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SERVICE MANUAL

Machine: *PLL PSD PSL PLE*

Manual No: *119000*

Edition 2008B

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1 General information and technical data

Scope of Service Manual

General

This manual describes the service procedures for ATLET low lifters and stackers. Use the manual for quick and correct service of respective truck models.

You may find contradictions in the manual compared to the models supplied due to optional designs and upgrades, and the like.

⚠ ***Warning!***

If the truck is rebuilt after delivery or supplemented in such a manner that safety may be affected, ATLET AB or its authorised representative should be contacted.

Unauthorised truck modification is not permitted. Only in the event that the truck manufacturer is no longer in business and there is no successor to the business, may the user arrange for a modification or alteration to a powered industrial truck, provided, however, that the user shall:

- Arrange for the modification or alteration to be designed, tested and implemented by an expert engineer(s) in industrial trucks and their safety.
- Maintain a permanent record of the design, test(s) and implementation of the modification or alteration.
- Approve and make appropriate changes to the capacity plate(s), decals, tags and instruction manuals.
- Affix a permanent and readily visible label to the truck stating the manner in which the truck has been modified or altered together with the date of the modification or alteration, and the name and address of the organisation that accomplished the tasks.

The content of this service manual is protected by copyright law and may not be copied, fully or in part, without written permission. The material has undergone careful examination with regard to correctness. Subject to alteration. In the event of inconsistent information in the Swedish and translated editions, it is the Swedish edition that applies.

Modifications and updates will be distributed via ATLET AB Service Manual Change.

Scope of the P series

The manual covers the low lifter PLL and stacker PSD.

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How to use the manual

Structure

The manual is built up according to the same principles as ATLET spare parts catalogues, with the truck divided into one subsystem per section.

Sections 1 - 3 in this manual contain more comprehensive information regarding technical data, general service instructions and tools.

Sections 4-12 in this manual contain information limited to a specific area in the truck concerning the description of the mechanical handling of different components, e.g. Master (section 6) and Hydraulic system (section 8).

The software is described in section 10.

The main principle for extra accessories is to place them under the respective sections. Otherwise they are placed under section 12 “Miscellaneous”. For this reason section 12 is not always included in the Service Manual.

For specific problems or information about procedures, look in the main index for the correct section in the manual.

Symbol key

Warning!

Used for risk of personal injury.

Important!

Used for risk of damage to machine.

Note!

Used for general observation.

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Safety instructions

General

Extreme importance must be placed on precautionary measures to avoid accidents during all work on the vehicle.

A general rule is to always implement preventive measures that are adapted to the type of vehicle to be worked on. The general rules below must always be observed:

- Smoking or naked flames are strictly forbidden as there is a risk of explosion in the vicinity of batteries and while working on gas equipped vehicles.
- The battery should always be protected during grinding work.
- Local fire directives should always be followed.
- The drive wheel should always be lifted up free from the floor during service work to prevent the vehicle from moving.
- The battery plug should be pulled out before working on the electrical system. The battery plug may only be connected while trouble shooting, and when the greatest of care is exercised, (with the truck raised).
- To prevent injuries caused by crushing the battery plug should always be removed when working on and around the mast and hydraulic unit. The mast or hydraulic unit can be actuated due to an electrical fault or a mistake while working.

⚠ ***Warning!***

Having the power connected to the truck while working on and around the mast can lead to fatal injury!

- When working on and around lifting devices and the hydraulic unit, they must be locked by using the mast lock, wooden blocks or some other appropriate means.
- No other persons should be in the vicinity of the truck when it is test run in conjunction with repair work, in view of the risk of accidents or near-accidents from the truck making an unexpected manoeuvre.
- The system should not be pressurised, e.g. the pump motor switched off and the forks in their lowest position, when dismantling parts of the hydraulic system.
- All metal objects such as watches, chains, spectacles and rings should be removed when working on the electrical system, or in its immediate vicinity. A short-circuit from such objects can result in serious burn injuries.

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Lifting the truck

Inspection/Preparation

- When the truck is lifted using a jack, make sure you secure it with blocks. The truck must not rest on the jack, while work is carried out.
- Ensure that straps, wires or chains have a sufficient lifting capacity before lifting the truck.
- Ensure that the drive wheel runs free of the floor before trouble shooting.

Permitted lifting points

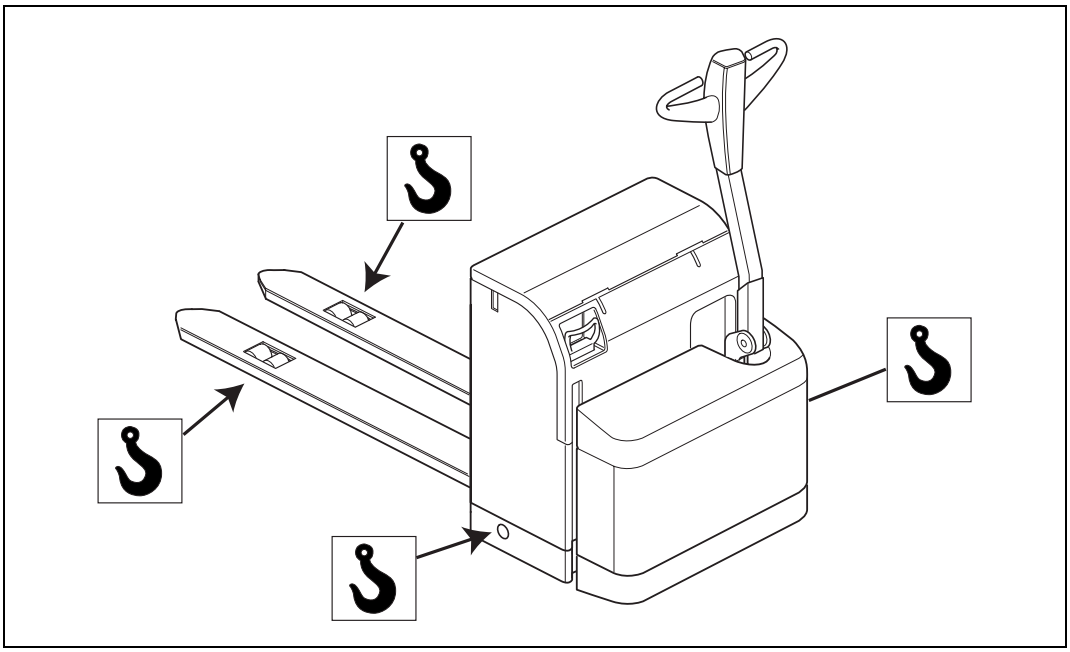

Figure 1.1 Permitted lifting points

Figure1.1 shows where the permitted lifting points are placed on the truck. The lifting points are marked with a decal representing a lifting hook.

⚠ ***Warning!***

The machine must never be lifted in any other points than the ones shown.

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Figure 1.2 shows where the jack should be placed.

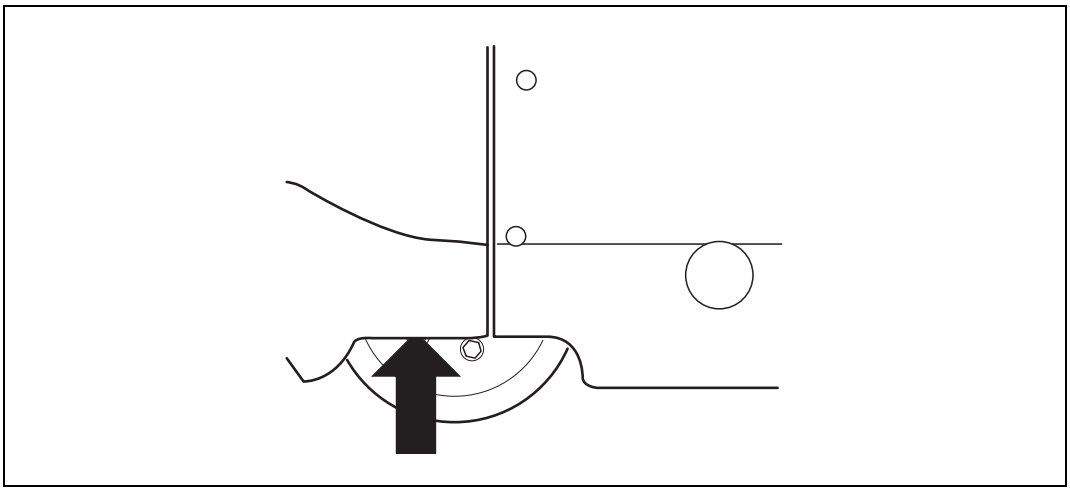

Figure 1.2 Permitted lifting points, jack

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Welding on the truck

- During welding work the battery plug should always be disconnected and all connections to the control units and regulators (applies to all electronic units) disconnected. On completion of welding work the connectors should first be connected to the electronic units, after which the battery plug is then connected to the battery.
- The return cable clamp should always be connected as close the welding area as possible to eliminate damage to surrounding components.

Atlet AB takes care of the environment

The majority of our products consist of metal that can be completely recycled.

Environmental impact

All products have an impact on the environment throughout their entire life cycle.

The consumption of energy during their use is one of the most important factors that influences the environment.

Through correct care, maintenance and use the consumption of energy can be reduced, thereby reducing the environmental impact.

Waste

Waste material in conjunction with repairs, maintenance, cleaning, or scrapping, should be collected and disposed of in an environment-friendly way and in accordance with the directives of respective countries. Such work should only be carried out in areas intended for this purpose.

Recyclable material should be taken care of by specialised authorities.

Environmentally hazardous waste, such as oil filters, batteries and electronics, can have a negative effect on the environment, or health, if handled incorrectly.

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Preparations

Service

- Go through all the safety instructions.
- Make sure that you have all the essential tools close at hand before starting work.
- Before cabling or other electrical components are disconnected, check the colour codes and check for damage to cables or connections.
- When complex components are repaired and dismantled, make sure that you have good control of the different component parts to avoid the risk of confusion.
- When repairing or maintaining sensitive components, make sure that you use clean tools and work on a clean work surface.
- Dismantle, inspect and adjust components according to the prescribed routines. See respective sections for detailed information.

Trouble shooting

When you suspect that a component is defective, do not replace it immediately. First check the surrounding equipment and carry out complete trouble shooting according to the trouble shooting chart. Make sure you know the reason for the fault before replacing a component.

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Data PLL, PSD

Designations

Truck designation

Table 1.1 Truck designations

Truck type	PLL	Low lifter
	PSD	Stacker
	PSL	Stacker
Load capacity	PLL 145	1450 kg
	PLL 180	1800 kg
	PLL 200	2000 kg
	PSD 125/160	1250 kg forks only. 1600 kg in total (800+800 kg)
	PSL 125	1250 kg

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Type designation

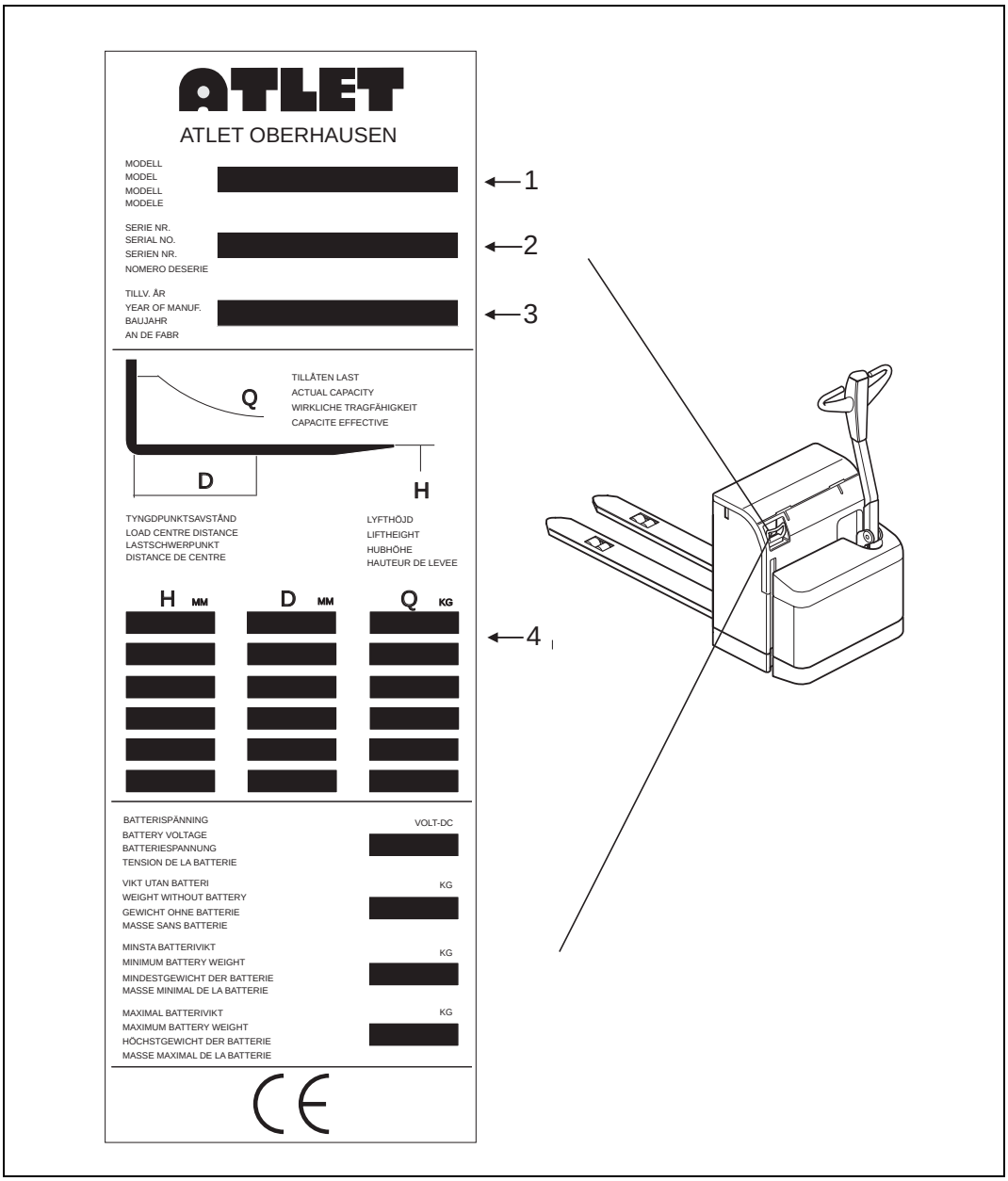

Figure 1.3 Example of type plate (–2006w36)

1. Model designation.
2. Type Series no/Version (S=Special ver.).
3. Year of manufacture, week, and warranty period in months (only Sweden). (On the assumption that the service instructions in the warranty regulations are followed).
4. Where appropriate load limitations depending on the position of the load on the forks (D) and/or lifting height (Q).

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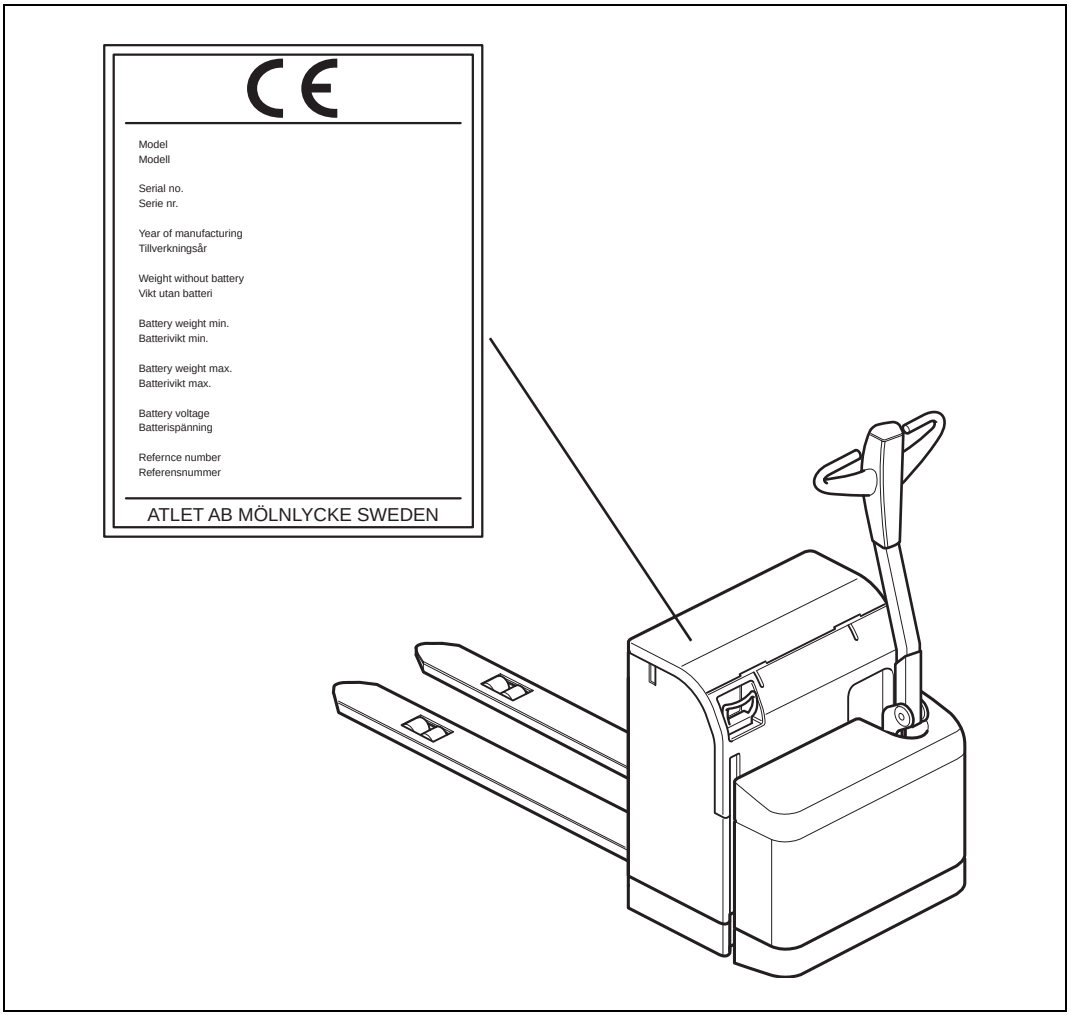

Figure 1.4 Example of type plate (2006w37–)

Explanation of Model designation

Example: **PSD 125 T 160 30**

Truck type
Load capacity/10
Mast type
Battery Ah/5
Charger Ampere

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Note!

In cases where the machine plate has been lost or become illegible, it must be renewed immediately. In order to identify the machine's serial number, there is a plate located on each main component such as drive motor, gearbox, hydraulic unit, TMC etc. For some machines there is even a plate attached inside the battery compartment, or serial number punched on the side of the mast.

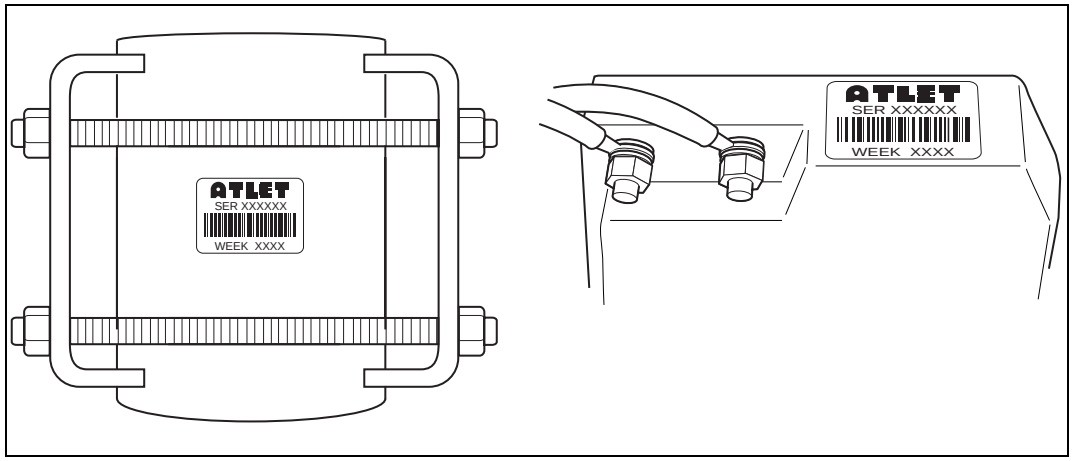

Figure 1.5 Example of plate with serial number.

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Dimensions and weights

Dimensions PLL PSD

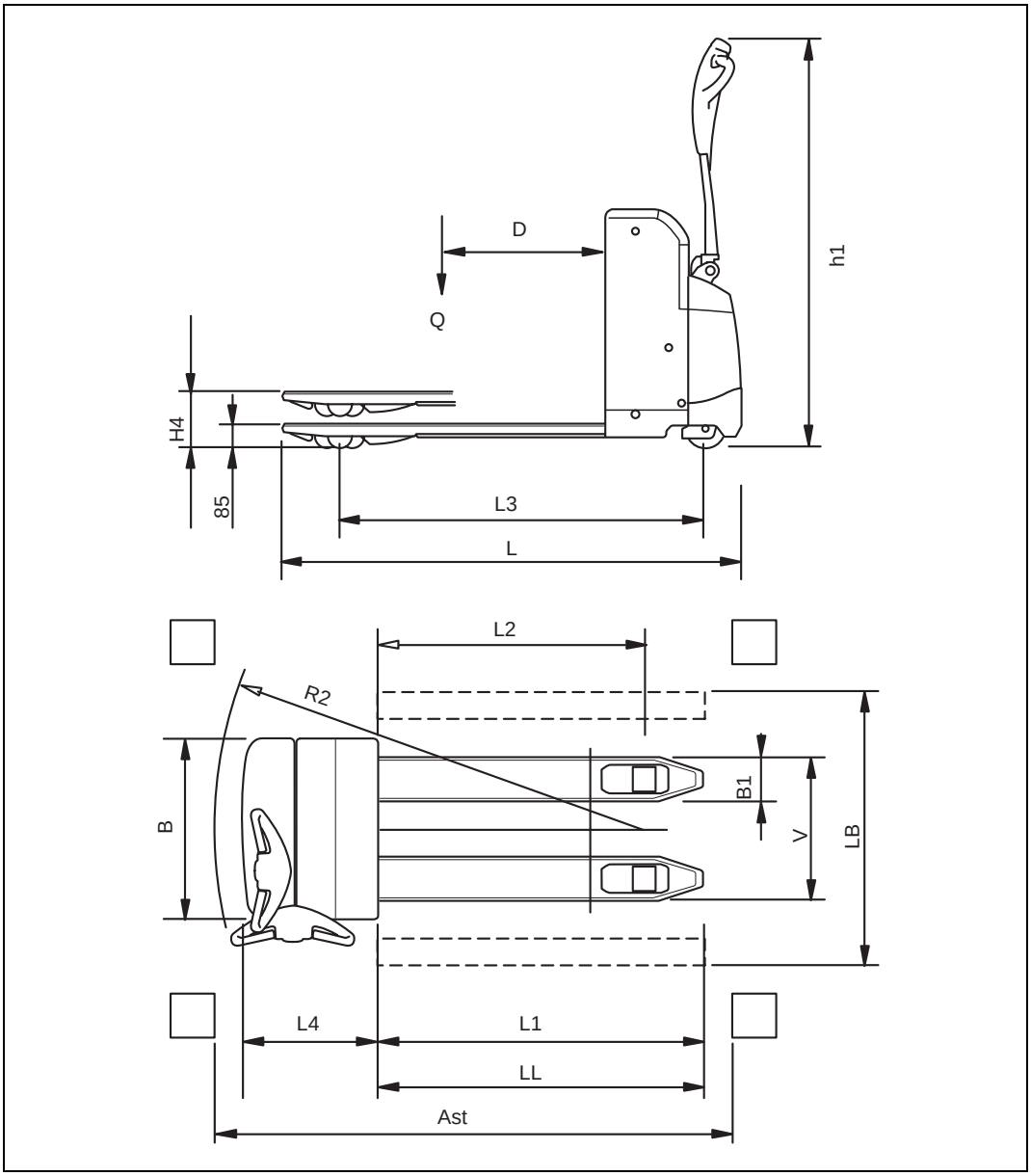

Figure 1.6 Positions for dimensions PLL

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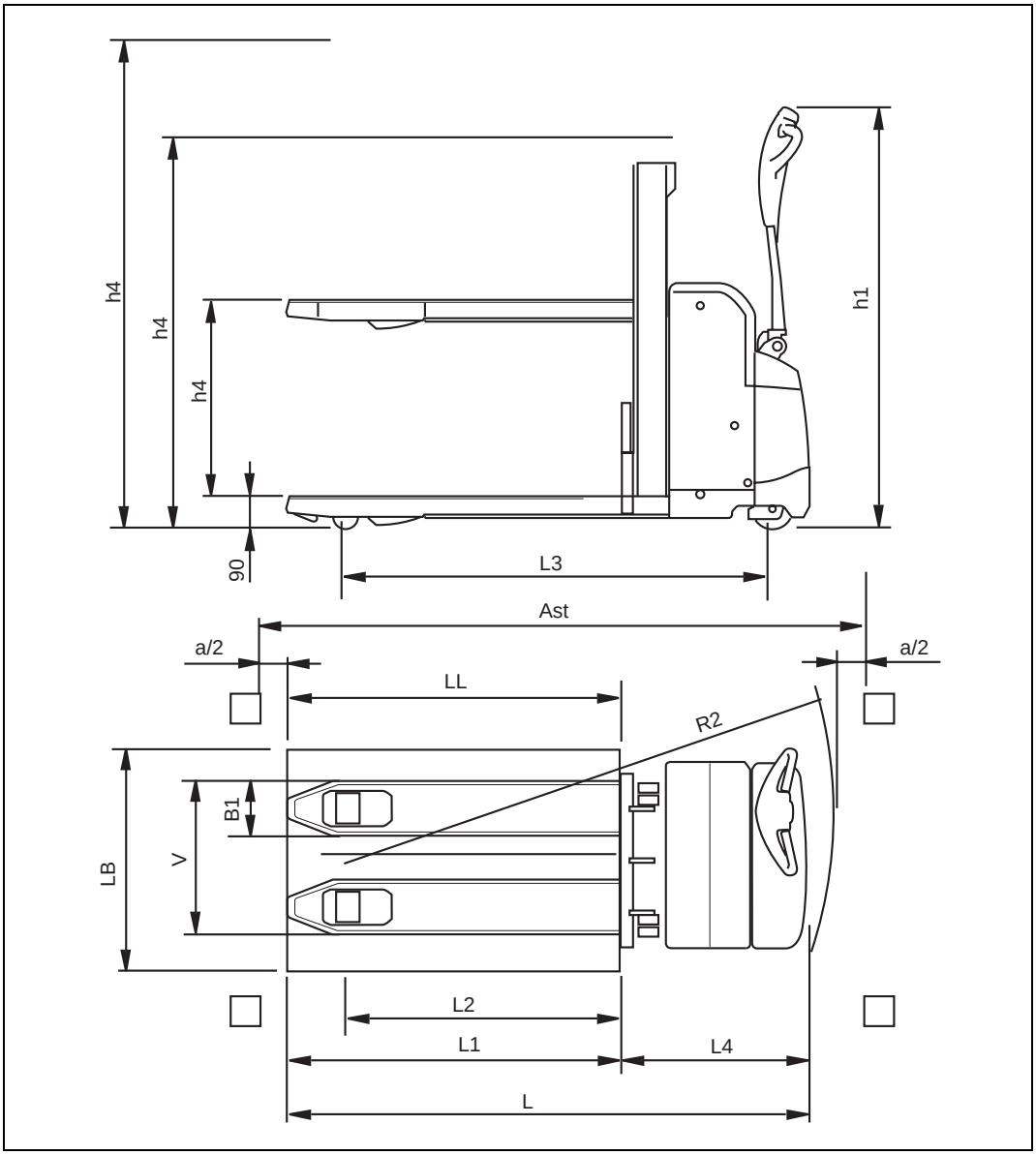

Figure 1.7 Positions for dimensions PSD

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Component specification

Table 1.2 Component specification

Component		Specification	
Drive motor		Drive voltage	24V
		Output standard	1 kW 45 min
		Insulation resistance	25 MΩ
Gearbox		Gear ratio (standard)	31,3:1
		Oil volume	0.8 litres
Hydraulic system	PLL 180/200	Max pressure	150-160 bar
		Oil volume	max 0.75 litres
	PLL 145	Max pressure	150-160 bar
		Oil volume	max 0.6 litres
Hydraulic unit (motor and pump)		Output	2.2 kW
Control system for drive motor		Type FZ2009	AC0 CAN
		Voltage	24 V
		Max current	150A (RMS) for 2 min
Fuses		Control fuse 1	7.5 A
		Pump motor fuse 1	80 A
		Drive motor fuse 1	100 A

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Recommended consumable materials

Oil and grease

Table 1.3 Table of recommended types of oil and grease

Brand	Gearbox oil As per API value GL-5		Hydraulic oil As per ISO VG 32, VG 15		Bearing grease NLGI 2 Lithium base
	Normal	Cold store	Normal (32)	Cold store (15)	
BP	BP Energear HYPO 80W140 EP	BP Energear SHX-S 75W/140 EPS	BP Bartran HV-32	BP Bartran SHF-S	Energrease LC 2
Castrol	-	-	Hyspin SHS 32	Hydraulic oil OM 15 Alt: Hyspin AWH 15	LMx
Mobil	-	-	DTE 13 M SHS 32	Flowrex 1	Mobilplex 48
Shell	-	-	Tellus oil TX 32	Tellus oil T 15	Retinax EP2
Statoil / Exxon	-	-	SHS 32	J 26	Uniway LIX 625
Texaco	-	-	Rando oil HDZ 32	Rando oil HDZ 15	Hytex EP2

Important!

Do not mix different lubricants, and absolutely not synthetic oil with mineral oil, since this can affect the properties of the oil!

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Standards and abbreviations

Screws

Tightening torque, screws and nuts

Table 1.4 Tightening torque, screws and nuts

DIM	Tensile grade			
	4,6	8,8	10,9	12,9
	Nm	Nm	Nm	Nm
M4	1,1	2,9	4,0	4,9
M5	2,2	5,7	8,1	9,7
M6	3,7	9,8	14	17
M8	8,9	24	33	40
M10	17	47	65	79
M12	30	81	114	136
M14	48	128	181	217
M16	74	197	277	333
M18	103	275	386	463
M20	144	385	541	649

The tightening torque in the table above are standard values. In some cases a specific tightening torque is specified in respective sections. If no tightening torque is specified in the service instructions, the values shown in the table above apply.

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Tightening torque, hydraulic couplings

Table 1.5 Tightening torque, hydraulic couplings

Tightening torque: Pipe thread / metric thread:			
Metric fine thread	**Whitworth pipe thread**	**MA (Nm) with**	**MA (Nm) with elastic (O-ring coupling)**
M10 x 1	G 1/8"	25	10
M12 x 1.5		30	20
M14 x 1.5	G 1/4"	50	30
M16 x 1.5	G 3/8"	80	35
M18 x 1.5		90	40
M20 x 1.5	G 1/2"	130	50
M22 x 1.5		150	60
M26 x 1.5		250	70
M27 x 1.5	G 3/4"	250	80
M27 x 2		250	90
	G 1"	350	140
M33 x 2		400	140
M42 x 2	G 11/4"	600	240
M48 x 2	G 11/2"	800	300

Conversion tables

Table 1.6 Conversion table, torque units

Newton metre (Nm)	Kilopond metre (kpm)	Poundforce inch (lbg x in)	Poundforce foot (lbf x ft)
1	0.10	8.85	0.74
9.81	1	86.80	7.23
0.11	0.01	1	0.08
1.36	0.14	12.00	1

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Table 1.7 Conversion table, pressure units

Pa (N/m^2)	Bar (1mb=1hPa)	at (kp/cm2)	dry (mm Hg, 0 C)	atm
1	10 -5	1.020*10 -5	7.501*10 -3	9.869*10 -6
9.807*10 4	0.9807	1	735.6	0.9678
133.3	1.333*10 -3	1.360*10 -3	1	1.316*10 -3
1.013*10 5	1.013	1.033	760	1

Table 1.8 Conversion table, speed

m/s	km/h
1	3.6
0.278	1

Standard abbreviations

Table 1.9 Standard abbreviations

Magnitude	Unit	Designation
Current	Ampere	A
Voltage	Volt	V
Resistance	Ohm	Ω
Output	Watt	W
Torque	Newton metre	Nm
Pressure	Pascal	Pa

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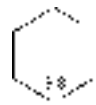
Screw types and tensile grades

Table 1.10

Figure	Screw type	Designation	Tensile grade
	M6S	Hexagon screw	8.8 10.9
	MC6S	Hexagon hole screw	8.8 10.9 12.9
	MF6S	Hexagon hole screw, countersunk	10.9
	MCS	Slotted screw	4.6
	MVBF	Oval head counter-sunk screw	4.6

Marking with the manufacturer's trademark, including the tensile grade, is compulsory for screws with a thread diameter from 5 mm and in tensile grades according to the table above. Marking only takes place when the shape of the product permits this.

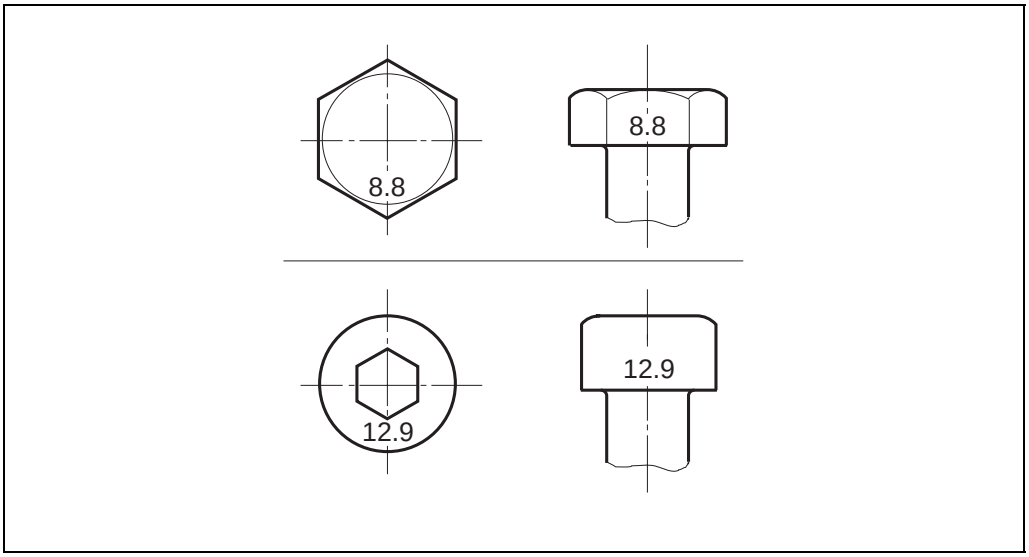


Figure 1.8 Example of marking

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Colour of the truck

The truck is painted in colours with the following NCS colour codes:

Table 1.11 NCS colour codes

Machine colour	Designation
Yellow	NCS 0070-Y20R
Medium grey	NCS 7000
Dark grey	NCS 8000

Colour codes, cabling

The colour markings of all cables included in the truck can be seen in the Atlet wiring diagrams. The abbreviations have the following significance:

Table 1.12 Colour codes Atlet wiring diagrams

Code	Cable colour
Y	Yellow
BL	Blue
SB	Black
W	White
GN	Green
GR	Grey
R	Red
BN	Brown
VO	Violet
P	Pink
OR	Orange

Note!

Two-colour cables are shown with both colour codes separated by a slash. E.g. blue/yellow cable is shown with colour code BL/Y.

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Designations

Electrical components normally have a designation of two letters:

Table 1.13 First letter

Code	Designation (Eng)
A	Component or function without its own letter below
C	Capacitor
D/V	Diode
E	Electrical component
F	Fuse
I	Indicator
K	Connector
L	Coil/inductive element
M	Motor
P/X	Connection
R	Resistor
S	Switch
T	Terminal
Y	Valve/brake
H	Audible warning unit/light
G	Battery

Table 1.14 Second letter

Code	Designation (Eng)
B	Brake
C	Control system
E	Emergency function
F	Forward
H	Hour
K	Key
L	Lowering
M	Manoeuvre
P	Pump
R	Reverse
S	Speed

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SERVICE MANUAL

Machine: PLL PSD PSL

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2 Special tools

Special tools PLL/PSD/PSL

Introduction

All special tools can be ordered from Atlet AB.

List of tools

Cleaning fluid

Table 2.1 Recommended cleaning fluid, electronics

Designation	Part number	Applications
Cleaning fluid	P/N 112268	Cleaning of electric motors from gearbox oil and other dirt

Chain spray

Table 2.2 Recommended chain spray

Designation	Part number	Applications
Chain spray	P/N 001196	Lubrication of chains

Crimping tool

Table 2.3 Crimping tool

Designation	Part number	Applications
Crimping tool Molex	P/N 006454	Cable connections
Pin extractor	P/N 006456	Cable connector

Lifting eye

Table 2.4 Lifting eye

Designation	Part number	Applications
Lifting eye	P/N 104737	Lifting eye for drive unit.

For detailed information on the above products, please contact Atlet.

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SERVICE MANUAL

Machine: *PLL PSD PSL PLE*

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3 Service

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3 Service

Regular maintenance

Introduction

Preventive maintenance should be carried out regularly for normal use of the truck. The planned service includes operations such as test driving, function tests, and changing of filters and oils etc. Service is planned at different intervals depending on the running time of the truck. If the truck is working in extreme conditions or in demanding environments, servicing can be planned at tighter intervals.

Safety

Important!

Check under each separate section which safety instructions are applicable for work on the truck.

Inspection of the external functions in the power steering system should be carried out after every service and after work carried out in the electrical system. All function tests of the safety system should be made with the speed controller in neutral position, see section 10.

Recommendation

Information on what the truck owner should take into consideration.

Regular inspection should be carried out by specially appointed and trained personnel with a good working knowledge of the function and maintenance of the truck.
To obtain the best results from your investment in your truck we advise you to contact your local Atlet representative and to sign up for a service contract for regular inspection.

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Daily inspection

(This section is an extract from the driver instructions.)

This section provides information on what the truck owner should take into consideration.

☞ ***Important!***

Naked flames or smoking are prohibited when checking the specific acid weight and level.

☞ ***Important!***

When changing or checking the battery use ergonomic work procedures to avoid injury.

This is the responsibility of the truck driver (before each shift).

1. The battery should be checked every day. See separate maintenance instruction. Note that the acid level rises somewhat during charging.
2. Check that the battery cables, connections and plugs are connected correctly and not damaged.
3. Check that the battery is properly secured in its compartment.
4. Check if the truck has leaked oil.
5. Check the transport and safety signals.
6. Check the braking effect on the main brake and parking brake.
7. Check for external damage on the wheels.
8. On trucks equipped with a truck computer, check that there are no error messages on the display.

☞ ***Important!***

NOTE! Faults detected during daily inspection are reported to the management. See driver instructions.

This is the responsibility of the truck driver (after each shift).

Battery charging

Battery service should only be carried out by specially trained personnel. This training is given on truck driver courses. Batteries may, however, be charged by other personnel on the assumption that the battery plug is used to connect the battery to the charging unit. The battery is charged in accordance with the recommendation from the battery manufacturer. Only fully automatic charging units should be used. If an unregulated charger is used the battery charging should be checked by measuring the specific acid weight in the cells.

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Important!

The specific acid weight should also be checked even when an automatic charger is used. For other information concerning batteries and fully automatic chargers, see the separate maintenance instructions on the battery and charger.

Important!

If the battery is charged in the truck, the top plastic hatch must be opened during charging. This is to avoid-explosive oxyhydrogen gas accumulating in the battery compartment.

Weekly inspection (30 hours of operation)

(This section is an extract from the driver instructions.)

Responsibility: Truck driver

1. The battery is cleaned externally with hot water and rags.
2. Check the oil level in the hydraulic system by pushing all the hydraulic cylinders to their end positions. Now check that the fork carriage goes all the way up to maximum lifting height without the pump sucking air.
3. Check that the wheels have not separated – tread/hub and tread/cord.
4. Check the specific acid weight. See separate battery maintenance instructions.
5. The outside of the truck should be cleaned. Vacuum clean, and wipe with moist cloth in the driver cab. Use care when using a water hose. Electric panels and circuit boards should always be protected from splashed water when washing.

First service

The first service should be carried out after 200 hours. This service has the purpose of ensuring the function of the truck and its component parts.

- Change the oil in the gearbox.
- Change the hydraulic oil filter.
- Test the function of the entire machine in accordance with the following list.

Main service

EN-1726 and ISO 3691 specify that regular preventive maintenance should be carried out on the truck. To guarantee high quality, operation reliability and personal safety, this maintenance should be carried out by Atlet Service or by personnel specially trained by Atlet. To comply with this requirement Atlet has prepared the following major service points, which should be checked every 500 hours of operation. These hours should be reduced if the working environment or application is hard e.g. Cold Store.

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- Check for external damage on chassis.
- Check of weld joints at vital points.
- Check of lifting devices.
- Check of component attachments.
- Function test, control lever.
- Check of the horn.
- Test drive backwards and forwards, and turning.
- Check of the drive unit.
- Check of all the wheels.
- Test of the brake function.
- Oil and filter change according to instructions.
- Check for oil leakage.
- Check of the hydraulic unit, pipes and hoses.
- Check of the cylinders.
- Function test, lifting and lowering.
- Lubrication in accordance with lubrication chart.
- Measurement and check of the battery and charging function.

Extra service inspections

What has been mentioned above is applicable on the assumption that the machine is working in normal conditions on single shifts. In dirty or dusty environments, poor floor conditions, or where there are large variations in temperatures, the service intervals must be arranged more frequently.

None of the above mentioned inspection can be debited to Atlet Products.

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Check list, service inspection

For further information about procedures for inspections, repairs and replacements refer to respective sections. Planned service inspections are implemented in accordance with the following points:

Chassis					
Inspection points	**Symptom**	**Inspection**	**B Service**	**A Service**	**Service code**
Signs/Decals	None, unreadable	Visual	X	X	1024, 1101
Panels	Attachment, damage	Visual, tools	X	X	1102, 1032
Load wheel, Castor wheel	Damage, wear	Visual	X	X	1108, 1109
	Noise	Listen, tool	X	X	
	Attachment	Visual, tools		X	
Rubber mats, Rubber protectors	Damage	Visual	X	X	1105, 1058
	Attachment	Visual, tools	X	X	
Chassis, general	Appearance	Visual		X	1001, 1033, 1112
	Damage	Visual		X	
	Loose screws	Tools	X	X	

Mast					
Inspection points	**Symptom**	**Inspection**	**B Service**	**A Service**	**Service code**
Push rods	Locking.	Tools	X	X	2105
	Damage	Visual	X	X	
Forks	Cracks, damage	Visual		X	2026
	Wear	Visual		X	
	Angle, deformation	Visual, tools		X	

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Mast					
Inspection points	**Symptom**	**Inspection**	**B Service**	**A Service**	**Service code**
Fork carriage*	Cracks, damage	Visual		X	2007, 2004
	Play, damage, wear on rollers	Visual, operating test		X	
	Angle, deformation	Visual	X	X	
	Attachment rollers	Visual, tools		X	
Mast profiles*	Cracks, damage	Visual		X	2101
	Wear, cracks	Visual	X	X	

*PSD

Drive unit					
Inspection points	**Symptom**	**Inspection**	**B Service**	**A Service**	**Service code**
Gearbox	Oil level	Visual, filling	X	X	3006, 3101, 3107
	Oil leakage	Visual, tools	X	X	
Drive motor	Function, noise	Listen, tool	X	X	7028, 7113, 7039, 7027, 7112
	Cable connections	Visual, tools	X	X	
Drive wheel	Noise	Listen, tool	X	X	3002, 3005
	Damage, wear	Visual	X	X	
	Attachment, play	Visual, tools	X	X	
Sliding bearing	Noise	Listen, lubricate	X	X	3103
Drive shaft	Noise	Listen, tool	X	X	3104
Gear	Noise	Listen, tool	X	X	3102, 3106

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Steering					
Inspection points	**Symptom**	**Inspection**	**B Service**	**A Service**	**Service code**
Guide bearing	Noise	Listen, lubricate	X	X	4101
Control arm attachment	Play	Visual		X	4103
	Attachment	Tools	X	X	

Brake					
Inspection points	**Symptom**	**Inspection**	**B Service**	**A Service**	**Service code**
Braking force	Malfunction	Function test, tools	X	X	5012
Parking brake	Malfunction	Function test, tools	X	X	5014
Brake cable	Abrasion	Visual	X	X	5002
Brake disc	Wear	Visual, tools	X	X	5104

Hydraulic system					
Inspection points	**Symptom**	**Inspection**	**B Service**	**A Service**	**Service code**
Hydraulic tank	Oil level	Visual, filling	X	X	6012, 6102
	Damage, leakage contamination	Visual, cleaning	X	X	
	Filter blocked	Visual, replace		X	
Cylinders	Function	Function test, stopwatch		X	6001, 6017
	Damage	Visual, replace	X	X	
	Leakage	Visual, tools, replace	X	X	
	Weld damage	Visual, tools, replace		X	
	Damage, chain attachments	Visual, tools	X	X	

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Hydraulic system					
Inspection points	**Symptom**	**Inspection**	**B Service**	**A Service**	**Service code**
Hoses	Leakage, damage	Visual, tools	X	X	6007, 6008
	Attachment	Visual, tools	X	X	
Nipples	Leakage	Visual, tools	X	X	6019
Pump motor	Function, noise	Listen, tool	X	X	7030, 7029
	Cable connections	Visual, tools		X	
Hydraulic pump	Leakage	Visual, tools	X	X	6109
	Damage	Visual, tools		X	
	Noise	Listen	X	X	
Overcurrent valve	Malfunction	Test	X	X	6105
	Leakage	Visual, tools		X	
Solenoid valve	Malfunction	Test	X	X	6018
	Leakage	Visual, tools		X	
Prop. valve	Malfunction	Test	X	X	6018
	Leakage	Visual, tools		X	

For more information regarding the hydraulic system, also see section 8 and lift cylinders section 9.

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Electrical system					
Inspection points	**Symptom**	**Inspection**	**B Service**	**A Service**	**Service code**
Contactors	Malfunction	Visual, tools, replace	X	X	7107
	Cable break	Visual, tools	X	X	
	Contactor tip	Visual, tools	X	X	
Battery	Charging	Tools	X	X	7032
	Low acid level	Tools	X	X	
	Low acid weight	Tools	X	X	
	Damage	Visual	X	X	
Transistor system AC	Cable break	Visual, tools	X	X	7025
Cabling	Damage, break	Visual, tools	X	X	7007, 7009 7010, 7039 7104, 7112
Horn	Malfunction	Function test	X	X	7014
Speed con-troller	Attachment	Visual, tools		X	7011, 7106
	Malfunction	Function test	X	X	
		Calibration	X	X	
Fuses	Blown	Visual, replace	X	X	7103
Battery plug	Malfunction	Function test, tools		X	7008
Hour meter	Malfunction		X	X	7012
Battery indicator	Malfunction		X	X	7013
Safety switch	Emergency stop	Malfunction	X	X	7020
Microswitch	Function	Function test		X	7017

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Electrical system					
Inspection points	**Symptom**	**Inspection**	**B Service**	**A Service**	**Service code**
ATC T4	Function Cable connections	Visual	X	X	7004

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Code explanation

Chassis			
Code	**Designation**	**Check**	**Reference to section**
1001	Machine housing	Cracks in weld joints, collision damage, tightening of screws/attachments.	1
1024	Machine name-plate	Attachment: text should correspond with machine type, and symbols and warning decals should be fitted.	1
1032	Panels	Attached with screws and clips, as well as bonded parts.	4
1033	Colour	Peeling of paint and attachment/lack of decals.	1
1042	Load guard	Cracks in weld joints, collision damage, tightening of screws/attachments.	1
1058	Rubber strips	Attached with glue or screws/weld bolts	-
1101	Decals	Damage	-
1102	Chassis, covers	Damage, battery cover	4
1108 1109	Load wheel bearing Castor wheel bearing	The operation is frictionless, remove any string, plastic bands etc. that have stuck. Vulkollan wheel wear. Dirt.	4 6
1112	Accessories	User Manual, areometer and battery water bottle.	-

Mast			
Code	**Designation**	**Check**	**Reference to section**
2004	Frame section	Attachment of the mast in machine housing.	1
2007	Rollers in fork carriage	Washers. Lubrication of roller surfaces.	1 6
2026	Forks	Cracks, damage, parallelism, height over floor.	6
2101	Mast play	Check max play, Cams. Lubricate slide surfaces.	6
2102	Lift chains	Check wear.	4
2105	Push rods / Pull rods	Locking, damage	6

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Drive unit			
Code	**Designation**	**Check**	**Reference to section**
3002	Drive wheel	Wear, damage, clean	5
3005	Drive wheel bolt	Attachment.	5
3006	Oil leakage	Leakage from axles, joints, plugs or material.	5
3101	Oil level	Oil level. Oil change.	1 5
3102	Noise	Gears.	5
3103	Sliding bearing	Noise, lubrication	5
3104	Drive shaft	Tightening, play	5
3106	Gears	Gear ratio	5
3107	Gear housing	Check wear.	5

Steering			
Code	**Designation**	**Check**	**Reference to section**
4103	Control arm attach-ment	Play, bushings, attachment	7
4104	Guide bearing	Play, lubrication	1 7

Brake unit			
Code	**Designation**	**Check**	**Reference to section**
5002	Brake cable	Attachment, damage	11
5012	Braking force	Braking distance	11
5014	Parking brake	Function, cable connections	11
5104	Brake discs	Friction surface> min level all round	11

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Hydraulic system			
Code	**Designation**	**Check**	**Reference to section**
6001	Lift cylinders	Leakage by attachments, weld joints, scraper, piston rod	9
6007	Couplings	Leakage.	-
6008	Hoses	Cracks, wear, damage	1
6012	Oil level in tank	Oil level between min and max	1 8
6017	Lowering	Check lowering speed	8
6018	Solenoid valve	Leakage in slide, connections, tightening	-
6019	Nipples	Leakage. Tightening.	-
6102	Filter	Replace if necessary	8
6105	Overflow valve	Function, adjustment as per max lifting capacity. Locking.	8
6109	Hydraulic pump	Leakage between pump and motor	-

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Electrical system			
Code	**Designation**	**Check**	**Reference to section**
7007	Battery cables	Attachment, damage	-
7008	Battery connections	That cable connections are not overheating. Remove oxide.	-
7009	Main power cable	Attachment, damage	-
7010	Control cable	Attachment, damage	-
7011	Speed controller	Function.	-
7014	Horn	Function. Oxide deposits.	-
7017	Microswitch	Function. Attachment.	-
7020	Emergency switch	Function.	-
7025	Transistor system	Dirt, moisture. Cable connections, oxide.	-
7029	Pump motor carbon brushes	Wear	8
7030	Pump motor	Attachment. Cleaning.	5
7032	Battery	Acid level, charging. Note: read-off from hydrometer, clean if necessary.	-
7035	Speed switch	Switches in gates and platform that control creep speed. Attachment.	10
7103	Fuses	That they are not brittle, oxidised.	1
7104	Cabling	Cable connections, attachment, run free from sharp edges. Insulation.	-
7106	Speed controller	Attachment and function.	11
7107	Contactors	Contact surfaces, cable connections, dust guard.	-
7112 7039	Drive motor cables	Attachment, damage, insulation, oxidation.	-
7113	Housing drive motor	Noise, grease, play.	5
7004	Truck computer	Error log	10

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Specific instructions

Specific instructions for storage of machines for periods longer than one month.

Storage of machines and motors

Machines in storage that will not to be used within a month, must be given special attention so that problems do not occur when they are to be used again. Dust, dirt, condensation and moisture caused by large changes in temperature and problems with rust and oxidisation must be prevented. Motors should therefore be protected with waxed paper or the like, and a moisture absorbing material.

Drive motor

Preventive maintenance

Preventive maintenance is implemented in accordance with the recommended intervals in the service chart.

In some cases, however, exceptions must be made and the intervals shortened in relation to the conditions at customer, e.g. a severe environment with dust, high humidity levels, or salt, etc.

- Listen for noise from the bearings when the motor is run. Check that it does not vibrate abnormally.
- The motor is blown clean with dry compressed air, or cleaned with a vacuum cleaner. A cleaning fluid should be used to drive out oil and dirt, if oil has leaked from the gearbox into the motor.
- Check the insulation resistance for the motore, see specification in section 1 for correect value.

Gearbox

First service

First oil change after 200 h

- The first oil change should be made after approx. 200 hours.
- Use a recommended type of oil, see section 1.

Preventive maintenance

Oil level checked during each service

- The oil level is checked during each service.
- The steering bearing must be greased at least once a year. New greasing is essential if steam cleaning or high pressure washing has been carried out.

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Note!

Remember to fill up the gearbox after changing the oil or changing the gearbox. See section 5 for proceedure.

Note!

Spent oil should be taken care of and recycled according to the applicable legislation in respective countries.

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Lift chains and forks

Check

Forks and lifting chains should be checked during each service

For safety reasons the forks and all lifting chains should be checked during each service.

If a lifting chain fails to be approved in any respect, the complete chain must be replaced and it is not permitted to replace single parts of a lifting chain.

Important!

If the lifting chain is not up to standard at any point, the complete chain must be replaced.

See section 6 for instructions concerning checking of chains and forks.

Regular maintenance

The chain should be kept clean.

Lubricant (see "Check list, service inspection" on page 3.7) must be regularly applied on the chain so that all the working surfaces are constantly lubricated.

The chain should be kept in motion when lubricating to ensure that the lubricant penetrates the working surfaces between the link plates and pins. All excess lubricant should wiped off, but solvent must not be used.

If the chain runs dry it should be lubricated more often, and this also applies if the truck is working in special environments such as cold stores, etc.

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Hydraulic oil

First service

Hydraulic oil filer change after 500 h

- Oil filters should be changed after 500 hours.

Intervals

After 500 hours of operation: The hydraulic oil filter and air filter to the hydraulic oil tank should be changed after no more than 500 hours of operation. This refers to those types of trucks that have replaceable filters. Clean the suction filter.

After every 1000 hours of operation: Change the hydraulic oil, oil filter and air filter after 1000 hours of operation, or once every year (which ever comes is first).

If the hydraulic oil has been heated over 60 degrees Celsius the oil and the filter should be immediately changed since its lubricating properties will have been altered.

If the hydraulic oil has been contaminated with water (e.g. from cold store) this can be detected in that the oil becomes milky, or smells bad.

It can also be checked with the following simple test:

1. Use protective glasses, gloves and clothes, and observe the fire instructions for the premises.

⚠ ***Warning!***

Risk for burn injuries on the skin.

2. Take a little hydraulic oil in a teaspoon and heat the spoon with a cigarette lighter – if there is a crackling sound this proves that it contains water and should be changed.

The hydraulic oil should be filtered when filling, by pouring the oil through the filter.

Recommended replacement

Hydraulic hoses should be replaced after 5 years, since the rubber in the hose is perishable.

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SERVICE MANUAL

Machine: *PLL/PSD/ PSL/PLE*

Manual No: *119000*

Edition 2006B

4 Chassis

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Scope 4.3
Machine housing 4.3
Covers and panels 4.3
Castor wheel 4.4

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Dismantling of panels 4.5
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Replacing the castor wheel/bearing 4.6
Battery 4.8
Changing the battery 4.8

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4 Chassis

Design and function

Scope

A chassis normally includes the supporting parts of a construction and in the case of a truck the chassis consists of the machine housing, panels and castor wheel.

The straddle legs and load wheel could be considered to be part of the chassis, but since they are part of the mast the instructions for these are to be found in chapter 6, Mast, instead.

Machine housing

The chassis on the PLL and PSD trucks consists of a machine housing. This is where all the truck components, such as the mast, drive unit, and hydraulic system are mounted.

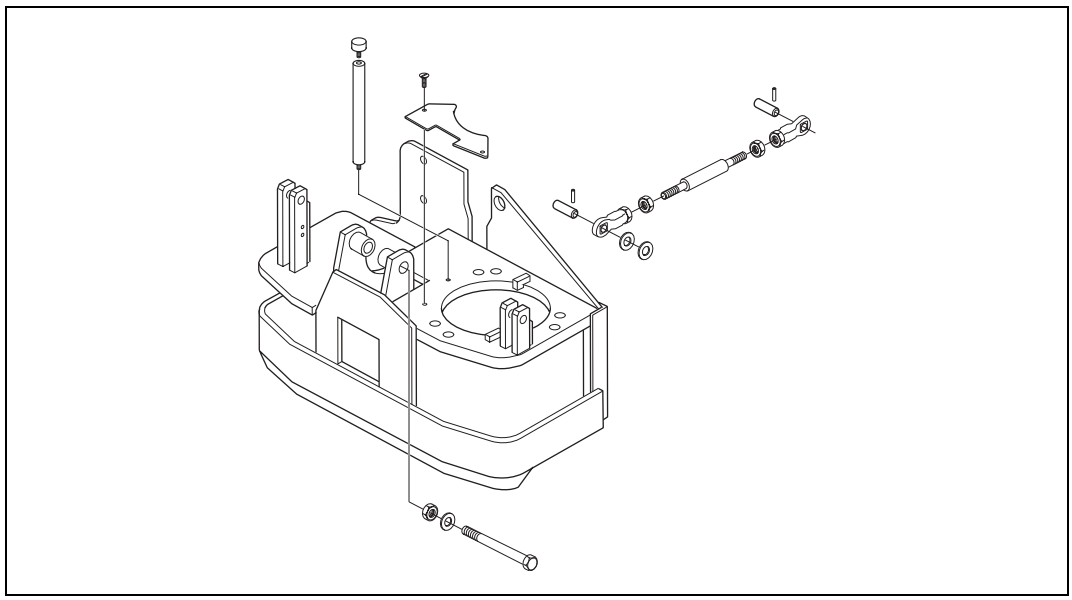

Figure 4.1 Machine housing PLL/PSD

Covers and panels

The function of the panels is to protect the driver from moving parts, electrical components, oils and fluids, and to protect the components inside from external damage and dirtying.

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Castor wheel

The castor wheel functions as a support wheel, since the drive wheel is mounted asymmetrically on one side of the truck.

The castor wheel is a completely separate and free-turning wheel placed under the machine housing. It consists of a wheel mounted in a wheel fork. The castor wheel is spring-mounted to ensure good contact with the floor and to reduce the noise.

Shims are mounted between the castor wheel attachment plate and the machine housing to compensate for differences in the diameter of the drive wheel and castor wheel.

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Repair instructions

Covers and panels

The recyclable panels are manufactured of durable plastic.

Dismantling of panels

- Remove the panels with an Allen key, size 5.
- Clean the panels with soapy water.
- White impact marks may appear after minor damage. These can be removed by carefully heating with a hot air gun.

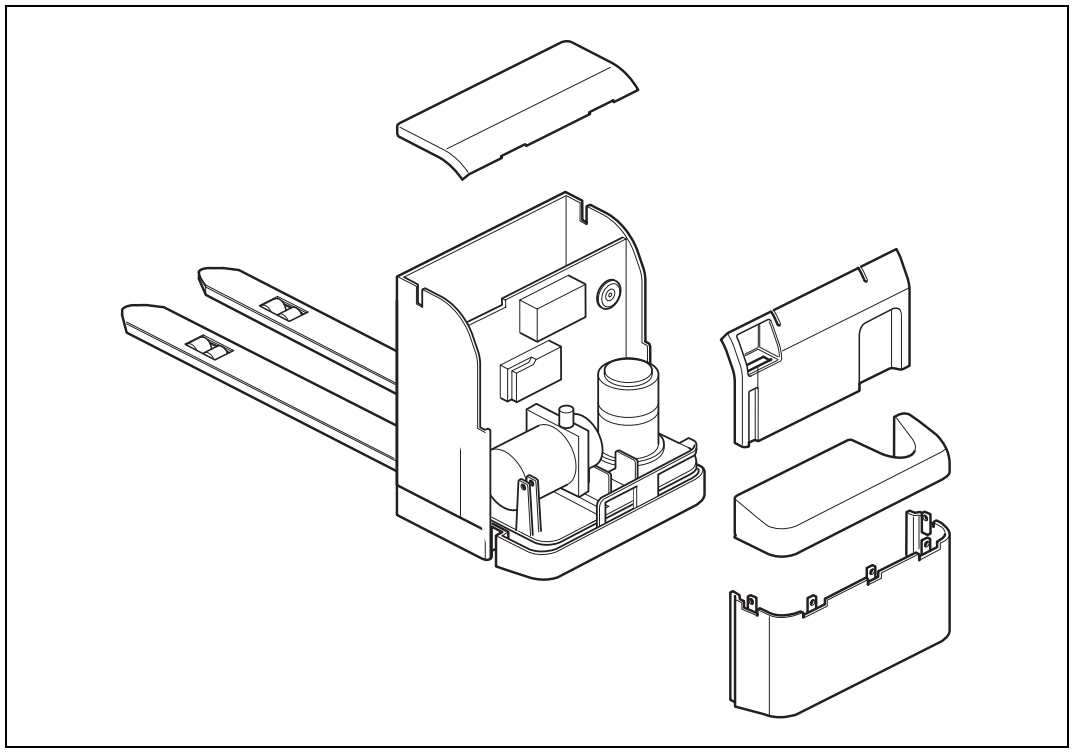

Figure 4.2 Covers

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Castor wheel

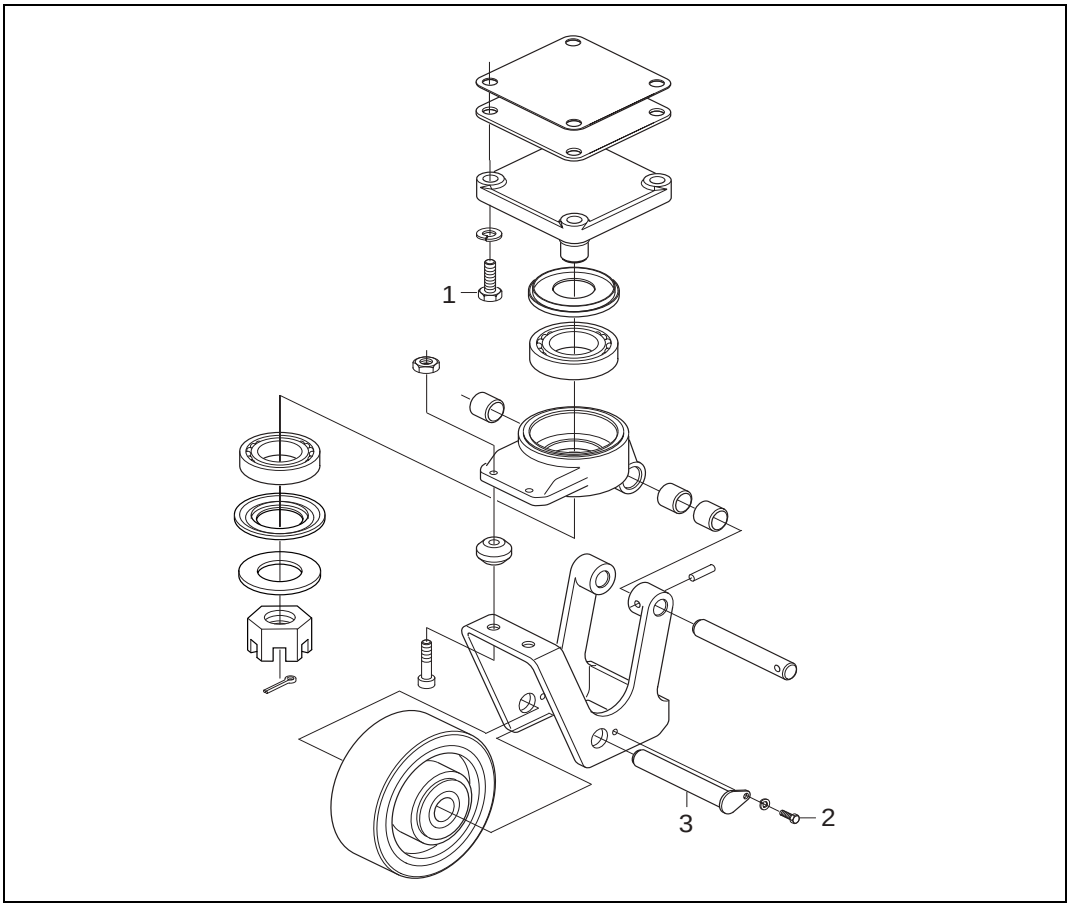

Figure 4.3 Castor wheel PLL/PSD

Replacing the castor wheel/bearing

Dismantling

- Remove the plastic cover from the machine housing.
- Lift up the machine housing approx. 30 cm, and secure with blocks underneath.
- Loosen the bolts, pos. 1 figure4.3.
- Take out the castor wheel unit and support the fork in a vice.
- Loosen the bolt, pos. 2, and drive out the wheel axle, pos. 3, so that the wheel can be removed from the fork.

Note!

Reuse spacers, shims.

- Support the wheel in the vice.
- Pull out the bearings with a bearing extractor.

Assembly

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- Lubricate the wheel bearing seats with grease, and press in the bearings with a suitable drift.
- Place the wheel fork with the side facing down.
- Hold the wheel and spacers together, and insert the wheel in the fork.
- Fit the wheel axle, pos. 3.
- Fit the bolts, pos. 2.
- Lift up the complete castor wheel under the machine housing. Fit the screws, pos 1.

Note!

Check the positioning to make sure the grease cup comes in the right direction.

- Tighten to the correct torque.
- Refit the covers and lower down the machine to the floor.

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Battery

Changing the battery

Work in an area where the old battery can be removed without risk to the environment from battery acid. Wear acidproof gloves and clothes, plus acidproof glasses, to provide protection from burn injuries.

1. Separate the battery plug.

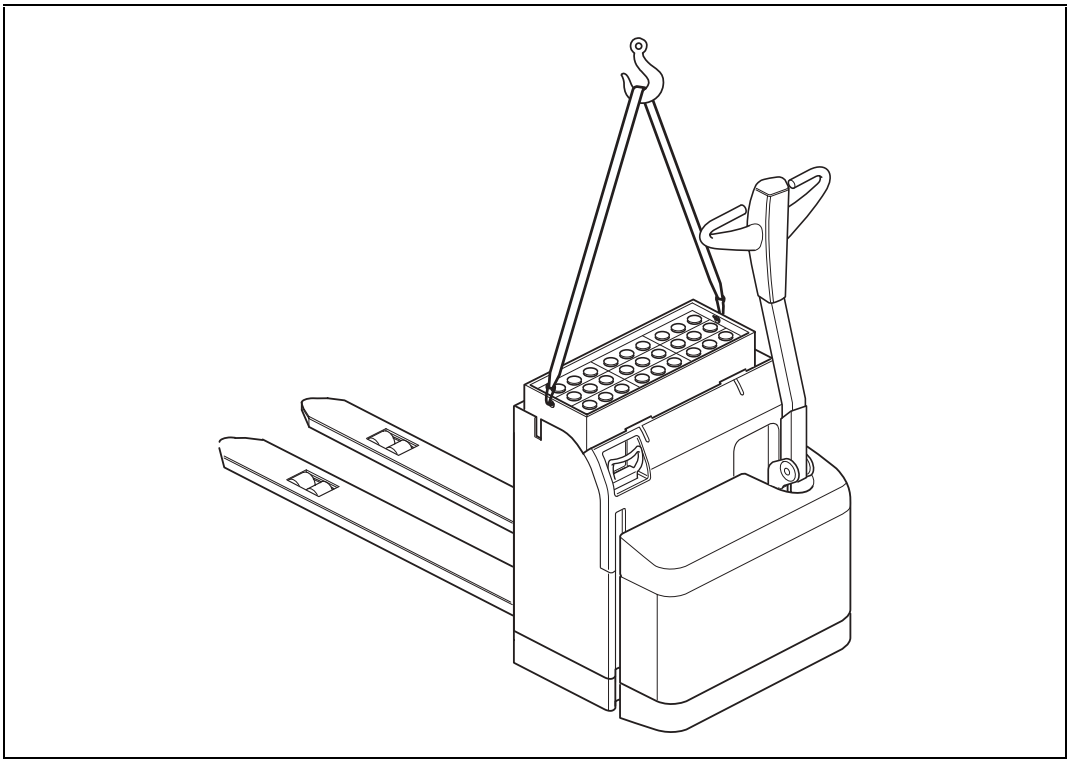

Figure 4.4 *Illustration of changing the battery*

2. Open the battery cover.
3. Attach the lifting device in the lifting eyes.
4. Lift the battery and set it to one side.

Warning!

Observe care to avoid “splashing” waste acid or oxide from the battery.

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SERVICE MANUAL

Machine: *PLL PSD PSL PLE*

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Drive motor 5.3
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5 Drive unit

Design and function

Introduction

The drive unit is mounted in an assembly containing the brakes, drive motor, gearbox and drive wheel.

For technical data regarding component parts, see section 1.

Drive motor

The drive motor on PLL and PSD is a three-phase induction motor. A pulse transducer is enclosed in the bearing on the non-driving end of the motor and this provides speed return to the motor controller, see section 10.

The motor is mounted directly on the gearbox and the transmission of power take place via individually adjusted gear wheels.

Gearbox

The gearbox is designed to produce the best gear ratio over the speed range of the drive motor.

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Repair instructions

Preparations

1. Switch off the power.
2. Remove the panels on the machine housing, see section 4.

Drive motor

The drive motor is mounted on the top of the inner ring in the guide bearing, with a total of four screws. These screws go from the top of the motor through the drive motor housing.

During all maintenance work on the bearing block it is important to observe care during assembly and dismantling to avoid damaging the bearing and shaft seal. Special attention should also be paid to the gear wheel, since damage to this can result in abnormal noise.

Motor screws

Since the motor screws (marked with X in the figure) are secured with Loctite the recommended tool to loosen the screws is a hexagon key with guide point according to DIN 6911.

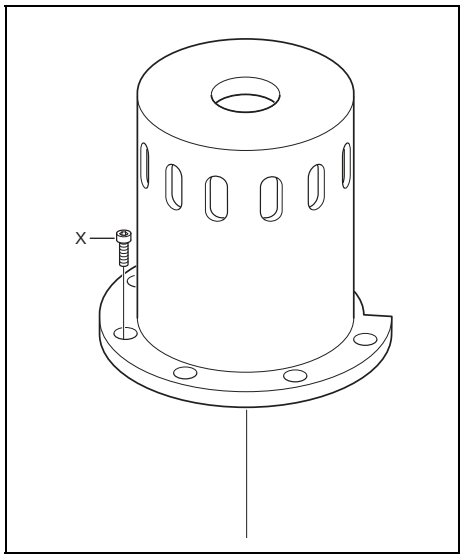

Figure 5.1 Motor screws (M8x35mm / DIN 6912).

Assembly of the transducer bearing

When fitting the transducer bearing in the upper housing on the motor it is very important that it is pressed into place. The transducer bearing must not be exposed to any form of shock loads. It is also important that the pressure is applied directly on the outer bearing ring. No pressure must be applied on the inner bearing ring.

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Important!

The transducer bearing must not be exposed to any form of shock loads.

Once the transducer bearing is in position in the upper housing it is secured with its lock ring and the extra protective ring, and with the screws and underlying lock rings.

After fitting the transducer bearing the rotor shaft is pressed into the inner bearing ring. It is important not to expose the outer bearing ring to pressure, and this is achieved in that the inner bearing ring receives counter pressure during the pressing.

The assembly of the rotor shaft is complete when the unit is fixed by the circlip in its groove.

Assembly of ball bearing and shaft seal in the guide bearing inner ring/gear box upper housing

The ball bearing is pressed in place in inner ring on the guide bearing. The pressure must be applied on the outer bearing ring to avoid damaging the balls and ball races. The bearing is secured by fitting the circlip in its groove. The shaft seal can now be fitted.

When assembling the complete motor on the gearbox the inner ring on the guide bearing and the inner surface shaft seal should be protected with grease to avoid damage, especially on the sealing surface.

Housing drive motor

Machines in storage that will not to be used within a month, must be given special attention so that problems do not occur when they are to be used again. Dust, dirt, condensation and moisture caused by large changes in temperature and problems with rust and oxidisation must be prevented. Motors should therefore be protected with waxed paper or the like, and a moisture absorbing material.

Gearbox

Service work on the gearbox is limited to changing the studs on the wheel and changing the lower shaft seal.

Changing the wheel studs

After removing the stud that is to be changed the threads on the new stud and the threads in the hole should be cleaned from oil and grease. The threads should be treated with Loctite 270 or the equivalent before the new stud is screwed in. The stud is tightened with a torque of 25Nm.

Service and fitting of the lower shaft seal on the gearbox

The shaft seal can be removed after removing the protective disc.

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The seal seat in the casing and the surface to which the seal is to seal should be cleaned before fitting a new seal. The seal should also be greased before it is fitted. The protective disc is replaced after fitting the shaft seal.

Checking the oil level and filling up with oil

Oil is poured in through the upper filler screw hole. The correct level is at the lower edge of the hole.

The oil level should be regularly checked to avoid damage to the gearbox.

Oil change

The oil is drained out through the lower oil plug hole. The oil can be drained more easily if it is warm.

Spent oil should be taken care of and recycled according to the applicable legislation in respective countries.

Before screwing in the oil plug again it should be cleaned.

Drive wheel

Replacing the drive wheel

1. Lift up the truck so that the drive wheel can rotate freely.
2. Release the battery plug.
3. Turn the drive wheel 45°.

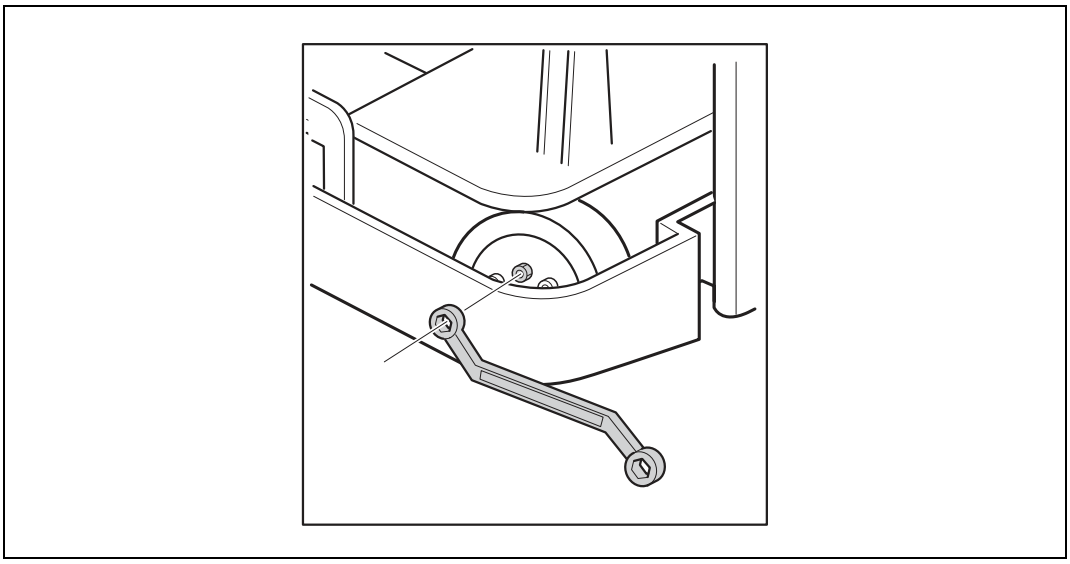

Figure 5.2 Loosen the nuts on the drive wheel.

4. Loosen the wheel nuts.
5. Replace the drive wheel.

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6. Tighten the wheel nuts.
7. Start the truck and test drive in both directions. The wheel must not catch or jam.

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Diagnostics and trouble shooting

Trouble shooting chart

Symptom	Cause	Action
The wheel has a flapping sound when driving.	The tyre has separated due to impact.	1. Change the wheel. 2. Examine the floor for any irregularities.
The wheel squeaks continuously when driving.	Bearing is damaged.	1. Replace bearing. 2. Inform the driver that cords and plastic etc. should be removed daily and the floor kept clean.
The wheel is flat after long breaks, but becomes round after driving for a while.	The wheel mass has become warm while driving and deforms when parked.	Try a different type of wheel.
The wheel has a deformity that does not disappear when driving.	A “blow out” has taken place due to overheating and changed the molecular structure of the wheel mass.	Change the wheel.
The truck feels jerky when driving.	Hard foreign object has fastened in the drive wheel.	1. Remove the object or change the wheel. 2. See also items above.
The truck jumps at regular intervals, proportional to the speed, when driving.	The wheel is oval.	1. Change the wheel. 2. Check/adjust the brake. 3. See also items above.
The wheel has transverse cracks and small bits have fallen out of the tyre.	The wheel has been heated. Small cracks appear with hard acceleration and reversing.	1. Lower the acceleration and reversing rate. 2. Change the wheel if necessary.
The wheel has one or more small deformations.	Locking of the brakes so that the wheel slides, or loose objects on the floor that prevent the wheel from rotating.	1. Remove objects on the floor. 2. Tell the driver to brake more smoothly.
Oil on the floor.	Leaking seal around the drive axle.	• Replace seal or: • if there are cracks in the casting the gearbox must be replaced.

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Symptom	Cause	Action
Grating noise when accelerating or using the reversing brake.	1. Defective gear wheel in the drive unit.	Check the cogs by removing the cover.
	2. Too little oil in the gearbox.	If there are cracks in the casting the gearbox must be replaced.
Grating noise when the truck is lifted up and the drive wheel can rotate freely and the motor rotates.	Faulty bearing in the drive motor.	Dismantle and renovate the drive motor.
The truck rolls "sluggishly".	1. The brakes are applied.	• Replace brake disc. If this does not help: • replace the complete brake unit.
	2. The drive unit has seized.	If there are cracks in the casting the gearbox must be replaced.
Clicking sound when driving.	Faulty wheel bearing.	Change the wheel.
Clicking sound when driving.	Loose wheel.	• Tighten the wheel. If this does not help: • change the wheel.

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6 Mast system

Design and function

Mast system

The truck variants in the P series have the following fork/mast alternatives:

- PLL: Low-lifting forks
- PSD: Mast

Fork carriage

Different fork arrangements are mounted on the back of the fork carriage.

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Repair instructions

Replacing the mast

Dismantling and assembling the masts, general

The following is generally applicable for all types of masts when dismantling:

- Stand in an area with adequate ceiling height and with approved lifting devices.

The following is generally applicable for all types of masts when assembling:

- The mast is assembled in the reverse order to dismantling.

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Fork carriage, general

Dismantling the fork carriage

1. Lower down the fork carriage on a Euro pallet, or the like.
2. Remove the lift chains.
3. Lift up the inner mast with truck’s standard hydraulic system until the fork carriage is released.

☞ ***Important!***

Observe great caution!

4. Reverse the truck away.

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Diagnostics and trouble shooting

Trouble shooting chart

Table 6.1 Symptom/Action table

Symptom	Possible reason	Action
Play on mast.	Mast rollers not shimmed enough.	Re-shim.
The mast lowers unevenly, jumps.	Mast rollers shimmed too tight.	Re-shim.
	No grease on the mast roller surfaces.	Grease roller surfaces.
The mast squeaks.	No grease on the mast roller surfaces.	Grease roller surfaces.

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7 Steering

Design and function

General

The steering movement is transferred mechanically from the tiller arm directly to the drive unit.

Steering

The truck is steered by turning the complete tiller arm, which directly affects the angle of the drive wheel. There is a switch in the arm, which by means of switching off the current and actuating the brake causes the truck to stop when the arm is in its upper and lower end positions. It is therefore only possible to drive the truck when the arm is between these end positions. There is also a belly switch, which stops the truck when pushed in. The purpose of the belly switch it to prevent the operator being crushed between the truck and other objects.

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Repair instructions

Cleaning

The tiller arm and tiller head are cleaned with compressed air, or by vacuum cleaning. The covers can be cleaned with lukewarm water and a mild soap solution.

Note!

High pressure washing must not be used.

Tiller head (–2007w27)

Replacing

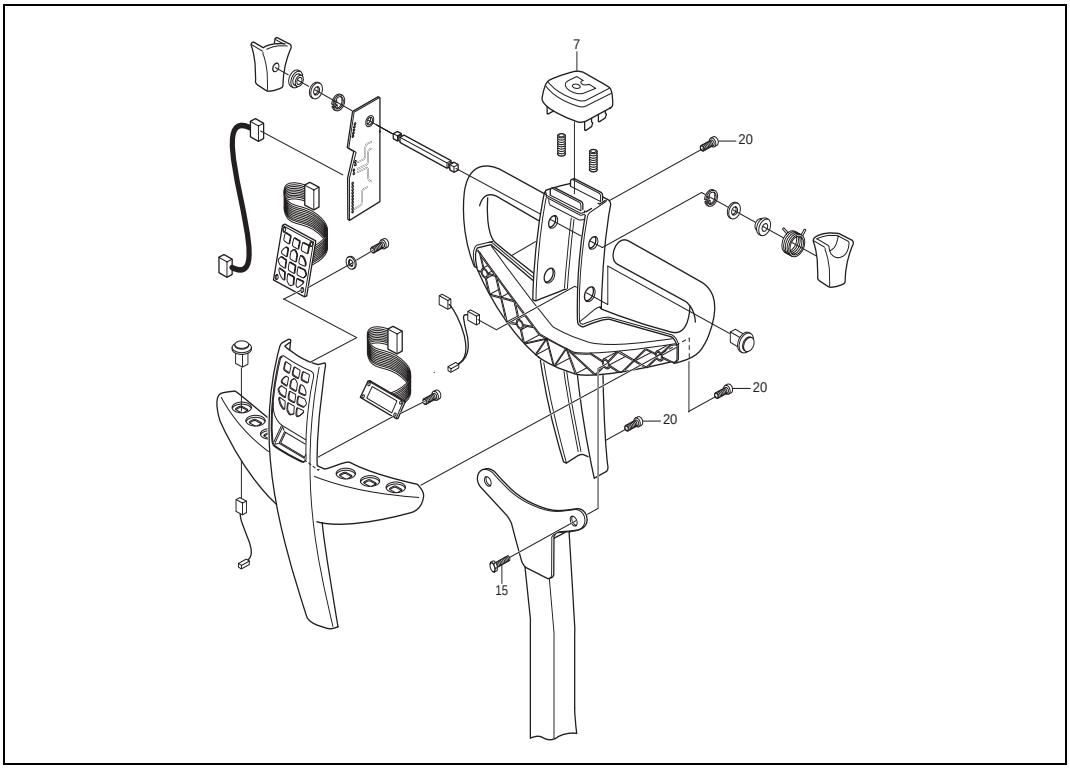

Figure 7.1 Tiller head

1. Loosen the three screws, pos. 20 see Figure 7.1, that secure the upper cover.
2. Press in the belly switch, pos. 7 see Figure 7.1, and release the cover by carefully pushing it upwards and outwards.
3. Loosen the two screws. pos. 15 see Figure 7.1.
4. Loosen the requisite connectors to replace the head.
5. Assemble in the reverse order.

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Tiller arm head (2007w28–)

Dismantling the tiller arm head

1. Undo the screws that hold the upper and lower cover together.
2. Release the snap on clip (A) at the front of the tiller arm head.
3. Carefully lift up the front section of the upper cover, shown by arrow B. Now move the upper cover backwards, see arrow C.

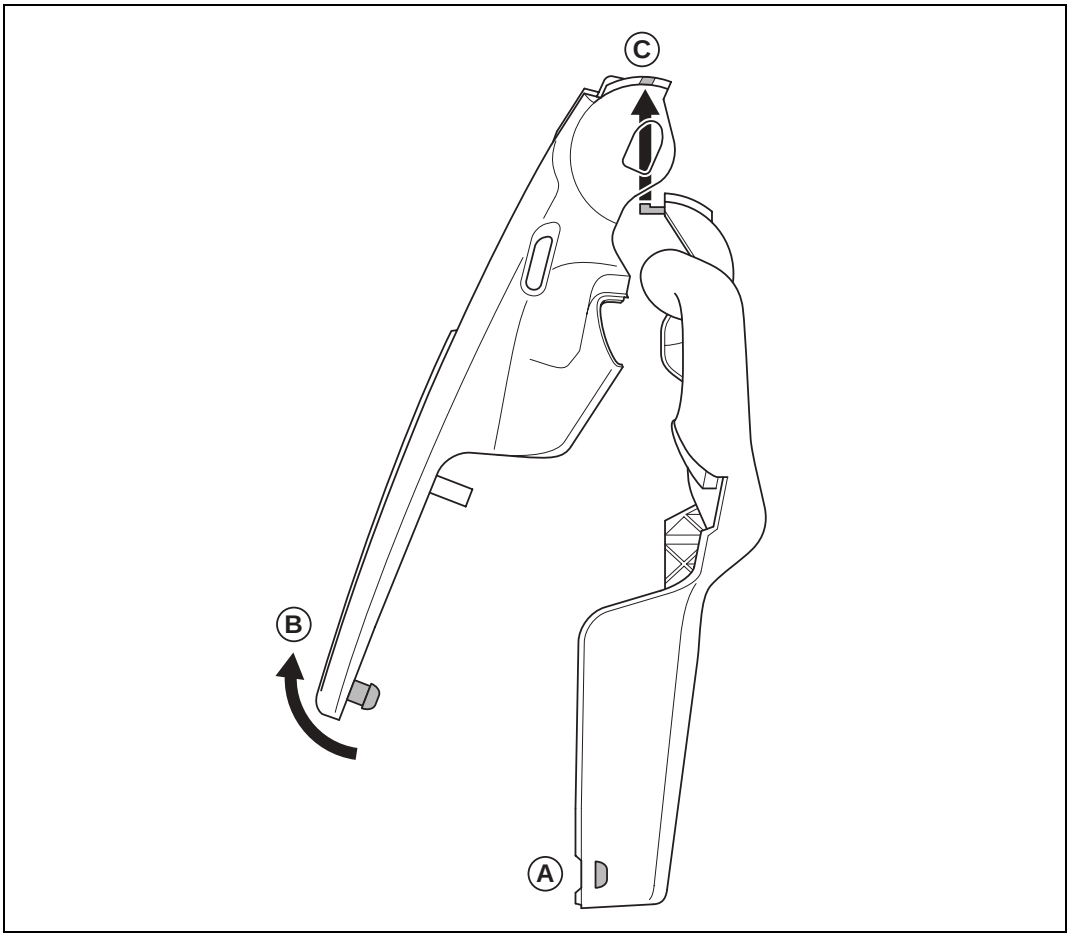

Figure 7.2 Dismantling the tiller arm head

4. Turn the upper cover to the right. The cover can now hang by the main cable.

Important!

Make sure the programming cable load is not too great.

5. Assemble in the reverse order.

Important!

Ensure that no cables get jammed when fitting the head.

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Dismantling buttons lift/lower

1. Open the tiller arm head as shown in the description “Dismantling the tiller arm head” on page 5.
2. Dismantle the buttons by releasing the snap on attachments from the inside, see Figure 7.3.

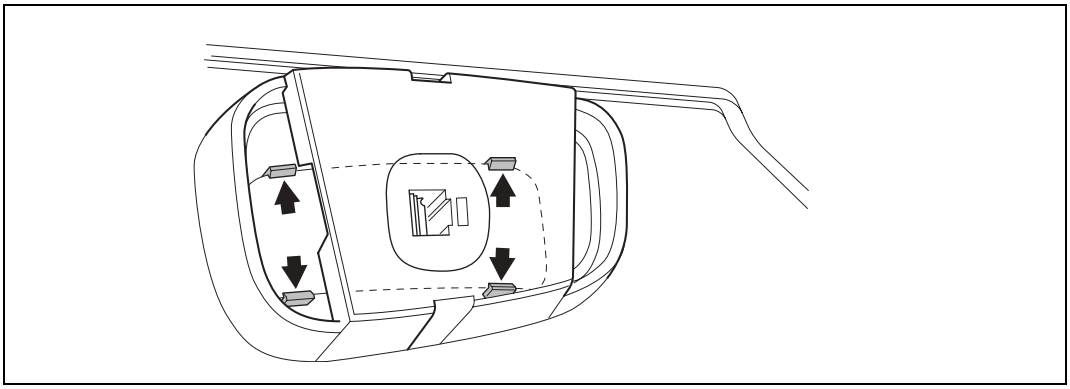

Figure 7.3 Dismantling buttons lift/lower

3. Dismantle the inner section by sliding it in the direction of the axle. Now lift the section out from the top.

☞ ***Important!***

Following dismantling, a new button must be fitted as the snap fasteners may be damaged.

Dismantling the speed controller

☞ ***Important!***

Apply the removable thread locking, e.g. loctite 243, on the screws to the speed controller.

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Assembly of main cable

Attaching the tiller arm's main cable:

Attach the cable using the cable clip in the tiller arm head. Attach the cable in the machine using cable ties in the motor.

Important!

The cable should have sufficient “slack” to allow the arm to be lowered to its bottom position without stretching the cable. It should also be possible to open the top section of the tiller arm head without any restrictions from the cable.

Important!

The length of cable must not cause the programming cable to take the load when the top section is hanging by the cable.

Cable routing standard design

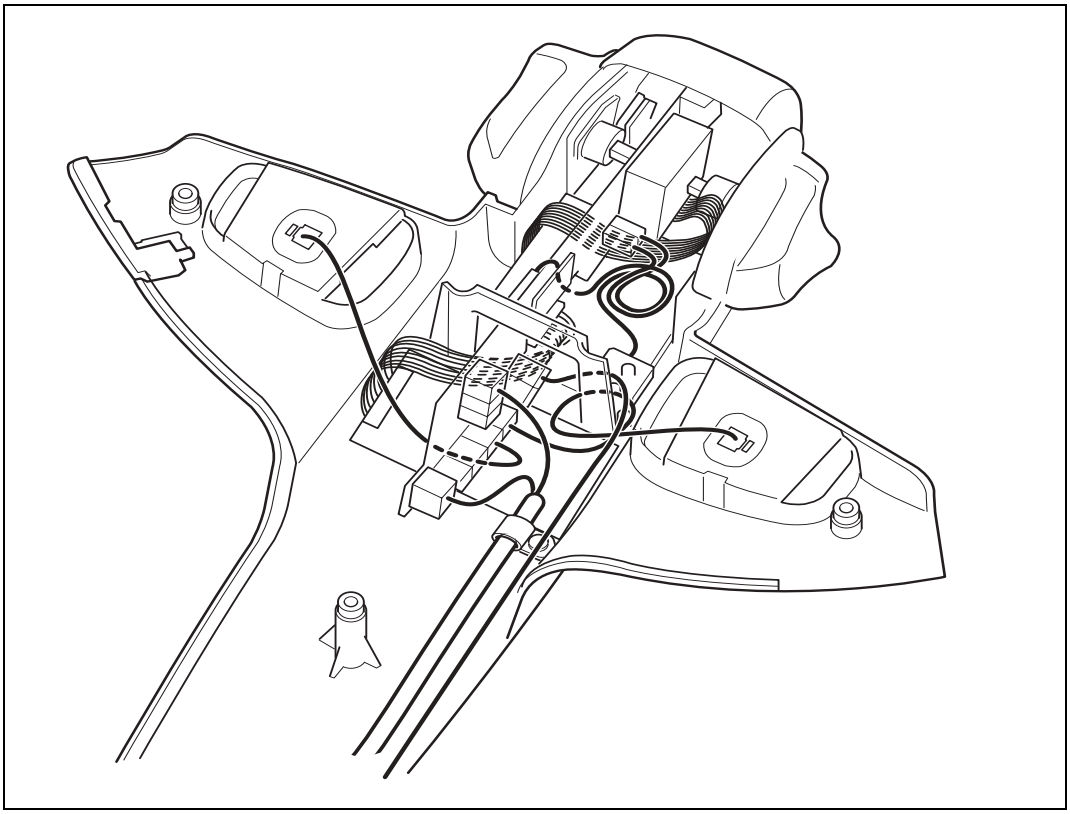

Figure 7.4 Cable routing, standard design

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Cable routing optional

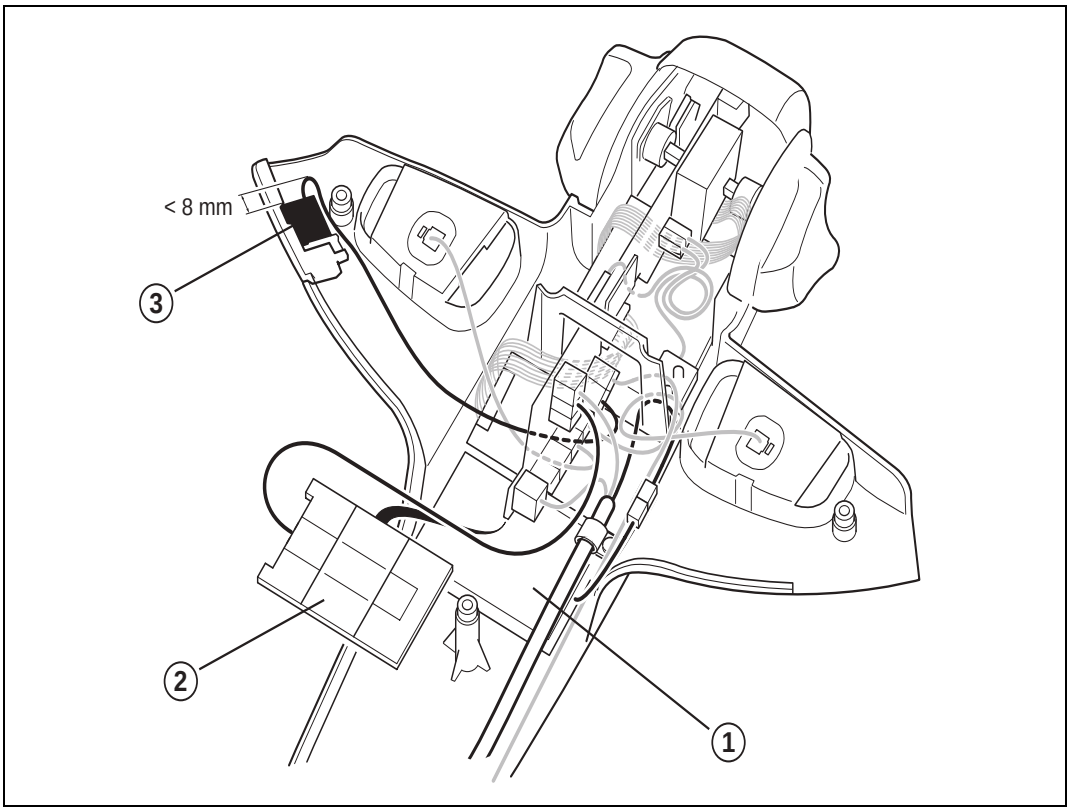

Figure 7.5 Cable routing, optional

Table 7.1 Cable routing, optional

Position	Description
1	Smartcard
2	Heat resistance
3	Tiller-up drive

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Tiller arm (2007w28–)

Dismantling the gas spring

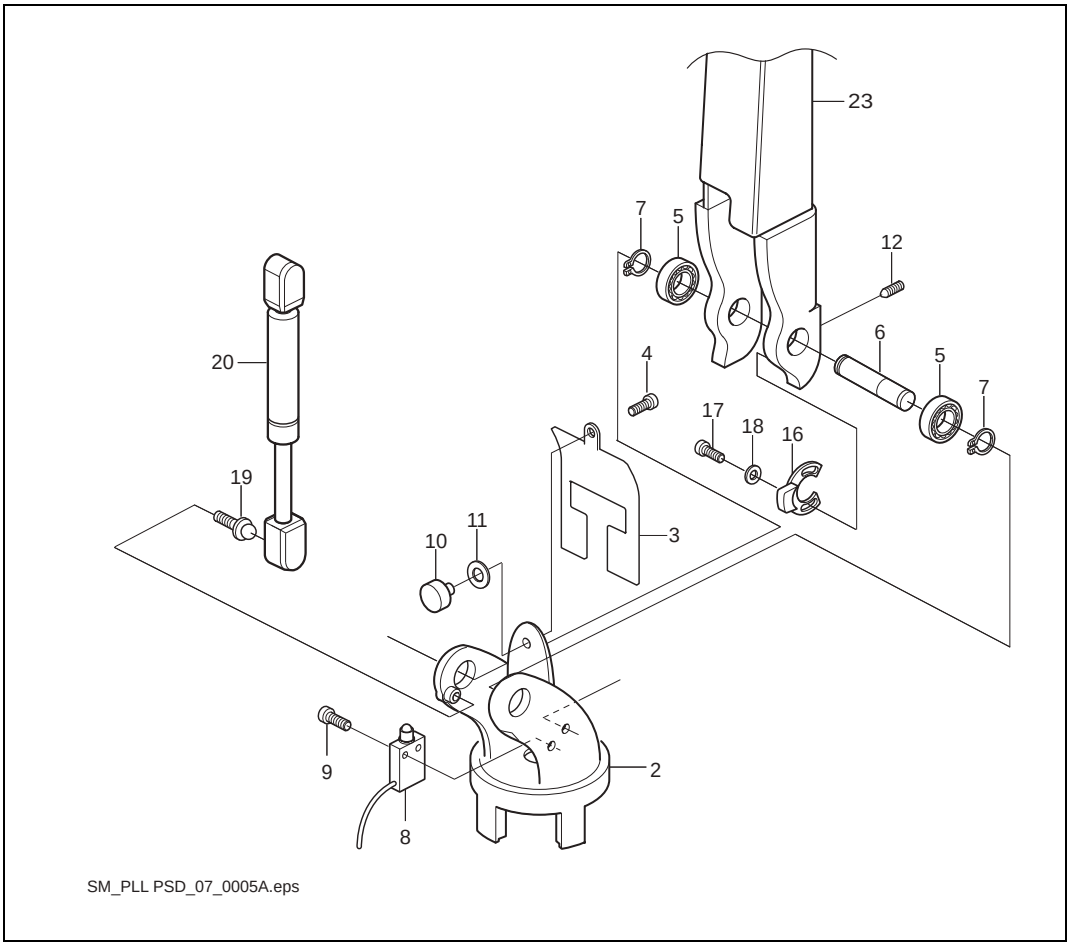

Figure 7.6 Tiller arm

1. Loosen the rubber damper (10).
2. Move the arm forwards.
3. Loosen the gas spring by opening the strap on the ball retainer using a screwdriver. Now pull off the gas spring from the ball screw.
4. Assemble in the reverse order.

Important!

Apply grease to the ball retainer.

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8 Hydraulic system

Design and function

General

Lift

The driver operates a lift switch, which activates the lift motor by means of a contactor. The motor drives the hydraulic pump, which pumps hydraulic oil to the lift cylinders.

In the hydraulic system there is a pressure limiting valve, which limits the maximum hydraulic oil pressure. The pressure of the hydraulic oil is built up when the cylinder goes towards its end position. A pressure limiting valve opens when the maximum system pressure is reached, which leads the oil from the pump back to the tank. The opening pressure of the pressure limiting valve is set at the factory, so that the machine will be able to do the work it is designed for.

⚠ ***Warning!***

The pressure limiting valve must only be adjusted by authorised and trained personnel, since it is a safety part. All work with the hydraulic system should be carried out in a pressureless state, and in a clean environment.

Lower

Between the hydraulic pump and the cylinder there is a check device, on certain trucks in the form of a lowering brake valve, which regulates the lowering speed by checking the return flow of hydraulic oil.

Hose rupture valve

Hose rupture valves, the purpose of which is to prevent the forks dropping down out of control if, for example, a hydraulic hose ruptures, are fitted in most of the lift cylinders. They are placed in front of the nipple connected for the supply of hydraulic oil.

Electric solenoid valve

General

The electric solenoid valve controls the lifting and lowering movements on the truck. The solenoid valve is actuated electronically by the driver by means of a lift switch.

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Lifting function

The pump produces pressure to the lift cylinders through the open solenoid valve. If the lift cylinders are obstructed, have an excessive load, or if there is a fault on the solenoid valve so that it does not open, the oil will return to the tank through the pressure limiting valve.

Lowering function

The solenoid valve opens to release the oil from the lift cylinders. When the fork carriage presses down the lift cylinder the oil flow goes through the lowering valve,which regulates the lowering speed.

Hydraulic diagram

Table 8.1 List of hydraulic diagrams for PLL/PSD

Description	Reference	Page
Hydraulic diagram PLL		8.6
Hydraulic diagram PSD		8.8

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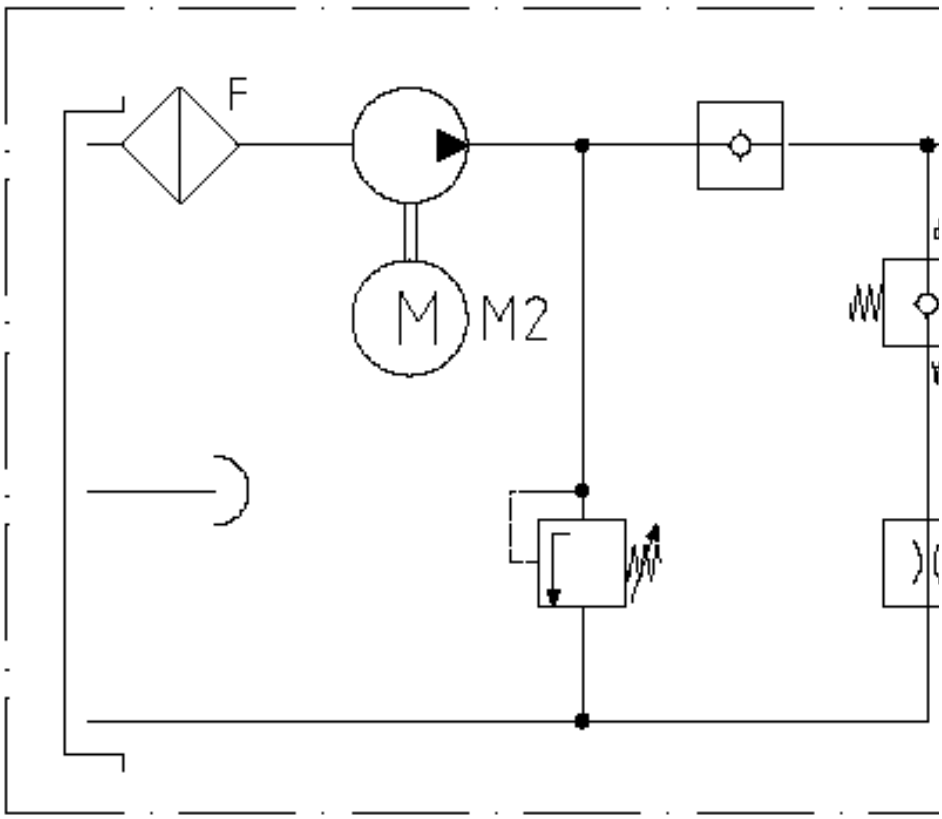
Hydraulic diagram PLL



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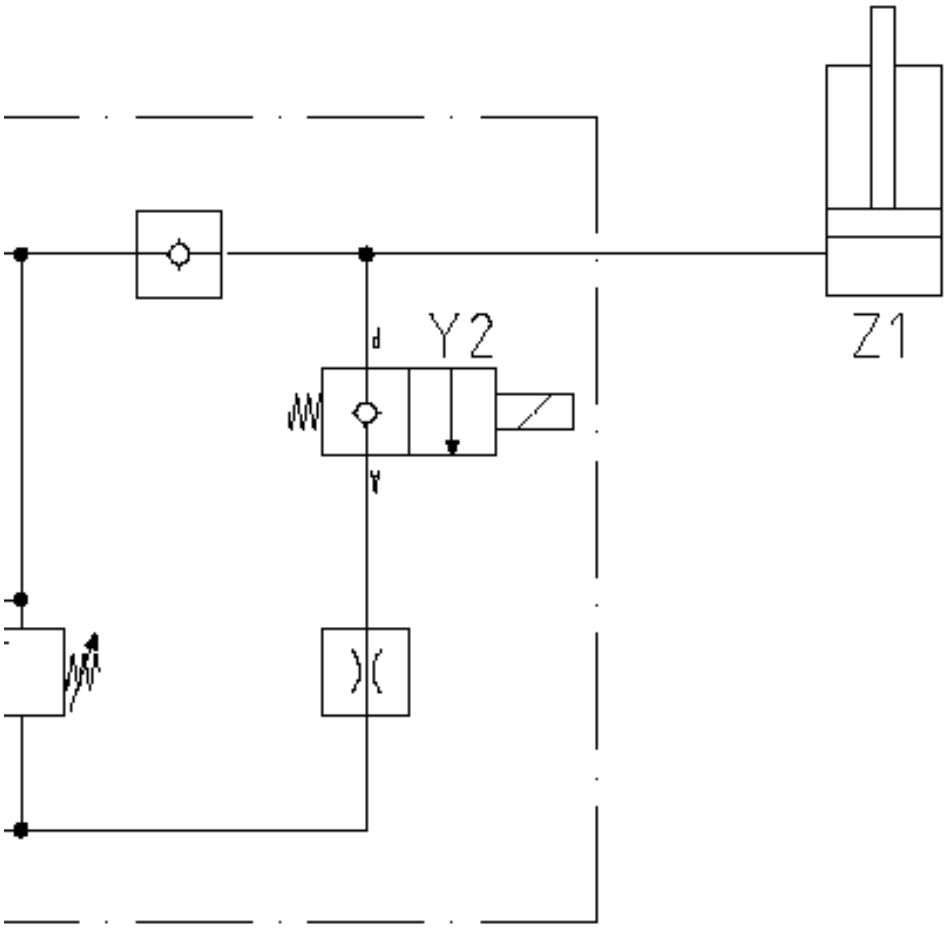

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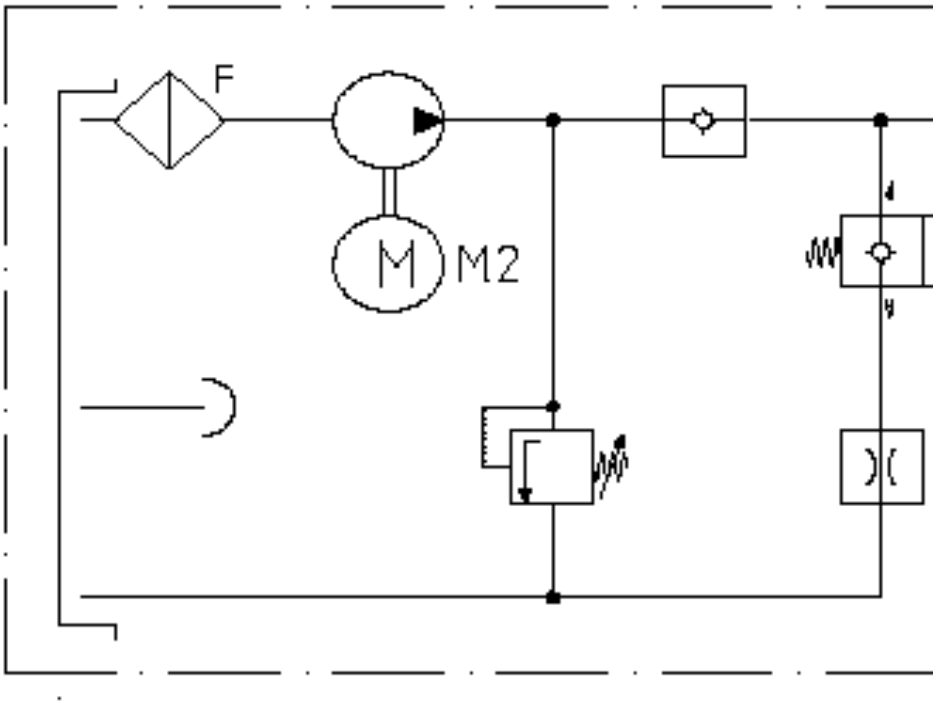
Hydraulic diagram PSD



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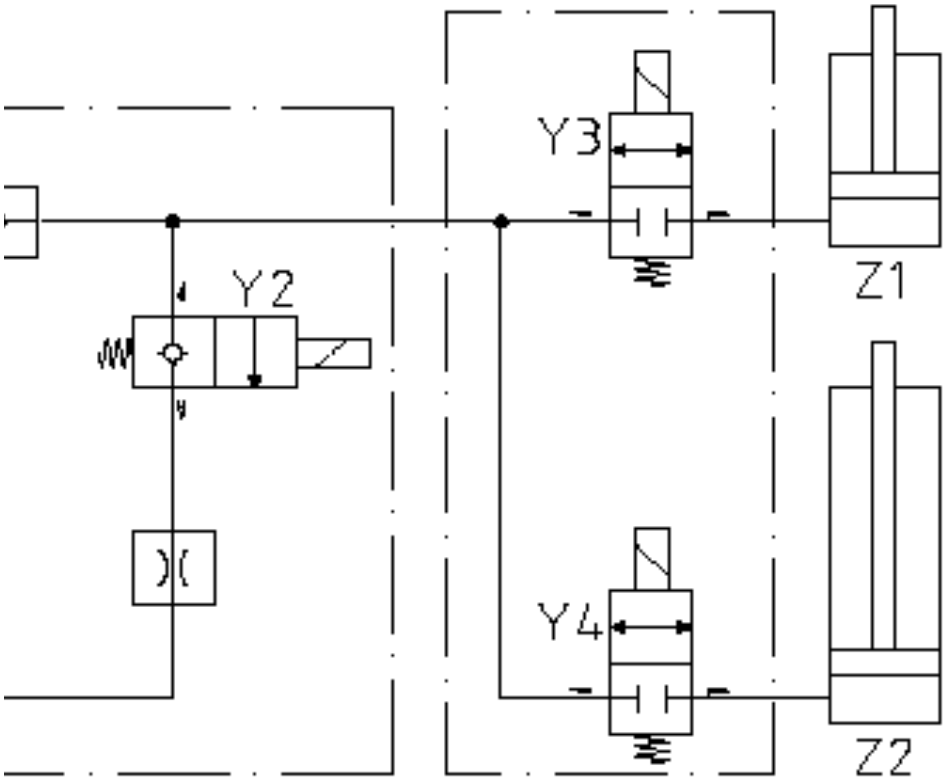

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Repair instructions

Hydraulic system

General rules

Important!

Cleanliness during all work with hydraulic components is of the greatest importance for the operating safety and service-life of the system. The following should be taken into consideration:

- Dirt particles must not get into components.
- Do not use cloths that release fibres or particles.
- Only use clean tools.
- Carefully clean tanks, pipes and hoses before installation.
- Welded or hot-bent pipes must be pickled (cleaned with acid bath) and washed before they are built-in.
- The oil tank must be closed and provided with an efficient air filter to prevent dirt contaminating the hydraulic system.
- Sealing compounds such as flax, cement or thread tape are not permitted.
- Take into consideration the specified operating data.
- Do not exceed permitted pressures and volume flows.
- Do not exceed or go below the specified temperature range.
- Pay attention to specified electrical voltages and power consumption.

Note!

All work with the hydraulic system should be carried in a pressureless state and in a clean environment.

Installation

To prevent dirt and corrosion in the hydraulic system all hydraulic components should be provided with plastic plugs in the connections before they are delivered. Only remove these plugs just before the component is to be installed in the machine. Retaining screws and connections must correspond with those on the drawing. Retaining screws should not be tightened with a higher torque than what is specified on the drawing. If such information is missing, the torque should not exceed what is specified in section 1.

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Connections

Couplings should be fitted according to the torque specified in section 1. We recommend couplings with elastic seals. Such couplings are necessary for control valves. Ring couplings do not seal at the low torque generally applicable for proportional valves.

Connect pipes and hoses in accordance with the hydraulic diagram. Pay attention to the connection designations. Do not use force, and avoid building-in tensions in pipes, etc.

Start up

Check that everything is connected in accordance with the hydraulic diagram. Set the pressure limiting valves down to a very low pressure if they are not sealed. Start-up with low pressure and volume flows.

Test the function and tightness of the system. Clean the system by allowing oil to pass over the filter for a while, without loading the system (replace the filter insert at the recommended intervals). Check the oil level. Set the pressure and volume flows slowly to the values they should have. Check the connected measuring equipment regularly, where appropriate. Pay attention to the noise level since abnormal noise implies defects. Test during variable loads that components are correctly fitted, and that the system is tight.

In the event of returning equipment to the manufacturer, protect polished surfaces from damage and dirt by covering them with foil and protective paper. Fit plastic plugs in all connections. Send the complete components, not loose parts.

Hydraulic oil

Properties of the hydraulic oil

The hydraulic oils recommended in this manual, section 1, have properties that promote a long service-life and good functionality, and these are the oils that should be used in the truck. The hydraulic oil used in Atlet trucks should comply with Atlet quality requirements:

- Smooth action.
- Long service-life.
- High viscosity index with wide range of temperature applications.
- Good low-temperature properties.
- High filterability.
- Good air and water separating capacity.
- Good wear protection.
- Good oxidation stability.
- Minimum foaming.
- Provide protection from rust and corrosion.
- Good adhesive capacity.

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Motor, hydraulic unit

When the performance of a motor changes it should be inspected internally, immediately. One of the most common reasons for trouble is some form of malfunction in the area of the brushes.

The brushes can be worn out, or get stuck in the brush holders. In either case insufficient electrical contact between the brushes and the commutator can lead to serious damage to the commutator surface.

When to replace the brushes

- If a brush cannot move freely in its brush holder. To establish this the brush carrier must be removed from the brush rigging. The force of the brush spring should then push the brush as far out of the carrier as it is allowed by the cable.
- If a brush is at the end of its useful length. The length of the brushes should never fall below 10 mm (the length of a new brush is 17 mm). As this is difficult to measure, there is an alternative suggestion. Measure the difference between the cable wire and the end of the slot in the brush holder, which should be at least 1 mm. Even if this difference is a little more than this, it is recommended to change the brushes anyway since the remaining life of the brush may be less than the time to the next inspection.

When to replace the brushes

The brushes cannot be replaced but are part of a kit, comprising the brush, brush holder and spring. They can be installed by following these instructions.

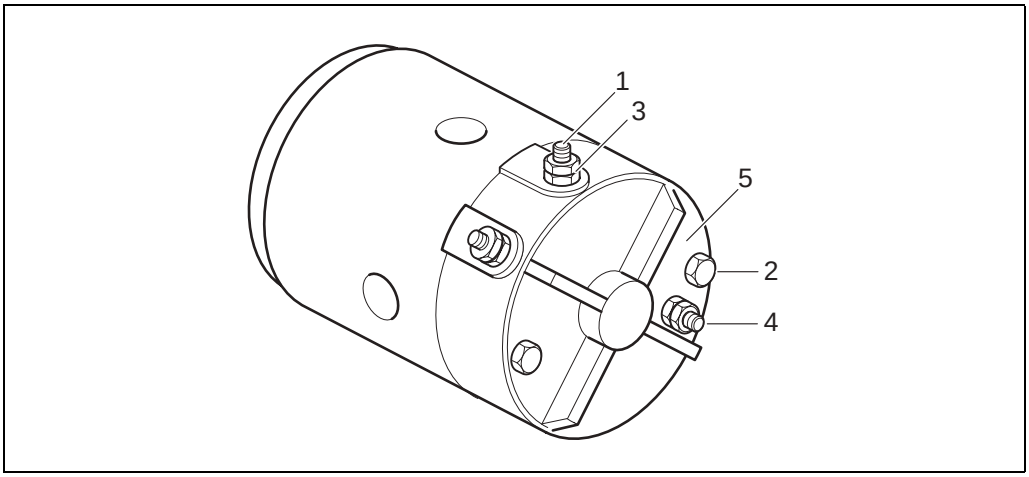

Figure 8.1

1. Disconnect the supply voltage from the motor by removing the cables from the motor terminals (pos. 1 figure 8.1).
2. Undo the through bolts from the rear of the motor (pos. 2 figure 8.1).
3. Remove the motor from the application.
4. Stand the motor on the drive end.
5. Release the terminal nuts (pos. 3 figure 8.1). In the case of an earth return motor the earth connection on the rear bracket of the motor must also be disconnected (pos. 4 figure 8.1).

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6. Remove the rear bracket (pos. 5 figure 8.1). The terminals should stay in position, however, if they remain located in the rear casting then a slight tap should be enough to release them.

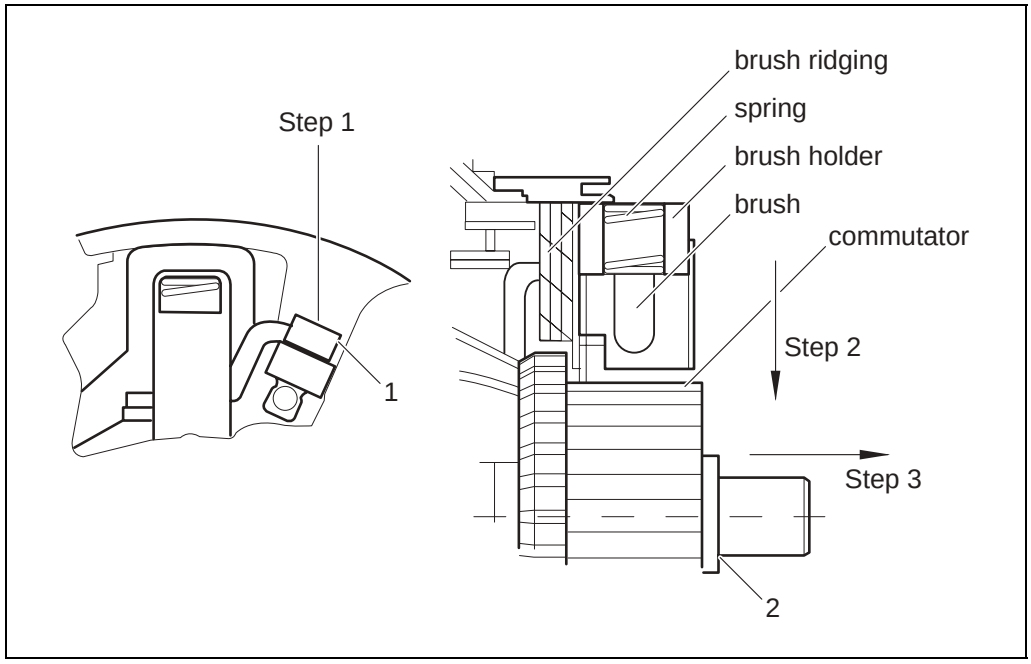

Figure 8.2

7. Disconnect all four brushes by undoing the screws (pos. 1 figure 8.2) - step 1, then push each brush kit towards the commutator - step 2. Now remove it from the brush rigging - step 3. Replace the old brush kit with a new one by following the above instructions in reverse. It is recommended that each brush is changed in turn to avoid confusion. Make sure that each brush kit is replaced with the correct part that has the brush cable on the same side. (Service kits consist of two matching pairs of brush kits!)
8. Re-tighten the screw (pos. 1 figure 8.2) with a torque of 1.3-1.8 Nm.
9. Relocate the terminals into the slots in the rear bracket and replace it on the motor. Ensure that a washer is in place between the armature and the bracket (pos. 2 figure 8.2) and that the bracket is positioned by a tooth and a slot respectively on the yoke and bracket.
10. Insert the through bolts and remount the motor on the application and tighten the bolts. The torque required is 4.8-6.8 Nm.
11. Re-torque the terminal nuts to 10-14 Nm (pos. 3 figure 8.1).
12. Reconnect the supply voltage.

Tips to prolong the life of the motor

- Rapid wear of the brushes and commutator is often caused by oil. The oil or grease burns because of the sparks produced by the brushes leaving behind an abrasive ash. In the event of any oil or grease being found in the motor, the cause of this must be eliminated immediately.
- Never overload the motor. Brushes that have been badly overheated irreversibly expand, and can stick in the brush holder.

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- The service-life of the brushes depends not only on the loading conditions, but also on the degree of commutator wear. The commutator surface should have a smooth, flat, grey/black appearance. A worn down commutator must be remachined (never use abrasive paper, abrasive stones or files!) to a roughness of Ra=0.8-1.8µm and a maximum run-out of 0.03 mm (with the armature supported at the bearing points). For the service-life of the commutator it is better to turn it down little and often, rather than infrequently but heavily. The minimum diameter of the commutator is 40.8 mm.
- The motor must never be subjected to full load immediately after the brushes have been changed.
- Check the field and armature windings for signs of overloading (overheating), dark-stained, brittle or burned insulation, and damage to the solder on the commutator. Motors with this kind of damage are no longer serviceable.
- Whenever possible, remove any dust or powder from the inside of the motor with compressed air.
- Dirty commutators should always be cleaned with a clean duster moistened with gasoline (do not use cotton waste, this leaves fibres behind) and dry thoroughly with compressed air.
- If a bearing bush looks as if it is out of oil (i.e. a lot of oil is seen on the armature washer or brush bracket), then lubricate it with some bearing grease.

Hose rupture valve

Dismantling and assembling

1. Lower down the forks and relieve the pressure.
2. Place protective paper under the cylinder to be repaired.
3. Loosen the pipe or hose that goes to the cylinder, and plug it.
4. Remove the nipple placed in the cylinder.
5. Unscrew the hose rupture valve, pos. 1 figure 8.3, that is screwed into the cylinder.

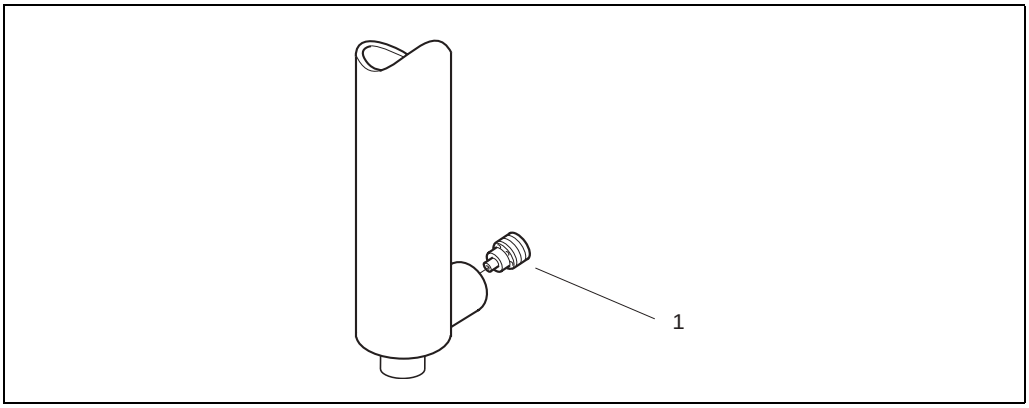

Figure 8.3 Hose rupture valve

6. If a fault is suspected, check the length of the spring in relation to the table or data sheet. Adjust, or fit a new valve.

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7. Fit the nipple, connect the pipes, and wipe clean.
8. Test run.

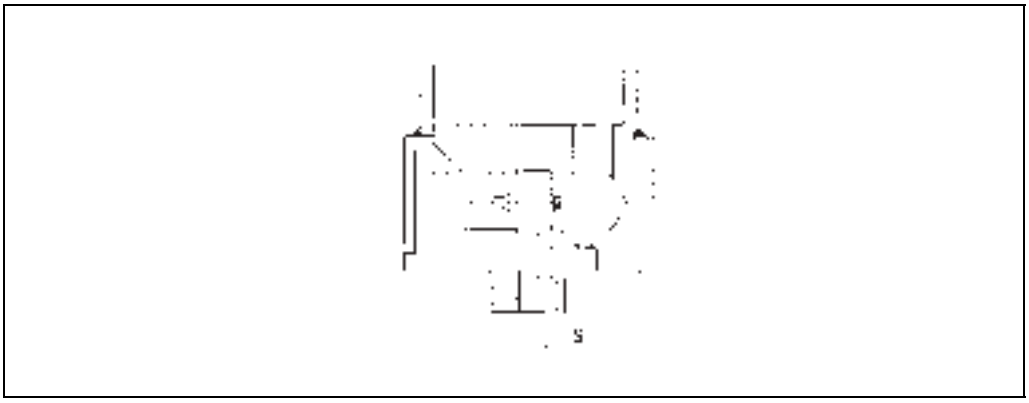

Figure 8.4 Hose rupture valve

Solenoid valve

General instructions when working with solenoid valve

1. Cleanliness

    - Dirt particles must not get into components.
    - Cloths must not shed fibres and particles.
    - Tools must be clean.
    - Tanks, pipes and hoses must be carefully cleaned before installation.
    - Welded or hot-bent pipes must be pickled and cleaned before they are built-in
    - The oil tank must be closed and provided with an efficient breather filter that prevent the penetration of dirt.

2. Sealing compound

    - Hemp, cement or sealing tape is not permitted.

3. Operating data

    - Do not exceed permitted pressures and volume flows.
    - Do not go beyond the specified temperature range.
    - Pay attention to specified electrical voltages and maximum power consumption.

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Solenoid valve, dismantling and assembling

1. Lower down the forks and relieve the pressure in the hydraulic system.
2. Place protective paper under the valve and release the electric cables to the valve.
3. Loosen all the oil pipes connected to the valve and plug them.
4. Loosen the valve from the truck, and lift it out.
5. When fitting, tighten the valve and then the oil pipes.
6. Adjust the pressure limiting valve to the rated weight in accordance with the machine name-plate.
7. Seal the setting.

Installation instruction for pipe couplings

To achieve a safe and tight connection when installing pipe couplings in the hydraulic system, the following points should be taken into consideration:

1. The pipe should be cut at right angles by means of a pipe cutter (see figure 8.5 and 8.6), after which it is deburred internally and externally, and carefully cleaned.

☞ ***Important!***

When using a pipe cutter the end of the pipe becomes skew, with the formation of substantial burrs internally and externally. It is therefore important to straighten the end of the pipe and remove the burrs, both internally and externally.

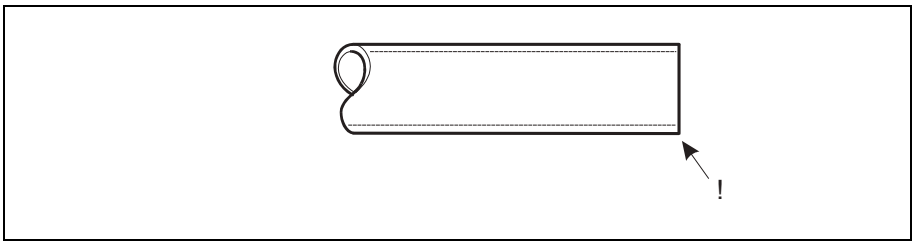

Figure 8.5 Cut at right-angles!

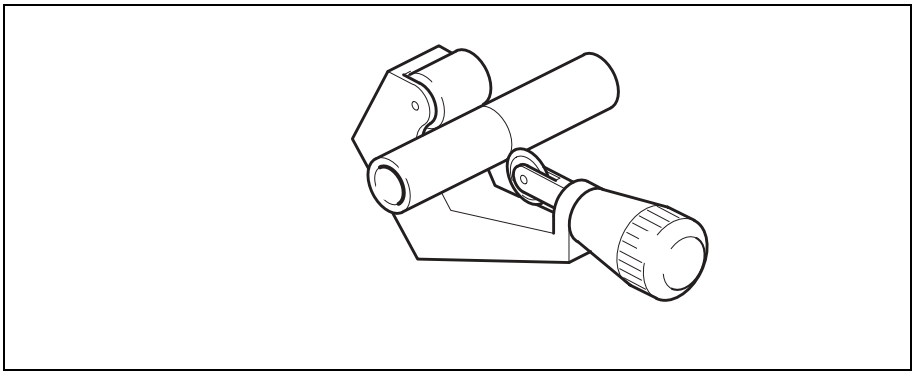

Figure 8.6 Pipe cutter

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2. Oil the thread and ring (not grease). Put the nut and ring over the pipe end as shown in the figure. If the ring cannot be worked over the pipe end it must absolutely not be enlarged. File down the pipe end instead.

3. Small pipe dimensions can be fitted directly in the coupling connected to the machine part. Screw the nut by hand until it lies flush with ring, press the pipe towards the shoulder in the coupling cone, and tighten the nut a ¾ turn.

Important!

The pipe must not follow round.

4. The ring will now have gripped the pipe, and no longer needs to be pressed against the shoulder. Complete the fitting with an additional ¾ turn of the nut. A mark on the nut simplifies following the specified torque, see figure8.7.

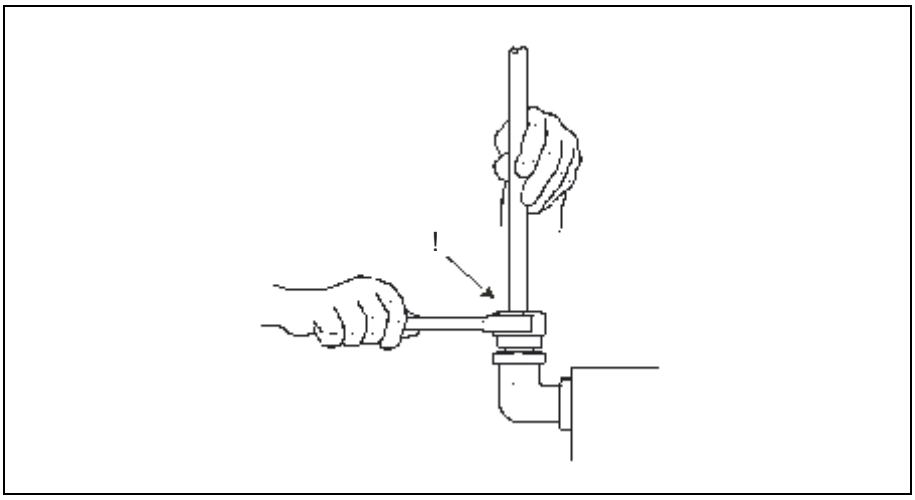

Figure 8.7 A mark on the nut simplifies the specified torque

5. Larger pipe dimensions and couplings in free pipes are preferably fitted by placing the coupling body in a vice. The U-ring spanner should be 15 times the nut width (can be extended with a piece of pipe). Otherwise fit according to point 3.
If several couplings of the same type are to be fitted, make sure that each pipe end goes in the same coupling cone it was previously fitted in.
Fitting is simplified if the nut is loosened and oil is applied between the friction surfaces.

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6. After fitting, release the cap nut and check that the ring has pressed up a visible swelling in the area in front of it, see figure 8.8. If not, give it another short turn. It is of no importance whether the ring can still be turned.

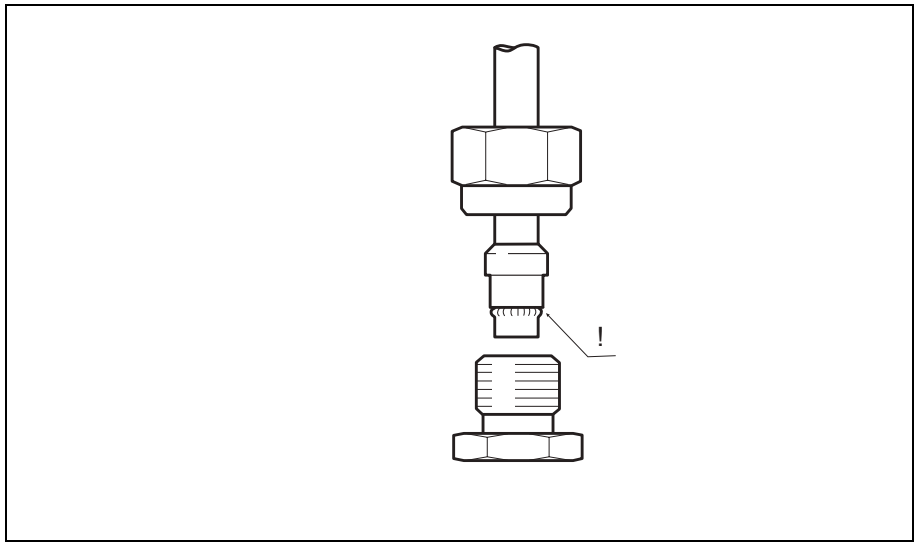

Figure 8.8 A visible swelling should have formed after tightening

After a visible swelling has formed the nut should be fitted without extension of the U-ring spanner, and without excessive force.

☞ ***Important!***

Refitting: After a visible swelling has formed the nut should be fitted without extension of the U-ring spanner, and without excessive force.

7. If the pipe is to be bent after a coupling, the straight pipe end should have a length of at least 2 nut heads, H.
Long and heavily loaded pipes should be provided with pipe clips.

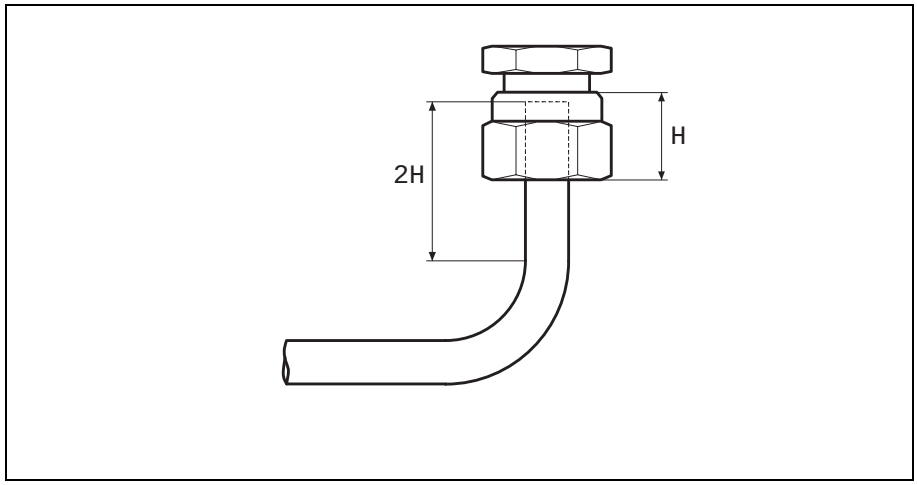

Figure 8.9 Straight pipe length between bend and coupling

8. The final assembly should be done with at least 1 turn of the nut from the point where it cannot be turned by hand.

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Diagnostics and trouble shooting

Symptom and Action

A number of fault symptoms have been listed in the table below, with a number of possible faults and repair procedures. It is therefore possible for other faults to have occurred in addition to the ones listed.

Table 8.2

Symptom	Possible fault	Action
The lift motor runs, but the fork carriage does not lift.	The lowering valve has jammed and is open.	1. Close the valve. 2. Adjust, or remove any dirt from the valve.
The lift motor runs, but the fork carriage lifts very slowly.	The machine is overloaded.	Lighten the load.
	The overflow valve is defective.	Adjust the valve to the rated weight.
	A foreign object has partially blocked a hose, hydraulic pipe or valve.	Take apart and clean.
	Hydraulic hose has been clenched.	Rearrange the hose and clamp secure.
The lift motor emits a screeching noise just before the fork carriage reaches the top.	The oil level is too low in the hydraulic tank.	1. Fill with hydraulic oil. When the tank is almost full, try with 0.1 litre at at time to avoid overfilling. 2. Find out the reason for the low level, and rectify the fault.
The fork carriage will not lower.	Valve does not open on return because of foreign object in the system.	Dismantle valve and clean.
	The hose rupture valve is closed because the lowering speed is too high.	Limit the lowering speed.
	The hose rupture valve is closed because the spring in the valve is defective.	Replace the hose rupture valve.
The fork carriage lowers too slowly.	Lowering valve or lowering brake valve is dirty or defective.	1. Run the lift motor for a maximum of 1 minute to see if the dirt releases. 2. If not, dismantle the valve and clean, or replace defective parts.
	The oil filter is blocked and dirty.	Change filter.

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Table 8.2

Symptom	Possible fault	Action
The fork carriage lowers too quickly.	The lowering brake valve is defective.	Replace the lower brake valve.
	The lowering brake valve is incorrectly adjusted.	Adjust the lowering brake valve.
Hydraulic oil flows out via the air filter.	Oil level too high.	Reduce the oil level to correct level.
	The oil foams.	Change the oil with oil that has the correct properties.
	Condensation water in oil tank.	Empty the tank of oil and fill with new hydraulic oil to correct level.
The fork carriage rocks when lifting.	Air in the hydraulic system.	Bleed the system via the air cylinders.
The hydraulic oil has a bad smell, sulphur.	The oil separators in the hydraulic oil are ruined.	1. Change the oil and filter. 2. Flush the complete system with new hydraulic oil.
	Motor oil has been used and caused the hydraulic oil to emulsify with water and then rot.	

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SERVICE MANUAL

Machine: PLL PSD

Manual No: 119000

Edition 2003

9 Lift cylinders

Design and function 9.3
Introduction 9.3

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Edition 2003

9 Lift cylinders

Design and function

Introduction

The lift cylinders consist of single-acting hydraulic cylinders, where hydraulic oil is pumped into the cylinder and presses out the piston rod.

When the driver activates the lowering function the cylinders are pressed together through a control valve releasing oil out from the cylinders. They are then pushed together by the weight of the forks, at the same time as the oil returns to the hydraulic tank.

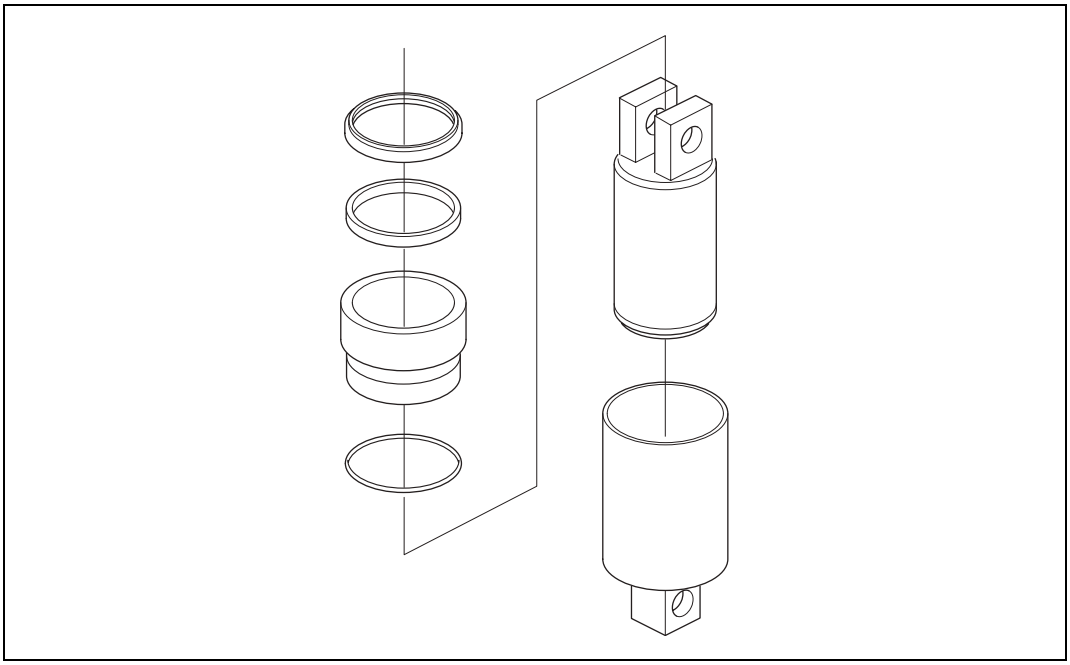

Bild 9.1 Lift cylinder PLL

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SERVICE MANUAL

Machine: *PLL PSD PSL PLE*

Manual No: *119000*

Edition 2008A

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10 Electrical system

Design and function

General

Description of components (ATC 4)

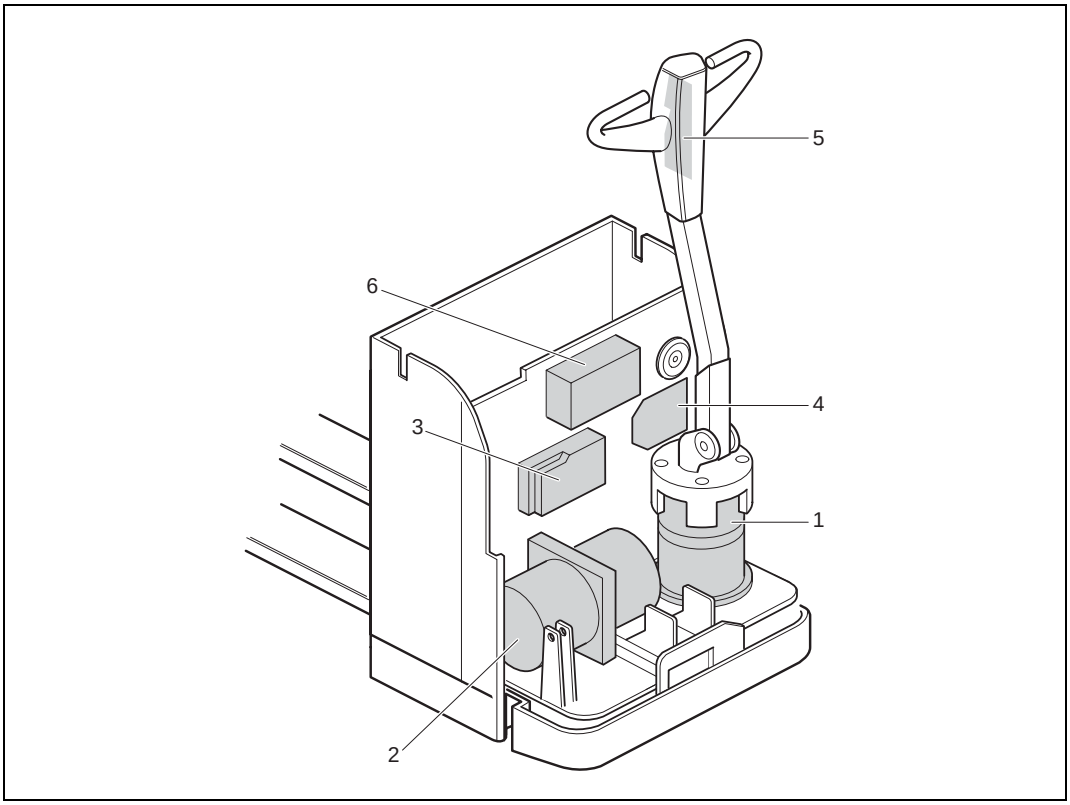

Figure 10.1 Components (ATC 4)

1. Drive motor.
2. Pump motor.
3. Traction motor controller.
4. Hydraulic valve controller.
5. ATLET truck computer.
6. On board battery charger (option).

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Description of components (Original)

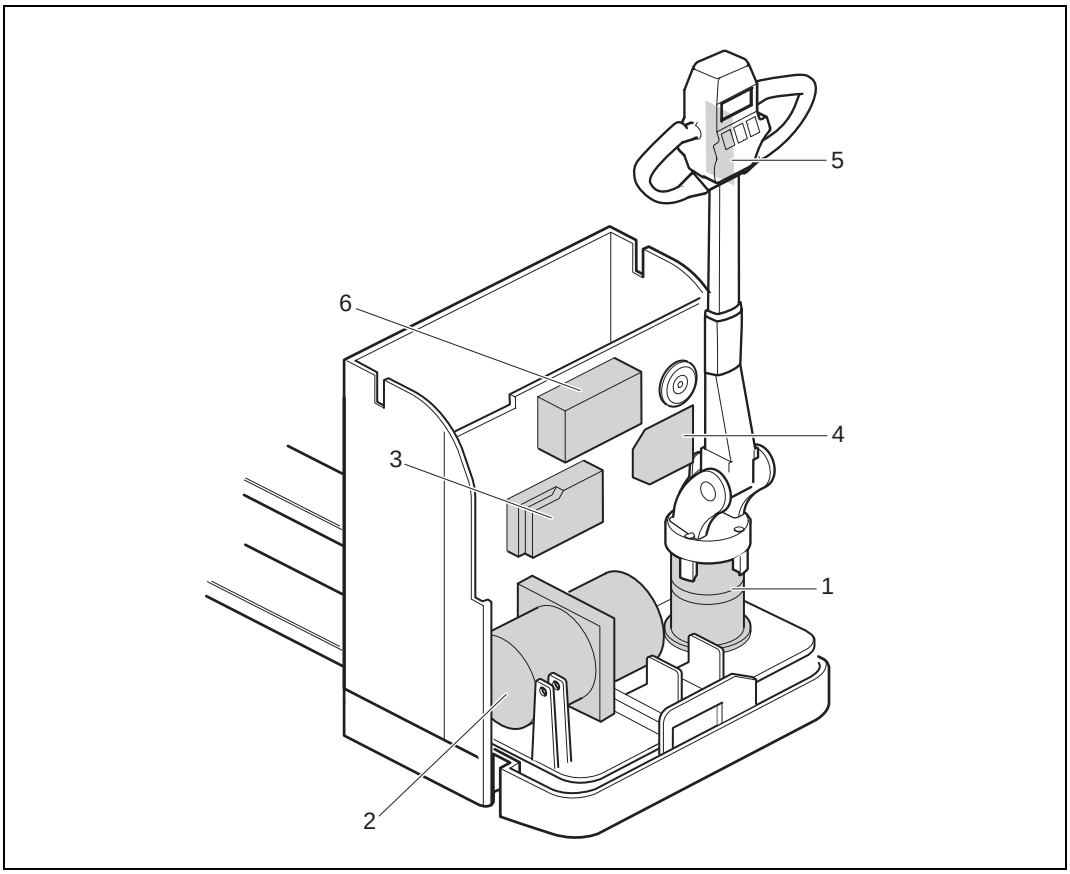

Figure 10.2 Components (Original)

1. Drive motor.
2. Pump motor.
3. Traction motor controller.
4. Hydraulic valve controller.
5. Original tillerhead.
6. On board battery charger (option).

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Description of components and interface

The ATC system consists of a keyboard (pos. 1), display (pos. 2) and an ATC card (pos. 3).

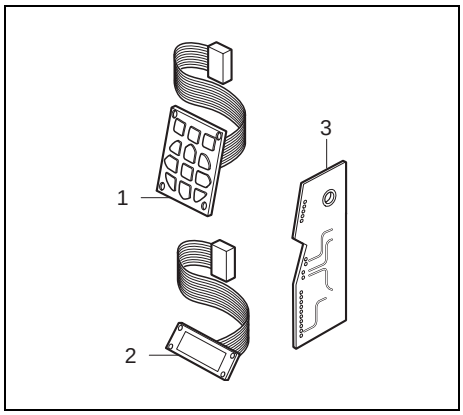

Figure 10.3

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Repair instructions

General

Safety procedures

Extreme importance must be placed on precautionary measures to avoid accidents during all work on the vehicle.

- The drive wheel should always be lifted up free from the floor during service work to prevent the vehicle from moving.
- The battery plug should be pulled out before working on the electrical system. The battery plug may only be connected while trouble shooting, and when the greatest of care is exercised, (with the truck raised).
- No other persons should be in the vicinity of the truck when it is test run in conjunction with repair work, in view of the risk of accidents or near-accidents from the truck making an unexpected manoeuvre.
- All metal objects such as watches, chains, spectacles and rings should be removed when working on the electrical system, or in its immediate vicinity. A short-circuit from such objects can result in serious burn injuries.
- Working with electrical vehicles can result in personal injury. All testing, trouble shooting and adjusting must be carried out by authorised personnel. The drive wheel should run free of the floor and be able to rotate freely during work.

⚠ ***Warning!***

Working with electrical vehicles can result in personal injury.

Electronic controllers

- All the electronic controllers in the truck have multiple safety systems.
- When replacing or repairing the electronic controllers, or removing cables, the battery should always be disconnected.

☞ ***Important!***

Incorrectly connected battery cables can destroy the electronic controllers.

⚠ ***Warning!***

During all work on the truck the drive wheel must be lifted up from the floor to prevent accidents occurring.

After the power has been disconnected to the controller and work or trouble shooting is to be conducted, there can be residual voltage in the capacitors for a few minutes. For this reason observe care when working with current-carrying tools during this period.

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Abbreviations

AC	Alternating Current
ATC	ATLET Truck Computer
B+	Battery positive
B-	Battery negative
CAN	Controller Area Network
DC	Direct Current
EPS	Electric Power Steering
HVC	Hydraulic Valve Controller
TMC	Traction Motor Controller
WG	Wire Guidance
BDI	Battery discharge indicator
ELCB	Electronically load compensated brake

Battery

Battery capacity

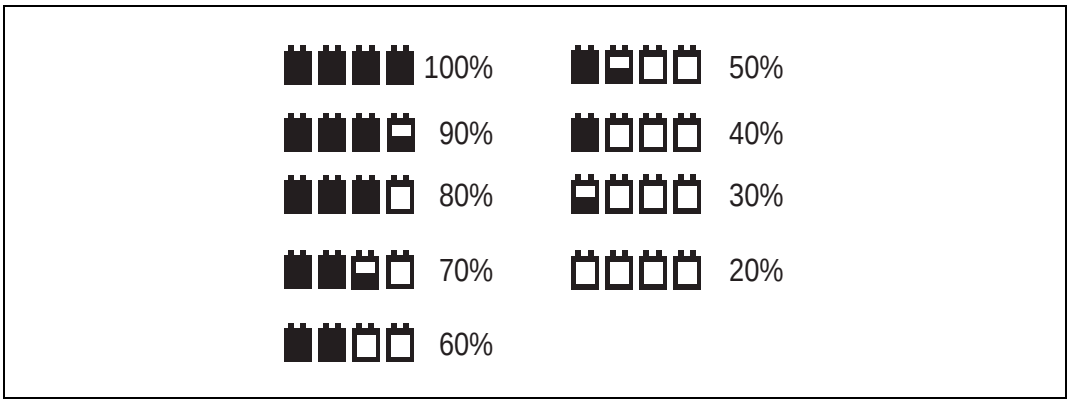

Figure 10.4 Battery capacity

The battery capacity is shown to the left on the bottom row on the display. Measurements are fully controlled by software, and no further electronics are required. The capacity is measured by measuring the battery voltage.

When the battery capacity gets too low the battery capacity value starts flashing and a buzzer is actuated.

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A lift stop is connected to the battery capacity measurement and is activated when only 20% capacity remains.

Battery capacity %	Unloaded pole voltage	Acid density g/cm3
0	22.92	1,070
10	23.20	1,093
20	23.47	1,116
30	23.75	1,139
40	24.03	1,162
50	24.30	1,185
60	24.58	1,208
70	24.85	1,231
80	25.13	1,254
90	25.41	1,277
100	25.68	1,300

In order to carry out a complete battery discharge indicator (BDI) adjustment, the following procedure has to be performed:

1. Connect a voltmeter directly to the B+ and B- poles of the battery.
2. Power up the truck and enter “ATLET menu => Settings => Battery => Calibrate”. Key in the value from the voltmeter by using the keypad. For example if the voltage 25.2 V is read from the voltmeter, key in 252.
3. Enter (ATLET menu => Settings => Battery =>) “Stepdown hi”. This parameter (0-9) decides how quickly the BDI reduces the indicated level when the battery has been recently charged.

   - If the indicator does not indicate 100% after a full recharge cycle, or drops too quickly in the range 100%-60%, this parameter should be decreased.
   - If the indicator drops too slowly in the range 100%-60%, this parameter should be increased.

4. Enter (ATLET menu => Settings => Battery =>) “Stepdown lo”. This parameter (0-9) decides how quickly the BDI reduces the indicated level when the battery is close to becoming discharged

   - If the indicator drops too quickly in the range 60%-20%, this parameter should be increased.

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- If the indicator drops too slowly in the range 60%-20%, shows too high a battery status, or the truck stops due to under voltage alarms, this parameter should be increased.

General handling

Function keypad

The keyboard is used for driver identification, settings, and for diagnostics. The keyboard consists of 12 keys, which have different functions depending on which position the system is in.

Key:	Function in		
	Input mode:	**Operational mode:**	**Service mode:**
	Enter a zero.	-	-
	Enter a one.	-	-
	Enter a two.	Switch between creep speed and full speed.	Step one step down in the menu tree.
	Enter a three.	-	-
	Enter a four.	-	Step one step to the left in the menu tree.
	Enter a five.	-	-
	Enter a six.	-	Step one step to the right in the menu tree.
	Enter a seven.	-	-
	Enter an eight.	Set the truck to full speed.	Step one step up in the menu tree.

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Key:	Function in		
	Input mode:	**Operational mode:**	**Service mode:**
	Enter a nine.	-	-
	-	Used for input to the level selector and to change the system status.	Steps to the upper menu level loop if pressed during input in the upper level.
	Used to accept the shown value.	Used to confirm a selected level in the level selector.	Used to select the shown menu alternative.

Function key combinations	
	A “monitor menu” can be obtained if the keys are pressed down at the same time in the Operational mode.

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Menu tree – start-up and top level

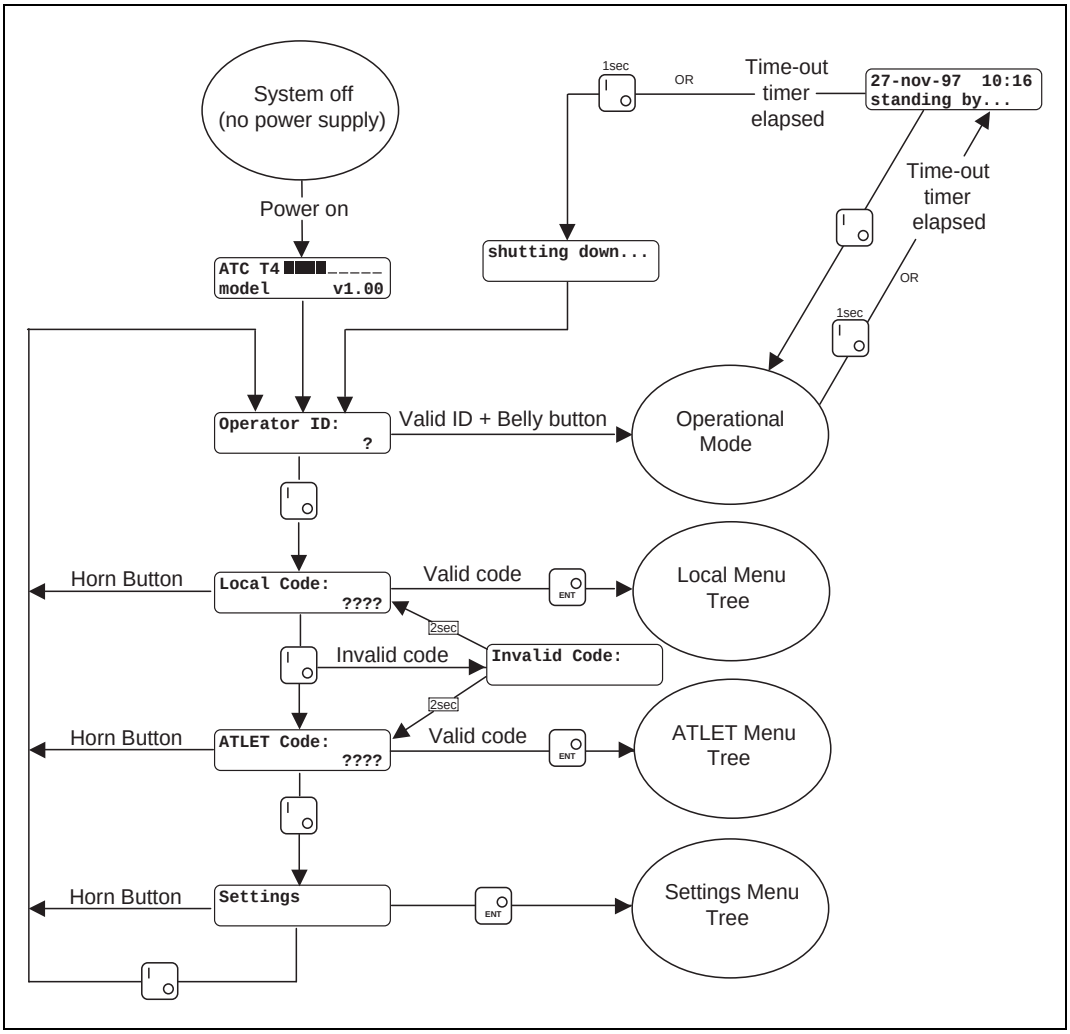

Figure 10.5 Menu tree

In Operational mode

If the [i] key is pressed for one second the truck will go to the “stand-by” mode. The changeover is confirmed by a peep.

In Stand-by mode

If the [i] key is pressed for less than one second the truck will go to the “operational mode” without asking for a PIN code. If the [i] key is pressed for one second the truck will return to the upper level and ask for an operator ID.

There is no reason for the operator to release the [i] key to log out directly from the operational mode.

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Contactors in cold storage rooms

Greasing

Kryotox grease, ATLET part number 110781, should be applied in all electrical contacts. The hand pump, part number 110782, should be used in order to do this. The grease should be applied to the contact surfaces when the contactors are drawn apart. The contactors are then reconnected and the grease is pressed from behind into the connector housing so that it is filled. All blocks that have more than one cable are considered to be contact blocks. Flat pins protected by some form of sheath should not be greased.

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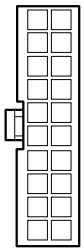
Drive and valve controller

Connector traction motor controller, specification

The traction motor controller has two connectors with I/Os for valves, sensors, change-over switches and programming tools, etc. Each connector pin is specified below with, where appropriate, the voltage level in connected condition.



Connector X6 (figure shows connector from the cabling side).

Table 10.1 Connector X6 traction motor conntroller AC0

Pin	Description	Comment
X6.1	Controlling of Drive contactor.	Controlled to B-.
X6.2	Supply to Drive contactor.	+24V
X6.3	Controlling of electric brake.	Controlled to B-.
X6.4	Controlling of pump contactor.	Controlled to B-.
X6.5	Supply to pump contactor/horn.	+24V
X6.6	Controlling of horn.	Controlled to B-.
X6.7	CAN communication.	CAN Low.
X6.8	Motor temp. sensor.	B-
X6.9	Pos. supply to drive motor encoder.	+12V
X6.10	Neg. supply to drive motor encoder.	B-
X6.11	Controlling of lowering valve.	+24V
X6.12	Neg. supply to lowering valve.	B-
X6.13	Signal input temp. sensor.	
X6.14	-	-
X6.15	-	-
X6.16	+12V supply to HVC.	+12V
X6.17	CAN communication.	CAN High.
X6.18	-	-
X6.19	Input A from drive motor encoder.	Synchronises the motor movement with pulses from the encoder.
X6.20	Input B from drive motor encoder.	Synchronises the motor movement with pulses from the encoder.

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Connector X5 (figure shows connector from the cabling side).

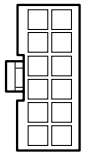

Table 10.2 Connector X5 traction motor controller AC0

Pin	Description	Comment
X5.1	Supply from F3 fuse.	+24V
X5.2	Joint supply to all digital inputs.	+24V
X5.3	Input from brake switch.	Closes in the upper and lower arm position.
X5.4	-	-
X5.5	-	-
X5.6	-	-
X5.7	Digital input.	Accessories: Input from lift stop switch, closed, breaks during lift stop.
X5.8	Digital input.	Brake open. The switch must be closed to be able to drive the truck.
X5.9	-	-
X5.10	-	-
X5.11	-	-
X5.12	-	-

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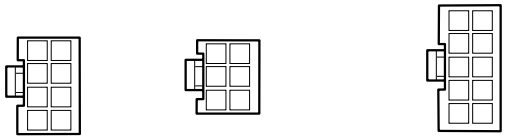
Valve controller HVC, contactors (PSD)



Pin	Description	Comment
X23.1	-	-
X23.2	-	-
X23.3	-	-
X23.4	Electrical valve, forks	Closes for fork lifting and lowering
X23.5	-	-
X23.6	Common feed to electrical valves	+24V
X23.7	-	-
X23.8	Electrical valve, straddle leg	Closes for straddle leg lifting and lowering

Pin	Description	Comment
X22.1	Feed from TMC	+12V
X22.2	Feed to outputs	+24V
X22.3	CAN communication	CAN low
X22.4	Negative feed	B-
X22.5	-	-
X22.6	CAN communication	CAN high

Contactor X24 is not used for PSD.

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Wiring diagram

All the wiring diagrams can be found in a separate “Wiring diagram handbook”, contact Atlet for further information.

The relevant wiring diagrams for PLL/PSD are specified in the table below.

Table 10.3

Description	Machine	Reference	Document code
Wiring diagram	PLL PSD		108113 116039 (2007w28–)
Wiring diagram, “Original”	PLL		115780
Wiring diagram, “Original”	PSD		115781
Circuit diagram	PLL		108634
Circuit diagram, “Original”	PLL		115329
Circuit diagram	PSD		108635
Circuit diagram, “Original”	PSD		115333

Insulation resistance

Routine test

You must first disconnect the connectors (plugs) before the truck is insulation tested in order to protect the controllers and other electrical components on the truck. This is because damage can occur, which will shorten the life of component parts. In the event of large insulation errors it is appropriate to use a universal instrument until the error has been found and then make a final insulation test.

This applies to all electronic units on the truck. The instrument has a dangerous voltage across the measuring terminals. Do not touch the terminals during testing.

Routines for insulation testing of all truck models.

1. Take out the insulation measurement instrument.
2. Set the test voltage to 100 volt.
3. Pull out the battery plug. Electrical components and electronic systems can be damaged by the test voltage. For this reason disconnect connections and contactors to these before doing the test.
4. Connect the instrument’s earth lead to the truck chassis at a point with good electrical contact. The other lead is connected to the plus pole on the electrical panel plug.
5. Press the start button and wait until the display has stabilised, then release the button and read-off the value on the display. The approved value on 24 volt machines should be at least 24000Ω , (24 kΩ).

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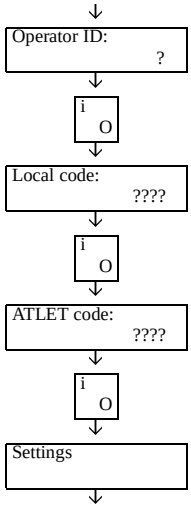
6. Let the earth lead remain attached to the chassis and connect the other lead to the minis pole on the electrical panel plug. After this repeat point 5.

Main Controller Unit ATC, Handling

Menus

When starting the ATC system there are four different basic menus the user can select. The user navigates between these different menus by means of the [i] key as shown in fig. Certain of the menus are protected by a password.



Navigation in the menus takes place by means of the keys on the keyboard. The keys four and six are used to step up and down, and keys two and eight to step from side to side. The arrows on the display show the possible directions.

The enter key is used to go into the submenus. To leave a selected menu, use the Exit selection together with the enter key. One refinement is that the horn key can be used as an escape key. It can also be used to step back in the menus to the Exit position. This function can also be used to cancel an initiated parameter change.

The menus are divided into three levels, as follows:

Operational

This menu is used to log into the Operational mode. Logon takes place by selecting driver ID, entering a password, and finally using the safety switch as an enter key. In the Operational mode it is possible to use the truck and all its functions.

Local Service

In the Local Service menu it is possible to change passwords for local service, add and remove drivers, and set the time/date, LCD contrast, and key sound. Certain statistical functions are also available here. A password is needed to access the Local Service menu.

Atlet Service

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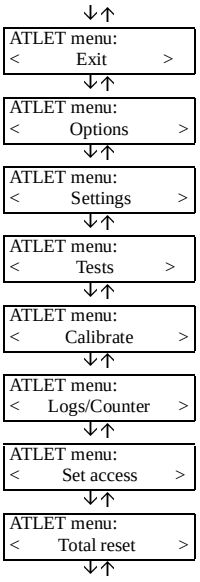
Atlet Service includes all the functions used by Atlet authorised service personnel. A password is needed to access the Atlet Service menu. The Atlet Service menu is built up as shown in fig.



- Exit – selected to exit the Atlet menu.
- Options – possibility to set the options available for the truck.
- Settings – possibility to set driver parameters, hydraulic parameters and battery parameters.
- Tests – tests I/Os.
- Calibrate – possibility to calibrate inputs.
- Log/Counters – possibility to read and clear temperature log, error log, and hour counter.
- Set access – possibility to add drivers, and set passwords for Atlet and local service.
- Total reset - Possibility to restore all settings, options, users, calibrations and logs to default values.

Settings

Under the settings menu it is possible to select the language shown in the display. Swedish, English, French, and a “custom” language can be selected. It is possible by using a PC and a special program to add on a “custom” language.

Total Reset

In the Total reset menu it is possible to restore all settings, options, users, calibrations and logs to default values.

- **Exit**: Exits the Total reset menu and performs a restart of the system. Note that the command means leaving the Atlet menu and performing an actual restart of the system.

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- **All Users**: Clears all users. The default user will be set instead. Also the Atlet code and the Local code will be set to the default codes.
- **Options**: Restores all options to default values.
- **Settings**: Restores all settings to default values.
- **Calibration**: Clears all calibrated values. A new calibration must be performed to make the truck work again.
- **Logs**: Clears all logs. Hour meters will not be cleared.

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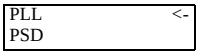
Set Truck Type

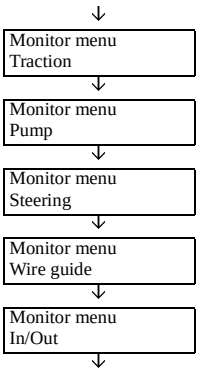
After clearing all settings or installing a new ATC, the truck type has to be set. When powering up the truck again the ATC will automatically open a menu asking which truck the ATC will be used in.



Scroll to the desired truck type and press enter. If the wrong type is selected, reset all settings in the Reset menu and try again.

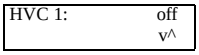
Monitor menu

By pressing the enter and 7 key at the same time it is possible to access the Monitor menu from the Operational mode. The Monitor menu shows the speed, power consumption, motor temperature and TMC temperature.



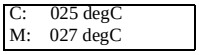
Switch off HVC

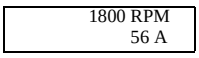
It is possible to switch off HVC. This is done under Atlet => settings => hydraulics => hvc setup.



Traction

Under the Traction menu it is possible to control the motor speed in real time and the power consumption or motor and TMC temperature.





Pump: Not relevant for PLL/PSD.

Steering: Not relevant for PLL/PSD.

Wire guide: Not relevant for PLL/PSD.

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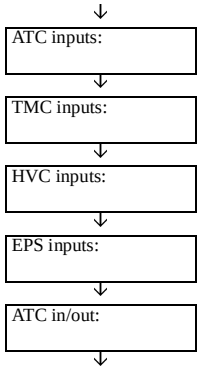
In/Out

Under In/Out it is possible to check all inputs to ATC, TMC and HVC in real time. It is also possible to check the ATC internal interlock functions. The function to check the inputs is built up as shown in fig:



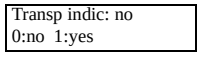
Note that the truck is in Operational mode when the Monitor menu is shown. In other words the truck can be driven, and therefore it is appropriate to block it up in accordance with the safety instructions.

Set Options

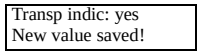
There are several different options under option. They are used to explain to ATC which accessories the truck is equipped with. Further information on which options are available and their function can be found under "Options" on page 10.36.

The option name and which status the option has (off or on) is specified in the first bar in the display. Setting an option is done as follows:

1. Step forward to the option to be set, and press enter.



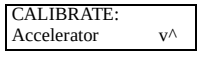
2. Press the 0 key to switch off the option, or 1 to set it.



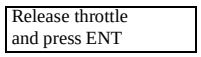
Calibrate accelerator

Under Calibrate it is possible to calibrate the accelerator. This is done as follows:

- Select accelerator, and press enter.



- Leave the accelerator in neutral, and press enter.



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- Apply maximum acceleration in both directions without pressing hard to the end position, and then press enter.

Go to end points and press ENT

- The display shows if the calibration was successful or not. (only Software 2.23–)

Ok! Press ENT

Not successful! Press ENT

- The calibration is now finished. A window is shown where it is possible to test the response of the accelerator. Press enter to end.

Signal check: 2.3V Out: 064%

☞ ***Important!***

The accelerator must be calibrated at each service.

Calibration of lifting and lowering controls (ATC T4 mk2, 2007w28–)

☞ ***Important!***

The lifting and lowering controls must be calibrated both at ON/OFF and proportional adjustment.

1. Open the Atlet menu => Calibrate => Lift/Lower. The following display appears:

Release lift press ENT

2. Check that there are no controllers activated. Now press ENT. The following display appears.

Order full raise press ENT

3. Press lift fully down on the right lift and lower control. Now press ENT.
4. The following display now appears.

Order full lower press ENT

Press lower fully down on the right lift and lower control. Now press ENT.

5. The display shows if the calibration was successful or not. (only Software 2.23–)

Ok! Press ENT

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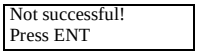
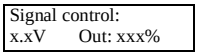


6. The following display appears:



You can now use this menu to check that the calibration is correct. Signal control should give the following values:

- When lift is activated: 4.7V (± 0.1V)
- Neutral (control not activated): 2.7V (± 0.1V)
- When lower is activated: 0.6V (± 0.1V)

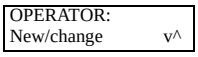
Press ENT.

7. Repeat the same calibration procedure for the left lift and lower control by selecting Channel 2, and follow steps 1-5. Exit by pressing ENT.
8. Leave the Atlet menu by going to Exit and pressing ENT.
9. Loosen the battery and then restart the truck.
10. Perform a function test of the lift and lower function.

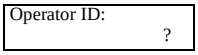
Add New Driver

New drivers can be added in the menu Set Access. Select Operator to add new driver.

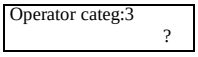
- Select new/change and press enter.



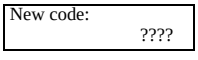
- Write in the driver ID to be changed/added.



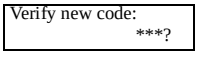
- Select the driver category the driver is to belong to.



- Select the code applicable for the driver. If the code or category is to be changed for an existing driver, the code associated with this driver ID must be specified first.



- To verify the code it must be entered one more time.



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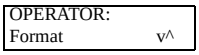
- Press enter to end.

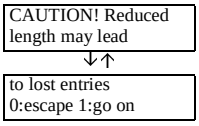
Change Format of Driver ID and Access Code

In the submenu Set Access there is a function to set the number of digits in the driver ID and access code. Both these can be set from between one to seven digits. Note that drivers with longer codes will not be able to logon if the number of digits is reduced! On the other hand if the number of digits is increased the requisite number of zeros will be added to existing, shorter codes.

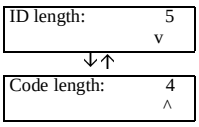
- The format of code/ID is changed in Set Access => Operator => Format.



- A warning in two parts is shown. Press 2 to see the second part of the warning. Continue by pressing 1.



- Change the length of ID or Code.

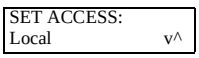


- Step out by pressing a four, or the horn key.

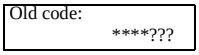
Change Access Code for Local or Atlet Service Menu

The codes for both Atlet and Local service can be changed in Set Access. This is done in the same way for both, as follows:

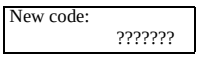
- Select Set Access => Local, and press enter.



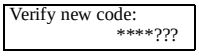
- Specify the valid code.



- Write in the new code.



- Verify the new code.



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- Press enter to end.

Log Functions and Hour Counter

There are two different log functions in ATC, error log and temperature log. Both can be read and cleared in Atlet Service.

There are also a number of hour counters and these can divided up into two categories, total time and trip time. Both can be read in Atlet Service, but only the trip category can be cleared. The times measured are:

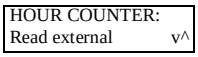
- Active time – the time the truck is used actively, or in other words the total of travel time and pump time.
- Log time – the time the system has been logged on.
- Travel time – the time the drive motor has been used.
- Pump time – the time the pump motor has been used.

The hour counters can also be read in external units, e.g. a TMC or HVC.

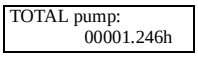
Read Hour Counter

- Select Hour counters under Logs/Counters.

- Select Trip, Total or External.



- Navigate between the four different hour counters.



- Step back with the 4 key or with the horn key.

Temperature Log

The temperator log registers temperature measurements from the truck drive motor and TMC in five different temperature intervals. The log saves the number of hours the different temperatures have been measured. A distinction is made between TMC and drive

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motor temperatures in different intervals, where TMC belongs to the lower intervals and the drive motor to the higher. See fig:

Table 10.4 Low intervals (TMC)

Temp. ranges:	**Hours** (the numbers are examples)
-40°C	436.53 h
41-50°C	271.28 h
51-60°C	42.74 h
61-70°C	3.61 h
>71°C	0.00 h

Table 10.5 High intervalls (Drive motor)

Temp. ranges:	**Hours** (the numbers are examples)
-60°C	137.63 h
61-80°C	41.77 h
81-100°C	24.88 h
101-120°C	2.6 h
>121°C	0.32 h

Error Log

ATC has an error log system that logs external and internal errors. External errors are errors that external units detect and report to ATC. Internal errors are errors that ATC detects itself. The error code, description of the error, date and time, are saved in the error log.

The error log function is based on four error classes:

- A – Shown in the display and saved in the log. Only cleared after it has been read.
- B – Shown in the display and saved in the log. Cleared when the error has ceased.
- C – Saved in the log. Not shown in the display.
- Warning – Gives a text warning. Certain warnings are logged.

In addition to being shown in the display, also indicates an error through an audible signal. The signal is repeated every other minute as long as the error/warning is shown in the display. The warning is shown in the full top bar on the display, while the error is shown in the second bar position 5-8.

The error log is divided into primary and secondary faults. A secondary error is an error that occurs 2 seconds after the first error occurred. If the last primary error is repeated

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without any other error occurring, this error will not be logged separately in the log. It will be added to a counter in the log of the last error instead.

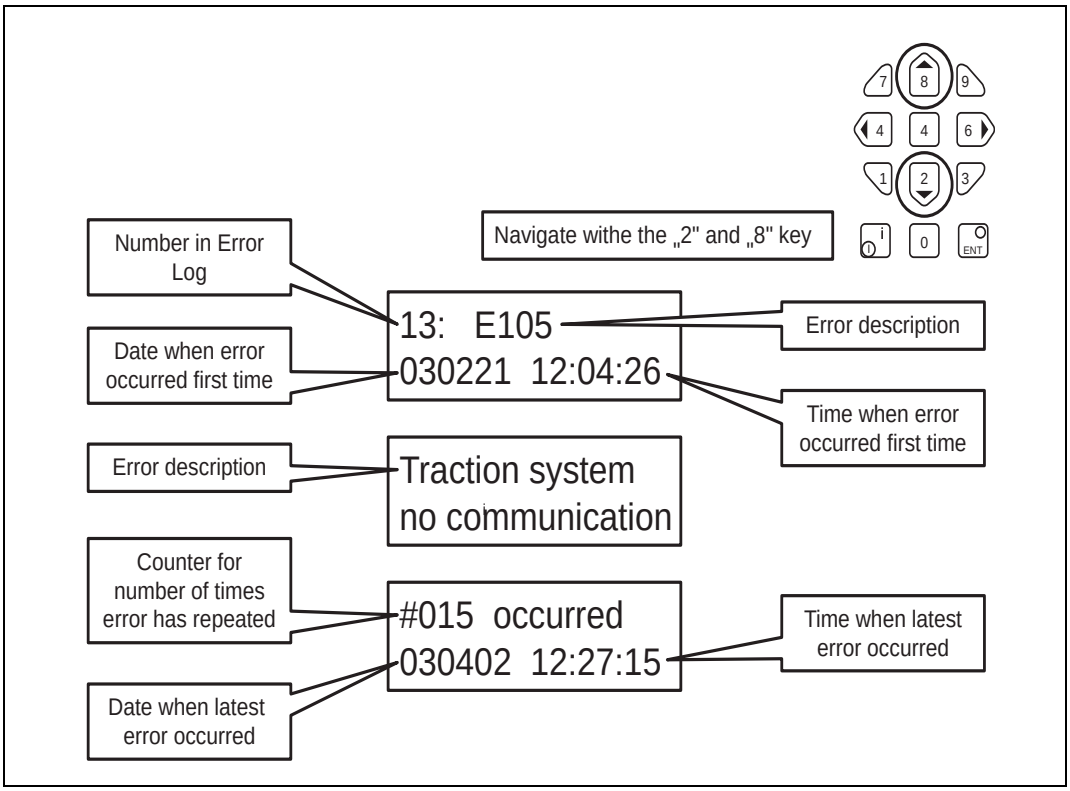

Figure 10.6 ATC T4 Error Log (Example)

Note!

If you reset the logbook, error code E027 will be logged.

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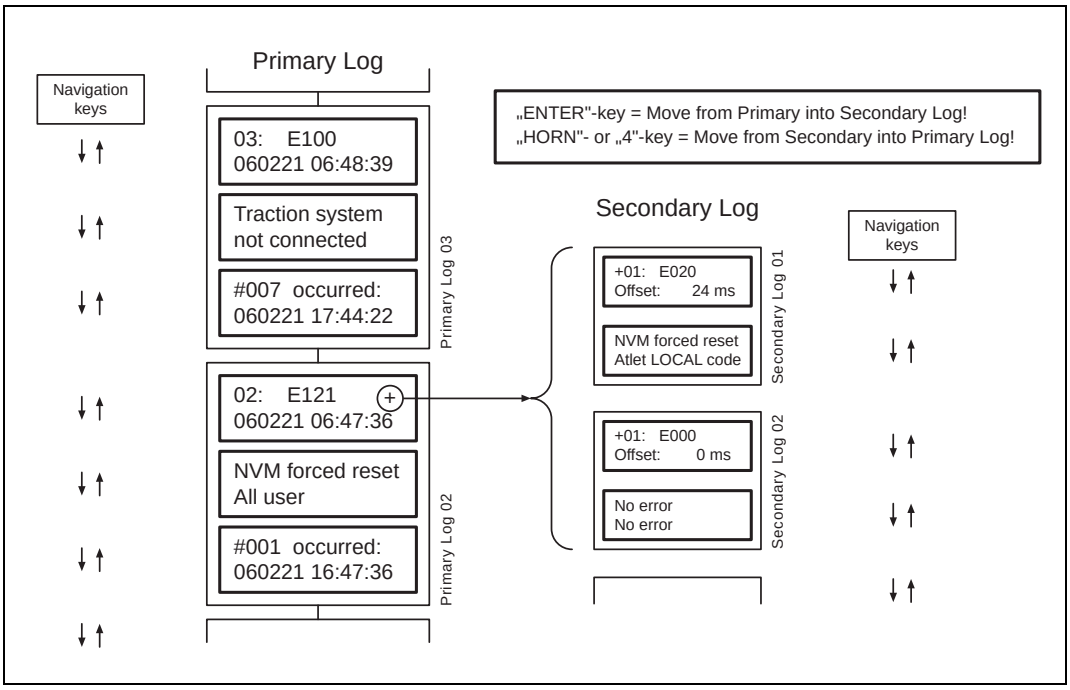

Figure 10.7 Error Log (Primary Log and Secondary Log)

Read Error Log

- The error log is opened with Log/Counters => Error log.

```
ATLET MENU:
<   Logs/Counters   >
```

- The primary faults in the error log are navigated with the 8 and 2 keys. Information is read from the error log as follows:

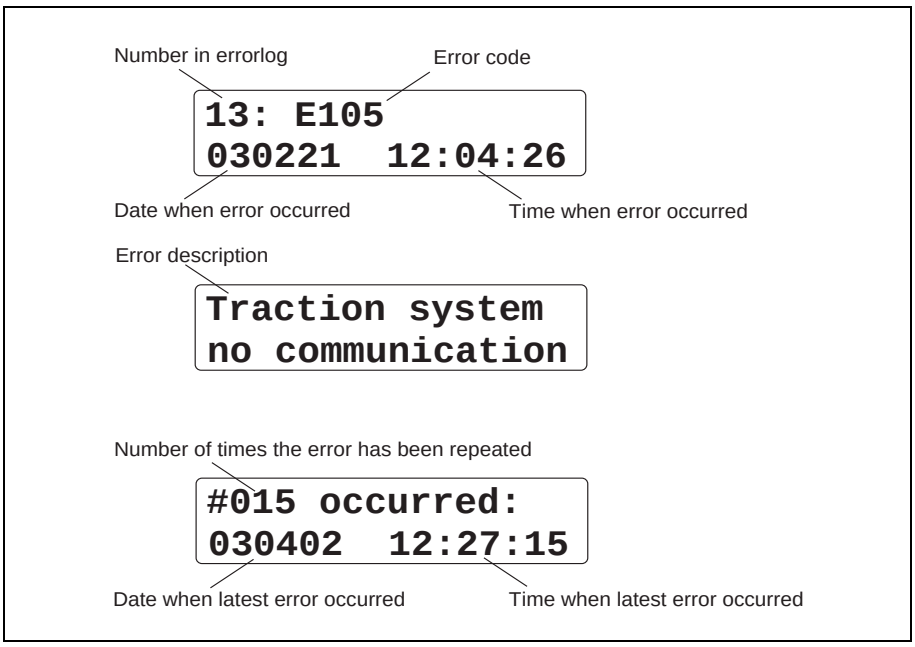

Figure 10.8

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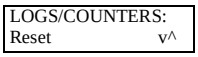
- The [i] key is used to access the secondary log. The secondary errors can then be navigated with the 2 and 8 keys.

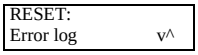
Clear Error Log

The error log in ATC only has 30 available positions and it may therefore be necessary to clear it occasionally.

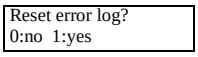
- To clear the error logs, select Logs/Counters => Reset.



- Select Error log.



- Select Yes.



Performance Parameters

The performance parameters in ATC are divided into two levels, machine parameters and driver parameters. The machine parameters represent the basic setting of the machine. They are preset at the factory and can only be changed by using a special PC program. The driver parameters are percentages of the machine parameters.

Driver Categories

The software in ATC supports four different driver categories. These are used to give different drivers difference performances. One example is the possibility to have a category for experienced drivers and one for beginners. All driver IDs must be associated with a driver category.

Parameter	Description	Limits
Fwd Speed	Maximum speed forward	20-100%
Rev Speed	Maximum speed in reverse	20-100%
Tract Accel	Acceleration	20-100%
Cutback 1	Creep speed	0-90%
Cutback 2	Tiller up drive speed	0-90%
Tract Curr	Current limit	20-100%
Rdc brake	Braking torque for reducer brake	0-100%
Neut brake	Braking torque for neutral position brake	0-100%
Rev brake	Braking torque for reversing brake	50-100%
Brake pedal	Braking torque for the ELCB brake	50-100%

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Set Driver Parameters

- Select Settings => Performance. Select the category the driver parameters are to be changed for.

```
PERFORMANCE:
Op category      1 v^
```

- Navigate amoung the different driver paraemeters with the 2 and 8 keys. Press enter to select parameter.

```
Cutback 2        20%
                 v^
```

- Write in a new value and press enter.

```
Cutback 2        25%
New value saved!
```

Pin Code

ATC uses a pin code instead of a key switch. Each driver is defined with a unique ID number. A pin code is linked to each driver ID, which can be 1-7 digits in length. Up to 100 driver IDs can be saved. The driver ID and code are used together to access the truck, thereby replacing the key switch.

Safety Checks

When logging into the truck there is a safety check of the brake switch, lift system, safety switch and speed controller. The lifting and speed controller should be inactivated when logging on and the brake switch should previously have been in neutral position. If any of these safety tests fail a warning is shown in the display, with a request to reset the activated control to neutral position. Depending on which control is activated an interlock function will be actuated to prevent the use of certain of the truck functions.

Warning text in display	Cause	Interlock function actuated
Release Throttle	The speed controller is actuated during logon. This warning can also be shown if the steering arm is moved to operational mode with an excessive throttle.	Speed interlock
Release Tiller	The brake switch was not in neutral position during start-up.	Safety interlock
Release controls	One of the keys for lifting/lowering was actuated during logon. Also shown if more than one lifting/lowering control is actuated simultaneously.	Lift interlock
Release controls	The safety switch has returned to neutral position after logon.	Safety interlock

Interlock function	System in the truck obstructed
Speed interlock	Drive system
Safety interlock	Drive system
Lift interlock	Lift system

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Speed Limits

In ATC there are two ways of achieving a reduction in speed during the operation of the truck, creep speed and tiller-up drive.

1. Creep speed is selected by switching with the 2 key between creep speed and full speed (key 8 to go straight to full speed). The actual position is shown in the display with a symbol representing a tortoise or a hare.

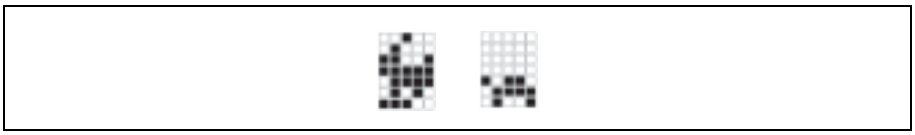

Figure 10.9

2. Tiller-up drive is a function that enables the truck to be operated with the tiller arm in raised position. This function is intended to facilitate manoeuvring in confined spaces. The speed of the truck is severely limited when this function is actuated. There is no indication on the display to confirm that tiller-up drive is actuated.

General Functional Description

For the truck to be in neutral position the following is necessary:

- The tiller arm must be raised.
- The drive wheel must point straight forwards.
- Forks in bottom position.
- Battery plug disconnected.
- Truck in room temperature (20°C).

Truck Mode

The truck can be in four different positions:

- OFF: Voltage disconnected.
- Logged on/Operational: To be compared with the battery plug connected and the key in the lock, key in on position.
- Logged off: To be compared with the battery plug connected but the key removed.
- Standby: To be compared with the battery plug connected and the key in the lock, but in off position.

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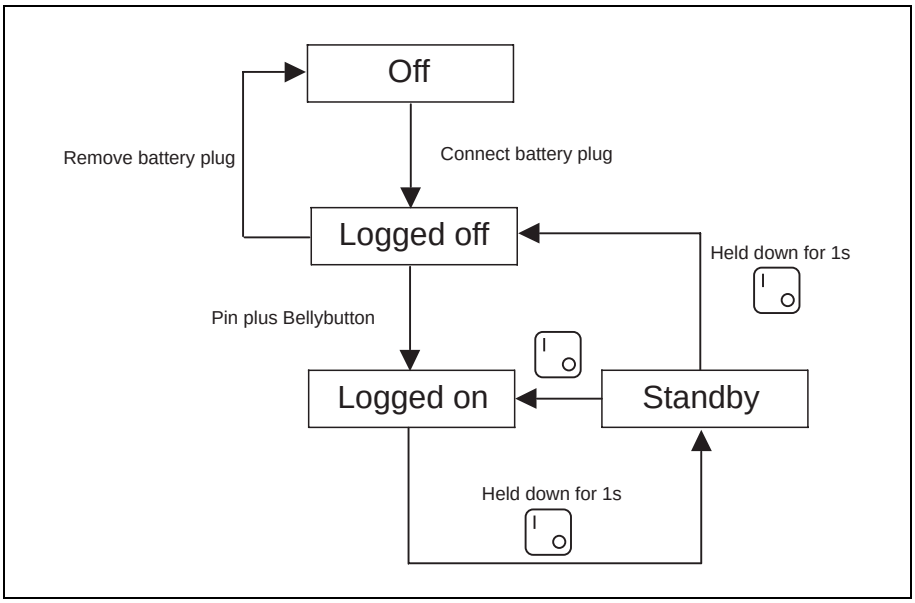

Figure 10.10

In Operational mode all the truck functions such as lifting/lowering and travel can be used. Logon with ID and pin code is required to access the Operational mode. In the Operational mode the driver can utilise a lot of information via the display, such as date, time, battery status, error codes and warning messages, etc.

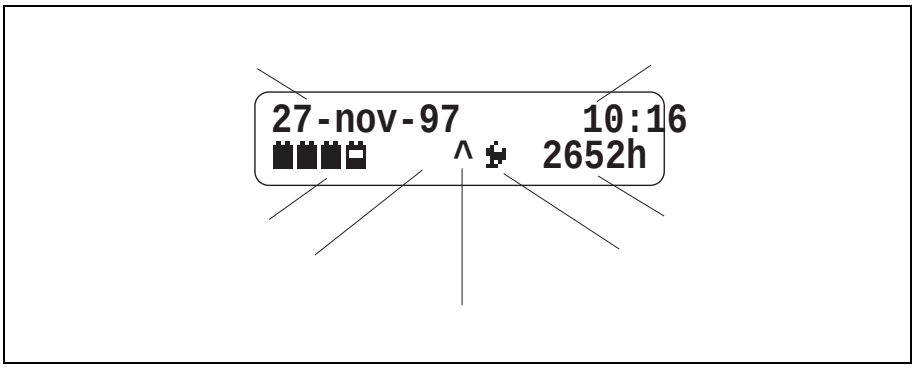

Figure 10.11

- Date - shows ATC date.
- Time - shows ATC time.
- Field for error codes – an error code is shown when an error occurs. When a warning is shown it is shown in the full upper bar instead.
- Symbol for creep speed/full speed - shows if the truck is in full speed or creep speed mode.
- Hour counter – shows active or logged on time, depending on which selection was made in the options menu.
- Battery indicator – shows battery status. When 20% battery status is reached the lift system ceases to be available.

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Temperatures

Controller temperature		
Situation	**Action**	**Indication**
Warning level 75-80°C	Current limit reduction starts.	TMC sends warning “Controller hot“.
Stop level ~100°C	Current limit reduction reaches zero.	Warning according to above remains.

Motor temperature		
Situation	**Action**	**Indication**
Warning level Adjustable temp level.	Current limit reduction to 70% of controller max.	TMC sends warning “Motor hot“.
Stop level Adjustable temp level.	Current limit reduction to 0% of controller max.	Warning according to above remains.

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Options

Option	Description
Lift limit	Lift stop for the fork lift. Stops the pump when the lift stop switch is actuated. The lift stop is connected to a digital input on TMC.
Restart	Restart of the fork lift, activated by pressing 2 on the keypad.
Safety syst	Safety system S3 (only PP* servo). When the safety system is enabled the speed is reduced during cornering. The safety system is a part of *Fleet Management*.
Effici log	Efficiency log. Included in *Fleet Management*.
Impact sens	Collision sensor. Included in *Fleet Management.* The collision sensor is purely software based. The speed is monitored, and sudden and rapid reductions in speed are interpreted - as different degrees of colliding. ***Log level*** -Setting for logging collisions. ***Warning level*** -Setting for collisions that give a warning on the display. ***Horn level*** -Setting for collisions that activate the horn. ***Stop level*** -Setting for collisions that stop the truck. ****Supervis level*** -Setting for collisions that require the truck to be unlocked using a code.
Damage rep	Damage log. 10 seconds after logging the truck reverts to crawl speed and the driver receives a number of questions about any damage. If the driver answers no, the truck switches to *Operational*, i.e. the truck runs as normal. Otherwise a question is asked about damage to different parts of the truck. Included in *Fleet Management*.
Time logoff	Time for automatic logging off. ***Del time a*** -Time to go to *Standby.* ***Del time b*** -Time to log off. **Dis tiller res (Disable tiller reset)** -If the parameter is set to “Yes”, you log on from *Standby* to *Operational* by pressing the *“I”-button twice.* If the parameter is set to “No”, you log on by activating the tiller arm's brake switch.
Smartcard	Smartcard is a unit mounted on the machine housing (servo) or the tiller arm. Smartcard permits a log on using a card instead of a PIN-code. ***Damage rep*** -Damage log for the Smartcard. Works as the damage log *Damage rep.*
Disp log on	If the option is enabled the log on time is shown on the display. Otherwise the active time is shown.
Summer time	Automatically sets the clock to summer time.
Keyswitch	If the option is enabled the keyswitch is used instead of the PIN-code when logging on.
Speed red	Speed reduction is connected to a digital input on TMC.
Service-Alarm	Automatic service reminder. ***Interval*** -Time for service interval.
Fixed platf	Activated when a fixed platform is used (only PLP).
TillerUpD	Holding in the button on the tiller arm allows the truck to be driven at crawl speed, without actuating the tiller arm brake switch (only PLL/PSD/PS).
Footswitch	Activates the foot switch on the operator lift (only PP).
Reverse ind	Reversing warning unit which is connected on HVC (only PP).

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Raise steer	Accompanying control (only PP).
Dual lift	Double proportional buttons (only PS/PSH)
Straddle	Adjustable support arm (only PSH). Can not be combined with *Dual lift.*
Belly start	If the parameter is set to “Yes”, the belly switch must be activated in order to log on (used as an “Enter” button). If the parameter is set to “No”, you are immediately logged on once the code has been entered.

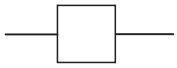
**Only shown if the option is activated.*

⚠ ***Warning!***

When options are stated as being truck specific, under no circumstance may these be activated on any other type of truck than the ones stated. This is on account of the software using the same digital inputs for different functions on different truck models.

ATC Logic

The truck control logic is nowadays mainly generated in the ATC software, and not as previously with cabling and the series and parallel connection of switches. For this reason it is no longer possible to measure all the logical conditions by means of a multimeter. This can now be done with the help of the Monitor menu function for input control. There is no circuit diagram for the software. Instead, a graphic description of the software conditions required for ATC to request procedures has been generated.



The condition **does not rule** if it is true. Can be compared with a NC contact.

The condition **rules** if it is true. Can be compared with a NO contact.

Two conditions after each other generate an **“and”**condition, i.e both conditions must rule for the objective to be achieved. Two parallel conditions generate an “**or**” condition, which means that it is sufficient for one of the conditions to rule for the objective to be achieved.

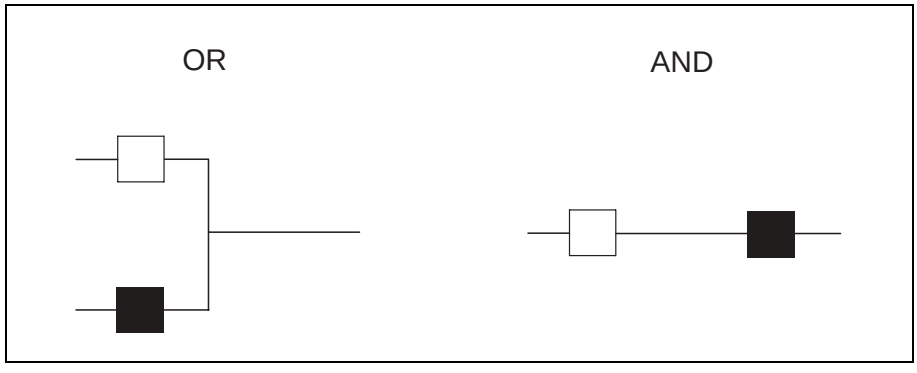


Figure 10.12

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Below is an example of how the horn works:

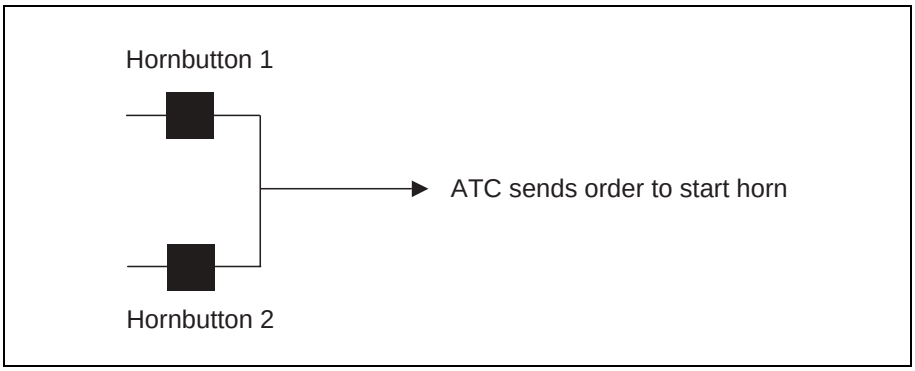

Figure 10.13

It is therefore sufficient for one of the horn keys to be actuated for it to start.

Direction selection

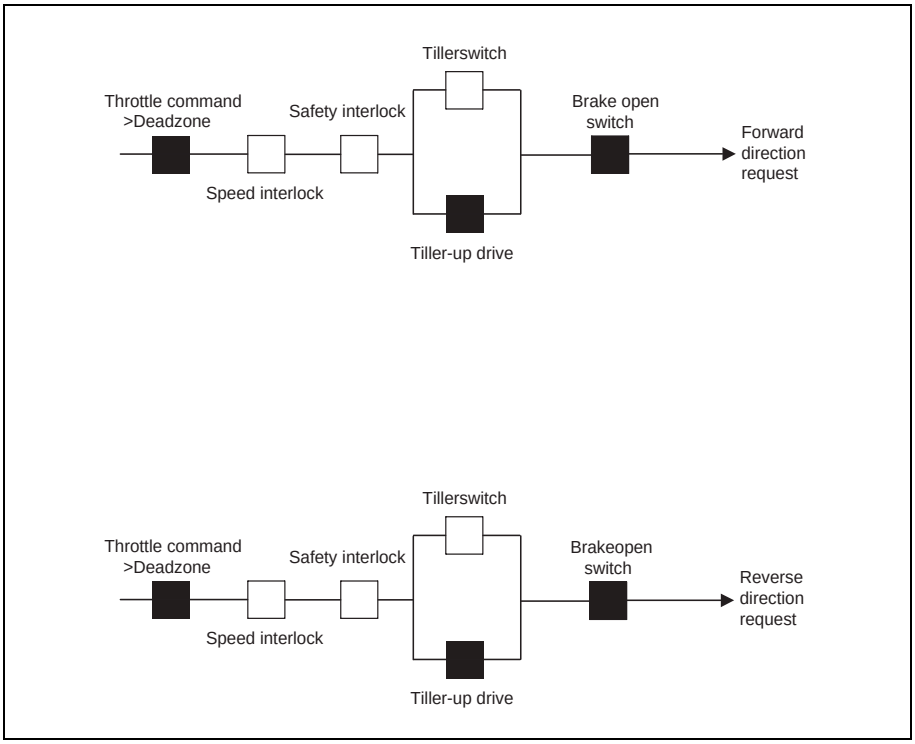

Figure 10.14

An explanation of the different interlock conditions is available under "Safety Checks" on page 10.32. For further information on the options, see chapter Options "Options" on page 10.36.

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Brake system

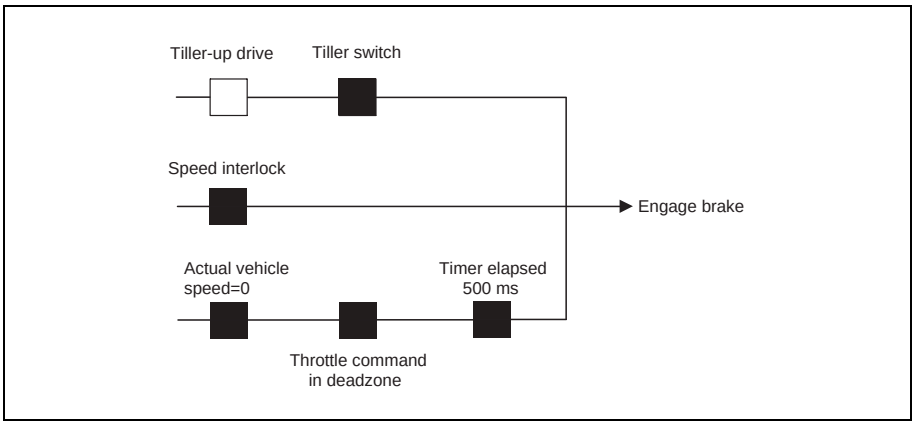

Figure 10.15

An explanation of the different interlock conditions is available under "Safety Checks" on page 10.32. Note that the brake will be automatically engaged after 500 ms on a stationary truck with the speed controller in neutral position.

PLL Lift system

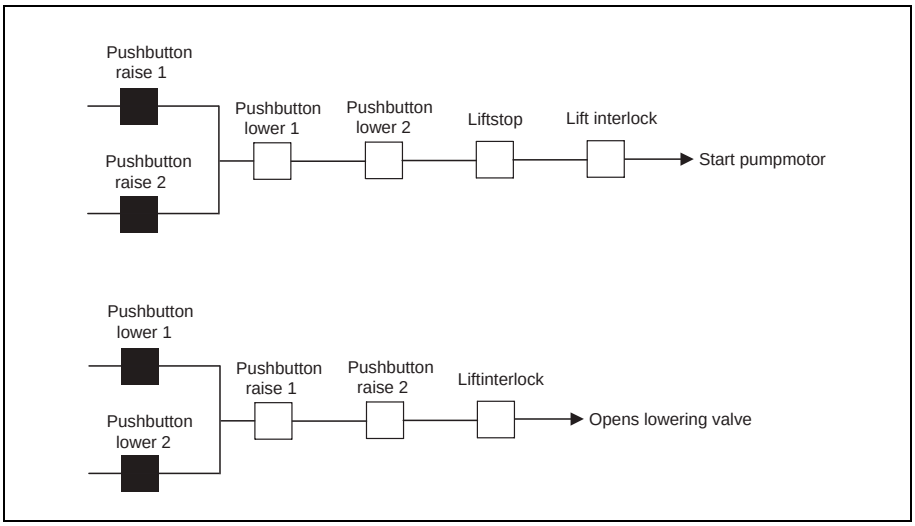

Figure 10.16

An explanation of the different interlock conditions is available under "Safety Checks" on page 10.32.

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PSD lift system

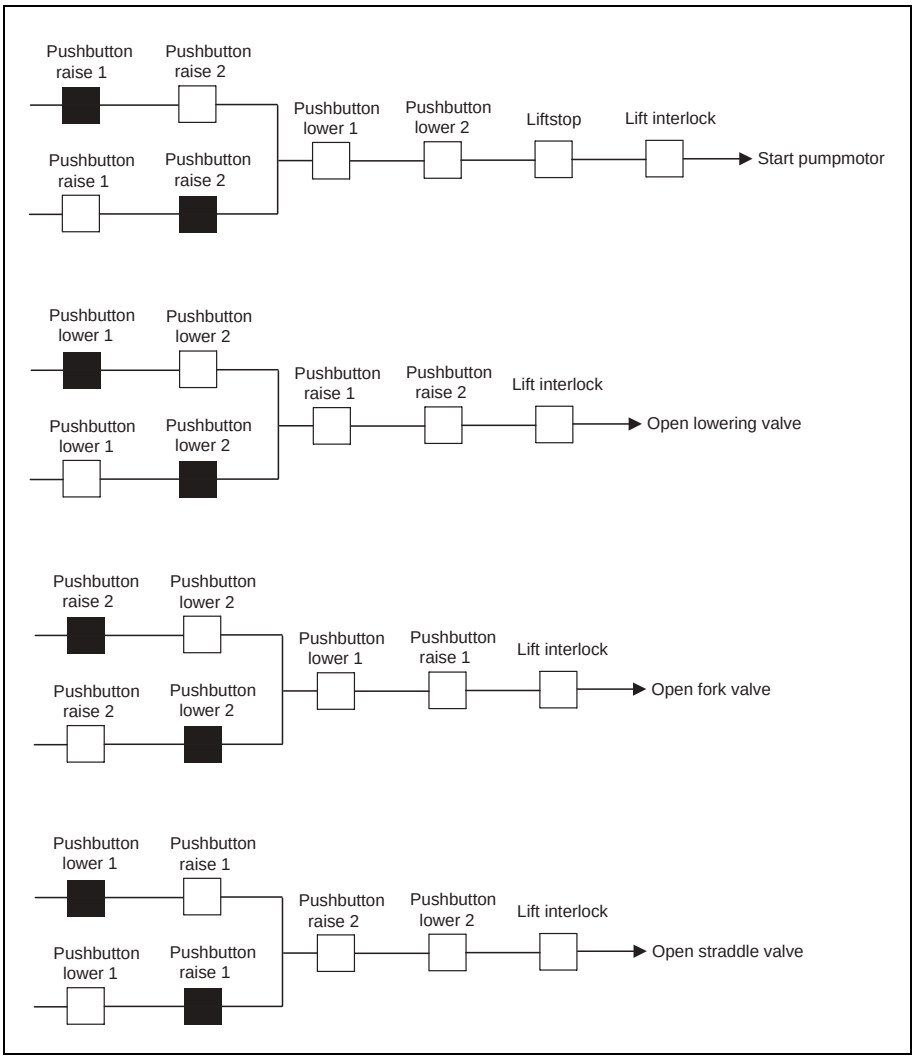

Figure 10.17

An explanation of the different interlock conditions is available under "Safety Checks" on page 10.32.

Printing of statistics

A function is available under CUSTOMER Service to print all statistic functions either individually or all at once. Any serial printer or a PC can be used for this purpose.

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ATC connector

ATC, connector and pin numbering.

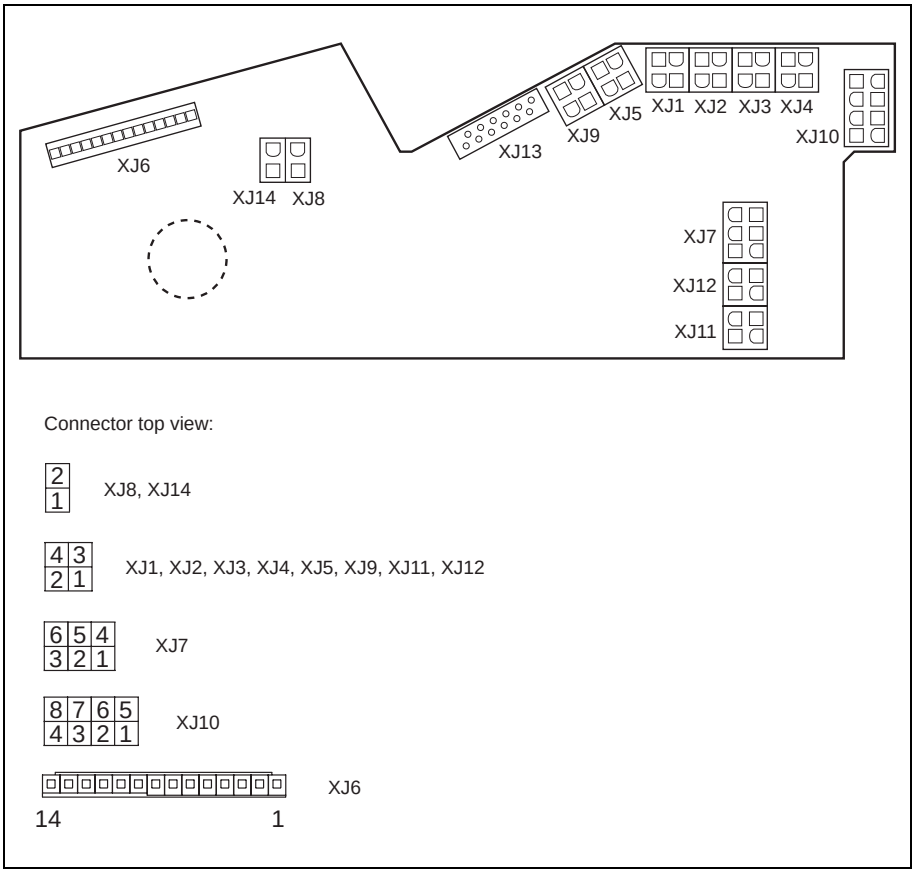

Figure 10.18 Cortex card

Digital I/Os

Digital inputs ATC

There are 12 digital inputs on the ATC card, of which seven are used for the pushbuttons on the tiller arm. The pushbuttons control the functions lift/lower, the horn, Tiller-up drive, and the raising/lowering of the straddle lift. The signal voltage is 5V.

The other five digital inputs are not used in these truck models.

The fact that the inputs are read by ATC can easily be confirmed by selecting Test =>Inputs in the ATLET service menu, and then activating the different functions.

The signal supply of approx. 5V is on pin no 1 in the following connectors:

Connector	Function	Comment
XJ1.3	Lift PLL/Lift straddle lift PSD	
XJ2.3	Lower PLL/Lower straddle lift PSD	

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Connec-tor	Function	Comment
XJ3.3	Lift	
XJ4.3	Lower	
XJ5.3	Creep drive (Tiller-up drive)	
XJ14.4	Horn 1	Supply 5V pin no 2
XJ14.3	Horn 2	

Digital inputs TMC

There are ten digital inputs in TMC, of which three are used for these truck models.

Signal supply 24V is taken from pin no X5.2.

Connec-tor	Function	Comment
X5.3	Brake switch	Closed in the upper and lower arm position.
X5.7	Top position switch	Breaks at end position
X5.8	Open brake	Prevents driving when the brake is mechanically disconnected. The switch is closed during normal operation.

Digital 24V outputs ATC

All the outputs in ATC are of the “low side” type, which means that they close to B-.

Only one output is used in these trucks. Signal supply 24V is on XJ11.3.

Connec-tor	Function	Comment
XJ11.4	Creep drive relay	Energises the creep drive relay K4 when the creep drive button is activated. The function of the relay is to release the brake when the arm is in its upper position and the Tiller-up drive function is used.

Digital 24V outputs TMC

There are five digital outputs in TMC. Five of these are of the “low side” type, which means that they close to B-. The fifth output is of the “high side” type, which means that it closes to B+. It is this fifth output that closes the lowering valve Y2.

Connec-tor	Function	Comment
X6.1	Energises main contactor K1	24V supply from X6.2
X6.3	Energises the electric brake Y1	24V supply via brake switch
X6.4	Energises the lift contactor K2	24V supply via X6.5

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Connector	Function	Comment
X6.6	Energises the horn H1	24V supply via X6.5
X6.11	Energises the lowering valve Y2	0V supply via X6.12. NOTE! This output is not short-circuit-proof

Digital 24V outputs HVC

The HVC module consists of five outputs, of which one can also be used as a proportional output. Only two digital on/off outputs are used for the two extra valves on PSD. All the outputs are of the “low side” type and close to B-. 24V supply to the valves is taken from X23.7.

Connector	Function	Comment
X23.4	Energises valve Y4	Activated together with the pump during lifting of the forks, and together with valve Y2 during lowering of the forks.
X23.7	Energises valve Y3	Activated together with the pump during lifting of the straddle lift, and together with valve Y2 during lowering of the straddle lift.

Cold resistance values PLL/PSD

Component	Resistance
Contactor K1	approx. 30 Ohm
Contactor K2	approx. 30 Ohm
Valve coil Y2	approx. 39 Ohm
Valve coil Y3	approx. 23 Ohm
Valve coil Y4	approx. 23 Ohm
Brake Y1	approx. 23 Ohm
Temperature sensor drive motor	approx. 940 Ohm at room temperature. The sensor has a positive temperature coefficient

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Fuses

Fuses		
F1	100A	Drive motor
F2	80A	Pump motor
F3	7.5A	Manoeuvring

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Diagnostics and trouble shooting

Truck Remote ACcess, TRAC

The purpose of TRAC is to create a remote access to the display and keyboard of the truck, so that an expert can make a remote analysis of the truck and guide local service personnel to trouble shooting.

Prerequisites

- GSM-phone with built in modem and serial cable (local TRAC experts can provide more information on suitable phones).
- GSM telephone subscription featuring “data call“ and a “data phone“ telephone number.

Utilization

After agreement with a TRAC expert to use the TRAC system:

- Prepare and connect according to the connecting procedure below.
- The TRAC expert may send text messages to you through the display of the truck.
- When the TRAC session is closed, await a phone call from the expert or call the expert yourself.
- Disconnect in reverse order (see connecting procedure).

Connecting Procedure

1. Step to TRAC using the arrow button, and enter the menu with the Enter button.
2. Choose “init phone“ and return to the TRAC menu with arrow ←.
3. When the phone rings, choose “answer phone“. Return with arrow ←.

Illustrated instructions are attached to the TRAC cable.

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Error code indicating ATC:

The error codes 1-33 are all memory errors that can occur in conjunction with program errors during unsuccessful reprograming or during electrostatic discharge.

Table 10.1

Error code indicating	Class	Explanation	Control/Procedure
E1 ATC invalid NVM access	Warning B	Attempt to write to invalid E2PROM address	Settings lost. No action.
E2 ATC NVM general access lost	Warning B	Time out under READ/WRITE access to E2PROM in NVM module	Settings lost. No action.
E3 ATC NVM (error) access lost	Warning B	Time out under READ/WRITE access to E2PROM in ERROR module	Settings lost. No action.
E4 ATC NVM parameter access lost	Warning B	Time out under READ/WRITE access to E2PROM in parameter module	Settings lost. No action.
E5 ATC NVM (access check) access lost	Warning B	Time out under READ/WRITE access to E2PROM in check access module	Settings lost. No action.
E6 ATC NVM (timer) access lost	Warning B	Time out under READ/WRITE access to E2PROM in timer module	Settings lost. No action.
E7 ATC NVM (statistics) access lost	Warning B	Time out under READ/WRITE access to E2PROM in statistics module	Settings lost. No action.
E8		Not used	
E9		Not used	
E10		Not used	
E11 ATC NVM parameters partially reset during start-up	C	One or more parameters (parameters/accessories/settings) outside the area. This can also happen when the system starts up for the first time.	New settings may be necessary.
E12 ATC NVM local code reset during start-up	C	Local access code outside area (0-9999999). This can also happen when the system starts up for the first time.	New settings may be necessary.
E13 ATC NVM ATLET code reset during start-up	C	ATLET access code outside area (0-9999999). This can also happen when the system starts up for the first time.	New settings may be necessary.
E14 ATC NVM user entry cleared during start-up	C	User ID/code or profile outside area	New settings may be necessary.

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Table 10.1

Error code indicating	Class	Explanation	Control/Procedure
E15 ATC NVM error log cleared during start-up	C	Error log corrupt	No action.
E16 ATC NVM timer (timers) cleared during start-up	C	Timer outside area	No action.
E17		Not used	
E18		Not used	
E19		Not used	
E20		Not used	
E21 ATC NVM all users forced to reset	C	All users forced to reset in the reset menu	New settings may be necessary.
E22 ATC NVM all users forced to reset	C	Accessory parameters forced to reset in the reset menu	New settings may be necessary.
E23 ATC NVM setting of parameters forced to reset	C	Setting parameters forced to reset in the reset menu	New settings may be necessary.
E24 ATC NVM calibration parameters forced to reset	C	Calibration parameters forced to reset in the reset menu	New settings may be necessary.
E25 ATC NVM all logs forced to reset	C	All logs forced to reset in the reset menu	No action.
E26		Not used	
E27 ATC NVM error log forced to reset	C	Error logs forced to resest in the ATLET menu	No action.
E28 ATC NVM temperature log forced to reset	C	Temperature logs forced to resest in the ATLET menu	No action.
E29 ATC NVM trip meter time/utilisation forced to reset	C	Trip meter time/utilisation forced to resest in the ATLET menu	No action.
E30 ATC NVM diver log forced to resest in the LOCAL menu	C	driver log forced to resest in the LOCAL menu	No action.
E31 ATC NVM effective time forced to resest in the LOCAL menu	C	Effective time forced to resest in the LOCAL menu	No action.
E32 ATC NVM damage log forced to resest in the LOCAL menu	C	Damage log forced to resest in the LOCAL menu	No action.

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Table 10.1

Error code indicating	Class	Explanation	Control/Procedure
E33 ATC NVM collision log forced to resest in the LOCAL menu	C	Collision log forced to resest in the LOCAL menu	No action.
E34		Not used	No action.
E35 ATC analog speed input not in approved voltage range	B	Analog speed input not in approved voltage range	Approved range approx. 0.3 – 4.8V 1. Recalibrate 2. Change ATC
E36 ATC analog brake input not in approved voltage range	B	Analog brake input not in approved voltage range	Not used on these truck models. If the error code still comes up check that ATC is correctly connected, otherwise change ATC.
E37 ATC analog lift input not in approved voltage range	B	Analog lift input not in approved voltage range	Not used on these truck models. If the error code still comes up check that ATC is correctly connected, otherwise change ATC
E38 ATC analog lower input not in approved voltage range	B	Analog lower input not in approved voltage range	Not used on these truck models. If the error code still comes up check that ATC is correctly connected, otherwise change ATC
E39 ATC Analog XJ3.3 (A-IN1) input not in approved voltage range	B	Analog XJ.3 (A-IN1) input not in approved voltage range	Not used on these truck models. If the error code still comes up check that ATC is correctly connected, otherwise change ATC.
E40 ATC Analog XJ4.3 (A-IN1) input not in approved voltage range	B	Analog XJ4.3 (A-IN1) input not in approved voltage range	Not used on these truck models. If the error code still comes up check that ATC is correctly connected, otherwise change ATC.
E41 ATC Analog potentiometer input, low value not in approved range	B	Analog potentiometer input, low value not in approved range	Not used on these truck models. If the error code still comes up check that ATC is correctly connected, otherwise change ATC.
E42 ATC Safety switch monitoring lost	A	Check of safety switch redundancy lost	If error recurs, change ATC.

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Table 10.1

Error code indicating	Class	Explanation	Control/Procedure
E43 ATC speed controller monitoring lost	B	Analog speed controller/check of speed controller signal in neutral position, lost	1. Recalibrate 2. Change ATC
E44		Not used	
E45		Not used	
E46 ATC Error detected on servo input	A	Error detected on servo input	Not used on these truck models.
E47			
E48			
E49			
E50 ATC/TMC low battery	C	Current battery status received from TMC is less than 20%	Charge the battery. In the event of repeated E50 logs, check BDI setting (Se "Battery capacity" on page 10.9).
E51 Com pot low fault	B	Common low supply range fault	1. Replace the lift/lower switch. 2. If the error still occurs replace the ATC.
E52		Not used	
E53 Hyd pot high fault	B	High supply to hydraulic controls supply range fault	1. Replace the lift/lower switch. 2. If the error still occurs replace the ATC.
E54		Not used	
E55		Not used	
E56 Lift range fault	B	Lift/lowering signal out of allowed range	• Tiller with on/off buttons: Reset calibration of lift lower and aux 1. • Tiller with rocker switch: Check the inductive sensors and the connections.
E57		Not used	
E58		Not used	
E59		Not used	

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Error code indicating TMC:

Table 10.2

Error code indicating	Class	Explanation	Control/Procedure
E100 CAN error	B	CAN communication error TMC on start-up	1. Check that TMC receives voltage supply 2. Check the CAN communication link between ATC and TMC to make sure there is no fault or short-circuit in the cables. See wiring diagram. 3. The may be a short-circuit on the ATC, TMC or HVC communikation port. Disconnect HVC and see if the error recurs, otherwise change TMC first and ATC as the other unit.
E101 TMC Watchdog	B	TMC monitoring has triggered	Try restarting the truck. If this does not help, change TMC.
E102 TMC logic error 1	B	Positive supply voltage to the logic is outside the range	1. Try restarting 2. Charge the battery if it is getting flat. 3. Check that the thick cables between the motor and TMC are properly tightened and that they have a low ohm factor. Check also the supply cables to TMC, and the cable and voltage supply to contact X5.1. 4. Change TMC 5. Change drive motor
E103 TMC logic error 2	B	Error in the part of the logic that handles the return supply of the phase voltage	1. Try restarting. 2. Charge the battery if it is getting flat. 3. Check that the thick cables between the motor and TMC are properly tightened and that they have a low ohm factor. Check also the supply cables to TMC, and the cable and voltage supply to contact X5.1. 4. Change TMC 5. Change drive motor
E104 TMC logic error 3	B	Error in the part of the logic that handles the overlead protection	1. Try restarting. If the error recurs, change TMC. 2. Change the motor

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Table 10.2

Error code indicating	Class	Explanation	Control/Procedure
E105 TMC emergency monitoring has tripped	B	Communication response from TMC has not been received in time	1. Restart 2. Check the CAN bus cable carefully if the error occurs repeatedly, to make sure there is no play on the connector ring and that the terminal resistance maintains 120 Ohm +/- 5%. 3. Check that the CAN bus is separated from the thick cables. Interferance can give rise to the error.
E106 TMC supply low E107 TMC supply high	B	This test is done on start-up and when stationary. (No drive manoeuvre is given)	1. Motor cable fault, connection fault, insulation fault in the motor or to chassis. 2. Change TMC
E108 TMC contactor closed	A	The main contactor contact tips are closed before voltage has reached the coil	Check main contactor K1 to make sure the contact tips are not welded, or that it is not short-circuited over the terminals via the cables.
E109 TMC contactor open	A	The logic has low voltage to main contactor K1 but the contactor tips do not close	1. Break in cables to the coil. 2. Break in coil. 3. The contactor tips do not close, or fail to connect with TMC.
E110 TMC current measuring in standby mode is not equal to zero	B	Check that the current is zero when truck is stationary	Change TMC
E111 TMC capacitor charging	B	The capacitor in TMC does not charge up as it should during start-up	1. Check that there is battery voltage to TMC, between B- and contact X5.1. If not, check battery voltage, supply cables and their connections. 2. Change TMC
E112 TMC output short-circuited	A	The output to the main contactor coil is short-circuited	1. Check that there is no short-circuit in main contactor K1, the coil, or that the freewheel diode is not reversed or short-circuited. Cut the diode and check that there is no short-circuit in the cables to the coil. 2. Change TMC
E113 TMC contactor output	B	The output for the main contactor does not function	1. Change TMC

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Table 10.2

Error code indicating	Class	Explanation	Control/Procedure
E114 TMC coil short-circuited	A	One of the outputs X6.1, X6.3, X6.4 or X6.6 is short circuited	1. There is a short-circuit in either the main contactor coil K1, the brake coil Y1, lift contactor coil K2, or in the horn. 2. There is a short-circuit in the cabling that connects to the components or in the free-wheel diodes, or in the capacitor that suppresses the horn. 3. Internal short-circuit in one of these outputs, change TMC
E115 TMC generic error	B	TMC self-test does not work	1. Try restarting a few times. If this does not rectify the problem, change TMC. **NOTE! The error is probably logged together with E123, but should normally never occur.** **If E115 or E123 are still be logged, this should be reported to the service function at ATLET AB**
E116 TMC CAN bus	A	Communication command from ATC not received in time	1. If other CAN errors are logged, rectify these first 2. There may be an error on ATC, interference on the CAN bus, or play in the CAN bus connector ring
E117 TMC wrong battery	B	Incorrect battery voltage	TMC may be incorrectly configured Change TMC
E118 TMC pulse transducer error	B	Error on the signal from the transducer bearing in the drive motor	Check and measure the transducer in accordance with the trouble shooting chart for "Drive motor" on page 10.59.
E119 TMC Brake output	A	Brake output X6.3 is defective	1. If there are other error codes logged, rectify these errors first 2. Change TMC
E120 TMC EEPROM error	C	EEPROM set to default. Error in the range that includes adjustable values.	The battery settings have probably been lost. See "Battery capacity" on page 10.9.
E121 TMC controller temperature	Warning C	The internal temperature monitoring has exceeded the 75°C warning level. The current is limited in relation to the temperature. TMC stops completely at 100°C.	1. See trouble shooting for "The drive motor looses power and the speed slowly drops." on page 10.61. 2. Change TMC

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Table 10.2

Error code indicating	Class	Explanation	Control/Procedure
E122 TMC motor temperature	Warn- ing C	The drive motor temperature has exceeded the warning level.	1. See trouble shooting for "High temperature in drive motor E122" on page 10.61.
E123 TMC generic	Warn- ing C	Generic warning	Try restarting a few times. If the error does not disappear, change TMC. **NOTE! The error is probably logged together with E115, but should normally never occur.** **If E115 or E123 are still be logged, this should be reported to the service function at ATLET AB**
E124 TMC PEV output	B	The output to lowering valve Y2 connection X6.11 is defective	First confirm that the valve coil is not short-circuited, that the freewheel diode short-circuits or is reversed, or that there is a short-circuit in the cabling. **NOTE! This output connects to B+ and is not short-circuit-proof. For this reason make sure to check that no external short-circuit exists before changing TMC.**
E125 TMC temperature sensor	Warn- ing C	The internal temperature sensor is defective	Change TMC
E126 TMC Temperature sensor drive motor	Warn- ing C	The drive motor temperature sensor is defective	First check trouble shooting for "High temperature in drive motor E122" on page 10.61.
E127 TMC Current sensor error	C	Current calibration in progress	Try restarting a few times. If this does not help, change TMC.

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Error code indicating HVC:

Table 10.3

Error code indicating	Class	Explanation	Control/Procedure
E130 HVC emergency monitoring error	B	Communication response from HVC has not been received in time	1. Restart 2. Check the CAN bus cabling carefully if the error occurs repeatedly, to make sure there is no play on the connector ring and that the terminal resistance maintains 120 Ohm +/- 5% 3. Check that the CAN bus is separated from the thick cables. Interferance can give rise to the error.
E131 HVC Watchdog	B	HVC monitoring has triggered	Try restarting the truck. If this does not help, change HVC.
E132 HVC “hi side drivers”	B	24 V supply to X22.2	1. Check that the battery is not low, or drops to below 16V when loaded. Charge the battery and check that there is a good low-resistance connection between X16 and X19.1 and from X19.1 to X22.2. Check also the minus cable K2.4- to X19.4 and from X19.4 to X22.4. 2. Change HVC
E133 HVC the proportional output is short-circuited	B	The proportional output is defective	This function is not used for these truck models. If the error still occurs, check that HVC has not been connected incorrectly. If not, change HVC.
E134 HVC On/Off outputs short-circuited	B	One or more On/Off outputs short-circuited	1. Check that there is no short-circuit in the cabling or free-wheel diodes to valve coils Y3 and Y4. The resistance when cold should be approx. 23 Ohm. 2. Change HVC
E135 HVC generic error	B	HVC self-test does not work	Try restarting a few times. If this does not rectify the problem, change TMC. **NOTE! Should normally never occur. If E135 still logs, this should be reported to the service function at ATLET AB**

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Table 10.3

Error code indicating	Class	Explanation	Control/Procedure
E136 HVC CAN bus	B	Communication command from ATC has not been received in time	1. If other CAN errors are logged, rectify these first. 2. There may be an error on ATC, interference on the CAN bus, or play in the CAN bus connector ring.
E137 HVC positive supply low	Warn-ing C	Positive logic supply is low	Check that HVC receives approx. 12V measured between X22.1 and X22.4. If not, check that TMC sends 12V from X6.16 loaded, unloaded. If the voltage rises unloaded it may be HVC consuming too much current, or alternatively TMC that cannot drive the out-put specified for 100mA. If there is a voltage drop between TMC and HVC, check the low-resistance connection X6.16 to X19.1 and from X19.1 to X22.1, plus the minus side K2.4- to X19.4 and from X19.4 to X22.4.
E138 HVC short-circuit in coil	Warn-ing C	Short-circuit in one or more On/Off control units	1. Check that there is no short-circuit in the cabling or free-wheel diodes to valve coils Y3 and Y4, or that one of the coils is speed short-circuited. The resistance when cold should be approx. 23 Ohm. 2. Change HVC
E139 HVC EEPROM error	C	EEPROM set to default	Log off and on, and note that the error codes disappear from the log book.
E140 HVC On/Off outputs not OK	Warn-ing C	On/Off outputs not OK	1. If there are other error logs in conjunction with this error, trouble shoot these first. 2. Do same trouble shooting as for error codes E134 and E138.
E141 HVC proportional output not OK	Warn-ing C	The proportional output is not OK	This function is not used for these truck models. If the error still occurs, check that HVC has not been connected incor-rectly. If not, change HVC.
E142 HVC ff coils	Warn-ing C	The proportional output is not OK	This function is not used for these truck models.

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Table 10.3

Error code indicating	Class	Explanation	Control/Procedure
E143 HVC CAN communication error	Warning C	No response from HVC on start-up	1. If this error should occur in a PLL truck without HVC, first check that the truck is not incorrectly configured for the use of HVC. 2. If TMC also reports error E100, trouble shoot for this error first. 3. Check the CAN communication connection between TMC and HVC 4. Check that HVC is actually supplied correctly from TMC. It should be 12V, measured between contact X22.1 and X22.4 5. If HVC is not supplied correctly by TMC, TMC should be changed, otherwise change HVC.

Other trouble shooting

Main contactor does not close

There may be other reasons why the main contactor does not close. For this reason, start trouble shooting by rectifying the last logged primary error code.

Have any related error codes been logged?	Yes →	See trouble shooting for respective error codes.
No ↓		
Is there 24V from TMC connection X6.2?	No →	Change TMC
Yes ↓		
Is there 24V to the main contactor plus connection K1.1?	No →	Check connection X6.2 - K1.1
Yes ↓		
Measure directly over the main contactor coil. Is there 24V?	No →	Check if cable connection K1.2 - X6.2 is OK and has low resistance by measuring the resistance to the front edge of X6, when the connector is pulled from TMC, to the front edge of the flat pin. If there is no connection, change or repair the cabling. Otherwise, change TMC
Yes ↓		

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Replace contactor

*The normal cold contactor resistance is approx. 30 ohm.

The truck and ATC have total function loss – the display does not go on

Is there 24V between F1 (between the large fuses) and the large pump contactor connection K2.4?	No →	Check the battery, battery plug, electrical panel plug and their connections.
Yes ↓		
Is there 24V between insulation bolt X16 and the large pump contactor connection K2.4?	No →	Check 7.5A fuse F3, and that there is 24V to one side of the fuse holder. Only measured with the fuse pulled out of the holder.
Yes ↓		
Is there 24V between X1.1 (the contact that connects to the steering arm) and the large pump contactor connection K2.4?	No →	Check that there is 24V on all the red/white cable connections in connector X21. Either there is a break or poor contact between X16 and X21.1, in toggle X21.1 - X21.2, or in the connection X21.2 - X1.1
Yes ↓		
Is there 24V between X1.1 and X1.5?	No →	Indicates break or poor connection in the blue minus cable between K2.4 and X1.5.
Yes ↓		
Open the steering arm head. Is there 24V between XJ10.1 and X1J10.5?	No →	Change the steering arm cabling, or repair.
Yes ↓		
Change ATC.		

NOTE! If the truck is equipped with a charger there may be a fault on this. If the truck functions when X21 is toggled, the charge should be changed.

All minus cables = blue

All plus cables in machine housing = red/ white

All plus cables in steering arm = red

NOTE! There may be an error on the display or display cable

Fuse

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The fuse for the drive motor (F1) is defective.

Change the fuse (with correct fuse value) and restart.

The most likely reason is that the mean current exceeds the rated current of the fuse. In conjunction with the change, carefully check the motor cables and the plus and minus cables to TMC to make sure they are correctly connected.

↓

Does the fuse blow just after the main contactor has closed?

Yes → Change TMC. If TMC is defective the most likely error is an exciter error with error codes E106 and E107.

No ↓

Start the truck again.

↓

Does the fuse blow again after the truck has been running for some time?

Yes → Check that the mechanical torque in the gearbox is not excessive.

Increased friction, increased load, high speed and rapid starting/stopping increase the average current for the controller. The truck may have been driven over its maximum performance.

If the truck has been run with a heavy load and at a high speed and with many stops and starts, or in some other way has exceeded its limitations, try to reduce the speed, load, acceleration and retardation.

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Drive motor

The drive motor only runs at low speed and with a ticking sound, or alternatively the motor does not start or runs irregularly with a low torque. TMC encoder error E118 is probably logged.

Pull out contact X9 that connects to the drive motor. Is there 12V between pin X6.9 and X6.10 in TMC?	No →	Pull out the contact X6 and check that the connections X6.9 - X9.1 and X6.10 - X9.4. If the cables are OK, change TMC.
Yes ↓		
Is there 12V between pin 1 and 4 in contact X9?	No →	Repair or change the cabling.
Yes ↓		
Replace the contacts and measure the voltage between X6.10 and X6.19 at the same time as the motor is run. An average value of 4-6 volt should be read off when measuring the DC. Ok?	No →	Carefully check that the cabling connection between X6.19 and X9.2 is OK and has a low resistance. If not, repair or change the cabling, otherwise change the drive motor.
Yes ↓		
Measure the voltage between X6.10 and X6.20 at the same time as the motor is run. An average value of 4-6 volt should be read off when measuring the DC. Ok?	No →	Carefully check that the cabling connection between X6.20 and X9.3 is OK and has a low resistance. If not, repair or change the cabling, otherwise change the drive motor.
Yes ↓		
An oscilloscope is required for further trouble shooting to determine whether the pulses from the motor sensor bearing are OK and 90 degrees out of phase. The error can either be in the motor or in TMC. Try the motor if it has low insulation resistance to the chassis. Otherwise start with TMC.		

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Drive function

The drive function does not work in one or two directions.

NOTE! If the brakes are applied and correctly adjusted they will hold the truck in spite of full modulation. For this reason, always check if the controller is working. It can be heard as a slight humming sound.

No → Reset the truck

Check that the safety switch has not temporarily jammed. If the error remains it will not be possible to restart the truck, and the question about the safety switch will still be in the display. Check also that the modulation from ATC works from approx. 2.5V in neutral position to close to 5V when driving in the direction of the forks, and close to 0V when driving in the opposite direction to the forks. Recalibrate if necessary.
There may be an error on the brake switch. Check that the brake switch has not jammed by checking the input for this via the test menu. The switch is normally open when the arm is between its upper and lower position. If there is 24V on TMC contact X5.3 the controller will not modulate and the brake will not be power actuated. Check also that the brake open switch functions as it should do. The switch should normally be closed when the brake is not disconnected, and there should be 24V to TMC contact X5.8. If not, check the cabling and switch.

Yes ↓
Reset the truck

Is there 24V to brake contact X7 when the truck is manoeuvred?

No →

Check that there is 24V on the brake switch contact X4.3 when the arm is in drive position. Check also that there is a connection between X4.3 and X7.1. If not, repair or change the cabling, or alternatively change brake switch S9 if this does not work.

Yes ↓

There is either a mechanical or an electrical fault in the brake. The resistance should be approx. 23 Ohm. Test if the brake functions if it is released from the motor. If not, change the brake.

NOTE! The brake switch input is tested during every new start to ensure that it closes to X5.3. If it not, a message is given to release up the arm before driving is permitted.

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High temperature in drive motor E122

If other error codes are logged, rectify these first. The drive motor may have become overheated because it has been run over its performance level for a long period. Check motor and gearbox.

Is the warning also given when the motor is cold?	No →	The truck may have been driven over its maximum performance. There may be a fault on the motor or gearbox. Reduce the drive performance temporarily.

Yes ↓

Check that the cabling connection between X6.8 and X9.5 is OK and has low-resistance, and do the same for X6.13 and X9.6. If not, repair or change the cabling. If the cabling is OK there is a fault on the temperature sensor, and error code E126 has probably been logged. The temperature sensor resistance at room temperature should be approx. 940 ohm, with increased resistance at rising temperature. This means that a cable break or a break in the sensor causes a max temperature alarm. The temperature sensing can be temporarily removed by connecting an external resistance of 1 kohm ½u. To repair the temperature sensing the motor must be cooled.

↓

Did this solve the problem? If not, change TMC.

For information on temperature log, see "Temperature Log" on page 10.27.

The drive motor looses power and the speed slowly drops.

High temperature in drive controller, error code E121 may be logged. A warning text is normally shown in the display.

TMC starts to module down the motor current linearly at 75°C to stop completely at 100°C. If the error occurs with a cold controller there is probably an error on the TMC internal temperature monitoring. If other error codes are logged, start the trouble shooting by rectifying these first. Otherwise, change the controller.

Check that the fan that cools TMC is working as it should and that the cooling fins on TMC are not blocked by dust and dirt. OK?	No →	Check the fan cabling and that there is 24V to the fan. Otherwise, change the fan and clean up dust and dirt.

Yes ↓

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Run the truck for an extended period in raised position and without load. Does the temperature in the controller still go over 75°C?	No →	The truck may have been driven over its maximum performance. Try to reduce the speed, load, acceleration and retardation.
Yes ↓		
Try to confirm if there is something that is increasing the torque, such as worn or jamming gearbox, and if the motor is working normally. OK?	No →	Rectify the gearbox or change the motor.
Yes ↓		
Change TMC		

For information on temperature log, see "Temperature Log" on page 10.27.

Lowering of the forks does not work

Does ATC read the input(s) in the menu “test inputs”? See, "Monitor menu" on page 10.22	No →	Check that the pushbutton closes at approx. 5V to ATC. Check also that 5V is available, otherwise change ATC.
Yes ↓		
Is there 24V over the valve coil during lowering?	No →	Test the cable connection between X6.11 and X2.1 and between X6.12 and Y2.2. If OK, change TMC.
Yes ↓		
Check that there is no break in the valve coil. A normal resistance value is approx. 39 ohm. If not, change coil.		

If the truck is a PSD, see also the trouble shooting for straddle lift.

NOTE! If other pushbuttons for the hydraulic function are actuated at the same time as the lowering button, the lowering is stopped. “Release controls” comes up in the display.

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Lifting of the forks does not work

NOTE! Certain trucks are equipped with end position stop. Before trouble shooting, temporarily set this option to “no”. If this solves the problem the top position switch should be checked in accordance with the trouble shooting chart for this.

Does the lift contactor actuate without the pump running?	No →	Check that the inputs for lift are read by ATC in the “inputs” menu in the test menu. If not, check that the pushbuttons work and close when actuated. Check that the pushbuttons receive approx. 5V from ATC. If not, change ATC. Check that there is not a break to pump contactor K2 by checking the cabling, and that there is not a break in the connector coil. If there is +24 V to the contactor with B- as reference and the contactor still does not pull, change TMC.
Yes ↓		
Is the fuse F2 intact?	No →	Change the fuse.
Yes ↓		
Check that 24V goes to the motor terminal. OK?	No →	The contact tips do not seem to conduct.
Yes ↓		
Check the brushes to the hydraulic unit, and that they are rest against the commutator. OK?	No →	Change the brushes, or adjust.
Yes ↓		
Change unit		

If the pump runs and the forks still do not lift there may be a fault in the hydraulics, a pump fault, or incorrectly connected hydraulic hoses.

NOTE! Remember to reset the option for end position switch lift if the truck is equipped with this.

If the truck is a PSD, see also the trouble shooting for straddle lift.

NOTE! If the battery is below 20% the lift stop will be actuated. Charge the battery.

NOTE! If other pushbuttons for the hydraulic function are actuated at the same time as the lifting button, the lifting is stopped. “Release controls” comes up in the display.

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The top position switch for lifting does not function

If the truck is equipped with top position switch for lifting this must normally be closed to enable lifting. The switch function can be checked in "Monitor menu" on page 10.22

Pull apart contact X15 and measure the resistance of the switch between pin 1 and 2 when the forks are completely lowered. OK?	No →	Check that the switch is not in mechanically actuated position. If OK, change switch.
Yes ↓		
Check that there is 24V to the switch and that TMC receives 24V on contact X5.7. OK?	No →	Check the cabling and that TMC supplies 24 V from contact X5.2. If not, change TMC.
Yes ↓		
Remove the option for top position switch in the options menu, or alternatively change TMC.		

Lifting of the straddle lift does not work (PSD)

Is the pump running?	Yes →	Check that there is 24 V to valve Y3. If not, check the cables and valve coil. If negative voltage is not received from HVC, change unit.
No ↓		
Check that the input is read by ATC. If not, check that the pushbutton works and that there is approx. 5V to the pushbutton via ATC. If not, change ATC.		

The resistance when cold for valve coil Y3 is approx. 23 ohm.

NOTE! If the top position switch for lifting does not function, the pump will not start. The movement will be stopped if the battery is below 20%.

NOTE! If other pushbuttons for the hydraulic function are actuated at the same time as lifting of the straddle lift, this will be stopped. “Release controls” comes up in the display.

Lowering of the straddle lift does not work (PSD)

Check the input for lowering, and that it is ready by ATC. OK?	No →	Check that the pushbutton works. If not, change it. Check also that ATC supplies approx. 5V to the pushbutton, and that there is 5V via the switch to the card. If not, change ATC.
Yes ↓		

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Does the lowering of the forks work?	No →	Go to trouble shooting for lowering of the forks and check valve Y2
Yes ↓		
Is there 24V to valve Y3?	No →	Check the cabling to valve Y4 and that HVC supplies voltage to valve Y3. If not, change HVC.
Yes ↓		
Change valve coil Y3.		

NOTE! If valve Y3 does not open the lifting of the straddle lift will not work either.

NOTE! If valve Y2 does not open it will not be possible to lower the forks or lower the straddle lift.

NOTE! The resistances when cold for valve Y2 are approx. 39 ohm, and for Y3 and Y4 approx. 23 ohm.

NOTE! If other pushbuttons for the hydraulic function are actutated at the same time as the lowering button for the straddle lift, the lowering of the straddle lift will be stopped. “Release controls” comes up in the display.

Tiller-up drive does not work

Is the input read by ATC? (Can be checked in "Monitor menu" on page 10.22)	No →	Check that the pushbutton switches, otherwise change pushbutton. Check that the ATC supplies approx. 5 V to the pushbutton. If not, change ATC.
Yes ↓		
Measure if there is 24 V to relay K4 over the coil between K4.86 and K4.85. OK?	No →	Check the arm cabling, and up to the relay. If defective, change cabling. Check that ATC supplies 24 V between pin 3 and 4 in contact XJ11. If not, change ATC.
Yes ↓		
Does relay K4 disconnect 24 V on connection K4.87?	No →	Change relay.
Yes ↓		
Does relay K4 disconnect 24 V to the brake switch contact connection X4.3 when the arm is in its upper position?	No →	Check cable connection K4.87 - X4.3. Probably a break or poor contact.
Yes ↓		
Check that 24V goes to the brake contact X7.1. If not, check the cabling.		

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No hydraulic operations work (PSD)

The pump runs for lifting operations but no hydraulic operations function. The truck can be driven.

Check that HVC is set to “ON”. Is it? (Föor more info, see section Switch off HVC.)	No →	Set HVC to “ON”.
Yes ↓		
Is HVC supplied with voltage? There should be possible to measure 24 V between X22.2 and X22.4, and there should be 12 V between X22.1 and X22.4. Is there?	No →	If 24V is lacking, check the cabling. If 12 V is lacking, check the cabling and that TMC actually supplies HVC with 12 V. If not, change TMC.
Yes ↓		
Does HVC supply 24V to the valve coils Y3 and Y4 from contact X23.7?	No →	Change HVC.
Yes ↓		
Check that the cabling is not damaged and that there is no break between X23.8 and Y3.2 or between X23.4 and Y4.2. OK?	No →	Change or repair the cabling.
Yes ↓		
Change HVC.		

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Appendix 1, Summary menu tree

In the following section, Appendix 1, menu trees (version 2.23) can be found for the menus listed below:

- Menu tree, Local menu
- Menu tree, Atlet menu
- Menu tree, Monitor menu
- Menu tree, Reset menu
- Menu tree, Language
- Menu tree, TRAC

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10 PLL/PSD with original tillerhead

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INTRODUCTION

Within the ZAPIMOS family, the AC0 controller respectively is the model suited for the control of 0.7 kW to 2.5kW motors. It has been expressively designed for battery electric traction. It is fit for electric pallet-trucks, golf cars, utility cars, etc.

Specification

Technical Data

Table 10.1

Three-phase-current controller, including	**- Microprocessor control - proportional electric braking of the traction motor incl. regeneration to the battery - CAN-BUS*- Interface**
Motor type	3-phase-AC*-asynchronous motor
Nominal battery voltage	24V, 36V or 48V
Nominal motor capacity	0,7 kW bis 2,5 kW
Operating frequency	8 kHz
min./max. ambient operating temperature	- 30 °C bis + 40 °C
max. controller operating temperature	+ 75 °C
Protection class	IP 54

Table 10.2

Type	**max. current with Booster (10 seconds)**	**max. current (2 minutes)**
AC0 24V 150A	165A	150A

The AC0-Controllers are available in two versions:

Version Standard (serial communication between controller and MDI, Plug C)

Version MDI PRC (CAN-BUS-communication between controller and MDI, Plug A)

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Block Diagram

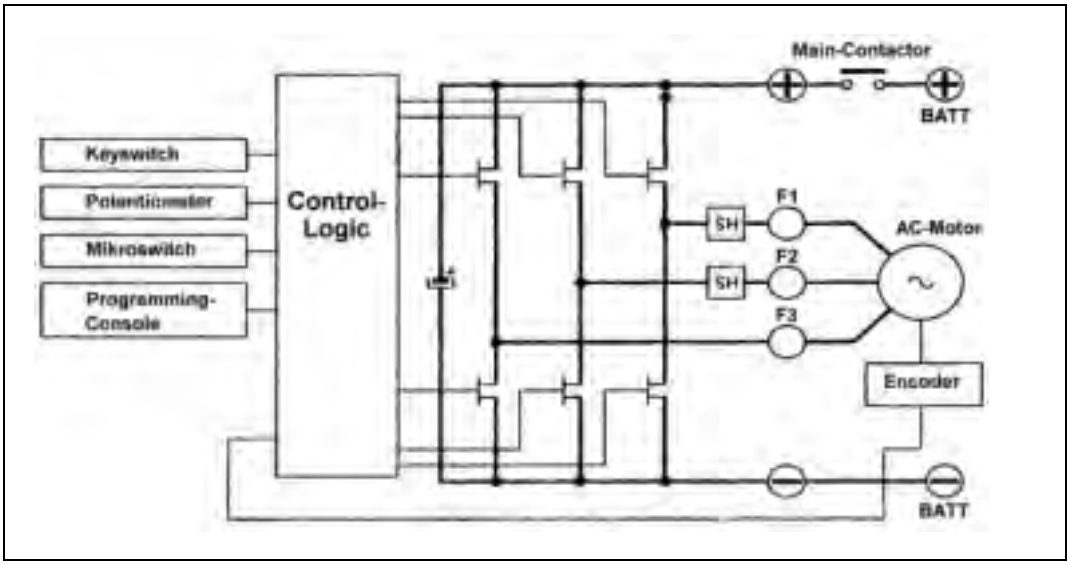

Figure 10.1 Block Diagram

Operation Elements

Potentiometer

A potentiometer with three connectors is to be used. The useful signal at the CPOT (B10) input ranges from 0 to 10V. The potentiometer's resistance must fall within 500 Ohms and 10 kOhms. At lower values B11/B12 is overloaded.

Connecting to the potentiometer to the controller

(Connection between controller and tillerhead)

The drawing opposite shows the voltage CPOT increasing from 0 Volt to MAX from both directions.

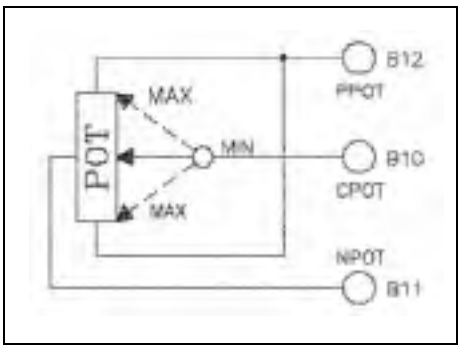

Figure 10.2 CPOT Voltage

Alternatively another potentiometer with a supply voltage of 12V and a load of 1,5mA to 30mA can be connected. For further values please refer to section 2.1 (PPOT, NPOT,

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CPOT). To facilitate reading this manual, the term “potentiometer” has been exclusively used.

With the help of a programming console the potentiometer can be automatically acquisitioned and the minimum and maximum value of the useful signal is saved for both directions of travel. This function chiefly serves for compensating any possible mechanical asymmetries and tolerances of the potentiometer.

The equipment considers the process to have been unsuccessful if the signals do not reach a minimum voltage of 3V.

Speed-Feedback

The control of the motor torque is speed feedback based. The speed detector is an incremental encoder designed as a motor bearing.

The speed sensor used in the Atlet C-Series is powered by 12 Volt (**A9** = **ENC +**, **A10** = **ENC -**). The speed signal input of the controller is **ENC A** (**A19**) and **ENC B** (**A20**).

Protection Features

Polarity Inversion:
In order not to damage the controller wiring is to be made exactly to the diagram. To protect from any polarity inversion and for disconnecting the controller from the battery a master contactor being controlled by the logic is installed. The logic itself is internally protected against polarity inversion.

Connection Errors:
All inputs are protected against connection errors. The output for controlling the master contactor can be maximum loaded with 2A and has been protected against overloading and short-circuits.

Thermal Protection:
Should the chopper temperature exceed +75°C the maximum current is reduced in proportion to the thermal increase. At +100°C the system is shut off.

Ambient Influences:
The controller is dust- and splash-proofed; protection class IP 54.

Low Battery Charge:
If the battery charge is too low the maximum current is reduced to half of the default value.

Protection against accidental start up:
To start the machine a precise sequence of operations must be adhered to. The direction selector must not be actuated until the key switch has been switched on and the tiller arm’s micro switch or the seat switch has been closed.

Uncontrolled Movements:
The main contactor will not close if:
-the power unit does not work
-the logic does improperly work

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-a micro switch has been actuated or is stuck
-the target value does not fall below the saved minimum value by 1V

Thermal Considerations

- The heat generated by the power block must be dissipated. For this to be possible the compartment must be ventilated and the heatsink materials ample.
- The thermal energy dissipated by the power block module varies and is dependent on the current drawn and the application. Abnormal ambient air temperatures should be considered. In situations where either ventilation is poor or heat exchange is difficult, forced air ventilation should be used.

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Electrical Connections

Control Connectors

The assignment of the control connectors depends on the control's type (standard or MDI PRC) and the input programming (options).

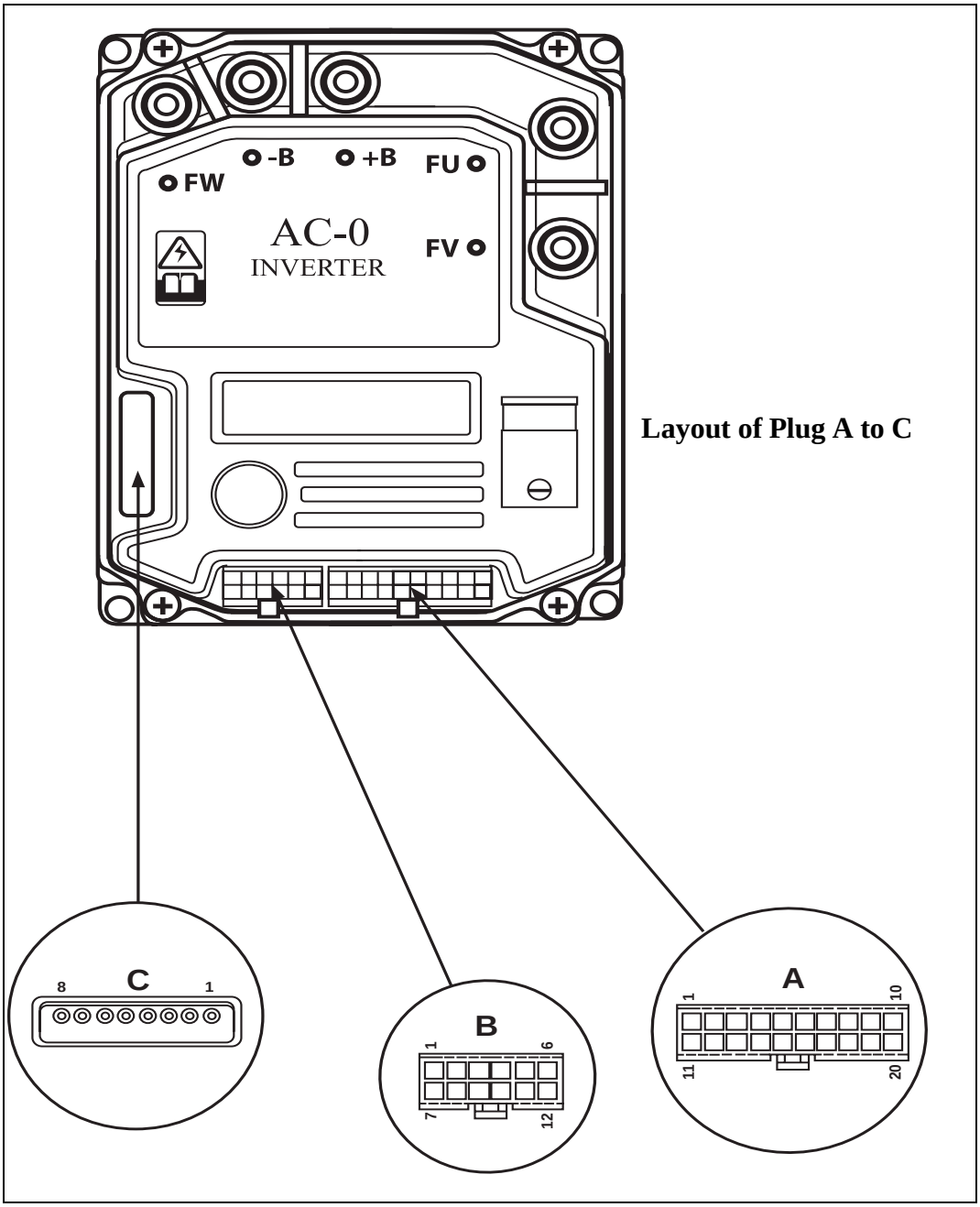

Figure 10.3 Control Connectors

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Port Description

Table 10.3 Port Description

PIN	Function	Description
A1	NLC	Minus output of main contactor coil
A2	PLC, PEB/PHYD	Plus output of main contactor coil or magnetic brake, or positive of steering aid contactor respectively
A3	NBRAKE/ NHYD	Minus output of magnetic brake coil, or steering aid contactor respectively (depending on AUX OUTPUT #1 option); max. current 3 A
A4	NPC	Minus output of pump contactor
A5	PPC, PEV	Plus output of pump contactor coil and lowering valve
A6	NEV	Minus output of lowering valve coil
A7	CAN-L	Low* level voltage of CAN-BUS interface (CAN LOW; I/O)
A8	NPOTB	Minus output of brake pedal potentiometer (-Batt)
A9	ENC +	Plus voltage supply of incremental speed encoder
A10	ENC -	Minus voltage supply of incremental speed encoder
A11	HM/ PEV (+B)	Output of external hour meter, or plus output of magnetic valve on the MDI PRC; (battery voltage - max. current 3A)
A12	-BATT	-Battery

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Table 10.3 Port Description

PIN	Function	Description
A13	Temp.-Sensor or SR1/HB	**AC-0:** Minus input (analog or digital) **AC-1:** Plus input (only digital) **Only AC-0:** analog input: temperature sensor traction motor SET INPUT #1 = Level 0 or Input: micro-switch speed reduction: 1 (creep 1); function is active if no pos. voltage is supplied (SET INPUT #1 = Level 1 option) respectively Input: micro-switch handbrake; the traction drive is shut off if no pos. voltage is supplied (SET INPUT #1 = Level2 option)
A14	SR2/ BACK FORW/ LIFT AUX	Version Standard: Input: micro-switch speed reduction 2 (creep 2); the function is active if no pos. voltage is supplied (SET INPUT #2 = PRESENT option) respectively Input: micro-switch backing forward travel; the function is active if pos. voltage is supplied / NOC function (voltage must be supplied to A15!) (SET INPUT #2 = OPTION #1) <u>Version MDI PRC:</u> Input: additional lift, Lifting (drives pump contactor and valve 3 on the MDI PRC); the function is active if pos. voltage is supplied

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Table 10.3 Port Description

PIN	Function	Description
A15	SR3/ BACK BACKW/ LOW AUX	Version Standard: Input: micro-switch speed reduction 3 (creep 3); the function is active if no pos. voltage is supplied (SET INPUT #3 = PRESENT option) or Input: micro-switch backing reverse travel; the function is active if no pos. voltage is supplied/NCC function (no voltage must be supplied to A14) (SET INPUT #3 = OPTION #1) Version MDI PRC: Additional lift, Lowering (drives the lowering valve (A5/A6) and valve 3 on the MDI PRC); the function is active if pos. voltage is supplied
A16	+12	Voltage supply for MDI PRC, if applicant; max. current 100mA
A17	CAN-H	High* level voltage of CAN-BUS interface (CAN HIGH; I/O)
A18	CPOTB	Input: brake pedal potentiometer wiper or Lift /Lower (only version MDI PRC); useful signal from 0V to 10V
A19	ENC A	Phase A incremental speed encoder
A20	ENC B	Phase B incremental speed encoder
B1	KEY	Input: key switch (batt. positive in series with controller current fuse and key switch)
B2	CM	Output: voltage supply positive for connected micro-switches
B3	TILLER/SEAT	Input: tiller arm micro-switches or seat (release) (depends on setting of TILLER SWITCH option); the function is active if pos. voltage is supplied

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Table 10.3 Port Description

PIN	Function	Description
B4	H&S	Input: micro-switch „Hard & Soft“ (speed red., change of acceleration and brake parameters, release independent of TILLER/SEAT – B3 Input); the function is active is pos. voltage is supplied
B5	BACKWARD	Input: micro-switch reverse travel; the function is active if pos. voltage is supplied
B6	FORWARD	Input: micro-switch forward travel; the function is active if pos. voltage is supplied
B7	BELLY/ BRAKE/ EX HYDRO	Option SET INPUT #4 = BELLY: Input: micro-switch quick inversion (dead man belly switch); The function is active is pos. voltage is supplied (QUICK INV LOGIC = OPTION #1) respectively The function is active if no pos. voltage is supplied and BACKWARD (B5) is simultaneously active (QUICK INV LOGIC = OPTION #2) or Option SET INPUT #4 = BRAKE: Input micro-switch brakes (braking pedal); the function is active is pos. voltage is supplied respectively Option SET INPUT #4 = EX HYDRO: Input: steering pressure switch for activating the steering aid; the function is active if pos. voltage is supplied
B8	LOWERING	Input: micro-switch Lowering (drives lowering valve (A5/A6); with MDI PRC, valve 4 on the MDI PRC is additionally driven); the function is active if pos. voltage is supplied

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Table 10.3 Port Description

PIN	Function	Description
B9	LIFTING	Input: micro-switch Lifting (drives pump contactor; with MDI PRC valve 4 on the MDI PRC is additionally driven); the function is active if pos. voltage is supplied
B10	CPOT	Input: Drive potentiometer wiper; useful signal from 0V (minimum speed) to 10V (maximum speed)
B11	NPOT	Input: Drive potentiometer negative (monitored)
B12	PPOT, PPOTB	Input: Drive potentiometer positive and output brake pedal potentiometer positive (+10V; Last > 1 kOhm)
C1	PCLRXD	Plus of serial interface receiver
C2	NCLRXD	Minus of serial interface receiver
C3	PCLTXD	Plus of serial interface transmitter
C4	NCLTXD	Minus of serial interface transmitter
C5	GND	Minus voltage supply of programming console
C6	+12	Plus voltage supply of programming console
C7	FLASH	Is externally connected to C8 for „Flash Memory“ programming purposes (optional)
C8	FLASH	Is externally connected to C7 for „Flash Memory“ programming purposes (optional)

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Encoder Connector (Incremental Speed Encoder)

The AC0 logic card can be configured for several encoders. The standard type of incremental speed encoder used for Atlet gives out 32 pulses each rpm at a power supply voltage of 12 Volt.

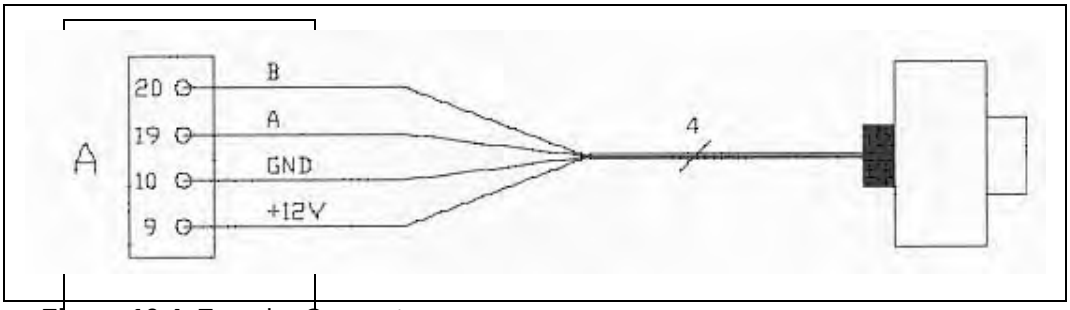

Figure 10.4 Encoder Connector

Power Connectors

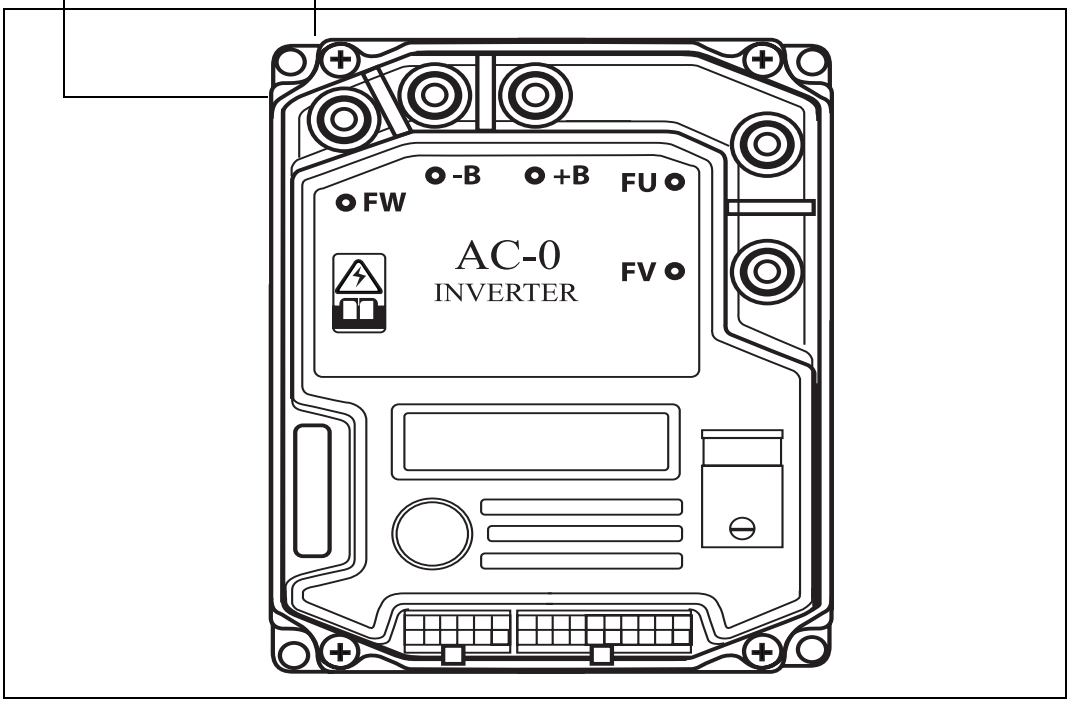

Figure 10.5 Power Connectors

Table 10.4

ACO	Description
+B	Battery + (from main contactor)
-B	Battery -
FU, FV, FW	Connection bars of the three motor phases; follow this sequence and the indication on the motor terminals.

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Programming Setup - using Programming Console

The ZAPI - Programming Console

The controller is configured and the various parameters are set using the programming console. The console is connected to the C connector of the AC0.

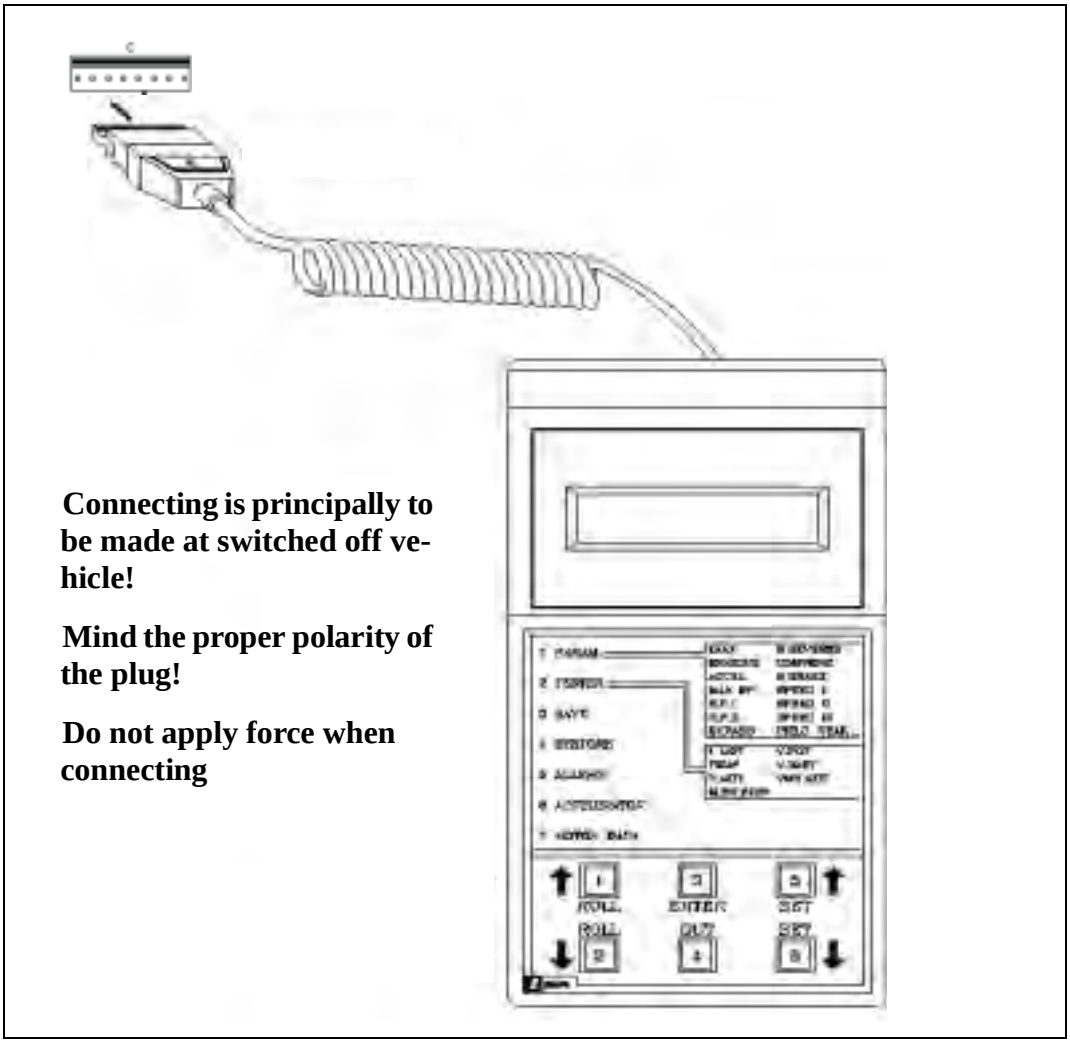

Figure 10.6 Zapi Programming Console

Handling

When switching on the console, the info menu displays the:

Type of control

Program release

Nominal voltage

Maximum current

Hour meter

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By pressing 1+5 (ROLL UP + SET UP) the configuration menu is called.

By pressing 3 (ENTER) the main menu is accessed.

Pressing 1 and 2 (ROLL) allows for paging within the menu.

By pressing 3 (ENTER) and 4 (OUT) the current submenu is accessed or quitted respectively.

Pressing 5 and 6 (SET) allows for making the desired settings.

Note!

Programming the AC0 control requires a console type “ULTRA“, release 3.02 or higher.

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Overview on the console functions when connected to an AC0 - Standard MDI -

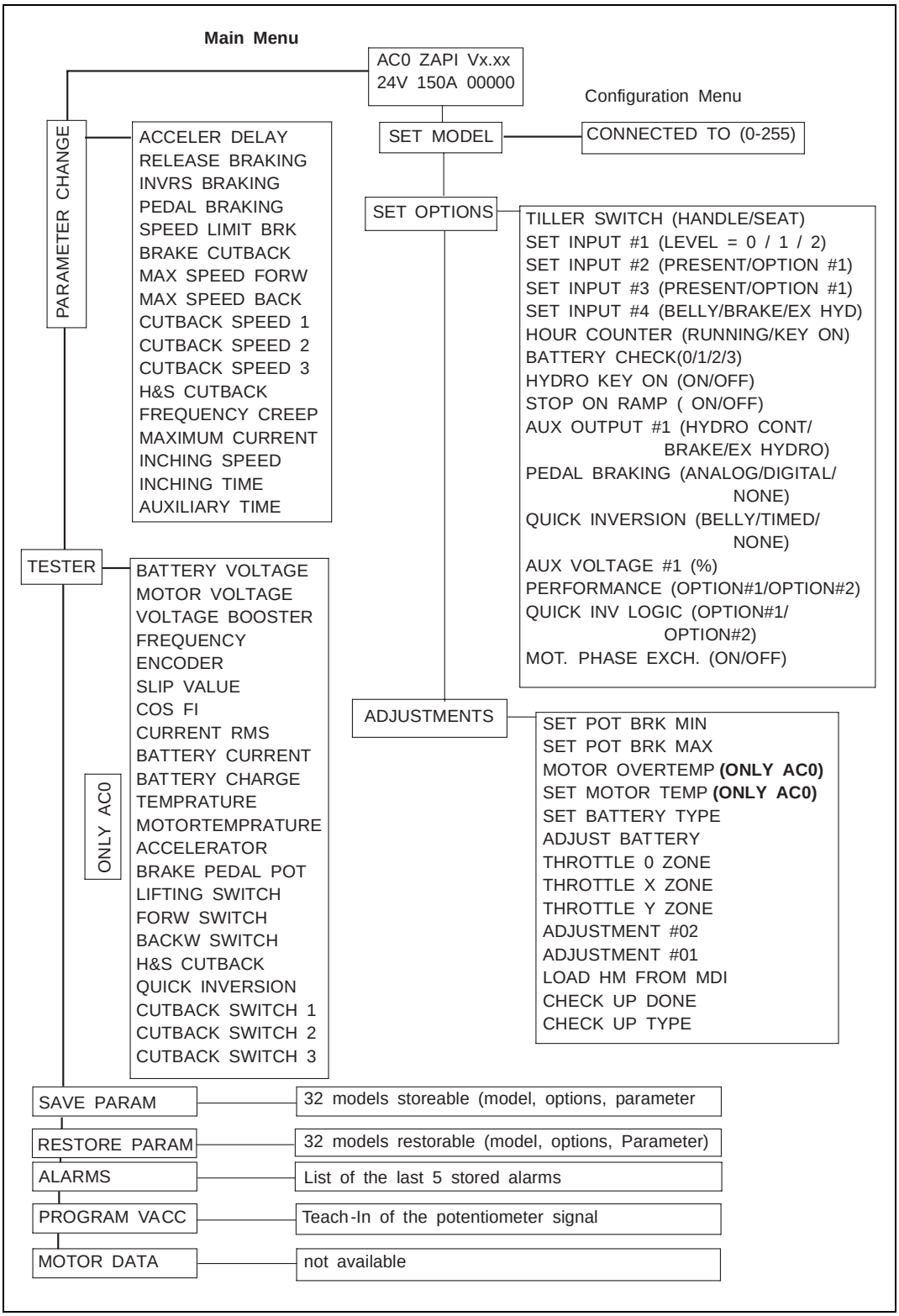

Figure 10.7

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Overview on the Console functions when connected to an AC0 - MDI PRC -

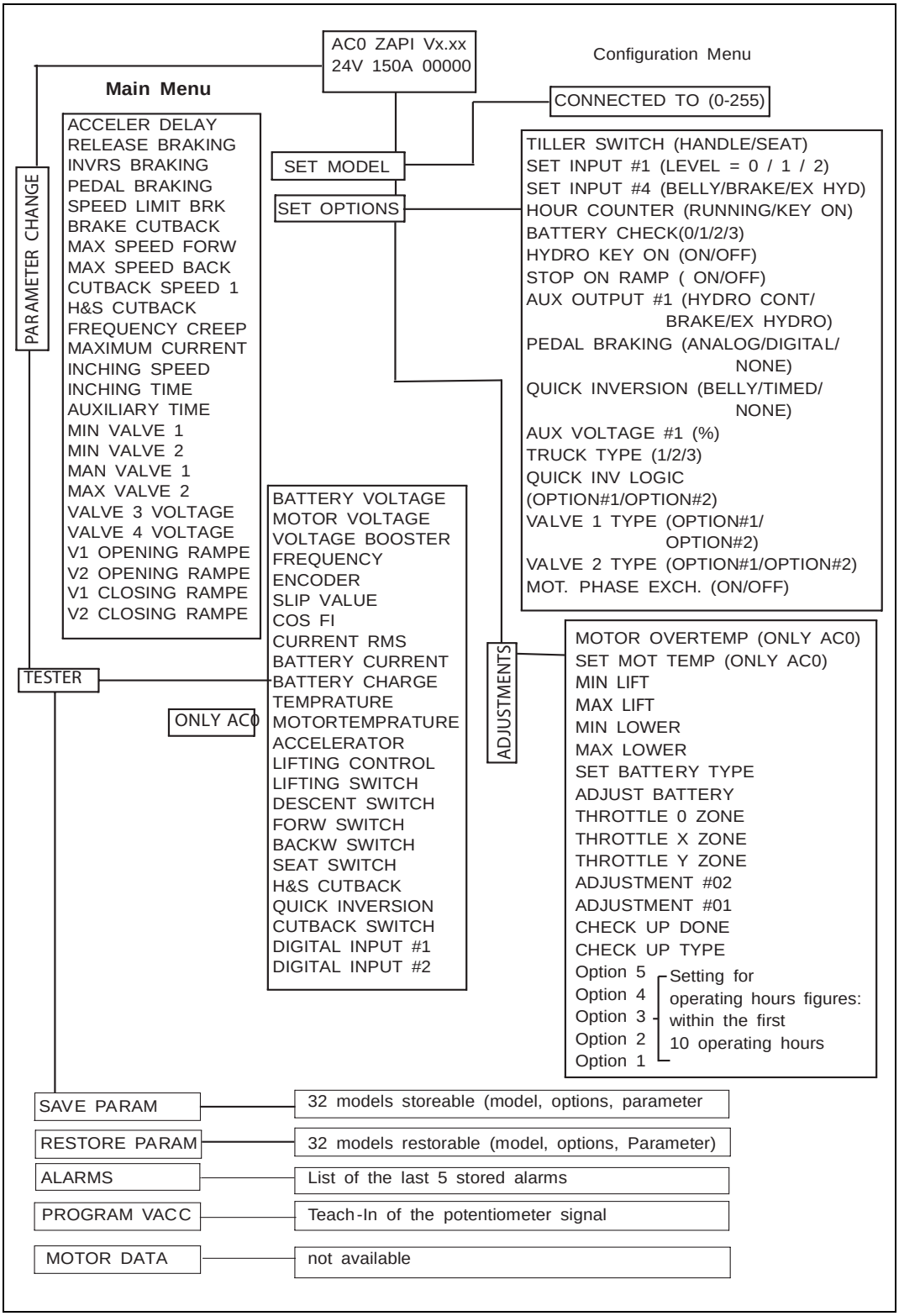

Figure 10.8

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Configuration of Options (SET OPTIONS)

Setting the options determines the functionality of certain input and outputs as well as certain functions of the controller.

Table 10.5 Configuration of Options

TILLER SWITCH:	HANDLE	To the input B3 there is a tiller arm micro-switch connected; the travel direction must not be selected until this micro-switch has been closed; as soon as it is reopened, the system shuts off the traction drive.
	SEAT	To the input B3 there is a seat switch connected; the travel direction must not be selected until the seat switch has been closed; when it is reopened, the system will not shut off the traction drive until the expiry of a short follow-up period.
SET INPUT #1:	LEVEL = 0	**Only for AC-0:** To the input A13 the traction motor's analog temperature sensor has been connected (KTY-83); Setpoint for message: MOTOR TEMPERATURE
	LEVEL = 1	To the input A13 a micro-switch for reducing the speed has been connected (NCC); the function is active when the switch is open.
	LEVEL = 2	To the input A13 a micro-switch for the handbrake has been connected; the traction drive is released when the switch is closed.
SET INPUT #2: (only Standard version)	PRESENT	To the input A14 a micro-switch for reducing the speed has been connected (NCC); the function is active when the switch is open.
	OPTION #1	To the input A14 a micro-switch for the forward backing has been connected; when the switch is closed, the vehicle travels for a set period and at a set speed in forward direction.
SET INPUT #3: (only Standard version)	PRESENT	To input A15 a micro-switch for reducing the speed (NCC) has been connected; the function is active if the switch is open.
	OPTION #1	To input A15 a< micro-switch for backward backing has been connected; if the switch is open the vehicle travels for a set period and at a set speed in reverse direction
SET INPUT #4:	BELLY	To input B7 a dead man belly switch for emergency reverse has been connected; the function is active if the switch is closed.

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Table 10.5 Configuration of Options

	BRAKE	To input B7 a micro-switch for braking (brake pedal) has been connected; the function is active if the switch is closed.
	EX HYDRO	To input B7 a steering pressure switch for activating the steering aid has been connected; the function is active if pos. voltage is applied.
HOUR COUNTER:	KEYON	The internal hour meter runs as soon as the controller has been switched on.
	RUNNING	The internal hour meter runs if the vehicle is driven or electrically slowed down or a hydraulic function is executed.
BATTERY CHECK:	0	The battery charging level is monitored, however, no warning will be issued.
	1	The battery charging level is monitored; if the battery level is only 10% an alarm is issued and lifting is no longer possible.
	2	The battery charging level is monitored; if the battery level is only 10%, an alarm is issued; the maximum drive speed is reduced to 25%.
	3	The battery charging level is monitored; if the battery level is only 10% an alarm is issued; the maximum drive speed is reduced to 25% and lifting is no longer possible.
HYDRO KEY ON: (only if AUX OUTPUT #1 = HYDRO CONT **or** EX HYDRO)	ON	Not used with Atlet products
	OFF	Not used with Atlet products
STOP ON RAMP:	ON	The truck is electrically held during a stop on a ramp for the time set under parameter AUXILIARY TIME. Then, the behaviour of the truck depends on the programming of the AUX OUTPUT #1 option (see table).
	OFF	The truck will not be electrically held if stopped on a ramp.
AUX OUTPUT #1: (also see table OUTPUT #1)	BRAKE	Output A3 drives the magnetic brake.
	HYDRO CONT	Not used with Atlet products

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Table 10.5 Configuration of Options

	EX HYDRO	Not used with Atlet products
PEDAL BRAKING:	ANALOG	Not used with Atlet products
	DIGITAL	Not used with Atlet products
	NONE	If no brake pedal with potentiometer and/or micro-switch is connected to the controller.
QUICK INVERSION: (only if option SET INPUT #4 = BELLY)	NONE	No emergency reverse function is carried out.
	TIMED	If the dead man belly switch is actuated, the system slows down the truck and accelerates in the reverse direction for a certain period of time.
	BELLY	If the dead man belly switch is actuated, the system slows down the truck and accelerates in the reverse direction until the belly switch is released again.
AUX VOLTAGE #1:	%	Voltage with which the main contactor's coil and the magnetic valve are triggered (% Vbatt); a low voltage reduces the input at the coil.
PERFORMANCE: (only Standard version)	OPTION #1	The acceleration and braking parameters are set in a way ensuring normal drive behaviour.
	OPTION #2	The acceleration and braking parameters are set in a way to meet more aggressive drive behaviour.
TRUCK TYPE: (only MDI PRC version)	1	Hydraulic functions Standard
	2	Not used with Atlet products
	3	Not used with Atlet products
QUICK INV LOGIC: (only if option SET INPUT #4 = BELLY)	OPTION #1	Emergency reverse is started if pos. voltage is applied to input B7 (BELLY).
	OPTION #2	Emergency reverse is started if pos. voltage is applied to input B7 (BELLY) and input B5 (BACKWARD) is active at the same time.

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Table 10.5 Configuration of Options

VALVE 1 TYPE: (only MDI PRC version)	OPTION #1	Valve 1 on the MDI PRC is an ON/OFF-type valve.
	OPTION #2	Not used with Atlet products
VALVE 2 TYPE: (only MDI PRC version)	OPTION #1	Valve 2 on the MDI PRC is an ON/OFF-type valve.
	OPTION #2	Not used with Atlet products
MOT. PHASE EXCH.	ON	The motor phases for the drive motor are switched. Currently used for the Sauer/Danfoss motor.
	OFF	Currently used for the Kordel motor.

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AUX OUTPUT #1

Table 10.6 Table AUX OUTPUT#1

AUX OUTPUT #1	STOP ON RAMP	Output A3	Behaviour on a slope
BRAKE	ON	-Drives the coil of a electromagnetic brake.	The truck is electrically held when stopped on a slope; when the time set at the "Auxiliary Time" parameter is elapsed, the brake is applied and the 3-phase bridge is released. **Do not use this combination if the negative brake is not installed.**
BRAKE	OFF	-Drives the coil of a electromagnetic brake.	The truck is not electrically held when stopped on a slope, but comes down very slowly; when the time set at the "auxiliary time" parameter is elapsed, the magnetic brake is applied and the 3-phase bridge is opened. **Do not use this combination if the** negative brake (e.g. a magnetic brake) is not installed.
HYDRO CONT	ON	-Drives the coil of a hydraulic steering contactor.	The truck is electrically held when stopped on a slope; when the time set at the "auxiliary time" parameter is elapsed, the truck comes down very slowly, till the flat is reached.
HYDRO CONT	OFF	-Drives the coil of a hydraulic steering contactor.	The truck is not electrically held when stopped on a slope, but comes down very slowly till the flat is reached.
EX HYDRO	ON	-Drives the coil of a hydraulic steering contactor.	The truck is electrically held when stopped on a slope; when the time set at the "auxiliary time" parameter is elapsed, the truck comes down very slowly, till the flat is reached.
EX HYDRO	OFF	-Drives the coil of a hydraulic steering contactor.	The truck is not electrically held when stopped on a slope, but comes down very slowly till the flat is reached.

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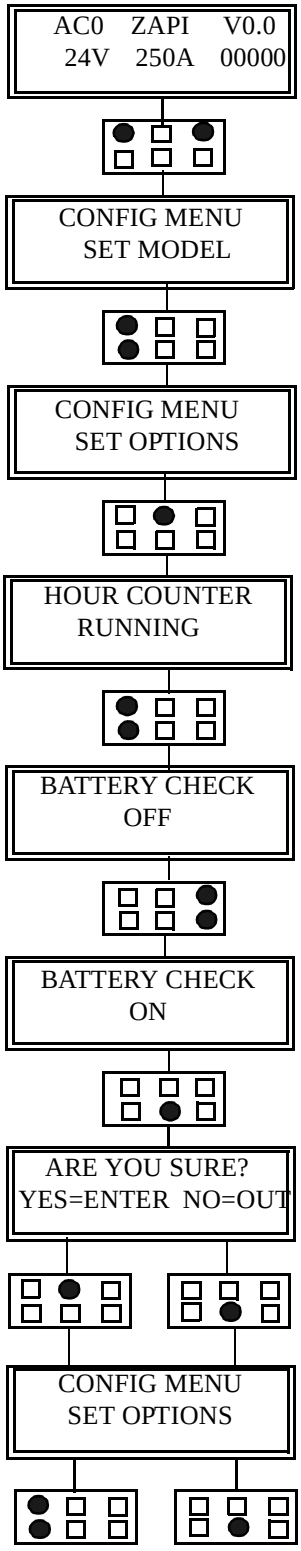
Configuration SET OPTIONS with Programming console:

1. Info menu
2. Simultaneously press ROLL UP + SET UP to access the configuration menu.
3. The SET MODEL menu is displayed.
4. Select the SET OPTIONS menu via ROLL UP or ROLL DOWN.
5. The SET OPTIONS menu is displayed.
6. Press ENTER to access the menu.
7. The first menu item is displayed.
8. ROLL UP and ROLL DOWN allows for scrolling through the various menu options.
9. A new menu item is displayed.
10. SET UP and SET DOWN allow for changing the settings.
11. The new settings are displayed.
12. When all options have been set as desired press OUT to quit the menu.
13. You are prompted to confirm your changes.
14. ENTER saves the changes; OUT undoes them.
15. The menu title SET OPTIONS is displayed again.
16. Select a new menu via ROLL UP or ROLL DOWN or return to the info menu by pressing OUT.



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Calibration (ADJUSTMENTS)

Table 10.7 Callibration (Adjustments)

SET POT BRK MIN (only Standard version)	Not used with Atlet products
SET POT BRK MAX (only Standard version)	Not used with Atlet products
MOTOR OVERTEMP	Setpoint for issuing MOTOR TEMPERATURE error message; Only alarm message is issued, no reduction
SET MOT TEMP	The motor temperature sensed by the controller is synchronized with the actual motor temperature. This may become necessary if e.g. the temperature sensor has not been mounted into the winding
MIN LIFT (only MDI PRC version)	Minimum value of the lifting potentiometer **Not used with Atlet products**
Programming:	Select respective menu option; the currently saved value is displayed; press ENTER; actuate the „Lifting“ lever just as much as required for the micro-switch to close and the displayed voltage to reach its lowest value; then press OUT; press ENTER to save
MAX LIFT (only MDI PRC version)	Maximum value of the lifting potentiometer Not used with Atlet products
Programming:	Select respective menu option; the currently saved value is displayed; press ENTER; actuate the „Lifting“ lever just as much as required for the micro-switch to close and the displayed voltage to reach its high-est value; then press OUT; press ENTER to save
MIN LOWER (only MDI PRC version)	Minimum value of the lowering potentiometer Not used with Atlet products
Programming:	Select respective menu option; the currently saved value is displayed; press ENTER; actuate the „Lowering“ lever just as much as required for the micro-switch to close and the displayed voltage to reach its lowest value; then press OUT; press ENTER to save

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Table 10.7 Callibration (Adjustments)

MAX LOWER (only MDI PRC version)	Maximum value of the lowering potentiometer Not used with Atlet products
Programming:	Select respective menu option; the currently saved value is displayed; press ENTER; actuate the „Lowering“ lever just as much as required for the micro-switch to close and the displayed voltage to reach its highest value; then press OUT; press ENTER to save
SET BATTERY TYPE	Setting of battery nominal voltage
Programming:	Select respective menu option; set battery nominal voltage using SET UP or SET DOWN button.
ADJUST BATTERY	The battery voltage sensed by the controller is synchronized with the actual battery voltage. This may become necessary if e.g. the voltage drop on the supply voltage cable (key switch) is relatively high.
Programming:	Select respective menu option; set correct battery voltage via SET UP or SET DOWN button, The voltage is measured on the key switch input by means of a multimeter.
THROTTLE 0 ZONE	Dead zone at the beginning of the target value curve (see graph)
Programming:	Select respective menu option; enter desired value via SET UP or SET DOWN.
THROTTLE X POINT	Changes the characteristic of the target value curve (see graph)
Programming:	Select respective menu option; set desired value via SET UP or SET DOWN.
THROTTLE Y POINT	Changes the characteristic of the target value curve (see graph)
Programming:	Select respective menu option; set desired value via SET UP or SET DOWN.

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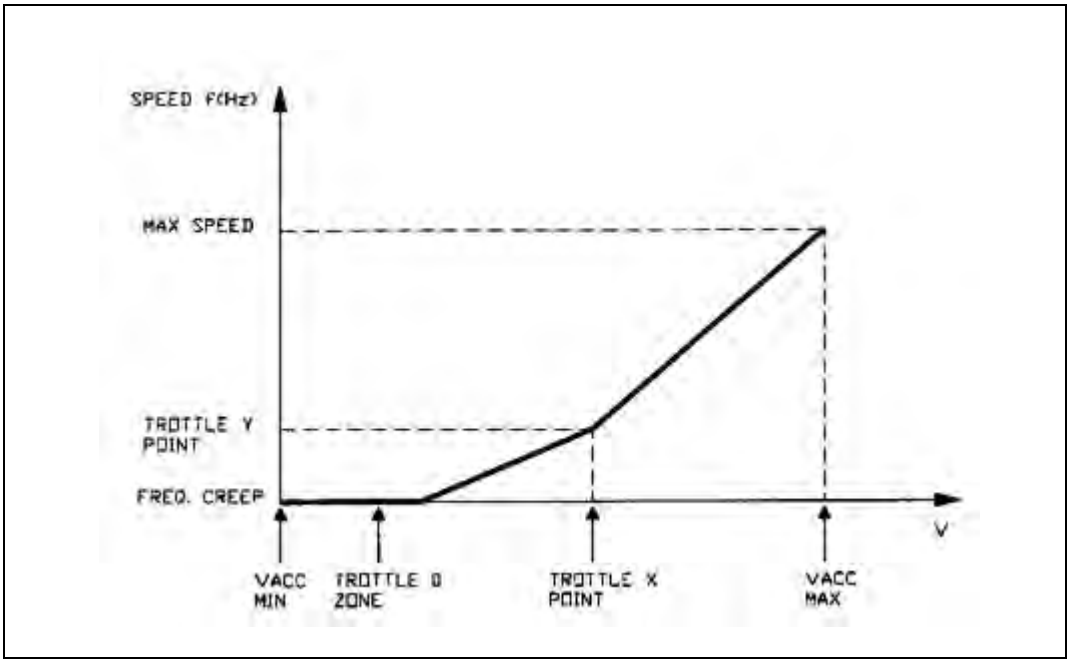

Figure 10.9

Note!

The VACC MIN and VACC MAX values are assessed via the PROGRAM VACC function.

Table 10.8

ADJUSTMENT #01	Upper limit value of battery discharge table (see graph) Corresponds to setpoint of 100% after 90% capacity available.
Programming:	Select respective menu option; set desired value via SET UP or SET DOWN.
ADJUSTMENT #02	Lower limit value of battery discharge table (see graph) Corresponds to setpoint of 20% on 10% capacity available.
Programmng:	Select respective menu option; set desired value via SET UP or SET DOWN.
LOAD HM FROM MDI (only Standard version)	Parameter LOAD HM FROM MDI = ON transmits the current MDI hour counter to the controller. The data are then considered as current operating hours by the controller (e.g. if the controller has been exchanged).
CHECK UP DONE	Reset current maintenance interval
CHECK UP TYPE	See below

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If needed, a maintenance interval can be defaulted and set via parameter CHECK UP TYPE:

Table 10.9 CHECK UP TYPE

CHECK UP TYPE	After 300 hs: Alarm	After 340 hs: red. speed	After 380 hs: Truck stops
NONE = Basic settings	No	No	No
OPTION 1	Yes	No	No
OPTION 2	Yes	Yes	No
OPTION 3	Yes	Yes	Yes

If option CHECK UP TYPE has not been set to NONE the message CHECK UP NEEDED (AL 99 on MDI) will be displayed on the console after 300 hours. Depending on the speed reduction settings, the truck will be stopped after further 40 or 80 hours.

(Intervals or hours and functions depend on software in use!)

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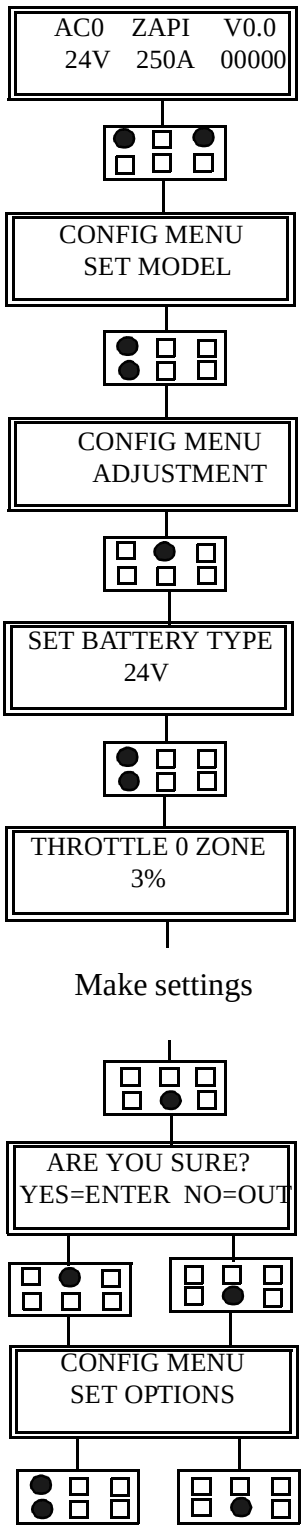
Calibration with the programming console:

1. Info menu
2. Simultaneously press ROLL UP + SET UP to access the configuration menu.
3. The SET MODEL menu is displayed.
4. Select ADJUSTMENT menu via ROLL UP or ROLL DOWN.
5. The ADJUSTMENT menu is displayed.
6. Press ENTER to access the menu.
7. The first menu option is displayed.
8. ROLL UP and ROLL DOWN allow for scrolling through the various menu options.
9. A new menu option is displayed.
10. Make settings as described above.
11. If settings are complete, press OUT to quit the menu.
12. You are prompted to confirm the changes.
13. Press ENTER to save the changes or OUT to ondo.
14. The title of the ADJUSTMENT menu is displayed again.
15. Select a new menu via ROLL UP or ROLL DOWN or return to the info menu by pressing OUT.



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Parameter setting (PARAMETER CHANGE)

In this menu the various parameters of the controller are set. Normally, there are 10 settings (0 to 9) available for each parameter. The console can be left plugged to the machine during operation. This allows for immediately testing the effect of a parameter change. Confirming the changes and saving them to the controller must, however, be done at halt.

1) ACCELER DELAY
Start-up delay; the time required until the frequency has risen from 0Hz to 100Hz; the values indicated in the table are ideal values; the actual start-up ramp is influenced by several motor control parameters and especially by the motor load. If a creep speed or H&S has been activated the start-up time will be prolonged.

2) RELEASE BRAKING
Braking intensity if the drive switch is completely released or the travel direction is undone; time required for the frequency to drop from 100Hz to 0Hz; the values indicated in the table are ideal values; the actual delay ramp is influenced by several motor control parameters, especially by the motor load. If a creep speed or H&S has been activated, the braking intensity is reduced.

3) INVERS BRAKING
Braking intensity at change of travel direction; the time required for the the frequency to drop from 100Hz to 0Hz; the values indicated in the table are ideal values; the actual delay ramp is influenced by several motor control parameters, especially by the motor load. If a creep speed or H&S has been activated, the braking intensity is reduced.

4) PEDAL BRAKING
Braking intensity at completely released drive switch or undone travel selection and simultaneously actuated brake pedal; the values indicated in the table are ideal values; the actual delay ramp is influenced by several motor control parameters, especially by the motor load. If a creep speed or H&S has been activated, the braking intensity is reduced.

5) SPEED LIMIT BRK
Braking intensity if the drive switch is somewhat turned back; time required for the frequency to reach a value corresponding to the new target value; the values indicated in the table are ideal values; the actual delay ramp is influenced by several motor control parameters, especially by the motor load. If a creep speed or H&S has been activated, the braking intensity is reduced.

6) BRAKE CUTBACK
Braking intensity if a speed reduction has been activated; time required for the frequency to reach a value equalling the new target value; the values indicated in the table are ideal values; the actual delay ramp is influenced by several motor control parameters, especially by the motor load. If a creep speed or H&S has been activated, the braking intensity is reduced.

7) MAX SPEED FORW
Maximum speed forward

8) MAX SPEED BACK
Maximum speed backward

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9) CUTBACK SPEED 1
Speed reduction 1 (creep speed 1); settable in % of the programmed maximum speed for the current travel direction; the maximum of the target value will be reduced, i. e. the complete mechanical control range will be available for a reduced electrical control range, this allows for a sensitive driving at reduced speed.

10) CUTBACK SPEED 2 (only Standard version)
Speed reduction 2 (creep speed 2); settable in % of the programmed maximum speed for the current travel direction; the maximum of the target value will be reduced, i. e. the complete mechanical control range will be available for a reduced electrical control range, this allows for a sensitive driving at reduced speed.

11) CUTBACK SPEED 3 (only Standard version)
Speed reduction 3 (creep speed 3); settable in % of the programmed maximum speed for the current travel direction; the maximum of the target value will be reduced, i. e. the complete mechanical control range will be available for a reduced electrical control range, this allows for a sensitive driving at reduced speed.

12) H&S CUTBACK
Speed reduction (creep speed), if input H&S has been activated; settable in % of the programmed maximum speed for the current travel direction; the maximum of the target value will be reduced, i. e. the complete mechanical control range will be available for a reduced electrical control range, this allows for a sensitive driving at reduced speed.

13) FREQUENCY CREEP
Minimum frequency; i. e. as soon as a direction signal is applied to the controller and travelling has been released, a certain voltage with a frequency just as high as required for not starting the motor to turn is applied to the motor; this allows for a more prompt response to a travel command.

14) MAXIMUM CURRENT
Maximum motor current RMS (current limitation)

15) INCHING SPEED (Backing Speed)
Speed at forward or backward backing.

16) INCHING TIME (Backing Time)
Maximum period for which the truck travels if forward or backward backing has been activated; even if the button is pressed down longer, travelling will be interrupted upon elapsing of the period set here.

17) AUXILIARY TIME
Period for which the truck will be held on a slope when stopped if option STOP ON RAMP = ON.

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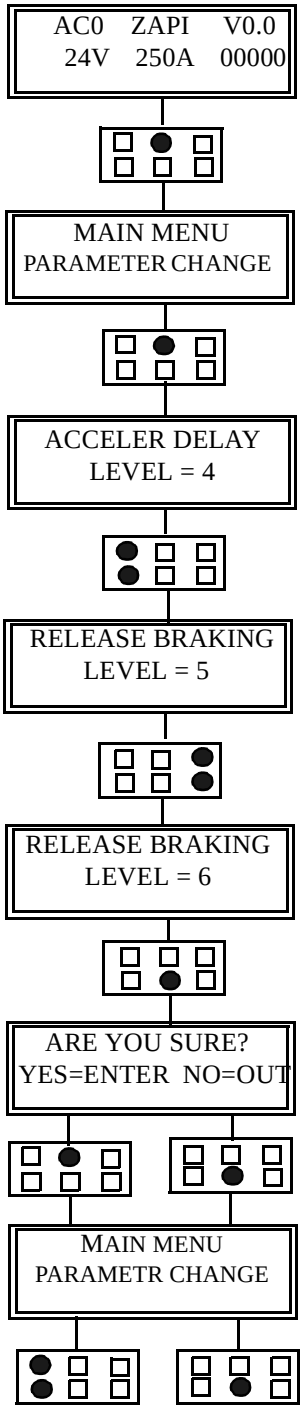
Setting parameters with the programming console:

1. Info menu
2. Press ENTER to access the main menu.
3. The first menu PARAMETER CHANGE is displayed.
4. Press ENTER to access the menu.
5. The first parameter and its current level is displayed.
6. ROLL UP and ROLL DOWN allow for scrolling through the different parameters.
7. A new parameter is displayed.
8. SET UP and SET DOWN allow for changing the level.
9. The new setting is displayed.
10. If all parameters have been set as desired, press OUT to quit the menu.
11. You are prompted to confirm the changes.
12. Pressing ENTER saves the changes; pressing OUT undoes them.
13. The menu title PARAMETER CHANGE is displayed again.
14. ROLL UP and ROLL DOWN allow for selecting another menu or press OUT to return to the info menu.



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Measurement and Test Functions (TESTER)

Table 10.10 Measurement and Test Functions (TESTER)

BATTERY VOLTAGE:	The battery voltage in V measured at the key switch input
MOTOR VOLTAGE:	The motor voltage in % of the maximum permissible motor voltage
VOLTAGE BOOSTER:	The voltage increase in % above motor's nominal voltage
FREQUENCY (f1):	The frequency applied to the field winding measured in Hz
ENCODER (f2):	The anchor torque in Hz
SLIP VALUE (f5):	The slip in Hz f5 = f1 – f2; If the difference is positive, the machine works as a motor; if it is negative, it serves as a generator
COS FI:	The cos φ of the motor (real time calculation)
CURRENT RMS:	The phase current in A (RMS)
BATTERY CURRENT:	Battery current (calculated, not measured)
BATTERY CHARGE:	Remaining battery charge in % of full charge
TEMPERATURE: MOTORTEMPERA-TURE	The control's temperature in °C, measured in the aluminium baseplate next to the MOSFET´s The temperature measured via the motor's temperature sensor
ACCELERATOR:	The voltage of the target signal Drive corresponding to input CPOT (B10); the voltage is displayed in V on the left of the display; on the right, the value is indicated as % of the maximum useful signal – determined via PROGRAM VACC
BRAKE PEDAL POT: (only Standard version) (only if option PEDAL BRAKING = ANA-LOG)	The voltage of the brake pedal's target signal corresponding to input CPOTB (A18); the voltage is displayed in V on the left of the display, the value indicated on the right represents the value in % of the maximum use-ful signal (setting SET POT BRK MAX)
LIFTING CONTROL: (only MDI PRC ver-sion)	The voltage of the target signal Lifting corresponding to input CPOTB (A18); the voltage is displayed in V on the left of the display; the value indicated on the right represents the value in % of the maximum useful sig-nal (setting MAX LIFT)

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Table 10.10 Measurement and Test Functions (TESTER)

LIFTING SWITCH: Lifting initial with old tillerhead; Lifting mast with new tillerhead.	Is the state of the digital input LIFTING (B9) ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
DESCENT SWITCH: Lowering initial with old tillerhead; Lowering mast with new tillerhead.	Is the state of the digital input LOWERING (B8) ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
FORWARD SWITCH:	Is the state of the digital input FORWARD (B6) ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
BACKWARD SWITCH:	Is the state of the digital input BACKWARD (B5) ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
SEAT SWITCH: (only if option TILLER SWITCH = SEAT)	Is the state of the digital input Seat Switch (Release) SEAT (B3) ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
TILLER SWITCH: (only if option TILLER SWITCH = HANDLE)	Is the state of the digital input tiller micro-switch (Release) TILLER (B3) ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
H&S CUTBACK:	Is the state of the digital input „Hard&Soft“ H&S (B4) ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
QUICK INVERSION: (only if option SET INPUT #4 = BELLY)	Is the state of the digital input Emergency Inversion BELLY (B7) ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active

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Table 10.10 Measurement and Test Functions (TESTER)

BRAKE SWITCH: (only if option SET INPUT #4 = BRAKE)	Is the state of the digital input BRAKE (B7) ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
EXCLUSIVE HYDRO: (only if option SET INPUT #4 = EX HYDRO)	Is the state of the digital input steering pressure switch (activate steering aid) EX HYDRO (B7) ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
CUTBACK SWITCH 1: (only if option SET INPUT #1 = LEVEL 1)	Is the state of the digital input Speed Reduction (Creep speed) SR1 (A13); ON/GND = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
HAND BRAKE: (only if option SET INPUT #1 = LEVEL 2)	Is the state of the digital input handbrake HB (A13); ON/GND = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
CUTBACK SWITCH 2: (only Standard version) (only if option SET INPUT #2 = PRESENT)	Is the state of the digital input Speed Reduction (Creep speed) SR2 (A14); ON/GND = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
BACKING FORW: **(INCHING FORW:)** (only Standard version) (only if option SET INPUT #2 = OPTION #1)	Is the state of the digital input backing forward BACK FORW (A14); ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
DIGITAL INPUT #1: (only MDI PRC version) Lifting mast with old tillerhead; Lifting initial with new tillerhead.	Is the state of the digital input LIFT AUX (A14); ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active

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Table 10.10 Measurement and Test Functions (TESTER)

CUTBACK SWITCH 3: (only Standard version) (only if option SET INPUT #3 = PRESENT)	Is the state of the digital input Speed Reduction (Creep speed) SR3 (A15); ON/GND = no voltage applied (switch open); function active OFF/+VB =pos. voltage applied (switch closed); function not active
BACKING BACK: **(INCHING BACK:)** (only Standard version) (only if option SET INPUT #3 = OPTION #1)	Is the state of the digital input backing backwards BACK BACK (A15); ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active
DIGITAL INPUT #2: (only MDI PRC version) Lowering mast with old tillerhead; Lowering initial with new tillerhead.	Is the state of the digital input LOW AUX (A15); ON/+VB = pos. voltage applied (switch closed); function active OFF/GND =no voltage applied (switch open); function not active

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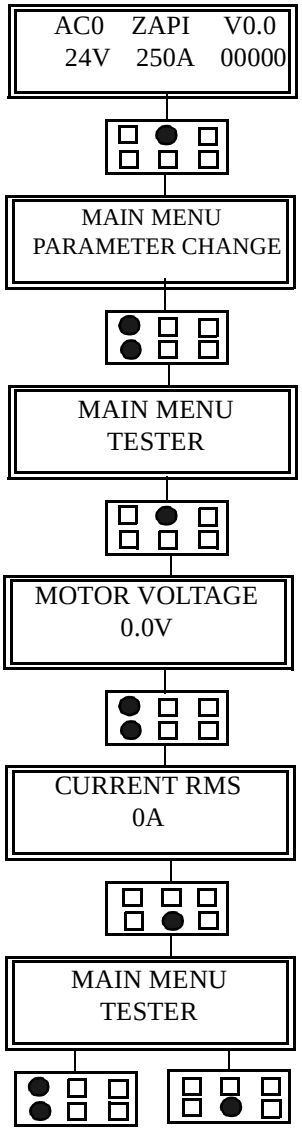
The TESTER function on the programming console:



1. Info menu
2. Press ENTER to access the main menu.
3. The first menu PARAMETER CHANGE is displayed.
4. ROLL UP and ROLL DOWN allow for scrolling through the different menus.
5. The TESTER menu is displayed.
6. Press ENTER to access the menu.
7. The first signal and its current value are displayed.
8. ROLL UP and ROLL DOWN allow for scrolling through the different signals.
9. A new signal is displayed.
10. To quit the menu, press OUT.
11. The menu title TESTER is displayed again.
12. Select another menu via ROLL UP and ROLL DOWN or press OUT to return to the info menu.

Saving Settings (SAVE PARAM)

- Only functions with the console software ver. 3.12 or higher -

The configuration data and parameter settings can be saved to the console using the SAVE PARAM function. For saving, 32 memory positions are available. The saved data can be restored to another controller of the same type using the RESTORE PARAM function

The following data are saved: - all parameter values (PARAMETER CHANGE)

- the configuration of the options (SET OPTIONS)
- the calibration values (ADJUSTMENT)

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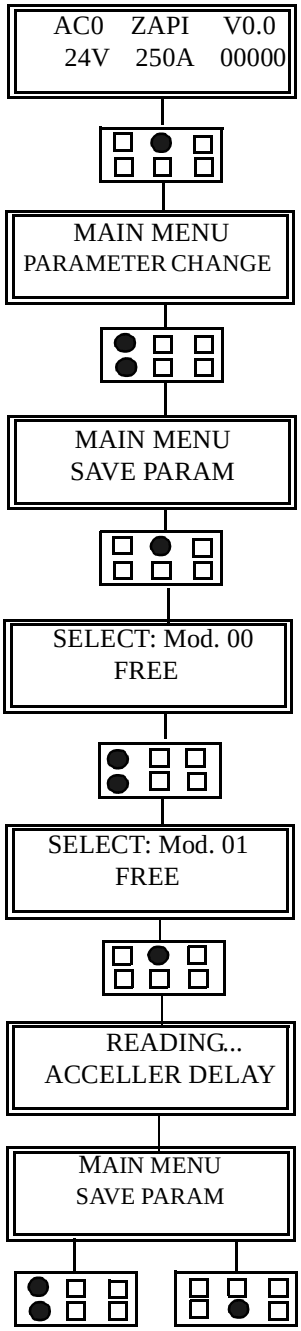
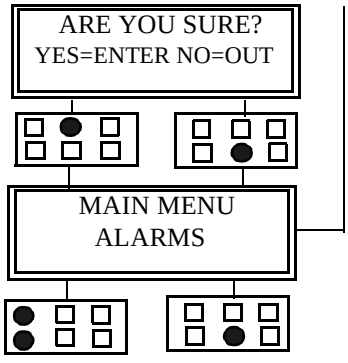
The SAVE PARAM function with the programming console:

1. Info menu
2. Press ENTER to access the main menu.
3. The first menu PARAMETER CHANGE is displayed.
4. ROLL UP and ROLL DOWN allow for scrolling through the different menus.
5. The SAVE PARAM menu is displayed.
6. Press ENTER to access the menu.
7. The first line shows the number of the memory position, the second the type of controller or „FREE“, if the position has not yet been assigned.
8. ROLL UP and ROLL DOWN allow for scrolling through the different program positions (memory locations).
9. A new position is displayed.
10. To store the control’s settings to this position press ENTER.
11. The second line now shows the parameters just being saved one of the other.
12. When the process has been completed, the menu title SAVE PARAM is displayed again.
13. Select a new menu via ROLL UP and ROLL DOWN or return to the info menu by pressing OUT.





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Restoring settings (RESTORE PARAM)

- Only functions with the console software ver. 3.12 or higher -

The data saved to the console can be restored to another controller of the same type using the RESTORE PARAM function.

⚠ ***Warning!***

Attention:Uploading the data stored in the console overwrites the data existing in the controller!

The following data are uploaded:

- all parameter values (PARAMETER CHANGE)
- the configuration of the options (SET OPTIONS)
- the calibration values (ADJUSTMENT)

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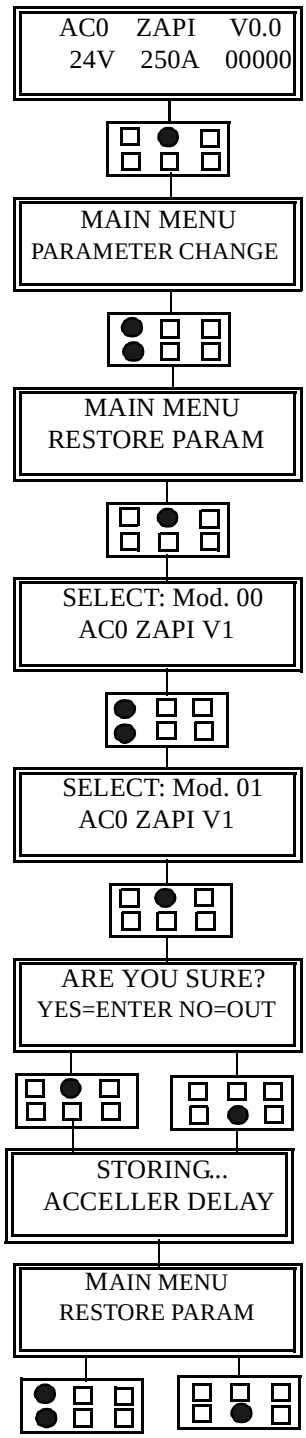
The RESTORE PARAM function with the programming console:

1. Info menu
2. Press ENTER to access the main menu.
3. The first menu PARAMETER CHANGE is displayed.
4. ROLL UP and ROLL DOWN allow for scrolling through the different menus.
5. The RESTORE PARAM menu is displayed.
6. Press ENTER to access the menu.
7. The first line shows the number of the program position; the second indicates the type of controller.
8. ROLL UP and ROLL DOWN allow for scrolling through the different program positions.
9. The new position is displayed.
10. When the desired position is displayed press ENTER.
11. You are prompted to confirm the upload position.
12. OUT cancels the process (→ 14)). ENTER starts the upload process.
13. The second line now shows the parameters being uploaded to the controller one after the other.
14. When the process has been completed, the menu title RESTORE PARAM is displayed again.
15. Select another menu via ROLL UP and ROLL DOWN or return to the info menu by pressing OUT.



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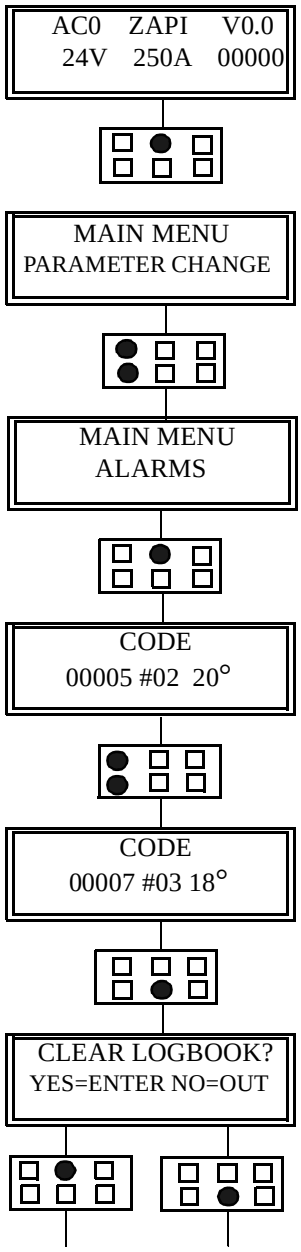
Error Messages (ALARMS)

The controller stores the last five error messages including the following information: type of error; number of recurrence, number of operating hours counted; temperature of the power unit. These data can be retrieved in the ALARMS menu.

The ALARMS with the programming console:

1. Info menu
2. Press ENTER to access the main menu.
3. The first menu PARAMETER CHANGE is displayed.
4. ROLL UP and ROLL DOWN allow for scrolling through the different menus.
5. The ALARMS menu is displayed.
6. Press ENTER to access the menu.
7. The first line shows the last error message; the second line shows the hour counter, the number the error reoccurred and the temperature (if no error occurred, ALARM NULL is displayed).
8. ROLL UP allows for scrolling through earlier error messages, ROLL DOWN scrolls through the alarms in reverse order.
9. Another error message is displayed.
10. Press OUT to quit the menu.
11. You are prompted to delete the error messages saved.
12. Press OUT for keeping them stored (=> 14)). Pressing ENTER results in a second prompting.
13. Press ENTER to delete the error messages; OUT cancels the process and keeps them stored.
14. The menu title ALARMS is displayed again.
15. Select another menu via ROLL UP and ROLL DOWN or return to the info menu by pressing OUT.



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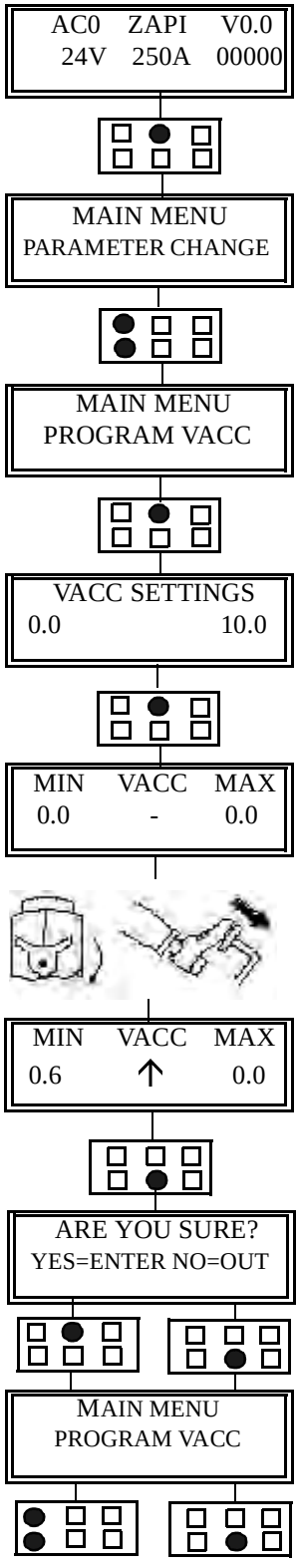
Teach-In the Potentiometer Signal (PROGRAM VACC)

This function allows for capturing and saving the minimum and maximum value of the potentiometer signal for both directions. This allows to compensate any mechanical deviations of the potentiometer.

The PROGRAM VACC function with the programming console:

1. Info menu
2. Press ENTER to access the main menu.
3. The first menu PARAMETER CHANGE is displayed.
4. ROLL UP and ROLL DOWN allow for scrolling through the different menus.
5. The PROGRAM VACC is displayed.
6. Press ENTER to access the menu.
7. The minimum and maximum value saved for the forward direction and lifting function (input E1) respectively are displayed.
8. Press ENTER.
9. Now, the controller and the console are ready to capture the potentiometer signal.
10. Select a travel direction and slowly - especially in the beginning – press the accelerator down to the stop and release it. Then, the same has to be done for the other travel direction.
11. The new minimum and maximum values for the respective travel direction are only displayed during the capturing process. The arrow in the mid of the display indicates the travel direction. Once the drive switch returned into the „Zero“ position 0.0 is displayed for both values.
12. When the capturing process has been completed, press OUT to quit the menu.
13. A prompt is displayed.
14. Press ENTER to save all values captured. Press OUT to undo.
15. The menu title PROGRAM VACC is displayed again.
16. Select another menu via ROLL UP and ROLL DOWN or return to the info menu by pressing OUT.



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The Setting Process

The programming console is connected to the switched off truck. Then both are switched on. If correctly wired and no component is defect, the display shows the info menu.

Has the controller already been customized, continue as described under item 3, if not proceed as follows:

1. Configure options (SET OPTIONS)
2. Set battery voltage (ADJUSTMENT)
3. Check functions of all assigned inputs including the potentiometer with the help of the tester (TESTER)
4. Automatically capture the potentiometer signal (PROGRAM VACC)
5. Set maximum current (current limitation) as set out in table (MAXIMUM CURRENT)
6. Set minimum frequency (FREQUENCY CREEP):
   Set level to 0.6Hz; press drive switch so that the micro-switch just closes; increase level until the motor starts running and then take the level back by one step.
7. Set start-up delay (acceleration) (ACCELER DELAY):
   Accelerate the truck in both directions from stop to maximum speed; change level until the desired acceleration has been achieved.
8. Set braking intensity for slightly returned drive switch (SPEED LIMIT BRK):
   Accelerate truck to maximum speed; return drive switch a bit; change level until the desired braking intensity has been achieved.
9. Set braking intensity for released drive switch or drive switch in neutral position (RELEASE BRAKING):
   Accelerate truck to maximum speed; release drive switch without pressing a pedal; change level until the desired braking intensity has been achieved.
10. Set braking intensity for pressed down brake pedal
    (PEDAL BRAKING):
    Accelerate truck to maximum speed; release drive switch and simultaneously press the brake pedal lightly; change level until the desired braking intensity has been achieved.
11. Set braking intensity for inversion braking (INVERSION BRAKING):
    Accelerate truck to ca. 25% drive speed; change direction; change level until the desired braking intensity has been achieved (do not set braking intensity too hard); accelerate truck to maximum speed; change direction; adjust level if necessary.
12. Set maximum speed forward/backward (MAX SPEED FORW, MAX SPEED BACK):
    Select forward direction; accelerate truck to maximum speed; change level until the desired speed has been reach; repeat process for maximum speed backward.

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13. Set reduced speed (Creep speed):
    Open micro-switch for creep speed; accelerate truck to maximum speed and change CUTBACK SPEED level until the desired speed has been achieved.
14. Hold time for truck halted on slope. Set AUXILIARY TIME in accordance with the table or by testing.
15. Drive time and speed at backing. Set BACKING TIME and BACKING SPEED in accordance with table or by testing (if backing available)
16. Set voltages and ramps for valves 1-4 (only MDI PRC version).

Especially with forklift trucks, all settings for the maximum and reduced speeds as well as for the braking behaviour are first to be made with unloaded truck, then with loaded one.

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Error messages

Monitoring Functions of the Controller

The microprocessor monitors the control's basic functions. This monitoring and analysis falls to four areas:

1. When switching on the key switch the following is tested:
   Watch-Dog, current sensor, charging of capacitors, phase voltage, contactor driving, CAN-BUS interface, the presence of a direction or hydraulic function related signal, and check whether the potentiometer' target value is too high.
2. At halt, the following is tested:
   Watch-Dog, phase voltage, contactor driving, current sensor, CAN-BUS interface, and whether the potentiometer's target value is too high
3. During operation, the following is tested:
   Watch-Dog, current sensor, contactor driving, and CAN-BUS interface
4. Permanently monitored are:
   Motor and power unit temperature

If an error is detected, the alarm LED emits a flash code and the exact error message can be called via the console. In addition, the error message can be called via the CAN-BUS.

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Error-Code Table

Table 10.11 Error-Code Table

Index	Error-Code MDI	Error-Code Console	Error Description	Cause / Solution
1	02A00/AL00	BATTERY LOW	Only if option BATTERY CHECK = ON . The residual battery charge amounts to not more than 10% of full charge or a problem with the controller, wiring (measure on B1)	1.) Charge battery or 2.) check wiring or 3.) replace controller.
2	02A08/AL08	WATCHDOG	Test at stop and during operation; self-test within logic;	Replace controller
3	02A13/AL13	EEPROM KO	Error in memory sector in which the parameter settings are stored. System shuts off.	Turn key switch off and on again or replace E-Prom or complete controller.
4	02A16/AL16	AUX OUTPUT KO	Microprocessor checks driver for magnetic brake. If driver state does not correspond to microprocessor signal, an alarm is issued.	Check magnetic brake wiring, E-brake, diode or replace controller if need be.
5	02A17/AL17	LOGIC FAILURE #3	Error in the controller hardware circuit protecting against high currents.	Replace controller
6	02A18/AL18	LOGIC FAILURE #2	Error in the controller hardware circuit responsible for the phase current's feedback.	Replace controller
7	02A19/AL19	LOGIC FAILURE #1	Safety circuit protecting against over-/undervoltage responded.	An under-/overvoltage occured -> check wiring or defect in safety circuit -> replace controller
8	02A30/02A31 AL30/AL31	VMN LOW /VMN HIGH	Test upon start-up and at halt. Error in wiring, e.g. motor cable not connected or disconnected. Earth connector of the motor, controller defect.	Check wiring of mains cable; replace motor; replace controller
9	02A38/AL38	CONTACTOR OPEN	Main contactor does not pick up or does not switch through.	Check wiring (output A1 measurement), contactor defect -> change +Batt is not applied to main contactor -> measure/check

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Table 10.11 Error-Code Table

Index	Error-Code MDI	Error-Code Console	Error Description	Cause / Solution
10	02A61/AL61	HIGH TEMPER-TURE	If control's is temperature above 75 ° C an alarm is issued. The maximum current is reduced in proportion to the temperature rise. At 100°C the system is shut off. If this alarm occurs at normal temperature the control-ler or temperature sensor or their connections are defect.	1.) Connectors of temperature sensor lose or defect -> check, retighten connectors.2.) replace controller 3.) check heat sink
11	02A67	CAN BUS KO	Can–Bus interrupted or controller defect.	Check CAN-Bus connections or / and replace controller.Note !!! At wrong software in control-ler (CLL instead of CSD) this error also occurs.
12	02A70/AL70	ENCODER ERROR	Encoder defect/connectors defect. Controller defect	Check encoder and control connectors -> replace controller or traction motor is necessary.
13	02A73/AL73	THERMIC SEN-SOR KO	The temperature range of the temperature sensor is per-manently monitored. If an error occurs, an alarm is issued.	Sensor connectors lose or defect -> tighten or repair. Temperature sensor defect -> replace con-troller.
14	02A79/AL79	INCORRECT START	Start sequence not ok. The system only starts if first the key switch, then the tiller micro-switch and then the drive switch is actuated.	Direction switch or micro-switch stuck, miswired -> check. If none of these errors is present, replace controller. Note !!! The error is not saved in the alarm menu.
15	02A86/AL86	PEDAL WIRE KO	Permanent test. If a defect on the traction potentiometer or the respective wiring is detected, an alarm is issued.	Potentiometer connector N POT or PPOT not wired or disconnected, miswired potentiometer. Potentiometer defect or out of setting.
16	16A70	HW OVER CURR	Overcurrent protection on the digital outputs NEVD1 (A6 -> lovering valve) or NEVD2 (A4 -> pump contac-tor) responds. (only MDI-PRC)	From 3A overcurrent, an alarm is issued, check layout of magnetic valves; check pump contactor and its wiring; check respective controller con-nectors.
17	16A90	NEVP1 NOT OK	Short-circuit on the proportional outputs NEVP1 (A8) or NEVP 2 (A 9) (only MDI -PRC), A(A9: connectors on the MDI-PRC display.	MDI display defect, replace. Check MDI connec-tion. Check wiring. Replace controller.

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Table 10.11 Error-Code Table

Index	Error-Code MDI	Error-Code Console	Error Description	Cause / Solution
18	16A74	DRIVER SHORTED	Short-circuit on the digital outputs NEVD1 (A6) or EVD2 (A4) (only MDI-PRC).	Check respective valve and its wiring, replace magnetic valves is need be; check respective controller connectors.
19	16A75	CONTACTOR DRIVER	Disconnection to the driven load on the digital outputs NEVD1 (A6),NEVD2 (A4) (only MDI-PRC)	Check wiring of valves and pump contactor -> eliminate disconnection; check respective controller connectors.
20	16A88	POS DRV SHORTED	Short-circuit of the positive voltage supply on the loads connected to EVD1 (A6) ,EVD2 (A4).	Check wiring of valves and pump contactor -> eliminate disconnection; check respective controller connectors.
21	16A89	PEVP NOT OK	Positive voltage supply to the connected loads non-existent (only MDI-PRC).	Check wiring of valves and pump contactor -> eliminate disconnection; check respective controller connectors.
22	02A60/AL60	CAPICITOR CHARGE	Test during self-monitoring upon start-up. The controller tries to charge the capacitors via a power resistor. If this fails within a certain period of time, an alarm is issued. The main contactor does not pick up.	a.) The connection to the power resistor is open -> replace controller. b.) Defect in charging circuit -> replace controller c.) power unit defect - > replace controller d) Check for motor cable disconnection -> depending on phase disconnection controller detects AL60 instead of AL31
23	02A78/AL78	VACC NOT OK	Test at halt. If the voltage of the potentiometer signal is higher than 1V above the minimum value saved, an alarm is issued.	a.) Connecting wire for potentiometer disconnected b.) Potentiometer miswired c.) Potentiometer defect or out of setting d.) PROGRAMM VACC function not or improperly used. (calibration)
24	AL06	SERIAL ERROR #1	No communication with the connected controller.	Check serial connection, replace MDI and/or controller if necessary.(only MDI error)

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Table 10.11 Error-Code Table

Index	Error-Code MDI	Error-Code Console	Error Description	Cause / Solution
25	02A65/AL65	MOTOR TEMPER-ATURE	The maximum temperature of the drive motor has been reached. Value can be set at parameter (MOTOR OVERTEMP).	Either traction motor excessively heated up - > check by measuring the temperature, check motor for ground contact, check wiring, check setting for Set-Motor-Temperature -> set to actual ambient temperature if necessary.
26	02A76/AL76	COIL SHORTED	An error on the contactor control of the main contactor is detected upon start-up. (Short-circuit / overload)	a.) Contactor coil of main contactor short-circuited -> replace main contactor. b.) Miswired contactor coil -> check wiring c.) Error in electronic unit - > replace controller d.) Short ciruit (e.g. magnetic brake; freewheel diode) -> check wiring, eliminate short circuit, replace parts if need be
27	02A80/AL80	FORW + BACKW	A permanent test is carried out. If the controller detects that both direction signals are applied at the same time, an alarm is issuer.	a.) Miswiring check, eliminate error) b.) direction micro-switch stuck c.) operating error d.) if none of the aforementioned causes applies - > replace controller
28	AL93	WRONG SET BATT	Battery voltage does not correspond to the voltage required by the controller. Example: 48 V battery on 24 V truck: In this case, this error would occur.	Battery voltage must be 24 V, otherwise: exchange battery at overvoltage.
29	AL98	CLEARING MDI HM	If the system (controller/MDI) detects a time difference greater than 10 hours (between MDI memory and controller), the system assumes that one part has been replaced. If nothing happens within the next minute, the MDI's hour counter is automatically cleared and replaced by the controller hour counter.	Always occurs if a) controller has been replaced b) MDI has been replaced Note !! Only occurs on CLL
30	02A99/AL99	CHECK UP NEEDED	Warns the user that the time interval programmed for the next service expired.	Service! And, depending on request or default: set " Check up Type " (see Chapter: Annex: MDI)

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Table 10.11 Error-Code Table

Index	Error-Code MDI	Error-Code Console	Error Description	Cause / Solution
31	02A55	PROG LIFT LEVER	PROG LIFT LEVER (only MDI PRC version or LEHCI / CSD) (MDI-Alarm 55) Permanent test. If the controller detects that the lifting/ lowering potentiometer or the respective wiring is defect, an alarm is issued.	a) Potentiometer connector NPOT or PPOT not wired or disconnected: -> eliminate error b) Potentiometer defect or out of setting: -> replace poti if need be
32	?	MDI COIL SHORTED	The coil of one of the ON/OFF valves is short-circuited. The error is detected by the MDI PRC and communicated to the AC0 Controller via the CAN-BUS interface.	Possible causes: a) coil of one valve or respective wiring short-circuited b) MDI PRC defect -> replace MDI PRC
33	?	MDI VALVE DRIVER	One of the drivers for the ON/OFF valves is defect. The error is detected by the MDI PRC and communicated to the AC0 cler via the CAN-BUS interface.	Replace MDI PRC
34	16A74	MDI DRIVER SHORTED	One of the drivers for the ON/OFF valves is short-circuited. The error is detected by the MDI PRC and communicated to the AC0 controller via the CAN-BUS interface.	Possible causes: a) external wiring short-circuited b) MDI PRC defect -> replace MDI PRC
35	?	MDI PEV	The positive voltage supply to the valves is of incorrect value. The error is detected by the MDI PRC and communicated to the AC0 via the CAN-BUS interface.	
36	AL89	PEV NOT OK	The voltage on output A11 (HM – Standard version / PEV – MDI PRC version) is incorrect.	Possible causes: a) Transistor output defect -> replace controller b) Logic defect -> replace controller
37	16A89	PEVP NOT OK	The positive supply voltage of an output load is not ok (only MDI-PRC).	Possible causes: a) external wiring short-circuited of pump contactor / valve coil b) MDI PRC defect -> replace MDI PRC

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Service Instructions ⚠

Table 10.12 Service Instructions

Check wear of contactor contacts: At already heave development of pearls and extremely worn contacts, replace.	Every 3 months
Check micro-switch Pedal / Tiller head: Meter the voltage drop on a closed contact. There must be no voltage drop and consequently no resistance. In addition, the switching noise must be clear and unambiguous.	Every 3 months
Check power cable to battery and motor: Cable, cable glands, and insulation must be in perfect condition.	Every 3 months
Mechanically check Pedal/Tiller head for the operability: All movable parts must run smooth and must not stick. The springs must work safely. The potentiometer must completely cover the actual or programmed control range.	Every 3 months
Mechanically check the operability of the contactors: All movable parts must run smooth and must not stick. The springs must work safely.	Every 3 months

Qualified personnel must make servicing. Exclusively original spare parts must be used. Installations and wirings must be made precisely according to drawing; any modifications require the consent of the controller supplier (Zapi). Otherwise, no liability is accepted for any troubles possibly arising.

All obvious and alleged defects being noticed by the user or the service personnel must by reported to the responsible representative of ZAPI who will then decide on further actions aimed at ensuring the further functional safety of the truck.

In case of any damages to the electrical system preventing a safe operation of the truck, the truck has to be taken out of operation.

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MDI AND MDI - PRC

MDI Connection

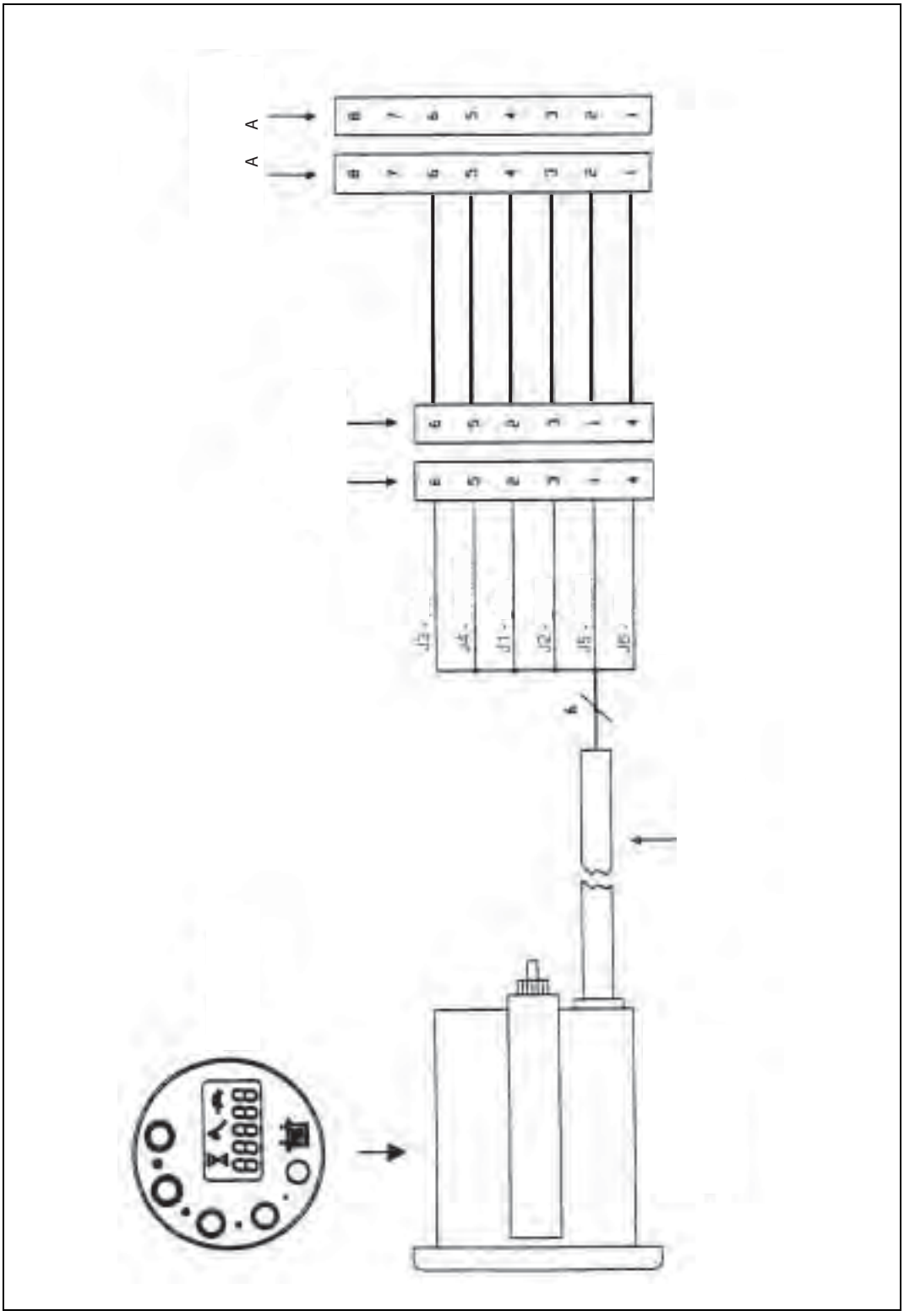

Figure 10.10 MDI Connection

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Dimensions MDI IP64

Legend:

1. plastic housing
2. mounting bracket
3. MOLEX MINI FIT plug, 6 pins (5557) with socket contacts (5556)
4. locking screw
5. rubber seal
6. cable route (external)

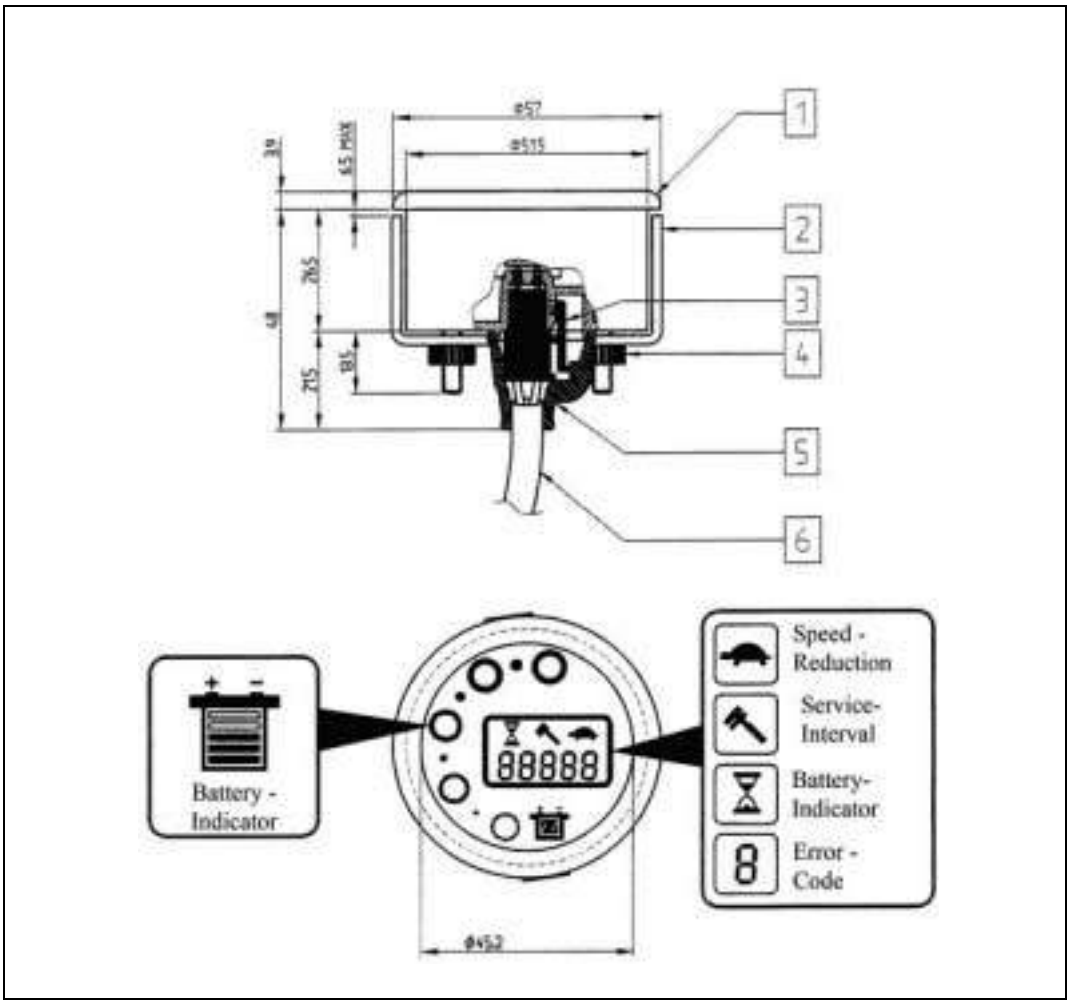

Figure 10.11 Dimensions MDI IP64

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MDI IP64 *Connection*

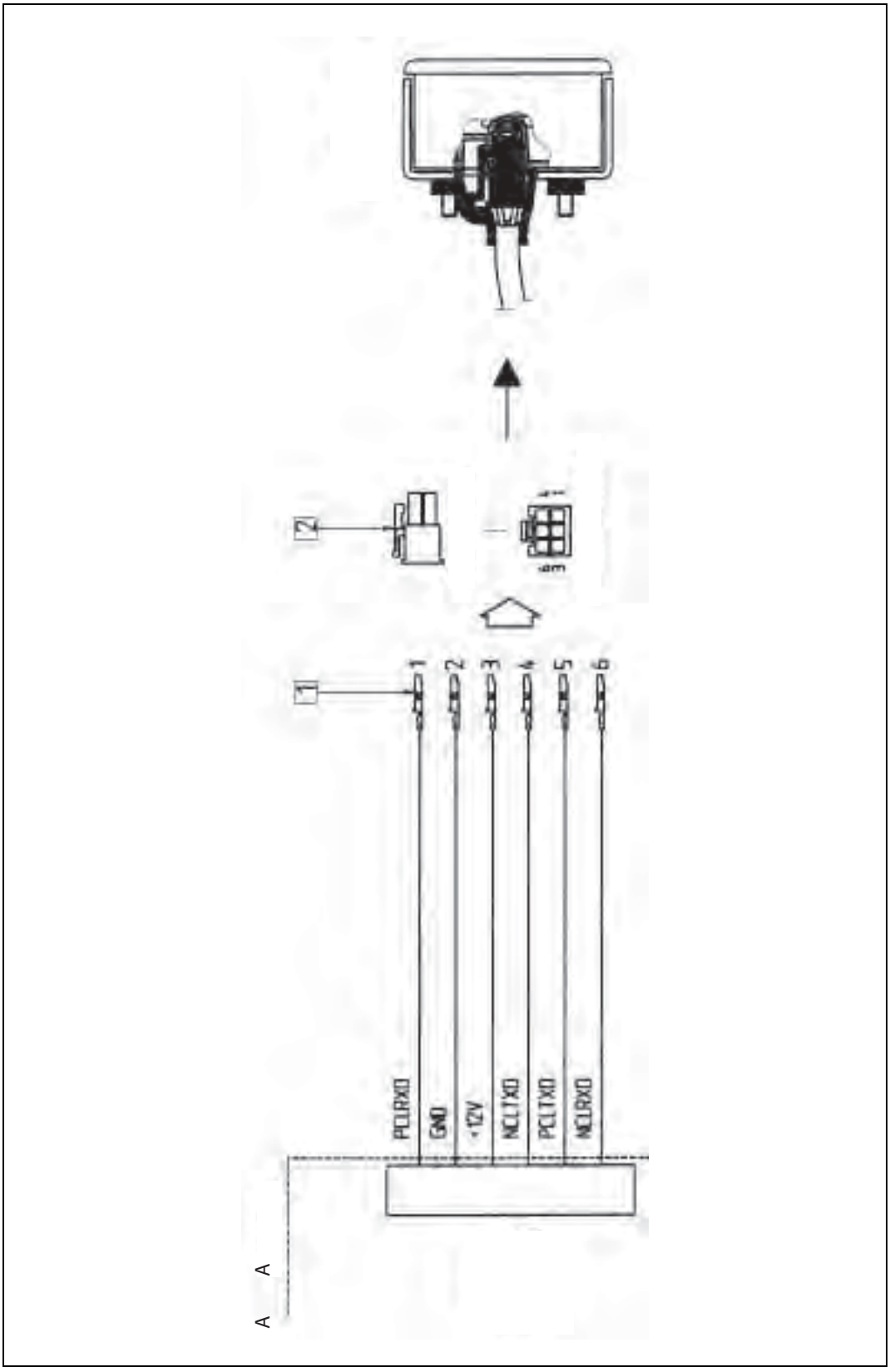

Figure 10.12 MDI IP64 Connection

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MDI-PRC

In addition to its standard features (see Annex MDI), the digital multi-purpose instrument MDI PRC provides for additional outputs to drive certain loads (e. g. valves, relays, etc.).

The unit must be supplied with +12V (Pin 5) and –BATT (Pin 3). These potentials are normally provided at the drive or pump controller, must, however, not necessarily be taken from there. Via the connectors 10 (CAN HIGH) and 11 (CAN LOW) the MDI PRC can communicate with several controls via a CAN-BUS connection.

To pin 1, the power supply of the driven loads is connected. It should correspond to their nominal load and is independent of the battery voltage. If power is supplied from the drive or pump controller via the MDI PRC to the loads (up to 24 VDC), they do not require any external safety circuit. If power is externally supplied (> 24 VDC), each load driven by the MDI PRC must feature a safety circuit.

Pin 2 provides the positive voltage supply from the drive or pump controller via the MDI PRC (Pin 1) for the two loads VALVE 3 (EVD1) and VALVE 4 (EVD2). Is this is used no external safety circuit is required on the loads. Pin 6 negatively drives VALVE 3 (EVD1), Pin 4 negatively drives VALVE 4 (EVD2). The conditions for driving depend on the connected drive or pump controller and are transmitted to the MDI PRC via the CAN-BUS interface. Both loads can exclusively be driven ON or OFF.

Pin 7 provides the positive voltage supply from the drive or pump controller via the MDI PRC (Pin 1) for the two loads VALVE 1 (EVP1) and VALVE 2 (EVP2). If this is used no external safety circuit is required on the loads. Pin 8 negatively drives VALVE 1 (EVP1), Pin 9 negatively drives VALVE 2 (EVP2). The conditions for driving depend on the connected drive or pump controller and are transmitted to the MDI PRC via the CAN-BUS interface. Both loads can either be driven ON or OFF or proportionally controlled. The setting can be programmed in the connected control’s „Options“ menu.

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⚠ *Warning!*

VALVE 1 (EVP1) and VALVE 2 (EVP2) can <u>not be simultaneously</u> driven. Only one of the two loads can be active at a time

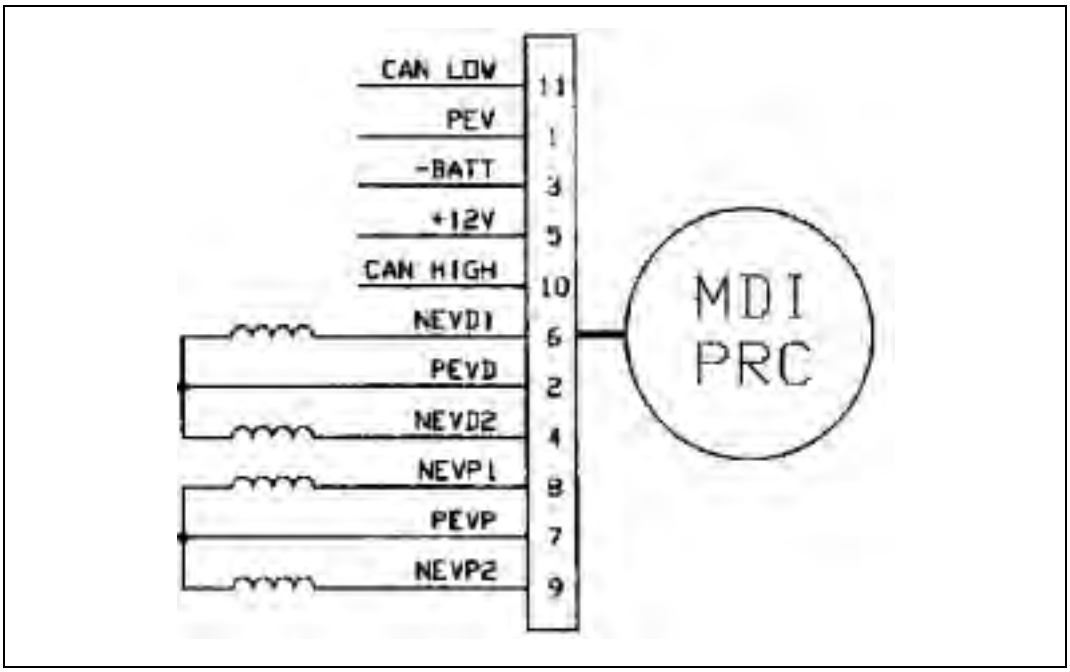

Figure 10.13

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GLOSSARY

AC	(**A**lternate **C**urrent) is a term of an electrical current with permanent changing polarity and value.
BOOSTER	Is an „Amplifier-Circuit“ of the power block of the AC0 Controller.
CAN-BUS	(**C**ontrol **A**rea **N**etwork) is a bus-system which interconnects the components of a truck, e.g. An digital protocol handles the bus communication via two wires (CAN-LOW and CAN-HIGH).
DC	(**D**irect **C**urrent) is a term of an electrical current without changing polarity and value.
Inkremental-Encoder	An inkremental-Encoder is a sensor, which gives out two Pauls-Pause-Signals (PWM) shifted by 90° . Due to the shifting of both signals and of the number of pulses it is possible for the controller to detect the direction and speed of a motor.
HIGH(-Signal)	Voltage level of a digital signal; a little bit below the plus power supply voltage.
LOW(-Signal)	Voltage level of a digital signal; a little bit above the minus power supply voltage GND (0 Volt).
MDI	(**M**ulti-purpose **D**igital **I**nstrument) is a digital instrument showing different information on a display.
Watch-Dog	Is an internal function, observing the correct work of the AC0 Controller software .
ZAPIMOS	Zapi is the manufactor of the AC0. **MOS** (**M**etal **O**xyd **S**emiconductor) is a special technology of power transistors, working in the power block of the AC0 Controller.

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Adjustment Values

PLL Kordel

Truck type	**:**	**PLL/PSL**	**Software**	**:**	**AC0T2AE LA1.18**
Battery type	**:**	**Acid**	**Tillerhead**	**:**	**Lafis**
Drive unit	**:**	**Kordel***	**Battery check**	**:**	**yes**

* MAIN MENU *	-> Parameter change	-> Acceleration delay	Level 0-9	Level 0
		-> Release braking	Level 0-9	Level 3
		-> Invers braking	Level 0-9	Level 9
		-> Pedal braking	Level 0-9	Level 0
		-> Speed limit braking	Level 0-9	Level 1
		-> Brake cutback	Level 0-9	Level 5
		-> Maximum speed forward	0-140 Hz	140 Hz *
		-> Maximum speed back-ward	0-140 Hz	140 Hz *
		-> Cutback speed	0-100%	100%
		-> Cutback speed 2	0-100%	100%
		-> Cutback speed 3	0-100%	100%
		-> HS cutback	0-100%	26%

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	-> Frequency creep	0.30-3.00 Hz	1.20 Hz
	-> Maximum current	Level 0-9	Level 9
	-> Inching speed	0-18 Hz	0 Hz
	-> Inching time	Level 0-9	Level 0
	-> Auxiliary time	0-5.0	1.5
	-> Aux time #1	0.00-6.00	1.00
-> Tester	-> Battery voltage	V	
	-> Motor voltage	%	
	-> Voltage booster	%	
	-> Frequency	Hz	
	-> Encoder	Hz	
	-> Slip value	Hz	
	-> Current RMS	A	
	-> Battery current	A	
	-> Battery charge	%	
	-> Temperature	°C	
	-> Motor temperature	°C	
	-> Accelerator	V	
	-> Lifting control	V	
	-> Lifting switch	ON/OFF	
	-> Descent switch	ON/OFF	

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		-> Digital input # 1	ON/OFF	
		-> Digital input # 2	ON/OFF	
		-> Forward switch	ON/OFF	
		-> Backward switch	ON/OFF	
		-> Handle/seat switch	ON/OFF	
		-> HS cutback	ON/OFF	
		-> Quick inversion	ON/OFF	
	-> Save parameter			
	-> Restore parameter			
	-> Alarms			
	-> Program VACC			
	-> Motor data			
* CONFIGURATION MENU *	-> Set modell	-> Modell type	0-255	2
	-> Set options	-> Tiller switch	Handle/seat	Handle
		-> 1 Micro switch	ON/OFF	OFF
		-> Set input #1	Level 0-2	Level 0
		-> Set input #2	Present / Option #1	Option #1
		-> Set input #3	Present / Option #1	Present
		-> Set input #4	Belly / brake / exclusive hydro	Belly
		-> Hour counter	Running / key on	Running

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	-> Battery check	Level 0-3	Level 1		
	-> Hydro key on	ON / OFF	OFF		
	-> Stop on ramp	ON / OFF	ON		
	-> Aux output #1	Brake / free / hydro contactor / exclusive hydro	Brake		
	-> Pedal braking	None / digital / analog	None		
	-> Quick inversion	Belly / timed / none	Belly		
	-> Aux voltage #1	10-100 %	100 %		
	-> Perfomance	Option #1 / option #2	Option #1		
	-> MDI-PRC	Absent / present	Absent		
	-> Quick inversion logic	Option #1 / option #2	Option #2		
	-> Mot. phase exch.	ON/OFF	OFF	*	Added in 1.18
-> Adjustments	-> Set potential brake min	not adjustable	0.4 V		
	-> Set potential brake max	not adjustable	4.5 V		
	-> Motor overtemperature	70 - 160 °C	120 °C		
	-> Set motor temp	+/-100 °C	20 °C		
	-> Set battery type	24 -48 V	24 V		
	-> Adjust battery	0.0 - 26.3 V	25.7 V		
	-> Throttle 0 zone	0 - 17 %	9 %		
	-> Throttle x zone	18 - 100 %	45 %		

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		-> Throttle y zone	4 - 100 %	25 %	
		-> Adjustment #01	Level 0-9	Level 6	
		-> Adjustment #02	Level 0-9	Level 9	
		-> Load HM from MDI	ON / OFF	OFF	
		-> Check up done	ON / OFF	OFF	
		-> Check up type	None / option #1 / option #2 / option #3 / option #4	None	
* ZAPI MENU *	-> Special adjust-ments	-> Adjustment #1	fixed value	100 %	
		-> Adjustment #2	fixed value	98 %	
		-> Set current	0 - 1000 A	150 A	
		-> Set temperature	fixed value	25 °C	
		-> Aux function 1	fixed value	Level 15	
		-> Aux function 2	fixed value	Level 15	
	-> Hardware settings	-> AC type 0	ON / OFF	ON	
		-> Compensation	ON / OFF	ON	
		-> Slip control	ON / OFF	ON	
		-> DC-link compensation	ON / OFF	ON	
		-> Sat frequency	0 -100 Hz	75 Hz	*
		-> Braking modul	0 - 200 Hz	75 Hz	*
		-> Minimum voltage	0 - 100 %	2 %	
		-> Boost at low frequency	0 - 100 %	45 %	*

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-> Boost at high frequency	0 - 100 %	45 %	
-> Boost corner frequency	0 - 200 Hz	80 Hz	*
-> Braking booster	0 - 100 %	21 %	
-> Motor resistance	Level 0 - 9	Level 0	
-> Slip coefficient	Level 0 - 9	Level 0	
-> Maxslip reset	0.20 - 2.00 Hz	0.60 Hz	
-> Maxslip low frequency	4.00 - 10.00 Hz	6.00 Hz	
-> Maxslip inc frequency	0 - 4.5	1.5	*
-> Maxslip frequency	0 - 100 Hz	40 Hz	
-> Maxslip inc	0 - 100 Hz	20 Hz	
-> Option 07	Level 0 - 9	Level 1	
-> Option 08	Level 0 - 9	Level 6	
-> Option 06	Level 0 - 9	Level 6	

-> Read RAM

-> Read EEPROM

-> Clear EEPROM

-> Clear console

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PLL Sauer

Truck type	**:**	**PLL/PSL**	**Software**	**:**	**AC0T2AE LA1.18**
Battery type	**:**	**Acid**	**Tillerhead**	**:**	**Lafis**
Drive unit	**:**	**Sauer/Danfoss***	**Battery check**	**:**	**yes**

* MAIN MENU *	-> Parameter change	-> Acceleration delay	Level 0-9	Level 0
		-> Release braking	Level 0-9	Level 3
		-> Invers braking	Level 0-9	Level 9
		-> Pedal braking	Level 0-9	Level 0
		-> Speed limit braking	Level 0-9	Level 1
		-> Brake cutback	Level 0-9	Level 5
		-> Maximum speed forward	0-140 Hz	120 Hz *
		-> Maximum speed back-ward	0-140 Hz	120 Hz *
		-> Cutback speed	0-100%	100%
		-> Cutback speed 2	0-100%	100%
		-> Cutback speed 3	0-100%	100%
		-> HS cutback	0-100%	26%
		-> Frequency creep	0.30-3.00 Hz	1.20 Hz

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	-> Maximum current	Level 0-9	Level 9
	-> Inching speed	0-18 Hz	0 Hz
	-> Inching time	Level 0-9	Level 0
	-> Auxiliary time	0-5.0	1.5
	-> Aux time #1	0.00-6.00	1.00
-> Tester	-> Battery voltage	V	
	-> Motor voltage	%	
	-> Voltage booster	%	
	-> Frequency	Hz	
	-> Encoder	Hz	
	-> Slip value	Hz	
	-> Current RMS	A	
	-> Battery current	A	
	-> Battery charge	%	
	-> Temperature	°C	
	-> Motor temperature	°C	
	-> Accelerator	V	
	-> Lifting control	V	
	-> Lifting switch	ON/OFF	
	-> Descent switch	ON/OFF	
	-> Digital input # 1	ON/OFF	

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		-> Digital input # 2	ON/OFF	
		-> Forward switch	ON/OFF	
		-> Backward switch	ON/OFF	
		-> Handle/seat switch	ON/OFF	
		-> HS cutback	ON/OFF	
		-> Quick inversion	ON/OFF	
	-> Save parameter			
	-> Restore parameter			
	-> Alarms			
	-> Program VACC			
	-> Motor data			
* CONFIGURATION MENU *	-> Set modell	-> Modell type	0-255	2
	-> Set options	-> Tiller switch	Handle/seat	Handle
		-> 1Micro switch	ON/OFF	OFF
		-> Set input #1	Level 0-2	Level 0
		-> Set input #2	Present / Option #1	Option #1
		-> Set input #3	Present / Option #1	Present
		-> Set input #4	Belly / brake / exclusive hydro	Belly
		-> Hour counter	Running / key on	Running
		-> Battery check	Level 0-3	Level 1

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	-> Hydro key on	ON / OFF	OFF		
	-> Stop on ramp	ON / OFF	ON		
	-> Aux output #1	Brake / free / hydro contactor / exclusive hydro	Brake		
	-> Pedal braking	None / digital / analog	None		
	-> Quick inversion	Belly / timed / none	Belly		
	-> Aux voltage #1	10-100 %	100 %		
	-> Perfomance	Option #1 / option #2	Option #1		
	-> MDI-PRC	Absent / present	Absent		
	-> Quick inversion logic	Option #1 / option #2	Option #2		
	-> Mot. phase exch.	ON/OFF	ON	*	Added in 1.18
-> Adjustments	-> Set potential brake min	not adjustable	0.4 V		
	-> Set potential brake max	not adjustable	4.5 V		
	-> Motor overtemperature	70 - 160 °C	120 °C		
	-> Set motor temp	+/-100 °C	20 °C		
	-> Set battery type	24 -48 V	24 V		
	-> Adjust battery	0.0 - 26.3 V	25.7 V		
	-> Throttle 0 zone	0 - 17 %	9 %		
	-> Throttle x zone	18 - 100 %	45 %		
	-> Throttle y zone	4 - 100 %	25 %		

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		-> Adjustment #01	Level 0-9	Level 6	
		-> Adjustment #02	Level 0-9	Level 9	
		-> Load HM from MDI	ON / OFF	OFF	
b					
		-> Check up done	ON / OFF	OFF	
		-> Check up type	None / option #1 / option #2 / option #3 / option #4	None	
* ZAPI MENU *	-> Special adjust-ments	-> Adjustment #1	fixed value	100 %	
		-> Adjustment #2	fixed value	98 %	
		-> Set current	0 - 1000 A	150 A	
		-> Set temperature	fixed value	25 °C	
		-> Aux function 1	fixed value	Level 15	
		-> Aux function 2	fixed value	Level 15	
	-> Hardware settings	-> AC type 0	ON / OFF	ON	
		-> Compensation	ON / OFF	ON	
		-> Slip control	ON / OFF	ON	
		-> DC-link compensation	ON / OFF	ON	
		-> Sat frequency	0 -100 Hz	90 Hz	*
		-> Braking modul	0 - 200 Hz	90 Hz	*
		-> Minimum voltage	0 - 100 %	2 %	
		-> Boost at low frequency	0 - 100 %	40 %	
		-> Boost at high frequency	0 - 100 %	45 %	

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-> Boost corner frequency	0 - 200 Hz	55 Hz	*
-> Braking booster	0 - 100 %	21 %	
-> Motor resistance	Level 0 - 9	Level 0	
-> Slip coefficient	Level 0 - 9	Level 0	
-> Maxslip reset	0.20 - 2.00 Hz	0.60 Hz	
-> Maxslip low frequency	4.00 - 10.00 Hz	6.00 Hz	
-> Maxslip inc frequency	0 - 4.5	0.5	*
-> Maxslip frequency	0 - 100 Hz	40 Hz	
-> Maxslip inc	0 - 100 Hz	20 Hz	
-> Option 07	Level 0 - 9	Level 1	
-> Option 08	Level 0 - 9	Level 6	
-> Option 06	Level 0 - 9	Level 6	

-> Read RAM

-> Read EEPROM

-> Clear EEPROM

-> Clear console

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PSD Kordel

Truck type	**:**	**PSD/(PLE)**	**Software**	**:**	**AC0T2AE LA1.18**
Battery type	**:**	**Acid**	**Tillerhead**	**:**	**Lafis**
Drive unit	**:**	**Kordel***	**Battery check**	**:**	**yes**

* MAIN MENU *	-> Parameter change	-> Acceleration delay	Level 0-9	Level 0
		-> Release braking	Level 0-9	Level 3
		-> Invers braking	Level 0-9	Level 9
		-> Pedal braking	Level 0-9	Level 0
		-> Speed limit braking	Level 0-9	Level 1
		-> Brake cutback	Level 0-9	Level 5
		-> Maximum speed forward	0-140 Hz	140 Hz
		-> Maximum speed back-ward	0-140 Hz	140 Hz
		-> Cutback speed	0-100%	100%
		-> Cutback speed 2	0-100%	
		-> Cutback speed 3	0-100%	
		-> HS cutback	0-100%	26%
		-> Frequency creep	0.30-3.00 Hz	1.20 Hz

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	-> Maximum current	Level 0-9	Level 9
	-> Inching speed	0-18 Hz	
	-> Inching time	Level 0-9	
	-> Auxiliary time	0-5.0	1.5
	-> Minimum valve 1	0-255	0
	-> Minimum valve 2	0-255	0
	-> Maximum valve 1	0-255	255
	-> Maximum valve 2	0-255	255
	-> Valves voltage	12-120 V	24 V
	-> Valve 3 voltage	0-100%	100 %
	-> Valve 4 voltage	0-100%	100 %
	-> V 1 opening ramp	0.0-2.0	1.1
	-> V 2 opening ramp	0.0-2.0	1.1
	-> V 1 closing ramp	0.2-2.0	1.2
	-> V 2 closing ramp	0.2-2.0	1.2
	-> Aux time #1	0.00-6.00	1.00
	-> Dittering freq	Level 1-3	3
	-> Ditter amplitude	0-255	255
-> Tester	-> Battery voltage	V	
	-> Motor voltage	%	
	-> Voltage booster	%	

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-> Frequency	Hz
-> Encoder	Hz
-> Slip value	Hz
-> Current RMS	A
-> Battery current	A
-> Battery charge	%
-> Temperature	°C
-> Motor temperature	°C
-> Accelerator	V
-> Lifting control	V
-> Lifting switch	ON/OFF
-> Descent switch	ON/OFF
-> Digital input # 1	ON/OFF
-> Digital input # 2	ON/OFF
-> Forward switch	ON/OFF
-> Backward switch	ON/OFF
-> Handle/seat switch	ON/OFF
-> HS cutback	ON/OFF
-> Quick inversion	ON/OFF

-> Save parameter

-> Restore parameter

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	-> Alarms			
	-> Program VACC			
	-> Motor data			
* CONFIGURATION MENU *	-> Set modell	-> Modell type	0-255	2
	-> Set options	-> Tiller switch	Handle/seat	Handle
		-> 1Micro switch	ON/OFF	OFF
		-> Set input #1	Level 0-2	Level 0
		-> Set input #2	Present / Option #1	
		-> Set input #3	Present / Option #1	
		-> Set input #4	Belly / brake / exclusive hydro	Belly
		-> Hour counter	Running / key on	Running
		-> Battery check	Level 0-3	Level 1
		-> Hydro key on	ON / OFF	OFF
		-> Stop on ramp	ON / OFF	ON
		-> Aux output #1	Brake / free / hydro contactor / exclusive hydro	Brake
		-> Pedal braking	None / digital / analog	None
		-> Quick inversion	Belly / timed / none	Belly
		-> Aux voltage #1	10-100 %	100 %
		-> Perfomance	Option #1 / option #2	Option #1

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	-> Truck type	1 - 3	1		
	-> MDI-PRC	Absent / present	Present		
	-> Quick inversion logic	Option #1 / option #2	Option #2		
	-> Valve 1 type	Option #1 / option #2	Option #1		
	-> Valve 2 type	Option #1 / option #2	Option #1		
	-> Mot. phase exch.	ON/OFF	OFF	*	Added in 1.18
-> Adjustments	-> Minimum lift	not adjustable	2.6 V		
	-> Maximum lift	not adjustable	5.0 V		
	-> Minimum lower	not adjustable	0.0 V		
	-> Maximum lower	not adjustable	2.2 V		
	-> Set potential brake min	not adjustable			
	-> Set potential brake max	not adjustable			
	-> Motor overtemp	70 - 160 °C	120 °C		
	-> Set motor temp	+/-100 °C	20 °C		
	-> Set battery type	24 -48 V	24 V		
	-> Adjust battery	0.0 - 26.3 V	25.7 V		
	-> Throttle 0 zone	0 - 17 %	9 %		
	-> Throttle x zone	18 - 100 %	45 %		
	-> Throttle y zone	4 - 100 %	25 %		
	-> Adjustment #01	Level 0-9	Level 6		

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		-> Adjustment #02	Level 0-9	Level 9
		-> Load HM from MDI	ON / OFF	OFF
		-> Check up done	ON / OFF	OFF
		-> Check up type	None / option #1 / option #2 / option #3 / option #4	None
		-> Option 05	0 - 9	0
		-> Option 04	0 - 9	0
		-> Option 03	0 - 9	0
		-> Option 02	0 - 9	0
		-> Option 01	0 - 9	0
* ZAPI MENU *	-> Special adjust-ments	-> Adjustment #1	fixed value	100 %
		-> Adjustment #2	fixed value	98 %
		-> Set current	0 - 1000 A	150 A
		-> Set temperature	fixed value	25 °C
		-> Aux function 1	fixed value	Level 15
		-> Aux function 2	fixed value	Level 15
	-> Hardware settings	-> AC type 0	ON / OFF	ON
		-> Compensation	ON / OFF	ON
		-> Slip control	ON / OFF	ON
		-> DC-link compensation	ON / OFF	ON
		-> Sat frequency	0 -100 Hz	75 Hz *

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-> Braking modul	0 - 200 Hz	75 Hz	*
-> Minimum voltage	0 - 100 %	2 %	
-> Boost at low frequency	0 - 100 %	45 %	*
-> Boost at high frequency	0 - 100 %	45 %	
-> Boost corner frequency	0 - 200 Hz	80 Hz	*
-> Braking booster	0 - 100 %	21 %	
-> Motor resistance	Level 0 - 9	Level 0	
-> Slip coefficient	Level 0 - 9	Level 0	
-> Maxslip reset	0.20 - 2.00 Hz	0.60 Hz	
-> Maxslip low frequency	4.00 - 10.00 Hz	6.00 Hz	
-> Maxslip inc frequency	0 - 4.5	1.5	*
-> Maxslip frequency	0 - 100 Hz	40 Hz	
-> Maxslip inc	0 - 100 Hz	20 Hz	
-> Option 07	Level 0 - 9	Level 1	
-> Option 08	Level 0 - 9	Level 6	
-> Option 06	Level 0 - 9	Level 6	

-> Read RAM

-> Read EEPROM

-> Clear EEPROM

-> Clear console

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PSD Sauer

Truck type	**:**	**PSD/(PLE)**	**Software**	**:**	**AC0T2AE LA1.18**
Battery type	**:**	**Acid**	**Tillerhead**	**:**	**Lafis**
Drive unit	**:**	**Sauer/Danfoss***	**Battery check**	**:**	**yes**

* MAIN MENU *	-> Parameter change	-> Acceleration delay	Level 0-9	Level 0
		-> Release braking	Level 0-9	Level 3
		-> Invers braking	Level 0-9	Level 9
		-> Pedal braking	Level 0-9	Level 0
		-> Speed limit braking	Level 0-9	Level 1
		-> Brake cutback	Level 0-9	Level 5
		-> Maximum speed forward	0-140 Hz	120 Hz
		-> Maximum speed back-ward	0-140 Hz	120 Hz
		-> Cutback speed	0-100%	100%
		-> Cutback speed 2	0-100%	
		-> Cutback speed 3	0-100%	
		-> HS cutback	0-100%	26%

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	-> Frequency creep	0.30-3.00 Hz	1.20 Hz
	-> Maximum current	Level 0-9	Level 9
	-> Inching speed	0-18 Hz	
	-> Inching time	Level 0-9	
	-> Auxiliary time	0-5.0	1.5
	-> Minimum valve 1	0-255	0
	-> Minimum valve 2	0-255	0
	-> Maximum valve 1	0-255	255
	-> Maximum valve 2	0-255	255
	-> Valves voltage	12-120 V	24 V
	-> Valve 3 voltage	0-100%	100 %
	-> Valve 4 voltage	0-100%	100 %
	-> V 1 opening ramp	0.0-2.0	1.1
	-> V 2 opening ramp	0.0-2.0	1.1
	-> V 1 closing ramp	0.2-2.0	1.2
	-> V 2 closing ramp	0.2-2.0	1.2
	-> Aux time #1	0.00-6.00	1.00
	-> Dittering freq	Level 1-3	3
	-> Ditter amplitude	0-255	255
-> Tester	-> Battery voltage	V	
	-> Motor voltage	%	

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-> Voltage booster	%
-> Frequency	Hz
-> Encoder	Hz
-> Slip value	Hz
-> Current RMS	A
-> Battery current	A
-> Battery charge	%
-> Temperature	°C
-> Motor temperature	°C
-> Accelerator	V
-> Lifting control	V
-> Lifting switch	ON/OFF
-> Descent switch	ON/OFF
-> Digital input # 1	ON/OFF
-> Digital input # 2	ON/OFF
-> Forward switch	ON/OFF
-> Backward switch	ON/OFF
-> Handle/seat switch	ON/OFF
-> HS cutback	ON/OFF
-> Quick inversion	ON/OFF

-> Save parameter

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	-> Restore parameter			
	-> Alarms			
	-> Program VACC			
	-> Motor data			
* CONFIGURATION MENU *	-> Set modell	-> Modell type	0-255	2
	-> Set options	-> Tiller switch	Handle/seat	Handle
		-> 1Micro switch	ON/OFF	OFF
		-> Set input #1	Level 0-2	Level 0
		-> Set input #2	Present / Option #1	
		-> Set input #3	Present / Option #1	
		-> Set input #4	Belly / brake / exclusive hydro	Belly
		-> Hour counter	Running / key on	Running
		-> Battery check	Level 0-3	Level 1
		-> Hydro key on	ON / OFF	OFF
		-> Stop on ramp	ON / OFF	ON
		-> Aux output #1	Brake / free / hydro contactor / exclusive hydro	Brake
		-> Pedal braking	None / digital / analog	None
		-> Quick inversion	Belly / timed / none	Belly
		-> Aux voltage #1	10-100 %	100 %
		-> Perfomance	Option #1 / option #2	Option #1

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	-> Truck type	1 - 3	1		
	-> MDI-PRC	Absent / present	Present		
	-> Quick inversion logic	Option #1 / option #2	Option #2		
	-> Valve 1 type	Option #1 / option #2	Option #1		
	-> Valve 2 type	Option #1 / option #2	Option #1		
	-> Mot. phase exch.	ON/OFF	ON	*	Added in 1.18
-> Adjustments	-> Minimum lift	not adjustable	2.6 V		
	-> Maximum lift	not adjustable	5.0 V		
	-> Minimum lower	not adjustable	0.0 V		
	-> Maximum lower	not adjustable	2.2 V		
	-> Set potential brake min	not adjustable			
	-> Set potential brake max	not adjustable			
	-> Motor overtemp	70 - 160 °C	120 °C		
	-> Set motor temp	+/-100 °C	20 °C		
	-> Set battery type	24 -48 V	24 V		
	-> Adjust battery	0.0 - 26.3 V	25.7 V		
	-> Throttle 0 zone	0 - 17 %	9 %		
	-> Throttle x zone	18 - 100 %	45 %		
	-> Throttle y zone	4 - 100 %	25 %		

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		-> Adjustment #01	Level 0-9	Level 6
		-> Adjustment #02	Level 0-9	Level 9
		-> Load HM from MDI	ON / OFF	OFF
		-> Check up done	ON / OFF	OFF
		-> Check up type	None / option #1 / option #2 / option #3 / option #4	None
		-> Option 05	0 - 9	0
		-> Option 04	0 - 9	0
		-> Option 03	0 - 9	0
		-> Option 02	0 - 9	0
		-> Option 01	0 - 9	0
* ZAPI MENU *	-> Special adjust-ments	-> Adjustment #1	fixed value	100 %
		-> Adjustment #2	fixed value	98 %
		-> Set current	0 - 1000 A	150 A
		-> Set temperature	fixed value	25 °C
		-> Aux function 1	fixed value	Level 15
		-> Aux function 2	fixed value	Level 15
	-> Hardware settings	-> AC type 0	ON / OFF	ON
		-> Compensation	ON / OFF	ON
		-> Slip control	ON / OFF	ON
		-> DC-link compensation	ON / OFF	ON

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-> Sat frequency	0 -100 Hz	90 Hz	*
-> Braking modul	0 - 200 Hz	90 Hz	*
-> Minimum voltage	0 - 100 %	2 %	
-> Boost at low frequency	0 - 100 %	40 %	*
-> Boost at high frequency	0 - 100 %	45 %	
-> Boost corner frequency	0 - 200 Hz	55 Hz	*
-> Braking booster	0 - 100 %	21 %	
-> Motor resistance	Level 0 - 9	Level 0	
-> Slip coefficient	Level 0 - 9	Level 0	
-> Maxslip reset	0.20 - 2.00 Hz	0.60 Hz	
-> Maxslip low frequency	4.00 - 10.00 Hz	6.00 Hz	
-> Maxslip inc frequency	0 - 4.5	0.5	*
-> Maxslip frequency	0 - 100 Hz	40 Hz	
-> Maxslip inc	0 - 100 Hz	20 Hz	
-> Option 07	Level 0 - 9	Level 1	
-> Option 08	Level 0 - 9	Level 6	
-> Option 06	Level 0 - 9	Level 6	

-> Read RAM

-> Read EEPROM

-> Clear EEPROM

-> Clear console

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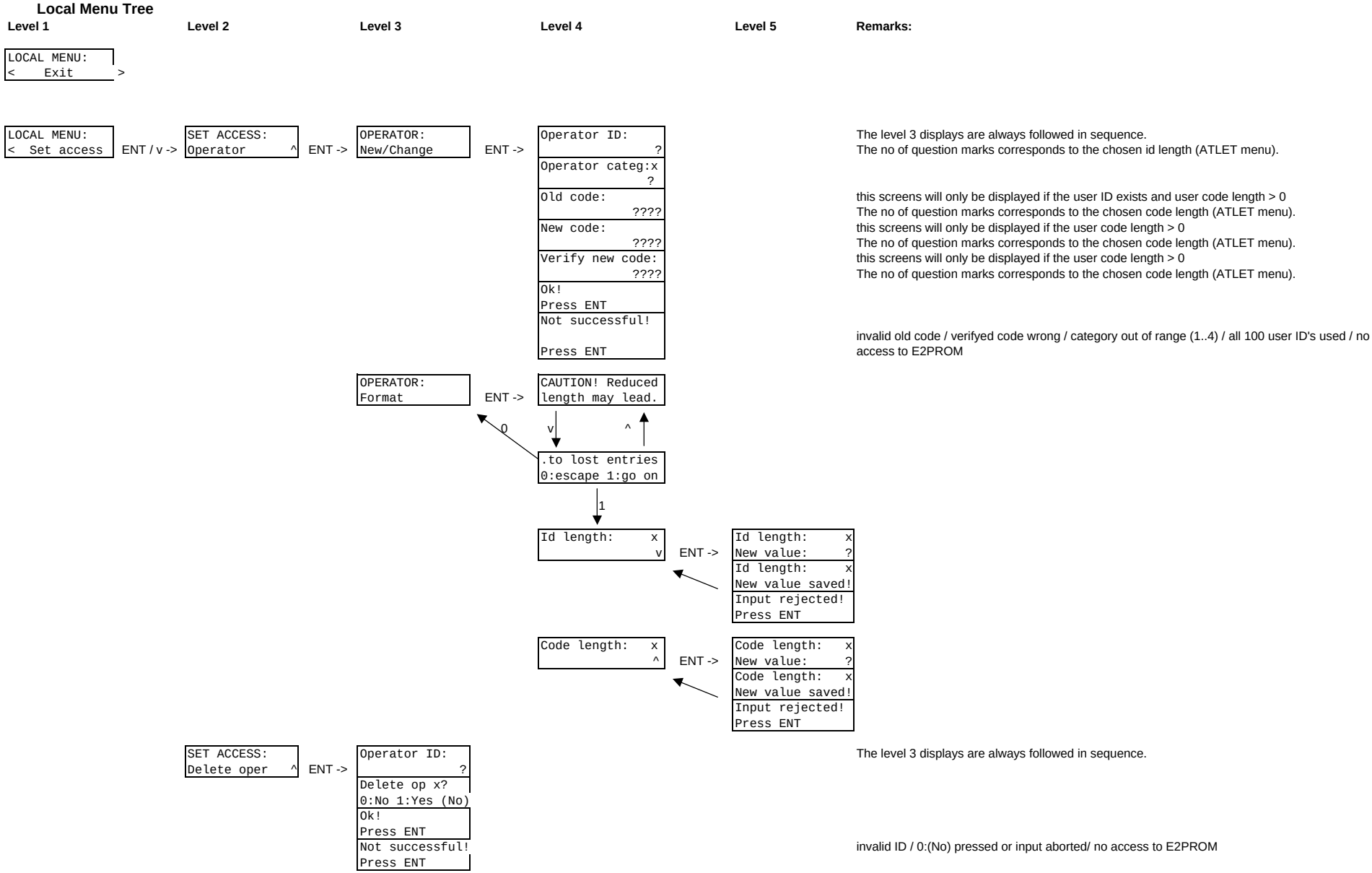
Local Menu Tree



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Local Menu Tree

Level 1	Level 2	Level 3	Level 4	Level 5	Remarks:
	SET ACCESS: Local ^ ENT ->	Old code: ???????			The level 3 displays are always followed in sequence.
		New code: ???????			
		Verify new code: ???????			
		Ok! Press ENT			
		Not successful! Press ENT			invalid old code / verifyed code wrong / no access to E2PROM
LOCAL MENU: <Fleet manager ENT / v ->	FLEET MANAGER: Unlock ^v				This menu entry resets the Impact Sensor actions. To be used by warehouse manegement to acknowledge impact.
	FLEET MANAGER: Read logs ^ ENT ->	READ LOGS: Operator log ^ ENT ->	<o>: [date] [time] - [time]		List of the 30 most recent operator sessions.
		READ LOGS: Efficiency ^ ENT ->	EFFICIENCY: Worst ^v ENT ->	<o>: xx(mn)% Curr:iii(mn)A	List sorted from worst to best operator (Act). xx = active time / logged on time * 100; iii = mean main active current draw; mn = corresponding mean value for all operators;
			EFFICIENCY: Best ^v ENT ->	<o>: xx(mn)% Curr:iii(mn)A	List sorted from best to worst operator (Act). xx = active time / logged on time * 100; iii = mean main active current draw; mn = corresponding mean value for all operators;
			Operator id: ? ENT ->	<o>: xx(mn)% T:xx(mn)P:xx(mn)	Any operator's efficiency. <o> = operator id (1 - 100) T = traction; P = pump; mn = corresponding mean value for all operators;
		READ LOGS: Damage log ^ ENT ->	DAMAGE LOG: Worst ^v ENT ->	<o>: xxx(mn) <o>: xxx(mn)	<o> = operator who used the truck immediately before damage was reported. xxx = number of reported damages. List sorted from greatest to smallest no of reported damages.
			DAMAGE LOG: Best ^v ENT ->	<o>: xxx(mn) <o>: xxx(mn)	<o> = operator who used the truck immediately before damage was reported. xxx = number of reported damages. List sorted from smallest to greatest no of reported damages.
			DAMAGE LOG: Chronological ^v ENT ->	30:[date] [time] <o>: <dc> v v v 01:[date] [time] <o>: <dc>	List sorted in chronological order. <o> = operator who used the truck immediately before damage was reported. <dc> = damage code (max two characters long).

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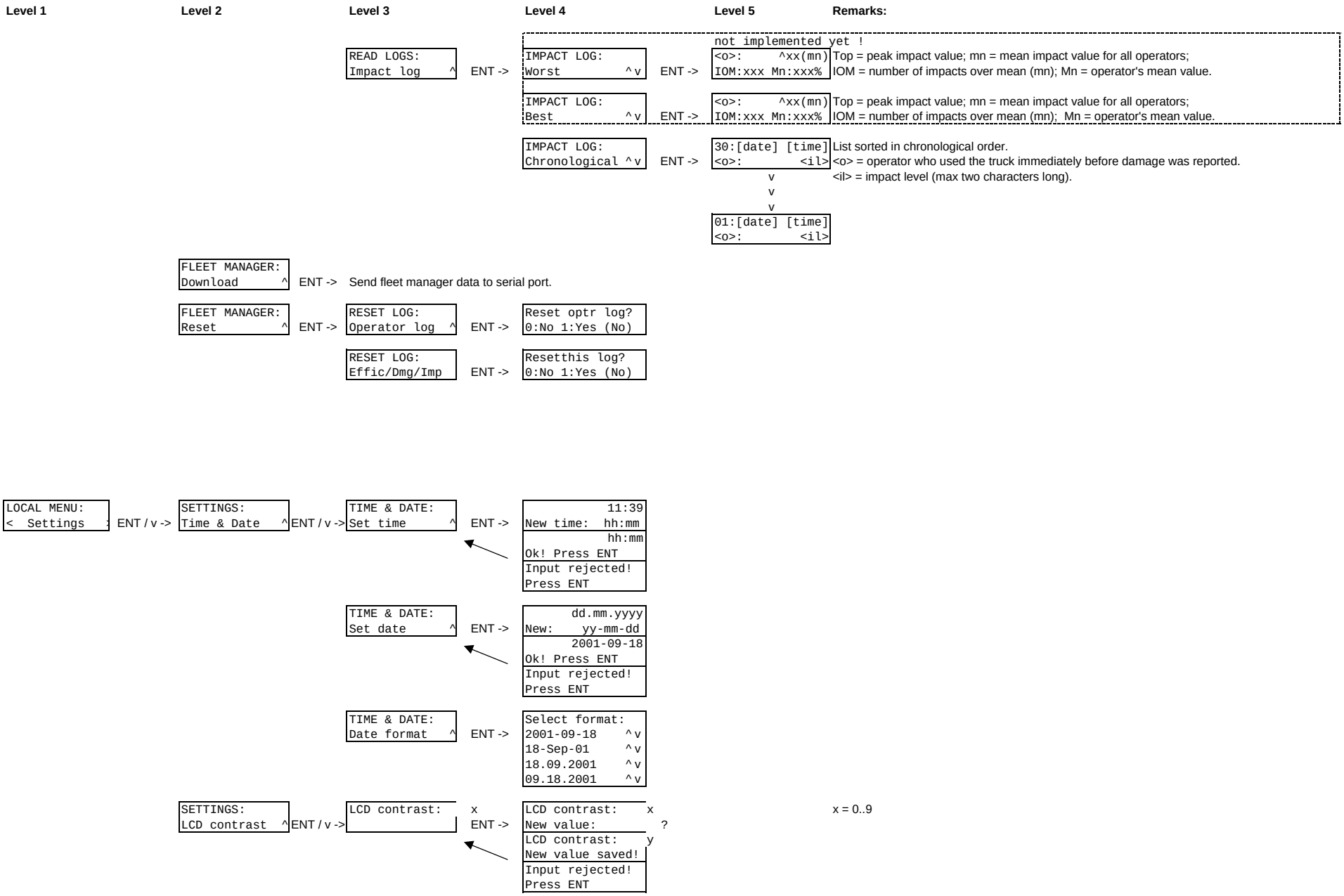
Local Menu Tree



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Local Menu Tree

Level 1	Level 2	Level 3	Level 4	Level 5	Remarks:
LOCAL MENU: < Card reader	CARD READER: Enable/disable	Smartcard:xxx ^v	smartcard:xxx 0:no 1:yes		
			smartcard:yyy New value saved!		
			Input rejected! Press ENT		
	SETTINGS: Key sound ^	Key sound: xxx	Key sound: xxx 0:no 1:yes		
			Key sound: yyy New value saved!		
			Input rejected! Press ENT		

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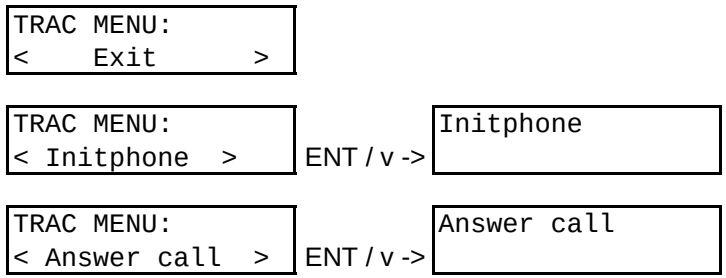
TRAC


TRAC MENU:
< Exit >
TRAC MENU:
< Initphone >
ENT / v ->
Initphone
TRAC MENU:
< Answer call >
ENT / v ->
Answer call

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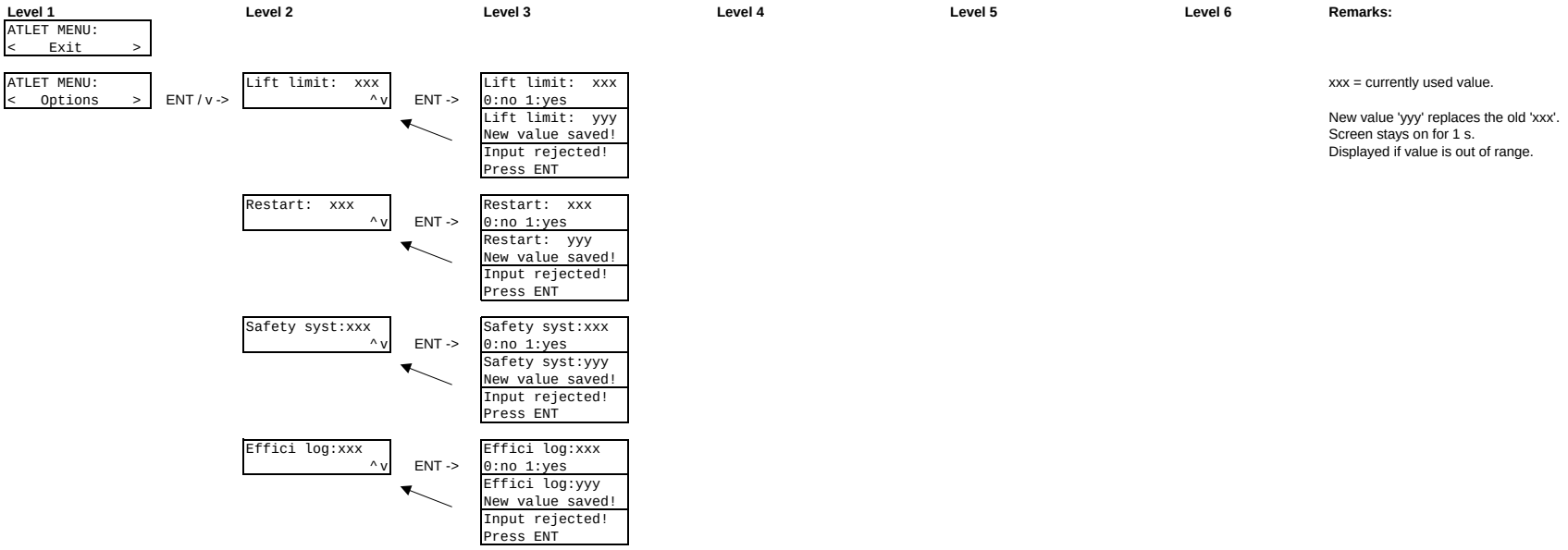
ATLET Menu tree



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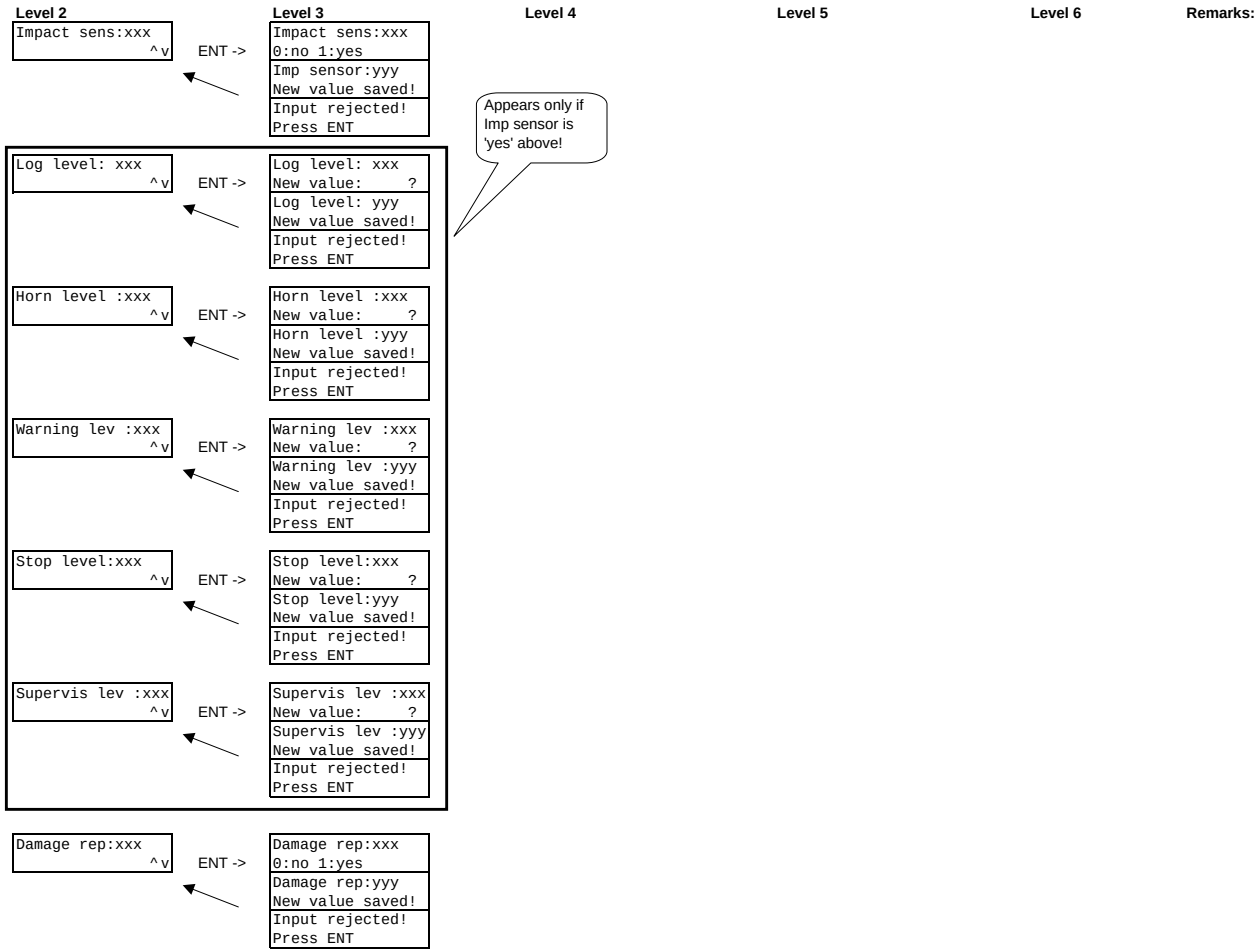
ATLET Menu tree



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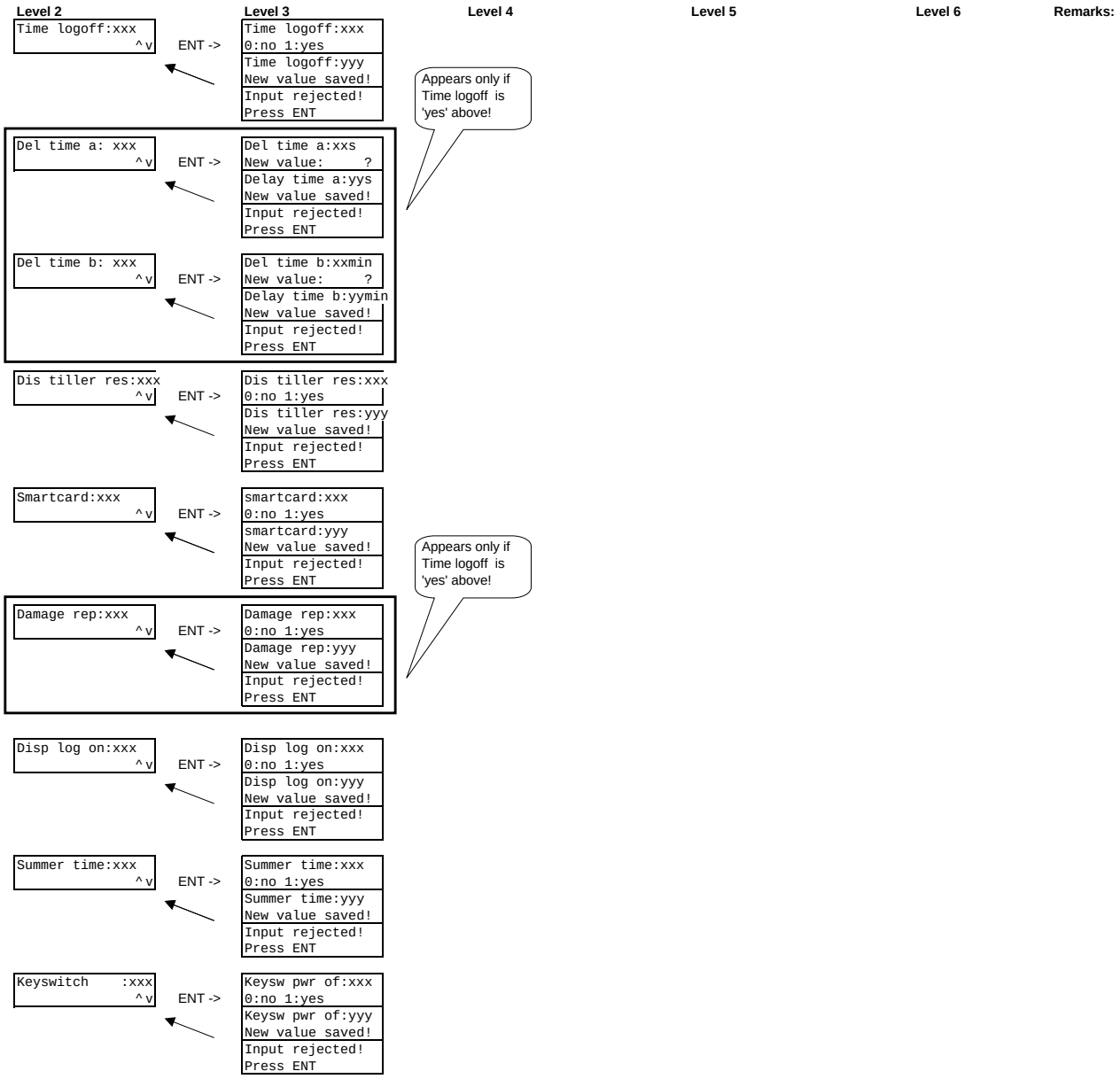
ATLET Menu tree



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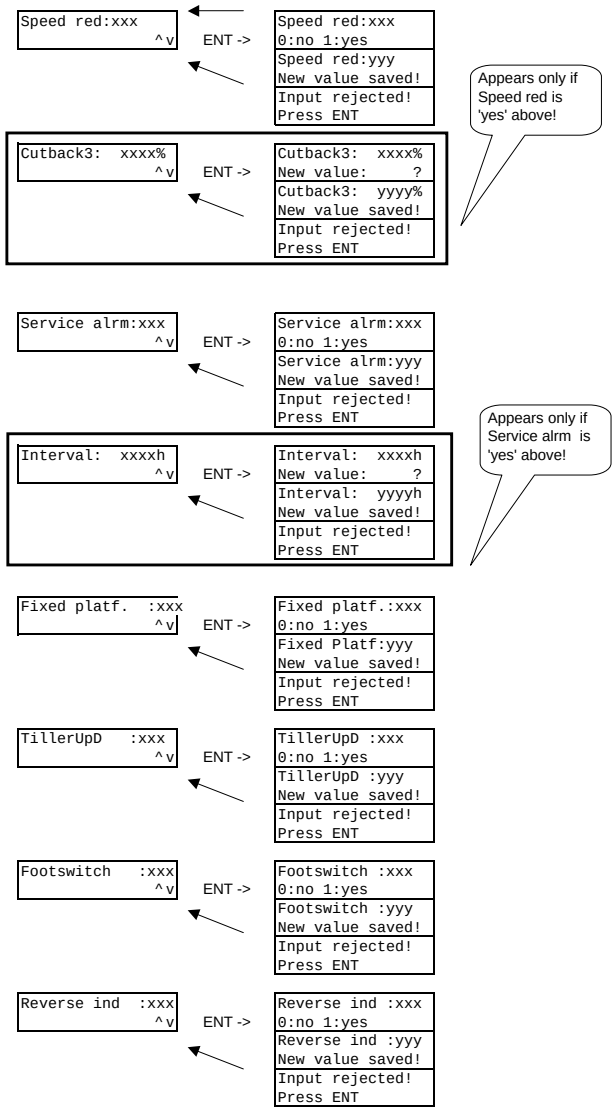
ATLET Menu tree

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Remarks:



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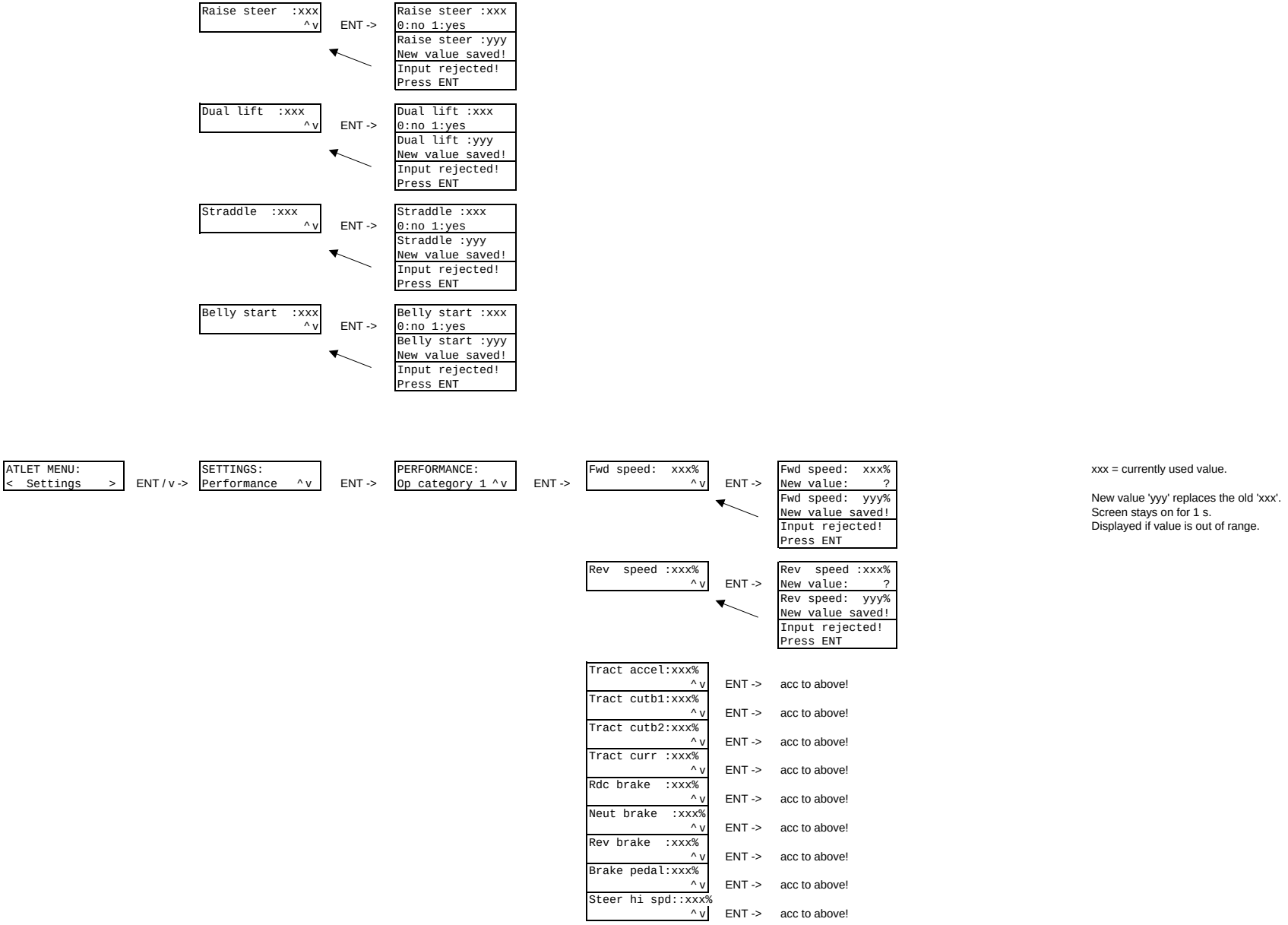
ATLET Menu tree

Level 1 | **Level 2** | **Level 3** | **Level 4** | **Level 5** | **Level 6** | **Remarks:**



xxx = currently used value.

New value 'yyy' replaces the old 'xxx'.
Screen stays on for 1 s.
Displayed if value is out of range.

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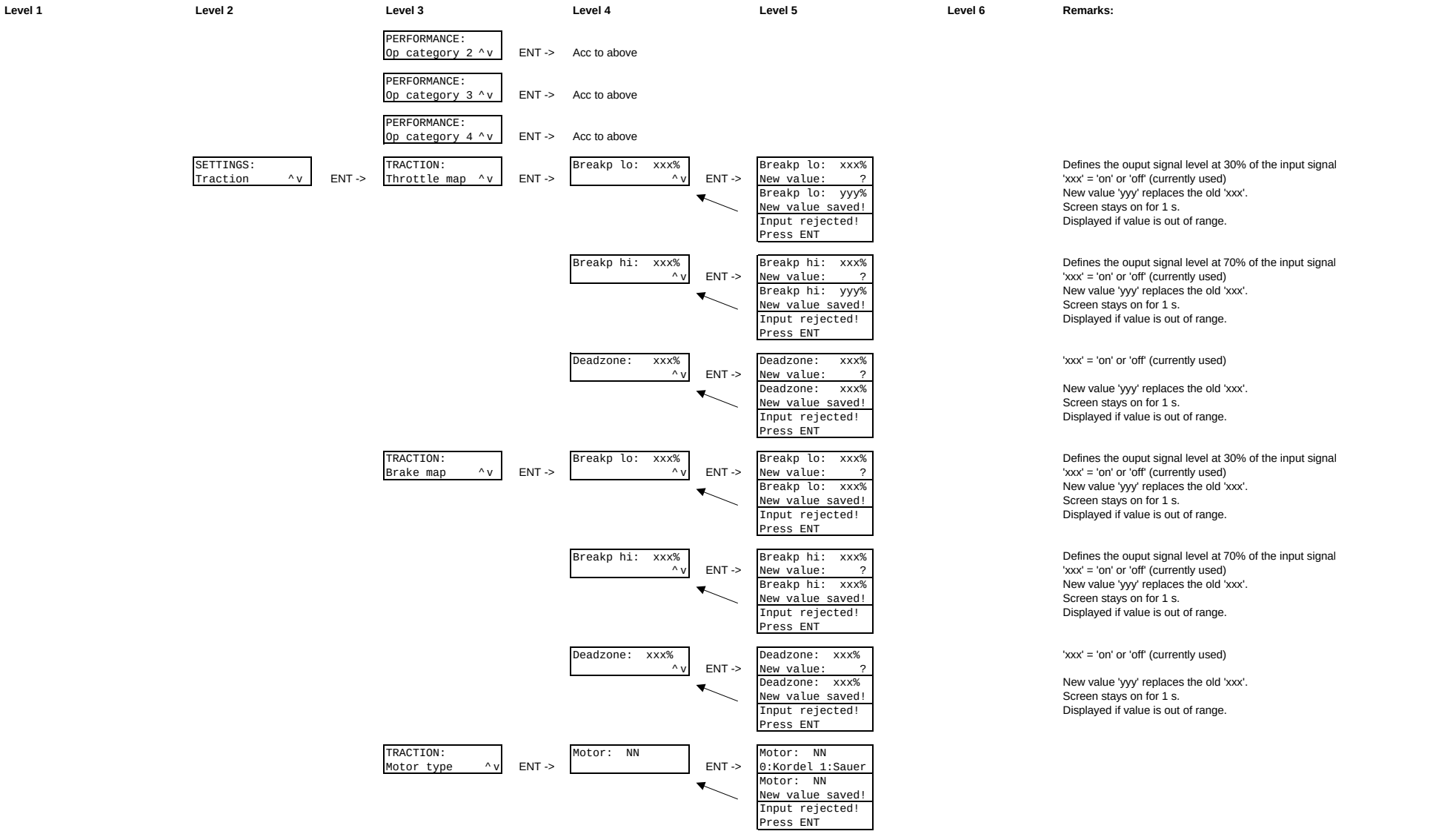
ATLET Menu tree



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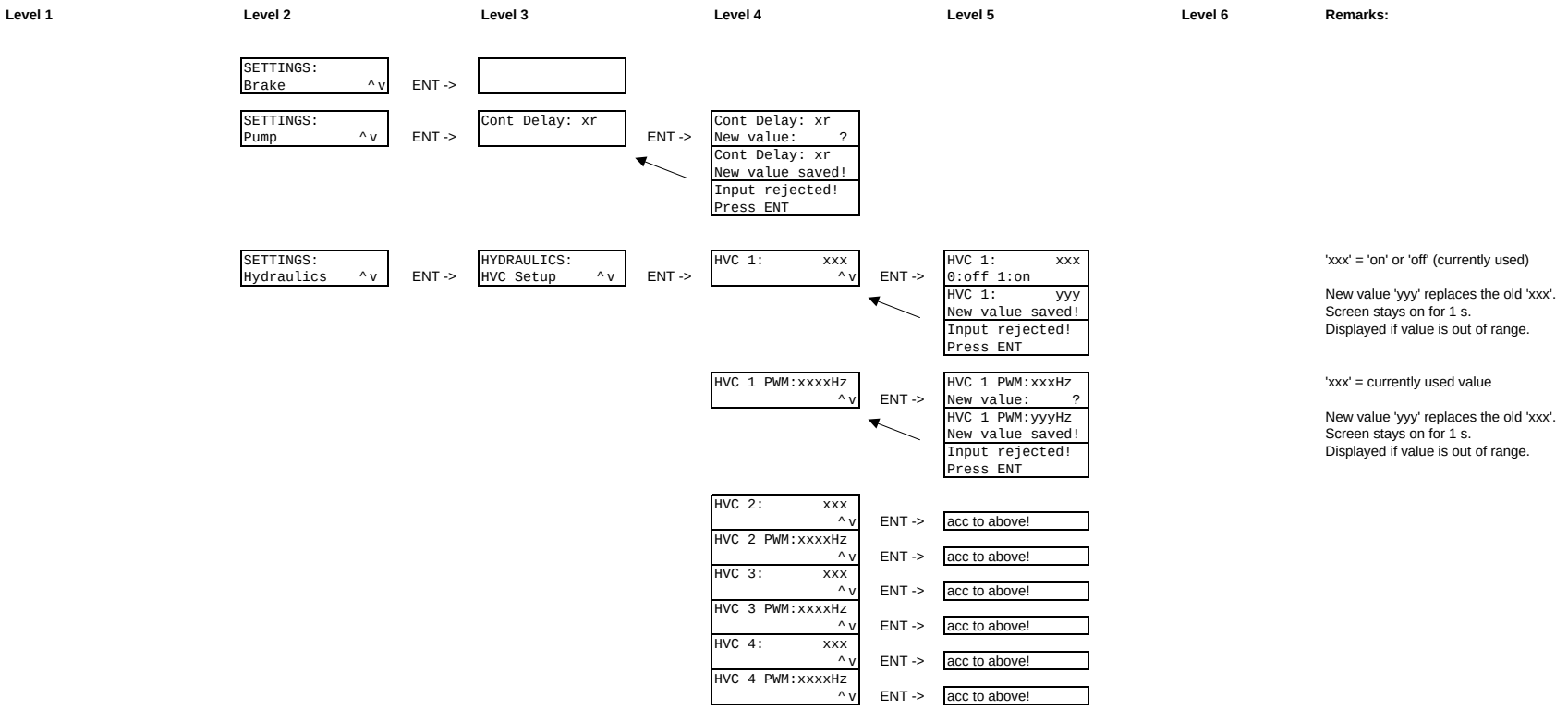
ATLET Menu tree



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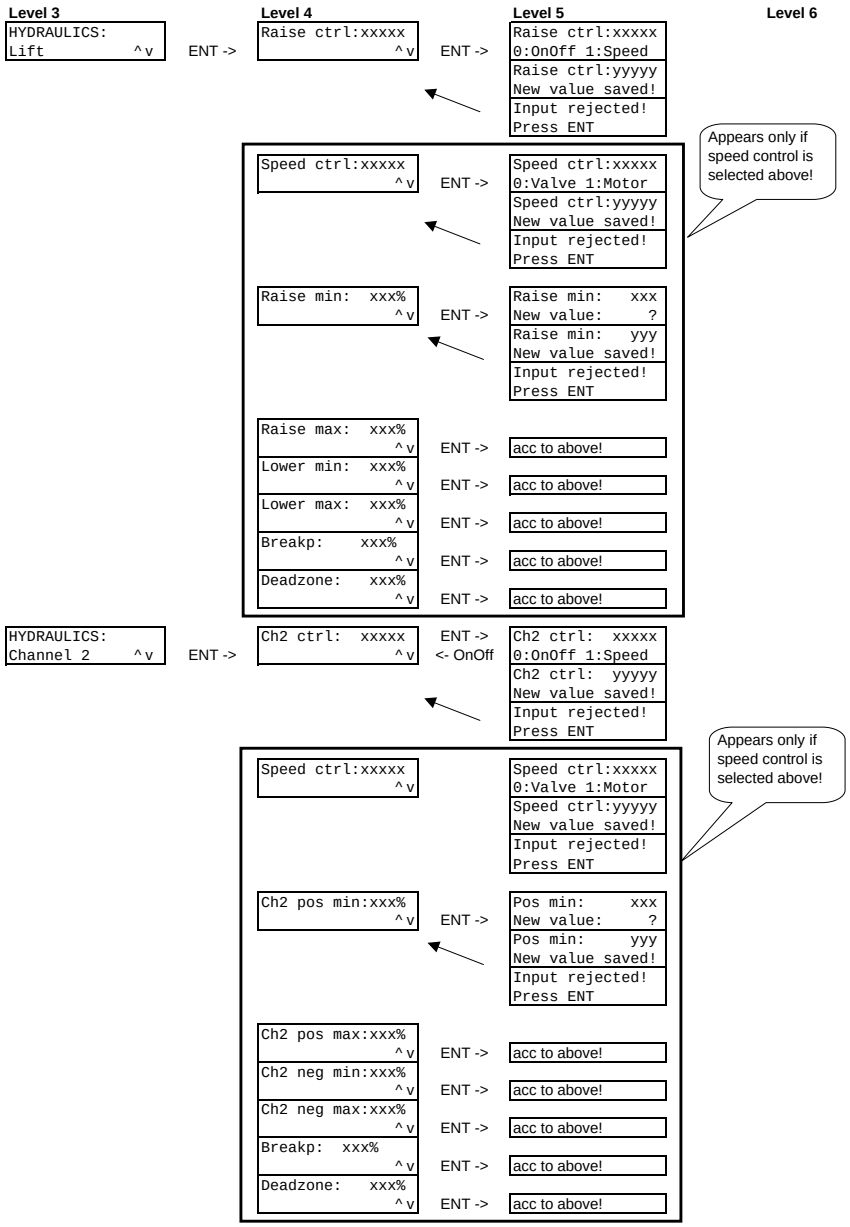
ATLET Menu tree



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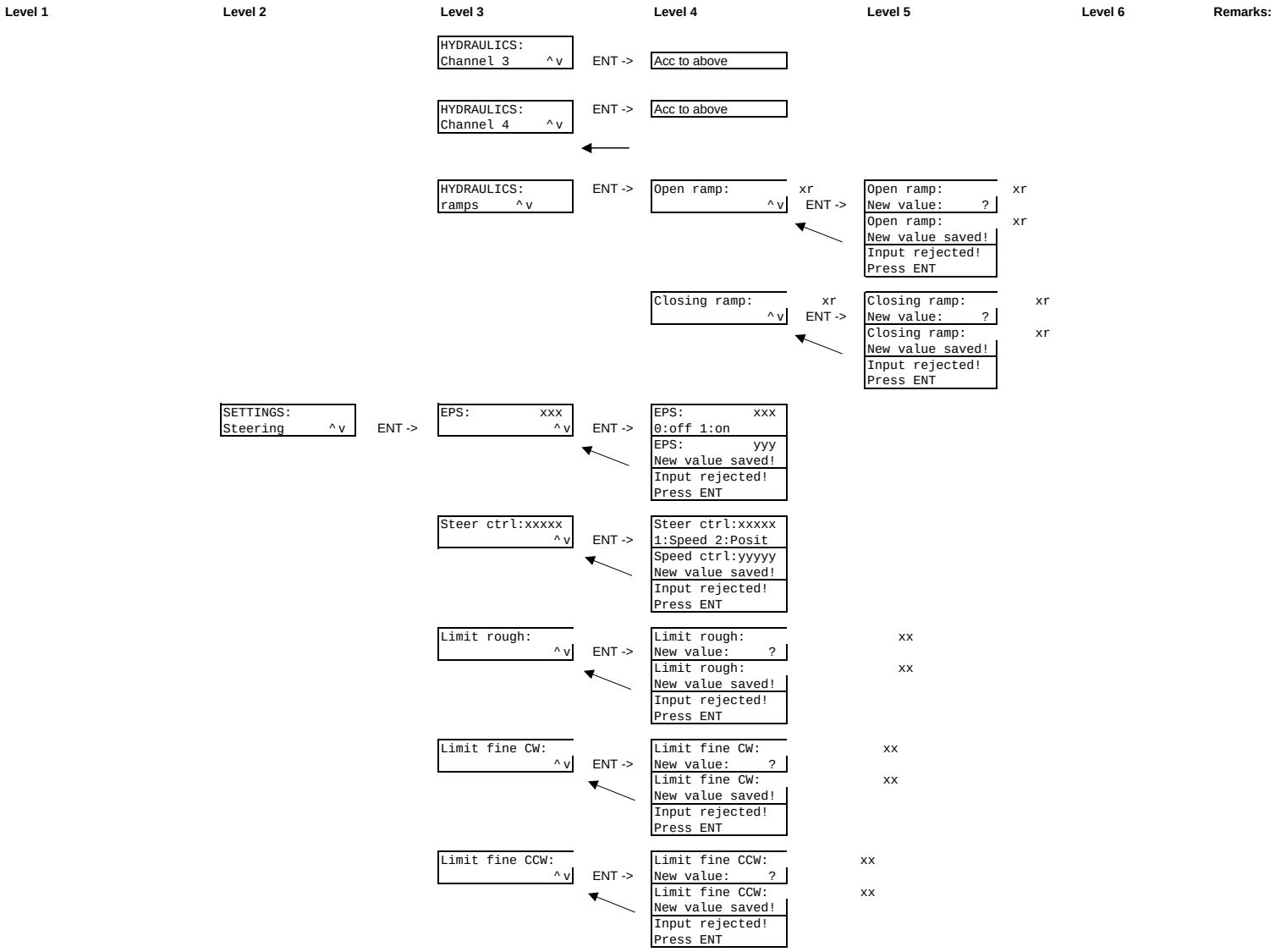
ATLET Menu tree



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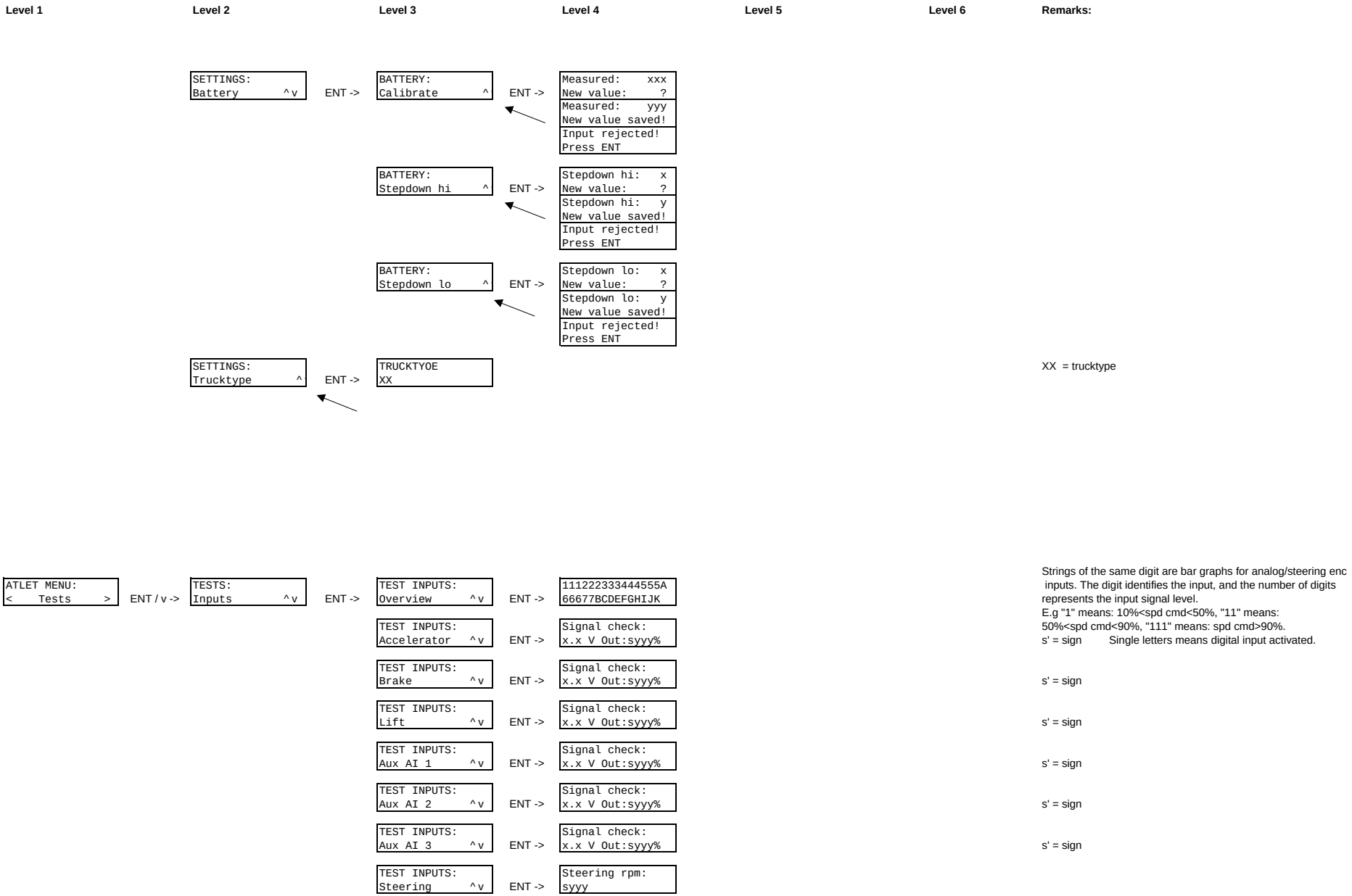
ATLET Menu tree



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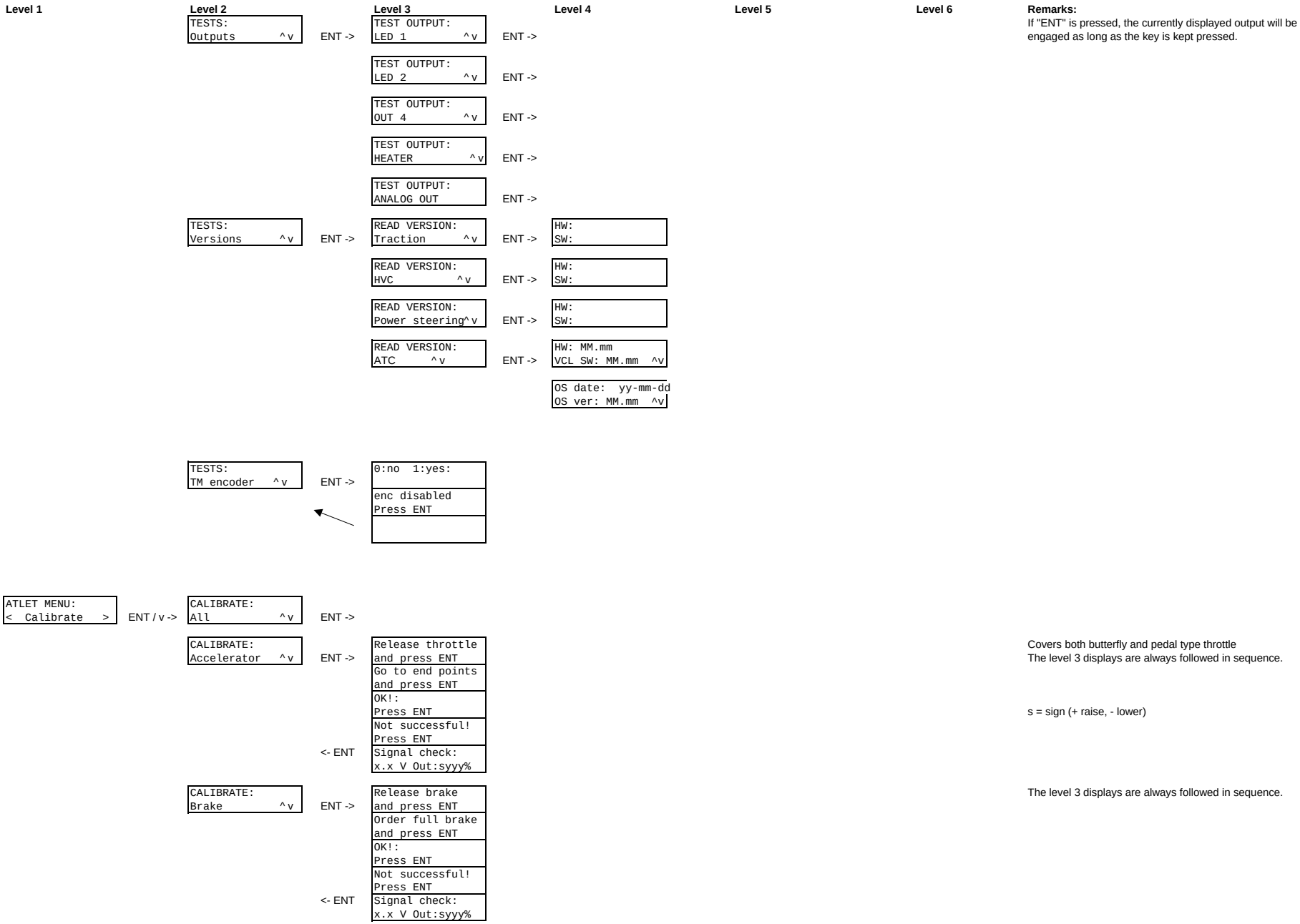
ATLET Menu tree



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ATLET Menu tree

Level 1	Level 2		Level 3	Level 4	Level 5	Level 6	Remarks:
	CALIBRATE: Lift ^v	ENT ->	Release lift and press ENT				Covers both combined and separate raise/lower controls. The level 3 displays are always followed in sequence.
			Order full raise and press ENT				
			Order full lower and press ENT				
			OK!: Press ENT				s = sign (+ raise, - lower)
			Not successful! Press ENT				
		<- ENT	Signal check: x.x V Out:syyy%				
	CALIBRATE: Channel 2 ^v	ENT ->	Release ch2 and press ENT				
			Order full +dir and press ENT				
			Order full -dir and press ENT				
			OK!: Press ENT				
			Not successful! Press ENT				
		<- ENT	Signal check: x.x V Out:syyy%				
	CALIBRATE: Channel 3 ^v	ENT ->	According to "Channel 2"				
	CALIBRATE: Channel 4 ^v	ENT ->	According to "Channel 2"				
	CALIBRATE: Steering ^v	ENT ->	Center steering and press ENT				
			Calibration done press ENT				
			Calicrate failed Press ENT				
	CALIBRATE: Update angle ^v	ENT ->	Update angle				

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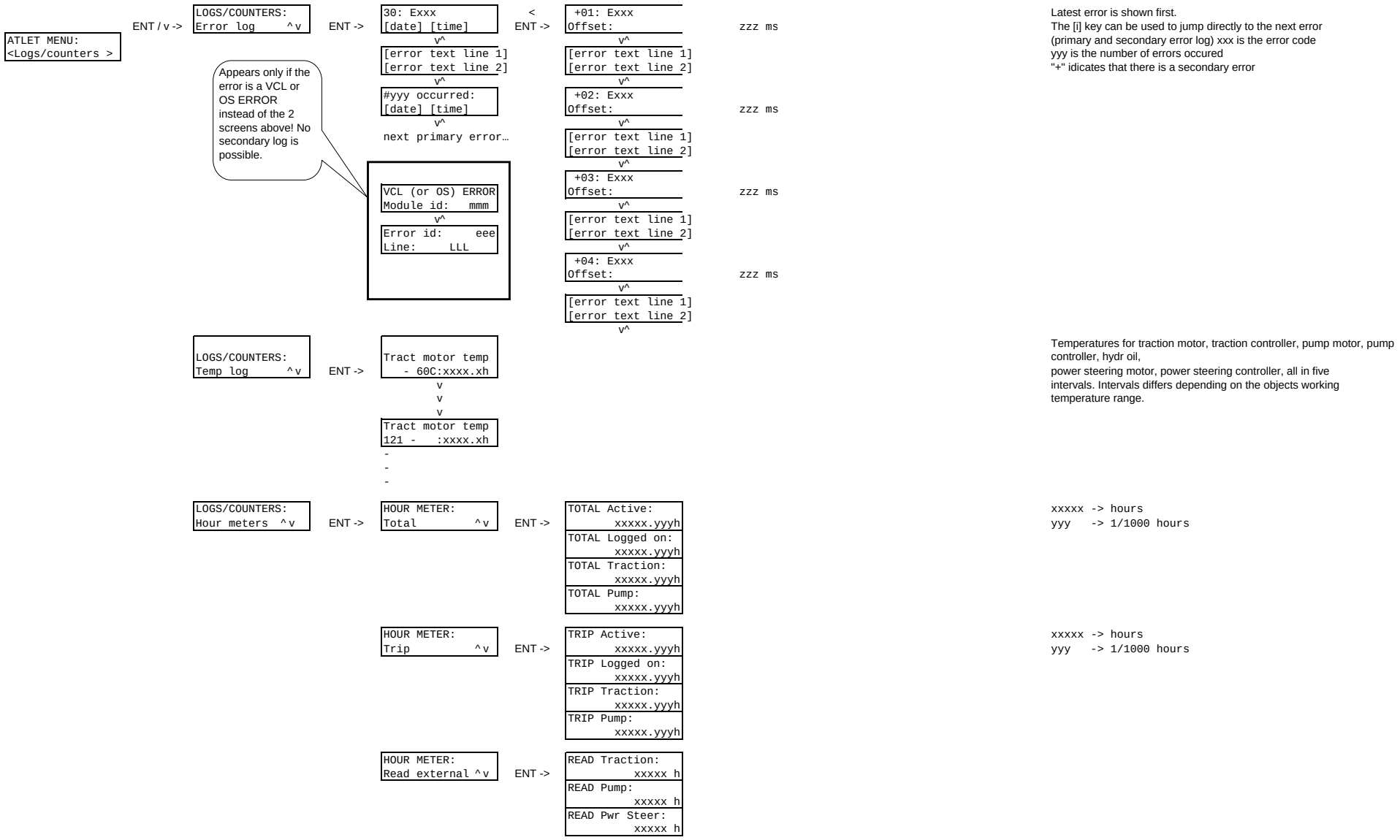
ATLET Menu tree



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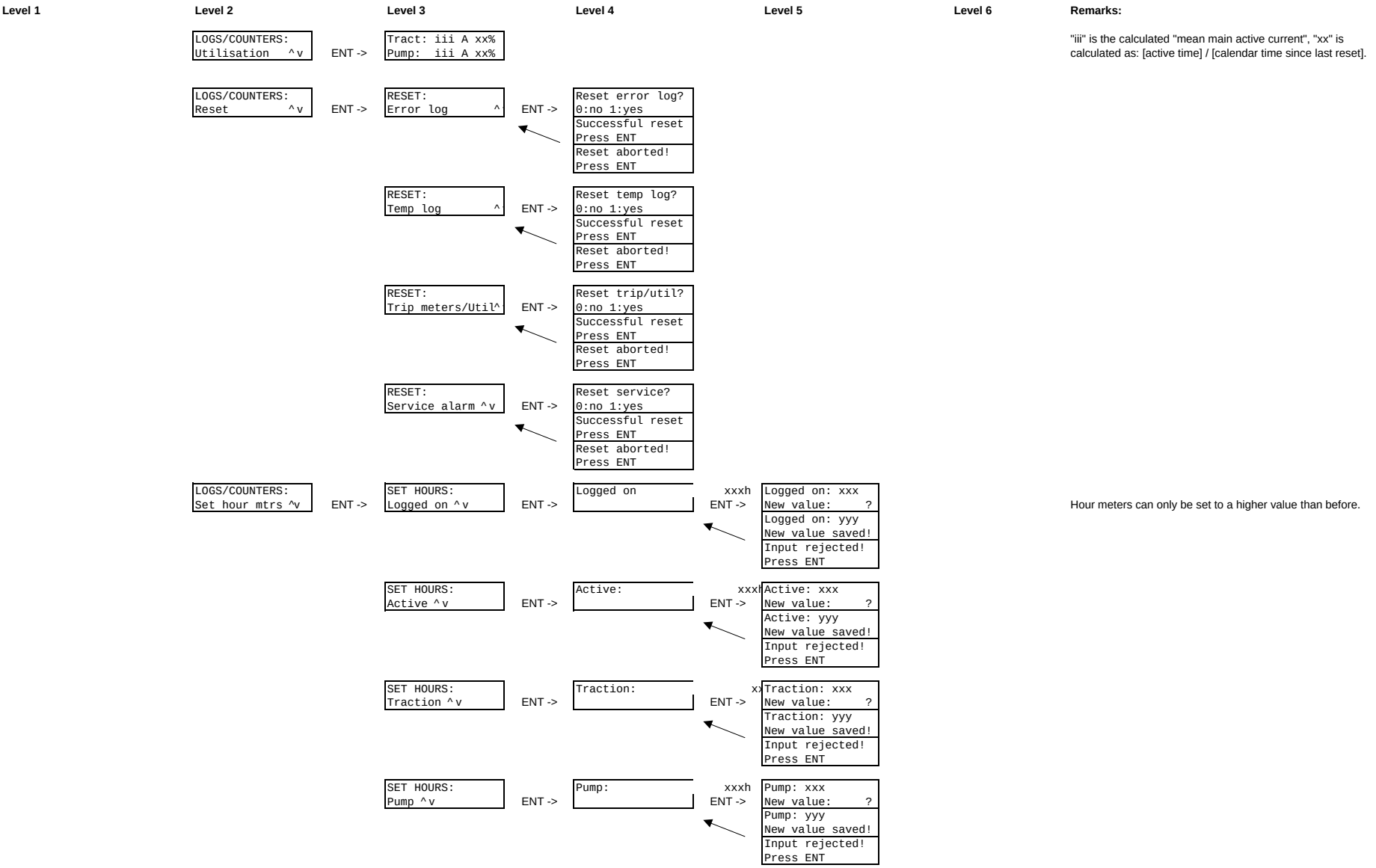
ATLET Menu tree



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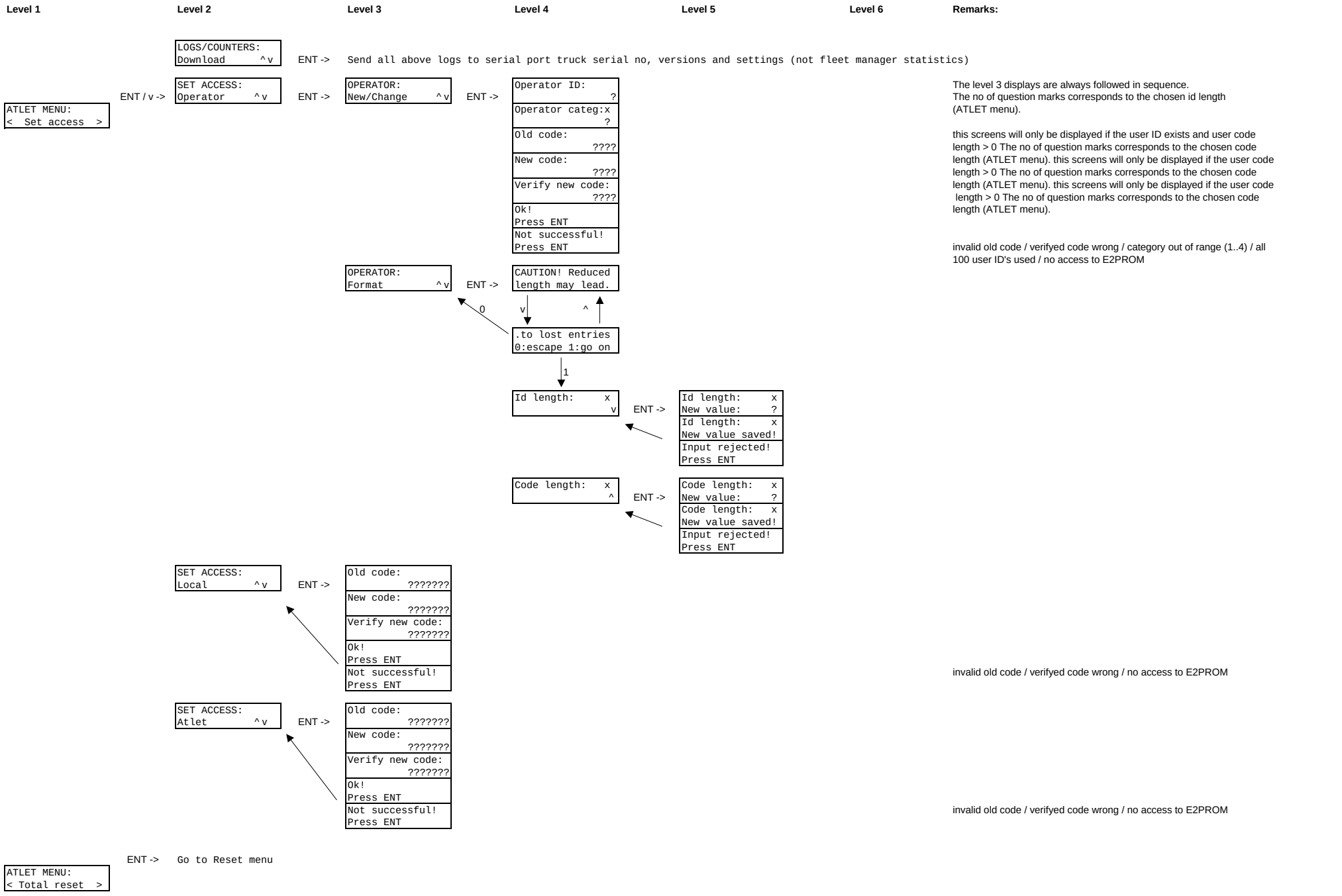
ATLET Menu tree



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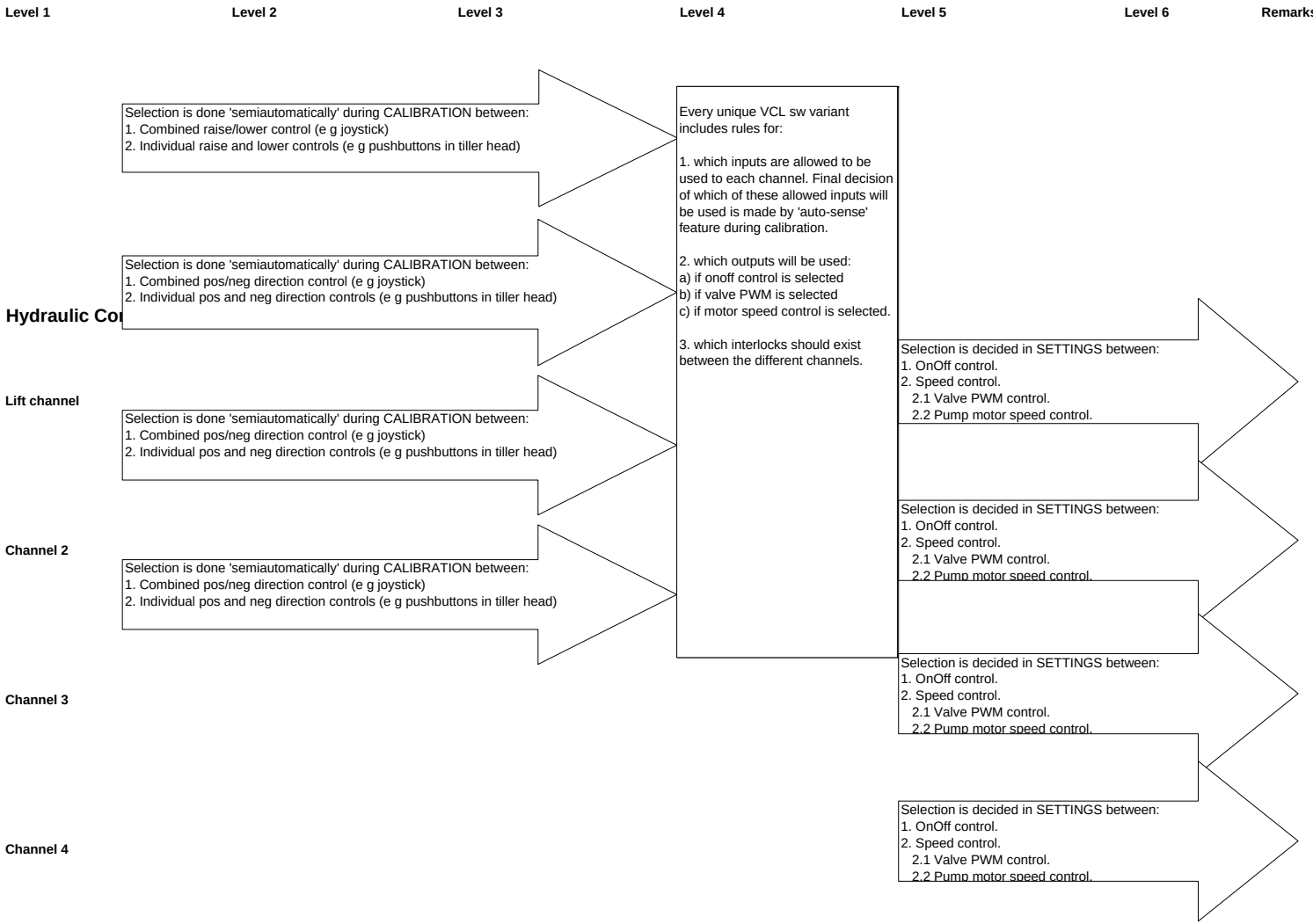
ATLET Menu tree



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ATLET Menu tree

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Remarks:

Example 1 - tiller application
Lift channel is analog, with valve PWM output. Inputs are decided in Atlet menu/Calibrate/Lift menu. When the display requests "full raise" the proportional pushbutton
connected to J9 (lift) is activated by the engineer followed by ENT. Cortex then recognises this input as the raise input. The display requests "full lower" and the operator pushes the button connected to J8 (lower).
Cortex has now detected which inputs are used for raise and lower, and has also stored at which input levels full output should be given.
Output type is selected in Atlet menu/Settings/Hydraulics/Lift. First of all, speed control is selected. Now, further settings are needed. In this case, a porportional valve will be controlled by HVC 1.
The engineer selects valve speed control. Fixed outputs for contactor prop valve and dir valve are hardcoded. Output relations to dead zone passing and to calibrated maximum input are entered.

Channel 2 is 'digital', with onoff valve control. No input calibrations need to be done, since output is defined as 'onoff'. Hardcoded definitions for input and output associations take effect.

Example 2 - rider stacker
Lift channel is analog, with joystick and pump motor speed control. Input calibration is carried out as in example 1. Cortex recognizes the a 'combined' raise/lower control from the voltage levels read during calibration.
Output setting s are set to 'speed control' and 'motor'. Raise command is sent to hardcoded adress in PMC, lower command is sent to HVC 1.

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Language Tree

Level 1	Level 2	Level 3	Level 4	Level 5	Remarks:
SELECT LANGUAGE: English ^v Svenska Deutsch Francais Custom					

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Monitor menu

Level 1		Level 2		Level 3	Remarks:
MONITOR MENU: < Exit >					
MONITOR MENU: < Traction >	ENT / v ->	TRACTION: Drive Monitor ^ v	ENT ->	xxxxrpm +/-iii A	"xxxx" = motor speed in rpm; "iii" = motor current
		TRACTION: Temp Monitor ^ v	ENT ->	C: +/-ttt degC M: +/-TTT degC	"ttt" = controller temperature; "TTT" = motor temperature
MONITOR MENU: < Pump >	ENT / v ->	xxxxrpm +/-iii A v ^ C:ttt M:TTT degC			
MONITOR MENU: < Steering >	ENT / v ->	Angle: xx Record angle			
MONITOR MENU: < Wire guide >	ENT / v ->		not implemented yet		
MONITOR MENU: < In/Out >		IN/OUT: ATC inputs: ^ v	ENT / v ->	Accelerator xxx Raise1 xxx Raise2 xxx Lower1 xxx Lower2 xxx Belly x BellyInv x **TillerUpD x** **Horn x** **Dig_in1 x** **Dig_in2 x** **Dig_in3 x** **Dig_in4 x** **Dig_in5 x**	

Monitor menu

Level 1	Level 2		Level 3	Remarks:
	IN/OUT: TMC inputs: ^ v	ENT / v ->	**Dig_in1 x** **Dig_in2 x** **Dig_in3 x** **Dig_in4 x** **Dig_in5 x** **Dig_in6 x** **Dig_in7 x**	
	IN/OUT: HVC inputs: ^ v	ENT / v ->	**Dig_in1 x** **Dig_in2 x** **Dig_in3 x** **A_in 1 xxx**	
	IN/OUT: EPS inputs: ^ v	ENT / v ->		
	IN/OUT: ATC int/out: ^ v	ENT / v ->	Lift int x Speed int x Safety int x Max spd xxx Forward x **Reverse x** **Brake x** **Liftstop x**	

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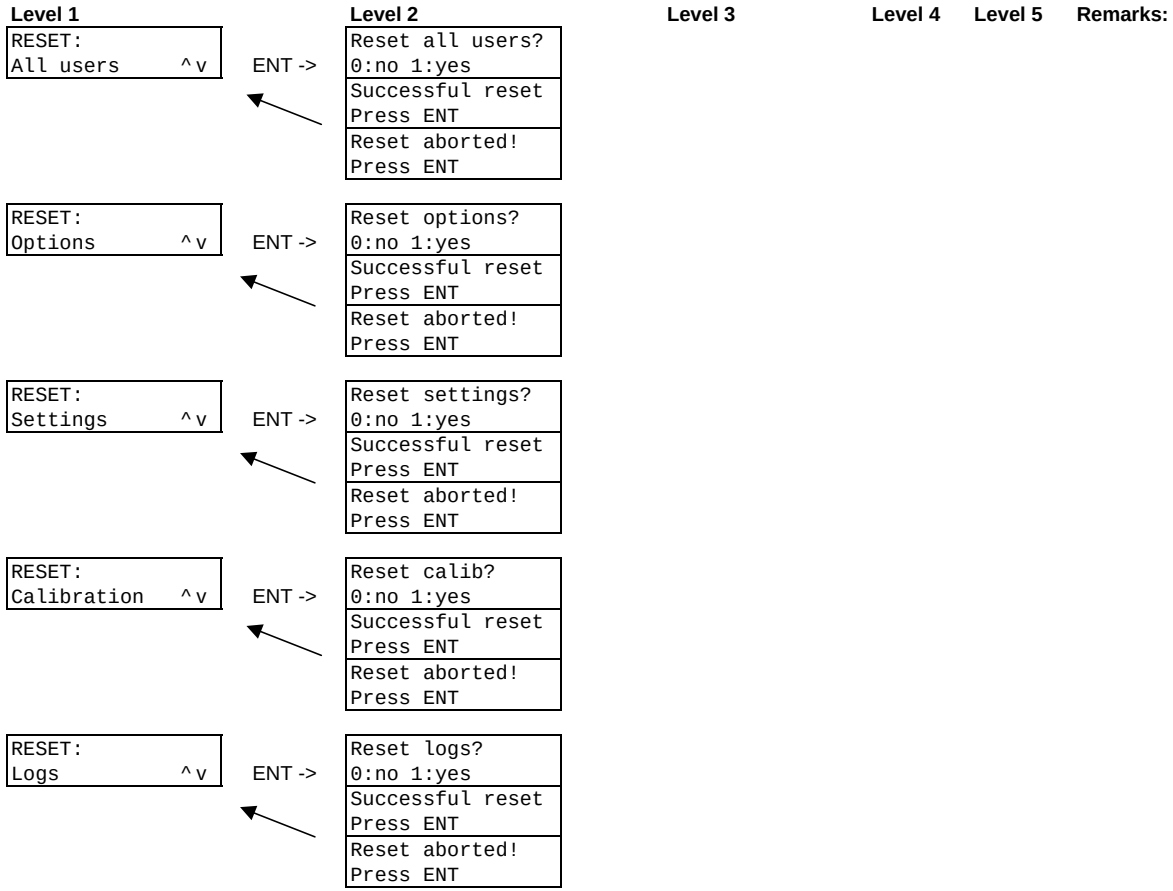
Reset menu



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SERVICE MANUAL

Machine: *PLL PSD PSL PLE*

Manual No: *119000*

Edition 2007B

11 Brake and drive system

Design and function 11.3
Electric brake 11.3

Repair instructions 11.4
Electric brake 11.4
Manual release of the brake 11.5

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Edition 2007B

11 Brake and drive system

Design and function

Electric brake

PLL and PSD are equipped with an electric brake. The electric brake is a safety brake with two friction surfaces. The braking torque is produced by spring pressure. The brake is activated when the voltage over the coil is lost, i.e. the truck is braked when it it without voltage.

When the brake is activated the springs press on the plate, which is pressed axially to the rotor. When the brake is to be released the coil is supplied with battery voltage. The magnetic field created between the plate and the magnetic part allows the rotor to rotate freely.

The brake is activated in different ways (see also wiring diagram):

1. Via the drive motor controller when the controller indicates a serious fault.
2. Via the steering servo controller, which breaks the brake coil supply to the plus pole on the battery if a serious fault is indicated.

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Repair instructions

Electric brake

The brake on PLL/PSD requires a minimum of maintenance. It does not need to be adjusted, and compensates automatically for wear. The A gap is 0.3 mm. The rotor should be replaced when the A gap is a maximum of 0.6 mm.

Note!

The rotor should be replaced when the A gap is a maximum of 0.6 mm.

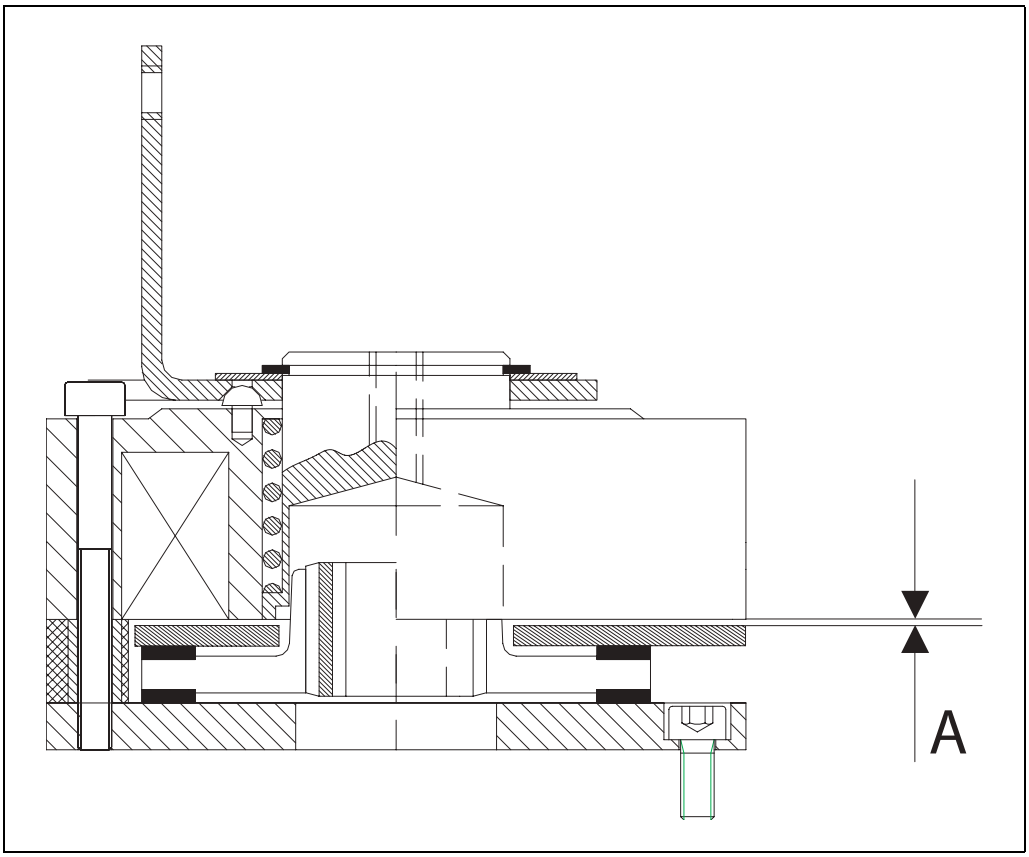

Figure 11.1

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Manual release of the brake

The brake can be released manually. This allows for the movement of a truck that has no power supply. Release the brake by turning the handle at the top of the brake clockwise (A). The truck cannot be operated in this position. To return to normal operation, turn the handle anticlockwise back to normal position (B).

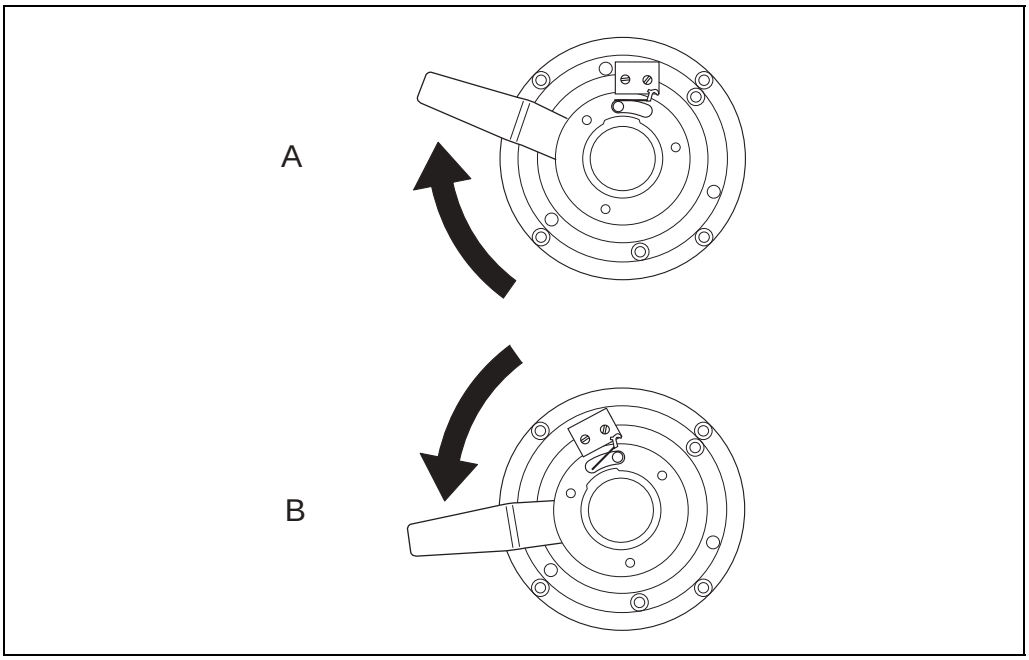

Figure 11.2

Important!

The brake may only be released when the truck is standing still on clean, level and solid ground.

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