



# Installation Guide

---

Wheelchair drive control *BonRoll*

---

### **Disclaimer**

The manufacturer is not liable for any damage or claim on persons or objects arising from the improper operation of the described product. Before the operation of the product, the instruction manual has to be read carefully and be understood.

## Content

1. Introduction.....	5
2. Installation.....	7
2.1 Mounting.....	7
2.2 Connecting the devices.....	8
2.2.1 Joystick and display.....	8
2.2.2 Main batteries.....	8
2.2.3 Magnetic brakes.....	8
2.2.4 Main motors.....	9
2.2.5 Steering motor.....	9
2.2.6 Adjusting for Home- and/or Street-Mode.....	10
3. Configuration via Configuration Software.....	12
3.1 Installation of the PC Configuration Software.....	12
3.2 Connecting the <i>BonRoll</i> drive control to your PC.....	13
3.3 Switching on the BonRoll drive control.....	13
3.4 Adjust basic values on the BonRoll drive control.....	13
3.4.1 Wheelchair basics.....	14
4. Connection of auxiliary motors.....	17
4.1 Configuring the auxiliary motors with the Software.....	17
5. Error and Alarm Codes.....	17
6. Connector pin assignment.....	18



## 1. Introduction



*This chapter describes some basic issues regarding the installation of the BonRoll wheelchair drive*

With the motor controlling system *BonRoll* for electronic wheelchairs of BONNEL TECHNOLOGIE you have settled on a high-quality controlling system. Please read the following installation manual carefully in order to assure a save installation and operation.

Due to its easy and intuitive operation, the motor controlling system *BonRoll* suits all DC-operated electronic wheelchairs with collector motors and with front-wheel or back-wheel drive. Thanks to its two selectable operation modus' ("Street" and "Home, see Chapter 2.2.6, p. 10), the *BonRoll* may be used for wheelchairs with (like for a car) as well as without front-steering.

Besides, *BonRoll* offers many additional functions: with the six servo motors e.g. the position of the seating, the back- and the feet support may be controlled continuously. Lights and direction indicators can easily be operated. Thanks to a special interface, additional accessories may be connected, e.g. an alternative wheelchair controlling systems such as a suck- and blow controlling system or a remote control of other devices steered by the joystick on the wheelchair.

Using a data link and special software the controlling system and each of the servo motors can be configured differently. This results in a high bandwidth of possible calibrations/configurations and numerous usages for different types of wheelchairs. Besides, there are many options to configure numerous other parameters, such as the acceleration-, braking- and curve-behavior of the wheelchair. Furthermore, various motors may be interfaced and operated simultaneously in order that the programmed seating positions may quickly be attained. A status indication of the drive battery shows permanently its residual state of charge. As soon as a certain level of charge has been reached, an automatic switch to the energy-saving



*Electric wheelchair with BonRoll drive control unit*



*Bon Roll* Steuereinheit

modus is carried out.

The main components of the motor controlling systems *BonRoll* are the control panel, the joystick device (connected by a flexible steel joint) and the control unit. A CAN-Bus, often used by the automobile industry, enables the components to communicate to each other. The resulting permanent control of the different components of the system enables an instant and save switch-off of the steering in case of a breakdown or deficiency of one of the components.

The following paragraphs of this instruction manual offer a precise step-by step instruction for the installation and calibration of the control unit.



*Bon Roll* main unit

## 2. Installation



*This chapter contains detailed information about the installation and the connection of the single parts and their connection to the motors, lights and similar.*

*Please perform all the steps in the same order as described in the following chapters.*

Before initiation of the device (before switching it on) it has to be fully installed / connected. The wheelchair drive control checks at every startup if all the essential components are connected.

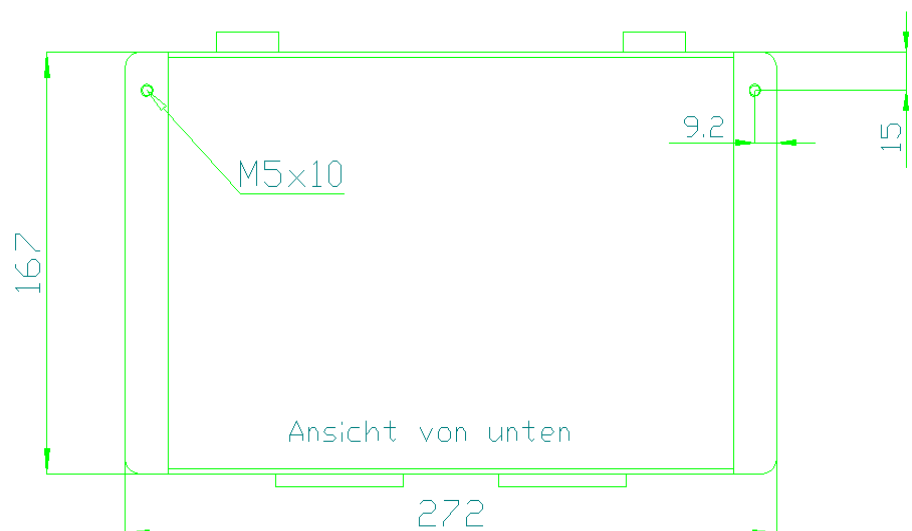
If the device is run without proper installation/connection, error messages (see chapter 5, p. 17) will occur. Besides, this can lead to the destruction of the device, the wheelchair or individuals.

In particular it is necessary to connect the main motors, the brakes and the steering sensor. Additionally it is necessary to check the right adjustment of the Home- / Street- Mode switch (see chapter 2.2.6, p. 10).

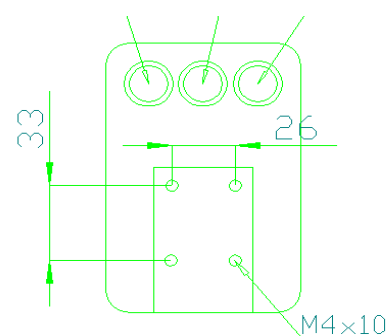
### 2.1 Mounting

First of all, all parts of the wheelchair drive control have to be mounted on a suitable place. That means the joystick unit and the main unit have to be fixed on the wheelchair.

Dimensions of the main unit (seen from below)



Dimensions of the joystick unit (seen from below)



## 2.2 Connecting the devices

The connectors and the wiring harness are labeled to ease the installation.

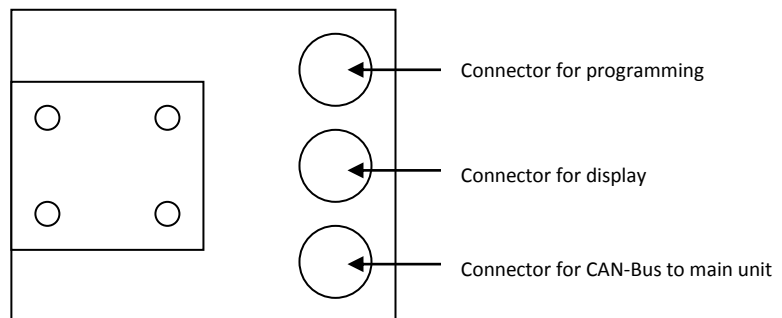
Please do not start the drive control before performing all the steps described below.

### 2.2.1 Joystick and display

The joystick and the display part have to be connected via CAN-Bus.



Display- and joystick-unit



View on joystick **from below** - connections

### 2.2.2 Main batteries

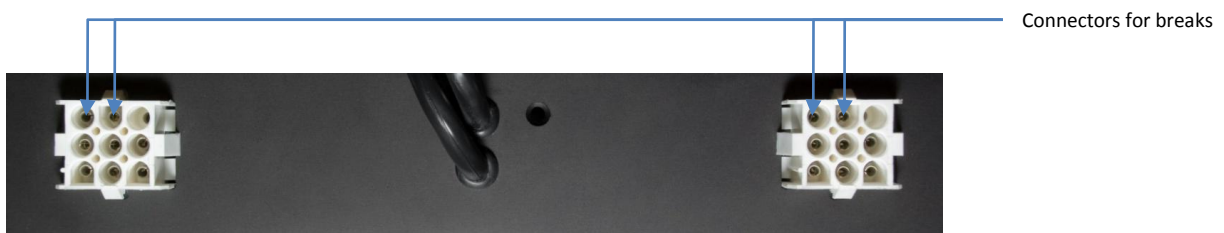


The two main supply cables have to be connected to a 24V DC source (2x 12V batteries in serial connection).

Connectors for Batteries

### 2.2.3 Magnetic brakes

The *BonRoll* drive control checks at every startup if all the essential components are connected. Therefore the brakes have to be connected, too.



Connectors for breaks

The brakes work with 24V DC. For the first second during and after brake release, the brake solenoid is supplied with full current. Afterwards, to save energy, the current is pulsed with a frequency of about 260Hz.

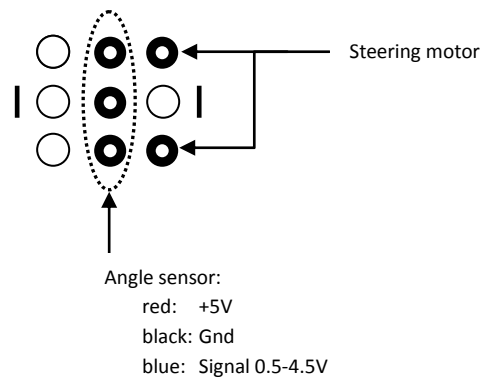
For test purposes by qualified personal the drive control can also be operated without magnetic brakes. Therefore a 220Ω resistor has to be connected instead of the brakes. Please never use the wheelchair for disabled without proper brakes.

### 2.2.4 Main motors

The two main motors have to be connected to the marked connector / wires

### 2.2.5 Steering motor

The connector for the steering functions is displayed below. Cable and connector are labeled.



Please take care of the *right direction of rotation when connecting the two devices!* Both, the sensor and the motor must have the same direction. If not, the sensor will report, that a position has not be reached yet, the control unit will enhance the power to the steering motor – but as it turns into the wrong direction the sensor will report a even worse position and so on - until the sensor or the motor are destroyed.

#### Angle sensor

First, the angle sensor for the steering motor has to be connected. It is important to employ an angle sensor with the same data as the normally used “elobau 424Z”-sensor.

That means:

Operating voltage:	5V DC ±0.5V
Output signal:	0.5 - 4.5V
Center position:	3V
Angle rate:	±60°
Load resistance:	> 10kΩ

If other sensors shall be used, the output signal can be adjusted by resistors.

### Steering motor

The steering motor runs at 24V. The maximum current (when motor has reached an arrester/block!) is 7A which results in a max. power of 170W. Our motor has a nominal consumption of 40W.

### 2.2.6 Adjusting for Home- and/or Street-Mode

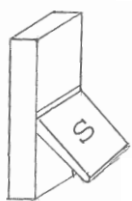
The *BonRoll* wheelchair drive control can handle two different drive & steer modes. Depending on the mode you will use, you need at least one of the prearrangements described below. As the control system checks connected sensors, it will end up with an error message if none or the wrong sensors for the actual mode are connected.

We suggest preparing both of the prearrangements to avoid any damage or error messages of the drive control system.

#### Street Mode:

The first drive & steer mode is the well known Street-Mode. Here you control the wheelchair similar as a car; it has rear wheel drive with (electronic) differential and is directed by steering the front wheels.

The necessary prearrangement is, to connect the angle sensor properly as described. Additionally, the Home-/ Street-Mode switch located on the wire harness has to be turned to Street-Mode (see fig.).



Switch position for Street-Mode

The switch simulates the position switch of an auxiliary, fifth wheel (described in the next chapter). If such an auxiliary wheel with a position which shall be used, the prepared switch has to be replaced with the position switch.

#### Home Mode

The second drive & steer mode is the so called Home-Mode. In this mode a fifth, auxiliary wheel is lowered which lifts the two front wheels over the ground. The wheelchair changes to a kind of trike with a front wheel which can rotate 360° round its own axis (see picture below).

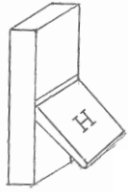


Auxiliary fifth wheel for Home-Mode

Then the wheelchair is steered like a tank or track vehicle by changing the rotation direction of each of the two rear wheels.

This mode enhances the maneuverability of the wheelchair and thus eases driving around in narrow places.

For test purposes, a manual lowered auxiliary wheel without position switch can be used. To avoid an error message of the control unit, a switch that simulates the position switch, has to be turned in the home position (see fig.).



Switch position for Home-Mode

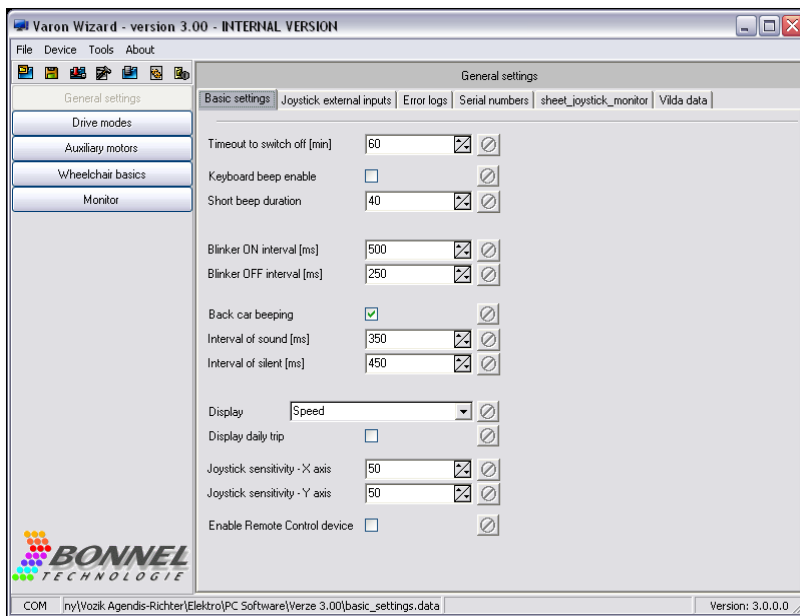
### 3. Configuration via Configuration Software



*This chapter contains information about the installation of the Configuration Software and the adjustment and modulation of the BonRoll wheelchair drive control.*

The *BonRoll* wheelchair drive control is configured with the provided Configuration Software. The entire basic configuration as well as the “fine-tuning” can be comfortably done from the PC taking advantage of the graphical user interface and the context-sensitive help.

*Before configuring the BonRoll drive control, all the steps described in Chapter 2 have to be finished.*



Screenshot of the Configuration Software

#### 3.1 Installation of the PC Configuration Software

It is necessary that your PC has at least one free COM-Port for the connection to the *BonRoll* drive control. The Software was developed for MS Windows XP®, but it should also work with newer Windows® editions. In case of any problems please activate the XP compatibility mode.

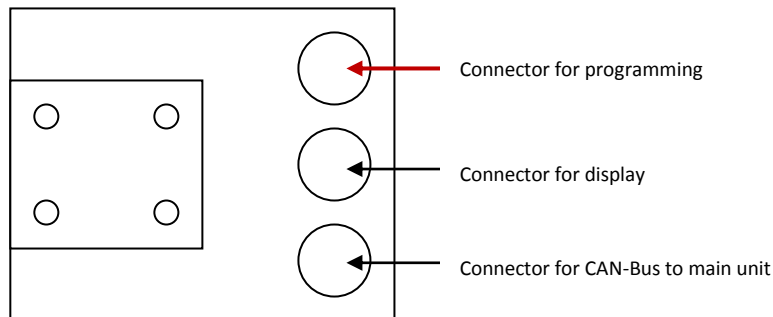
The Configuration Software does not have to be installed nor do you need administrator rights to use it.

Copy the "BonRoll Configurator.exe" file and the two "basic\_settings\_\*.data" files to the same folder on your local hard disk. Please ensure read AND write access for this folder for the future user of the Configuration Software.

To run the Configuration Software, please start the "BonRoll Configurator.exe"

### 3.2 Connecting the *BonRoll* drive control to your PC

To connect the *BonRoll* wheelchair drive control to the PC with the Configuration Software, just connect one side of the connection cable to a free COM-Port on your PC or laptop and the CAN-Bus plug to the joystick unit as shown in the figure below.



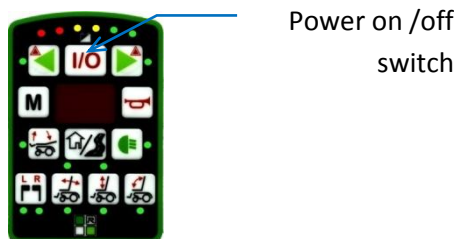
View on joystick **from below** - connections

### 3.3 Switching on the *BonRoll* drive control

*Before switching on the *BonRoll* drive control, please ensure, that all the steps described in Chapter 2 have been finished.*

*Do not drive with the wheelchair before finishing the basic configurations as described in chapter 3.4.*

To switch on the *BonRoll* drive control use the power button on the display unit (see picture).



### 3.4 Adjust basic values on the *BonRoll* drive control



*This chapter describes how to setup the basic settings of the drive control, which have in any case to be set.*

*Additional information to the other settings can be found pointing with the mouse on the respective editable field.*

To adjust the basic values on the BonRoll drive control, start the Configuration Software while the drive control is connected to the PC and the drive control is switched on.



*All the settings for one particular wheelchair can be saved in a particular file and archived and reused.*

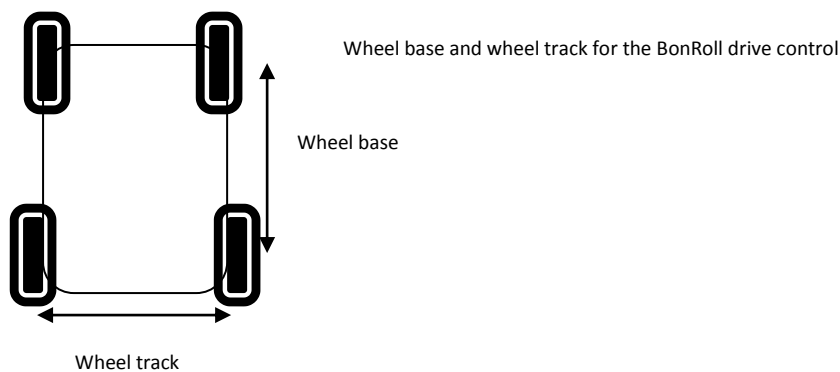
The adjustment of the basic settings is described in the next paragraphs.

### 3.4.1 Wheelchair basics

*These are the essential settings that have to be set before using the wheelchair.*

#### **Wheel base,-track and -diameter**

The wheel base and the wheel track have to be adjusted



The wheel track and the wheel diameter is applied on the powered wheels.

#### **Gear ratio and motor rpm**

Please enter the original rounds per minute (rpm) at the motor and the gear ratio.

#### **Motor Ri**

This value can normally not be exactly determinate by simple measurement. For a first approximation measuring can help.

As we know your motor has 500W we suggest you as a first approximation a value of about 75 mΩ.

For fine-tuning adjustment please perform the following steps:

1. Lift the driven wheels so that they can turn in the air (so that the wheelchair cannot drive)
2. Switch to the fifth (fast) speed range (push the M-button for changing the speed-modes, then switch with the joystick sideward until P5 is reached, then confirm with joystick forward)

3. Push the joystick forward, the wheels should start to turn.
4. Release the joystick (it should turn to zero position) and the wheels should stop turning. If not, please try with other values ( $\pm 30\%$ ,  $\pm 60\%$ , ...) until start stop works well.
5. Reduce the Ri value to 90% of the identified value.
6. Lower the driven wheels so that they can turn on the ground (so that the wheelchair can drive)
7. Set the "Park brake delay" value to zero.
8. Build some kind of "emergency brake" by fixing a cord around the main fuse.
9. Please carefully try to drive with the wheelchair on a free space. Try to stop the wheelchair at low and mid speed by releasing the joystick to zero position. If everything is somehow right proceed to the next step.
10. Drive full speed forward and release the joystick to zero. Drive full speed backward and release the joystick to zero.  
If the wheelchair stops somehow hard, so if the magnetic brakes react before the wheelchair stops, the Ri value should be slightly\* (ca. 10-20) increased.  
If the wheelchair stops and afterwards tries to roll a small bit in the opposite direction, the Ri value should be slightly decreased.
11. Reset the "Park brake delay" value to 100ms.

*These essential settings have to be adjusted before using the wheelchair for the first time. All the other settings can be adjusted later according to the experiences with the handling and performance of the wheelchair.*

*All other parameters should do quite well at their default values.*

### **Park brake delay**

This is the time after releasing the joystick to zero position, within which the device zeros the voltage at the magnetic brakes so that they block the wheels.

This parameter can be seen as an adjustment to set the braking speed and intensity together with the "Motor Ri" value.

### **Emergency braking delay**

If an error occurs (see errors in chapter 5), e.g. if the joystick does not respond anymore, the wheelchair is stopped. Therefore the power of the main motors is linearly reduced from 100% to 0% within XXX ms.

### **Steering mechanism settings: Minimal speed**

To avoid overriding of the steering wheels, the steering speed is stepped while turning an angle. That means, first the wheels turn fast, and some degrees before the desired angle is reached, the angular velocity is reduced in steps.

The minimal speed is the lowest of ten speed steps which is used.

---

\* As the Ri value is transmitted by a 10bit AD-converter, minimal corrections on the Ri value are not taken into account.

**Steering mechanism settings: Maximal speed**

To avoid overriding of the steering wheels, the steering speed is stepped while turning an angle. That means, first the wheels turn fast, and some degrees before the desired angle is reached, the angular velocity is reduced in steps.

The maximal speed is the highest of ten speed steps which is used.

**Steering mechanism settings: Smoothness**

This parameter controls the relation between the steering angle that has to be changed (according to joystick command) and the angular rate in which the change is done. This is done by a decrease of the angular velocity before reaching the target angle (to avoid overriding).

The speed is lower, the higher the smoothness value is.

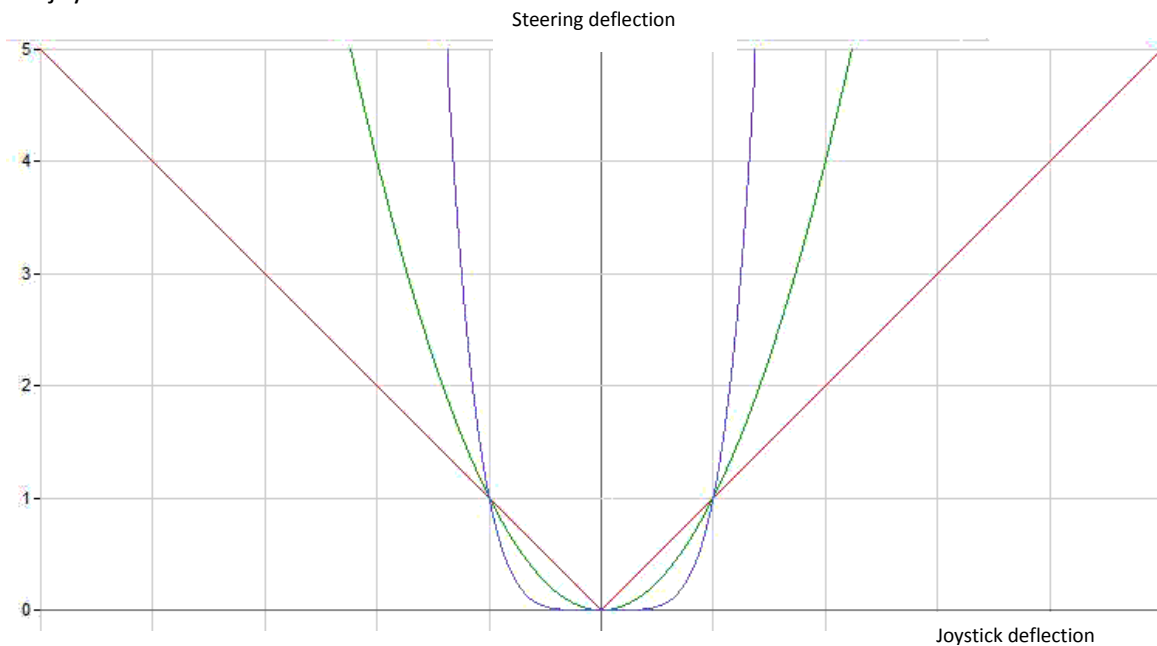
**Steering mechanism settings: Linearity**

This parameter describes the relation between the joystick deflection and the steering deflection of the steering wheels (only Street Mode).

The mathematical relation regarding a linearity parameter of  $xx$  is:

$$\text{joystick deflection}^{x \cdot x} = \text{steering deflection}$$

This means that, regarding a linearity parameter of 20, the steering deflection is the square of the joystick deflection.



Linearity parameter

With this factor the directional stability can be improved.

## 4. Connection of auxiliary motors

The auxiliary motors have to be connected to the main unit as showed in the figure in chapter 6 on page 18.

The motors can be either 12V or 24V, the maximum current should not exceed 3A.

The connector is a AMP Multilock Type 040.

### 4.1 Configuring the auxiliary motors with the Software

All the motors are configured with the Configuration Software.

In the upper left part of the window the motors are enabled and their Voltage is assigned.

In the upper right part of the window the end switch setting is done. No watch means, the motor has its own end position check and switch. Back EMF means the BonRoll drive control checks the rpm (generated voltage while turning – principle) and identifies thus the end points. On end: off means the position switch turns off reaching the end point; On end: on is the opposite.

The motor names can be changed in the lower part of the window.

## 5. Error and Alarm Codes

Error		
Error-Number	Error Description	Troubleshooting
01	Joystick not calibrated	Recalibrate Joystick
04	The main unit does not respond during shut down	Contact BONNEL
05	One or more devices (joystick, display, main unit) do not shut down	Contact BONNEL
06	Joystick does not respond	Check cables; Contact BONNEL
07	Main unit does not respond	Contact BONNEL
08	Angle sensor and position switch of fifth wheel (Home Mode) not detected.	Check sensors
09	Joystick data not in valid range	Recalibrate Joystick
10	Main unit reported problems and was restarted	
11	The drive control was shut down because of timeout	No Problem, just timeout to save battery
12	Main unit firmware version does not match	Contact BONNEL for new firmware
13	Display unit firmware version does not match	Contact BONNEL for new firmware
14	Joystick unit firmware version does not match	Contact BONNEL for new firmware
15	One or both main motors or magnetic brakes are not connected	Check motors and brakes

17	Error in power electronics (H-bridge); main motors not connected	Check connections of the main motors, contact BONNEL
18	Error in angle sensor	Check sensor
19	Battery voltage dropped below 15V	Load/change batteries
20	Position switch of fifth wheel (Home Mode) not responding or not detected.	Check position switch; contact BONNEL
22	Joystick firmware 3 programmed on a joystick for version 2	Contact BONNEL

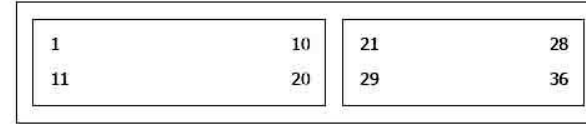
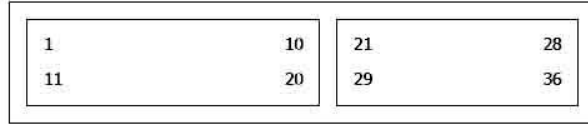
Alarm		
Alarm-Number	Alarm Description	Troubleshooting
02	Manual brakes are disengaged	Manual brakes are permanently disengaged for manual maneuvering, magnetic brakes cannot work
08	Service interval. Kilometer counter (factory setting, adjustable) run out	Service & counter reset
09	12V source broken, lights and blinkers out of order	Contact BONNEL
10	Version of PC software not correct	Contact BONNEL

*Other indicators:*

Indicators	
Indicator description	Troubleshooting
Battery indicator is blinking (stepped)	Battery connected to charger
LED indicating Home/Street-Mode is slowly blinking	Switch for limited speed is activating
LED indicating Home/Street-Mode is quickly blinking	Switch for blocking motors is activating
Battery indicator is blinking and "bt" is on display	Battery voltage is 2V under the minimal value (as set in Configuration Software)

## 6. Connector pin assignment

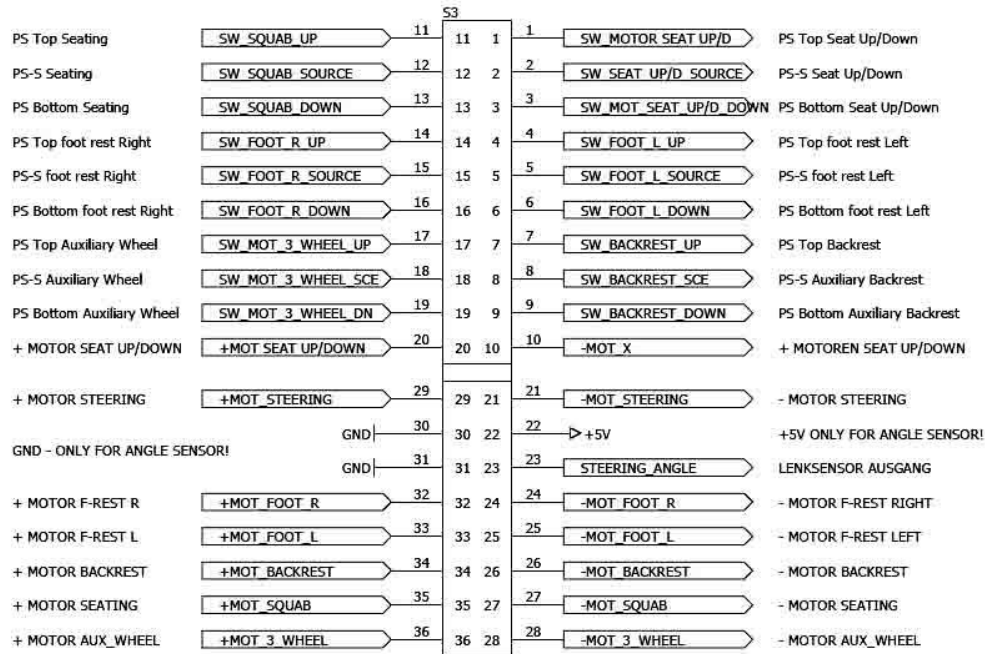
The connector pin assignment for the auxiliary motors is displayed on the next page.



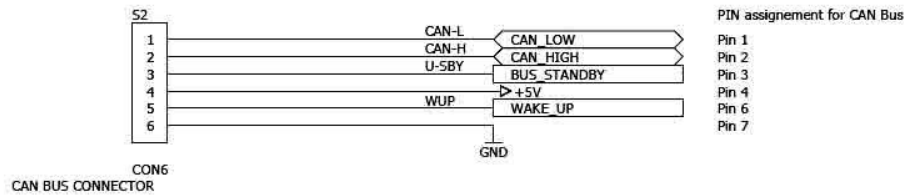
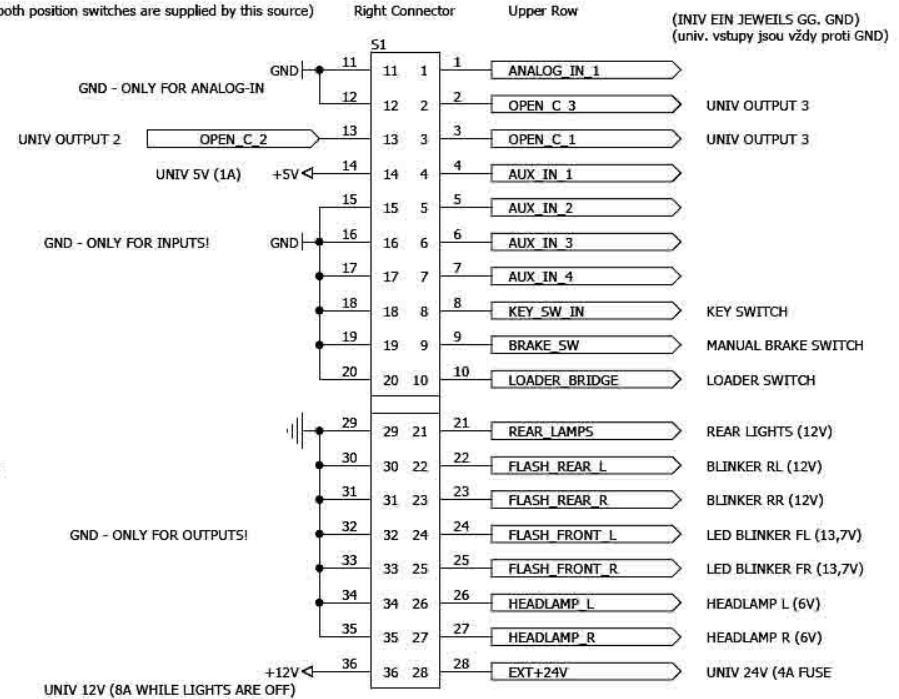
CONNECTOR FIRMWAR



PS = Position Switch  
PS-S Position Switch Source (both position switches are supplied by this source)  
Left Connector



PS = Position Switch  
PS-S Position Switch Source (both position switches are supplied by this source)  
Right Connector



STAND 18.01.2007  
Stav 18.01.2007 /BoG  
ACHTUNG - GILT FÜR DIE LEITERPLATTE MC0703 (Steuerung Version 2007)  
POZOR - PLATĚ PRO DESKU MC0703

Title		
ROLLSTUHLSTEUERUNG - ANSCHLUSSBELEGUNG		
Size	Number	Revision
A4		0.2

© 2010 BONNEL TECHNOLOGIE GmbH

version 02/2010

—

Change and errors excepted

Duplication and reproduction requires  
previous written authorization from  
BONNEL Technologie GmbH, Germany