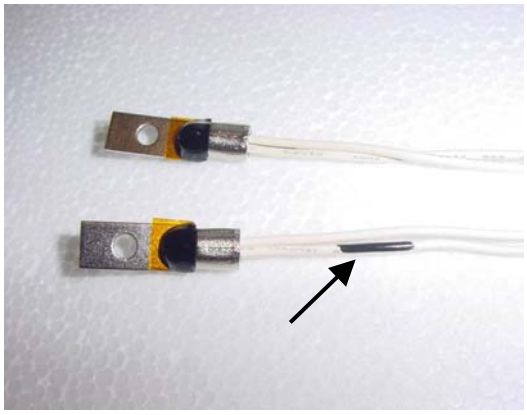


Figure 4.2.11.4
The side with the black mark is connected to the Mowing side

Figure 4.2.11.5
Attaching the Thermistor to the drive motor shading using pop rivet

H. Repeat the same steps to attach the other Thermistor to the mowing motor shading. Confirm the Thermistor is well attached and aligned, as illustrated in Figure 4.2.11.6.

Figure 4.2.11.6
Proper attachment of the Thermistor to the Drive motor shading

I. Replace the cover as outlined in **section 4.2.2.**

J. Perform 'Thermistors test' under the 'Service' menu (section 4.4.6).

K. Complete the **General Test** as outlined in **section 5.1**.

4.2.12 Front wheel spring/locker replacement

Required tools:	Wide flat screwdriver	Procedure duration:	10 minutes

NOTE: Read **Service Bulletin #RL0536-05** - Front Wheel Detent Change (**Section 7.1**) before starting this procedure.

A. Remove the Power Pack from the Robomow.

B. Remove the cover, as outlined in **section 4.2.1**.

C. Locate the broken spring clip / stopper and remove it from its place.

D. Insert the new part, as illustrated in the Figures below:

Figure 4.2.12.1
Insertion of the first side of a spring clip

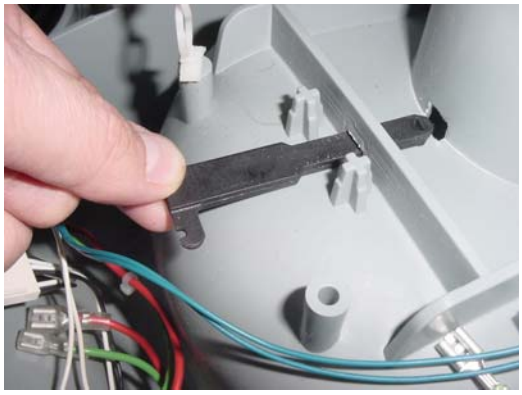


Figure 4.2.12.2
Insertion of the front wheel stopper to it place

E. Squeeze the old configuration spring clips as illustrated in Figure 4.2.12.3 below.

F. Add the two springs (in the new configuration) the secure the stopper in its place, as illustrated in Figure 4.2.12.4.

Figure 4.2.12.3
Proper attachment of the Thermistor to the Drive motor shading

Figure 4.2.12.4
Proper position of the front wheel stopper with the springs

G. Rotate the front wheel height adjustment and verify it “clicks” into place every turn.

H. Return the cover as outlined in **section 4.2.2.**

I. Complete the **General Test** as outlined in **section 5.1**.

4.3 Power Pack Procedures

The Power Pack is not designed to be opened for service or repair as it does not contain either moving parts or parts that are expected to fail. However, procedures are included to allow access if necessary.

4.3.1 Power Pack opening and cable layout

Required tools:	Flat screwdriver	Procedure duration:	10 minutes

A. Remove the Power Pack from the Robomow.

B. Identify the two notches on the side-wall of the power pack.

C. Identify the latch that can be seen through these notches just behind the side-wall.

D. Insert a flat screwdriver through the notch and reach behind the latch.

E. With one hand pull up on the cover just above the screwdriver while simultaneously using the screwdriver to pull the latch, as illustrated in Figure 4.3.1.1.

Figure 4.3.1.1
Opening the Power Pack cover

F. Repeat step ‘D’ and ‘E’ for the other sides of the power pack.

G. The inside arrangement and cable layout of the power pack is outlined in Figure 4.3.1.2

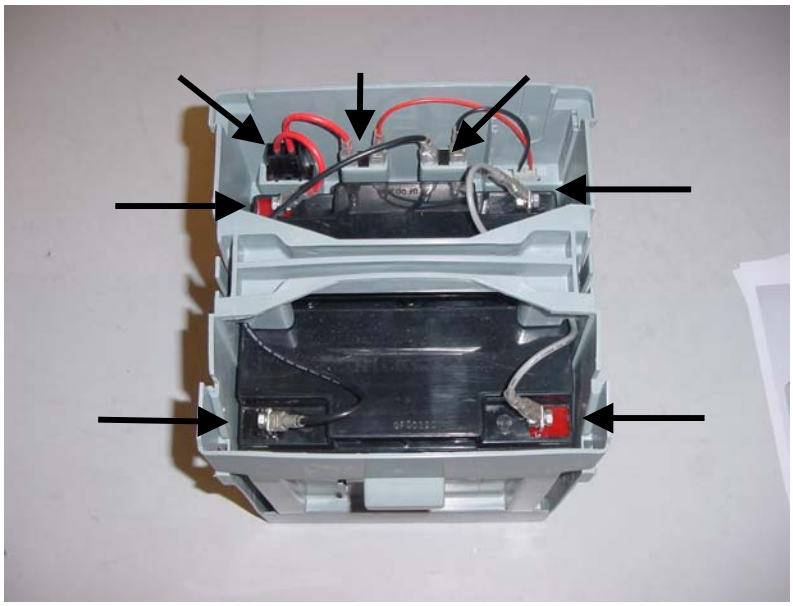


Figure 4.3.1.2
The inside of a Power Pack

H. In order to close the power pack cover, place the cover over the case in its proper position and hit the cover, straight on the latch, to force them down into their notches. Verify the cover fits tightly in place.

I. Place the power pack into a Robomow, plug in a charger and verify there is indication of charging process on the Manual Controller display.

4.3.2 Power Pack terminal replacement

Required tools:	Small flat screwdriver	Procedure duration:	10 minutes

A. Remove the Power Pack from the Robomow.

B. Open the Power Pack as outlined in procedure 4.3.1.

C. Identify the defective terminal you would like to replace and disconnect both cables attached to it.

D. Using the screwdriver, force the center latch of the Power Pack terminal flat against the plastic wall while pushing it down, as illustrated in Figure 4.3.2.1 below.

E. Take the defective terminal and discard it.

F. Take the new terminal and position it as illustrated in Figure 4.3.2.2 below, and slide it all the way up until it is stopped when the terminal "knee" hits the plastic.

Figure 4.3.2.1
Releasing the power pack terminal

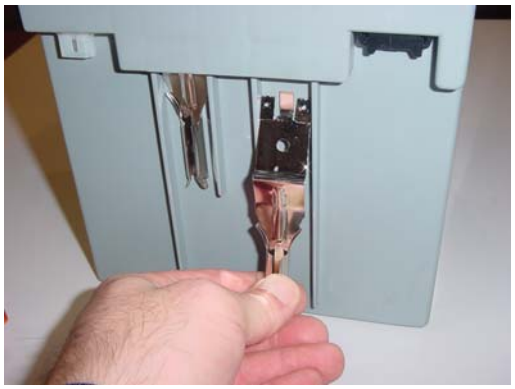


Figure 4.3.2.2
Positioning the terminal for insertion

G. Press on the terminal "knee" simultaneously inside and up to bring it inside the positioning hole, as illustrated in Figure 4.3.2.3 below.

H. Verify the proper positioning of the terminal by looking inside the case and observing that the center latch is in its proper position, as illustrated in Figure 4.3.2.4 below.

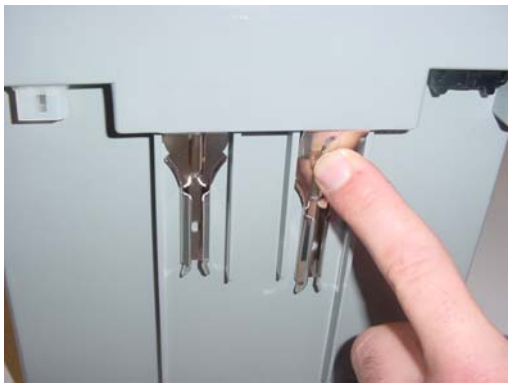


Figure 4.3.2.3
Forcing the terminal into position

Figure 4.3.2.4
Proper position of the terminal –
a look from the inside

I. Connect both cables to the power pack terminal, as illustrated in Figure 4.3.2.1. Ensure correct polarity.
J. Verify the functionality of the repair by placing the power pack in a Robomow and observing it turning on.
K. Close the case cover as illustrated in procedure 4.3.1.

4.4 Charging Station Procedures

4.4.1 Charging Station contacts replacement

Required tools:	Philips screwdriver	Procedure duration:	5 minutes

A. Remove the Robomow from the Charging Station.

B. Disconnect the Power Supply from the wall socket.

C. Disconnect the two cables (Red and Green) from the tabs on the Charging Station contacts, as illustrated in Figure 4.4.1.1 below.

D. Open the screws at the sides of the contacts, as illustrated in Figure 4.4.1.2 below and remove the contacts assembly from its place.

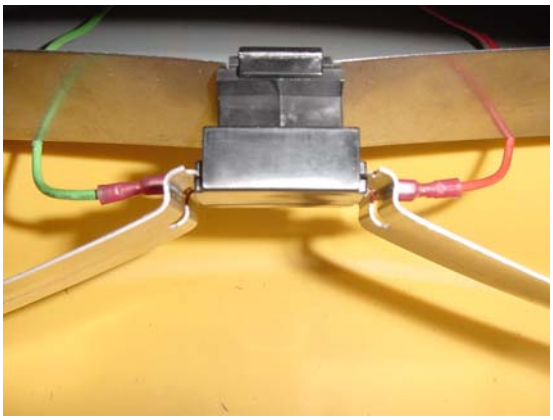


Figure 4.4.1.1
Disconnection of the contact cables

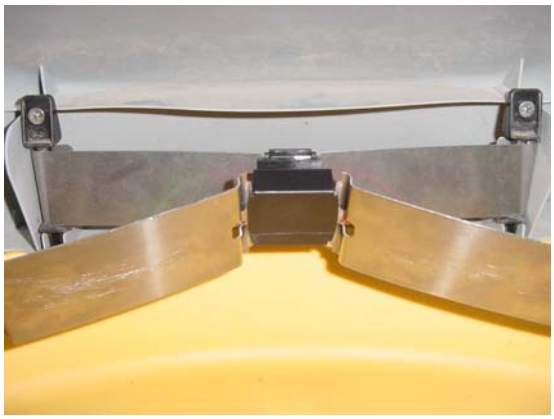


Figure 4.4.1.2
Opening the contacts screws

E. Replace the docking contact assembly with a new one. Place the contacts holder above the aperture in the cover, as illustrated in Figure 4.4.1.3 below.

F. Confirm the holder is placed in the apertures and tighten the screws. Ensure the contacts assembly is properly placed as illustrated in Figure 4.4.1.4.

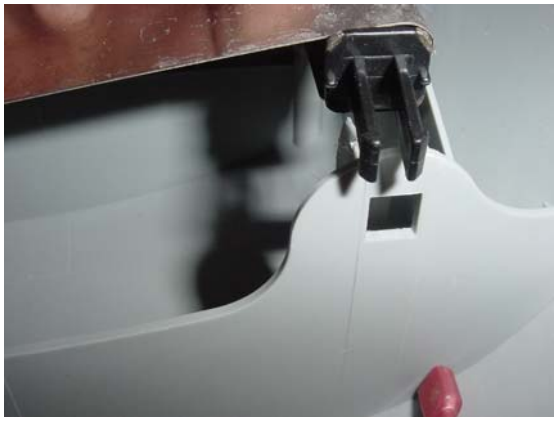


Figure 4.4.1.3
Align the contact holder against the aperture

Figure 4.4.1.4
Final position of the contacts assembly

G. Connect the contacts cables (Red and Green) back to the taps as illustrated in Figure 4.4.1.1 above (confirm the Red is connected to the RH side and the Green to the LH side).

H. Connect the Power supply to the wall socket and switch on the Charging Station board to check the functionality of the Charging Station.

4.4.2 Power Supply replacement

Required tools:	Philips screwdriver	Procedure duration:	10 minutes

A. Remove the Robomow from the Charging Station.

B. Disconnect the Power Supply from the wall socket.

C. Open the two screws on the Charging Station cover, as illustrated in Figure 4.4.2.1 to remove the Charging Station Cover.

D. Open the two screws on the Docking Board to release the Power Supply cable, as illustrated in Figure 4.4.2.2 below.

Figure 4.4.2.1
Opening the screws to remove the cover

Figure 4.4.2.2
Power Supply cable screws

E. Replace the faulty Power Supply with a new one. Lay the Power Supply cable in a safe way to prevent injury. Pull the cable through the aperture and secure it, as illustrated in Figure 4.4.2.3.

F. Connect the cable ends to the docking board connector, as illustrated in Figure 4.4.3.4 – confirm the black cable is connected to the RH side and the white cable to the LH side (the colors are printed on the board itself).

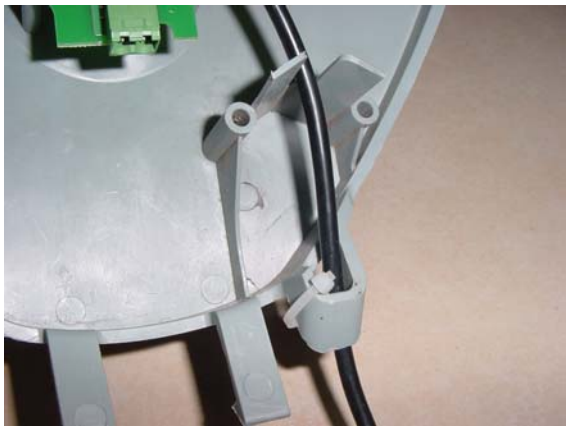


Figure 4.4.2.3
The track of the Power Supply cable

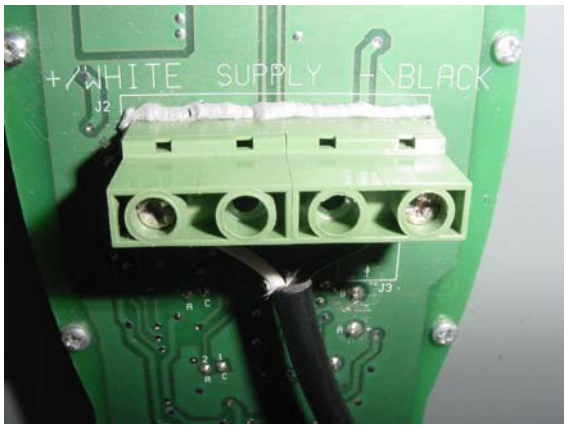


Figure 4.4.2.4
Proper polarity of Power Supply connection

G. Confirm proper layout of the Power Supply cable from the cover, as illustrated in Figure 4.4.2.5 below.
H. Connect the Power supply to the wall socket and switch on the Charging Station board to check the functionality of the Charging Station.

Figure 4.4.2.5
The track of the Power Supply cable

4.4.3 Docking Board replacement

Required tools:	Philips screwdriver	Procedure duration:	15 minutes

A. Remove the Robomow from the Charging Station.

B. Disconnect the Power Supply from the wall socket.

C. Remove the cover and disconnect the Power Supply from the Docking Board, as explained in section 4.4.2.

D. Open the 8 screws on the Docking Board, as illustrated in Figure 4.4.3.1.

E. Remove the faulty board and replace it with a new one. Lay the cover on its back and confirm the push button is in its place and in the right direction (flat surface towards the docking board) and that the docking board seal is properly seated in its place on the gray plastic edge, as illustrated in Figure 4.4.3.2 below.

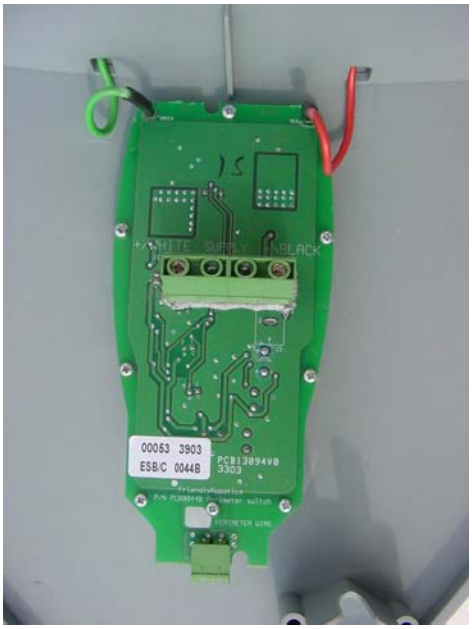


Figure 4.4.3.1
Docking board 8 screws

Figure 4.4.3.2
Proper position of the push button and the seal

F. Place the board on the seal so the 8 holes on the board are exactly above the counter-holes in the cover and tighten the 8 screws.

G. Repeat steps F to H, as explained in section 4.4.2.

5. Diagnostics

The *Diagnostics* section of the Service Guide refers directly to the 'Service' menu accessed on the Robomow Manual controller. The Robomow has a series of self-diagnostic tests that allow it to pinpoint problems or test systems affecting the operation. By entering the 'Service' menu and selecting the specific system or component test, the Robomow will display either a 'Pass' or 'Fail' message or display a fault code, which is referenced in *Section 5.6* to determine the nature of the problem.

This section closely cross-references with Section 3, *Troubleshooting*. In Section 3, many of the troubleshooting flow charts request a specific diagnostic test to be performed. The results of each of these diagnostic tests are then used to determine the system or component of failure. This section outlines the procedure for performing these tests as well as an interpretation of the results, found in the *Fault Code Tables*, Section 5.6.

5. Diagnostics - Contents

5.1 General Test

The *General Test* is a basic test that should be performed whenever a technician initiates a service repair on a Robomow. The test is designed so that most common problems found in normal operation will be readily apparent. The General Test should be performed regardless of whether any work was actually performed out on a unit. This ensures a "Duty of Care" to the customer, and will also serve to insure that all safety systems are working properly prior to a customer using the unit.

The *General Test* should also be performed after any service routine was performed. This will insure that the maintenance was performed correctly and that no additional problems were introduced to the unit during the service routine.

The *General Test* and certain of the other diagnostics tests need to be performed in a simulated lawn with the layout as shown below:

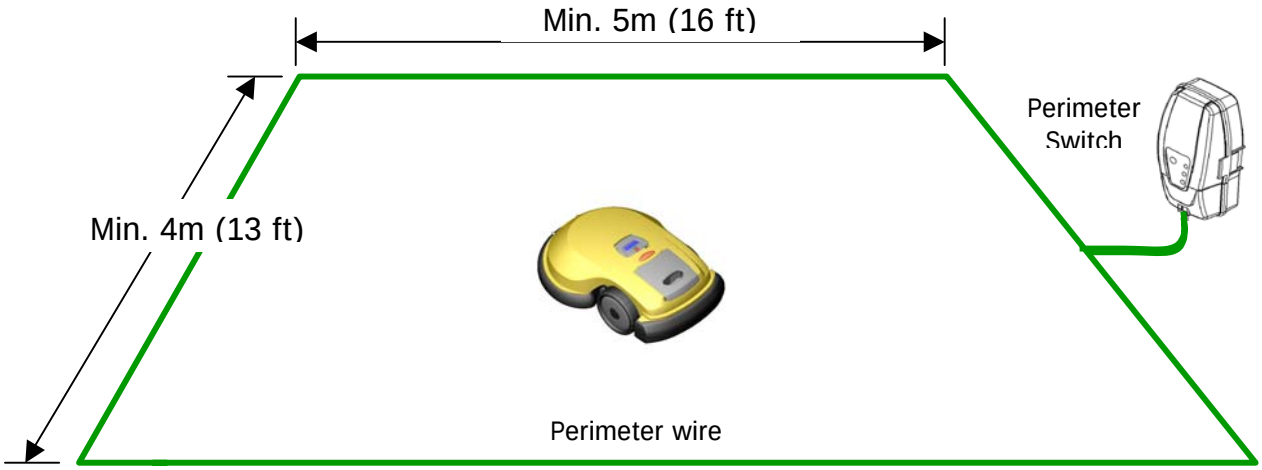


Figure 5.1.1
Simulated Lawn for General Test

A. **Remove the Power Pack** from the Robomow and perform a mechanical inspection:

1. Check that the fuse cover is in place and secure.
2. Check the operation and functionality of the rear height adjustment.
3. Confirm the top edge of the bumpers at the rear wheels sliding seal area is firmly secured between gray base and yellow top cover gray base
4. Check that the blades are sharp and securely attached.
5. Check the operation of the front wheel by insuring it is free to rotate in all directions.

B. Clean the unit using compressed air; particularly inside the Power Pack well and Manual controller well drain holes. A damp cloth and a wooden stick can also be used to remove stubborn dirt and debris. Do not wash with a hose.

C. Insert the Power Pack and perform the following tests:

1. Check that the operating lamp illuminates when the Power Pack is inserted.
2. Check that the Manual controller display is working properly. Inspect the controller for signs of damage to the housing, cable, buttons or display.
3. Slightly lift the front of the unit by the carrying handle and insure that the unit announces the front wheel lifted audio alert.
4. Confirm that the bumpers are functioning correctly by using the 'Bumper tests' under the 'Safety tests' menu. Hit the top of the mower hard with your hand and make sure the bumper sound is not heard.
5. Confirm that the Manual controller buttons are functioning correctly by using the 'Buttons test' under the 'Safety tests' menu.
6. Check charging

SAFETY FIRST! Before completing the following tests, insure that the test area is clear of persons and obstacles. Remove all floor debris to prevent it from being thrown by the rotating blades. Keep feet and hands away from the blades and the drive wheels when testing.

D. Drive the Robomow manually forwards, backwards, left and right and perform the 'Drive motor test' under the 'Service' menu (See section 5.4.4).

E. Manually activate the mowing motors and perform the 'Mowing test' under the 'Service' menu (See section 5.4.5).

F. Operate the Robomow automatically in the simulated lawn. Verify it follow the perimeter wire in edge mode and move in a straight lines when it moves inside the area in Scan mode.

5.2 Service Key

The *Service Key* is a function in the Robomow software that allows a service technician to access diagnostics and service functions. These menu functions are not available to the end user.

In order to access the *Service Key*, select the 'Service' menu item under the 'User options' menu and press the 'GO' button. Use the arrow buttons to scroll through the numbers. Use the 'GO' button to acknowledge each number and move to the next digit. Use the 'C' button to cancel a selection and move back in the sequence.

Use this process to select the number **12321**. This is the required code to enter the 'Service' function menus.

(RL500: On Manual/settings press green button, scroll up to Service key, insert 12321, green button, Confirm, green button and the menu will jump to Diagnostics. Green button to get into diagnostic mode and now scroll down or up to the wanted test).

Calibration, Tests and Settings

Various calibrations, tests and settings are found under the 'Service' menu that may be used by the technician. Each of these tests is selectable by simply scrolling through the menu. After completing work in a specific area, perform the test shown in the procedure and then perform the *General Test* outlined in Section 5.1. This will insure that the repair has been done properly and that the unit functions satisfactorily.

The results of some tests will be a pass or fail while others will display a fault code number. Refer to the fault code in Section 5.6 *Diagnostics Fault Codes*.

Please follow the instructions for each test carefully. At the end of each test press the 'C' button to exit. Continual pressing of the 'C' button will move you up through the menu levels, until you arrive at the Main Menu.

Too busy, lack of time or do not understand the test fully: At least operate the Robomow on the test area in automatic mode, to make sure it is fully operational. Testing it in manual mode for driving or manual mowing is not satisfactory at all prior to handing it back to the customer. The Robomow has built in warning and indication system that will pop up on the display in Automatic mode in case you forgot to perform any of the needed calibrations after service.

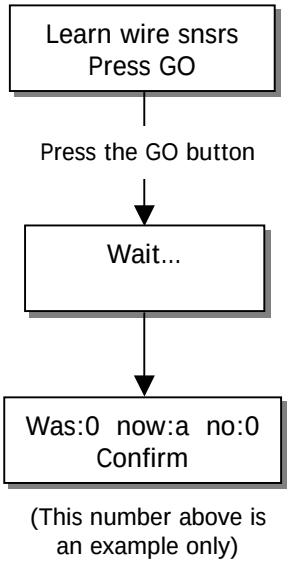
5.3 Calibration Procedures

5.3.1 Learn Wire Sensors

This is a calibration of the wire sensors. This must always be performed after replacement of a wire sensor or main board.

IMORTANT: if this procedure is not performed the message ‘Move from wire’ will display on the manual controller, in automatic mode initiation, regardless of where the unit is positioned.

A. Place the Robomow inside an operating perimeter wire, at least 1m (3ft) from the nearest wire.
B. Select *Learn Wire Sensors* in the ‘Service’ menu.
C. Verify that the perimeter switch is on.
D. Perform *Learn Wire Sensors* as described below:



Note: it is important to confirm. If this is not done, the calibration will not be recorded.

Press GO button to confirm

Note: if the perimeter switch is off a ‘No wire signal’ message will be displayed.

5.3.2 Edge Calibration

Edge Calibration determines the position of the Robomow relative to the wire in edge mode.

A. Verify that the perimeter switch/docking board switch is **on**.

B. There are two options to perform the *Edge Calibration*:

1. If the wire is visible, position the Robomow over a perimeter wire. The Robomow should be positioned on the wire facing in a counter-clockwise position when viewed from the inside of the perimeter. Cutting height and ground clearance should be set to the middle position. The wire should be centered relative to the unit, and the unit should be at least 3m (10 ft) away from the nearest corner of the perimeter (See Figure A below).
2. If the wire is not visible, position the Robomow inside the lawn, perpendicular to a section of straight perimeter wire and at least 3m (10 ft) from a corner (See Figure B below).

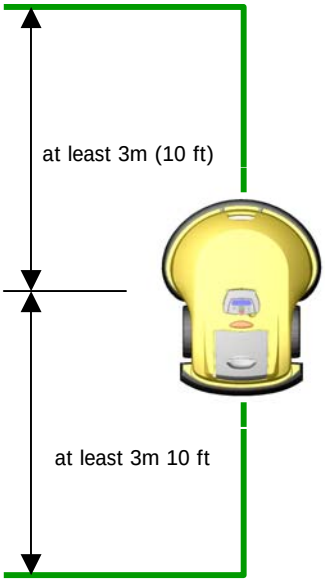


Figure A

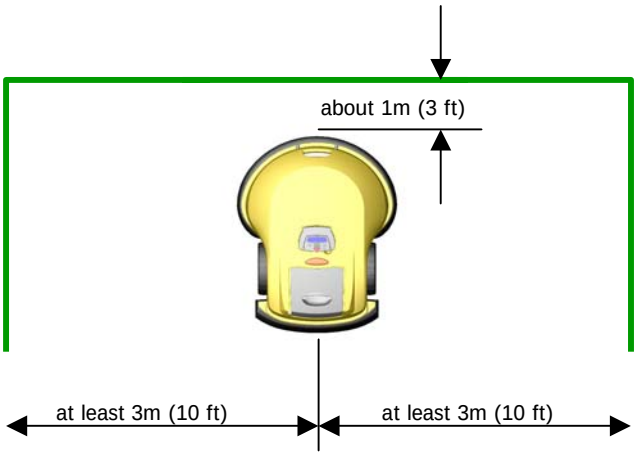
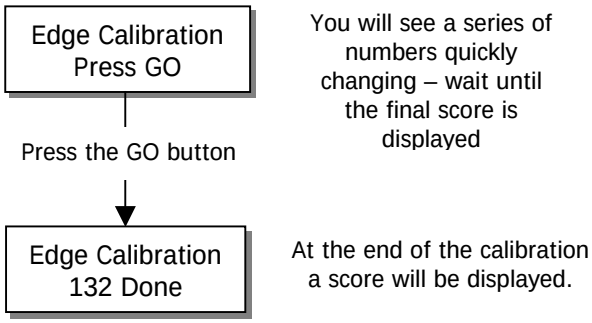


Figure B

C. Select *Edge Calibration* in the 'Service' menu.

D. Complete *Edge Calibration* as described below:



(This score is an example only)

5.3.3 Set Country

It used for positioning the Robomow globally. This operation is important, as the Robomow needs to be able to adjust the sensitivity of the magnetic navigation system to its location on the globe. This process should be done only once, prior to the first automatic operation. This is a preliminary step to *DK Calibration*. *DK Calibration* will not succeed without first setting the country location.

5.3.4 DK Calibration

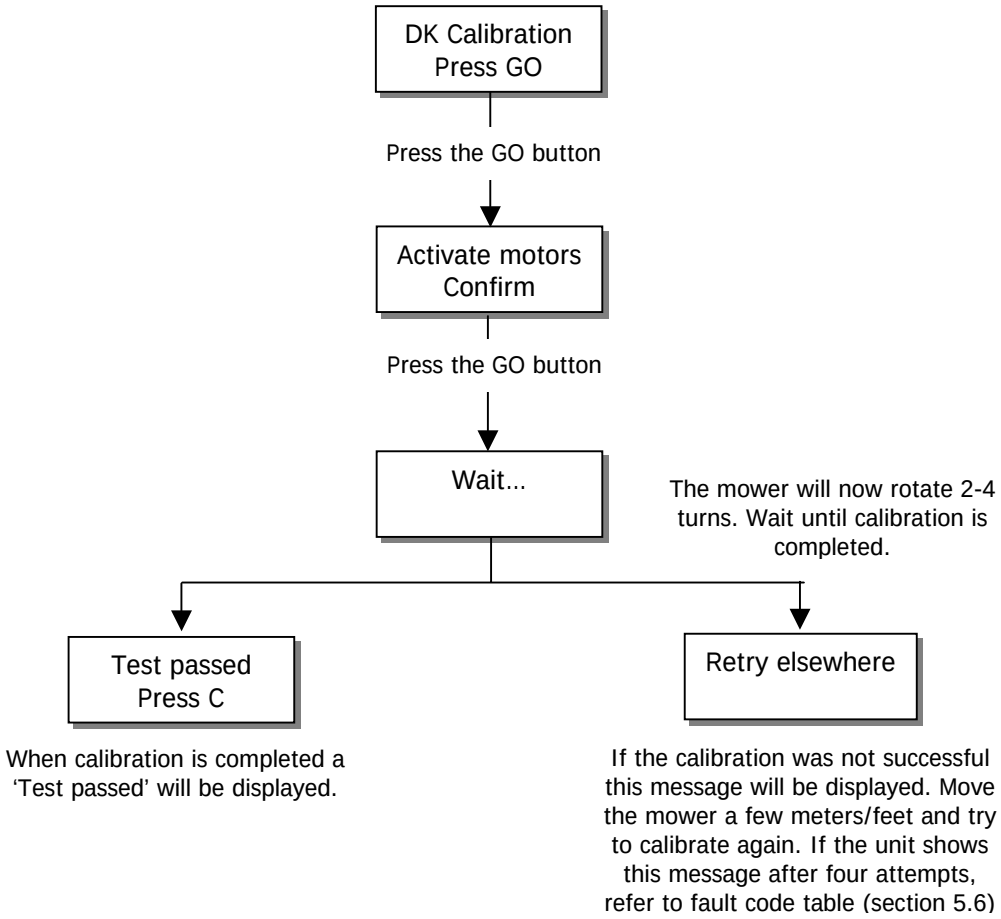
The DK (Direction Keeping) calibration calibrates the Robomow to the magnetic fields in the customer's yard.

A. Enter *DK Calibration* in the 'Service' menu.

B. Verify that *Set Country* is already set at the correct country for use.

C. Insure the Robomow is positioned on a leveled and smooth surface inside the perimeter wire. It should not be placed close to anything that could alter the earth's magnetic field such as buried or overhead power lines, large metal objects or concrete floors with steel reinforcing bars for example.

D. Turn the Perimeter switch on and perform the *DK Calibration* as shown in the sequence below:



5.4 Tests Procedures

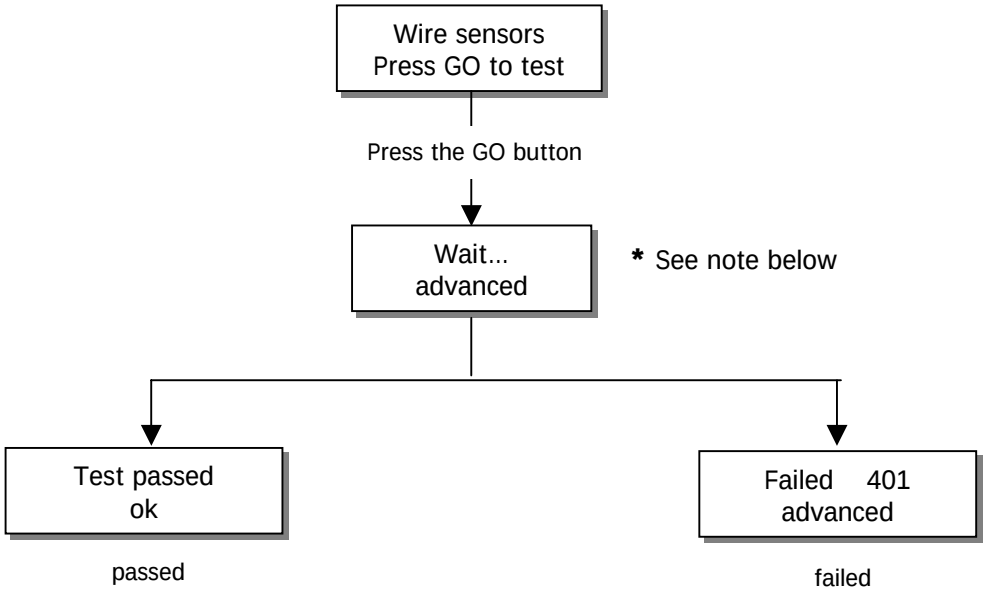
5.4.1 Wire Sensors

The test is used to check the operation of the wire sensors. 'Wire sensors' is a diagnostic process that tests the operation of the four wire sensors on the mower. It has two levels of testing, basic and advanced. Under the basic testing it is a 'pass-fail' test with a fault code listed for the failure message. The advanced testing shows the physical reading of each of the four wire sensors, which on occasion may be helpful, is troubleshooting. Typically, the basic test is sufficient.

A. Place the mower inside the perimeter wire area and turn the perimeter switch on.

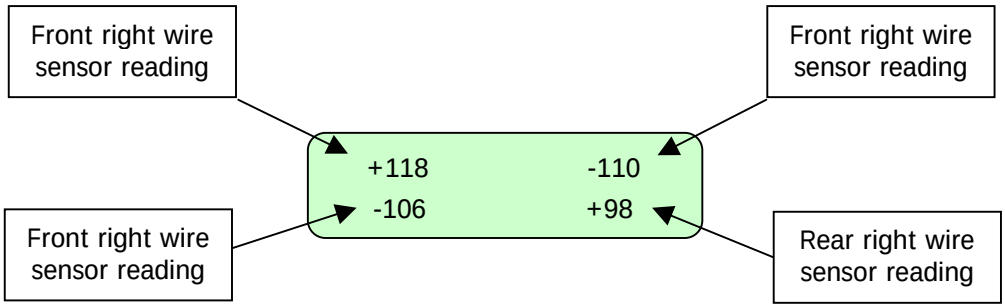
B. Select *Wire Sensors* in the 'Service' menu (RL500: Diagnostics>Wire sensors).

C. Perform the test as follows:



D. If the manual controller display shows 'Failed', note the code number and refer to Section 5.6, Diagnostic Fault Codes. Follow the appropriate procedure from the Troubleshooting Guide for further instructions.

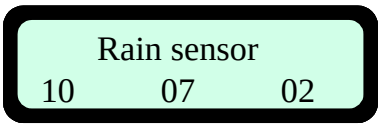
*** Note:** Pressing the GO button twice will display the readings of the four wire sensors simultaneously on the manual controller. There is +/- sign before each of the readings; the phase sign should be changed between '+' to '-' every 4 to 6 seconds on average. If it is changed in higher frequency it is points on problem in the Main Board.



Note: If tested on a smaller yard or on a wired workbench, this test will fail due the yard being too small. In this case test in advanced mode only to see the wire raw reading and to make sure none of them isn't zero or very low comparing to the others.

5.4.2 Rain Sensor

This test checks the rain sensor reading.
As pressing the GO button to perform the test, the following is displayed:



- The left number indicates the actual reading of the rain sensor, which is updated every 5 seconds.
- The middle number indicates the sensitivity of the rain sensor in which the mower will detect rain below the threshold set. This threshold can be set by the user under the '*User Preferences'* menu.
- The right number indicates the rain sensor status when 0 means that rain sensor's existence is unknown, 1 means that rain sensor does not exist and 2 means that rain sensor exists.

Note: Under the 'User preferences'→ 'Rain sensor' menu, there are another two options allowed:
- Changing the rain detection sensitivity (the default detection is below 7).
- Turning the rain sensor to off to enable operation in rain and wet grass conditions.

5.4.3 Direction Keeper

Checks the operation of the Direction Keeper (Electric compass).

A. Select *Direction Keeper* in the 'Service' menu.

B. Press the GO button for testing the direction keeper

C. The manual controller will display 'Test passed' or 'Failed +fault code'

E. If the manual controller display shows 'Failed', note the code number and refer to Section 5.6, Diagnostic Fault Codes. Follow the appropriate procedure from the Troubleshooting Guide for further instructions.

5.4.4 Drive Motor

This test checks the operation of the drive motors. This test should be performed when the Robomow is securely propped up on a stand so that the drive wheels will not touch the ground. The front wheel must be firmly on the ground.

A. Insure the drive wheels are off the ground.

B. Select *Drive Motors* in the 'Service' menu.

C. Press the GO button for testing the drive motors – the drive motors will run forward then reverse.

D. The manual controller will display 'Test passed' or 'Failed +fault code'

F. If the manual controller display shows 'Failed', note the code number and refer to Section 5.6, Diagnostic Fault Codes. Follow the appropriate procedure from the Troubleshooting Guide for further instructions.

It is recommended to perform this test again and after pressing GO for activating motors, press the green button again for advanced diagnostics mode. The drive motors will rotate the drive wheels for a long time, displaying two sets of numbers. The top display line will be RPM and will look like this: 82 – RPM – 83. The number to the left indicates the left wheel/drive motor speed. The bottom line of the display will indicate the power needed to get to these RPM values, which will look like this: 58- PWM – 59. Again, the left number for the current needed to run the left wheel/drive motor and the right one for the right wheel/drive motor. These raw readings can be used to detect whether there is an increased friction on one of the wheels or if any of the electronic components are faulty. For instance, if there are no numbers shown at all (Unless it is an RL800 where this doesn't count) it means the main board is faulty, if all the wiring is connected well.

5.4.5 Mowing Motor

This test checks the operation of the mowing motors.

IMPORTANT: SAFETY FIRST! Make sure that there is nothing under the mowing deck, or any loose clothing etc. that can get caught in the blades. Keep hands and feet well away from the mower. Perform this test after insuring that there is no debris that can be picked up and thrown by the blades.

A. Insure the cutting height and ground clearance settings are on the highest setting.

B. Enter *Mowing Motors* in the 'Service' menu.

C. Press the GO button for testing the motors.

D. Press the GO button again to confirm activation of the motors for the test - the mowing motors will run.

E. The manual controller will display 'Test passed' or 'Failed +fault code'

G. If the manual controller display shows 'Failed', note the code number and refer to Section 5.6, Diagnostic Fault Codes. Follow the appropriate procedure from the Troubleshooting Guide for further instructions.

5.4.6 Thermistors

This test checks the operation of the thermistors (there are two thermistors measuring the temperature of the right drive and mowing motors).

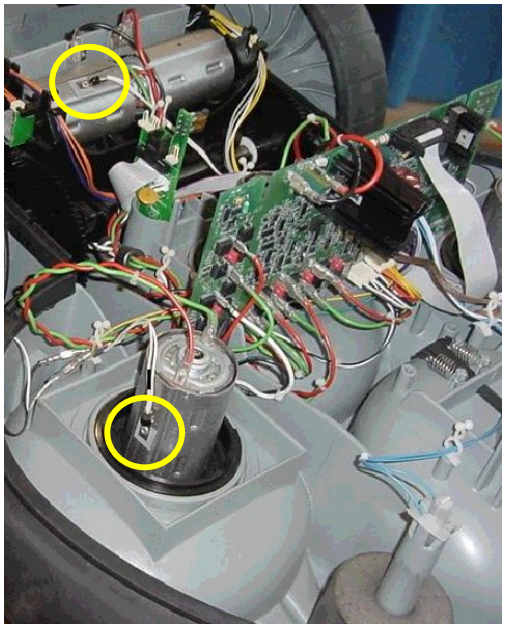
A. Insure the cutting height and ground clearance settings are on the highest setting.

B. Select *Thermistors* in the 'Service' menu.

C. Press the GO button for testing the thermistors.

D. The manual controller will display 'Test passed' or 'Test failed'

E. If the manual controller display shows 'Test failed', check the connection of the thermistors to the main board and also check for wiring damage.

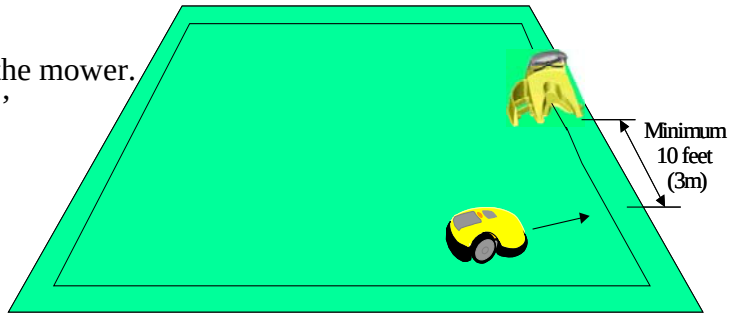


5.4.7 Docking Tests

This test checks the detection of the Charging Station by the Robomow.
Position the mower few meters (10 feet) before the Charging Station and follow the instruction below:

- Confirm the Docking Board is switched on.
- Insert the manual controller to its cradle in the mower.
- Choose the 'Tests' menu under the 'Service'
- Choose 'Docking tests' and press GO; the following is displayed:

Dock detection Press GO to test



- Press GO; the mower will start to move towards the Charging Station.
- The mower will try to connect to the Charging Station contacts and at the end of the test the following message will be displayed: when X can be one of the following values:

1) **01** - Docking was successfully detected
2) **02** – Mower mounted the Charging Station fully without detecting docking voltage or bumper from the end of the docking
3) **04** - Mower mounted the Charging Station fully without detecting docking voltage, but bumper from the inner wall of the Charging Station was detected

5.4.8 Edge Tests

This test displays the reason for the edge termination by the mower.

Perform this test in the following cases:
1. Robomow doesn't complete the edge in Docking or in non-docking zone.
2. Robomow doesn't reach the Charging Station at the end of the operation and stopped with 'Docking problem' message on its way back to the station.

Once edge termination test is selected the robot will enter a mode where it can be operated in any way, such as normal sending to Edge mowing. The display will be normal, However, once it detects that edge process is done/finished/ or terminated it will stop and display the cause for the edge termination by displaying the message "*Test result: X*" when *'X'* can be one of the following values:
01 – The perimeter wire was detected as Perimeter Island.
02 – The mower has reached the maximum turns to left (quarters counted by the compass) while looking for the entry point in docking zone.
03 - The mower has reached the required distance while looking for the entry point in docking zone.
04 - The mower has reached the learned edge distance that was set by the user in this zone.
05 – The mower has reached the maximum turns to the left (quarters counted by the compass).
06 – Charging Station is detected during edge
07 – Drop-off (Front wheel sensor) is detected for a long time during edge

To perform the 'Edge test' follow the instructions below:

- Choose the 'Tests' menu under the 'Service'
- Scroll to 'Edge test'
- Press GO - 'Edge termination' will be displays
- Now the mower knows that next Edge performance is a test.

5.4.9 Bat. Maintenance

Battery Maintenance is a multiple menu selection. It can provide valuable information on the charging maintenance habits of the customer as well as to help in identifying a faulty power pack.

Last Battery Voltage – this selection will tell you the last measured voltage of the power pack. This number is updated frequently when in charging mode and in automatic operation mode. If the mower is allowed to enter deep sleep mode, the last recorded voltage prior to deep sleep will be recorded here. This can be useful in determining charger operation by viewing the voltage over time. Additionally, it can be used to view voltage over time while in operation to understand a discharge rate to determine power pack condition.

Warning Ignored – the energy management system of the mower will issue audible and text messaging alerts to the user to prompt them to connect the mower to the charger when not in use (if the customer has failed to do so). The warnings vary in frequency of time and loudness, depending on the time disconnected from the charger. This warning system will function for approximately 48 hours before shutting down and entering a deep sleep mode for energy conservation. This selection indicates how many times the customer has ignored the alert system and allowed the mower to enter the deep sleep mode. This can indicate poor maintenance by the customer and could cause diminished power pack performance and service life. While any number here is cause for concern and illustrates the need to educate the user on proper maintenance, a count of more than 2 or more is serious and can damage the power pack.

Poor Storage – poor storage counter indicates how many times the mower was put into operation where the power pack capacity was less than 80% of fully charged. This essentially indicates how often the mower was used prior to the power pack being fully charged, where the count will not start until there is a 20% capacity loss from fully charged. The 20% criteria is important, as many people will use the mower is several smaller areas in addition to one large area. A smaller area will discharge the power pack, but not to the 20% level, so we do not want to count these types of operations. A high count here, greater than 3 or 4 indicates the user is not allowing enough time for the power pack to fully charge. If they indicate they must do this in order to mow all of their lawn (unclear), it is suggested they purchase an additional power pack and external charger.

Lastly, if the voltage of a power pack when inserted is less than 90% of the last measured voltage, it indicates the user is not fully charging the power pack prior to off-season storage, which is critical for good service life.

Reset – allows for resetting of all the listed battery parameters back to zero when a new power pack has been put in service or possibly if a service repair was done which may have affected the counters.

5.5 Settings Procedures

5.5.1 Docking Options

General comment: There is no need to change the settings under the 'Docking Options', unless there is an exception case, which prevent the mower to works normally. These options appeared in the menu as a backup only.

5.5.1.1 Edge to Dock

The 'Edge to dock' enable the mower to complete the edge operation from the Charging Station back to the Charging Station without any condition, otherwise there are few events that may cause the mower to leave the edge, such as distance limit or number of turns to the right or to the left.
If the mower doesn't complete the edge in 'Dock zone', first perform 'Edge termination test' (refer to section 5.4.8) and based on the test result, decide about the next step to be done.

5.5.1.2 Docking search vlt.

Option to increase the 'Searching dock' threshold voltage to 22.5 or 23.0 (the default is 22.0) in case, which the mower doesn't succeed to drive back to the Charging Station because of low battery voltage.

5.5.1.3 Dock bumper

Changing this option to 'off' will change the bumper behavior so it will make bypass in every bumper event during 'Edge' mode and will not push against obstacle.
Note: Setting this option to 'off' may prevent the mower to enter the Charging Station in case, which bumper is detected as the mower enter to the Charging Station.

5.5.1.4 Islands

Setting this option to 'off' allow the mower to acquire the Perimeter Wire immediately as starting to search for the Charging Station with no need to converge to the end of the lawn.

5.5.2 Small Wheels

It is an option to set the size of the drive wheels being used on the Robomow. The default settings are:
- RL350/550: Small wheels set to 'on'.
- RL850/1000: Small wheels set to 'off'

This setting is used when changing the drive wheel size on the Robomow. If this setting is not correct for the wheel size, the mower will not navigate properly and will likely not drive in straight lines.

5.5.3 Enable DK

Enable DK is a feature that is helpful when operating the mower in an area where magnetic interference is suspected in a certain lawn or when the Robomow is operated indoors, i.e. at an exhibition.
Indoors exhibitions are typically on concrete floors that contain a great deal of metals. This large amount of metal will skew the magnetic field causing the mower to run in curved lines rather than straight lines. Turning the 'Enable DK' feature off will allow the mower to navigate solely on wheel rotation measurement, thereby not using the magnetic field of the earth. This will allow for straight lines in a show environment. The default of this feature is always on.

Enable DK is divided into 2 modes: 'edge' and 'scan' and it is possible to disable the DK either in edge or scan. Disabling the DK in the 2 modes enables to operate the mower without compass at all (or when the compass is faulty).

5.5.4 Max leg distance

Enable to set the max distance between the perimeter wires in every zone.
There is a monitoring system that detects the wire sensors readings during operation. If the readings are not changed for some time (it depends on the distance between the wires), it means that the mower is probably stuck in place.

For example:
in lawn 10 by 30, the mower will not drive more than 10 meters with the same readings, but in lawn 40 by 90 it may drive for 60 meters with no changes in the wire sensors readings.

If during scanning it is found that the max leg distance set by the user is shorter than what does the mower calculate, then the S.W will update it.

5.5.5 Thermistors (Enable)

Enable *Thermistors* is set to 'on' as the factory default. This option is used when replacing a main board in an older model Robomow, which was manufactured without thermistors. Under this scenario, *Thermistors* must be turned to off or a failure message will display. However, the new board supports the use of thermistors, so the customer may elect to have the thermistors added to the unit at his expense, as an upgrade.

5.5.6 Mowing (Enable)

The mowing feature provides the ability to disable the operation of the mowing motors. All other aspects of the mower will perform normally, however the blades will not rotate. This feature is useful when testing the set up of the perimeter wire prior to having the wire fully pegged to the ground, preventing the risk of cutting it. Additionally, it is a feature that can be used when using the mower in exhibitions, for safety reasons.

5.5.7 Drv. Over current (Drive Over current)

This feature monitors the drive over current by the software. The default threshold is 50 (software units). If the mower detects over current (above 50) for 5 seconds continuously, the mower changes direction. This option enables setting the drive over current (load) threshold in which the mower will change the drive direction.

5.5.8 Mow Over current

This feature monitors the mowing over current by the software. The default threshold is 10 (software units). If the mower detects over current (above 10) for 15 seconds continuously, the mower changes direction. This option enables setting the mow over current (load) threshold in which the mower will change direction to move from the area with high grass.

5.5.9 Auto Restart

This option enables to set the cases in which Robomow restarts the operation automatically within an hour after it has stopped during the operation.

5.5.9.1 Drive Overload

If the mower stops with the following 'Drive overload - cooling, wait…'(10 min above 100 or 1 sec above 105), it will stay awake for up to **60 minutes** with the displayed message and blinking operating light. If the mower cooled down to allowed temperature that enables the operation (Drive - **85 Celsius**), the mower will automatically renew the operation from the point he has stopped.

5.5.9.2 Mow Overload

If the mower stops with the following 'Mow overload - cooling, wait…'(10 min above 90 or 1 sec above 100), it will stay awake for up to **60 minutes** with the displayed message and blinking operating light. If the mower cooled down to allowed temperature that enables the operation (Mow - **80 Celsius**), the mower will automatically renew the operation from the point he has stopped.

5.5.9.3 Power Break

Electrical power interruption - In every signal interruption the RL1000 will stop with 'Waiting for signal…' message. If the signal comes back within 60 minutes from the stop, the mower will restart the operation automatically, otherwise it will stop with 'No wire signal – press GO'. The Operating Lamp is blinking all the time that the mower is waiting.

5.5.10 Special Display

Choosing the 'Special display' option enables to display the relevant parameters to tested process
(such as temp, volt and sensor readings) and to perform detailed diagnostics. After a specific display is selected use the CANCEL ('C') button to toggle between normal and special display,
and the STOP button to terminate the special display.

5.5.10.1 Charging display

In this display the LCD will display the following information:

1.Charging stage	2.Battery voltage	3.Charger voltage	4.Docking state
5.Charging time	6.Charging FET d2a	7.Charging FET temp.	8.Ambience temp.	9.Charging enable flag

1. Charging stage.
   The stage of the charging process.
2. Battery voltage.
   Battery voltage in volts.
3. Charger voltage.
   Power Supply voltage in volts.

4. Docking state.
   If the charging is done through the charging socket (placed in the Manual Controller Holder) then '00' is displayed in the docking state.

   If the charging is done through the Docking Station, one of the following numbers is displayed:

   01 - Charging through the docking station

   02 - Problem in charging through the docking station

   03 - Robomow is trying to reconnect to the docking station for recharging

   04 - Automatic departure time

   05 - The user initiated the departure time

   06 - Disconnected from charging in order to cool down because of overheat in the ambience-charging temp.

   07 - Disconnected from charging in order to cool down because of overheat in the charging FET temp.

   08 - Disconnected from charging in order to cool down because of overheat which is caused when battery voltage is too high during charging.

   09 - Disconnected from charging in order to heat up when needed

   10- Disconnect from charging in order to perform the 'Learn entry points' sequence

   11 - Disconnected from docking contacts

5. Charging time.
   Indicates the charging time in hours from the time the Robomow is connected to the Power Supply/Docking Station.

6. Charging FET D2A.

   Indicates the charging FET state (for minimal charging voltage value is 250 – stage 4 in the charging process, for maximal charging voltage value is 60 – stage 1 in the charging process)

   Definition: **FET** (Field-Effect Transistor) A transistor whose control, or gate, signal creates an electro-magnetic field, which turns the transistor ON or OFF.

7. Charging FET temperature.

   Indicates FET temperature (ºC) while in charging. If temperature > 125ºC then cooling is required.

8. Ambience temperature.

   Indicates the ambience temperature (ºC).

9. Charging enable flag.

   Indicates if charging is enabled.
   0 – Charging is disabled.
   1 – Charging is enabled.

5.5.10.2 Wire Sensors

In this display the LCD will display the following information:

1.Front left reading	**2.**Front right reading	**3.**Bit rate
4.Rear left reading	**5.**Rear right reading	**6.**Wire sensors state

1. Front left reading.
   Front left wire sensor reading.
2. Front right reading.
   Front right wire sensor reading.
3. Wire bit rate.
   Indicate the frequency of the wire signal (S.W units)
4. Rear left reading.
   Rear left wire sensor reading.
5. Rear right reading.
   Rear right wire sensor reading.
6. Wire sensors state.
   0 - all wire sensors are inside the garden
   1 - forward right sensor outside the garden
   2 - backward left sensor outside the garden
   4 - forward left sensor outside the garden
   5 - forward left and right sensors outside the garden
   6 - forward left and backward left sensors outside the garden
   7 - forward left forward right and backward left sensors outside the garden
   8 - backward right sensor outside the garden
   9 - forward right and backward right sensors outside the garden
   10 - backward left and right sensors outside the garden
   11 - backward left backward right and forward right sensors outside the garden
   13 - forward left forward right and backward right sensors outside the garden
   14 - backward left backward right and forward left sensors outside the garden
   15 - all wire sensors are outside the garden

5.5.10.3 Temperature

In this display the LCD will display the following information:

1.Mow temperature (ºC)	**2.**Right drive temperature (ºC)	**3.**Ambience temperature (ºC)
4.Mow temperature (A2D)	**5.**Right drive temperature (A2D)	**6.**Charging FET temperature (ºC)

1. Mow temperature (ºC).
   Mow temperature in ºC.
2. Right drive temperature (ºC).
   Right drive temperature in ºC.

3. Ambience temperature (ºC).
   Ambience temperature in ºC.
4. Mow temperature (a2d).
   Mow temperature in a2d.
   Otherwise - over current.
5. Right drive temperature (a2d).
   Right drive temperature in a2d.
6. Charging FET temperature (ºC).
   Charging FET temperature in ºC.

5.5.10.4 Edge

In this display the LCD will display the following information:

1.DK angle (degrees)	**2.**DK quarters	**3.**High edge speed
4.Moving toward DS	**5.**Wire sensors state	**6.**Dist from right turn (meters)

1. DK angle.
   DK angle in degrees.
2. DK quarters.
   DK quarters during edge.
3. High edge speed.
   Indicates if high speed during edge is enabled.
   0 – Disabled
   1 – Enabled
4. Moving towards Charging Station.
   Indicates if we are moving towards the Charging Station.
   0 – No
   1 - Yes
5. Wire sensors state:
   0 - all wire sensors are inside the garden
   1 - forward right sensor outside the garden
   2 - backward left sensor outside the garden
   4 - forward left sensor outside the garden
   5 - forward left and right sensors outside the garden
   6 - forward left and backward left sensors outside the garden
   7 - forward left forward right and backward left sensors outside the garden
   8 - backward right sensor outside the garden
   9 - forward right and backward right sensors outside the garden
   10 - backward left and right sensors outside the garden
   11 - backward left backward right and forward right sensors outside the garden
   13 - forward left forward right and backward right sensors outside the garden
   14 - backward left backward right and forward left sensors outside the garden
   15 - all wire sensors are outside the garden
6. Distance from right turn in meters

5.5.10.5 Drive motors

In this display the LCD will display the following information:

1.Left drive current (A2D)	**2.**Right drive current (A2D)	**3.**Right drive temperature (ºC)
4.Over current counter	**5.**Hardware over current	**6.**Right drive temperature (A2D)

1. Left drive current.
   Left drive current in a2d.
2. Right drive current.
   Right drive current in a2d.
3. Right drive temperature (ºC).
   Right drive temperature in ºC.
4. Over current counter.
   Indicates if drive over current is detected either by Hardware current limiter or by Software current readings.
   0 – No over current
   Otherwise - over current.
5. Hardware over current.
   Indicates if drive over current is detected by Hardware current limiter.
   0 – Over current not detected.
   1 - Over current detected
6. Right drive temperature (a2d).
   Right drive temperature in a2d.

5.5.10.6 Mow motors

In this display the LCD will display the following information:

1.Left mow current (A2D)	**2.**Middle mow current (A2D)	**3.**Right mow current (A2D)
4.Over current counter	**5.**Hardware over current	**6.**Temperature (ºC). or over current event counter

1. Left mow current.
   Left mow current in a2d.
2. Middle mow current.
   Middle mow current in a2d.
3. Right mow current.
   Right mow current in a2d.
4. Over current counter.
   Indicates if mow over current is detected either by Hardware current limiter or by Software current readings.
   0 – No over current
   Otherwise - over current

5. Hardware over current.
   Indicates if mow over current is detected by Hardware current limiter.
   0 – Over current not detected.
   1 - Over current detected
6. Mow temperature (ºC) or over current event counter
   The display will switch every 3 seconds between:
   1) Mow temperature in ºC.
   2) Mow over current events counter.

If mowing motors are off the following information will be displayed:

1. '0' (A constant '0' will be displayed)
2. Should be '0', otherwise represents the mowing disable reason.
3. Operation state.
4. Last stop cause reason.
5. Current movement id.
6. Should be '0', otherwise represents the mowing disable reason.

5.5.11 Factory Defaults

Choosing the '*Factory Defaults'* option will return all selectable settings back to the original factory setting. This option should be used after software upgrading is done. This can be helpful if the user has changed many settings, as it is faster than changing each item independently. After '*Factory Defaults*' is performed, the following procedures should be performed:

Learn Wire Sensors (See procedure in Section 5.3.1)
Edge Calibration (See procedure in Section 5.3.2)
Set Country (See procedure in Section 5.3.3)
DK Calibration (See procedure in Section 5.3.4)

5.6 Diagnostics Fault Codes

5.6.1 Drive Motors Problems

Fault #	Diagnosed item	Meaning	Possible cause
100	Drive motors (Forward)	Right motor current<100mA	Right motor is disconnected
101	Drive motors (Forward)	Left motor current<100mA	Left motor is disconnected
102	Drive motors (Forward)	Right & Left motors current<100mA	Right & Left motors are disconnected
110	Drive motors (Forward)	Right odometer reading=0	Right odometer is disconnected
111	Drive motors (Forward)	Left odometer reading=0	Left odometer is disconnected
112	Drive motors (Forward)	Right & Left odometer reading=0	Right & Left odometers are disconnected
120	Drive motors (Forward)	Right motor PWM>95%	Right wheel friction is too high
121	Drive motors (Forward)	Left motor PWM>95%	Left wheel friction is too high
121	Drive motors (Forward)	Right & Left motors PWM>95%	Right & Left wheels friction is too high
130	Drive motors (Forward)	Right wheel PWM>Left wheel PWM	Right wheel friction>Left wheel friction, or Right motor is slower than Left motor
131	Drive motors (Forward)	Left wheel PWM>Right wheel PWM	Left wheel friction>Right wheel friction, or Left motor is slower than Right motor
140	Drive motors (Forward)	Right PWM<78 or >82	Test again
141	Drive motors (Forward)	Left PWM<78 or >82	Test again
142	Drive motors (Forward)	Right & Left PWM<78 or >82	Test again
143	Drive motors (Forward)	Measured PWM difference >2	Test again
200	Drive motors (Backward)	Right motor current<100mA	Right motor is disconnected
201	Drive motors (Backward)	Left motor current<100mA	Left motor is disconnected
202	Drive motors (Backward)	Right & Left motors current<100mA	Right & Left motors are disconnected
210	Drive motors (Backward)	Right odometer reading=0	Right odometer are disconnected
211	Drive motors (Backward)	Left odometer reading=0	Left odometer are disconnected
212	Drive motors (Backward)	Right & Left odometer reading=0	Right & Left odometers are disconnected
220	Drive motors (Backward)	Right motor PWM>95%	Right wheel friction is too high

221	Drive motors (Backward)	Left motor PWM>95%	Left wheel friction is too high
222	Drive motors (Backward)	Right & Left motors PWM>95%	Right & Left wheels friction is too high
230	Drive motors (Backward)	Right wheel PWM>Left wheel PWM	Right wheel friction>Left wheel friction, or Right motor is slower than Left motor
231	Drive motors (Backward)	Left wheel PWM>Right wheel PWM	Left wheel friction>Right wheel friction, or Left motor is slower than Right motor
240	Drive motors (Backward)	Right PWM<78 or >82	Test again
241	Drive motors (Backward)	Left PWM<78 or >82	Test again
242	Drive motors (Backward)	Right & Left PWM<78 or >82	Test again
243	Drive motors (Backward)	Measured PWM difference >2	Test again

5.6.2 Mowing Motors Problems

Fault #	Diagnosed item	Meaning	Possible cause
301	Mowing motors	Right Motor current > 100mA	Right Motor power unit is faulty
302	Mowing motors	Mid Motor current > 100mA	Mid Motor power unit is faulty
303	Mowing motors	Right + Mid Motor current > 100mA	Right +Mid Motor power units are faulty
304	Mowing motors	Left Motor current > 100mA	Left Motor power units is faulty
305	Mowing motors	Right + Left Motor current > 100mA	Right +Left Motor power units are faulty
306	Mowing motors	Mid +Left Motor current > 100mA	Mid +Left Motor power units are faulty
307	Mowing motors	Right +Mid +Left Motor current > 100mA	Right +Mid +Left Motor power units are faulty
331	Mowing motors	Right Motor current < 100mA	Right Motor is disconnected
332	Mowing motors	Mid Motor current < 100mA	Mid Motor is disconnected
333	Mowing motors	Right +Mid Motor current < 100mA	Right +Mid Motor are disconnected
334	Mowing motors	Left Motor current < 100mA	Left Motor is disconnected
335	Mowing motors	Right +Left Motor current < 100mA	Right +Left Motors are disconnected
336	Mowing motors	Mid +Left Motor current < 100mA	Mid +Left Motors are disconnected
337	Mowing motors	Right +Mid +Left Motor current < 100mA	Right +Mid +Left Motors are disconnected
341	Mowing motors	Right Motor current > 2A	Right Motor is overloaded
342	Mowing motors	Mid Motor current > 2A	Mid Motor is overloaded
343	Mowing motors	Right +Mid Motor current > 2A	Right +Mid Motors are overloaded
344	Mowing motors	Left Motor current > 2A	Left Motor is overloaded
345	Mowing motors	Right +Left Motor current > 2A	Right +Left Motors are overloaded
346	Mowing motors	Mid +Left Motor current > 2A	Mid +Left Motors are overloaded
347	Mowing motors	Right +Mid +Left Motor current > 2A	Right +Mid +Left Motors are overloaded
351	Mowing motors	Right Motor current > 100mA	Right Motor stopping is faulty
352	Mowing motors	Mid Motor current > 100mA	Mid Motor stopping is faulty
353	Mowing motors	Right +Mid Motor current > 100mA	Right +Mid Motors stopping is faulty

354	Mowing motors	Left Motor current > 100mA	Left Motor stopping is faulty
355	Mowing motors	Right +Left Motor current > 100mA	Right +Left Motors stopping is faulty
356	Mowing motors	Mid +Left Motor current > 100mA	Mid +Left Motors stopping is faulty
357	Mowing motors	Right +Mid +Left Motor current > 100mA	Right +Mid +Left Motors stopping is faulty

5.6.3 Wire Sensors Problems

Fault #	Diagnosed item	Meaning	Possible cause
401	Wire sensors	FR sensor <2	FR sensor is disconnected
402	Wire sensors	FL sensor<2	FL sensor is disconnected
403	Wire sensors	FR+FL sensors<2	FR+FL sensors are disconnected
404	Wire sensors	RR sensor<2	RR sensor is disconnected
405	Wire sensors	FR+RR sensors<2	FR+RR sensors are disconnected
406	Wire sensors	FL+RR sensors<2	FL+RR sensors are disconnected
407	Wire sensors	FR+FL+RR sensors<2	FR+FL+RR sensors are disconnected
408	Wire sensors	RL sensor<2	RL sensor is disconnected
409	Wire sensors	FR+RL sensor <2	FR+RL sensor are disconnected
410	Wire sensors	FL+RL sensor<2	FL+RL sensor are disconnected
411	Wire sensors	FR+FL+RL sensors<2	FR+FL+RL sensors are disconnected
412	Wire sensors	RR+RL sensor<2	RR+RL sensor are disconnected
413	Wire sensors	FR+RR+RL sensors<2	FR+RR+RL sensors are disconnected
414	Wire sensors	FL+RR+RL sensors<2	FL+RR+RL sensors are disconnected
415	Wire sensors	FR+FL+RR+RL sensors<2	FR+FL+RR+RL sensors are disconnected
420	Wire sensors	Low beat rate (<30) from the VCXO (Oscillator)	Faulty or disconnected VCXO (soldering problem) Remedy – Main Board Replacement
421	Wire sensors	FR sensor is noisy	FR sensor is noisy
422	Wire sensors	FL sensor is noisy	FL sensor is noisy
423	Wire sensors	FR+FL sensors are noisy	FR+FL sensors are noisy
424	Wire sensors	RR sensor is noisy	RR sensor is noisy
425	Wire sensors	FR+RR sensors are noisy	FR+RR sensors are noisy
426	Wire sensors	FL+RR sensors are noisy	FL+RR sensors are noisy
427	Wire sensors	FR+FL+RR sensors are noisy	FR+FL+RR sensors are noisy
428	Wire sensors	RL sensor is noisy	RL sensor is noisy
429	Wire sensors	FR+RL sensor are noisy	FR+RL sensor are noisy
420	Wire sensors	FL+RL sensor are noisy	FL+RL sensor are noisy
431	Wire sensors	FR+FL+RL sensors are noisy	FR+FL+RL sensors are noisy
432	Wire sensors	RR+RL sensor are noisy	RR+RL sensor are noisy
433	Wire sensors	FR+RR+RL sensors are noisy	FR+RR+RL sensors are noisy
434	Wire sensors	FL+RR+RL sensors are noisy	FL+RR+RL sensors are noisy
435	Wire sensors	FR+FL+RR+RL sensors are noisy	FR+FL+RR+RL sensors are noisy
450	Wire sensors	Beat rate problem	Beat rate problem

5.6.4 Direction Keeping Problems

Fault #	Diagnosed item	Meaning	Possible cause
500	Direction Keeper	Low resolution reading=0	Direction keeper is faulty
510	Direction Keeper	Low resolution readings are noisy	Direction keeper is noisy
523	Direction Keeper	Coils 1+2 cannot be zeroed	Magnetic interference or coils disconnected
525	Direction Keeper	Coils 1+3 cannot be zeroed	Magnetic interference or coils disconnected
526	Direction Keeper	Coils 2+3 cannot be zeroed	Magnetic interference or coils disconnected
527	Direction Keeper	Coils 1+2+3 cannot be zeroed	Magnetic interference or coils disconnected
528	Direction Keeper	At least two coils cannot be zeroed cannot be zeroed	Magnetic interference or coils disconnected
529	Direction Keeper	Coils 1+3 cannot be zeroed	Magnetic interference or coils disconnected
530	Direction Keeper	Coils 2+3 cannot be zeroed	Magnetic interference or coils disconnected
531	Direction Keeper	Coils 1+2+4 cannot be zeroed	Magnetic interference or coils disconnected
532	Direction Keeper	Coils 3+4 cannot be zeroed	Magnetic interference or coils disconnected
533	Direction Keeper	Coils 1+3+4 cannot be zeroed	Magnetic interference or coils disconnected
534	Direction Keeper	Coils 2+3+4 cannot be zeroed	Magnetic interference or coils disconnected
535	Direction Keeper	Coils 1+2+3+4 cannot be zeroed	Magnetic interference or coils disconnected

5.7 Last Stop Cause

Every time the mower stops with an error message (+ Press GO), it is possible to look at the 'Last stop cause' information under the 'Information' menu and to have more details about the reason, which cause the mower to stop.

The table below shows the description of the stop cause:

Stop cause #	Message	Description
1		Internal use
2	Blocked path	Bumper event was received during GO sequence
3	Start elsewhere	Software problem – bumper related
4	Start elsewhere	Software problem – bumper related
5	Start elsewhere	Software problem – bumper related
6	Start elsewhere	Software problem – bumper related
7	Drive overload	Drive motor overload
8	Low battery	Very low battery voltage
9	Start elsewhere	Software problem
10	Drive problem	Problem in the odometer (drive wheels are active but odometer pulses are not detected)
11	Drive overload	Drive motor overload
11 (only in 2005 version)	Start elsewhere	Time out during forward or backward movements during scanning (The robot is probably stuck)
12	Front wheel prob.	Robomow has exceeded the allowed front wheel detection time (Drop off)
13	D.K. problem	DK problem
14	Start elsewhere	DK current calibration failure (During the mowing motors activation in the GO sequence)
15	Start elsewhere	Software problem
16	Start elsewhere	Software problem
17	Start elsewhere	Software problem
18	Start elsewhere	Software problem
19	Start elsewhere	Time out during forward or backward movements during scanning (The robot is probably stuck)
20	No wire signal	Mechanism for recovering from electricity power interruption during automatic operation has failed
21	Mowing overload	Mechanism for recovering from mowing motors overheat during automatic operation has failed
22	Front wheel prob.	Robomow has exceeded the allowed front wheel detection time (Drop off)

Stop cause #	Message	Description
23	Start elsewhere	Problem with the wire during Edge Robomow has detected that all 4 wire sensors are outside the garden for too long
24	Start elsewhere	Problem with the wire during Edge
25	Start elsewhere	Problem with the wire during Edge Robomow unable to locate the wire for too long
26	Start elsewhere	Failure of the Wire Acquisition process
27	Start elsewhere	Software problem
28	Start elsewhere	Failure of the Wire Acquisition process - rear bumper was detected during Acquisition
29	Max dist reached	Robomow has reached the maximal Edge distance during the “Learn Edge" process
30	Docking problem	Edge process was terminated before we reached the docking station
31	Start elsewhere	Software problem
32	Start elsewhere	Software problem
33	Drive overload	Mechanism for recovering from drive motors overheat during automatic operation has failed
34	Check mow height	Mowing motors problem Mowing motors are off but high currents are measured. This means that either the mowing motors or the Main board are damaged.
36	Check mow height	Mowing motors problem High Mowing motors currents are detected after Mowing currents calibration in GO (after mowing motors are activated for a few seconds when robot is not moving).
37	Start elsewhere	Software problem
38	Start elsewhere	Software problem
39	Start elsewhere	Software problem
40	Check mow height	Mowing motors problem Too many over current events occurred during automatic mode.
41	Start elsewhere	Software problem
42	Start elsewhere	Software problem
43	Check mow height	Mowing motors problem Over current event during manual mode
44	Start elsewhere	Software problem
45	Docking problem	Failure connecting to the docking station
46	Start elsewhere	Software problem
47	Start elsewhere	Software problem
48	Start elsewhere	Software problem

Stop cause #	Message	Description
49	Start elsewhere	Problem with the wire sensors readings
50	Start elsewhere	Software problem
51	Start elsewhere	Problem with the wire sensors readings
52	Start elsewhere	Software problem
53	Blocked path	Path is blocked
54	No wire signal	No wire signal during automatic operation
55	Front bumper disc	Front bumper disconnected
56	Rear bumper disc	Rear bumper disconnected
57	Front bmp pressed	Front bumper pressed
58	Front bmp pressed	Front bumper pressed
59	Rear bmp pressed	Rear bumper pressed
60	Move from wire	Problem with the wire sensors readings Perimeter wire might be too close
61	Start elsewhere	Problem with the wire sensors readings
62	Start elsewhere	Problem with the wire sensors readings Wire synchronization failure
63	No wire signal	No wire signal
64	Set country	Set country
65	Calibration req.	DK calibration is required
66	Enable dock on/off	Enable/Disable docking station
67	Start elsewhere	Software problem
68	Blocked path	Bumper detection during manual mowing
72	Start elsewhere	Software problem
73	Start elsewhere	Software problem
76	Frnt bumper disc	Front bumper disconnected
77	Rear bumper disc	Rear bumper disconnected
78	Time completed	Working time expired
79	Start elsewhere	Software problem
80	Start elsewhere	Software problem
81	Start elsewhere	Problem with the wire sensors readings
82	No wire signal	No wire signal
83	No wire signal	No wire signal detected during GO
84	Move from wire	Problem with the wire sensors readings Perimeter wire might be too close
85	Start elsewhere	Problem with the wire sensors readings
86	Start elsewhere	Problem with the wire sensors readings

Stop cause #	Message	Description
87	No wire signal	No wire signal
88	Move from wire	Problem with the wire sensors readings
89	Start elsewhere	Problem with the wire sensors readings
90	Move from wire	Problem with the wire sensors readings Perimeter wire might be too close
91	Start elsewhere	Problem with the wire sensors readings
92	Move from wire	Problem with the wire sensors readings Perimeter wire might be too close
93	Start elsewhere	Problem with the wire sensors readings
94	No wire signal	No wire signal
95	No wire signal	No wire signal
96	Recharge batt.	Battery needs recharging
98	Start elsewhere	Software problem
100	Check mow height	Mowing motors problem
101	Mowing Overload	Mowing motors overload
102	Drive overload	Drive motors overload
103	Start elsewhere	Problem with the wire sensors readings during Edge
107	Start elsewhere	Failure of the Wire Rescue maneuver
109	Start elsewhere	Software problem
113	Replace lamp	Replace lamp
114	Thermistors fail	Thermistors failure
115	Bumper disc.	Bumper disconnected
116	Bumper disc.	Bumper disconnected
117	'Button name' pressed	One of the remote's buttons is pressed during power up
118	Start elsewhere	Problem with the wire sensors readings
119	Rain detected	Rain detected
120	Replace blades	Replace blades
121	Docking problem	Robot did not succeed disconnecting from the docking
122	Docking problem	Edge process was terminated before we reached the docking station because perimeter island was detected
123	Docking problem	Edge process was terminated before we reached the docking station because we reached the required DK quarters
124	Docking problem	Software problem
125	Docking problem	Edge process was terminated before we reached the docking station because we reached the required edge distance that was set by the user in this Zone
126	Docking problem	Edge process was terminated before we reached the docking station because we reached the required DK quarters

Stop cause #	Message	Description
128	Max dist reached	Robomow has reached the maximal Edge distance during the “Wire position test"
129	Test result: ‘result’	Termination of the Edge termination test
130	Test result: ‘result’	Termination of the docking station entry test
131	Docking problem	Robomow has slid off the docking station more than 5 times during the current charging process
132	Docking problem	Robomow has slid off the docking station more than 5 times during the current charging process
134	Low temperature	Ambient temperature is too low for more than 12 hours during the charging process
135	High temperature	Ambient temperature is too high for more than 12 hours during the charging process
136	Charging failure	Charging problem
137	Charging failure	Charging FET temperature is too high for more than 3 hours during the charging process
138	Check P. switch	Perimeter switch problem
139	Check Power	No wire or charger voltage are detected in the docking station for more than 1 minute
140	Check Power	Charging problem
141		STOP button was pressed during automatic operation
142		Remote was taken out during automatic operation
143	Left/Mid/Right mow problem	Disconnected or burnt Left Right or Middle mowing motor
144	Start elsewhere	Robot stuck monitor detection. Robot is stuck in place for too long.
145	One of the following: No wire signal Mowing overload Drive overload	Auto restart mechanism stop.

6. Friendly Robotics Procedures and policies

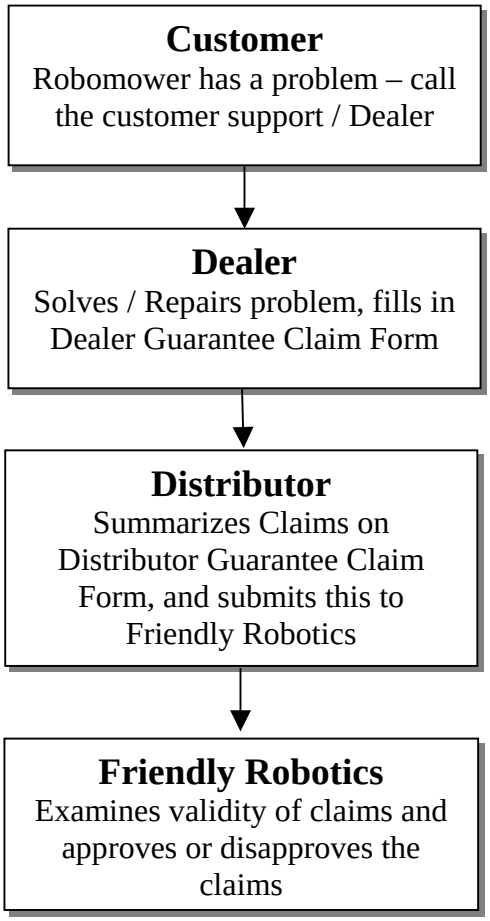
6.1 Warranty Claims

6.1.1 Warranty Claims Procedure

This document describes the warranty cost recognition policy for the Robomower from January 01, 2004 and beyond. It contains guidelines and explanations for filling and reporting the Warranty claim forms by Friendly authorized distributors to Friendly Robotics and the approval procedure of the claims by Friendly Robotics.

6.1.1.1 Claim submission procedure

The complete process, starting with a customer complaint and ending with a credit from Friendly, is illustrated in the flowchart below:



6.1.1.1.1 Customer Complaint

In case of a problem with the Robomower, the customer should call to the Customer Support or the nearest local dealer for assistance.

6.1.1.1.2 Dealers Activities

A valid proof of purchase is required for warranty repairs. The Dealer should try solving the problem over the phone, as described in the Problem Analysis Flowcharts section of the Service Guide. If the problem was not solved over the phone, either the customer should bring/send the faulty mower to the dealer or the dealer should visit the customer's residence, depending on the problem type and the dealer's policy.

If the dealer cannot solve/repair the problem, it should be communicated to the Distributor.

If the dealer solves the problem and decides to claim the repair expenses from Friendly, a written Warranty Claim should be sent to the Distributor. All service calls for which claims were made during one month should be sent to the Distributor during the following month. The dealer MUST provide the following information for EVERY repair of every claim:

- Dealer name
- Service date
- Product and model name
- Serial number
- Date of product purchase by the customer
- Warranty period end date
- Problem description (FCS code)
- Parts required to complete repair
- Cost claimed (labor time and spare parts cost)

All these items are required by Friendly Robotics for every claim and a claim cannot be considered unless all of this information was provided by the dealer and received by Friendly. Together with this monthly report, all faulty parts identified and associated with a specific claim, should be kept by the Dealer for 90 days from repair or until the claim has been paid, whichever comes first.

The warranty period for products is defined in the warranty card provided with each unit. Any nominated dealer of Distributor may repair any product during this period. Any such claim shall be submitted to Distributor on a monthly basis. The warranty claim made by the Dealer should be provided to Distributor no later than 60 days from the date of the repair.

IMPORTANT!

Claims submitted to Friendly Robotics after more than 90 days from the repair date will not be recognized. It is important to submit the claims you have on a monthly base, so the approval process will be completed on time.

6.1.1.1.3 Distributor Activities

The distributor should review every claim submitted by a dealer and verify the following:

- Dealer provided all required information and details.
- All faulty spare parts were kept or supplied with the claim and were identified.
- The product repaired was under Warranty.
- The claim is logical in terms of applied solution, time claimed and total claim amount.

A Claim will be approved by the Distributor and included in the Claims report sent to Friendly, only if all of the above conditions were met.

The Distributor should summarize all approved Warranty claims submitted by the Dealers on an Excel sheet called Distributor Warranty Claim Form (see appendix A). A separated report should be formed for every product model (i.e. RL500, RL800, RL550, RL850 and RL1000). At the top of every report the following should be written:

- Distributor name
- Country
- Product / model
- Claim period (month)

The form includes the following details for each claim:

- Dealer's claim number
- Product serial number
- Date of repair
- Date of sale
- Parts used
- Time claimed (time cost, spares cost and administration cost)
- FCS Code (codes describe the failure).

The Distributor should summarize Warranty Claim received from the Dealers on a monthly basis and send the claim to Friendly Robotics every month for the month preceding it. The Claims should be submitted to Friendly no later than **90 days** from the date of the repair.

The Distributor should hold the faulty parts for 90 days from repair or until the claim has been paid, whichever comes first.

6.1.1.1.4 Friendly Robotics Activities

Friendly Robotics will examine every claim. In order to expedite the claim examination process, all required details should be provided in the Warranty Claims report in order to prevent delay in the approval process. Whenever it will be deemed necessary by Friendly to analyze a faulty part, the part should be sent to Friendly. Friendly reserves the right to ask for any faulty part that was claimed for to be shipped for inspection.

Claims approval by Friendly's Customer Support will be sent both to the Distributor and to Friendly's Finance Department. The approval received from Friendly Customer Support will enable the Distributor to scrap all the faulty parts defined under a specific report, which had been approved. Friendly Robotics Finance Department will send a credit note that can be deducted from future payments to Friendly Robotics.

6.1.1.2 Distributor Warranty Claim Form filling instructions

The Distributor should summarize the Warranty Claims on the Excel file supplied by Friendly Robotics (see appendix A). The report should be submitted on a monthly basis. This form is identical to all distributors and is supplied by Friendly Robotics. The distributor should fill only the yellow cells in the 'Warranty Claims Report' spreadsheet; the second and the third spreadsheets used as data inputs to fulfill the first spreadsheet; the fourth spreadsheet is automatically filled summarizing the total parts used.

The following information should be filled in the first spreadsheet:

1. **Distributor** (cell C6)**:** the name of the distributor company.
2. **Country** (cell C7)**:** the country where the distributor is active.
3. **Product / Model** (cell C8)**:** the name of the product / model. Every report should summarize the Warranty claims of each model separately.
4. **Claim Period (month)** (cell N6)**:** the month, which this report is referring to. One report should be sent every month for each product. Do not separate the claims for more than one report in the same month.
5. **Shop rate (€ per hour)** (cell N7)**:** The labor cost of the dealer per hour.
6. **Claim Date** (cell N8)**:** the date, which the Warranty Claims report is sent to Friendly Robotics.
7. **Dealer's Claim No.** (column B): the number of the claim received from the dealer.
8. **Serial No.** (column C)**:** Serial number of the product – it can be found under the Power Pack. The format of the serial number is IRL with another 10 digits (IRLxxxxxxxxxx) – do no make any shortening.
9. **Operation Hours** (column D)**:** total operation hours of the mower.
10. **Date of Repair (column E): Date the unit was repaired by the dealer.**
11. **Date of Sale** (column F): Date the product was purchased by the customer.
12. **Part used** (column H): Fill the item number (changed from 1,2,3 to 128) of the part used, taken from the second spreadsheet 'Parts List & Cost & Time' (column A). Press cell number G11 (Part No.) in the first spreadsheet 'Warranty Claims Report' to show the part list.
13. **Part Description, Labor Time and Part Cost** (columns I to K): These columns are automatically filled from the data appeared in the second spreadsheet 'Parts List & Cost & Time' (for more details about the time claimed calculation refer to appendix B).
14. **Part used** (columns M, R and V): These are optional columns to be filled in case there is more than one part replaced in the same claim.

15. **Part Description, Labor Time and Part Cost (for the second, third and fourth part in the same claim):** In such case, where more than one part is used to repair the unit, the labor time for the second and third parts is taken from column E at the second spreadsheet 'Parts List & Cost & Time', as there is no need to add again the time to remove the cover and the time required to test the mower at the end of the repair.
16. **Summary** (columns AA to AE): All these columns are automatically summarized.
17. **Other Cost** (column AC)**:** this column is reserved for cases, for which the dealer repairs the unit without replacing any part. In such case the details of the 'Other Cost' should be filled in columns AU, which describes the details of the repair and AQ which summaries the repair time.
18. **Total** (column AE)**:** The total cost, calculated automatically as sum of all the costs related mentioned before.
19. **FCS Code:** See detailed explanation in paragraph 6.2

6.1.1.3 Items and Conditions Not Covered under Warranty:

1. Normal wear and tear, including blades and fading of paint or plastic parts.
2. Any product or part that has been altered, misused, abused or requires replacement or repair due to accidents or lack of proper maintenance.
3. Cost of Setup (installation or reinstallation of the perimeter wire), removal of installation or any costs or damages associated with improper installation or use of product.
4. Any product that has been opened, repaired, modified or altered by anyone other than a Friendly Robotics authorized repair technician.
5. Repairs necessary due to improper battery care, electrical supply irregularities, or failure to properly prepare the mower or battery for winter storage or other extended storage periods.
6. Repairs necessary due to water damage, other than incidental rain exposure.
7. Transportation costs. The owner bears all responsibility for transportation costs to an authorized Friendly Robotics service.
8. Power Pack warranty is limited to 18 months from manufacturing date (printed on the 4 first digits in the product serial number) or one year from date of purchase, whichever comes first.
9. Robomower replacement is not approved under warranty, unless written approval is given from Friendly Robotics Customer Support.

6.1.2 Friendly Coding System (FCS) Explanation

Friendly Coding System (FCS) is Friendly's method for recording and tracking customer complaints about the Robomower performance. The purpose of the FCS is to systematically and logically capture and organize the information coming from the customers, the evolution of every complaint and repair, in a way that will be easier to classify and analyze the data.

Instead of writing out a textual report on every customer complaint or faulty unit, a code is inserted and it details the customer complaint, root cause and what was done to solve the problem. In addition, the FCS will allow for easier data presentation in different levels and views to measure the Robomower quality in various metrics.

In FCS, every case (customer complaint / service call) consists of 3 difference fields:

1) Customer Observation Code
2) Failure Code
3) Repair Code

6.1.2.1 Customer Observation

The Customer Observation Code is a record of the customer complaint. It should be logged by the call center/service provider and include the customer perception of the problem and the conclusion of the interviewer based on the answers provided by the customer. The Customer Observation Code is divided into groups according to their families (Power Pack, Manual Controller, Mowing and so on). Where available you can find the relevant 'problem analysis flowchart' for the customer observation.

Customer Observation

A Error Message (red) / Symptom (black)		Flowchart
	Area coverage	
101	Uncut area in the lawn edge	3.2.4.2
102	Many patches of uncut grass	3.2.5.1
103	Robomower ignores areas	3.2.5.2
109	Other coverage issues	
	General	
111	Dissatisfaction from product performances	
112	Smoke comes from the robot / Burnt smell	
113	Robot doesn't work / dead	3.2.2.1
114	Stops with no message	3.2.5.3
115	The robot is too noisy	3.2.12.1
116	Operating light does not work	
119	Other general issues	
	Setup (Perimeter Switch and Wire)	
121	Wire disconnected (P. switch warning)	3.2.1.1
122	Replace battery (P. switch warning)	3.2.1.2
123	Perimeter switch does not operate	3.2.1.3
129	Other issues	
	Power Pack & Charging	
131	Charging failure	3.2.2.2
132	Charging problem / Check Power	3.2.2.3
133	Short run time	3.2.2.5
134	Dead or week battery	3.2.2.1
135	Robomower does not 'Wake up'	3.2.2.1
136	Does not reach 'Fully charged'	
137	Long time to fully charge the battery	#RL0305-07
138	No Charging indication/ message	3.2.2.4
139	Charging socket damaged	
140	Faulty/damaged charger	
149	Other battery and charging issues	
	Edge	
151	Blocked path' message	3.1
152	Robomower doesn't complete edge	3.2.4.1
153	Not centered on the perimeter wire	3.2.4.2
154	Uncut edge	3.2.4.2
155	Mower crocess wire	3.2.5.6
156	'zigzagging' as it edges	3.2.4.3
159	Other edge issues	

Customer Observation

	A Error Message (red) / Symptom (black)	Flowchart
	Scan	
161	User Help Needed / Start Elsewhere message	3.1
162	Crocess wire (perimeter island)	3.2.5.6
163	Crocess wire, outside perimeter loop	3.2.5.6
164	Changes direction in the middle of the lawn	
165	Keeps going back and forth on the same lines	3.2.5.4
166	360 degrees circles	
167	Does not move in straight lines	3.2.5.5
169	Other scan issues	
	Manual mowing and controller	
171	Key pressed	3.1
172	Buttons do not respond	3.2.6.1
173	No / weak display	3.2.2.1
174	No audio/speech	
175	Does not switch to manual/automatic	3.2.6.2
176	Water and condensation inside	
177	Torn / fallen M. Controller button	
178	Display is in a foreign language	
179	Cannot start manual mowing	3.2.3.5
189	Other manual controller issues	
	Mowing system	
191	'Mow overload – Cooling, wait…' message	3.2.3.4
192	Mowing disabled	3.1
193	'Check mow height' message	3.2.3.1
194	Mowing motors do not start	3.2.3.3
195	Poor mulching	3.2.3.6
196	Uncut lane left	3.2.3.2
197	Cutting height is too high	
198	Broken / bent / blunt blade	
199	Mowing system is too noisy	3.2.12.1
209	Other mowing issues	
	Drive System + Wheels	
211	Front wheel problem' message	3.2.8.1
212	'Drive overload – press GO' message	3.2.7.1
213	'Drive overload – Cooling, wait…' message	3.2.7.2
214	'Drive problem' message	3.2.7.3
215	Front wheel does not rotate	
216	Front wheel comes out of its place	
217	The front wheel is noisy	3.2.12.1
218	The front wheel is stuck	
219	Drive wheel tire is worn out	
220	Excessive gear box noise	3.2.12.1
221	Broken ground clearance handle	
229	Other drive & wheels issues	

Customer Observation		
	A	
	Error Message (red) / Symptom (black)	Flowchart
	Packaging	
231	Missing part	
232	Damaged part	
233	Damaged box	
239	Other packaging issues	
	Bumpers and Sensors	
241	Bumper disconnected	3.2.9.2
242	Bumper pressed	3.2.9.1
243	No wire signal	3.2.10.1
244	Wire too close / Move from wire	3.2.10.2
245	Thermistors fail.	3.1
246	Bumper sounds without reason	3.2.9.3
247	Bumper is not responding	3.2.9.4
249	Other sensors issues	
	Docking Station	
251	Docking problem	3.1
252	Check P. Switch	3.1
253	Does not leave the Docking Station on time	3.2.11.1
254	Does not detect the Docking Station contacts	3.2.11.2
259	Other Docking Station issues	

The symptom can be defined by either an error message displayed on the Robomower LCD or by a customer observation when the user observes something, which causes dissatisfaction.

If an error message appears on the LCD the error message is the symptom. In all other cases the symptom code should be derived from the observation made by the customer.

The customer observations codes are divided into functional groups according to Robomower sub-systems, i.e. Power Pack & Charging, Manual Controller, Mowing system, and so on. For each sub-system, possible failures are listed. In addition, each sub-system has a code for 'Other issues' in case there is no code for a specific problem/failure.

6.1.2.2 Failure Code

The Failure Code identifies the root cause for the problem described in the Customer Observation Code. The failure code should be entered by a service technician upon completion of the problem analysis, repair and verification that the problem was resolved.

Two items define the Failure code:

Section code (column "B")
Defect code (column "C")
As can be seen in the table on the next pages:

Failure Code

B Component Code		C Defect Code	
900	Robot	AA	Bent
901	Software	AB	Broken / Cracked
902	Main Board	AC	Burnt
	Battery	AD	By special instruction from Friendly
101	Battery	AE	Corroded / penetrated water
102	Battery case	AF	Damaged
103	Battery cover	AG	Dead / weak
104	Battery cables	AH	Dirty
105	30A fuse	AI	Discolored / faded
106	Battery contacts	AJ	Disconnected
109	Other battery parts	AK	Distorted / twisted
	Charging	AL	Electrical malfunction
111	5A fuse	AM	Fallen
112	Power Supply	AN	False alarm
113	M. Controller Holder Ass.	AO	Faulty
114	External charger	AP	Foreign material present
115	External charger adaptor	AQ	Improperly adjusted
119	Other charging parts	AR	Improperly assembled
	Chassis & Operating light	AS	Improperly connection
121	Base	AT	Improperly installed
122	Top cover	AU	Improperly maintained / cared
123	Lamp board	AV	Improperly setting
124	Operating bulb	AW	Incomprehensible
125	Operating light seal	AX	Incorrect part use
126	Operating light cover	AY	Loose
127	Magnet for Manual Controller	AZ	Missing or lost part
129	Other parts	BA	Misunderstanding
	Drive unit	BB	No Malfunction
131	Gear case	BC	Noisy
132	Drive motor	BD	Not enough quantity
133	Gear frame	BE	Out of balance
134	Odometer board	BF	Over / under torqued
135	Odometer magnet	BG	Over heated
136	Pinion	BH	Over sensitive
137	Gear wheels	BI	Plugged / Clogged
138	Gear wheels	BJ	Poor
139	Other drive unit parts	BK	Poor finish
	Environment	BL	Poor fit
141	Bumpy area (refers to lawn)	BM	Rusted
142	High grass	BN	Scratched
143	Magnetic interruption	BO	separated
144	Many obstacles	BP	Slips
145	Narrow pass	BQ	Software bug
146	Pits (refers to local area)	BR	Stuck / Locked
147	Slopes	BS	Torn / Punctured
148	Area problem (too big or small)	BT	Turned off
149	Other environment parts	BU	Unsuitable storage
		BV	Vibrates
		BW	Worn excessively
		BX	Wrapped / wavy
		ZZ	Irrelevant

B Component Code	
	Setup
151	Perimeter switch
152	Battery holder for P. Switch
159	Othersetup parts
	Interconnects
161	Battery contacts to main b.
162	Bumpers to main board
163	Connector board
164	Connector board to main b.
165	Drive motor to main board
166	Drop off to main board
167	Front bumper to main b.
168	Mowing motor to main b.
169	Odometer to main board
170	Rear bumper to main b.
171	Wire sensor to main b.
172	Conn. board to docking contacts
179	Other interconnects parts
	MMI (Man-Machine Interface)
181	Manual Controller
182	M. Controller keypad
183	M. Controller buttons
184	Audio/Speaker
185	LCD
186	Manual Controller holder
189	Other MMI parts
	Mowing system
191	Blade locker
192	Blades
193	Mowing motor
199	Other mowing system parts
	Navigation
201	360 degrees Circles
202	D.K calibration
203	Inaccurate edge performance
204	Moves in curves / Banana shape
205	Wire escape
209	Other navigation parts

B Component Code	
	Packaging
211	Operation CD
212	Perimeter switch
213	P. switch mounting stake
214	Connectors
215	Robomower
216	RoboRuler
217	Pegs
218	Perimeter Wire
219	Power Pack
220	Operating Manual
229	Other packaging parts
	Sensors
231	Drop off
232	Front bumper
233	Rear bumper
234	Wire sensor
235	Thermistors
239	Other sensors parts
	Wheels
232	Drive wheel
233	Front wheel
234	Front wheel's locking spring
235	Tires
239	Other wheels parts
	Docking Station
241	Cover
242	Fence
243	Base
244	Contacts
245	Docking Board
246	Power Supply
249	Other Docking parts
999	Others

Component code

The component code identifies the faulty components within a major system. In case the faulty component does not appear in the component code of the specific section, there is a code for 'Other parts' in every section.

The 'Environment' section is an exception, as it does not relate to any system in the Robomower. It describes conditions outside the Robomower that can cause difficulties/problems/failures during operation such as high grass, slopes, etc. When the 'Environment' section is selected the defect code will be defined as 'Irrelevant' (ZZ).

Defect code

The defect code describes the type of problem discovered with the component identified in the section and component codes above. This problem is something that you can:

- See visually (broken, damaged, torn, missing etc.)
- Understand from your analysis (Dead/weak, Over heat etc.)
- Know about from your experience (S/W bug)

6.1.2.3 Repair Code

The repair code identifies the actual repair that was made to rectify the failure defined in the failure code.

Repair Code

D Repair Code	
A	Explanation
B	Cleaning
C	Calibration / Refit / Adjustment
D	S/W upgrade
E	H/W upgrade
F	Repair
G	Replacement (Main board)
H	Replacement (part)
I	Replacement (Robot)
J	Failure not found
K	Robot returned
Z	Other

The repair code defines the action taken by the person that had solved the problem. The repair codes are organized from the easy to the more difficult actions.

Appendix A – Distributor Warranty Claim Form

FriendlyRobotics

Distributor Warranty Claims Form

Distributor:	Geurts
Country:	Belgium
Model:	RL850

Claim Period (month):	Jan 2004
Shop rate (€ per hour):	35
Claim Date:	Feb 08, 2004

	BREAK DOWN:				Part No. 1				Part No. 2			
	Dealer's Claim No. #	Serial No.	Date of Repair	Date of Sale	Part No.	Part Description	Labor time (min.)	Part Cost (€)	Part No.	Part Description	Labor time (min.)	Part Cost (€)
1	915512	IRL0309030012	1-04ינואר-	10-03אפריל-	93	Main Board	65	150.92		-----	0	0.00
2	915513	IRL0309030044	12-04ינואר-	12-03מאי-	63	Man. cont. holder assembly	15	5.40	71	Power supply - Europe	0	13.95
3	915514	IRL0309030001	17-04ינואר-	01-03יוני-	115	Power Pack	10	74.34		-----	0	0.00
4	740	IRL0309030016	23-04ינואר-	19-03מאי-	93	Main Board	65	150.92	56	Mowing Unit + cable	10	40.95
5	578	IRL0309030017	24-04ינואר-	01-03יוני-	55	Perimeter Switch	10	47.20		-----	0	0.00
6	623	IRL0309030096	12-04ינואר-	12-03מאי-	83	Gear case	90	76.32	87	Front wheel	10	13.39
7	947	IRL0309030099	23-04ינואר-	04-02מאי-		-----	0	0.00		-----	0	0.00
8	1025	IRL0309030003	12-04ינואר-	04-02מאי-	68	Manual controller 04	15	48.13		-----	0	0.00
9						-----	0	0.00		-----	0	0.00
10						-----	0	0.00		-----	0	0.00
11						-----	0	0.00		-----	0	0.00
12						-----	0	0.00		-----	0	0.00
13						-----	0	0.00		-----	0	0.00
14						-----	0	0.00		-----	0	0.00
15						-----	0	0.00		-----	0	0.00
16						-----	0	0.00		-----	0	0.00
17						-----	0	0.00		-----	0	0.00
18												
19						-----	0	0.00		-----	0	0.00
20						-----	0	0.00		-----	0	0.00

	Total	Average
No. of claims:	8	
Time claimed:	5.00	0.63
Time Cost (€):	175.0	21.9
No. of parts:	11	1.38
Parts Cost (€):	662	83
Cost (€)	**855.0**	**106.9**

- Friendly Robotics Internal Use Only -

Approval signatures:

Name	Date

Credited:

Credit No.	Date

Part No. 3				Summary				
Part No.	Part Description	Labor time (min.)	Part Cost (€)	Total labor time (min.)	Total time cost (€)	Other costs (€)	Total Parts Cost (€)	**Total Cost (€)**
	-----	0	0.00	65	37.9	0.0	150.92	**188.8**
	-----	0	0.00	15	8.8	0.0	19.35	**28.1**
	-----	0	0.00	10	5.8	0.0	74.34	**80.2**
56	Mowing Unit + cable	10	40.95	85	49.6	0.0	232.82	**282.4**
	-----	0	0.00	10	5.8	0.0	47.20	**53.0**
	-----	0	0.00	100	58.3	0.0	89.71	**148.0**
	-----	0	0.00	0	0.0	17.5	0.00	**17.5**
	-----	0	0.00	15	8.8	0.0	48.13	**56.9**
	-----	0	0.00	0	0.0	0.0	0.00	**0.0**
	-----	0	0.00	0	0.0	0.0	0.00	**0.0**
	-----	0	0.00	0	0.0	0.0	0.00	**0.0**
	-----	0	0.00	0	0.0	0.0	0.00	**0.0**
	-----	0	0.00	0	0.0	0.0	0.00	**0.0**
	-----	0	0.00	0	0.0	0.0	0.00	**0.0**
	-----	0	0.00	0	0.0	0.0	0.00	**0.0**
	-----	0	0.00	0	0.0	0.0	0.00	**0.0**
	-----	0	0.00	0	0.0	0.0	0.00	**0.0**
	-----	0	0.00	0	0.0	0.0	0.00	**0.0**
	-----	0	0.00	0	0.0	0.0	0.00	**0.0**
	Total Time (Hours):			**5.00**	**175**	**18**	**662.47**	**855.0**

FCS Code (1)							
Customer Observation (A)		Component Code (B)		Failure Code (C)		Repair Code (D)	
135	Robomower does not 'Wake up'	902	Main Board	AF	Damaged	G	Replacement (Main board)
132	Charging problem / Check Power	113	M. Controller Holder Ass.	AE	Corroded / penetrated water	H	Replacement (part)
133	Short run time	101	Battery	AG	Dead / weak	H	Replacement (part)
194	Mowing motors do not start	902	Main Board	AC	Burnt	G	Replacement (Main board)
243	No wire signal	151	Perimeter switch	AL	Electrical malfunction	H	Replacement (part)
167	Does not move in straight lines	131	Gear case	AB	Broken / Cracked	H	Replacement (part)
241	Bumper disconnected	233	Rear bumper	AJ	Disconnected	F	Repair
172	Buttons do not respond	183	M. Controller buttons	AO	Faulty	H	Replacement (part)
115	The robot is too noisy						

(optional)

FCS Code (2)				Notes / Repair without replacing parts	Repair Time (min.)
Customer Observation (A)	Component Code (B)	Failure Code (C)	Repair Code (D)		
132	112	AO	H		
194	193	AC	H		
167	233	BR	H		
				Soldering the rear bumper wire to the bumper spring	30

Appendix B – Claimed Time

The time claimed is the time required to repair the unit. This time includes the **diagnostics time** needed to identify the problem, the **Test time** (see chapter 5.1 in the Service Guide) that should be performed after any service routine was performed on the unit and the **repair time** required to replace/repair the faulty part by the service/dealer.

The following formula describes the total time claimed calculation:

Diagnostics Time + Repair Time + Test Time = Time Claimed

The Time Claimed should be taken from the table shown in appendix 1 – the second spreadsheet 'Parts List & Cost & Time' in the excel file ('Warranty claim form 2004).

Below are some clarifications for the table (appendix 1) and the time claimed calculation:

- **Diagnostics time** is divided into three different time levels, 5, 10 and 15 minutes, based on an average time required to identify a problem before starting any repair activity on the unit.
- **Repair Time** should be taken from the table in appendix 1 in this document. When calculating the total repair time for internal procedures, where the cover is removed, 20 minutes are added to cover the time of the removing and returning the cover.
- **Test Time** is divided into three different time levels, 5, 10 and 15 minutes, based on an average time required to test the unit after the problem was fixed.

- **Claim with more than one faulty parts inside the mower**

  If it is required to replace more than one part during internal repair, where the cover is removed, the claimed time should be calculated as following:

Total time claimed (part 1) + Repair Time (part 2) = Total Time Claimed

Example

The customer is complaining about faulty mowing system.
During the service it was found that the Main Board and one of the mowing units are faulty.
When calculating the claimed time, take the 'Total claimed time' of part number 1 (Main Board) from the table, which is 60 minutes and add the repair time of part number 2 (Mowing unit), which is 10 minutes.
In total the claimed time for the above claim is 70 minutes (60+10).

6.2 Robomow Power Pack Charging Policy

6.2.1 Overview

A battery is an integral part of the electrical system for most motorcycles, snowmobiles, ATV's and watercraft.

Even so, batteries often receive less care than they deserve. And **improper care can lead to shortened battery life**.

Lead acid batteries are used as a power source for the Robomower that demands a constant and uninterruptible source of energy. The Robomower needs energy to operate the drive motors, the mowing system, the Main board, and other battery-drive accessories such as the LCD display and audio.

Glossary

- **Ampere -** The unit for measuring the flow of electric current.
- **Ampere-hour (Ah)** – The current in (A amperes) multiplied by time in (h hours). Used to indicate the capacity of a battery.
- **Capacity (C)** – Ampere-hours that can be discharged from a battery.
- **Cell** – the minimum unit, which a battery is composed of, consisting of positive and negative plates, separators, electrolyte, etc.
- **Charging** – the process of storing electrical energy in a battery in a chemical form.
- **Cycle Service** – The use of a battery with alternate repetition of charging and discharging. The battery cycles are measured to the point where the battery looses 20% of its initial capacity.
- **Cycle Service Life** – The total number of cycles expected at a given depth of discharge.
- **Discharge** – The process of drawing stored energy out of a battery in the form of electrical power.
- **Depth of discharge (D.O.D)** – The ratio of discharge capacity vs. the rated capacity of a battery.
- **Life Expectancy** – Expected service life of a battery expressed in total cycles.
- **Self-Discharge** – Loss of capacity without external current drain.
- **Shelf Life** – The maximum period of time a battery can be stored, under specified conditions, without needing supplementary charging.

Battery Specification

- Power Pack – 2 x 17 AH, 12V sealed lead acid
- Battery Model – NP17-12
- Cycle Service Life – 200-300 discharge/recharge cycles
- Weight - ~13KG
- Maintenance-free

Power Supply

The Robomower uses an external power supply to provide the required energy for charging while an on board computer controls the actual battery charging process.

The Power Supply is manufacturing by Eng. ELECTRIC Co. LTD
Friendly Robotics uses two power supply models:

A – Input: 120VAC 60 Hz 38 W
Output: 32VDC 900mA
This model is UL approved

B – Input: 230VAC 50 Hz 40 W
Output: 31VDC 900mA
This model is CE approved

6.2.2 Charging procedure

The charging cycle is divided into 3 stages* as follows:

Stage 1:
The Input voltage is maximal.
The time it takes to reach this voltage (T1) is recorded and will be used at later stage.
If T1 < 5 minutes and battery voltage is higher than 28V, we will skip stage 2 and move to the Floating stage.
If T1 >= 5 minutes and battery voltage is higher than 29.4V, we will move to stage 2.

Stage 2:
The voltage controller keeps the Input voltage at 29.4V.
The charging process will proceeds to the Floating stage after T1/2 hours if T > 6 hours or after 6 hours if T1 <= 6 hours

Stage 4 (Floating):
The voltage controller keeps the Input voltage at “floating” voltage of 27.2V and stays as is until charging process is terminated.

Top Charging

Top Charging is a recommended process to be applied to any battery, which has been stored for a long period of time, since the battery loses capacity through self-discharge.

Top Charging by Friendly Robotics

Friendly Robotics tests every battery prior to putting the battery into the Robomower package. If the battery voltage is less than 25.0V then the battery has to be charged prior the packaging process (the top charging process is defined in the 'Battery assembly and testing instruction' document).

Top Charging by Distributors and Dealers

Every distributor and dealer should recharge the batteries they have in stock during January. The Top Charging should be done for all units and batteries (as accessory) in stock at the end of the season. This will ensure that the **Life Expectancy** of the batteries will not be reduced and the battery life will not shorten. Top charging before the next season will ensure that all units in stock are ready to be sold and that the customer will receive the unit with a charged battery.

Top Charging by the customer

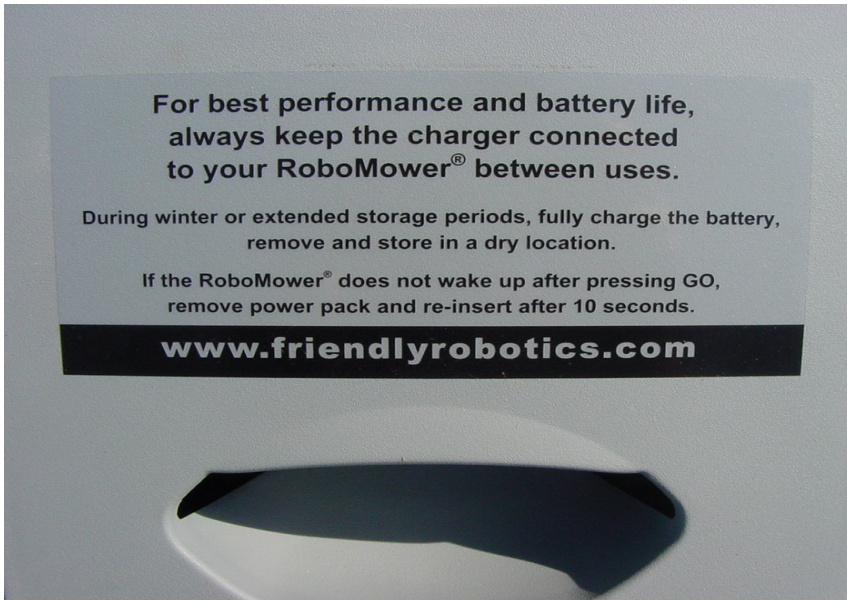
The Robomower is shipped with the power pack fuse removed in order to prevent inadvertent activation during shipping. This fuse must be inserted prior to operating the Robomower:

1. Remove the power pack from the Robomower.
2. Insert the fuse into the socket as shown in the drawing attached to the battery.
3. Re-insert the power pack into the Robomower.
4. Wait until a 'Fully charged' or 'Ready, keep charging' message appears before the initial operation.

Note: The mower's power pack has enough energy to complete all essential set up procedures However, Robomower should be charged until the 'Fully charged' or 'Ready, keep charging' message appears **prior** to first operation, in order to receive optimal performance and maintain the battery life.

Charging Procedure during the Service Life (between uses)

Every Battery should have a sticker with the following text:



1. Make sure the charger is plugged into a standard 110V or 220V household outlet.
2. Connect the charging plug to the Robomower at the manual controller base.
3. Pivot it up on its hinges, connect the charger plug and pivot it back to lie flush with the surface.
4. The display will read “Charging…”. The display will read “Fully Charged” or “Ready, keep charging” when ready for operation.
5. The charger is for indoor use only, on dry surface. Never charge in areas where water is a potential hazard.
6. The Robomower should be charging at all times when not in use. Continuous charging does not harm the batteries.

Note: The mower will alert when battery voltage is low (below the voltage level, which the ‘Recharge battery’ message had been displayed). In such a case an immediate charging is required.

Cautions:

(1) Operating the Robomower prior to having a ‘Fully charged’ or ‘Ready, keep charging’ message will reduce the battery life.

(2) Leaving the Robomower without charging after the ‘Recharge battery’ message is received will cause a deep discharge, which will reduce the battery life and capacity. In such a case the battery will dry in several days.

(3) Leaving the Robomower without charging after the ‘Fully charged’ or ‘Ready, keep charging’ message is received will cause the battery to dry in 6-10 weeks.

Winterizing charging procedure

The following procedure is recommended for extended storage periods, during the winter and for those households where the Robomower is stored in a geographic location where regular winter temperatures often drop below freezing:

1. Charge the battery until a ‘Fully Charged’ or ‘Ready, keep charging’ message is displayed.
2. Remove the battery and store outside the mower in a cool dry environment.
3. Repeat this process every 3 months.
4. If temperatures should drop below -20ºC (-4ºF), follows steps 1 through 3, and store the battery in a warmer place.
5. The Robomower should be charged at temperatures lower than 60ºC (140ºF) and higher than 0ºC (32ºF). Exceeding these conditions will cause a ‘High/Low temp – disconnect charger’ message to be displayed, until the temperatures return to the safe charging range.
6. Do not store or charge the Robomow with items pressing against the bumpers. Do not store or charge the Robomower if it is positioned on its bumpers.

Note: Mower has “Auto shutdown” after 20 minutes – if the mower is not in operation or charging for 15 minutes it will shut down automatically. In such case, the mower consumes about 10mA during the ‘sleep’. This is why we recommend removing the battery out of the mower during long storage periods if the charging process cannot be guaranteed.

6.2.3 Storage and shelf life

Storage between uses

The battery should always be kept in charging between uses during the mowing season.
It can be done by using the power supply through the Robomower when the battery is placed inside the Robomower or by an external charger when the battery is outside the Robomower.

Storage for a long period

During winter or extended storage periods, fully charge the battery, remove and store in a dry location. Or keep the charger connected during this period (see winterizing charging procedure).

6.2.4 Closure

Failures handling

See section 3.2.2 in the Service Guide

Battery warranty

The battery warranty given by Friendly Robotics is valid when following this charging procedure. Any case in which the customer did not follow this procedure, Friendly will not accept the claim.

7. Service Bulletins

Service Bulletins are special additional instructions to be followed when servicing or replacing a specific part or parts of the Robomower. Some may be relevant for specific models or serial number range. Such cases will be specified at the top part of each bulletin.

For the dealer's convenience, most of the Service Bulletins are printed and attached to the spare parts supplied by Friendly Robotics.

Once again, the Service Bulletins are in addition to the repair instructions of the Service Guide. Carefully read the Service Bulletin and the relevant procedure in chapter 4 in the Service Guide before replacing/assembling any part.

7. Service Bulletins - Contents

FriendlyRobotics

Service Bulletin #RL0536-01

Technical Service Bulletin

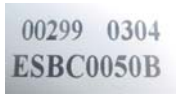
Date:	Sep. 20, 2005	Part Number:	SPP0019B
Product Model:	All	Serial Range:	All

Main Board (SPP0019B) Replacement Instructions

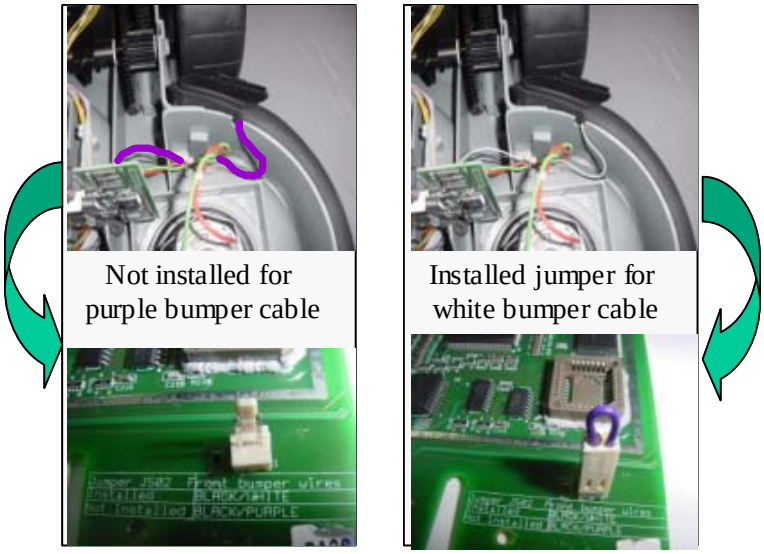
The following instructions are in addition to the standard procedure defined in the Service Guide.

Remove the faulty Main Board with its Flash and follow the instructions in the table below.

Note: Please refer to the Main Board Part Number as appeared on a white label placed on the board (the P/N in the right picture is ESBC050B).



Main Board	Use **ESBC050B** (S.W version 2.5-06/3.19-06/3.2-06/4.1-06) If the faulty Main Board has the required flash, remove it and insert into the new Main Board
S.W version	ESBC050B – S/W version marked with 06 (2.5/3.19/3.2/4.1)
Drive wheels setting	Confirm the Drive Wheels are set to the proper wheels size. Setting the wheels size is done by choosing the 'Small wheels' option in the 'Settings' menu under 'Service'.
Front Bumper Jumper (J502)	There are two types of front bumpers: Two separated springs (bumper cable is Black & **white**) and one spring (bumper cable is Black & **purple**). A Jumper is connected to the spare part board (See Figure 01) to support the Front Bumper with the two springs.
	ESBC050B – If the cable attached to the front bumper is **white - Leave the jumper on the board** Otherwise the Robomow will warn about 'Bumper disconnected' - If the cable attached to the front bumper is **purple - Remove the Jumper.** **An important safety note! -** If the Jumper is not removed Robomow will function properly, but will not warn in case of failure (disconnection).
Thermistors	If Robomow has Thermistors this issue is not relevant. When there are no Thermistors in the Robomower, one of the following MUST be done: 1. Assemble Thermistors to improve the protection on the Power Systems. 2. Set the 'Thermistors' parameter to 'off' in the 'Setting' options under the 'Service' menu.
Operating Manual	When replacing the Main Board and the S.W version to '06, provide the user with a new Manual



IMPORTANT!

After completing the Main Board replacement, perform 'Factory defaults' under the 'Service'>'Settings' menu (section 5.5.6 in the Service Guide) and perform the following steps under the 'Service'> 'Calibration' menu:

- 'Learn wire sensors' (section 5.3.1)
- 'Edge Calibration' (section 5.3.2)
- 'Set country' (section 5.3.3)
- 'D.K Calibration' (section 5.3.4)

Complete the **General Test** as outlined in **section 5.1**.

FriendlyRobotics

Service Bulletin #RL0536-02

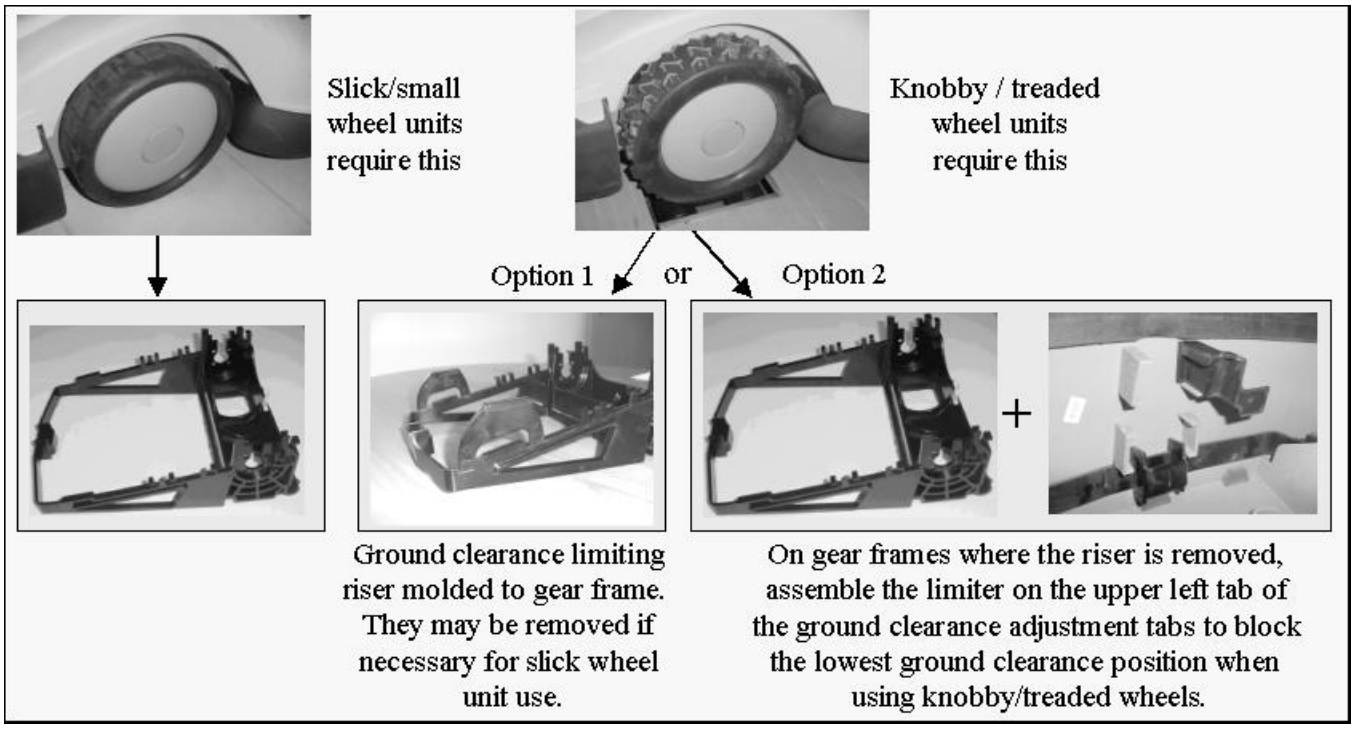
Technical Service Bulletin

Date:	October 23, 2005	Part Number:	SPP0004B / SPP0015A
Product Model:	All	Serial Range:	All

Gear Case/ Frame Modification

Two versions of the gear frame are found in the field. One version utilizes a ground clearance-limiting riser molded as part of the frame, while the other does not.

SPP0004B and SPP0015A will have the riser removed when received as a spare part. Included with these two parts is Ground Clearance Limiter part # GEN0202A. When using the gear frame version with the riser removed on units with the larger knobby/treaded wheels, it is also necessary to install the limiter (GEN0202A) to allow proper clearance between the wheels and the cowling. See Figure below. When using the frame where the riser is intact on units with knobby/treaded wheels, no additional procedure is required and the limiter (GEN0202A) is not needed.



Gear Case replacement

A new spare part Gear, part number (SPP0004B) was introduced in 2003. The Gear includes the following parts:

- Gear Case
- Ground Clearance Limiter (GEN0202A)
- Thermistors kit (SPP0020A)
- Extra motor shading (GEN0171A)

When replacing the Gear Case on all S/N units, follow the instructions below:

1. Disconnect the Thermistors connector from the Main Board.
2. Disconnect the right mowing motor from the Main Board and remove the right mowing motor shading.
3. Remove the faulty Gear.
4. Assemble the new Gear with the mowing motor shading (see Figure 1 below).
5. Use the Ground Clearance Limiter only if necessary, as explained on the first page.
6. Connect the Thermistors cable to the Main Board.

   If the Main Board has no Thermistors connector, leave the connector disconnected as an option to the future.

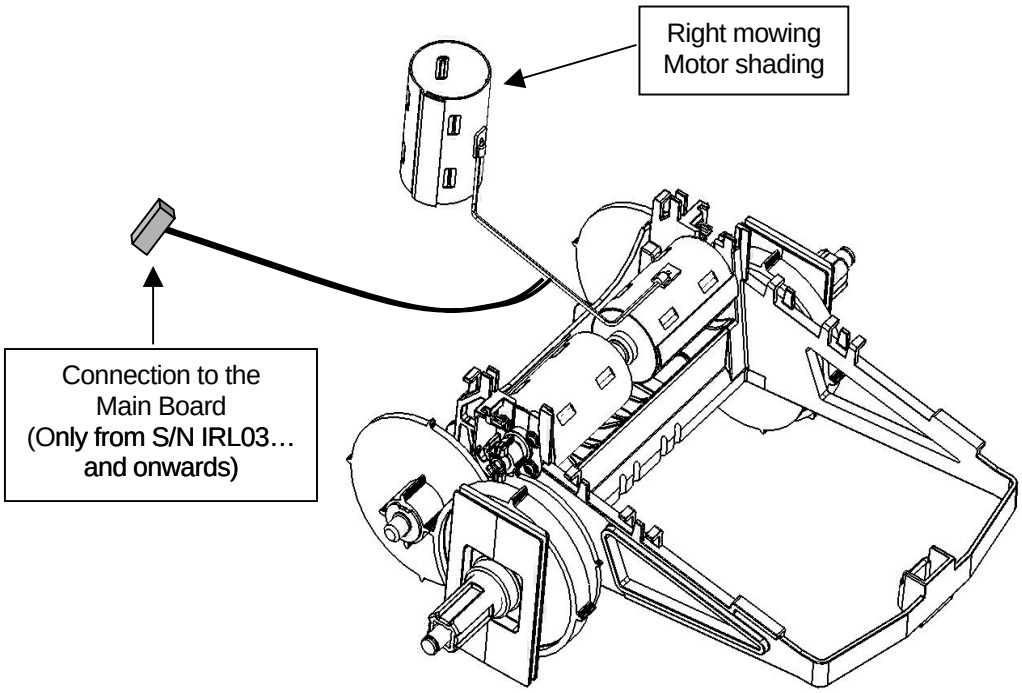


Figure 1

FriendlyRobotics

Service Bulletin #RL0536-03

Technical Service Bulletin

Date: October 26, 2005

Product Model: RL500/800/550/850

Serial Range: IRL02340100 and older

Part Number: SPP0018A

Countries Affected: All

Wire Sensors/Cable (SPP0018A)

A new wire sensor assembly was introduced in 2003. All four wire sensors and the harness are included as one assembly. Use this part for service on all units.

When servicing the sensors or sensor harness on units with S/N IRL02340100 and older , spare part SPP0018A is provided only. On these units, the right rear sensor board (Figure 1) must be removed from the support tower and placed in the right rear corner well of the base, as shown in Figure 2. Leave the black and white wires connected to the sensor board. All other sensor parts and wires are removed and discarded. Install part SPP0018A to complete the repair.

Figure 1

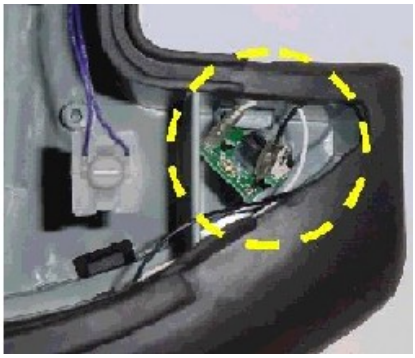


Figure 2

Note: Confirm that the top side of the sensor is in place, as shown in Figure 3.

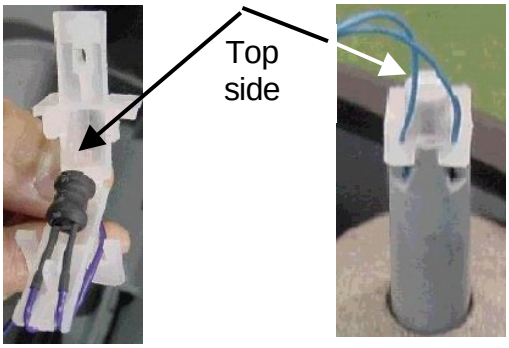


Figure 3

FriendlyRobotics

Service Bulletin #RL0536-04

Technical Service Bulletin

Date: September 20, 2005

Product Model: RL500/550/800/850

Serial Range: **IRL03010000 and onwards**

Part Number: GEN0094A

Countries Affected: All

RL Top Cover (GEN0094A) Water Drain Changes

A modified top cover was introduced in 2003 to accommodate changes in the water drain routing. This modification will not be included on the supplied spare part GEN0094A.

RL Top Cover spare part (GEN0094A) is received as shown in Figure1. If you are servicing a Robomower with a S/N **IRL02340100 and older** use the Top Cover as received without modifications.

If the S/N is **IRL0301… and onwards**, follow the modifying instructions below:

1. Cut an opening in the plastic as shown in Figure 2, to allow water to drain.
2. Note that the opening is done on the circular side of the extension.

Figure 1

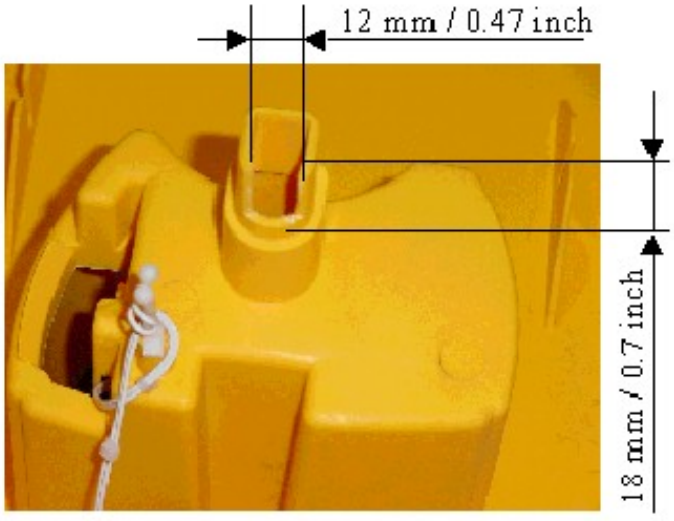


Figure 2

FriendlyRobotics

Service Bulletin #RL0536-05

Technical Service Bulletin

Date: September 20, 2005

Product Model: RL500/550/800/850

Serial Range: IRL03010000 and onwards

Part Number: GEN0207A / GEN0208A

Countries Affected: All

Front Wheel Detent Change

A new front wheel detent was introduced in 2003. If the S/N is **IRL03010000 and onwards,** use the new Front Wheel detent (GEN0207A) with two Front Wheel detent springs (GEN0208A) as shown in Figure 2 below.

If you are servicing a Robomower with a S/N **IRL02340100 and older,** use part number GEN0118A, front wheel detent spring, as shown in Figure 1 below.

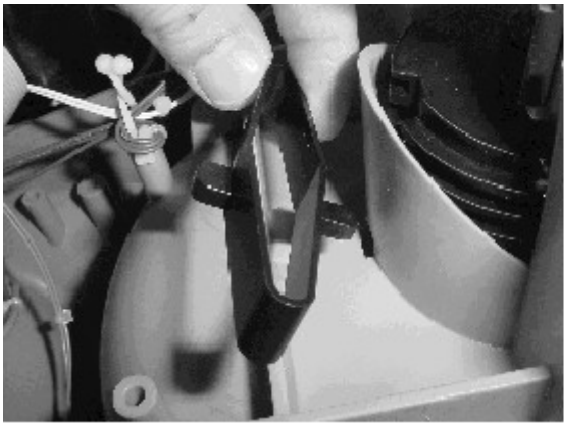


Figure 1

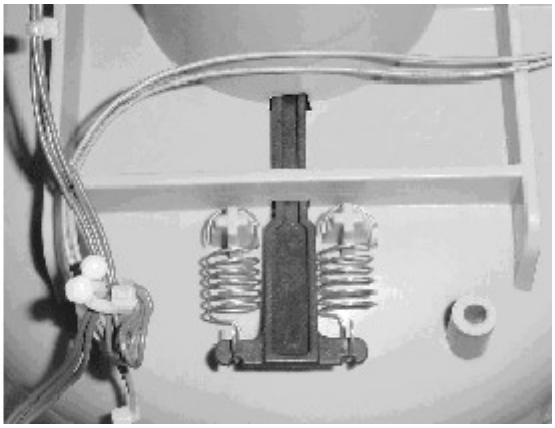


Figure 2

FriendlyRobotics

Service Bulletin #RL0536-06

Technical Service Bulletin

Date: October 25, 2002

Product Model: RL500/550/800/850

Serial Range: **IRL03010000 and later**

Part Number: MSB0065B – Mowing Unit

Countries Affected: All

Mowing Motor Replacement (MSB0065B)

A new mowing motor, part number (MSB0065B) was introduced in 2003. The wire harness at the motor end is now soldered to the terminals for better rigidity. When replacing the mowing motor of all S/N units it will be necessary to **remove the cowling first** in order to disconnect the motor wires from the main board. **Then remove from the blade motor** from the base with special tool TOL0001A. See Figure 1.

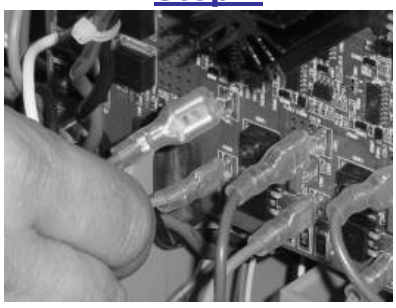
IMPORTANT - It is also necessary to remove the metal motor shield from the original motor and place it on the new motor prior to installation. See Figure 2.

Inventory of the MSB0065A, which does not have soldered leads, may be used for **IRL02340100** units and older until depleted and does not require removal of the cowling.

Figure 1

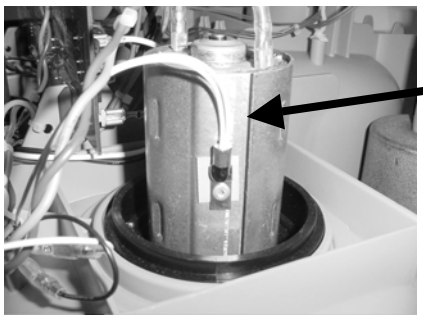
Step 1

Step 2



Step 3

Figure 2



Metal shield must be removed from motor and placed on new motor prior to installation.

FriendlyRobotics

Service Bulletin #RL0305-07

Technical Service Bulletin

Date: June 04, 2003

Product Model: RL550/800/850

Serial Range: **Beginning IRL03…**

Part Number: Robomower

Countries Affected: All

2003 RL550/RL800/RL850 Operating Manual Addendum

The 2003 Owner's Operating Manual indicates that a text message, 'Ready- Keep Charging' will appear on the LCD screen of the manual controller when the Power Pack is fully charged and ready for use. This typically occurs in approximately 24 hours, depending on state of charge when connected to the Robomower.

Please note that in some circumstances, the 'Ready-Keep Charging' message may not appear in this time frame, and may in fact not appear for a number of hours later. The message, 'Charging', will continue to display. **However, at the 24-26 hour time frame the Power Pack is fully charged and ready to be used even if the 'Ready-Keep Charging' message does not display.**

The message of 'Ready-Keep Charging' a result of various factors in the charging process, but has little impact from the current voltage level of the Power Pack. A variety of issues can delay the display of the message, such as ambient temperature and voltage output from the home receptacle. In any event, after approximately 24 hours of charging in the Robomower, the Power Pack is fully charged and ready to be used.

If the message of 'Ready-Keep Charging' is not displayed at all and 'Charging Failure' message is intermittently displayed while the mower is in charging, the S/W version of this Robomower should be replaced with an updated version (P/N PRG0005A - 3.2i - Apr 29, 2003). Call Friendly Customer Support to receive the most updated S.W. version.

FriendlyRobotics

Service Bulletin #RL0340-08

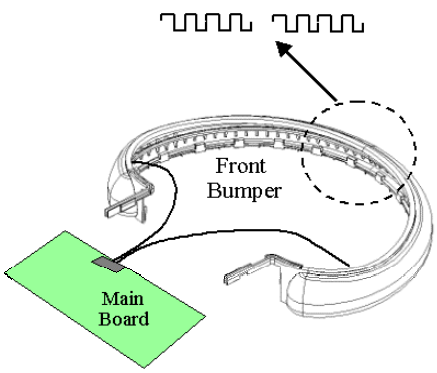
Technical Service Bulletin

Date:	October 02, 2002	Part Number:	MSB0106B
Product Model:	RL550/850/1000	Serial Range:	IRL0401… and later

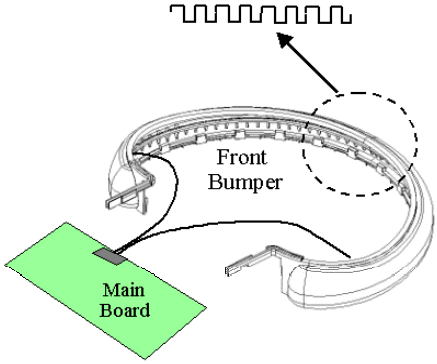
Front Bumper (MSB0196B) Replacement Instructions

The following instructions are in addition to the standard procedure defined in the Service Guide.

In order to improve the reliability and safety of the Robomower, the design of the Front Bumper was changed from 2 separate springs to one spring, which allows close lope control of the bumper functionality and warn about any disconnection in the Front Bumper continuity.



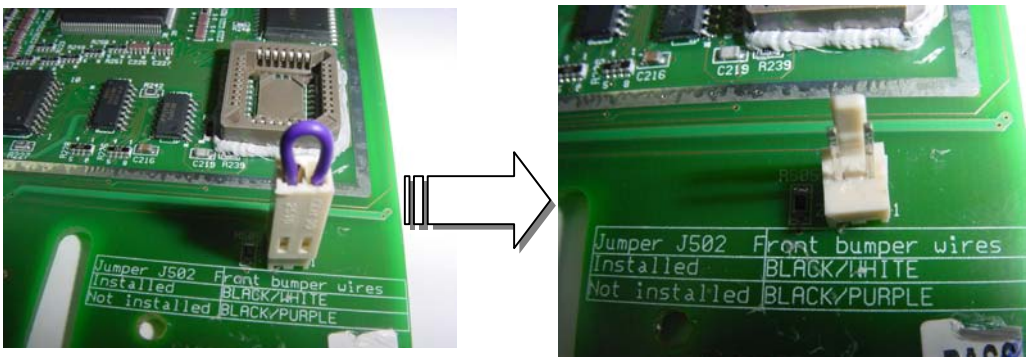
Old configuration – Two separate springs
Bumper cable to Main Board is **Black** & White



New configuration – One spring
Bumper cable to Main Board is **Black** & **Purple**

A Jumper is connected to the spare part Main Board to support the Front Bumper with the two springs (old configuration – bumper cable from Main Board is Black & White).

When servicing units with **S/N IRL0401… and later** - remove the Jumper.



Remove the jumper when servicing Robomower with S/N IRL0401… and later.

FriendlyRobotics

Service Bulletin #RL0536-09

Technical Service Bulletin

Date:	Oct 26, 2005	Part Number:	MSB0117A
Product Model:	RL350/550/800/850/1000	Countries Affected:	All
S.W version:	All		

Manual Controller (MSB0117A) Replacement Instructions

The following instructions are in addition to the standard procedure defined in the Service Guide.

Three Manual Controllers spare part are available in 2006 season:

1. P/N MSB0118A (Extended temperature range LCD – Green color LCD)
   P/N MSB0119A (Enhanced Manual Controller + Rain sensor)
2. Old versions:
   P/N MSB0112A (tones)
   P/N MSB0114A (speech- used in the US)

When servicing Robomow with S.W versions 3.19-04 / 3.2-04 / 4.1-04 and later use Manual Controller P/N MSB0117A/18/19 to all Robomow models (RL350/550/800/850/1000).

When servicing Robomower with S.W versions previous to those mentioned above*, all configurations of Manual Controllers can be used, but it is recommended to replace the same part number for the user's convenience, keeping the speech or tones features.

* Previous S.W versions are versions released before Aug 01, 2003 (The S.W version date is displayed as 'S.W version' menu under the 'Service' or the 'Information' menus).

FriendlyRobotics

Service Bulletin #RL0340-10

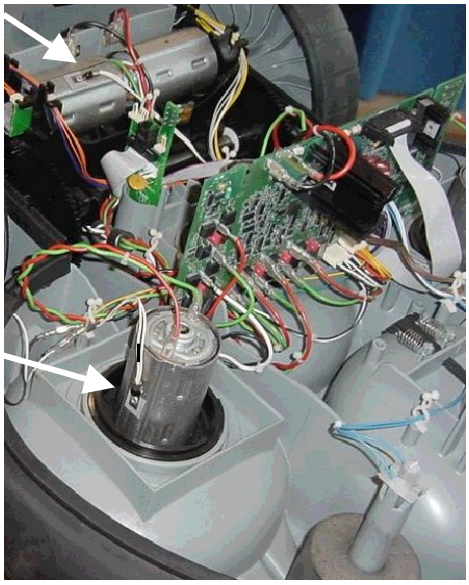
Technical Service Bulletin

Date:	October 02, 2002	Part Number:	SPP0020A
Product Model:	All	Serial Range:	All

Thermistors Kit (SPP0020A) Installation Instructions

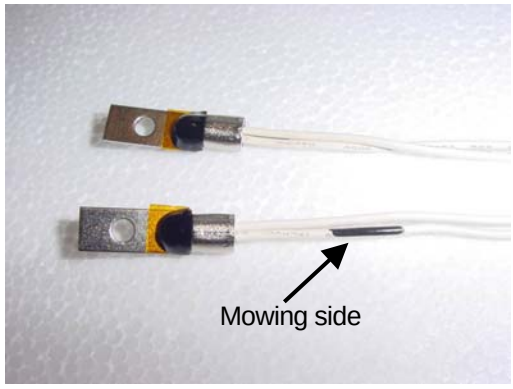
The following instructions are in addition to the standard procedure defined in the Service Guide.

1. Thermistors should be assembled to the right motors (Drive and Mow). Confirm the motor shields are round (if it is hexagon replace them)



2. Pad Placement

3. Confirm the cable with the black mark is connected to the Mowing side.



4. Attach the pop rivet with the Thermistor to the motor shield (view from the rear side)

5. Remove the left piece of the pop rivet

FriendlyRobotics

Service Bulletin #RL0536-11

Technical Service Bulletin

Date:	Sep 20, 2005	Part Numbers:	All Software Version
Product Model:	All	Countries Affected:	All
Serial Range:	All		

S.W. version (Flash) Replacement Instructions

The following instructions are in addition to the standard procedure defined in the Service Guide.

Spare Part Flash (S.W. version)	When to use?	Main Board	Manual Controller
SPP0033C/35C/ 36C/40C/41C 3.2-06	The most updated S.W version for RL850 - compatible with Main Board **ESBC050B**	**SPP0019B** Main Board label is marked with **ESBC050B**	All
SPP0101A-105A 4.1-06	The most updated S.W version for RL1000 - compatible with Main Board **ESBC050B**	**SPP0019B** Main Board label is marked with **ESBC050B**	All
SPP0027A 3.2a	The most updated S.W version compatible with Main Board **ESB0019B/C**.	Main Board label is marked with **ESB0019B/C**	MSB0112A MSB0114A (Does not support MSB0117A to MSB0019A)
PRG0005A 3.2i (Service Bulletin #RL0305-07)	Service version supporting Main Board **ESBC045B only** (especially for 'Charging failure' message received during the charging process)	Main Board label is marked with **ESBC045B**	MSB0112A MSB0114A (Does not support MSB0117A to MSB0019A)

NOTE: After replacing a flash (S.W version) it is required to perform the following steps:

1. ***'Factory defaults'*** under the 'Service>Settings' menu.
2. The mower will display 'Are you sure?' - Press the 'GO' button to confirm (it will reset).
3. Under 'Service' perform ***'Learn wire sensors'*** (Section 5.3.4 in the Service Guide)
4. Under 'Service' perform ***'Edge Calibration'*** (Section 5.3.3 in the Service Guide)
5. Under 'Service' perform ***'Set country'*** (Section 5.3.1 in the Service Guide).
6. Under 'Service' perform ***'DK Calibration'*** (Section 5.3.2 in the Service Guide).

Technical Service Bulletin

Date:	May 02, 2004	Part Numbers:	SPP0031A
Product Model:	RL1000	Countries Affected:	All
Serial Range:	Beginning with IRL04…		

Charging Contacts (SPP0031A) Replacement Instructions

Friendly Robotics has developed magnetic contacts for the RL1000 and the Charging Station.

The magnetic contacts confirm good contact between the Robomower charging contacts and the Docking Station contacts, reduce the cases of burnt contacts and increase the lifetime of the contacts.

Because of failure in the production process at the manufacturer plant the Docking Station plates were lose from its magnetic

The current contacts you have in the Docking Station will work well, but their lifetime will be shorter than the magnetic contacts.

Magnetic contacts were sent for replacement, below are the instructions to replace the contacts:

In case, which the Docking Station is already in operation follow the instructions from step A. If the Docking Station is still in the box start in step C:

A. Remove the Robomower from the Docking Station.
B. Disconnect the Power Supply from the wall socket.
C. Disconnect the two cables (Red and Green) from the tabs on the Docking Station contacts, as illustrated in Figure 1 below.

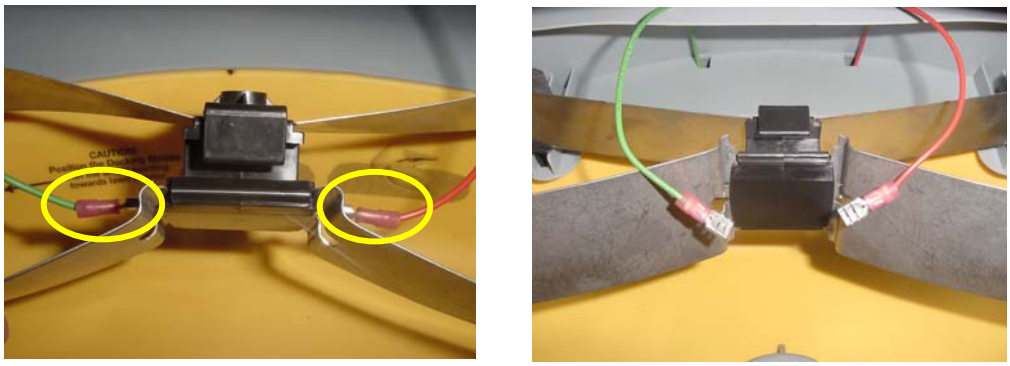


Figure 1
Disconnection of the contact cables

D. Open the screws at the sides of the contacts, as illustrated in Figure 2 below and remove the contacts assembly from its place.

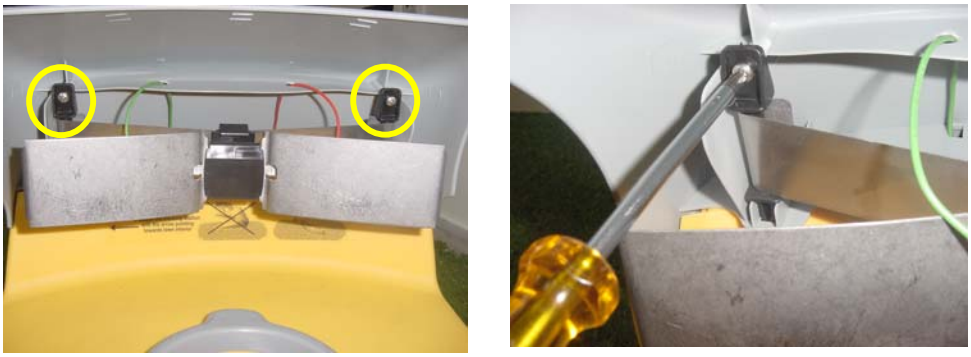


Figure 2
Opening the contacts screws

E. Replace the docking contact assembly with a new one, when the topside direction is as shown in Figure 3. Place the contacts holder above the aperture in the cover, as illustrated in Figure 4 below.

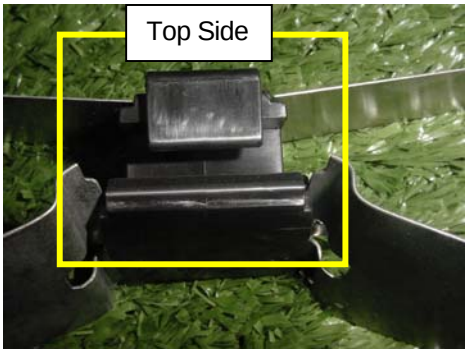


Figure 3
Top side direction of the contacts

the aperture assembly

Figure 4
Align the contact holder against

F. Confirm the holder is placed in the apertures and tighten the screws. Ensure the contacts assembly is properly placed as illustrated in Figure 5.

G. Connect the contacts cables (Red and Green) back to the taps as illustrated in Figure 1 above (confirm the Red is connected to the RH side and the Green to the LH side).

H. Connect the Power supply to the wall socket and switch on the Docking Station board to check the functionality of the Docking Station.

Figure 5
Final position of the contacts