



Belrobotics

Leader in the automatic maintenance of large grounds

1	<i>Keyboard essentials and start-up of the robot</i>
2	<i>Test installation before burying the cable</i>
3	<i>Menu structure</i>
4	<i>Parameters</i>
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Parameters and options

The keyboard: 10 "digit" keys and 7 "action" keys

"On" To switch the robot on and to start it up (double function)

"F1" To get the robot back to its docking station. Once the battery is recharged, **the robot resumes its mowing cycle.**

"F2" Two possible actions, according to context:

- To move up menus and sub-menus
- To get the robot back to the docking station and **to stay at the station after recharging.** Key "On" must be depressed to get it going after recharging

"F3" Three possible actions, according to context:

- To move down menus and sub-menus
- To display the track value (distance to the peripheral wire) and the signal phase (Positive = inside the wire; Negative = outside the wire) – and toggle through different zones for multi-zones mode
- Toggle between sets of parameters and options of different zones (in multi-zones mode)

"#" To access menus and submenus and to (un)select an option

"C" To get back into menus and sub-menus navigation

"★" To enter the machine code or parameters and to (un)select the rest days




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Parameters and options

Start-up the robot

1. Switch on the machine
2. Depress the « On » key
3. Read the screen
 - If a message shows, depress « C » key to go back to main menu
 - If « Menu » shows, everything is OK
4. Depress the « On » key again
 - The screen flashes for max 8 sec.
5. Close the lid
6. The robot starts the cutting heads individually in the following sequence over 5 sec.: H3 → H2 → H4 → H1 → H5
7. ... then leaves the docking station and starts working for about two hours before getting back to the docking station.





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Test installation before burying the cable

Parameters and options

Laying in the peripheral wire

1. Unroll the wire and lay it down on the ground surface. Avoid unnecessary connections.
2. Connect the docking station to the wire and to the electricity supply. Set up the robot and start it up
3. Carefully watch the robot at work on the lawn for at least 30 minutes. Test the machines on the following lines:
 - On the diagonals of the lawn
 - On the medians of the lawn
4. Make sure that the robot moves forward alongside a straight line and does not take a large curve. Make sure the robot does not slow down or stop unexpectedly
5. Depress "F1" to send the robot back to the docking station and check it finds its track border and progresses towards the docking station, and connects to the lading arm
6. If all is OK, lay down the cable in the ground with an appropriate cable laying machine
7. If you notice a suspect behaviour, take the robot back to the suspect spots, depress "F3" and write down the indicated track border and signal phase. Draw a map of the lawn, indicate suspect spots with track border values and phase signs and call Belrobotics

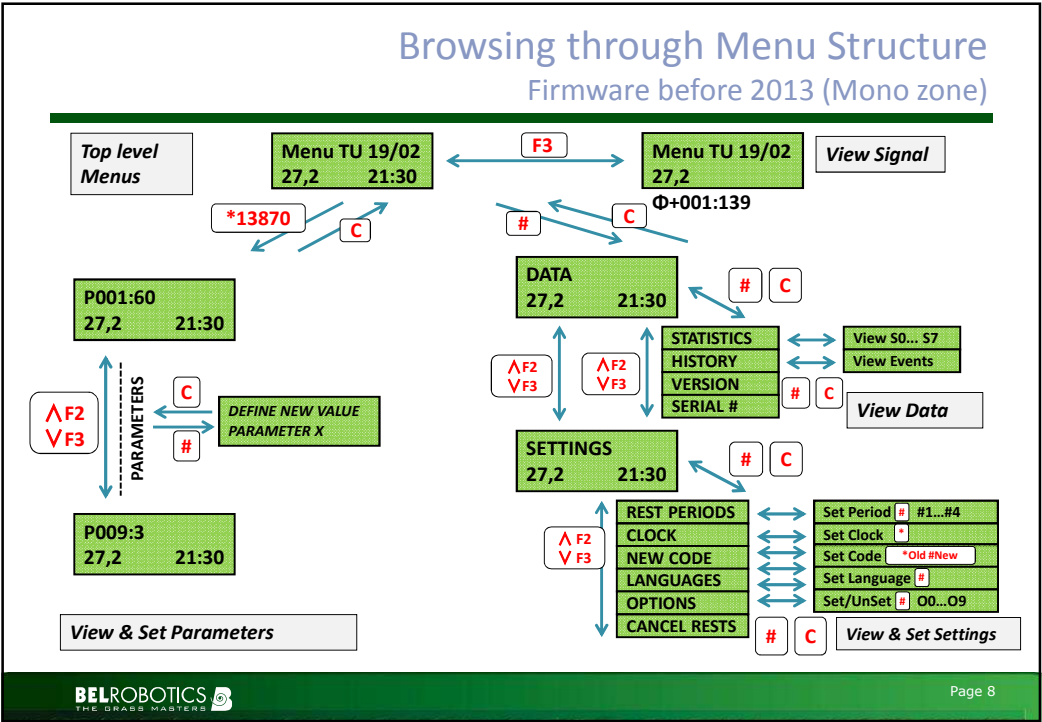
Belrobotics

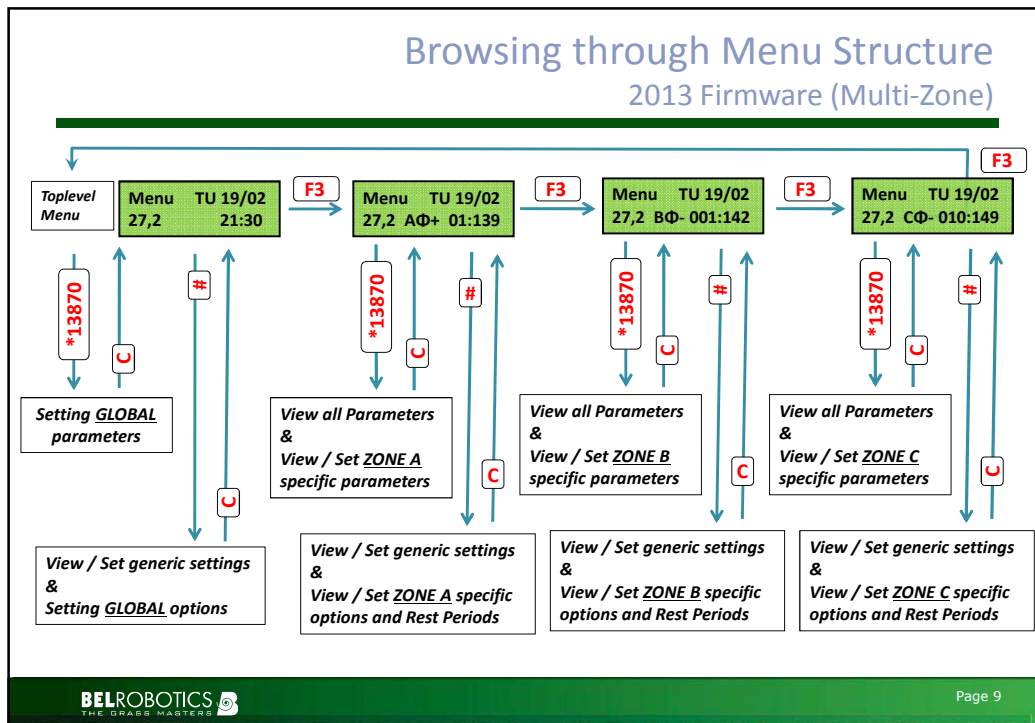
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3Menu structure

BELROBOTICS
THE GRASS MASTERS

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Browsing through Menu Structure 2013 Firmware (Multi-Zone)

- **Changes versus Pre-2013 Firmware (Mono-Zone)**
 - Multi-Zone aspects (see previous slide)
 - Global versus Zone Specific Parameters (see Parameters details)
 - Global versus Zone Specific Options (see Options details)
 - Rest Periods are Zone Specific + 5 Periods (instead of 4)
 - Settings Menu Order is changed :

OPTIONS
REST PERIODS
CLOCK
NEW CODE
LANGUAGES
CANCEL RESTS

Instead of

REST PERIODS
CLOCK
NEW CODE
LANGUAGES
OPTIONS
CANCEL RESTS

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4	Parameters

Parameters Overview

To access parameters, when MENU/ZONE is displayed, key in *13870

Parameters settings

Default values

Min/Max

PAR.	MEANING	Zone A	Zone B	Zone C	
P0	Signal sensitivity	30	30	30	See following slides
P1	Length of peripheral wire (x10m)	BM 60 PM 35 GM 23	BM 60 PM 35 GM 23	BM 60 PM 35 GM 23	13/120
P2	Max. distance alongside wire when leaving station (x10m)	10	10	10	0/50
P3	Minimum track border Segment	0	0	0	0/3
P4	Minimum track border line (in Segment)	120	120	120	0/255
P5	Nominal speed when mowing	GLOBAL (BM 50 ; PM 40 ; GM 29)			BM: 15/60 PM: 15/50, GM: 15/40
P6	Min. distance alongside wire when leaving station (x10m)	1	1	1	0 / 50
P7	Phase sensitivity	30	30	30	8/30
P8	Wire Signal Channel	0	0	0	0/5
P9	Distance astride wire when leaving the station (in m)	3	3	3	2/100
P10	Work time ratio factor	1	1	1	1/10



Parameters and options

Parameter P000 (Strength, Shape) and 007 (Phase)

- P000 and P007 are reserved for lawns featuring signal distortion, absorption, reflection, parasite emissions, etc.
 - Examples: applications with either metal, cables, water pipes, water ducts in the ground such as water storage stations, water treatment plants, high voltage electric stations, photovoltaic power plants, etc.
- On such tricky grounds, P000 et P007 make it possible to adapt tolerances in peripheral signal processing (*no other mower robot is able to do this!*)
- P000 and P007 rarely need be adjusted!**
- Next slide indicates how to identify “tricky” grounds
- P000 and P007 parameters are detailed in the following slides
- P000 is related to signal strength and shape. Factory setting = 30
- P007 is related to signal phase. Factory setting = 30


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Parameters and options

Debug mode to detect incorrect Strength, Shape or Phase

Zone (2013)

Phase & Shape

Menu TU 19/02

27,2 AΦ+ 001:139

Strength

See comments on next slide

Menu TU 19/02

27,2 AΦ+ 001:139

- Shape is OK
- Phase is OK → Nothing to do

Menu TU 19/02

27,2 AΦ- 001:139

- Shape is OK
- Phase is NOK → Adjust P007 (see next slides)

Menu TU 19/02

27,2 AΦX 001:139

- Shape is NOK → Adjust P000 (see next slides)
- Phase is OK

Menu TU 19/02

27,2 AΦ\ 001:139

- Shape is NOK → Adjust P000 first (see next slides)
- Phase is NOK → Then adjust P007 (see next slides)


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Parameters and options

Parameter P000 (Strength, Shape) and 007 (Phase)

1. **What is the function of these two parameters ?** They adjust tolerances of filters that process the peripheral signal
2. **When do these parameters need be changed ?** When there are magnetic disturbances in the field, that distort peripheral signal and do not allow digital filters of the robot to operate normally
3. **What may cause such magnetic disturbances ?**
 - Metal, cables, water pipes, water ducts in the ground such as water storage stations, water treatment plants, high voltage electric stations, photovoltaic power plants, green roofs, etc.
 - Antennas, other robot mowers, other magnetic transmitters

Parameters and options

Parameter P000 (Strength, Shape) and 007 (Phase)

4. How to change these parameters ?

Case 1: the robot makes maneuvers on its own, **far** from wire (> 10m away), with no obstacle in the way and sometimes issues a "STUCK ON WIRE" alarm.

=> **Decrease P007** (min. value = 8). The nearer to the wire the robot makes maneuvers, the more P007 need be decreased.

Case 2: the robot issues a "NO SIGNAL" alarm, **far** from its wire (> 10m away).

=> **Decrease P000** (min. value = 10). The heavier the magnetic disturbance, the more P000 need be decreased.

Parameters and options

Parameter P000 (Strength, Shape) and 007 (Phase)

Case 3: the robot keeps issuing a “NO SIGNAL” alarm, **far** from its wire (> 10m away) despite P000 set to its minimum value (P000 = 10).

=> Set **P000 at 158**

=> If still not OK, set **P000 at 148**



=> If still not OK, set **P000 at 138**

=> If still not OK, report to Belrobotics for support

Setting P000 at 138 – 158 may solve the issue but generate a risk of a robot going out of its delimited area, should two events happen at the same time:

- a peripheral signal cut-off
- an external magnetic field emitter (peripheral wire of other robot mowers, antennas, etc)

We strongly recommend physical barriers when setting P000 at these values!

Parameters and options

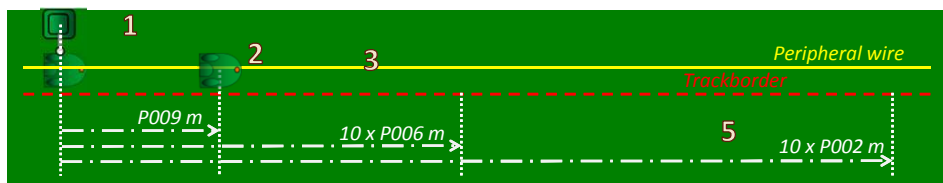
Parameter P001: Length of peripheral wire

- P001 indicates the length of the external perimeter of the peripheral wire (excluding islands, including pseudo islands), in multiple of 10 meters
- Examples:
 - P1 = 20 for a 200 m wire
(this is the minimum length of the wire)
 - P1 = 60 for a 600 m wire
 - P1 = 120 for a 1200 m wire
(this is the maximum length of the wire)
- Application: the robot computes the distance on its way back on its track border to the docking station. If such distance exceeds $1,2 \times P001$, the robot stops and shows the alarm « NO STATION »



Parameters and options

Parameters P002/P006/P009 – Leaving Charge Station Behavior



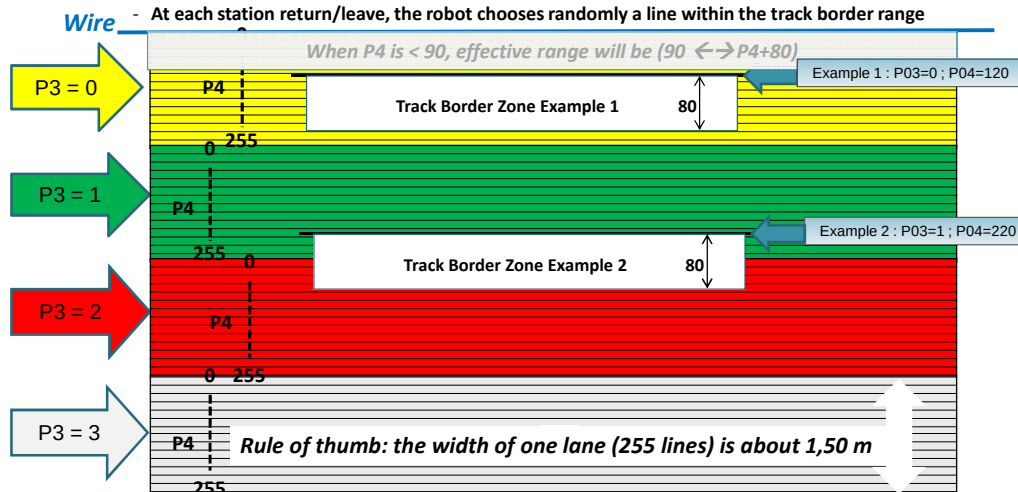
Departure sequence

1. The robot leaves the station and travels on the wire on a distance = $P009$ (in m).
If $P009 = 0$, this distance = 1 m
Application : Make sure the robot escapes from a recessed docking station after charging, and does not take its track border before it is on a wide and open area
2. At $P009$, the robot leaves the wire and moves to the track border (see $P003$ and $P004$)
3. The robot travels on its track border at least on a distance = $P006$ (in 10 m multiple) – $P009$ (in m)
4. The robot travels on its track border at the maximum on a distance = $P002$ (in 10 m multiple) – $P009$ (in m)
5. Actually, the robot will leave its track border at a location picked at random between $P006$ and $P002$
When $P002$ is set erroneously higher than $P006$ or $P006$ set erroneously lower than $P002$, the robot sets $P002 = P006$

Parameters and options

Parameters P003 and P004: Track Border Range Definition

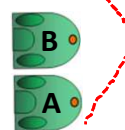
- $P3/P4$ define the limit of the track border range at the wire side
- Track Border width is fixed : 80 lines magnetic strength / real width (m) is weather dependent
- At each station return/leave, the robot chooses randomly a line within the track border range



How to set P003 and P004 in a narrow pass?

Use <F3> (debug) and <F1> (test > return) functions

1. Set the robot in the narrow pass near one peripheral wire (A) and press <F3> (debug) to read track. Move the robot till track reaches its maximum (B), assumed = (000:210)
2. This means the robot must always keep track $\leq$ (000:210) to return safely to its station (to travel on the right side of the road in this example). As track varies between P004 and P004 + 80, P004 should be set at maximum 130 in this example. Let's set P003 = 0 (most often in narrow passes) and P004 = 130
3. To check proper operation, manually move the robot to its most critical position (i.e. track = 210 in this example). Let's assume you set it at 000:208. Press <F1> <On> and see what happens. Pressing <F1> when a robot is set manually forces the robot to get back to its station on track set manually. Check that robot goes well back to station. If not, reduce P004 to lower settings. Remember that whatever value is set for P004 below 80, it will always be interpreted as 80



Parameters and options

Parameters P005: Robot Speed

- Speed must only be reduced in case of
 - uneven ground surfaces: irregularities, holes, etc.
- that
 - trigger lift sensors “for nothing”
 - damage suspensions, wheels and the mechanical framework of the robot (this is a case of warranty exclusion)

Parameter P005 – Speed	Bigmow	Parcmow	Greenmow
Minimum Speed	P005 = 020 = 0,4 m/sec	P005 = 020 = 0,4 m/sec	P005 = 020 = 0,4 m/sec
Maximum Speed	P005 = 050 = 1,0 m/sec	P005 = 040 = 0,8 m/sec	P005 = 030 = 0,6 m/sec

Parameters and options

Parameter P008: channel of wire signal (as from 2012 version)

Up to six adjacent lawns operating on different channels without mutual interferences. The selection button on the card in the docking station (0, 1, 2, 3, 4, 5) must correspond to the P008 setting.



Disregard channel 2 when a “old” signal Belrobotics machine is in operation in the vicinity of a new installation (risk of interference)

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5	Options

Options Overview

BM, PM, GM

Options settings

Option	MEANING	Zone A	Zone B	Zone C
O00	Multiple robots	GLOBAL (-)		
O01	Go back to station	GLOBAL (-)		
O02	Go back to then stay at station	GLOBAL (-)		
O03	Demonstration mode	GLOBAL (-)		
O04	Silent charge	GLOBAL (✓)		
O08	Phase inversion	GLOBAL (-)		
O09	Alternating Heads Rotation	GLOBAL (✓)		
O10	CCW docking direction	(-)	(-)	(-)
O11	Charge on 2 sides	(✓)	(✓)	(✓)
O13	"U-shape" return	(✓)	(✓)	(✓)
O14	Return astride wire	(-)	(-)	(-)
O15	Timer Off	(-)	(-)	(-)
O16	Multi-Zones	GLOBAL (-)		
O17	Enable Zone	(✓)	(-)	(-)
O18	Kbd Lock	GLOBAL (-)		

Parameters and options

Option 00 – Multiple robots

- This option is used when up to 3 robots operate on the same area (ex: 1 Bigmow and 1 Ballpicker, or 1 Bigmow and 2 Ballpickers)
- In such instance:
 - Each robot must have its down docking station for charging
 - Each docking station must be equipped with periscope sonar and presence detector
 - The peripheral signal is provided by one station only. All robots must be tuned to the channel selected on the docking station providing the signal
 - Option 00 must be selected on all robots
 - All robots must charge on the same side (Options 10 and 11)
 - All robots must use the same "shape" return (Option 13)
 - Parameter P03 must be either 1, 2 or 3 (never 0): this prevents a robot returning to its station collides with a robot charging at its docking station
 - All robots must navigate at the same speed (Parameter 05)
- *When used in a "old" signal configuration, jumpers must be adjusted on all station boards as depicted on next slide*

Parameters and options

Option 000: Multiple robots. Settings for “old” signal robots

	MACHINES				STATIONS		
	PAROCOW BIGMOW	Config. Option 0 PAROCOW- BIGMOW	BALL- PICKER	Config. Option 0 BALLPICKER	Station PAROCOW BIGMOW	Waste dump station	Charging station BALLPICKER
Standard	1	—	0		Single/ Unload Multi	BM BP	
	1	—	1	✓	Single/ Unload Multi	BM BP	
	1	—	>2	✓	Single/ Unload Multi	BM BP	Single/ Unload Multi
2 nd in use	>2 >2Station	✓	0		Single/ Unload Multi	BM BP	
	>2 >2Station	✓	1	✓	Single/ Unload Multi	BM BP	
	>2 >2Station	✓	>2	✓	Single/ Unload Multi	BM BP	Single/ Unload Multi
	0		1	—		Single/ Unload Multi	BM BP
	0		>2	✓		Single/ Unload Multi	Single/ Unload Multi

Parameters and options

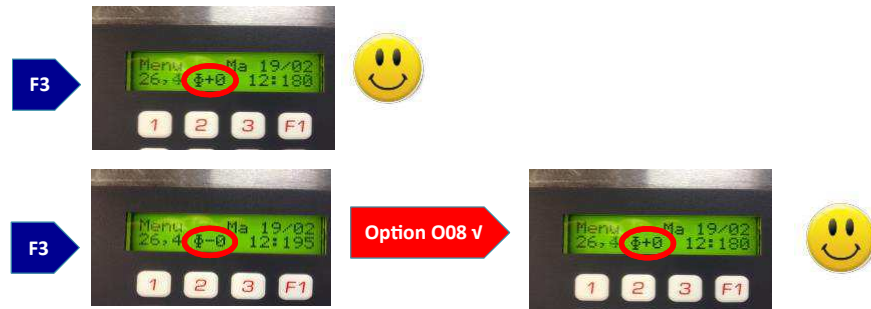
Option 03 – Demo mode

- Cutting heads do not spin.
- When **no** peripheral signal is available:
 - the robot manoeuvres only at obstacles;
 - the robot does not go back to the docking station.
- When a peripheral signal is available:
 - the robot manoeuvres at obstacles and at boundaries;
 - the robot goes back to the docking station;
 - the fast charge can be aborted by pressing the “ON” key touch
- Typical usage:
 - demonstration with a large audience (like on Trade Shows)
 - Settings check of parameters P2, P6 and P9 (if a peripheral signal is available)

Parameters and options

Option 08 – Phase inversion

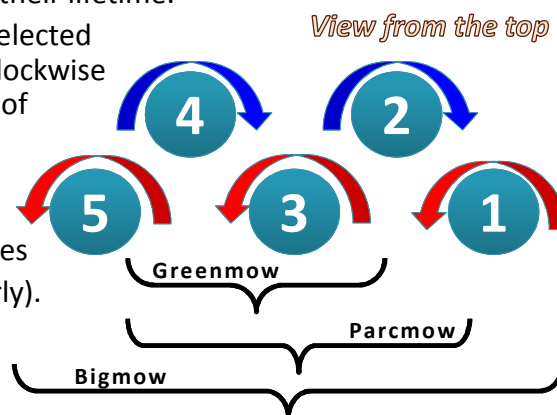
- After installation, check phase on the area to be mowed and press “F3”. If phase is positive, all is fine. If phase is negative, select option 08 to invert phase. Check again using “F3”.



Parameters and options

Option 09 – Inversion of rotation direction of cutting heads

- This option is selected by default. The rotation direction of cutting heads changes at each cycle: this allows to use both sides of cutting blades, hence extending their lifetime.
- When the option is not selected all cutting heads rotate clockwise at all times (no inversion of rotation direction).
- The option must be unselected when robot is working on golf practices (to eject golf balls properly).



Parameters and options

Options 10 and 11 – Return CW/CCW and Charge on 2 sides

- Start with setting Option 11, that has precedence on Option 10
 - Either the robot is allowed to come back to the station in two directions, in which case, Option 10 needs not be defined.
 - Or the robot comes back in one direction only, in which case, Option 10 defines the direction :
 - when selected, the robot gets back Counter-ClockWise. (CCW)
 - When not selected, the robot gets back ClockWise (CW)
- *Attention: “ClockWise” and “Counter ClockWise” do define direction taken by the robot alongside its wire when getting back to the station ; but **NOT** the charging side of the robot (as it differs depending on selected return method – “U” or “S”).*

Parameters and options

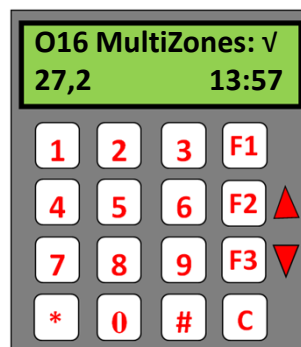
Option 14 – Return astride the wire

- This option should only be selected when all recommended settings do not allow to go back to the docking station through narrow paths or to avoid obstacles alongside the wire.
- When returning to the docking station astride the wire, the robot runs pretty slow and is not able to easily manoeuvre around obstacles in its way.
- Minimal distance between wires (in a narrow strait) is 600 mm (for the Bigmow) with full 650 mm clearance outside of the wire: this means a total width between walls of $650 + 600 + 650 = 1950$ mm (for the Bigmow).

Parameters and Options for Multi-zones

Option 16: Mono-Zone or Multi-Zones

- By default, the option is not selected and robots are in **"Mono-Zone mode"**. Nothing changes with respect to previous program versions.
- When option 16 is set, robots operate in **"Multi-Zones mode"**.
 - All parameters but P5 must be set individually for each zone.
 - Options 10, 11, 13, 14, 15 and 17 must be set individually for each zone



Parameters and Options for Multi-zones

Option 15: Timer Off

- When Option O15 Timer Off is selected for one specific zone
 - The robot ignores programmed rest time periods for this zone.
 - Programmed rest time periods become effective again when Option 015 is unchecked.
 - Programmed rest periods remain in memory, even when not effective.

Parameters and Options for Multi-zones

Option 17: Enable Zone

- When Option O17 Enable Zone is selected for one specific zone
 - The robot is allowed to operate in the displayed zone.
- When Option O17 Enable Zone is unchecked
 - The robot is not allowed to operate in the displayed zone.
 - Programmed parameters and options remain in memory, even when the zone is not enabled .

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