

# New Unit Information



## B 90 R

1.161-...

**Foreword**

Good service work requires comprehensive and practical training as well as clear documents.

We therefore provide regular basic training and further training courses for service technicians covering our whole range of products.

In addition, we produce service manuals for the most important units, which can initially be used as instructions and later for reference purposes.

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## 1.1 Technical features

The unit is a floor scrubber and is available as a battery (Bat) and package (Pack) version.

### Driving operation and steering

- 3-wheel running gear with front-wheel steering.
- Solid rubber tyres with tread.
- Driven by front wheel-hub motor.
- Forward and reverse drive with one drive pedal, switchover using selector button.
- The unit brakes automatically when the driver leaves the seat (seat contact sensor) or when the drive pedal is released.
- Electromagnetic brake on the wheel-hub motor prevents rolling away when the unit is switched off or if the EMERGENCY STOP switch has been activated.
- Driven by four 6 volt batteries (= 24 volt), maintenance-free or low maintenance.
- Battery monitoring with deep-discharge protection.
- Pack version supplied as a standard with maintenance-free batteries and battery charger.
- The operating hours are only counted if the unit is switched on with the key switch and the driver is seated on the seat (seat contact switch) and the unit is driven.

### Water system

Before use the fresh water tank must be filled with the correct proportions of water and cleaning agent. The water flows by means of gravity to the brush head (the solenoid valve opens in driving operation in scrubbing mode only). The water flow can be controlled using the handwheel of the metering valve.

### Suction feed operation

The suction beam is lowered with the lever, simultaneously switching on the suction motor (M4).

The suction motor (M4) generates a vacuum in the wastewater tank via the air ducts in the tank lid and in the unit housing. This pumps the wastewater from the suction beam through the suction hose and into the wastewater tank.

At the maximum level in the wastewater tank the float switch switches off the suction motor with a delay.

The freshwater tank is drained by removing the water filter.

#### Note:

If the suction motor is switched off with the switch, it continues running for approx. 10 sec in order to draw the residual water from the suction hose (after-running time).

### Suction beam

The rubber strips on the suction beam can be replaced without tools.

The suction beam tilt angle can be adjusted without tools.

### Electrics

The controls, the charger (PACK version) and the electronics, are located behind the front cover and the control panel.

- Control panel with EMERGENCY STOP switch.
- Battery charge control display.
- Battery monitoring and display for unit settings.
- Main fuse (F1) is fastened at the battery post (+).

## 1.1 Technical features

### Cleaning operation BR/BD

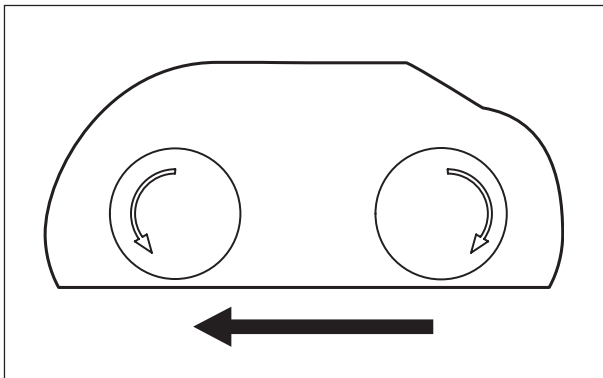
The brush head is lowered with the foot pedal, at the same time the brush motors are switched on, if the program switch (S9) is set to scrubbing, polishing and polishing-vacuuming.

The brush contact pressure can be adjusted with a lever (Advanced version only).

If the brush motors are overloaded, e.g. due to too high contact pressure or blocked brushes, they are automatically switched off (overload protection).

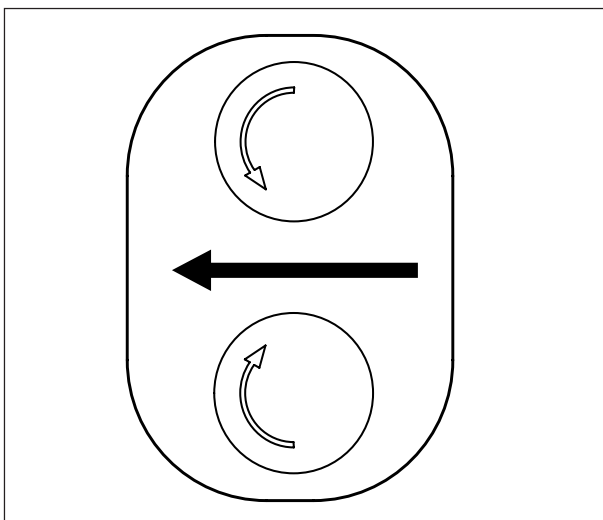
### Cleaning operation BR

The two brush rollers have the same speed and opposite directions of rotation, driven by a brush motor.



### Cleaning operation BD

The two disc brushes rotate towards each other with the same speed, driven by two disc brush motors.



### Battery

The remaining battery capacity is indicated by the flashing of the LED.

If the red LED lights up, all functions except driving operation are automatically switched off. It is still possible to drive to the next charging station.

### Battery charger

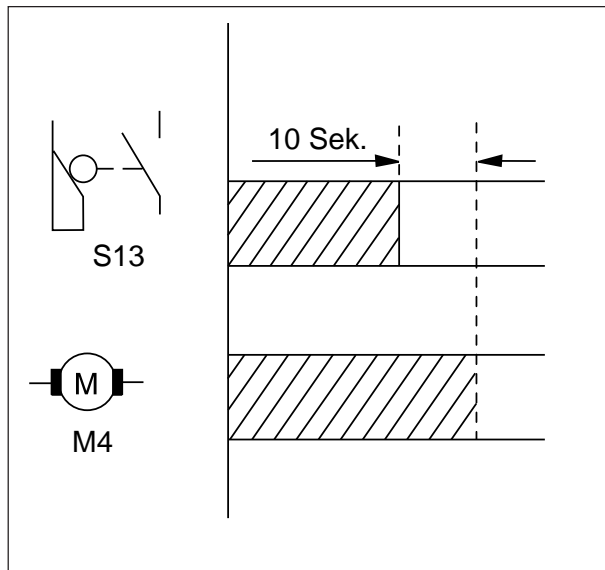
The BAT version is delivered without batteries and battery charger.

The battery charger and batteries are integrated in the Pack version unit.

#### Note:

For a detailed description of the battery and the battery charger, as well as information on maintenance and technical specifications, please refer to the Service Manual "Battery Technology" (5.905-331).

## 1.1 Technical features



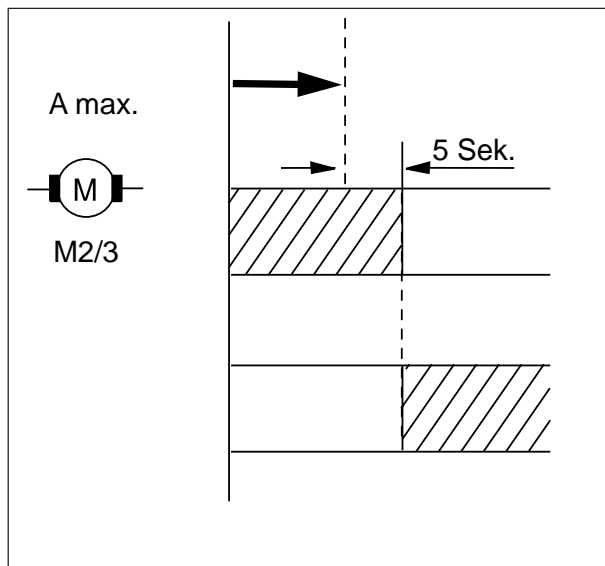
*suction beam raised*

### suction beam raised

When the suction beam is raised, a microswitch is actuated which causes the electronic control circuits to switch off the suction motor with a time delay of approx. 10 seconds. The time delay prevents dirty water from escaping from the suction hose before it is collected in the wastewater tank.

S13 Microswitch, suction motor

M4 Suction motor



*Brush motor overload*

### Brush motor overload

If the brush motors are overloaded due to excessive contact pressure or a foreign body / string wrapped around the brush, the current consumption becomes too high. After a time delay of approx. 5 seconds, the electronic control circuits switches off the brush motors and the indicator lamp lights up. The time delay prevents short-term load peaks resulting in immediate shut-off of the brush motors. The time delay is set in the factory and cannot be changed.

M2/3 Brush motors

A max Max. current consumption

#### Note:

When the unit is at a standstill, the brush motors switch off after 0-5 seconds (manufacture setting 2 seconds) (adjustable using the Setup menu of the printed circuit boards of the Advanced version only) and immediately switches back on when driving operation is started again.

### Wastewater tank is full

If the wastewater tank is full the suction motor (M4) switches off with a delay. The wastewater tank has to be emptied.



## 1.2 View from the front



- |                                               |                                              |
|-----------------------------------------------|----------------------------------------------|
| 1 Cover, wastewater tank                      | 9 Wiper strip (not Classic version)          |
| 2 Wastewater tank                             | 10 Pedal for raising/lowering the brush head |
| 3 Control panel                               | 11 Ram protector                             |
| 4 Control knob, water flow                    | 12 Fresh-water tank                          |
| 5 Lever for raising/lowering the suction beam | 13 Cap, fresh-water tank                     |
| 6 Suction hose, cleaning agent (DOSE)         | 14 Seat, with microswitch                    |
| 7 Cleaning agent bottle (DOSE)                | 15 Steering wheel                            |
| 8 Brush head                                  | 16 Drive pedal                               |



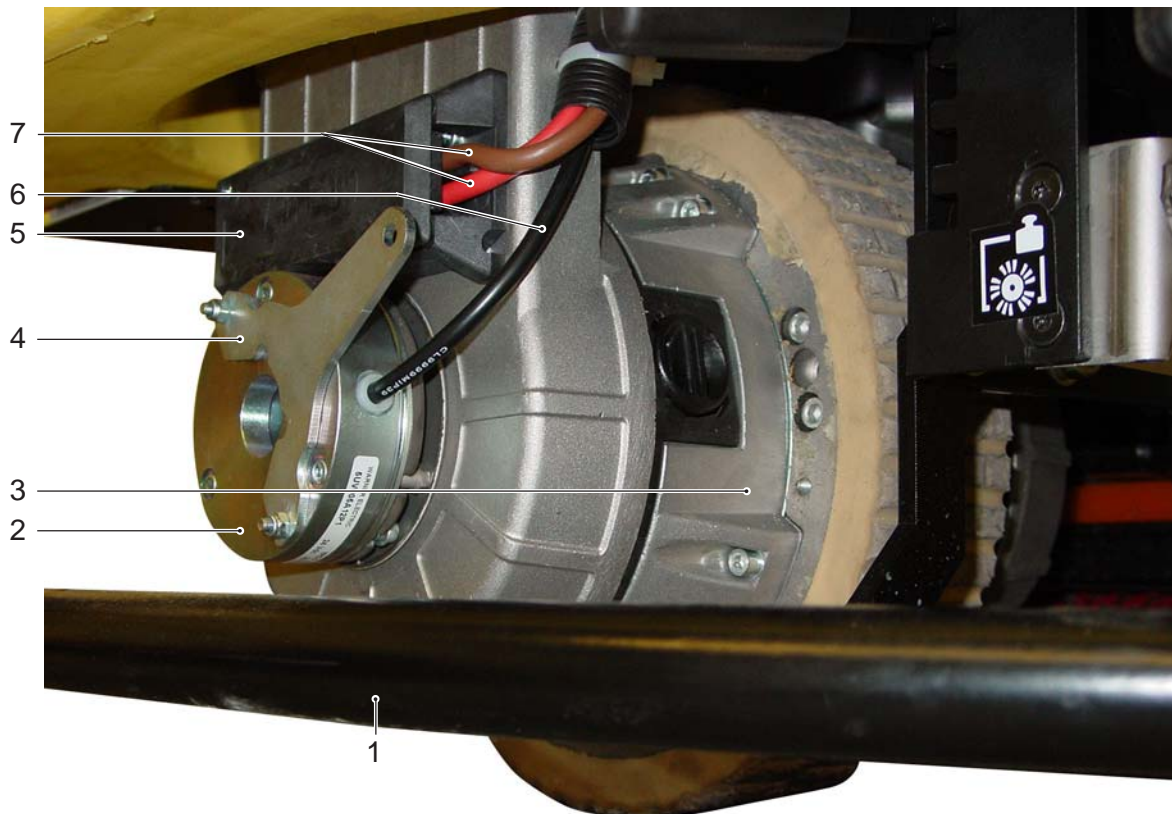
### 1.3 Rear view



- 1 Cover, wastewater tank
- 2 Wastewater tank
- 3 Deflection roller, suction beam

- 4 suction beam
- 5 Supply roller for suction beam
- 6 Drain hose, wastewater tank

## 2.1 Wheel hub motor



- 1 Ram protector
- 2 Electromagnetic brake (Y1)
- 3 Front wheel, wheel hub motor (M1)
- 4 Freewheeling lever, wheel hub motor (M1)
- 5 Cover, carbon brushes
- 6 Wire, electromagnetic brake (Y1)
- 7 Wire, wheel hub motor (M1)

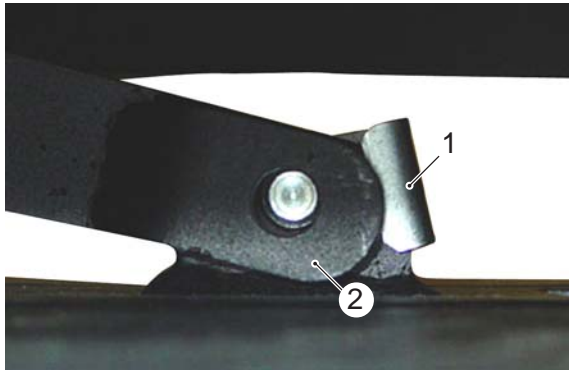
**Note:**

The drive motor is switched to forwards or reverse drive using the buttons on the control panel.

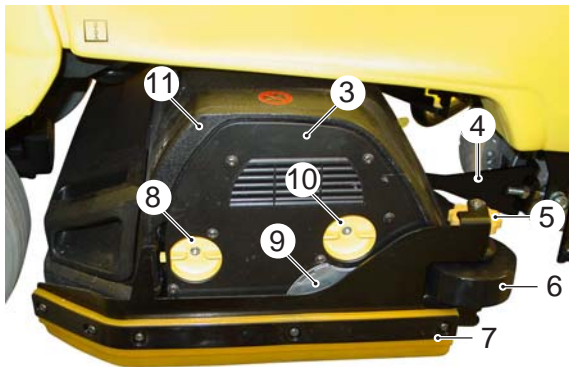
To move the unit in neutral, the freewheeling lever on the left-hand side of the drive motor must be pulled towards the outside and locked in position with a suitable object.

The freewheeling lever (5) disengages the electromagnetic brake (2) of the wheel-hub motor (M1).

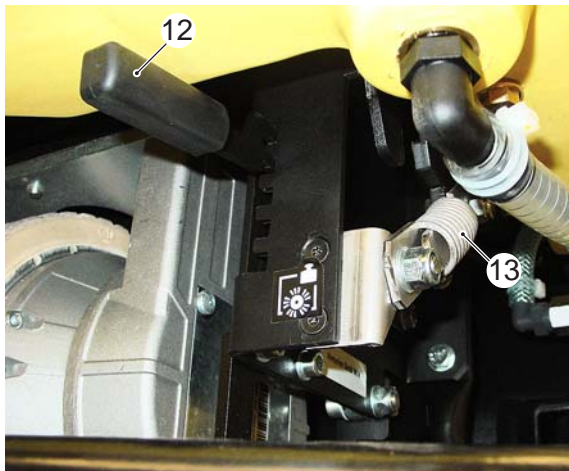
## 2.2 Brush head



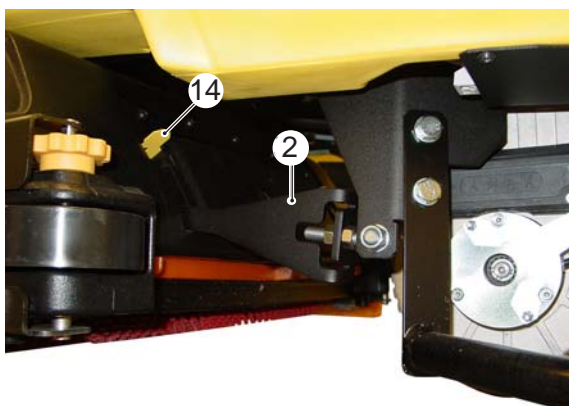
*Brush head retainer*



*Brush head*



*Brush contact pressure lever*



*Guide, brush head*

### Lowering the brush head

To raise/lower the brush head (see page 8, Item 10), press down the front area of the pedal, disengage and allow pedal to move upwards.

### Lowering the brush head

To raise/lower the brush head, see page 8, press rear area of pedal and latch into position.

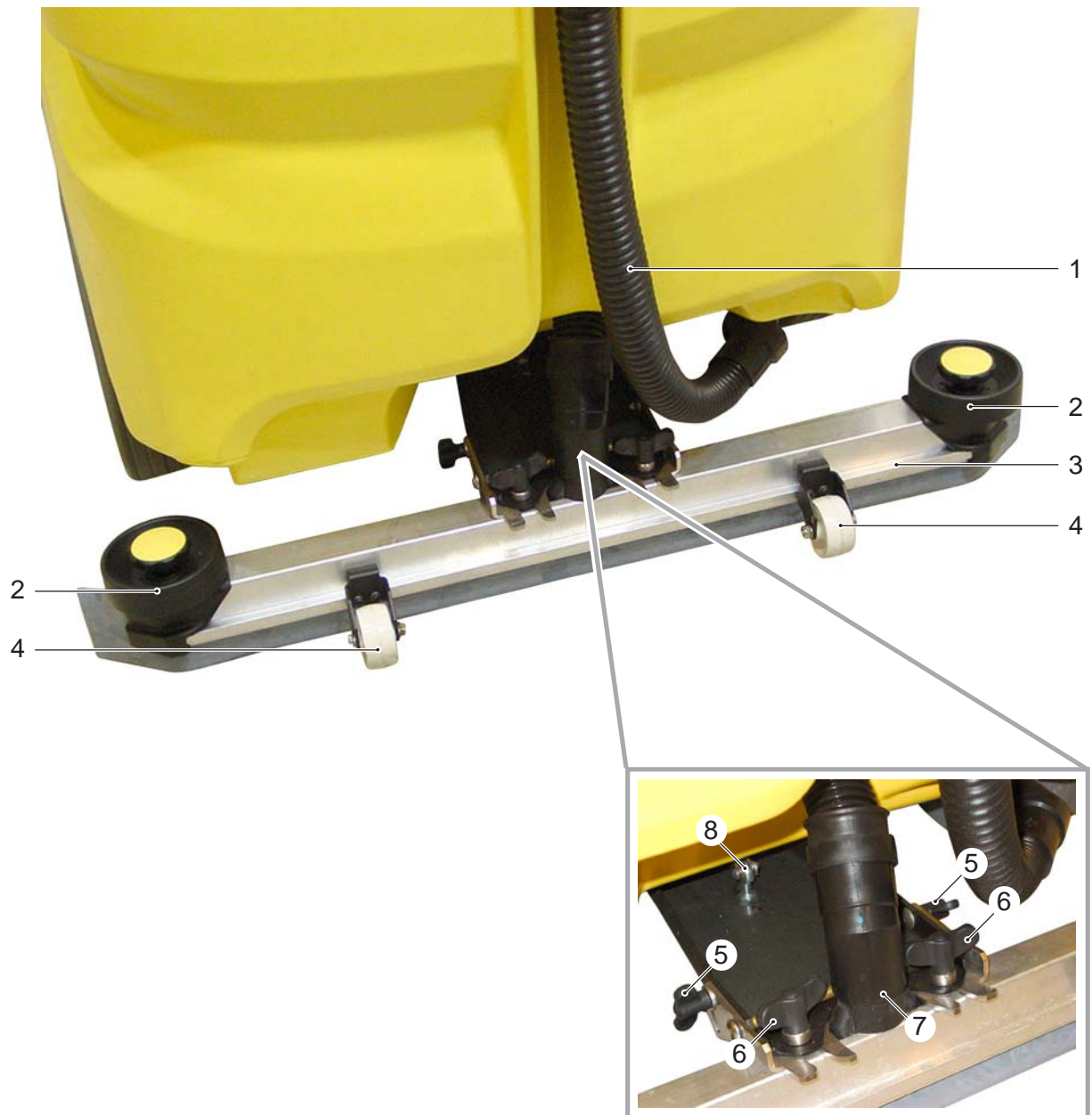
The brush contact pressure is adjusted using the lever (12) (not Classic version).

Lever upwards: Increase contact pressure.

Lever downwards: Reduce contact pressure.

- 1 Retaining pin with locking device
- 2 Brush head retainer
- 3 Brush drive assembly cover plate
- 4 Guide (2x), brush head
- 5 Adjusting wheel, wiper strip (not Classic version)
- 6 Deflection roller
- 7 Wiper strip (not Classic version)
- 8 Locking device, wiper strip (not Classic version)
- 9 Bearing cover, brush roller
- 10 Locking device, bearing cover
- 11 Brush head
- 12 Lever, brush contact pressure (not Classic version)
- 13 Spring, brush contact pressure (not Classic version)
- 14 Retaining clamp (2x), brush head

## 2.3 Suction beam



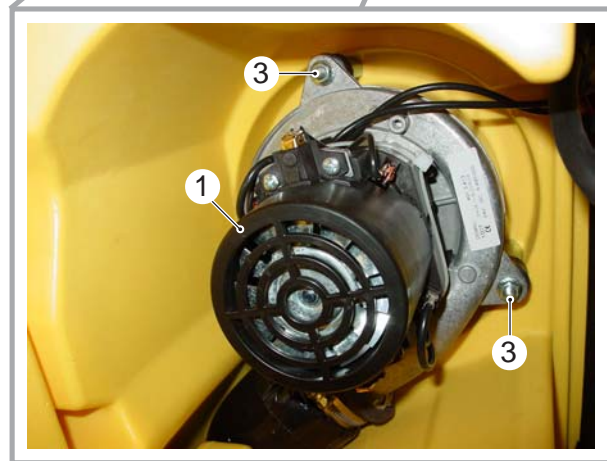
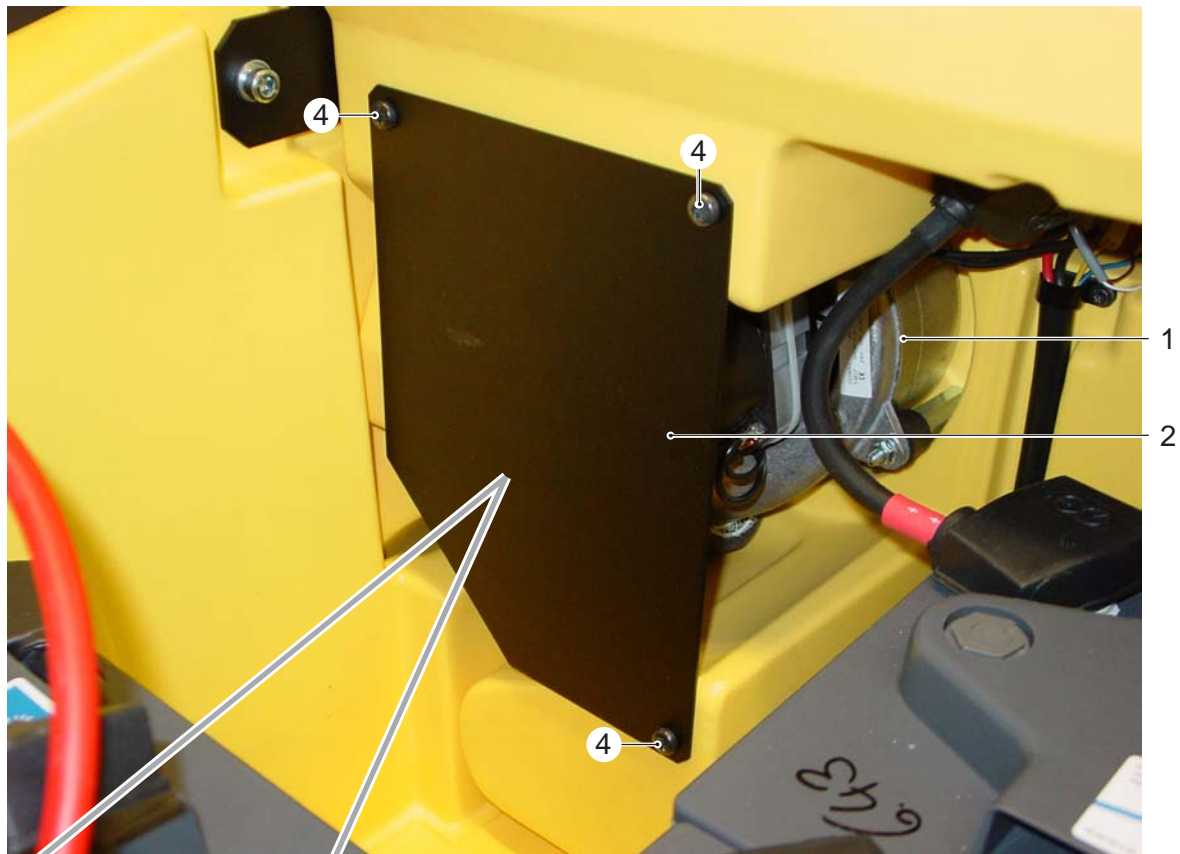
- 1 Drain hose, wastewater tank
- 2 Deflection roller, suction beam
- 3 Suction beam
- 4 Supply roller for suction beam
- 5 Wing screws (2x), adjusting suction beam tilt
- 6 Wing bolts (2x), suction beam tangential position adjustment (up to 5°)
- 7 Connection, suction hose
- 8 Cable control fastening, raise/lower suction beam

**Note:**

The front rubber strip is grooved as a standard and the rear is smooth. Both rubber strips can be turned over if worn to extend endurance.



## 2.4 Suction motor



### Suction motor

The suction motor (1) generates a vacuum in the wastewater tank, with which the wastewater is sucked up from the floor through the suction beam.

The suction motor (1) is located at the rear left-hand side under the seat, behind a cover plate (2).

- Lift up seat.
- Remove the three retaining screws (4) on the cover plate (2).
- Remove the three fastening nuts (3) on the suction motor (1) and remove the suction motor (1).

- 1 Suction motor (M4)
- 2 Guard
- 3 Retaining screws, suction motor (M4)
- 4 Retaining screws, cover plate

## 2.5 DOSE cleaning agent metering pump (optional)



- 1 Cover, cleaning agent metering pump (M6)
- 2 Cleaning agent metering pump (M6)
- 3 Cleaning agent bottle
- 4 Suction hose, cleaning agent

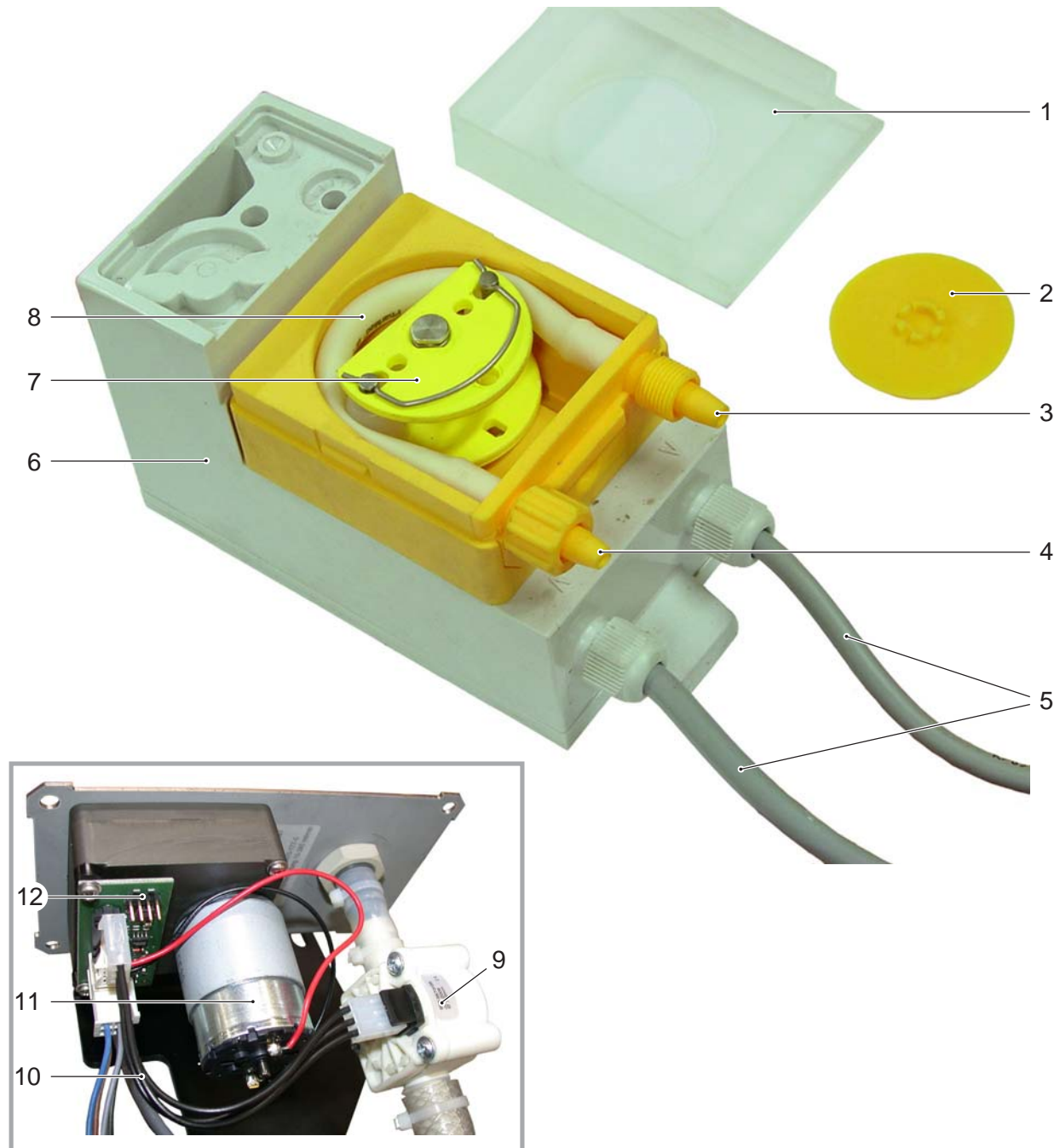
### Cleaning agent canister

A 1 litre bottle of cleaning agent can be accommodated in the recess on the left underneath the driver's seat.

### Cleaning agent metering pump (M6)

The cleaning agent metering pump (2) pumps the cleaning agent through the water inlet hose to the brush head.

## 2.5 DOSE cleaning agent metering pump (optional)

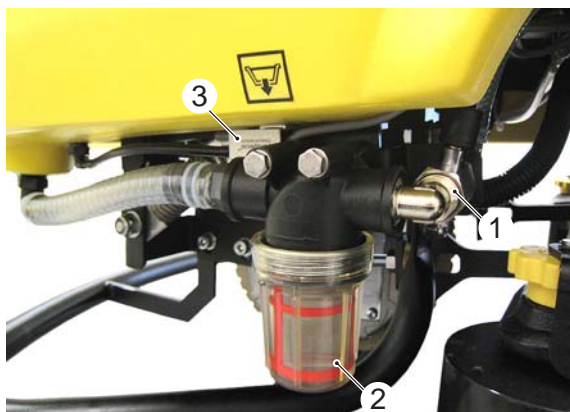


- 1 Cover, cleaning agent metering pump (M6)
- 2 Cap, pump rotor
- 3 Pump outlet
- 4 Pump inlet
- 5 Connection cable, cleaning agent metering pump (M6)
- 6 Cleaning agent metering pump (M6)

- 7 Transport rotor
- 8 Transport hose
- 9 Flowmeter
- 10 Control cable, flowmeter
- 11 Motor, cleaning agent metering pump (M6)
- 12 Connection printed circuit board



## 2.6 Water system



Water filter

### Draining the freshwater tank

The water filter (2) is located on the front left-hand side under the fresh water tank. The water filter must be removed to drain the freshwater tank. Do not lose the seal!

The water filter (2) cleans the fresh water to remove contaminations and to protect the flowmeter (DOSE) and the water system.

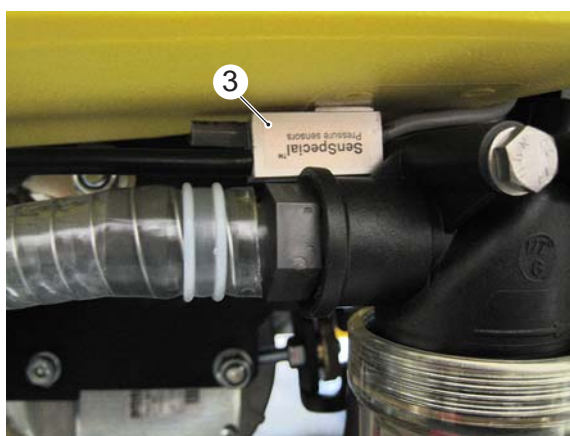


Water flow control valve

### Metering valve, water flow

The water flow metering valve (1) is located on the left in front of the brush head.

It controls the flow of water fed to the brush head. The valve is controlled by the water flow control (4).



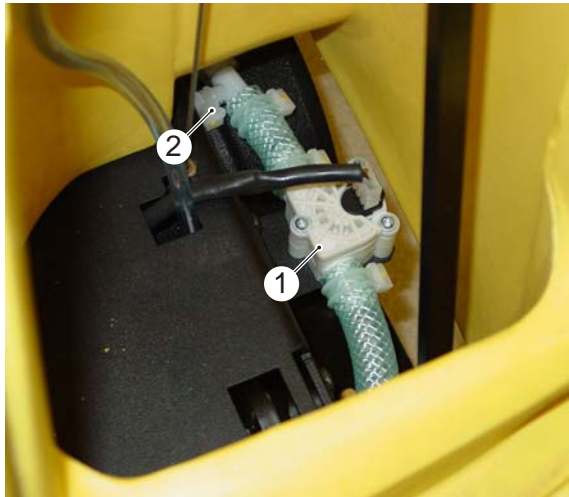
Pressure sensor

### Pressure sensor for measuring water level in freshwater tank (Adv and DOSE versions only)

The pressure sensor measures the water level in the freshwater tank and shows this in the display on the control panel. To this end the pressure sensor must be activated in the "Parameter Settings" Setup menu.

- 1 Water flow metering valve
- 2 Water filter
- 3 Pressure sensor
- 4 Water flow control valve

## 2.6 Water system

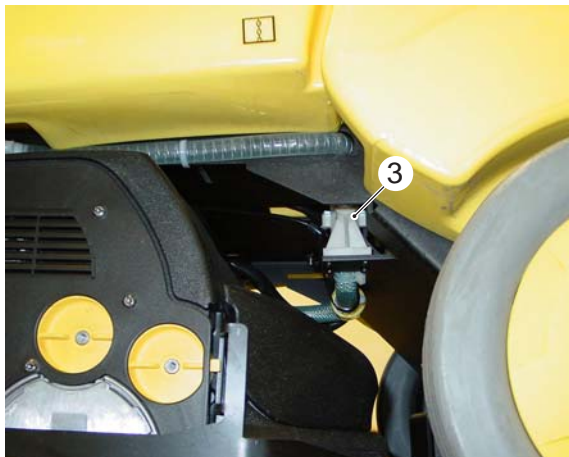


Flowmeter

### Flowmeter (DOSE)

The flow meter (1) is located on the left under the cover at the pedal for raising/lowering the brush head.

The set water volume is measured, the corresponding quantity of cleaning agent is then added by switching on the cleaning agent metering pump.

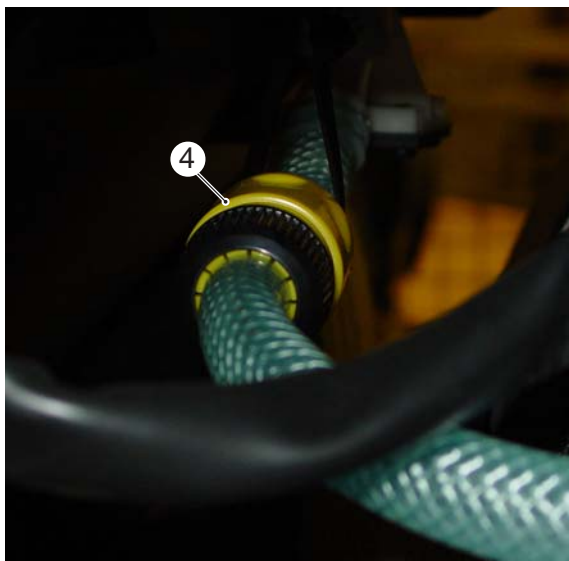


Water shut-off valve

### Water shut-off valve

The water shut-off valve (3) is located on the bottom left-hand side behind the brush head.

It is used to switch the water on and off by a corresponding selection at the program selection switch on the control panel.



Water connection, brush head

### Water connection, brush head

The water connection (4) is located in the middle of the vehicle, behind the brush head.

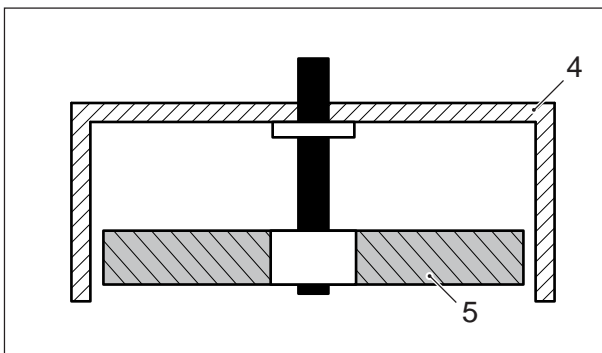
It can be used to quickly and easily disconnect the brush head from the water system.

- 1 Flowmeter
- 2 Connection, cleaning agent
- 3 Water shut-off valve
- 4 Water connection, brush head

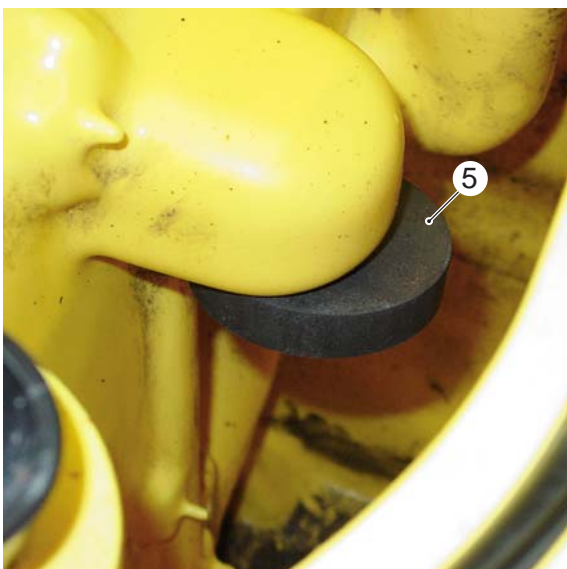
## 2.7. Wastewater tank



Wastewater tank



Float with protective cap



Float without protective cap

### Wastewater tank

The wastewater tank (1) is located above the rear axle. It can be opened by lifting up the tank lid (3) (red arrow).

### Float

The float (5) is mounted under a protective cap (4) to protect it against soiling.

The float (5) switches off the suction motor when the wastewater tank is full.

- 1 Wastewater tank
- 2 Drain hose, wastewater tank
- 3 Cover, wastewater tank
- 4 Protective cap, float
- 5 Float

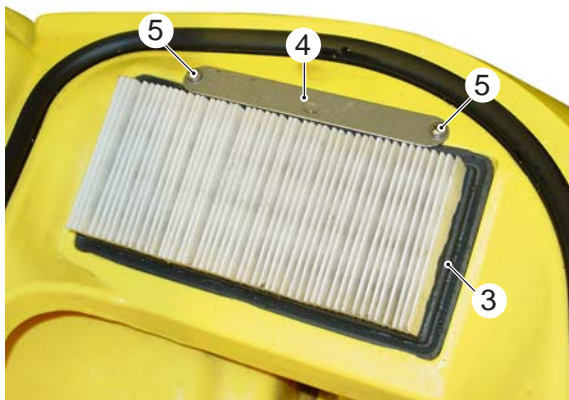
## 2.7. Wastewater tank



Wastewater intake

### Wastewater suction

The wastewater is pumped from the suction beam through the suction hose (2) and into the wastewater tank.



Flat pleated filter

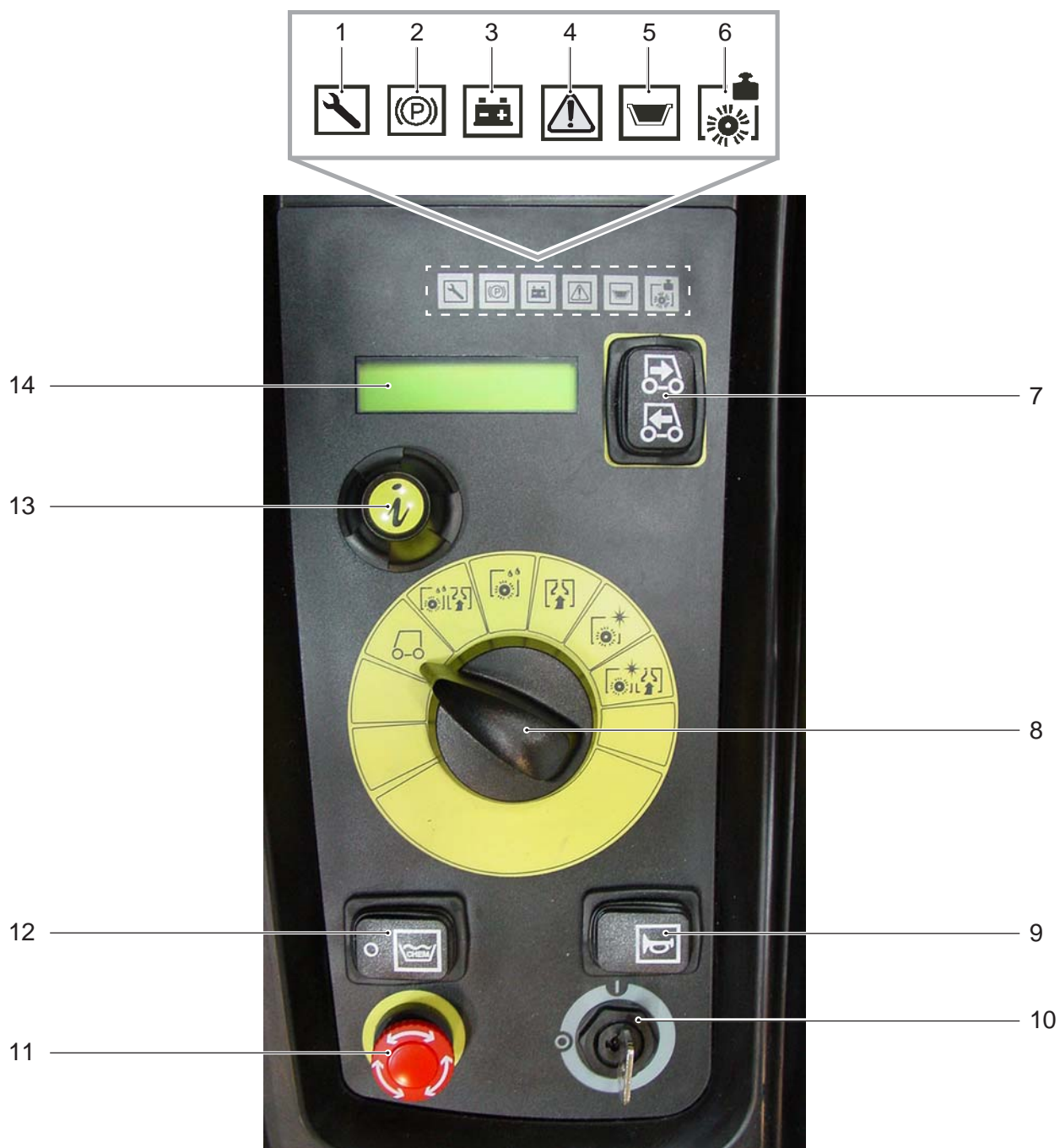
### Flat pleated filter

The flat pleated filter (3) is located on the rear right-hand side in the wastewater tank. It filters the drawn in air of the suction motor (M4) to protect it against dirt particles. To disassemble, the retaining screws (5) are removed, the mounting plate (4) is removed and the flat pleated filter (3) is removed.

- 1 Seal, cover
- 2 Suction hose from suction beam
- 3 Flat pleated filter, air intake from suction motor
- 4 Mounting plate, flat pleated filter
- 5 Retaining screws (2x), mounting plate

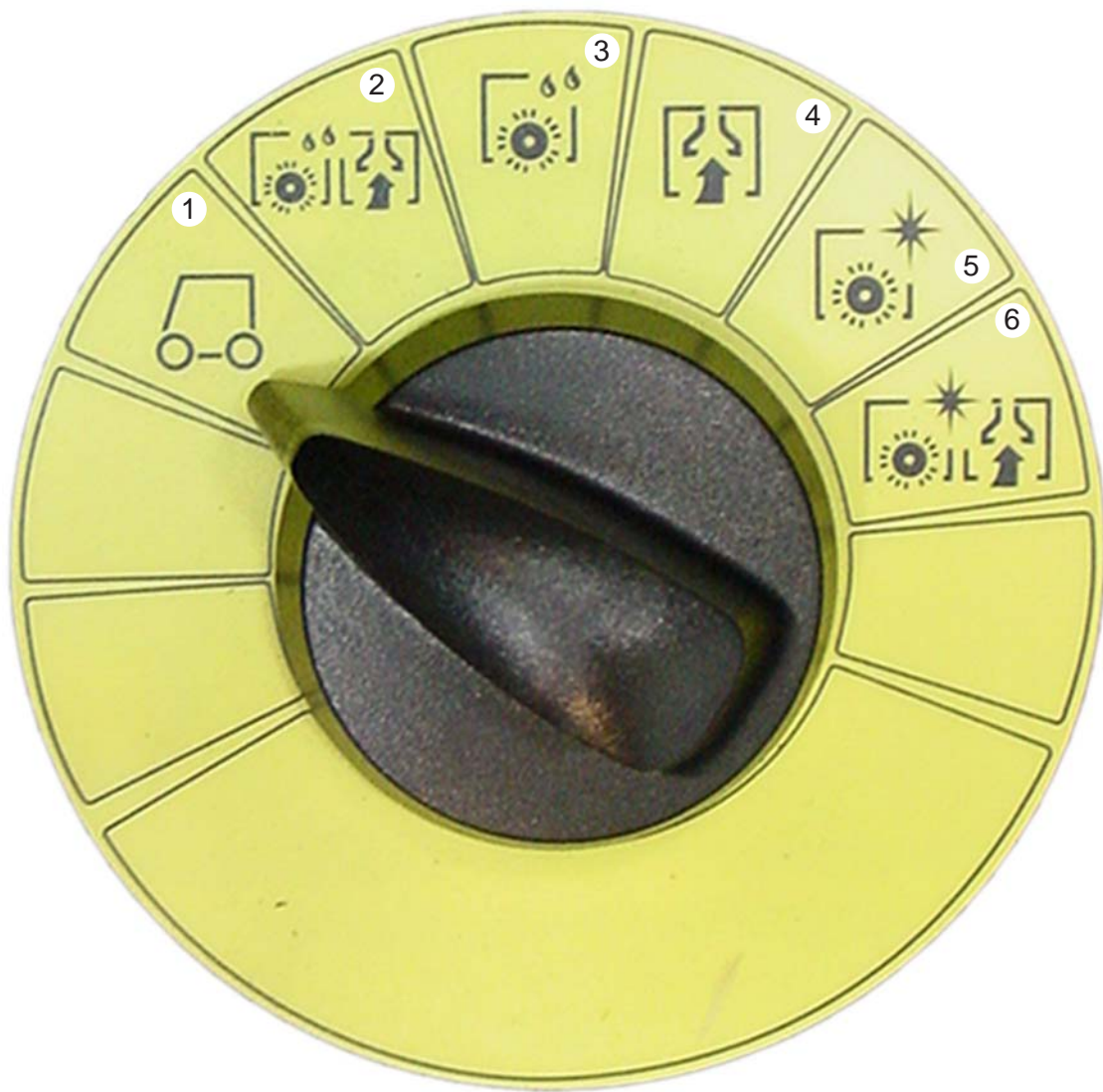


## 2.8 Control panel (Adv)



- |                                              |                                                                  |
|----------------------------------------------|------------------------------------------------------------------|
| 1 Indicator light, service mode              | 9 Pushbutton (S3), horn                                          |
| 2 Indicator light, parking brake active      | 10 Key switch (S0)                                               |
| 3 Indicator light, battery monitoring        | 11 EMERGENCY-STOP switch (S1)                                    |
| 4 Indicator light, fault                     | 12 Switch (S8), cleaning agent metering pump (optional)          |
| 5 Indicator light, wastewater tank full      | 13 Info button, rotary and keying function (not Classic version) |
| 6 Indicator light, brush motor overload      | 14 Display, warning and Info module                              |
| 7 Direction of travel changeover switch (S2) |                                                                  |
| 8 Program switch (S9)                        |                                                                  |

## 2.9 Program switch



- 1 Drive (without cleaning functions)
- 2 Wet scrubbing (with suction)
- 3 Wet scrubbing (without suction)
- 4 Suction (without scrubbing)
- 5 Polishing (without suction)
- 6 Polishing (with suction)

## 2.10 Seat switch



Seat



Seat switch (S10)

- 1 Seat
- 2 Seat switch (S10)

### Seat switch (S10)

The seat switch (2) is integrated in the seat (1) and is accessible from underneath. To access it, lift up the seat.

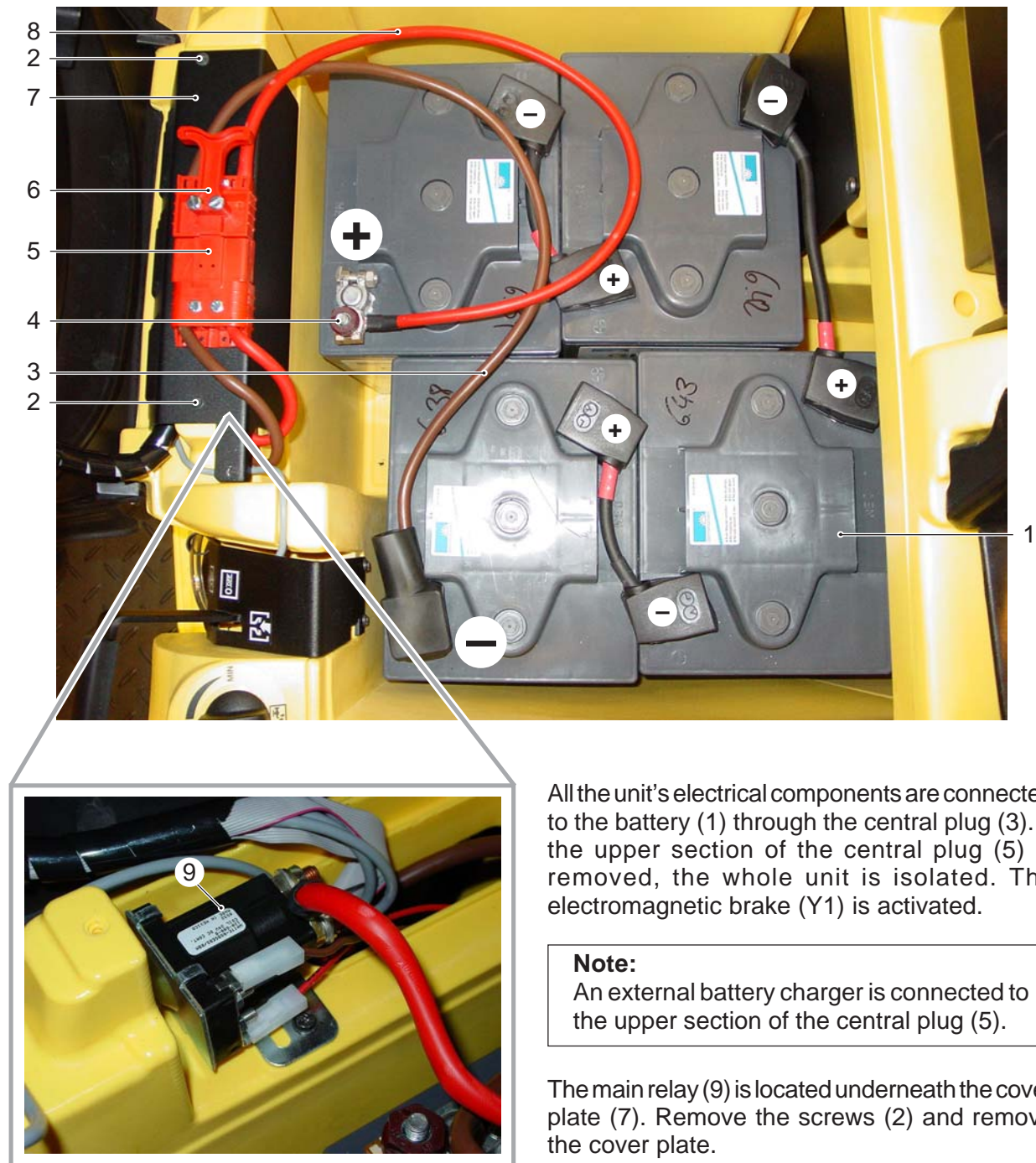
**Note:**

The seat switch (2) is actuated with a weight of 5 kg and higher.

In case of danger, it acts as a safety switch for the unit operator. The unit is braked to a stop if the operator leaves the seat (1) for more than 1.5 seconds while the machine is running.



## 2.11 Battery and main relay



All the unit's electrical components are connected to the battery (1) through the central plug (3). If the upper section of the central plug (5) is removed, the whole unit is isolated. The electromagnetic brake (Y1) is activated.

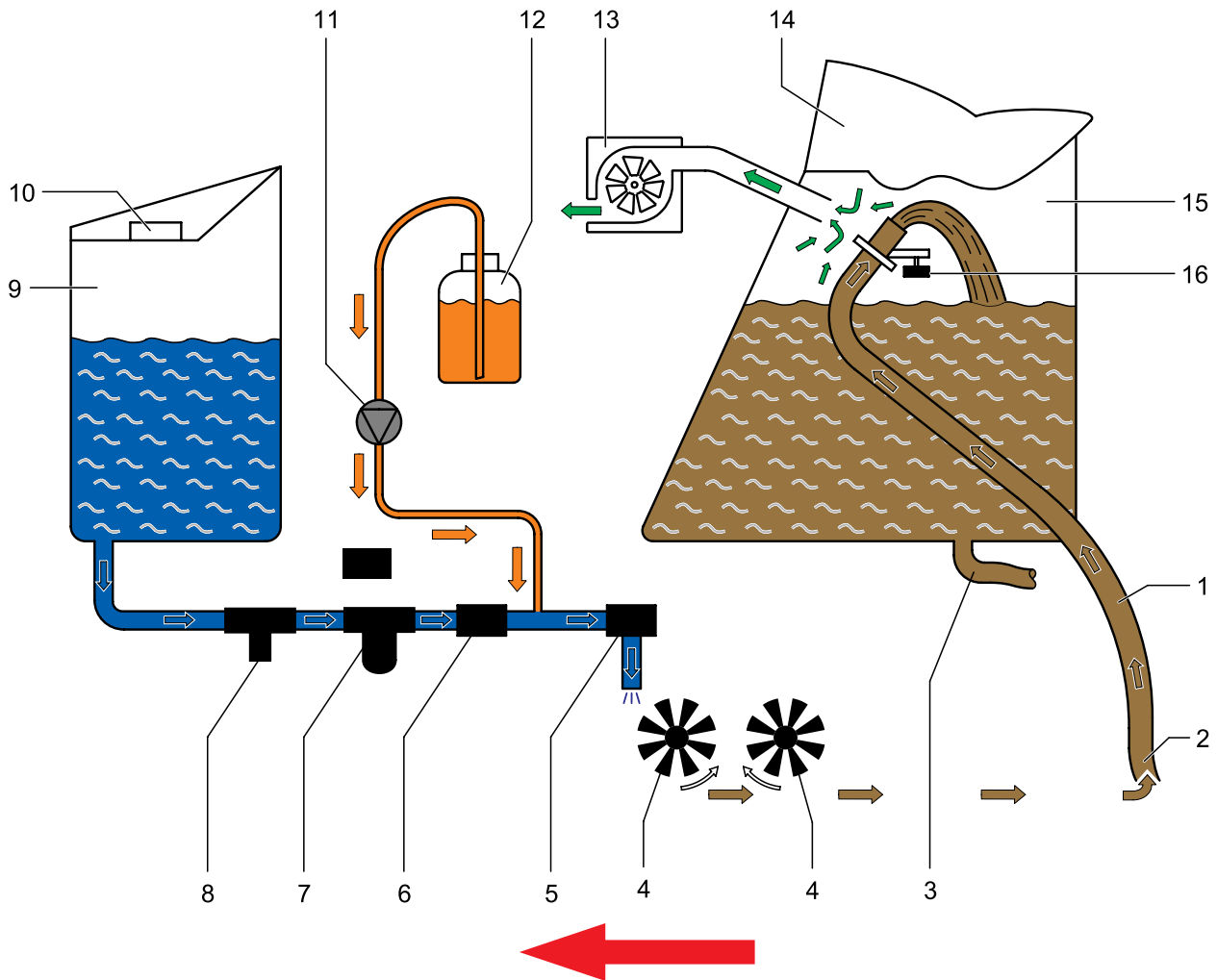
**Note:**

An external battery charger is connected to the upper section of the central plug (5).

The main relay (9) is located underneath the cover plate (7). Remove the screws (2) and remove the cover plate.

- 1 Battery (G1), 24 V/180 Ah, maintenance-free
- 2 Screws, cover plate
- 3 Connection cable with battery (-)
- 4 Main fuse (F1)
- 5 Central plug (X1)
- 6 Central plug upper section
- 7 Cover plate
- 8 Connection cable with battery (+)
- 9 Main relay (K1)

## 2.12 Function diagram



- |                                                               |                                                      |
|---------------------------------------------------------------|------------------------------------------------------|
| 1 Suction hose                                                | 9 Fresh-water tank                                   |
| 2 Suction beam                                                | 10 Cap, fresh-water tank                             |
| 3 Drain hose, wastewater tank                                 | 11 DOSE cleaning agent metering pump (M6) (optional) |
| 4 Brush roller (2x) (rotational direction towards each other) | 12 Cleaning agent bottle (DOSE)                      |
| 5 Water shut-off valve (Y2)                                   | 13 Suction motor (M4)                                |
| 6 Flowmeter                                                   | 14 Cover, wastewater tank                            |
| 7 Water filter                                                | 15 Wastewater tank                                   |
| 8 Fresh water drain cock                                      | 16 Float switch (S11)                                |

## 2.13 Operator and service program overview

Program switch Position 1-6	Cleaning agent metering pump (DOSE)	Brush speed (FACT)	Cleaning speed (Cleanspeed)	Speed of the suction motor (SUCTION)
<b>1 Drive</b> (without cleaning function)	–	–	–	–
<b>2 Wet scrub</b> (with suction)	1,0%	Power	4 bar	Power
<b>3 Wet scrub</b> (without suction)	1,0%	Power	4 bar	–
<b>4 Suction</b> (without scrubbing)	–	–	4 bar	Power
<b>5 Polish</b> (without suction)	–	Power	4 bar	–
<b>6 Polish</b> (with suction)	–	Power	4 bar	Power

Manufacture settings (see also Chapter 2.14.8)

### Operator functions:

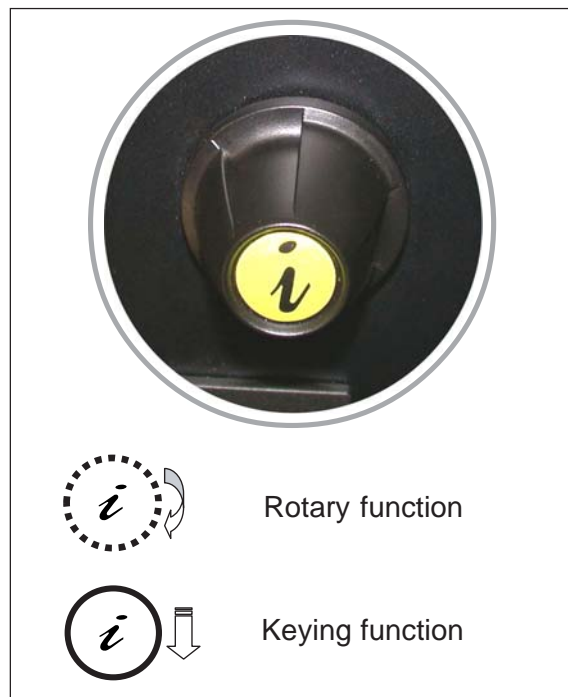
The overview describes the operator functions with the corresponding processes and access to the information menu. The manufacture settings for the operator functions is given in the table. Further details are given in Chapter 2.14.

### Service program overview

The service mode is available to the customer service technician for troubleshooting and adjustment work.

The service mode consists of the tester mode and the setup menu.

The service diagnostic function is not yet available and will be introduced at a later date.



Info button with functions

### Note:

The Info button is not included in the Classic version. Changes in the Setup menu of the Classic version can only be made using a special tool (see Chapter 8).

Access by selecting the menu items takes place using the information button.

Info button symbols used (see figure):

Rotary function: for selecting the menu.

Keying function: for confirming the menu selection.

Inching function: for fine adjustment (e.g. limit switch).

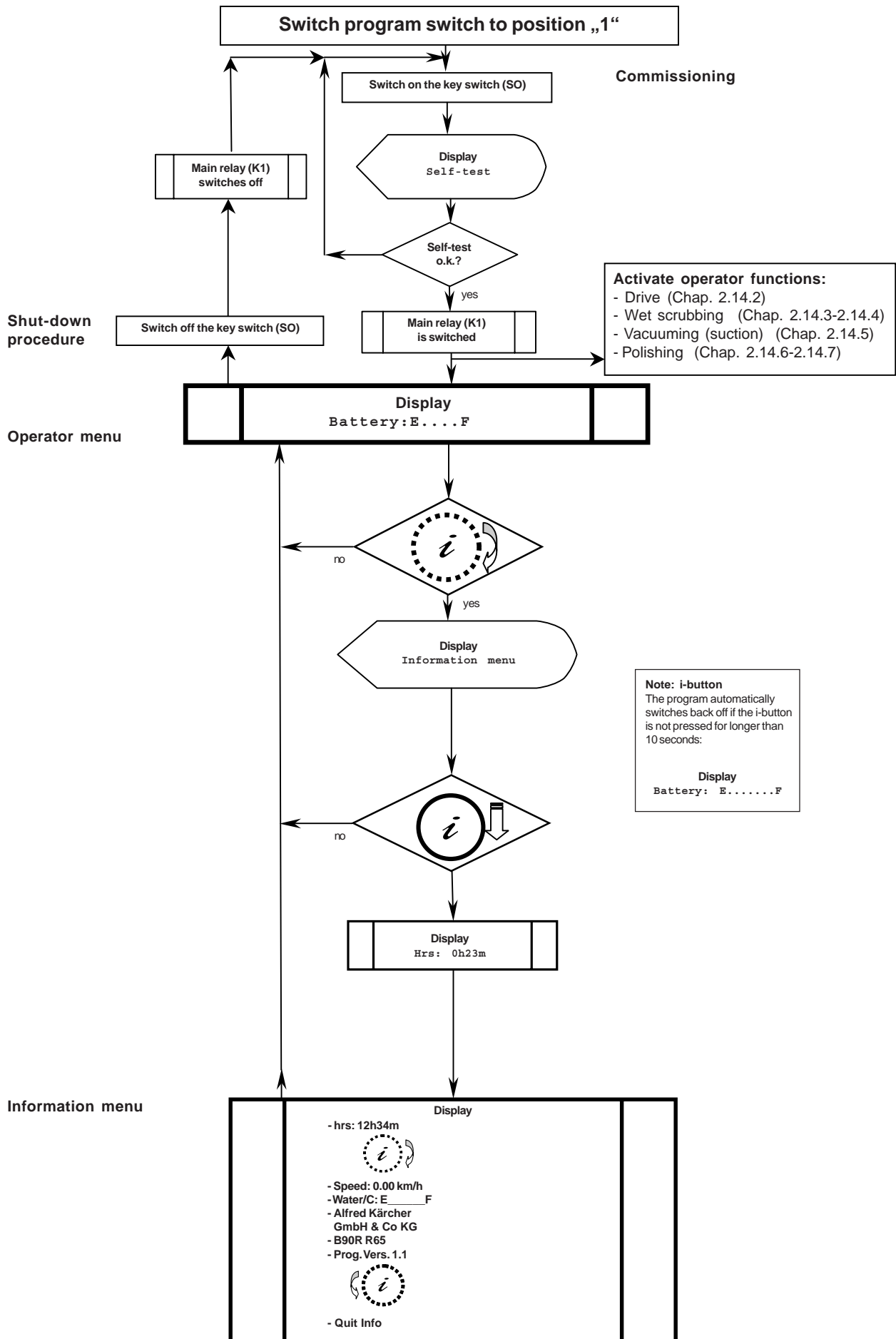
## 2.14 Operator functions

For operator (user)	For service technician	
<b>Operator functions</b> <ol style="list-style-type: none"> <li>1. Drive (without cleaning function)</li> <li>2. Wet scrubbing (with suction)</li> <li>3. Wet scrubbing (without suction)</li> <li>4. Suction (without cleaning function)</li> <li>5. Polishing (without suction)</li> <li>6. Polishing (with suction)</li> </ol> <b>Operator settings:</b> Settings which can be changed by the operator: <ul style="list-style-type: none"> <li>– Water flow through mechanical valve</li> <li>– Brush speed (FACT), BR 55/90 R, BR 65/90 R and BR 75/90 R only</li> <li>– Cleaning speed</li> <li>– Cleaning agent metering pump (DOSE)</li> <li>– Speed of the suction motor (SUCTION)</li> </ul>	<b>Test mode</b> <ul style="list-style-type: none"> <li>– Drive unit</li> <li>– Brush drive assembly</li> <li>– Suction motor</li> <li>– Cleaning agent metering</li> <li>– Water valve</li> </ul> <b>1. Test mode functional note</b> All functions can be activated in test mode, independently of the program switch.	<b>Setup menu</b> <ul style="list-style-type: none"> <li>– System settings</li> <li>– Drive settings</li> <li>– Machine features</li> <li>– Local language</li> </ul>

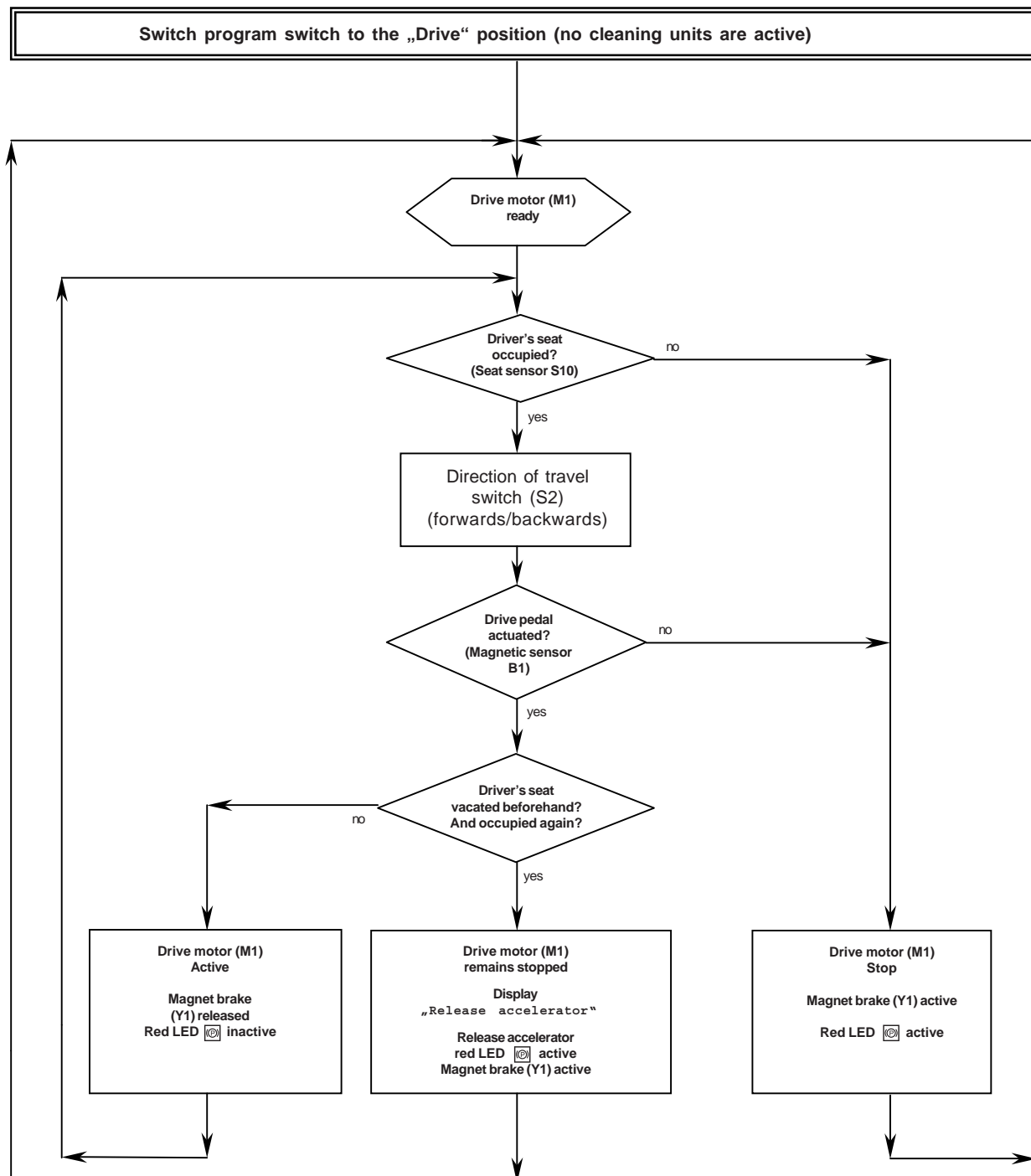
**Note:**

Apart from the test mode and setup menu, the service diagnosis will be introduced at a later date.

## 2.14.1 Initial operation and information menu



## 2.14.2 Drive (without cleaning functions)


**Note:**

For improved ride comfort, the direction of travel switch (S2) can be actuated as wished when the drive pedal is depressed.  
The machine gently brakes to a standstill and independently accelerates in the new selected direction of travel.

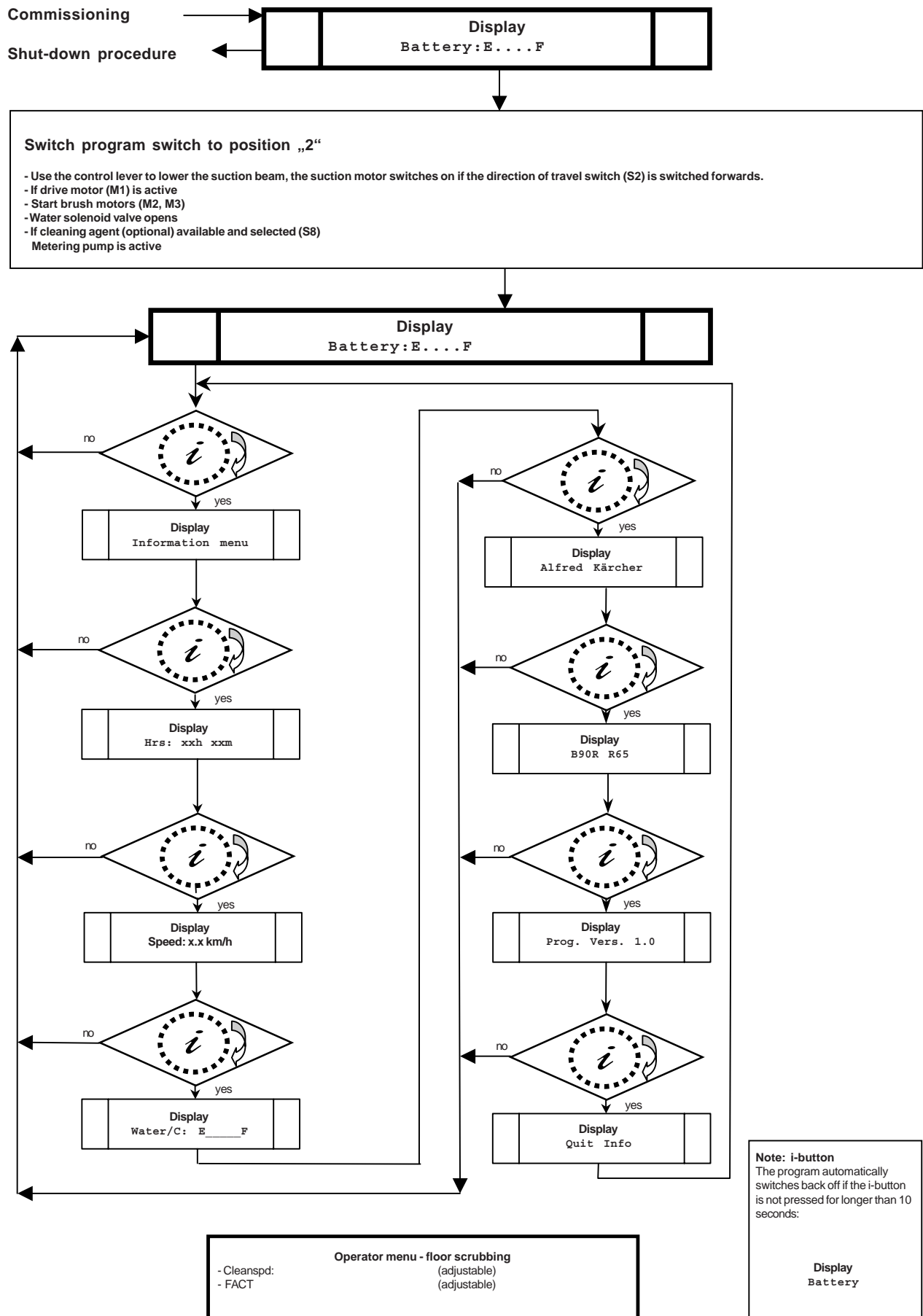
**Note:**

If the rotary pulse encoder is turned in an anti-clockwise direction the cursor works in the opposite direction, i.e. the menu is opened from the last to the first parameter. The last saved cursor can be called up again after quitting the menu, e.g. by switching back to the battery display.

## 2.14.3 Wet scrubbing (with suction)

Commissioning

Shut-down procedure

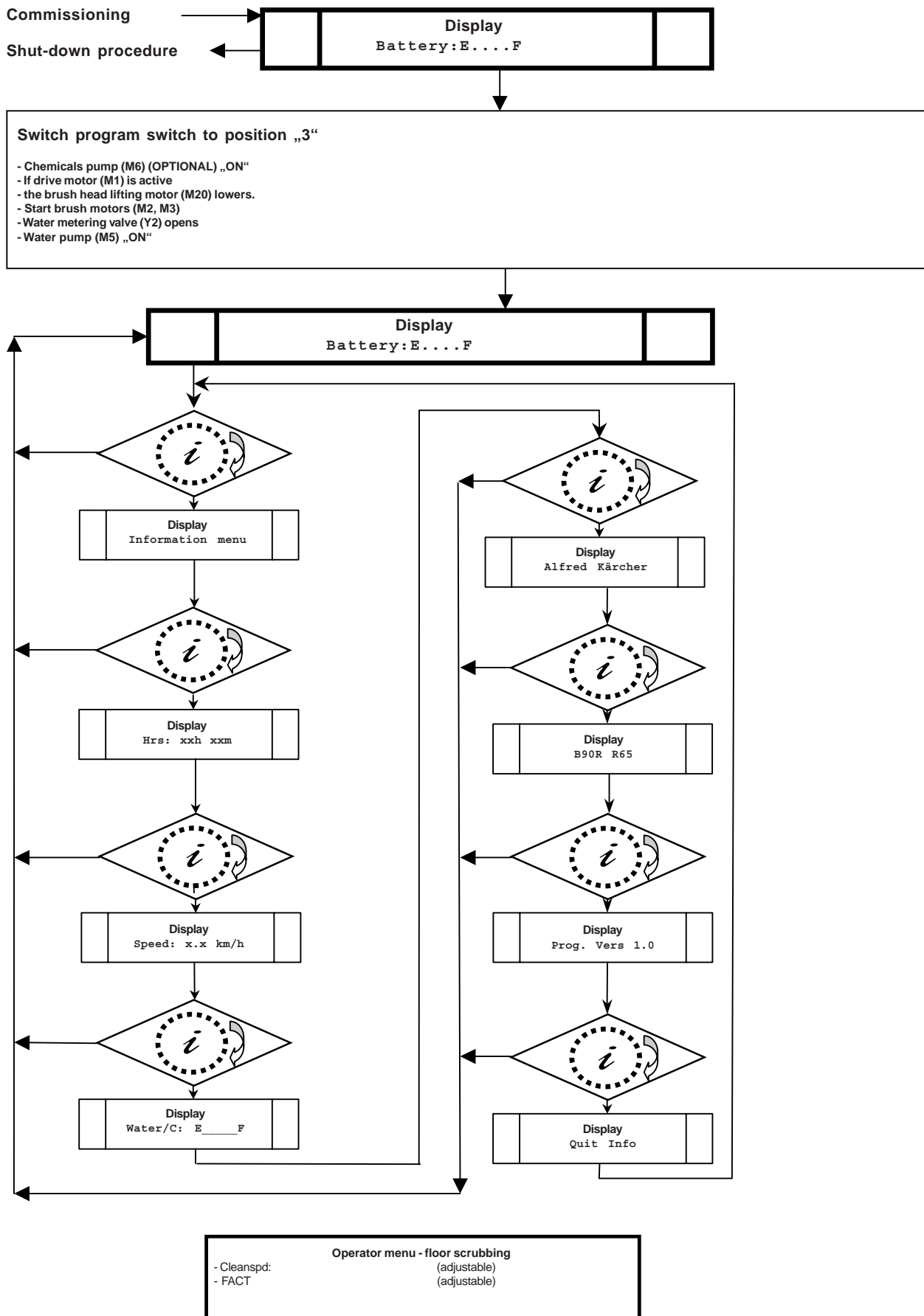




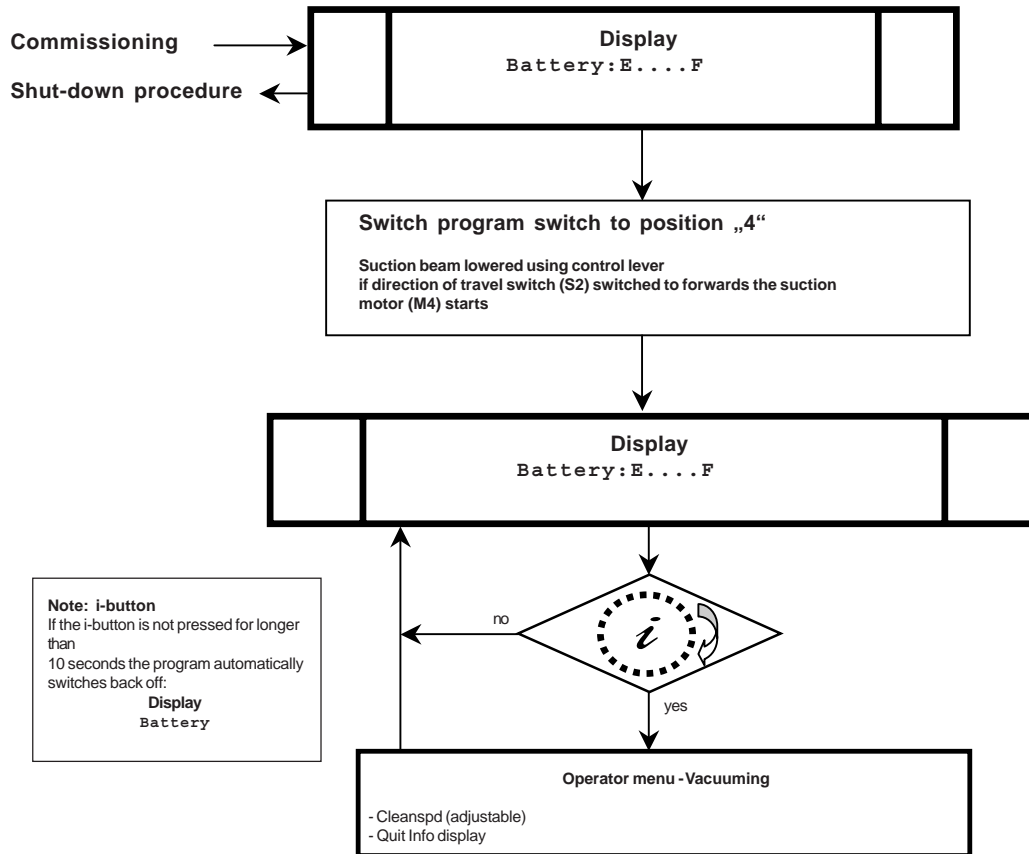
## 2.14.4 Wet scrubbing (without suction)

Commissioning

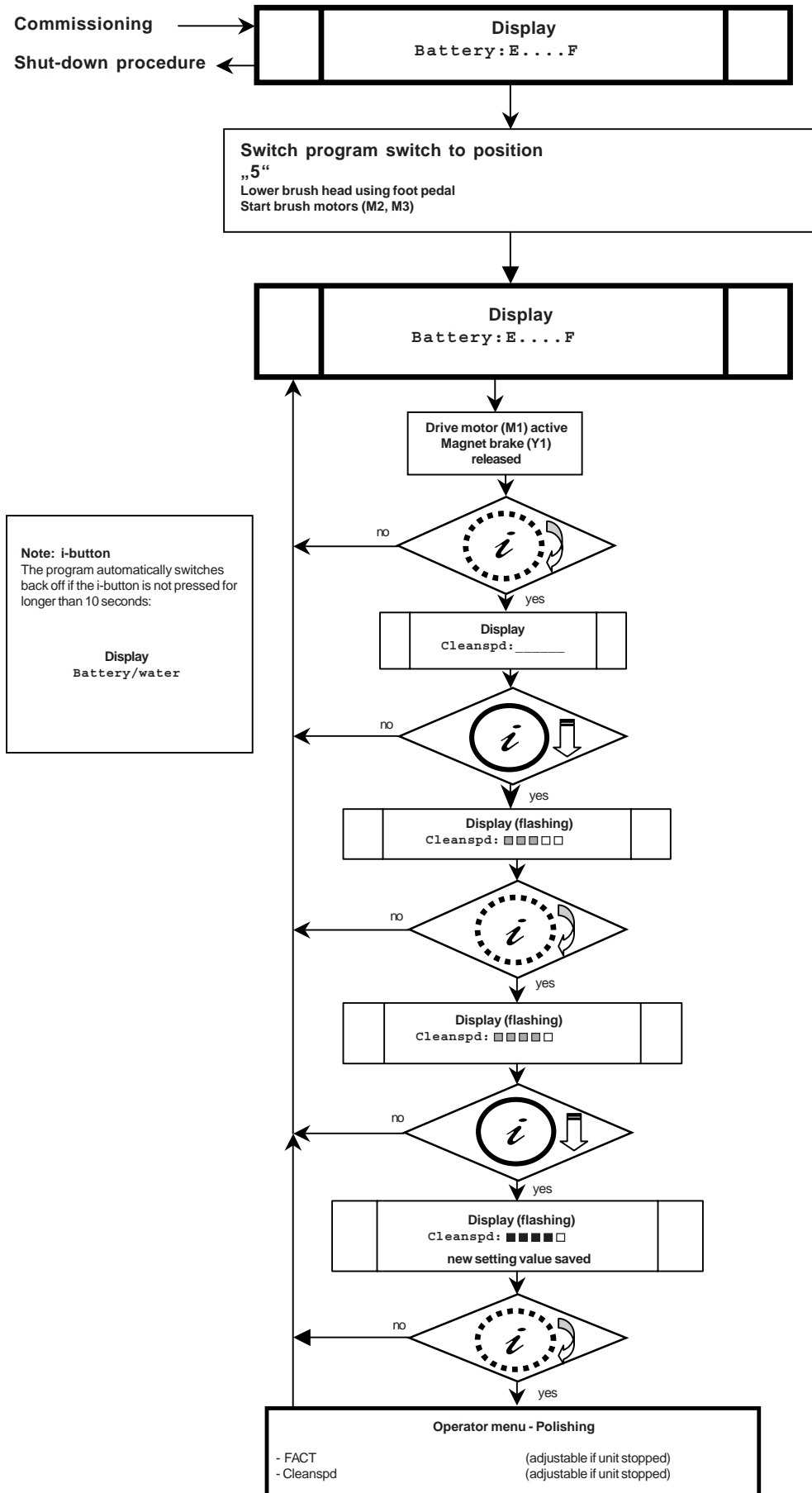
Shut-down procedure



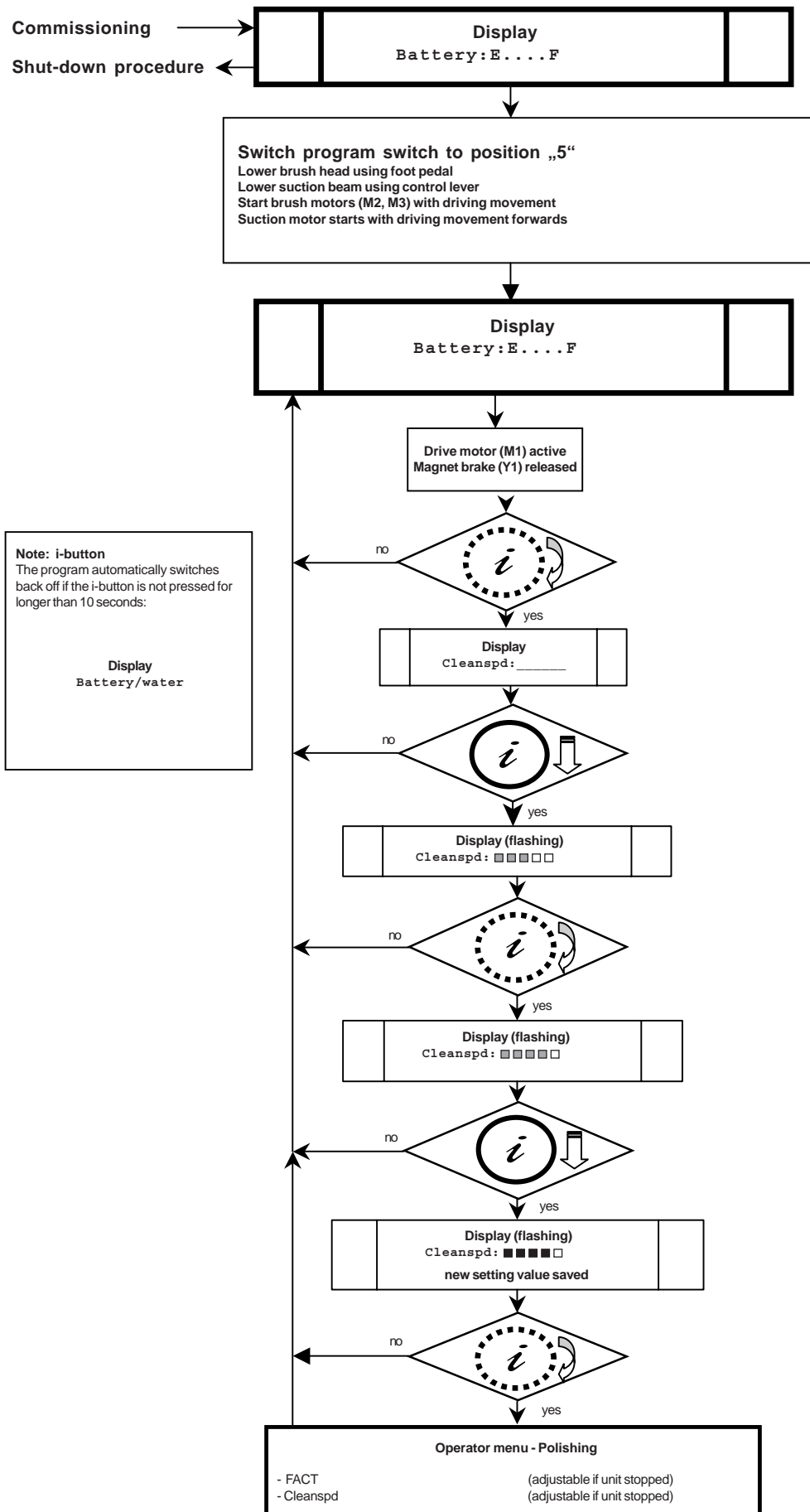
## 2.14.5 Suction (without scrubbing)



## 2.14.6 Polishing (without suction)



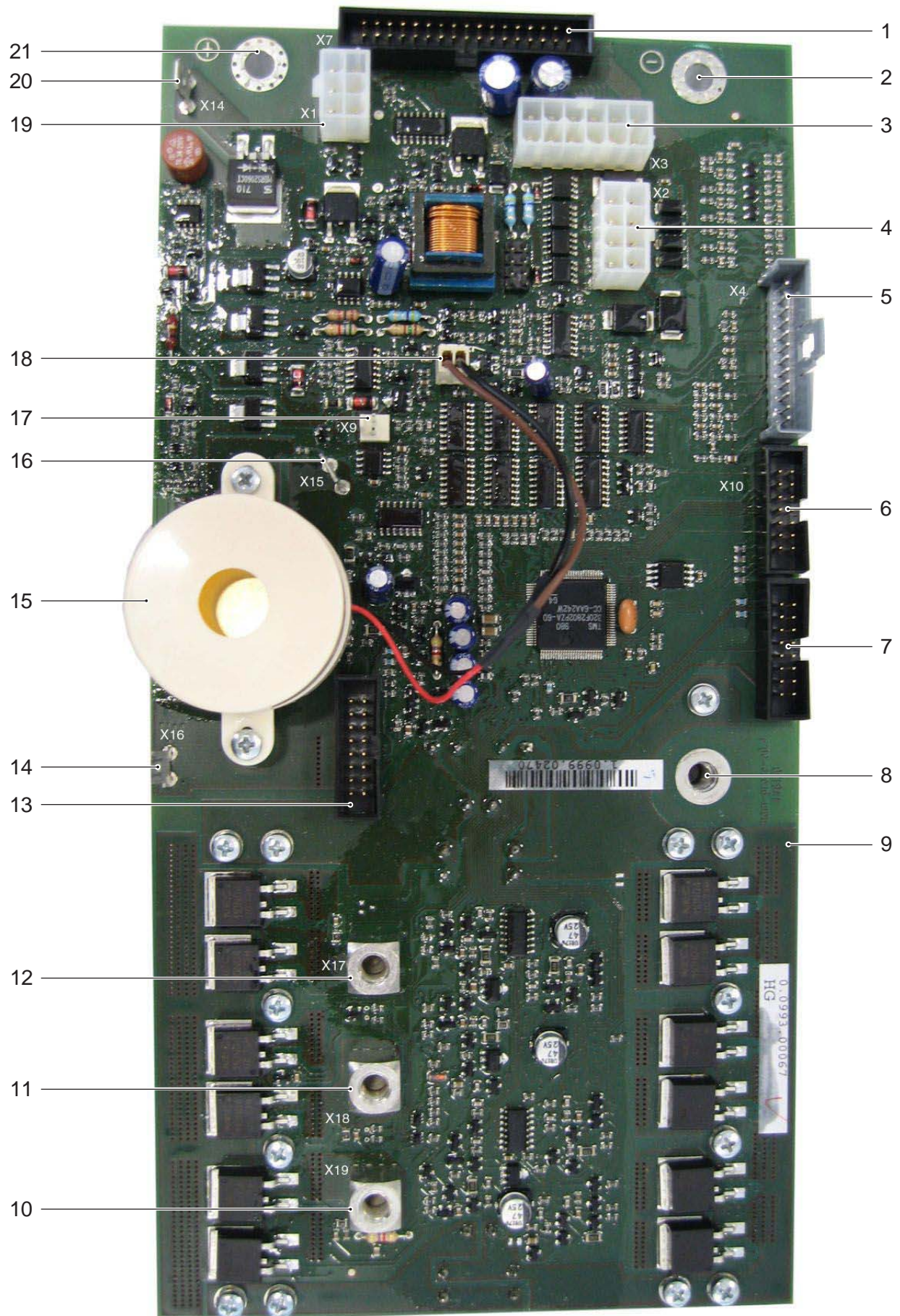
## 2.14.7 Polishing (with suction)



## 2.14.8 Manufacture settings - operator functions

PROCESS SWITCH MENU manufacture settings - Dated 09/07				
Process name/ Position Program switch	Adjustable process parameter	Display Manufacture setting	Display MIN/MAX	Notes
<b>1. Drive (without cleaning function)</b>	—	—	—	No setting features provided.
<b>2. Wet scrubbing (with suction)</b>	Cleaning agent metering pump (DOSE)	1%	0% - 3,0%	—
	Brush speed (FACT)	Power Clean	Power Clean Whisper Clean Fine Clean	Power Clean = 100% speed Whisper Clean = 65% speed Fine Clean = 40% speed
	Brush after-running time on stopping	2s	0s - 5s	Time from machine being brought to a standstill within which the roller head continues to scrub the floor.
	Working speed	4	1 - 6	Speed if the accelerator is fully pushed down: 1 = 1 km/h 2 = 2 km/h ..... 6 = 6 km/h
	Speed of the suction motor (SUCTION)	Power	Whisper Power	—
<b>3. Wet scrubbing (without suction)</b>	Cleaning agent metering pump (DOSE)	1%	0% - 3,0%	see 2.
	Brush speed (FACT)	Power Clean	Power Clean Whisper Clean Fine Clean	see 2.
	Brush after-running time on stopping	2s	0s - 5s	see 2.
	Working speed	4	1 - 6	see 2.
<b>4. Suction (without scrubbing)</b>	Working speed	4	1 - 6	see 2.
	Speed of the suction motor (SUCTION)	Power	Whisper Power	see 2.
<b>5. Polishing (without suction)</b>	Brush speed (FACT)	Power Clean	Power Clean Whisper Clean Fine Clean	see 2.
	Brush after-running time on stopping	2s	0s - 5s	see 2.
	Working speed	4	1 - 6	see 2.
<b>6. Polishing (with suction)</b>	Brush speed (FACT)	Power Clean	Power Clean Whisper Clean Fine Clean	see 2.
	Brush after-running time on stopping	2s	0s - 5s	see 2.
	Working speed	4	1 - 6	see 2.
	Speed of the suction motor (SUCTION)	Power	Whisper Power	see 2.

### 3.1 Hybrid module



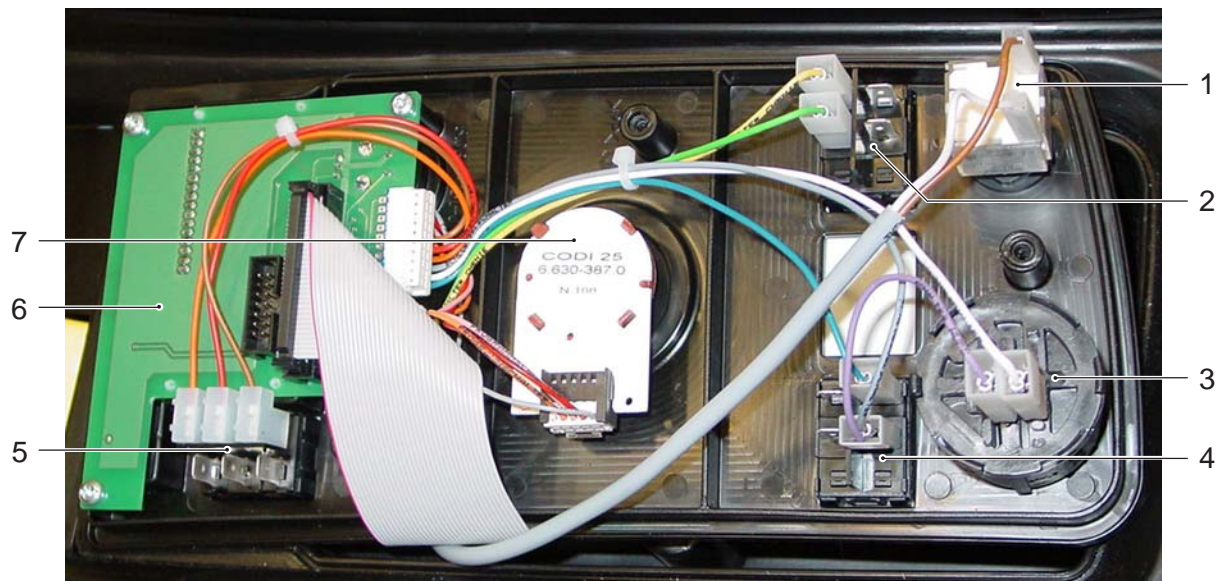


### 3.1 Hybrid module

- 1 Terminal strip (X1/A1), control panel
- 2 Connecting terminal (X13/A1), battery negative post, Service Module
- 3 Terminal strip (X3/A1), magnetic sensor (B1), DOSE cleaning agent metering pump (optional) (M6), EMERGENCY STOP switch (S1), electromagnetic brake (Y1)
- 4 Terminal strip (X2/A1), main relay (K1), water valve (Y2)
- 5 Terminal strip (X4/A1), battery charger (Batt Pack) (U1)
- 6 Terminal strip (X10/A1), not used
- 7 Terminal strip, not used
- 8 Connecting terminal (X20/A1), brush motor negative post for brush motor 1 (M2) and brush motor 2 (M3)
- 9 Hybrid module (A1)
- 10 Connecting terminal (X19/A1), brush motor positive post for brush motor 1 (M2) and brush motor 2 (M3)
- 11 Connecting terminal (X18/A1), wheel hub motor (M1)
- 12 Connecting terminal (X17/A1), wheel hub motor (M1)
- 13 Terminal strip, not used
- 14 Terminal strip (X16/A1), not used
- 15 Horn / buzzer (H1)
- 16 Connecting terminal (X15/A1), not used
- 17 Terminal strip (X9/A1), not used
- 18 Terminal strip (X8/A1), horn / buzzer (H1)
- 19 Terminal strip (X1/A1), battery charger (Batt Pack) (U1), Service Module
- 20 Connecting terminal (X14/A1), main relay (K1)
- 21 Connecting terminal (X12/A1), battery positive post via main relay (K1) and main fuse (F1)

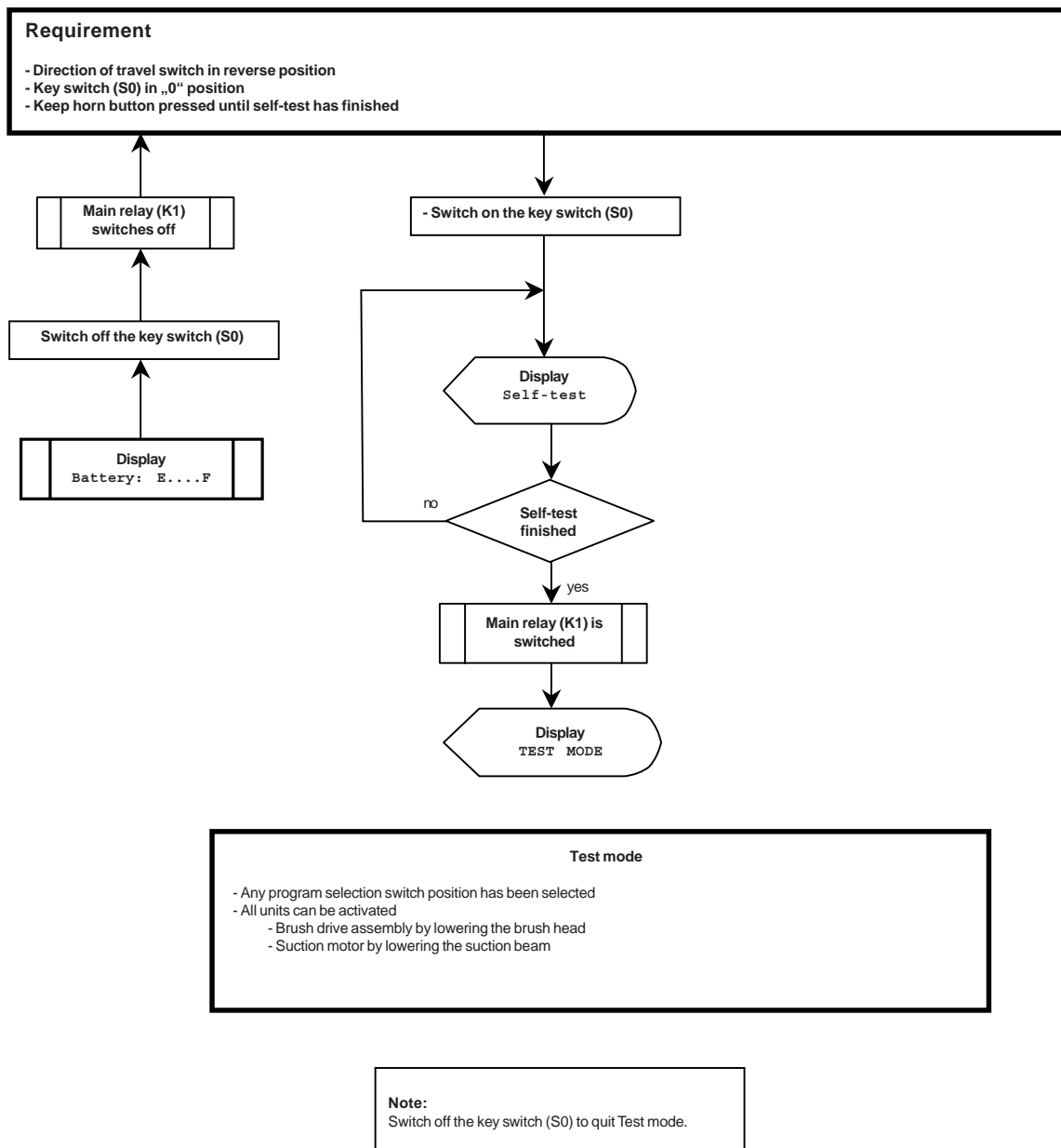


### 3.2 Control panel from below

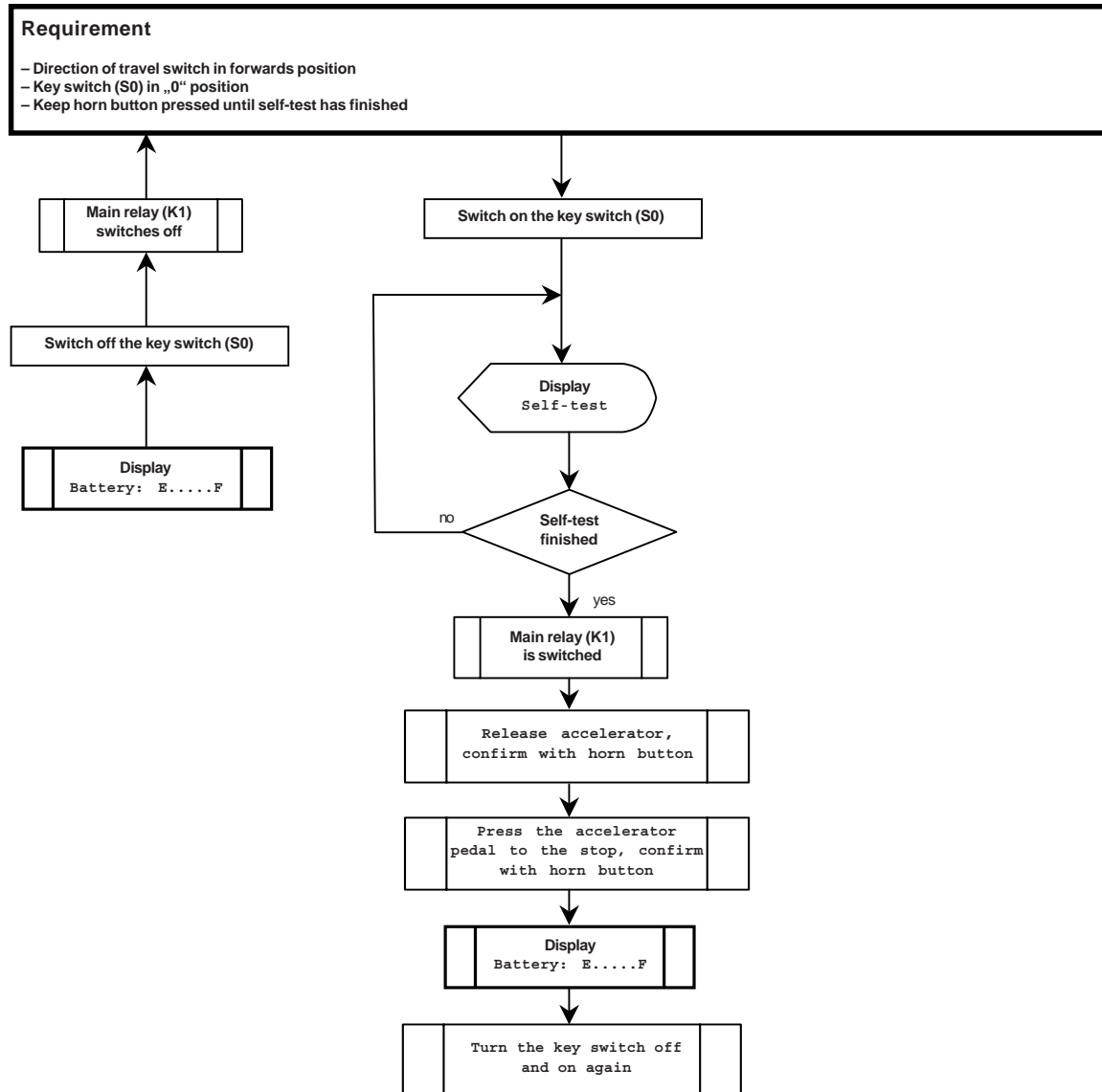


- 1 EMERGENCY-STOP switch (S1)
- 2 Switch, DOSE cleaning agent metering pump (optional) (S8)
- 3 Key switch (S0)
- 4 push-button, horn (S3)
- 5 Direction of travel changeover switch (S2)
- 6 Info module with display, LED displays and Info button
- 7 Program switch (S9)

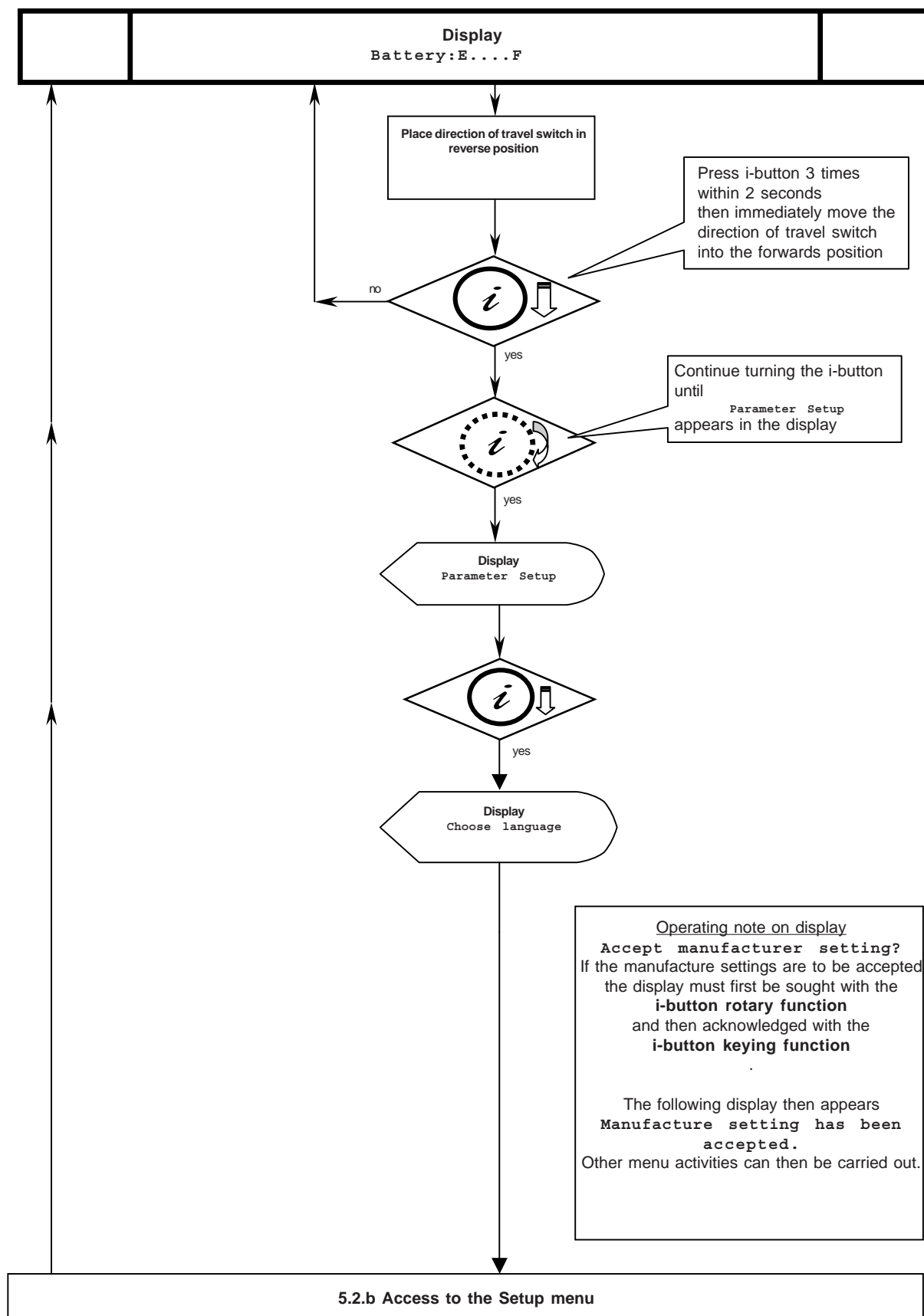
## 4.1 Access to Test mode



## 4.2 Accelerator calibration



### 4.3 Access to the Setup menu



### 4.3.1 Parameter settings

Setup parameters	Lower limit	Upper limit	Default value	Classic	Advanced	Note
Language	English	Turkish	English	English	English	
Standby	5s	60s	30s	30s	30s	
Discharge voltage	19.5 V	22.6 V	21.8 V	21.8 V	21.8 V	Safety-relevant parameters
Brush current	20 A	80 A	80 A	80 A	80 A	
Drive current	10 A	80 A	80 A	80 A	80 A	Safety-relevant parameters
CleanSpdEdit	0	1	1	1	1	
FACT_VacEdit	0	1	1	1	1	
Edit chemicals	0	1	1	1	1	
Level sensor	0	1	0	0	1	Level sensor available = 1
Machine type	R/D/K	R/D/K	D	D	D or R	Head: R = Rolls, D = Disc or K = Sweeper
Working width	40 cm	95 cm	65 cm	65 cm	Head width	Enter installed head width
Suction after-run	0s	20s	10s	10s	10s	
Brush stop	0s	5s	2s	2s	2s	
Braking ramp	0	20	19	19	19	Safety-relevant parameters
Acceleration ramp	0	20	14	14	14	
SpeedFWD	0.0 km/h	8.0 km/h	6.0 km/h	6.0 km/h	6.0 km/h	
SpeedREV	0.0 km/h	8.0 km/h	3.5 km/h	3.5 km/h	3.5 km/h	

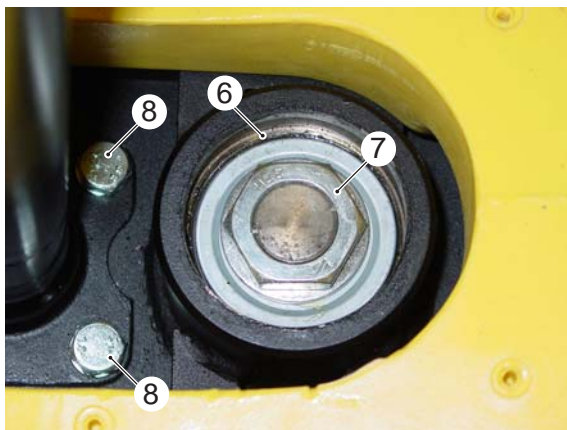
Operator parameters	Lower limit	Upper limit	Default value	Classic	Advanced	Note
Cleanspeed	0	6	4	4	4	
FACT	Fine	Power	Power	Power	Power	
SUCTION	Whisper	Power	Power	Power	Power	
DOSE	0,5 %	3,5 %	1,0 %	1,0 %	1,0 %	



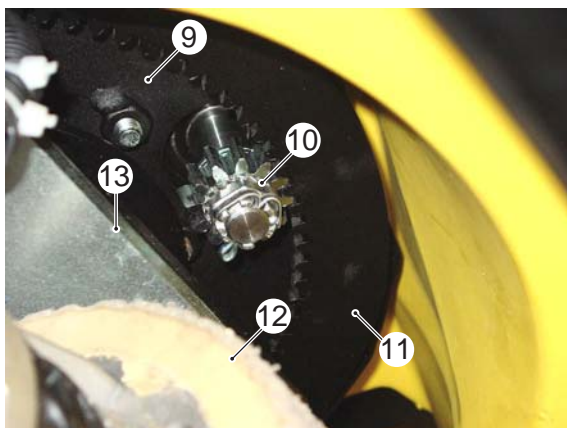
## 4.4 Steering



Steering wheel



Steering bearing, cover plate removed



Draglink with toothed wheel

### Steering column (without panel)

The steering column pipe (4) with internal steering rod (10) is fixed to the base frame (9) with four retaining screws (8).

The steering movement of the steering wheel is transferred through the toothed wheel (10) to the toothed ring (11) and steering head (13).

#### Note:

The toothed wheel (10) and the toothed ring (11) must have a small clearance (0.5-0.8 mm / 0.02-0.03 in). At the full steering angle (straight ahead  $\pm 90^\circ$ ) the cables (see chapter 2.1, Item 7) must not be taut and rub against the chassis. Regularly grease the toothed ring (11) and toothed wheel (10) (grease grade 6.288-000) in order to minimise wear.

### Steering head

The steering head (13) is fixed to the steering bearing (6) with a nut (7).

#### Note:

The steering bearing (6) is adjusted fixed by the nut (7). An incorrectly fixed nut can cause noises and damage to the bearing.

- 1 Steering wheel
- 2 Screw, steering column fixing bracket
- 3 Fixing bracket, steering column
- 4 Steering column pipe
- 5 Cover plate, steering bearing
- 6 Steering bearing
- 7 Nut, steering head
- 8 Retaining screws (4x), steering column
- 9 Base frame
- 10 Draglink with toothed wheel
- 11 Sprocket-wheel
- 12 Front wheel with wheel hub motor (M1)
- 13 Steering head

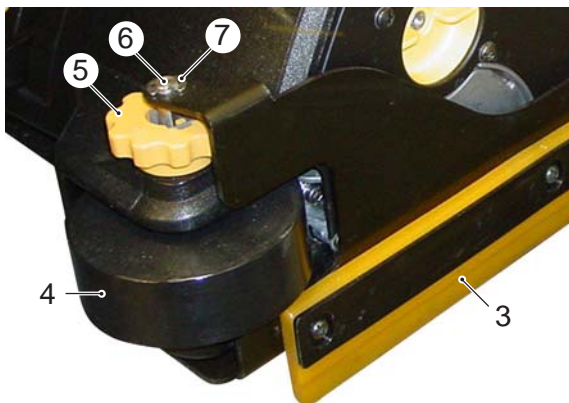
## 4.5 Maintenance work on the brush head



Wiper strip

### Replacing the wiper strip

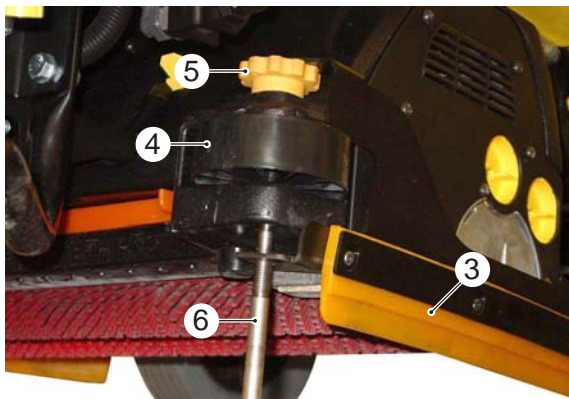
- Remove the 5 retaining screws (1) on the mounting plate (2) of the wiper strip (3) and remove wiper strip.
- Install new wiper strip.



Adjustment, wiper strip

### Remove the wiper strip adjustment

- Remove circlip (7).
- Use the adjusting wheel (5) to remove the locator pin (6) from below.
- Pull out the locator pin (6), remove adjusting screw (5) and deflection roller (4).



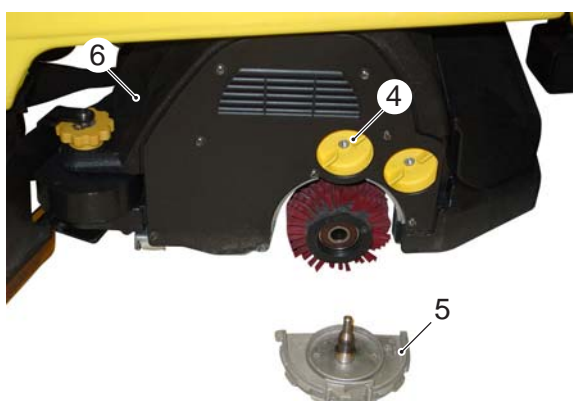
Locator pin, adjustment

- 1 Retaining screws, wiper strip
- 2 Mounting plate, wiper strip
- 3 Wiper strip
- 4 Deflection roller
- 5 Adjusting wheel, wiper strip
- 6 Locator pin
- 7 Circlip

## 4.5 Maintenance work on the brush head



Wiper strip



Bearing head



Replace the brush roller

### Replace the brush roller

- Remove the locking device (1) of the wiper strip (2) and swing out the wiper strip (red arrow).
- Undo the locking device (4) of the bearing cover (5) and remove bearing cover (5).
- Pull out the brush (7) and check for wear, replace if necessary.
- Push new brush onto the opposite drive shaft and refit the bearing cover (5) and the wiper strip (2).

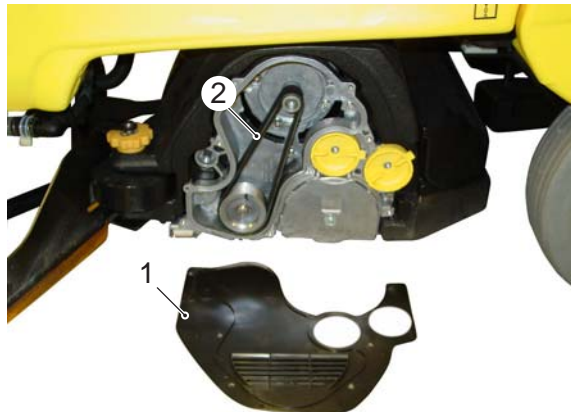
- 1 Locking device, wiper strip
- 2 Wiper strip
- 3 Cover plate, drive belt
- 4 Locking device, bearing cover
- 5 Bearing cover
- 6 Brush head
- 7 Brush roller



## 4.5 Maintenance work on the brush head



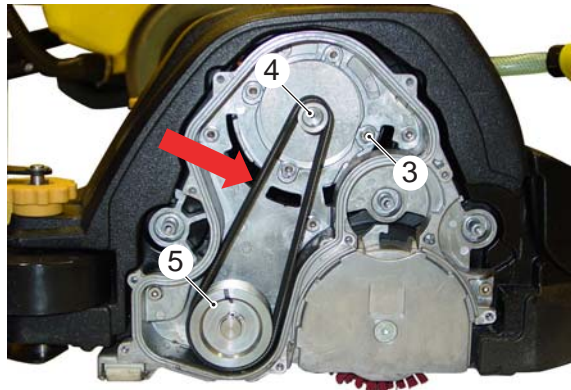
Guard



Drive belt



Tightening the drive belt



Drive belt tightened

### Replacing the drive belt

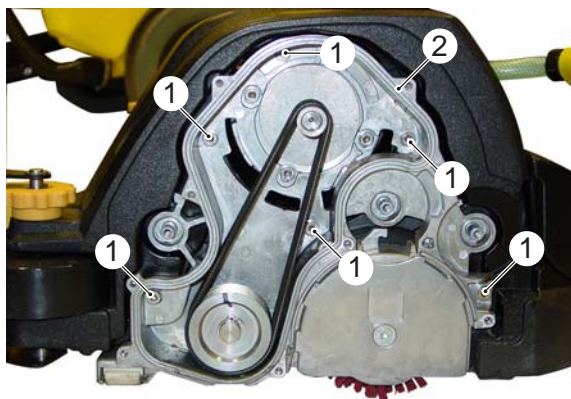
- Undo the locking device of the wiper strip and swing out the wiper strip.
- Remove cover plate (1)
- Loosen the 4 retaining screws (3) of the motor.
- Remove drive belt (2)
- Fit new drive belt, tighten and tighten the retaining screws (3) of the motor. The V-belt tension is determined by the location of the motor shaft (4) (tension by raising the motor, e.g. with a screwdriver, through oblong hole underneath the motor shaft).

#### Note:

The drive belt (2) must be tautened so that it can be pressed down with strong thumb pressure between the motor shaft (4) and driven the pulley (5) by max. 5 mm (red downwards arrow).

- 1 Cover plate, drive belt
- 2 Drive belt
- 3 Retaining screws (4x), brush motor (M2)
- 4 Motor shaft
- 5 Pulley, brush drive assembly

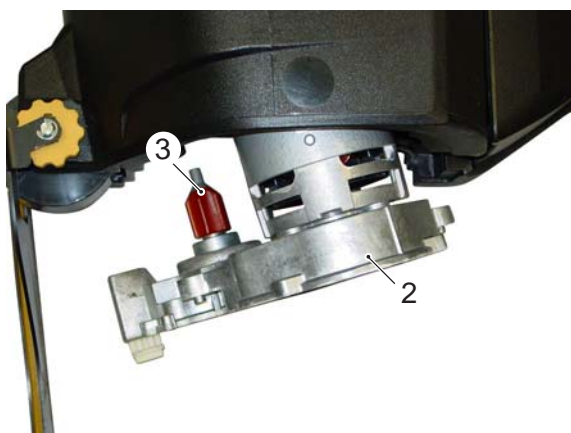
## 4.5 Maintenance work on the brush head



*Replacing the brush drive assembly*

### Replacing the brush drive assembly

- Undo the locking device of the wiper strip and swing out the wiper strip.
- Remove the cover plate.
- Remove the 6 retaining screws (1) of the brush drive assembly (2) and remove brush drive assembly.
- Install new brush drive assembly.

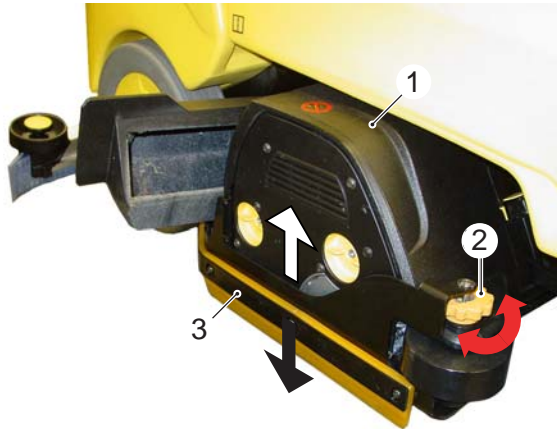


*Brush drive assembly*

- 1 Retaining screws, brush drive assembly
- 2 Brush drive assembly
- 3 Retainer pin, brush roller



## 4.5 Maintenance work on the brush head



Wiper strip

### Check brush rollers for foreign bodies/ remove

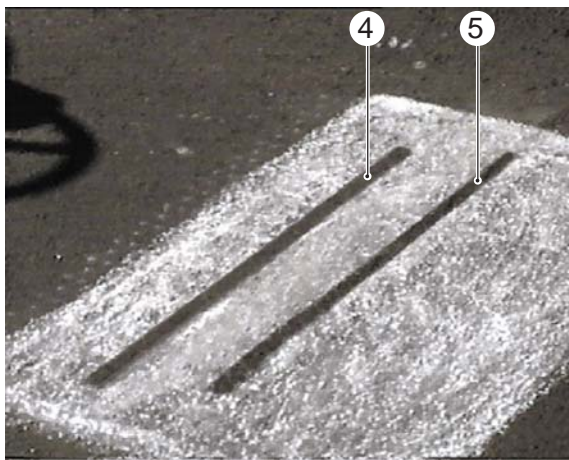
If foreign bodies are stuck to the brush roller they can impair the cleaning result.

- Remove foreign bodies from the brush roller.

### Check/adjust splashguard strips (not Classic version)

The side wiper strip (3) must lie on the floor when the brush head is lowered (1), so that no water can escape from the side.

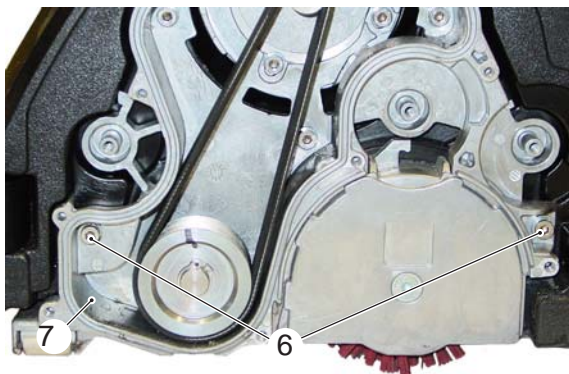
- Check/replace
- Adjust distance of wiper strip from the floor by turning the adjusting wheel (2) (red arrow).



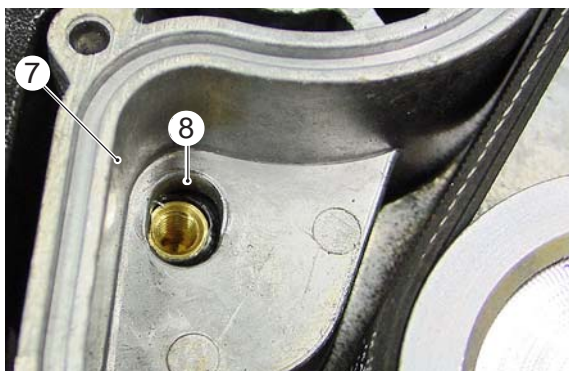
Brushing pattern

### Check brushing pattern

- Coat a flat, level surface with chalk and drive over it with the unit.
- Lower the brush head (1) and let the brushes run for approx. 3 seconds.
- Raise the brush head (1) and reverse with the machine.
- Check the brush pattern (4, 5).
- The brushing pattern of both brush rollers must be parallel and symmetrical.



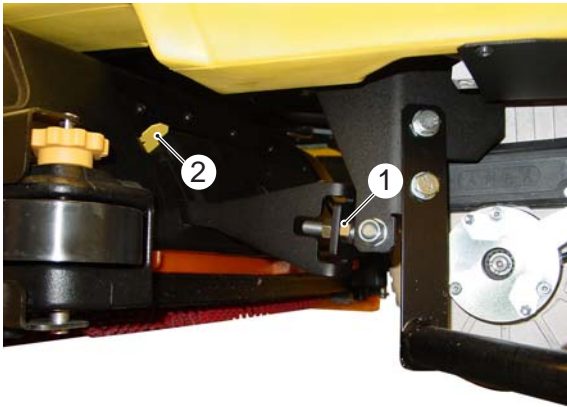
Retaining screws on the motor bearer



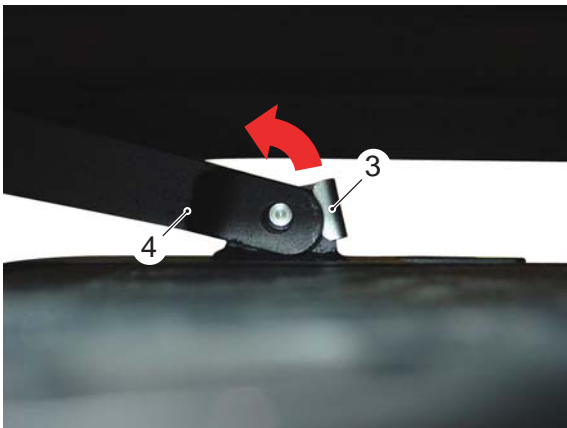
Oblong hole for adjusting the brushing pattern

- 1 Brush head
- 2 Adjusting wheel, wiper strip
- 3 Wiper strip
- 4 Brush pattern of the rear brush roller
- 5 Brush pattern of the front brush roller
- 6 Retaining screws (2x), motor bearer
- 7 Motor bearer
- 8 Oblong hole in the motor bearer for adjusting the brushing pattern

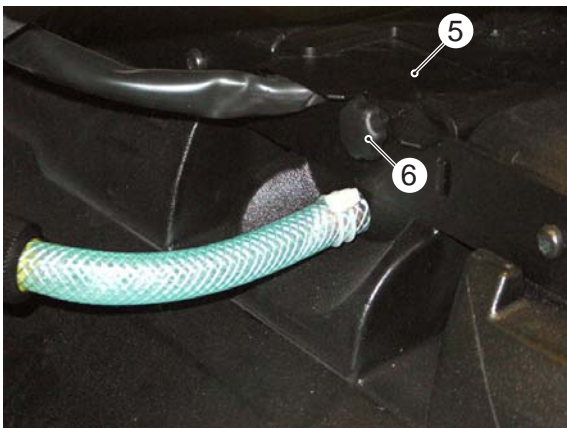
## 4.5 Maintenance work on the brush head



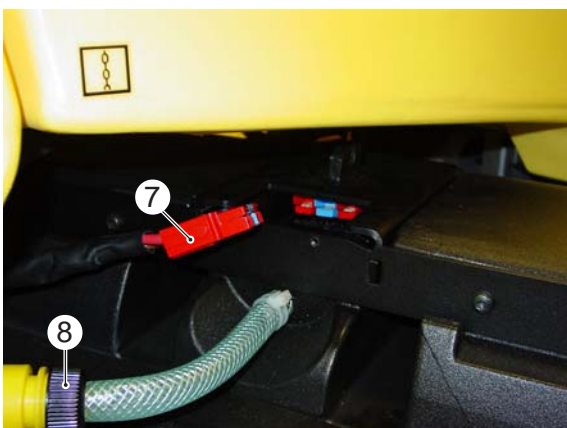
Guide, brush head



Brush head retainer



Guide, brush head



Brush head connections

### Adjust brushing pattern

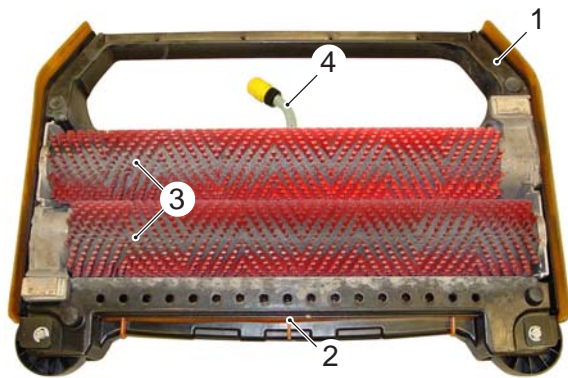
- Drive the unit onto a flat, level surface.
- Secure the unit against rolling away.
- Set program switch to position 6 (polishing - vacuuming) and completely lower the brush head (brush head must lie on the floor).
- Switch off key switch and press EMERGENCY STOP switch.
- Undo the adjusting screws (1).
- Undo the screws of the motor bearer (see page 47, Item 6).
- Horizontally align the brush head and tighten the screws of the motor bearer (see page 47, Item 6).
- Switch on the EMERGENCY STOP switch and key switch.
- Check brushing pattern again, if necessary make fine adjustment using the adjusting screws (1).

### Removing the brush head

- Secure the unit against rolling away.
- Lower brush head.
- Switch off unit and press EMERGENCY STOP switch (S1) (or disconnect central plug (X1)).
- Unclip retaining clamps (2).
- Remove water connection (8).
- Remove the retaining screw (6) from the cover (5).
- Disconnect the electrical connection (7).
- Turn retaining pins (3) on the brush head first in direction of arrow (red) and then pull out.
- Raise the brush head retainer again.
- The brush head can be pulled off from the side.
- Install in the reverse order.

- 1 Adjusting screws, brush head
- 2 Retaining clamp (2x), brush head
- 3 Retaining pin with locking device
- 4 Brush head retainer
- 5 Cover, electrical connection
- 6 Retaining screw, cover
- 7 Electrical connection, brush head
- 8 Water connection

## 4.5 Maintenance work on the brush head



*Brush head from below, removed*



*Water distribution strip*

### Replacing the water distribution strip

- The water distribution strip (2) is located in front of the front brush roller (3).
- Pull the water distribution strip (2) out of the brush head (1).

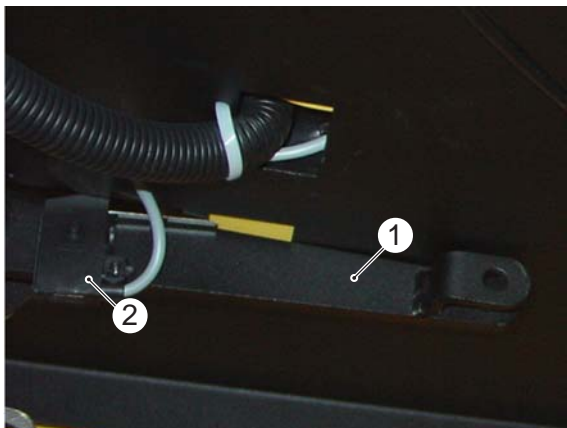
**Note:**

The water distribution strip (2) can also be replaced when the brush head (1) is installed.

- 1 Brush head
- 2 Water distribution strip
- 3 Brush rollers
- 4 Water connection, brush head



## 4.5 Maintenance work on the brush head



Brush head retainer

### Replacing the microswitch (2)

- The microswitch (2) is located on the brush head retainer (1) and switches the brush motors on and off.
- Remove the retaining screw (3) and remove the microswitch (2).

**Note:**

The microswitch (2) is not adjustable.



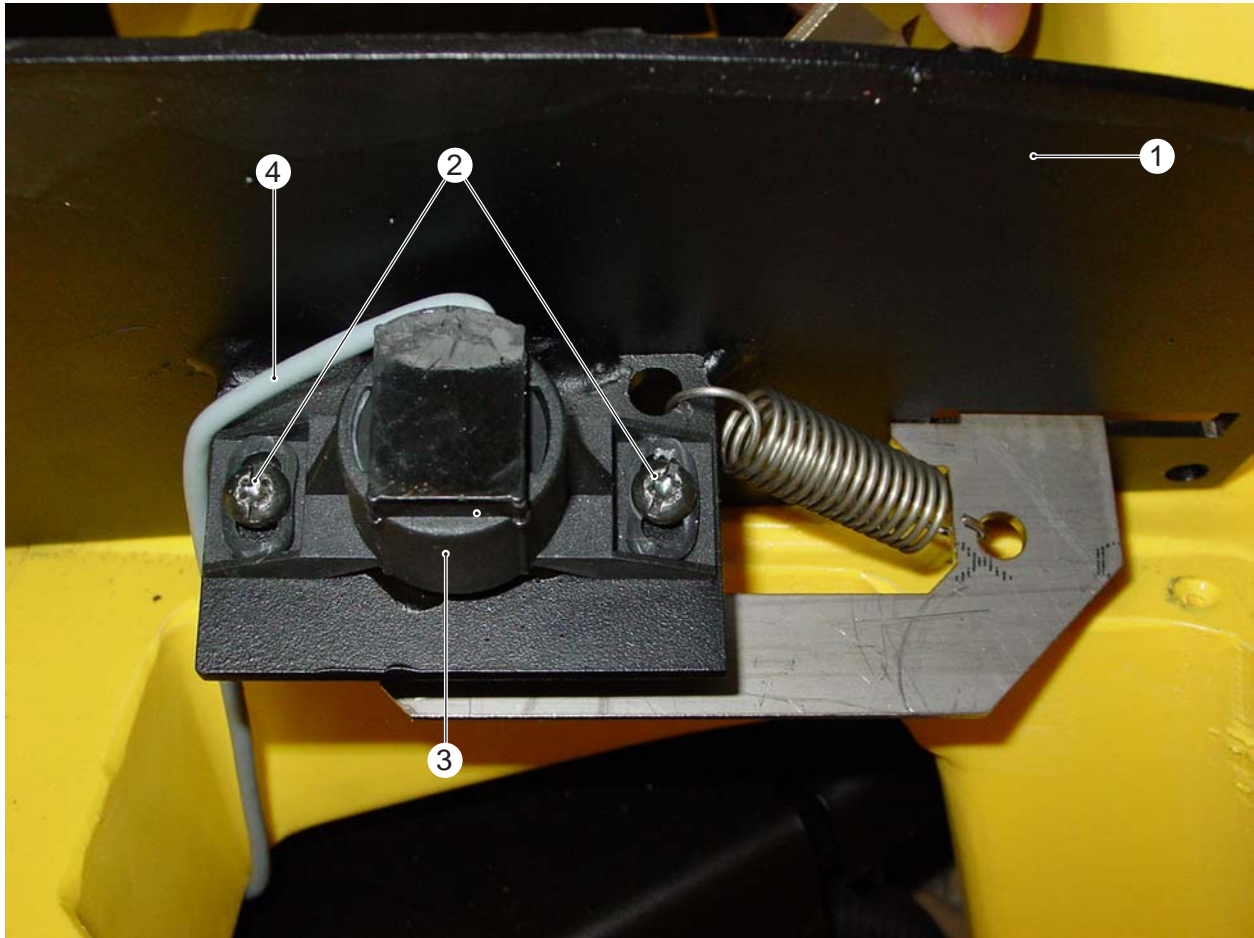
Microswitch, fixing



Microswitch

- 1 Brush head retainer
- 2 Microswitch (S12), brush motor
- 3 Retaining screw, microswitch (S12)

## 4.6 Drive sensor



- 1 floor panel
- 2 Retaining screws (2x), drive sensor
- 3 Drive sensor (B1)
- 4 Drive sensor, connection cable

### Adjusting the drive sensor (B1)

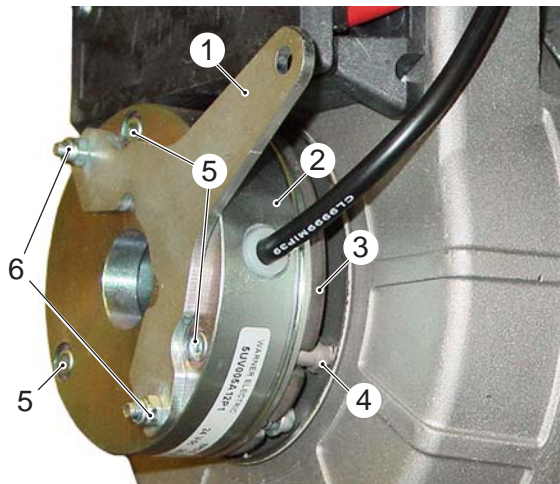
- Remove the retaining screws of the floor panel (1) and remove the floor panel.
- The drive sensor (3) no longer has to be calibrated using the retaining screws (2). It is automatically calibrated in Test mode (see Chapter 4.2). To do this, only the upper drive pedal position must be simulated and confirmed. The same applies to the lower drive pedal position.

**Note:**

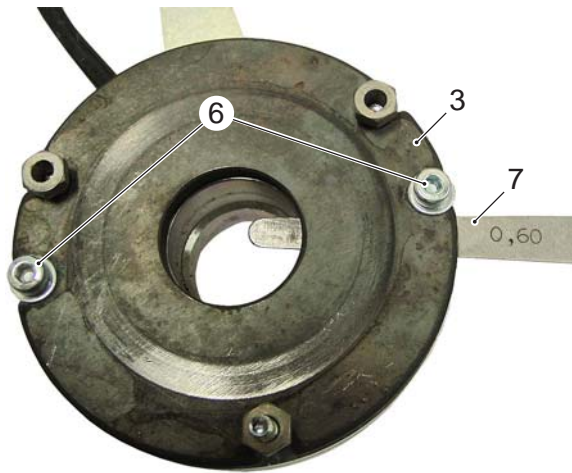
When installing the floor panel (1) ensure the connection cable (4) is laid properly. The connection cable (4) must not get clamped or jammed.



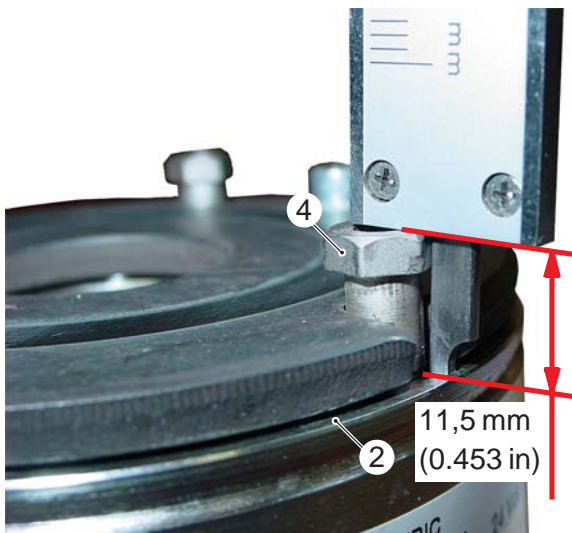
## 4.7 Adjusting the electromagnetic brake



Electromagnetic brake



Adjust lever function



Adjust brake disc air gap

Test and adjustment work on the electromagnetic brake are best carried out when the brake has been removed from the unit.

- Switch off the unit at the key switch and secure against rolling away.

### Remove the magnet coil (Y1) and adjust the lever

A distance of 0.6-0.8 mm (0.024-0.032 in) must exist between the magnet coil (2) and pressure plate (3) when dismantled to ensure the lever (1) unlocking function works.

- Remove retaining screws (5) and remove the magnet coil (2).
- Use a non-magnetisable feeler gauge (7) to measure the distance between the pressure plate (2) and the magnet coil (6) at the retaining screws (6).
- Use the retaining screws (6) to adjust the distance on both sides so that they are equal with 0.6-0.8 mm (0.024-0.032 in).

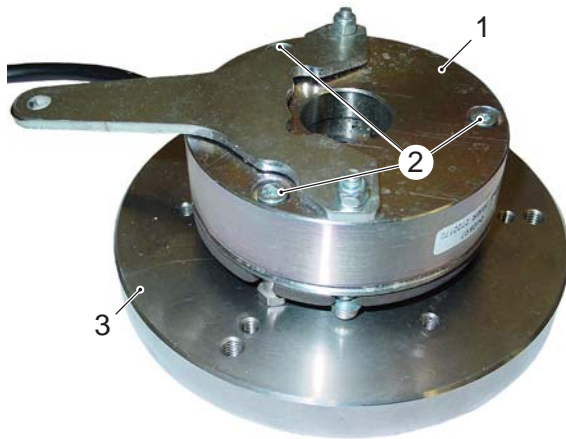
### Adjusting the brake air gap

To achieve perfect braking effect the distance between the magnet coil (2) and the top edge of the adjusting screw (4) must be set with a dimension of 11.5 mm (0.453 in).

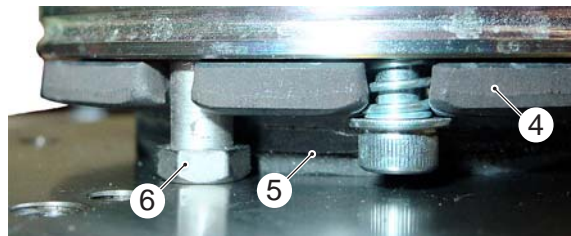
- Remove retaining screws (5) and remove the magnet coil (2).
- The distance to the magnet coil must be measured at all three adjusting screws (4) and set to 11.5 mm (0.453 in) by turning the adjusting screw (4) in or out.

- 1 Lever, for manually opening the brake
- 2 Magnetic coil (Y1)
- 3 Pressure plate
- 4 Adjusting screw (3x)
- 5 Retaining screw (3x), magnet coil (Torx 15)
- 6 Retaining screw, lever (2x)
- 7 Feeler gauge 0.6 mm (0.024 in)

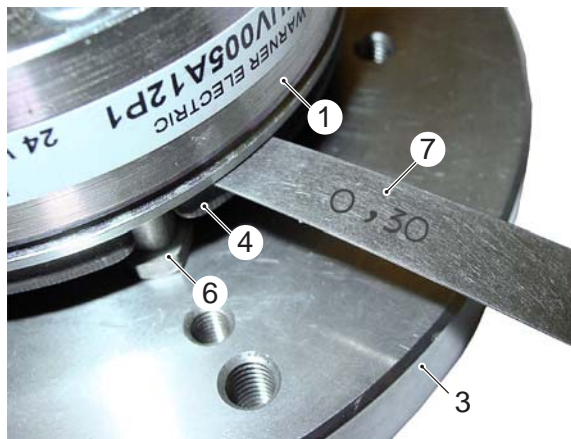
## 4.7 Adjusting the electromagnetic brake



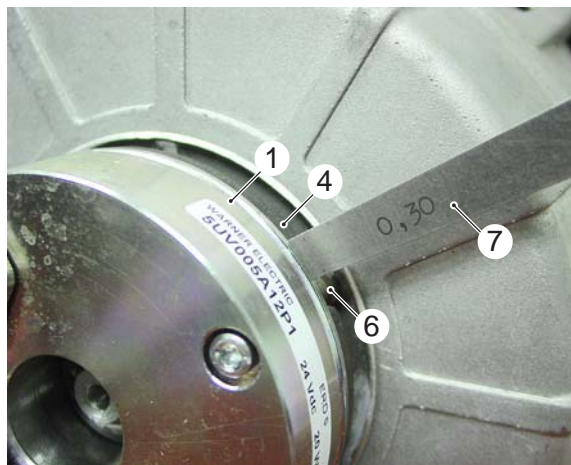
Electromagnetic brake on mounting plate



Brake disc



Check size of gap using mounting plate



Check size of gap in installed condition

### Check/correct setting

To check the setting, whether the distance between the pressure plate (4) and magnet coil (1) fits in the installed condition, the magnet coil (1) with brake disc (5) is screwed onto the mounting plate (3). The setting/adjustment on the mounting plate (3) is easier to make than in the installed magnet coil on the wheel hub motor.

- Screw the magnet coil (1) with brake disc (5) onto the mounting plate (3) using the retaining screws (2).
- Use a non-magnetisable feeler gauge (7) to measure the size of the gap between the pressure plate (1) and the magnet coil (6) at all three adjusting screws (6).
- The size of the gap must be set to between 0.2-0.35 mm (0.008-0.014 in).
- If the size of the gap is not set correctly the three retaining screws (2) must be undone and the size of the gap corrected at the adjusting screws (6) by turning them in or out.

After successful checking of the size of the gap the magnet coil (1) can be installed back on the wheel hub motor.

- Remove the retaining screws (2) and remove the magnet coil (1) with brake disc (5) from the mounting plate (3).
- Screw the magnet coil (1) with brake disc (5) onto the wheel hub motor (tightening torque (2.4 Nm).
- Check the size of the gap again at all three adjusting screws (6).
- If the size of the gap is not right it must be corrected as described above.

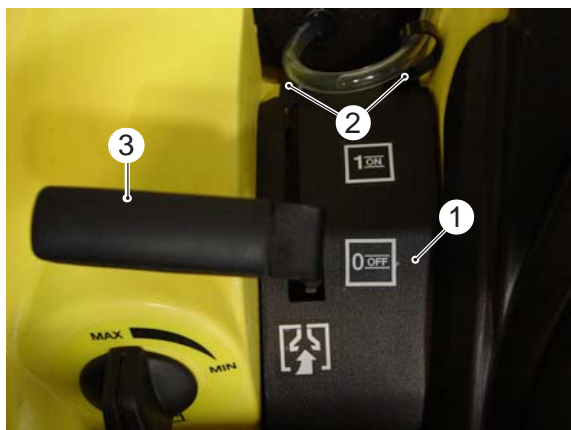
### Note:

The brake must safely and reliably hold the unit with max. load on an incline of 10 %.

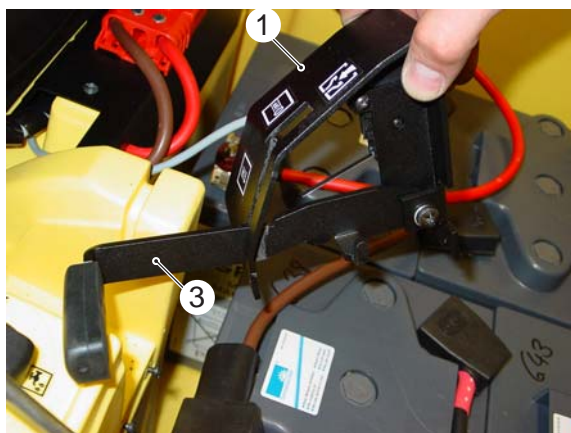
- 1 Magnetic coil (Y1)
- 2 Retaining screw (3x), magnet coil (Torx 15)
- 3 Mounting plate (5.116-199.0)
- 4 Pressure plate
- 5 Brake disc
- 6 Adjusting screw (3x), magnet coil
- 7 Feeler gauge 0,3 mm (0.012 in)



## 4.8 Cable control for suction beam



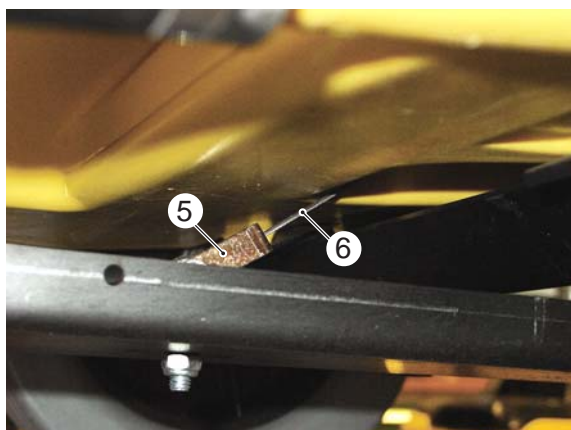
Lever, lift/lower the suction beam



Lever, lift/lower suction beam removed



Spring, cable control



Fixing, suction beam

### Replacing the cable control

- Lower the suction beam.
- Remove the two retaining screws (2) on the holder (1) and remove with lever (3).
- Unhook the spring (4) from the lever (3).
- Remove bracket (5) on the suction beam and pull out cable control (6) with sleeve.

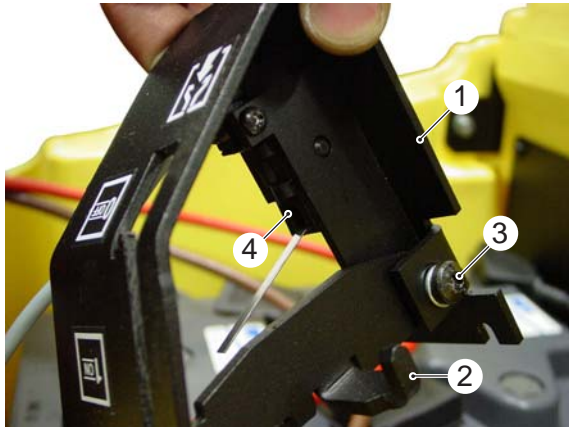
#### Note:

Check for secure fit when installing the spring (4).

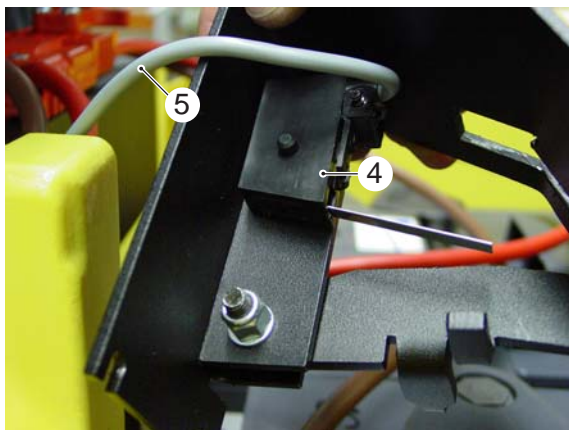
Always replace cable control together with sleeve only.

- 1 Holder, lever
- 2 Retaining screws (2x), holder
- 3 Lever, suction beam cable control
- 4 Spring, cable control
- 5 Bracket, suction beam
- 6 Cable control with sleeve

## 4.9 Microswitch on lever for suction beam



Microswitch (S13), suction motor ON/OFF



Cable, microswitch (S13)

### Replacing the microswitch (4)

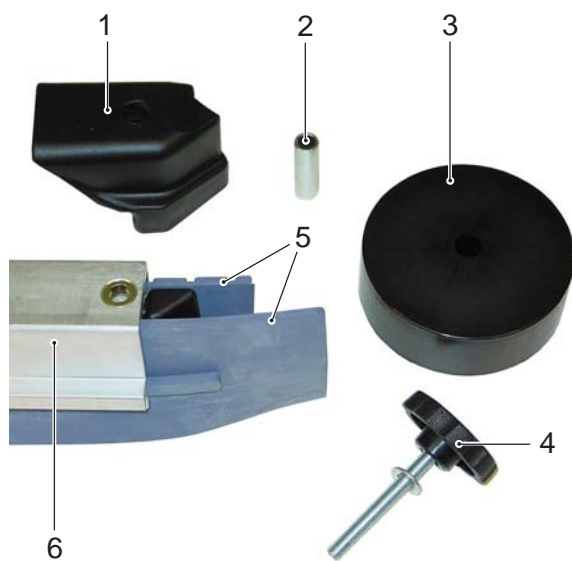
- Remove the two retaining screws (see Chapter 4.8, Item 2) on the holder (1) and remove with lever (2).
- Unhook the spring on the lever (see Chapter 4.8).
- Remove the retaining screw (3) on the holder and remove the microswitch (4).

**Note:**

When installing the microswitch (4) ensure the microswitch cable (5) is laid properly. The cable must not get clamped or jammed.

- 1 Holder, lever
- 2 Lever, suction beam cable control
- 3 Retaining screw, microswitch (S13)
- 4 Microswitch (S13), suction motor ON/OFF
- 5 Cable, microswitch (S13)

## 4.10 Maintenance work on the suction beam



Suction beam individual parts

### Clean/replace rubber strips on suction beam

Clean rubber strips (5) on suction beam and check for damage/wear. If necessary, turn over/replace.

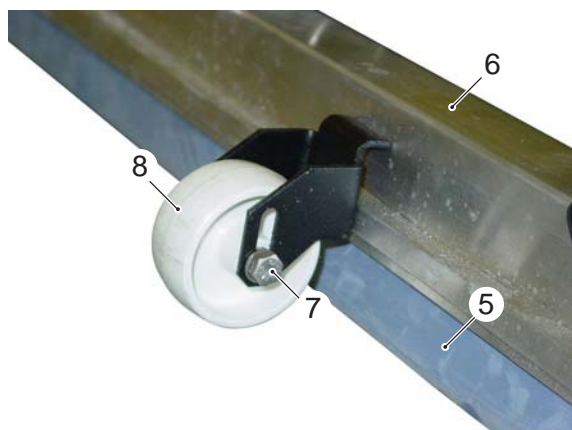
- Pull off retaining screw (4), deflection roller (3) with metal bushing (2) and rubber strip fastening (1) on both sides of the suction beam (6).
- Pull out side rubber strips (5) from the guide grooves, install new rubber strips in reverse order.

#### Note

The front and rear rubber strip can also be turned through 180°.

### Check/replace suction beam supply roller

- Remove the retaining screw (7) on the supply roller (8).
- Adjust the supply roller (8) so that the rubber strips (5) lie parallel and flush on the floor.

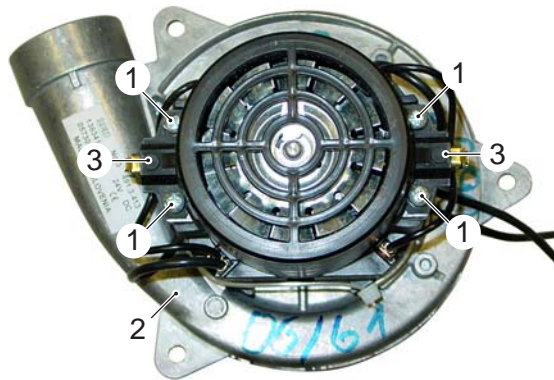


Suction motor (M4)

- 1 Rubber strip fastening
- 2 Metal bushing
- 3 Deflection roller
- 4 Retaining screw
- 5 Rubber strips
- 6 Suction beam
- 7 Retaining screw, supply roller
- 8 Supply roller, suction beam



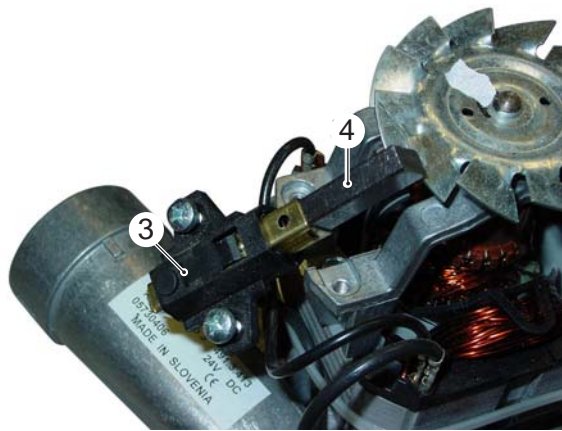
## 4.11 Suction motor



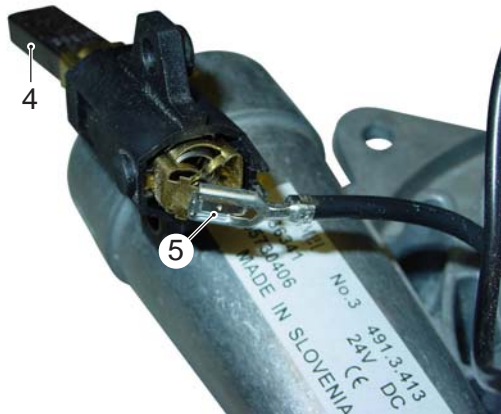
Suction motor (M4)

### Replacing the carbon brushes

- Remove suction motor (2) (see page 13).
- Remove out the retaining screws (1) from the carbon brush holders (3).
- Pull off the wire connector (5) on the carbon brush holder (3).



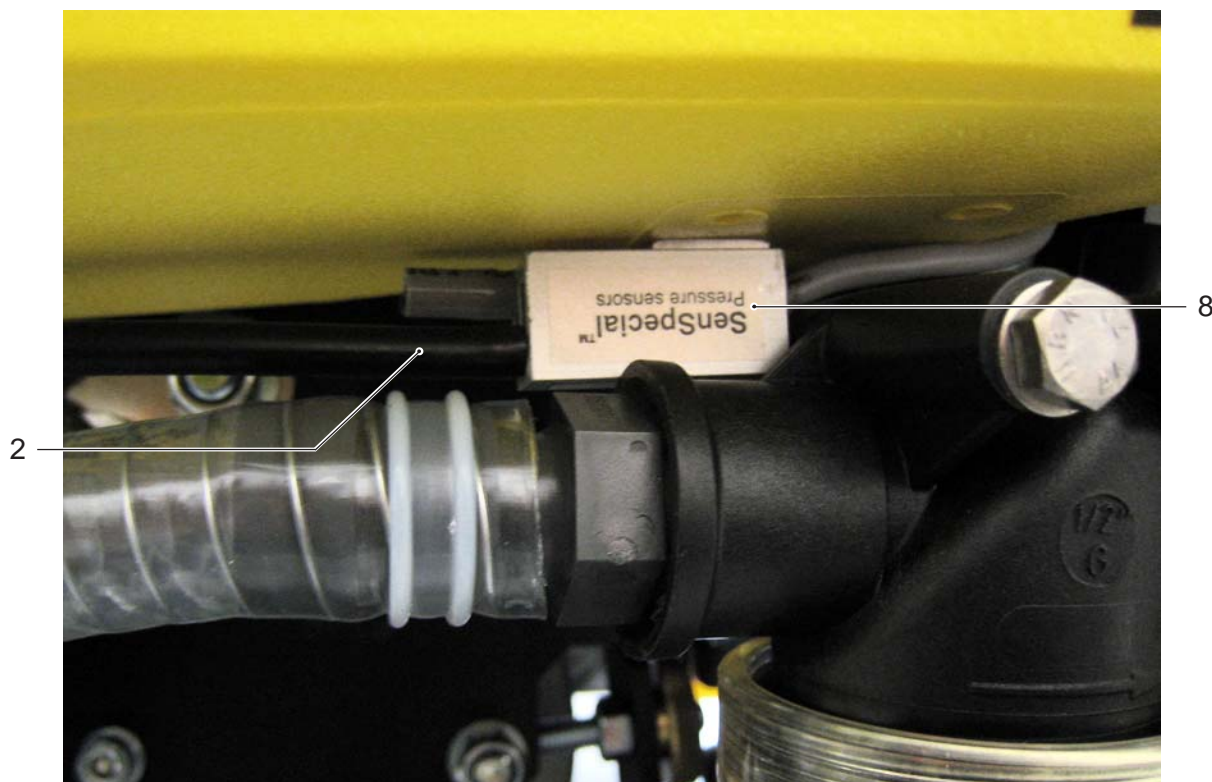
Carbon brush bracket, carbon brush



Carbon brush

- 1 Retaining screws, carbon brush bracket
- 2 Suction motor (M4)
- 3 Carbon brush bracket, carbon brush
- 4 Carbon brush
- 5 Wire connector, carbon brush

## 4.12 Pressure sensor (Adv and DOSE versions only)



- 1 Pressure sensor
- 2 Hose

### Checking the pressure sensor and hybrid module

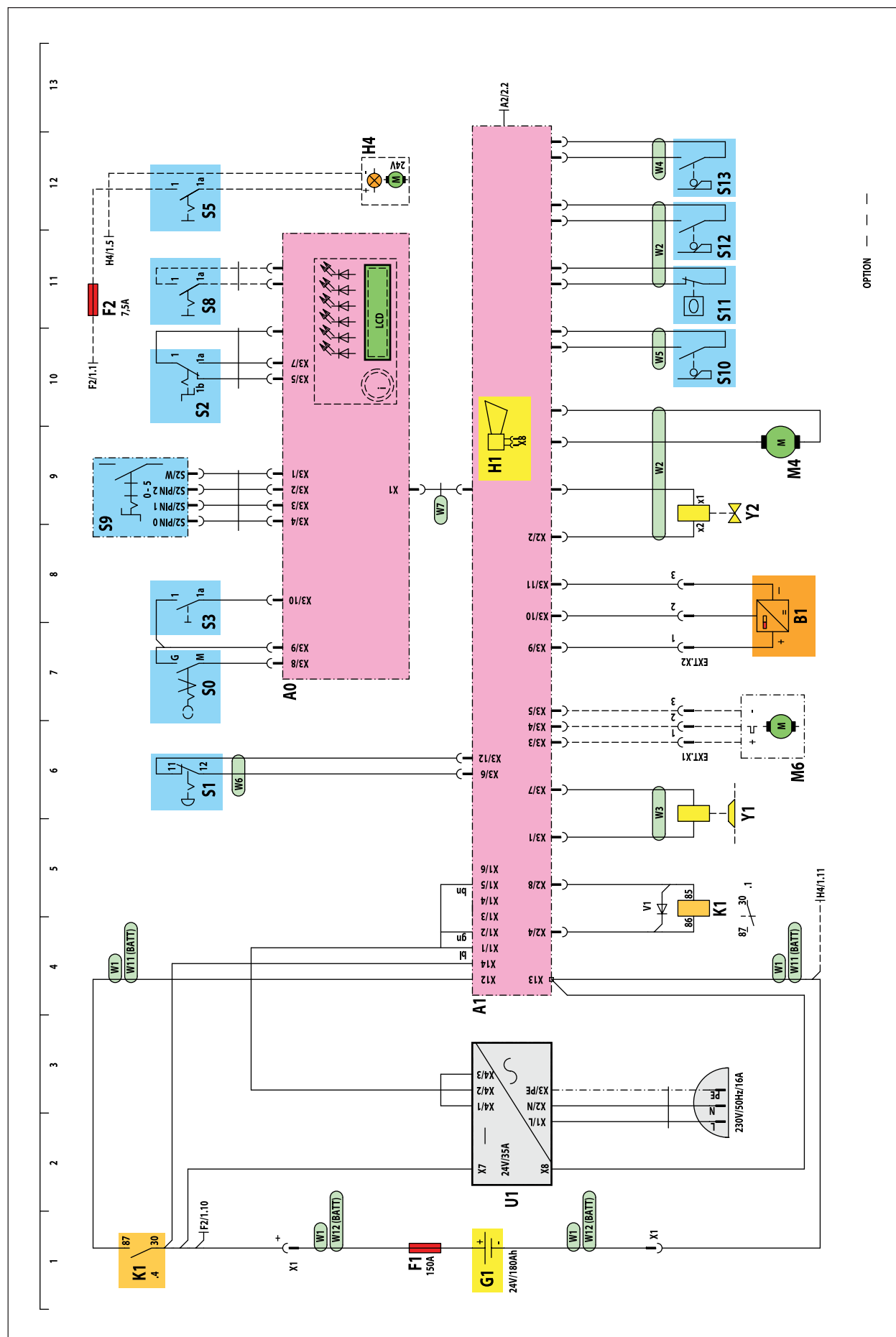
**Note**

The pressure sensor (1) is very pressure sensitive and can easily be destroyed. For this reason, never blow into the pressure sensor for testing purposes.

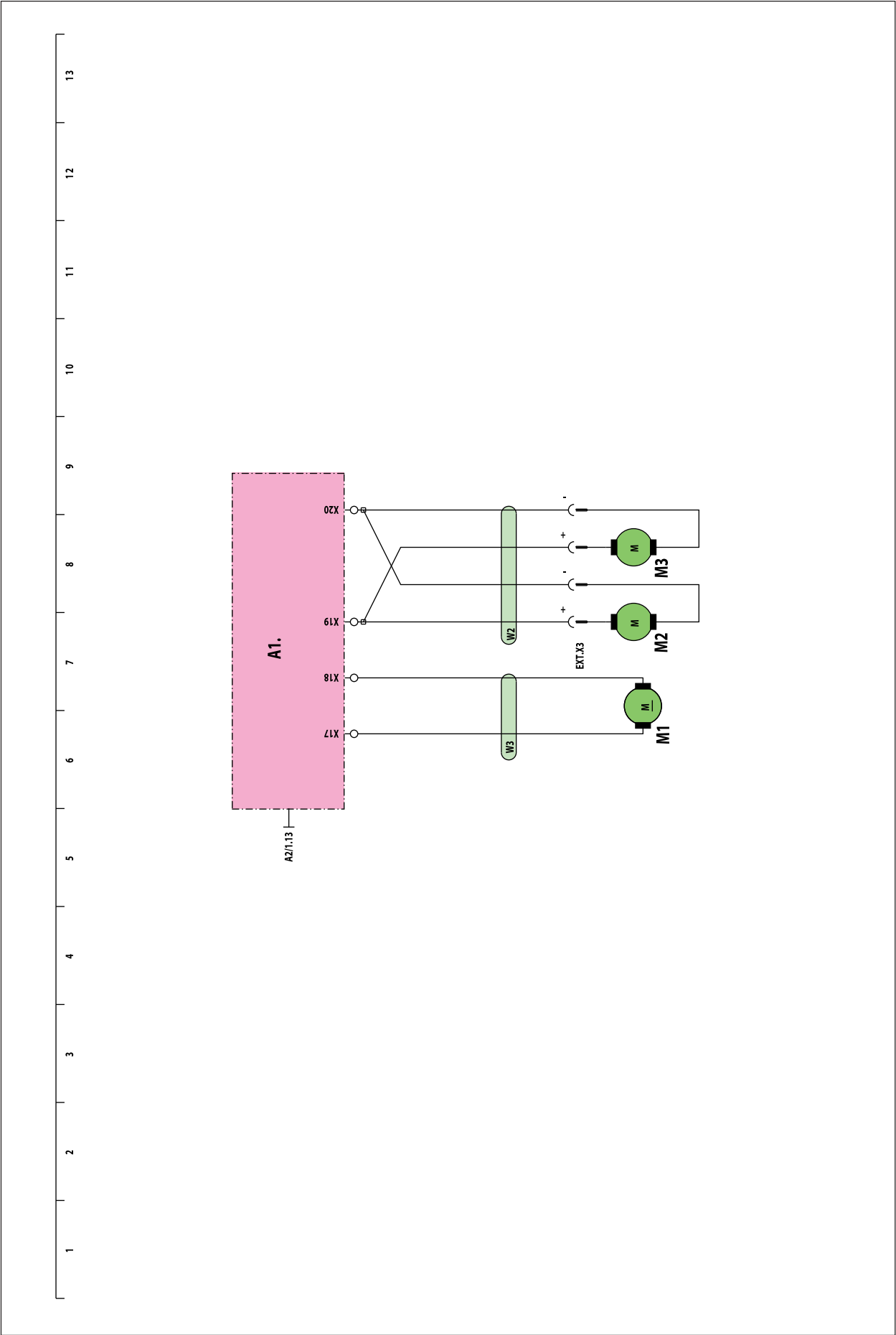
If there is no or an incorrect reading in the display concerning the water level in the freshwater tank the pressure sensor (1) must be checked as follows.

- If the hose (2) from the freshwater tank to the pressure sensor is pulled off, no bars are shown in the display. Updating the display can take up to two minutes.
- If the connecting terminal (X4/10, Volt out) of the pressure sensor (1) is plugged into the hybrid module, all the bars are shown in the display.
- If the connecting terminals (X4/10, Volt out) and (X4/ 11, GND) are jumpered at the hybrid module, no bars are shown in the display. The update takes approx. 10 seconds.

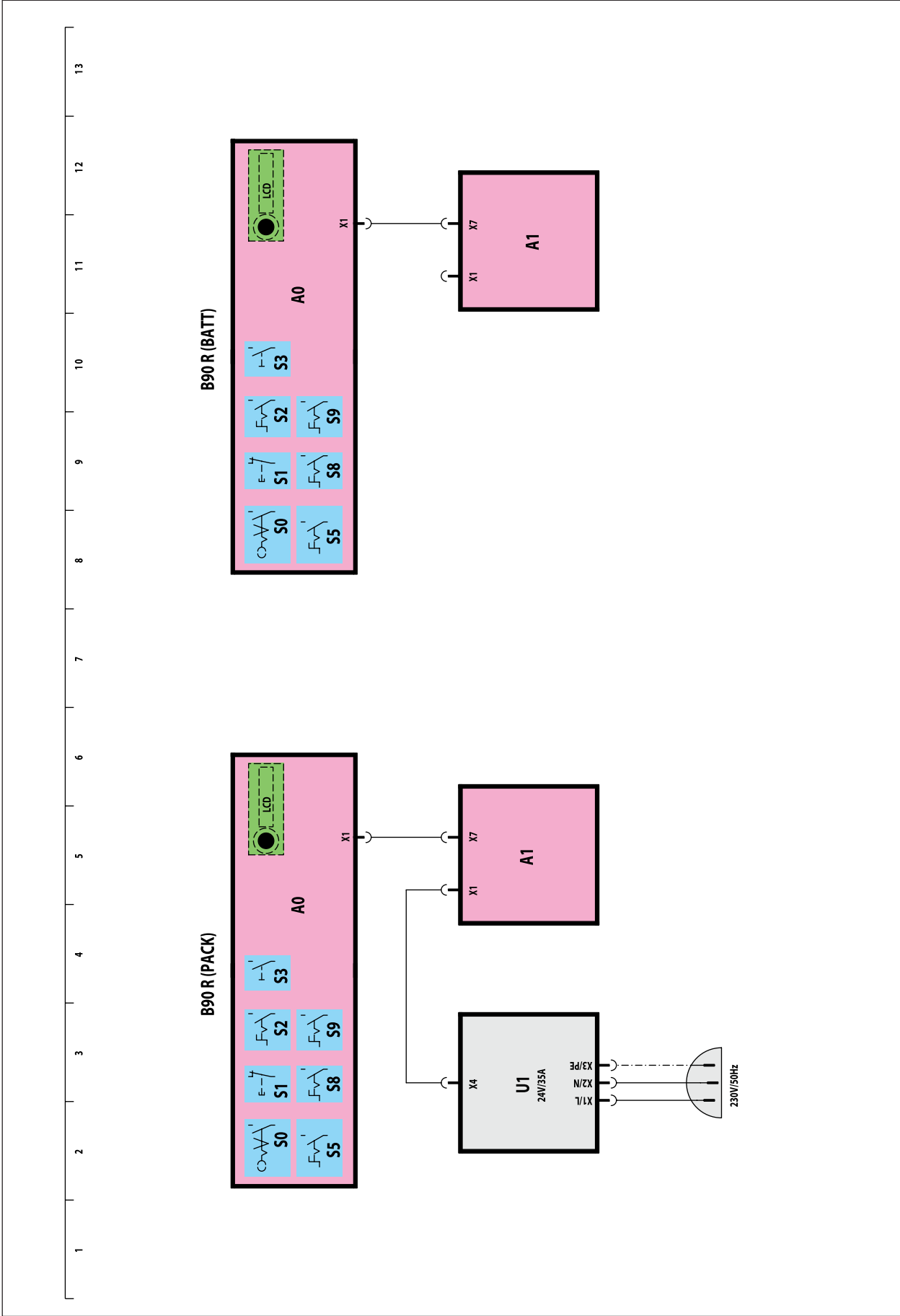
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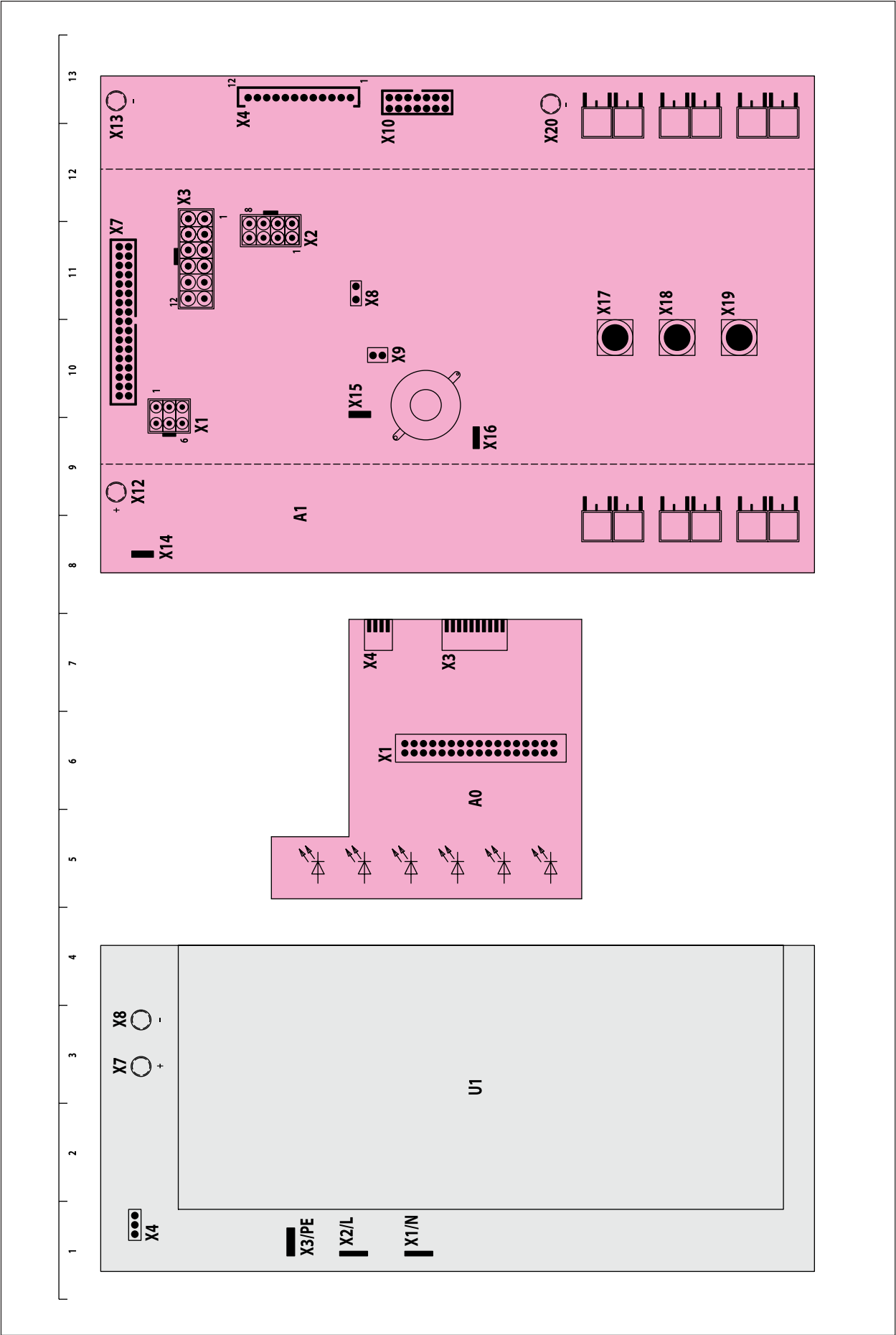
5.2 Circuit diagram 0.089-033.0, printed circuit board A1.



5.3 Circuit diagram 0.089-033.0, printed circuit board A0 (battery and battery pack)



5.4 Circuit diagram 0.089-033.0, printed circuit board assignment





## 5.5 Circuit diagram 0.089-033.0, key

- A0 Control panel
- A1 Hybrid module
  
- B1 Magnetic sensor, drive pedal
  
- F1 Main fuse (150A)
- F2 Fuse (7.5A), warning beacon light
  
- G1 24V/180 Ah battery, maintenance-free
  
- H1 Horn / buzzer
- H4 Warning beacon light
  
- M1 Wheel-hub motor
- M2 Brush motor 1
- M3 Brush motor 2
- M4 Suction motor
- M6 DOSE cleaning agent metering pump (optional)
  
- K1 Main relay
  
- S0 Key switch
- S1 EMERGENCY STOP switch
- S2 Direction of travel changeover switch
- S3 Pushbutton, horn
- S5 Switch, warning beacon light (optional)
- S8 Switch, DOSE cleaning agent metering pump (optional)
- S9 Program switch
- S10 Seat switch
- S11 Float switch, wastewater tank
- S12 Microswitch, brush
- S13 Microswitch, suction motor
  
- U1 Battery charger (Batt Pack)
  
- Y1 Electromagnetic brake
- Y2 Water valve
  
- X1 Central plug

## 6.1 Troubleshooting without displays

Fault	Solution
<b>Unit won't start.</b>	<ul style="list-style-type: none"> <li>– Plug in the battery plug connection (X1).</li> <li>– Move key switch (S0) into „1“ position.</li> <li>– Check/replace fuse (F1).</li> <li>– Check/charge battery (G1).</li> <li>– Unlock EMERGENCY STOP switch (S1).</li> <li>– Check/replace seat switch (S10).</li> <li>– Check/calibrate/replace drive sensor (B1).</li> <li>– Check main relay (K1).</li> <li>– Check/replace direction of travel switch (S2).</li> <li>– Check/replace wheel hub motor (M1) (carbon brushes).</li> </ul>
<b>Insufficient water volume</b>	<ul style="list-style-type: none"> <li>– Check freshwater tank/top up tank.</li> <li>– Check hoses for blockage/top up tank.</li> <li>– Clean water filter.</li> <li>– Check/replace water shut-off valve (Y2).</li> <li>– Clean water distribution strip.</li> </ul>
<b>Insufficient suction performance</b>	<ul style="list-style-type: none"> <li>– Clean seal between wastewater tank and tank cover and check for leaks/replace.</li> <li>– Clean/replace the flat pleated filter in the wastewater tank.</li> <li>– Clean/replace rubber strips on the suction beam.</li> <li>– Check suction hose for blockage/remove blockage.</li> <li>– Check suction hose for leaks/replace.</li> <li>– Check whether cover on wastewater drain hose is closed.</li> <li>– Check suction beam adjustment.</li> <li>– Attach additional weight (accessories) to the suction beam.</li> <li>– Check/replace suction motor microswitch (S13).</li> <li>– Wastewater tank is full.</li> <li>– Check/replace float switch (S11).</li> </ul>
<b>Inadequate cleaning result</b>	<ul style="list-style-type: none"> <li>– Adjust contact pressure (not Classic version)</li> <li>– Check brushes for wear/replace.</li> <li>– Suction performance too low (see above).</li> <li>– Clean/replace rubber strips on the suction beam.</li> </ul>
<b>Brushes won't turn</b>	<ul style="list-style-type: none"> <li>– Reduce contact pressure.</li> <li>– Check whether foreign bodies are blocking the brushes / remove foreign bodies.</li> <li>– Check electrical connection of brush head.</li> <li>– Set program selection switch (S9) to cleaning program, check/replace.</li> <li>– Check/replace brush motors microswitch (S12).</li> </ul>
<b>Wastewater drain hose is blocked</b>	<ul style="list-style-type: none"> <li>– Open metering equipment at the drain hose. Pull the suction hose off the suction beam and close off with your hand. Set program selection switch (S9) to vacuum. The blockage is sucked out of the drain hose into the dirt container.</li> </ul>
<b>Poor braking effect</b>	<ul style="list-style-type: none"> <li>– Check electromagnetic brake (Y1), adjust/replace.</li> </ul>
<b>Water level indication does not appear in the display</b>	<ul style="list-style-type: none"> <li>– Activate pressure sensor in the "Parameter Settings" Setup menu.</li> </ul>
<b>Water level displayed is incorrect</b>	<ul style="list-style-type: none"> <li>– The water hose from the freshwater tank to the pressure sensor is bent/check/replace water hose and pressure sensor.</li> </ul>

## 6.2 Troubleshooting with displays

If a fault occurs the first step is to perform a key reset.

Sporadically occurring faults can be an indication of very high static charges.

Display fault messages	Possible causes	Troubleshooting suggestions
EMERGENCY STOP button is pressed!?!	<ol style="list-style-type: none"> <li>1. EMERGENCY STOP pressed</li> <li>2. EMERGENCY STOP supply cable interrupted</li> </ol>	<ol style="list-style-type: none"> <li>1. Unlock the EMERGENCY STOP and perform key reset.</li> <li>2. Find cable interruption using ohmmeter and repair</li> </ol>
Ext. module hot! Leave to cool!	<ol style="list-style-type: none"> <li>1. Accessory module thermally overloaded.</li> <li>2. Ambient temperature of the machine is very high.</li> <li>3. Cooling air slits in the machine are not free.</li> <li>4. PACKAGE units: Charger fan U1 defective/blocked/not connected.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform key reset.</li> <li>2. Let the accessory module cool.</li> <li>3. Reduce load.</li> <li>4. Unblock/uncover the cooling air slits in the machine.</li> <li>5. Check existing fan and replace if necessary.</li> <li>6. Check bus cable between U1 and A1.</li> </ol>
Power module hot! Leave to cool!	<ol style="list-style-type: none"> <li>1. Power module thermally overloaded.</li> <li>2. Ambient temperature of the machine is very high.</li> <li>3. Cooling air slits in the machine are not free.</li> <li>4. PACKAGE units: Charger fan U1 defective/blocked/not connected.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform key reset.</li> <li>2. Let the power module cool.</li> <li>3. Reduce load.</li> <li>4. Unblock/uncover the cooling air slits in the machine.</li> <li>5. Check existing fan and replace if necessary.</li> <li>6. Check bus cable between U1 and A1.</li> </ol>
Lift module hot! Leave to cool!	<ol style="list-style-type: none"> <li>1. Lift module thermally overloaded.</li> <li>2. Ambient temperature of the machine is very high.</li> <li>3. Cooling air slits in the machine are not free.</li> <li>4. PACKAGE units: Charger fan U1 defective/blocked/not connected.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform key reset.</li> <li>2. Let the lift module cool.</li> <li>3. Reduce load.</li> <li>4. Unblock/uncover the cooling air slits in the machine.</li> <li>5. Check existing fan and replace if necessary.</li> <li>6. Check bus cable between U1 and A1.</li> </ol>

### Note

The B90R versions do not have any accessory modules or lift module.

## 6.2 Troubleshooting with displays

Display fault messages	Possible causes	Troubleshooting suggestions
Battery voltage <16V or 38V!	<ol style="list-style-type: none"> <li>1. Battery voltage outside the tolerance.</li> <li>2. During self-test after Key-On the battery voltage measurement in the power section and in the logic section differ (internal error).</li> </ol>	<p><b>1. Voltage too low:</b></p> <ol style="list-style-type: none"> <li>a. Measure voltage at X14 with Key-ON under load at X13 (earth).</li> <li>b. Measure voltage at X12 under load at X13 (earth).</li> <li>c. Measure voltage at general contactor (battery side) under load.</li> <li>d. Measure voltage at battery under load.</li> </ol> <p><b>2. Voltage too high:</b></p> <ol style="list-style-type: none"> <li>a. It is prohibited to charge the batteries using terminals with off board chargers while the control is connected.</li> <li>b. Occurs only if safety mechanisms fail and if connection to battery is interrupted. Ensure that the unit stops level and perform renewed key reset.</li> <li>c. Check that 24V battery set only is used.</li> </ol>
Supply failure to ACCELERATOR	<ol style="list-style-type: none"> <li>1. Short circuit in connection cable to accelerator.</li> <li>2. Defective accelerator.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check connector plug and wiring.</li> <li>2. Check accelerator.</li> </ol>
ACCELERATOR wire breakage	<ol style="list-style-type: none"> <li>1. Earth cable to the accelerator is interrupted.</li> <li>2. Defective accelerator.</li> </ol>	<ol style="list-style-type: none"> <li>1. Visually check accelerator wiring (connector plug worn in places, corrosion...), after correcting fault always calibrate accelerator!</li> <li>2. Replace accelerator.</li> </ol>
Recalibrate accelerator!	<ol style="list-style-type: none"> <li>1. Accelerator not calibrated or calibrated incorrectly.</li> <li>2. Wiring to the accelerator is defective.</li> <li>3. Defective accelerator.</li> </ol>	<ol style="list-style-type: none"> <li>1. Calibrate accelerator, especially if a new control and/or a new accelerator have been installed.</li> <li>2. Visually check accelerator wiring (connector plug/worn in places, corrosion...), after correcting fault always remember to repeat 1.</li> <li>3. Replace accelerator, then always repeat 1.</li> </ol>
Wire breakage LOAD X15/X16	<p><b>(B90R: suction motor, KM90/60: Shaker drive)</b></p> <ol style="list-style-type: none"> <li>1. Wiring/cable connections defective.</li> <li>2. Drive has high resistance.</li> </ol>	<ol style="list-style-type: none"> <li>1. Disconnect cable connection between drive and X15 and test with ohmmeter for continuity.</li> </ol>

## 6.2 Troubleshooting with displays

Display fault messages	Possible causes	Troubleshooting suggestions
Wire breakage LOAD X19/X20	<ol style="list-style-type: none"> <li>1. Plug connector not plugged in correctly at brush head.</li> <li>2. Wiring loose or damaged</li> <li>3. Brushes/sweeper drive not connected to X19/X20.</li> <li>4. Brushes/sweeper drive high resistance.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check plug connector at brush head.</li> <li>2. Disconnect connection X19 and test drive cables with ohmmeter for continuity.</li> <li>3. Check drive (e.g. carbon brushes loose/jammed).</li> <li>4. Connect connections with control terminals X19/X20.</li> </ol>
Wire breakage LOAD X17/X18	<ol style="list-style-type: none"> <li>1. Wiring loose or damaged.</li> <li>2. Drive system is not connected between X17 and X18.</li> <li>3. Drive system high resistance.</li> </ol>	<ol style="list-style-type: none"> <li>1. Disconnect terminal X17 and test drive cables with ohmmeter for continuity.</li> <li>2. Mechanically disconnect brake and turn drive through 2 revolutions (oxide layer on collector).</li> <li>3. Check drive (e.g. carbon brushes loose/jammed).</li> <li>4. Connect connections with control terminals X17/X18.</li> </ol>
Wire breakage BRAKE	<ol style="list-style-type: none"> <li>1. Plug-in contact open or loose.</li> <li>2. Wiring loose or damaged.</li> <li>3. Brake winding high resistance.</li> <li>4. Power transistor of brake control defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Disconnect plug connector X3 and test contacts X3/1 to X3/7 with ohmmeter for continuity.</li> <li>2. Check wiring for damage.</li> </ol>
Wire breakage MAIN CONTACTOR	<ol style="list-style-type: none"> <li>1. Plug-in contact open or loose.</li> <li>2. Wiring loose or damaged.</li> <li>3. Main contactor coil high resistance.</li> <li>4. Power transistor of contactor coil control defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Disconnect plug connector X2 and test contacts X2/4 to X2/8 with ohmmeter for continuity.</li> <li>2. Check wiring for damage.</li> </ol>
Wire breakage SMALL LOAD X2/5	<b>No load connection exists.</b>	—
Wire breakage SMALL LOAD X2/7	<ol style="list-style-type: none"> <li>1. Plug-in contact open or loose.</li> <li>2. Wiring damaged.</li> <li>3. Solenoid valve winding defective.</li> <li>4. Power transistor of load output X2/7 defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Plug connector X2 open and measure contacts X2/2 to X2/7 with ohmmeter.</li> <li>2. Check wiring for damage.</li> </ol>
Wire breakage SMALL LOAD X2/6	<b>Valve of fresh water supply</b> <ol style="list-style-type: none"> <li>1. Plug-in contact open or loose.</li> <li>2. Wiring damaged.</li> <li>3. Solenoid valve winding defective.</li> <li>4. Power transistor of load output X2/6 defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Plug connector X2 open and measure contacts X2/2 to X2/6 with ohmmeter.</li> <li>2. Check wiring for damage.</li> </ol>
Wire breakage SMALL LOAD X3/5	<b>No load connection exists.</b>	—



## 6.2 Troubleshooting with displays

Display fault messages	Possible causes	Troubleshooting suggestions
Short circuit LOADS X15-X20	<b>Joint, electronic back-up fuse for suction motor/shaker drive + drive system + brush drive assembly/ main brush drive has tripped.</b> <ol style="list-style-type: none"> <li>1. Wiring damaged.</li> <li>2. Interturn fault in drive windings.</li> <li>3. Power transistor/s of the power module is/are defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Disconnect all (+) cable connections of the loads X15-X20 concerned on control and drive side and test cable pairs of each individual load for short circuit using ohmmeter, replace defective cables.</li> <li>2. Reconnect loads step by step <ol style="list-style-type: none"> <li>a) Connect drive motor again with key Off and then perform key reset. Set program selection switch to transport operation and test drive system.</li> <li>b) Reconnect suction motor with key Off. Set program selection switch to vacuuming and lower suction beam and test.</li> <li>c) Reconnect brush motor(s) with key Off. Set program selector switch to Brush and test. If the fault occurs again, replace the faulty drive tracked down in this way.</li> </ol> </li> </ol>
Short circuit BRAKE/CONTACTOR	<ol style="list-style-type: none"> <li>1. Free-running diode at general contactor coil failed or coil connected with polarity reversal.</li> <li>2. Wiring damaged.</li> <li>3. Contactor coil has interwinding fault.</li> <li>4. Brake coil has interwinding fault.</li> <li>5. Power transistor of brake and/or contactor coil is defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Disconnect connector plug X2 and use ohmmeter to test contact X2/4 to X2/8 and X3/7 to X3/1 for short circuit.</li> <li>2. Disconnect contactor and brake from cable harness and use ohmmeter to test for interwinding fault.</li> </ol>
Battery charge profile error	<ol style="list-style-type: none"> <li>1. Battery set defective.</li> <li>2. Main charge time exceeded due to too high ambient temperature (charger reduces current).</li> <li>3. On board charger U1 destroyed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check battery set for correct voltage under load (each block) and replace if necessary.</li> <li>2. If ambient temperature too high carry out the charging process in a cooler place.</li> <li>3. Disconnect onboard charger from battery (X8+X9) and from mains. After 30 sec. reconnect to battery and connect with the mains.</li> </ol>
Flash memory faulty!	<ol style="list-style-type: none"> <li>1. Checksum error in program run memory of A1.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform key reset.</li> </ol>
Setup memory faulty!	<ol style="list-style-type: none"> <li>1. Checksum error in parameter and display text memory of A1.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform key reset.</li> </ol>

## 6.2 Troubleshooting with displays

Display fault messages	Possible causes	Troubleshooting suggestions
Supply stoppage to PCB (BAT)	<p><b>1. Voltage too low:</b></p> <ul style="list-style-type: none"> <li>a. Battery deep discharge or defect.</li> <li>b. Battery power supply cables interrupted.</li> <li>c. General contact has high contact resistance.</li> <li>d. Cable connections at A1 or battery posts loose or damaged (Caution! Burns on A1 possible!).</li> </ul> <p><b>2. Voltage too high:</b></p> <ul style="list-style-type: none"> <li>a. Incorrect off board charger feeds too high voltage into battery during charging via vehicle terminals while control is switched on.</li> <li>b. Drives try to feed back into battery; however, the connection with the battery is interrupted, control switches off to prevent dangerous high voltages in the power modules.</li> <li>c. Wrong battery set installed (e.g. 36V)</li> </ul> <p>3. Effect of high static charge if fault occurs sporadically.</p>	<p><b>1. Voltage too low:</b></p> <ul style="list-style-type: none"> <li>a. Measure voltage at X14 with Key-ON under load at X13 (earth).</li> <li>b. Measure voltage at X12 under load at X13 (earth).</li> <li>c. Measure voltage at general contactor (battery side) under load.</li> <li>d. Measure voltage at battery under load.</li> </ul> <p><b>2. Voltage too high:</b></p> <ul style="list-style-type: none"> <li>a. It is prohibited to charge the batteries using terminals with off board chargers while the control is connected.</li> <li>b. Occurs only if safety mechanisms fail and if connection to battery is interrupted. Ensure that the unit stops level and perform renewed key reset.</li> <li>c. Check that 24V battery set only is used.</li> </ul> <p>3. Use antistatic brushes. 4. Avoid polishing on PVC, linoleum or resin coated floorings.</p>
Supply stoppage to LOGIC ICs (5V0)	<ul style="list-style-type: none"> <li>1. Effect of high static charge if fault occurs sporadically.</li> <li>2. Defect in voltage controller at A1.</li> </ul>	<ul style="list-style-type: none"> <li>1. Use antistatic brushes.</li> <li>2. Avoid polishing on PVC, linoleum or resin coated floorings.</li> </ul>
Supply stoppage to PROCESSOR (3V3)		
Supply stoppage to PROC.-ADC (1V8)		
Supply stoppage to driver (13V)		
Short circuit X8X3/7-8, X2/6-8, X9	<p><b>Joint, electronic back-up fuse for optional fan at X9, horn at X8, div. small loads at X2 and X3 has tripped.</b></p> <ul style="list-style-type: none"> <li>1. Wiring damaged.</li> <li>2. Short circuit in loads.</li> <li>3. Power transistor/s at A1 is/are defective.</li> </ul>	<ul style="list-style-type: none"> <li>1. Disconnect all (+) cable connections of the loads X2, X3, X8, X9 concerned from A1 using Molex extractor tool. Use ohmmeter to test cable pairs of each individual pair for short circuit, replace defective cables.</li> <li>2. Connect all drives again step by step with key Off and then perform key reset. If fault occurs again, replace the load tracked down in this way.</li> </ul>

## 6.2 Troubleshooting with displays

Display fault messages	Possible causes	Troubleshooting suggestions
Short circuit LOAD X2/5,X3/5	<b>Joint, electronic back-up fuse for small loads X2/5 and X3/5 has tripped (metering pump)</b> <ol style="list-style-type: none"> <li>1. Wiring damaged.</li> <li>2. Short circuit in loads.</li> <li>3. Power transistor/s at A1 is/are defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Disconnect all (+) cable connections of the loads X2/5,X3/5 concerned from A1 using Molex extractor tool. Use ohmmeter to test cable pairs of each individual pair for short circuit, replace defective cables.</li> <li>2. Connect all drives again step by step with key Off and then perform key reset. If fault occurs again, replace the load tracked down in this way.</li> </ol>
Short circuit jumper POWER MOD.	<ol style="list-style-type: none"> <li>1. Immediately after key On the capacitors of the power/lift/extension modules cannot be charged.</li> <li>2. The error occurs after the wires are connected to the board. Troubleshooting Suggestions: Check that the traction motor (connected to X17 and X18) and the brush motor (connected to x19) are also correctly connected to the circuit board.</li> </ol>	<ol style="list-style-type: none"> <li>1. Removal all connections from X12 of the hybrid control and use ohmmeter to measure resistance between X12 and X13 (earth). If the resistance rises the capacitors can be charged. The control is ok.</li> <li>2. Check the resistance between the cables disconnected from X12 and X13 (earth). If path remains with low resistance (&lt;100Ohm), remove short circuit in cable harness.</li> <li>3. In PACKAGE version: Disconnect terminals X8 and X9 of the on board charger and measure resistance between them. If the path has low resistance (&lt;100Ohm), replace the charger.</li> </ol>
ACCELERATOR monitor faulty	<ol style="list-style-type: none"> <li>1. Effect of high static charge if fault occurs sporadically.</li> <li>2. Permanent failure of accelerator monitoring circuit at A1.</li> </ol>	<ol style="list-style-type: none"> <li>1. Use antistatic brushes.</li> <li>2. Avoid polishing on PVC, linoleum or resin coated floorings.</li> <li>3. Perform key reset.</li> </ol>
Processor function faulty	<ol style="list-style-type: none"> <li>1. Effect of high static charge if fault occurs sporadically.</li> <li>2. Processor failed at A1.</li> </ol>	<ol style="list-style-type: none"> <li>1. Use antistatic brushes.</li> <li>2. Avoid polishing on PVC, linoleum or resin coated floorings.</li> <li>3. Perform key reset.</li> </ol>
POWER MOD short circuit. LFET-B	<ol style="list-style-type: none"> <li>1. Drive system not connected to X17/X18.</li> <li>2. Wiring from X18 is connected to earth when drive system disconnected.</li> <li>3. Power transistors in the B quadrants of A1 are defective.</li> <li>4. Current measuring circuit at A1 defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Connect drive system connections with control terminals X17/X18.</li> <li>2. Check wiring for short circuits with earth (e.g. smell of burning).</li> <li>3. Check that the metal chassis of the machine has no connection with earth.</li> </ol>

## 6.2 Troubleshooting with displays

Display fault messages	Possible causes	Troubleshooting suggestions
POWER MOD short circuit. LFET-C	<ol style="list-style-type: none"> <li>1. Drive system not connected to X17/X18.</li> <li>2. Wiring from X17 is connected to earth when drive system disconnected.</li> <li>3. Power transistors in the C quadrants of A1 are defective.</li> <li>4. Current measuring circuit at A1 defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Connect drive system connections with control terminals X17/X18.</li> <li>2. Check wiring for short circuits with earth (e.g. smell of burning).</li> <li>3. Check that the metal chassis of the machine has no connection with earth.</li> </ol>
POWER MOD short circuit. HFET-B	<ol style="list-style-type: none"> <li>1. Drive system not connected to X17/X18.</li> <li>2. Wiring from X18 is connected to +Ubatt when drive system disconnected.</li> <li>3. Power transistors in the B quadrants of A1 are defective.</li> <li>4. Current measuring circuit at A1 defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Connect drive system connections with control terminals X17/X18.</li> <li>2. Check wiring for short circuits with +Ubatt (e.g. smell of burning).</li> <li>3. Check that the metal chassis of the machine has no connection with +Ubatt!</li> </ol>
POWER MOD short circuit. HFET-C	<ol style="list-style-type: none"> <li>1. Drive system not connected to X17/X18.</li> <li>2. Wiring from X17 is connected to +Ubatt when drive system disconnected.</li> <li>3. Power transistors in the C quadrants of A1 are defective.</li> <li>4. Current measuring circuit at A1 defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Connect drive system connections with control terminals X17/X18.</li> <li>2. Check wiring for short circuits with +Ubatt (e.g. smell of burning).</li> <li>3. Check that the metal chassis of the machine has no connection with +Ubatt!</li> </ol>
POWER MOD interruption. LFET-B	<ol style="list-style-type: none"> <li>1. Power transistors in the B quadrants of A1 are defective.</li> <li>2. Potential measuring circuit for B quadrants of A1 is defective.</li> </ol>	—
POWER MOD interruption. LFET-C	<ol style="list-style-type: none"> <li>1. Power transistors in the B quadrants of A1 are defective.</li> <li>2. Potential measuring circuit for B quadrants of A1 is defective.</li> </ol>	—
POWER MOD interruption. HFET-B	<ol style="list-style-type: none"> <li>1. Power transistors in the B quadrants of A1 are defective.</li> <li>2. Potential measuring circuit for B quadrants of A1 is defective.</li> </ol>	—
POWER MOD interruption. HFET-C	<ol style="list-style-type: none"> <li>1. Power transistors in the B quadrants of A1 are defective.</li> <li>2. Potential measuring circuit for B quadrants of A1 is defective.</li> </ol>	—
POWER MOD short circuit. LFET-BC	<ol style="list-style-type: none"> <li>1. Wiring from X17/X18 is connected to earth when drive system disconnected.</li> <li>2. Power transistors in the B/C quadrants at A1 with drive system disconnected defective.</li> <li>3. Current measuring circuit at A1 defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check wiring for short circuits with earth (e.g. smell of burning).</li> <li>2. Check that the metal chassis of the machine has no connection with earth!</li> </ol>
POWER MOD short circuit. HFET-BC	<ol style="list-style-type: none"> <li>1. Wiring from X17/X18 is connected to +Ubatt when drive system disconnected.</li> <li>2. Power transistors in the B/C quadrants of A1 with drive system disconnected defective.</li> <li>3. Current measuring circuit at A1 defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check wiring for short circuits with +Ubatt (e.g. smell of burning).</li> <li>2. Check that the metal chassis of the machine has no connection with +Ubatt!</li> </ol>

## 6.2 Troubleshooting with displays

Display fault messages	Possible causes	Troubleshooting suggestions
Short circuit X8X3/7-8,X2/6-8,X9	Identical fault to fault number 13	See action for fault number 13
Short circuit LOAD X2/5,X3/5	Identical fault to fault number 14	See action for fault number 14
Read error in file system	1. Parameter and display text memory faulty.	–
Missing file in file system	1. Data missing in the parameter and display text memory, usually language tables for display texts are missing	1. Set English as language in the setup menu and perform key reset.
Unknown command in the file system	1. Internal error.	1. Perform key reset.
SPI overflow to the file system	1. Internal communication error.	1. Perform key reset.
Write protection error in Flash	1. Internal error.	1. Perform key reset.
Processor monitoring circuit	1. Effect of high static charge if fault occurs sporadically. 2. Permanent failure of processor monitoring circuit at A1.	1. Use antistatic brushes. 2. Avoid polishing on PVC, linoleum or resin coated floorings. 3. Perform key reset.
Hardware fault in the on board charger	<b>PACKAGE versions:</b> 1. Fault in charger U1. 2. Hardware damage in charger U1.	1. Disconnect charger U1 from mains and disconnect terminals X8 and X9 from battery. 2. Reinstate all connections after 30 seconds. Connect U1 with the mains. Charging must start, always measure charging current in the battery using clip-on ammeter.
MAIN CONTACTOR fault	1. Load contact of general contact stick. 2. Intermediate circuit precharged, e.g. tab connector X15 and X14 mixed up.	1. Replace general contactor. 2. Correctly connect tab connectors X14 and X15.
BRUSH/ROLLER overload	<b>(Brush drive assembly)</b> 1. Drive mechanically blocked (wound wires). 2. Brushes/sweeping pattern incorrectly set. 3. Insufficient water and high brush pressure. 4. Mechanical defect (e.g. bearing damage). 5. "Max. brush current" parameter incorrectly set.	1. Check brushes/roller/broom for foreign bodies / clean. 2. Check current consumption under no load (unit idle) and under load. 3. Adjust brushes/sweeping pattern if necessary. 4. Check mechanical play and smooth running. 5. If necessary, correctly set „Max. brush current“ parameter in the setup.



## 6.2 Troubleshooting with displays

Display fault messages	Possible causes	Troubleshooting suggestions
DRIVE MOTOR overload	<ol style="list-style-type: none"> <li>1. Slope too large and/or too long.</li> <li>2. Drive mechanically blocked.</li> <li>3. Mechanical defect (e.g. bearing damage).</li> <li>4. „Max. motor current“ parameter incorrectly set.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check whether magnet brake drags or is blocked.</li> <li>2. Check mechanical play and smooth running (including rear wheels).</li> <li>3. Check current consumption under no load (unit idle) and under load.</li> <li>4. Refrain from cleaning on slopes.</li> <li>5. Refrain from long transport routes on slopes.</li> <li>6. If necessary, correctly set „Max. motor current“ parameter in the setup.</li> </ol>
Overload load X15/X16	<b>(Suction motor)</b> <ol style="list-style-type: none"> <li>1. Drive mechanically blocked.</li> <li>2. Mechanical defect (e.g. bearing damage).</li> <li>3. Parameter setting for max. motor current incorrectly set.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check motor/shaker for foreign bodies / clean.</li> <li>2. Check motor for water damage.</li> <li>3. Check float switch and float of wastewater tank are functioning properly and clean.</li> <li>4. Measure current consumption.</li> </ol>

### Note

If the faults cannot be corrected using the suggestions listed in Chapter 6.2 the relevant module (hybrid module/charge module) must be replaced.

## 7. Technical specifications

Unit type	Unit No.	Circuit Diagram	Operating instructions	Spare parts list Basic unit/ brush head
BR 90 R Classic	1.161-300	0.089-033.0	5.962-383.0	5.962-399.0 5.962-400.0
BD 90 R Classic Pack	1.161-301	0.089-033.0	5.962-383.0	5.962-399.0 5.962-400.0
BR 90 R Adv	1.161-302	0.089-033.0	5.962-383.0	5.962-399.0 5.962-400.0
BD 90 R Adv Pack	1.161-303	0.089-033.0	5.962-383.0	5.962-399.0 5.962-400.0
BR 90 R Adv Dose	1.161-304	0.089-033.0	5.962-383.0	5.962-399.0 5.962-400.0
BD 90 R Adv Dose Pack	1.161-305	0.089-033.0	5.962-383.0	5.962-399.0 5.962-400.0

The technical data sheet and the circuit diagram will be included in the next issue of the spare parts CD-ROM (DISIS) and are also available in kaercher-inside (<https://kaercher-inside.com>).

If required, the operating instructions and the spare parts lists can be ordered as a paper copy from the spare parts service by quoting the relevant part number.

## 8 Special Tools

Steering wheel puller	2.860-166.0
Clip-on ammeter	6.803-022.0
Adapter, for adjusting the magnet brake	5.116-199.0
Molex extraction tool	6.816-086.0
<u>For changes in the Setup menu of the Classic version</u>	
Control panel complete	4.841-186.0
Cable kit for current measurement of consumers at X3	4.822-877.0

## 9 Tightening torques

Retaining screws (3x), magnet coil (Y1)	2,4 Nm
Press-in threaded bush Hybrid Module (traction motor, brush motor)	12,8 Nm

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