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EN

User Manual

SMART DISPLAY

NOTES LEGEND

The symbol aboard is used inside this publication to indicate an annotation or a suggestion you should pay attention.

The symbol aboard is used inside this publication to indicate an action or a characteristic very important as for security. Pay special attention to the annotations pointed out with this symbol.

Contents

APPROVAL SIGNS

COMPANY FUNCTION	INITIALS	SIGN
PROJECT MANAGER	FG	
TECHNICAL ELECTRONIC MANAGER VISA	PP	
SALES MANAGER VISA	MC	

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1 INTRODUCTION

Smart display is an intelligent dashboard connected to the truck system by CAN-BUS line.
This dashboard provides the diagnostic and set-up of the whole truck system: Smart Display itself, Traction controller, Pump controller, Valve controller.
Connecting the Zapi handset or PcWin tool to Smart Display, it is possible to read and modify the setting of all the modules present on the CAN-BUS net.
Smart Display has an alphanumerical display two lines, 20 characters for line, built-in backlight. The display implements an interface to the operator through a main page and a number of submenus which will be described in one of the next chapters.
Access to Smart Display menu structure is provided by six operator buttons integrated in a membrane keyboard.
Furthermore Smart Display has six built-in red LED, which provide the operator with a easy information about the status of some truck devices.

2 GENERAL CHARACTERISTIC

2.1 Technical specifications

Voltage:.....24/36/48/72/80 V
Digital inputs [n°]:.....7
Analog input [n°] 1
Power outputs, 1.5 A continuous [n°]:.....2
Output, 100 mA max [n°] (optional): 1
RS-232 [n°]: 1
Can interface [n°]:.....1
Keyboard buttons [n°]: 6
LED [n°]: 6
Alphanumerical Display lines [n°]: 2
Alphanumerical Display character [n°, for line]: 20
Protection:.....IP65
External temperature range: standard version .....0÷50 °C
External temperature range: frozen cell version .....-35÷50 °C

3 INSTALLATION HINTS

In the description of these installation suggestions you will find some boxes of different colours, they mean:

*These are **information** useful for anyone is working on the installation, or a deeper examination of the content*

These are Warning boxes, they describe:
- operations that can lead to a failure of the electronic device or can be dangerous or harmful for the operator;
- items which are important to guarantee system performance and safety

3.1 Material overview

Before to start it is necessary to have the required material for a correct installation. Otherwise a wrong choice of cables or other parts could lead to failures/ misbehaviour/ bad performances.

3.1.1 Connection cables

For the auxiliary connections, use cables of 0.5-1.0 mm² section.

3.1.2 Fuses

- Use a 6.3 A Fuse for protection of the card.
- For Safety reasons, we recommend the use of protected fuses in order to prevent the spread of fused particles should the fuse blow.

3.2 Installation of the hardware

Before doing any operation, ensure that the battery is disconnected and when all the installation is completed start the machine with the drive wheels raised from the floor to ensure that any installation error do not compromise safety.

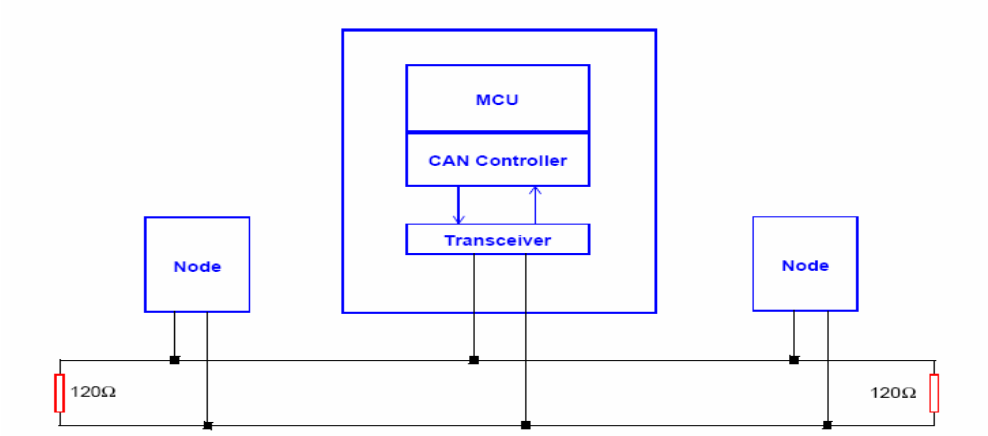
Do not connect the module to a battery with a nominal voltage different than the value indicated on the label. A higher battery voltage may cause a logic failure. A lower voltage may prevent the logic operating.

3.2.1 Controller heating

Smart Display does not need any means of heat dissipation. The frozen-cell version, provided with a built-in heater, is strongly recommended for frozen-cell applications.

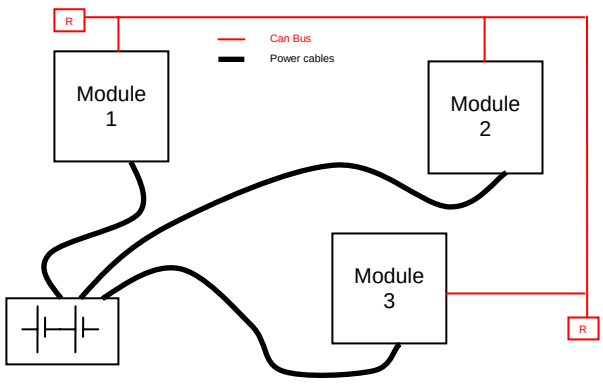
3.2.2 Wirings: CAN connections and possible interferences

CAN stands for Controller Area Network. It is a communication protocol for real time control applications. CAN operates at data rate of up to 1 Megabits per second.
It was invented by the German company Bosch to be used in the car industry to permit communication among the various electronic modules of a vehicle, connected as illustrated in this image:



- The best cable for can connections is the twisted pair; if it is necessary to increase the immunity of the system to disturbances, a good choice would be to use a cable with a shield connected to the frame of the truck. Sometimes it is sufficient a simple double wire cable or a duplex cable not shielded.
- In a system like an industrial truck, where power cables carry hundreds of Ampere, there are voltage drops due to the impedance of the cables, and that could cause errors on the data transmitted through the can wires. In the following figures there is an overview of wrong and right layouts of the cables routing.

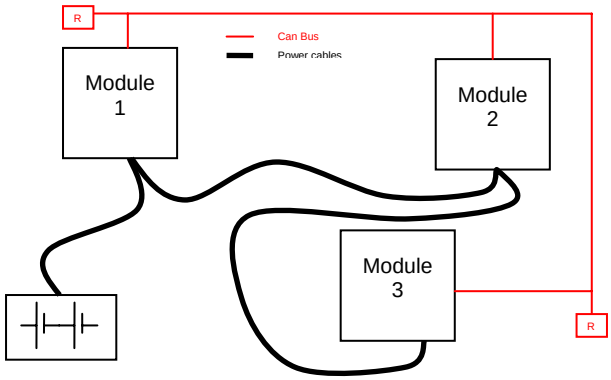
Wrong Layout:



The red lines are can wires.
The black boxes are different modules, for example traction controller, pump controller and display connected by canbus.
The black lines are the power cables.

This is apparently a good layout, but can bring to errors in the can line.
The best solution depends on the type of nodes (modules) connected in the network.
If the modules are very different in terms of power, then the preferable connection is the daisy chain.

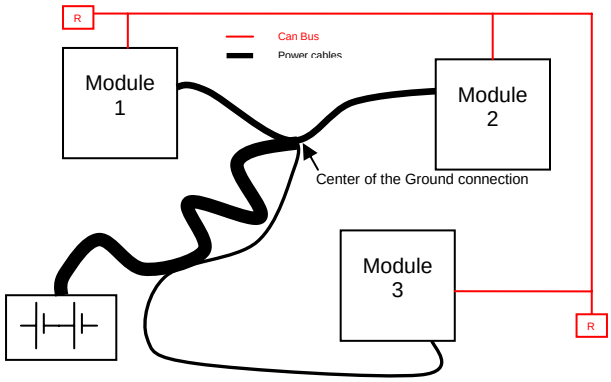
Correct Layout:



Note: Module 1 power > Module 2 power > Module 3 power

The chain starts from the –BATT post of the controller that works with the highest current, and the others are connected in a decreasing order of power.
Otherwise, if two controllers are similar in power (for example a traction and a pump motor controller) and a third module works with less current, the best way to deal this configuration is to create a common ground point (star configuration).

Correct Layout:



Note: Module 1 power ≈Module 2 power > Module 3 power

In this case the power cables starting from the two similar controllers must be as short as possible. Of course also the diameter of the cable concurs in the voltage

drops described before (higher diameter means lower impedance), so in this last example the cable between the minus of the Battery and the common ground point (pointed by the arrow in the image) must be dimensioned taking into account thermal and voltage drop problems.

Can advantages

The complexity of today systems needs more and more data, signal and information must flow from a node to another. CAN is the solution to different problems that arise from this complexity
- simplified design (readily available, multi sourced components and tools)
- lower costs (less and smaller cables)
- improved reliability (fewer connections)
- analysis of problems improved (easy connection with a pc to read the data flowing through the cable).

3.2.3 Wirings: I/O connections

- After crimping the cable, verify that all strands are entrapped in the wire barrel.
- Verify that all the crimped contacts are completely inserted on the connector cavities.

A cable connected to the wrong pin can lead to short circuits and failure; so, before turning on the truck for the first time, verify with a multimeter the continuity between the starting point and the end of a signal wire.

- For information about the mating connector pin assignment see the paragraph “description of the connectors”.

3.2.4 Insulation of truck frame

As stated by EN-1175 “Safety of machinery – Industrial truck”, chapter 5.7, “there shall be no electrical connection to the truck frame”. So the truck frame has to be isolated from any electrical potential of the truck power line.

3.3 Protection and safety features

3.3.1 Protection features

- **Connection Errors:**
  All inputs are protected against connection errors.
- **External agents:**
  The controller is protected against dust and the spray of liquid to a degree of protection meeting IP65.

3.3.2 Safety Features

ZAPI devices are designed according to the prEN954-1 specifications for safety related parts of control system and to UNI EN1175-1 norm.

The safety of the machine is strongly related to installation; length, layout and screening of electrical connections have to be carefully designed. ZAPI is always available to cooperate with the customer in order to evaluate installation and connection solutions. Furthermore, ZAPI is available to develop new SW or HW solutions to improve the safety of the machine, according to customer requirements.
Machine manufacturer holds the responsibility for the truck safety features and related approval.

3.4 EMC

EMC and ESD performances of an electronic system are strongly influenced by the installation. Special attention must be given to the lengths and the paths of the electric connections and the shields. This situation is beyond ZAPI's control. Zapi can offer assistance and suggestions, based on its years experience, on EMC related items. However, ZAPI declines any responsibility for non-compliance, malfunctions and failures, if correct testing is not made. The machine manufacturer holds the responsability to carry out machine validation, based on existing norms (EN12895 for industrial truck; EN50081-2 for other applications).

EMC stands for Electromagnetic Compatibility, and it represents the studies and the tests on the electromagnetic energy generated or received by an electrical device.
So the analysis works in two directions:

1) The study of the **emission** problems, the disturbances generated by the device and the possible countermeasure to prevent the propagation of that energy; we talk about “conduction” issues when guiding structures such as wires and cables are involved, “radiated emissions” issues when it is studied

the propagation of electromagnetic energy through the open space. In our case the origin of the disturbances can be found inside the controller with the switching of the mosfets which are working at high frequency and generate RF energy, **but wires and cables have the key role to propagate the disturbs because they works as antennas**, so a good layout of the cables and their shielding can solve the majority of the emission problems.

2) The study of the **immunity** can be divided in two main branches: protection from electromagnetic fields and from electrostatic discharge.
The **electromagnetic immunity** concern the susceptibility of the controller with regard to electromagnetic fields and their influence on the correct work made by the electronic device.
There are well defined tests which the machine has to be exposed to.
These tests are carried out at determined levels of electromagnetic fields, to simulate external undesired disturbances and verify the electronic devices response.

3) The second type of immunity, **ESD**, concerns the prevention of the effects of electric current due to excessive electric charge stored in an object. In fact, when a charge is created on a material and it remains there, it becomes an “electrostatic charge”; ESD happens when there is a rapid transfer from a charged object to another. This rapid transfer has, in turn, two important effects:
   A) this rapid charge transfer can determine, by induction, disturbs on the signal wiring and thus create malfunctions; **this effect is particularly critical in modern machines, with serial communications (canbus) which are spread everywhere on the truck and which carry critical information.**
   B) in the worst case and when the amount of charge is very high, the discharge process can determine failures in the electronic devices; the type of failure can vary from an intermittently malfunction to a completely failure of the electronic device.

IMPORTANT NOTE: it is always much easier and cheaper to avoid ESD from being generated, than to increase the level of immunity of the electronic devices.

There are different solutions for EMC issues, depending on level of emissions/ immunity required, the type of controller, materials and position of the wires and electronic components.

1) **EMISSIONS**. Three ways can be followed to reduce the emissions:

   A) SOURCE OF EMISSIONS: finding the main source of disturb and work on it.
   B) SHIELDING: enclosing contactor and controller in a shielded box; using shielded cables;
   C) LAYOUT: a good layout of the cables can minimize the antenna effect; cables running nearby the truck frame or in iron channels connected to truck frames is generally a suggested not expensive solution to reduce the emission level.

2) **ELECTROMAGNETIC IMMUNITY**. The considerations made for emissions are valid also for immunity. Additionally, further protection can be achieved with ferrite beads and bypass capacitors.

3) **ELECTROSTATIC IMMUNITY**. Three ways can be followed to prevent damages from ESD:

   A) PREVENTION: when handling ESD-sensitive electronic parts, ensure the operator is grounded; test grounding devices on a daily basis for correct functioning; this precaution is particularly important during controller handling in the storing and installation phase.
   B) ISOLATION: use anti-static containers when transferring ESD-sensitive material.
   C) GROUNDING: when a complete isolation cannot be achieved, a good grounding can divert the discharge current through a “safe” path; the frame of a truck can works like a “local earth ground”, absorbing excess charge. **So it is strongly suggested to connect to truck frame all the parts of the truck which can be touched by the operator, who is most of the time the source of ESD.**

4 DIAGNOSIS

Smart Display microcontroller continuously monitors the output stages and carries out a diagnostic procedure on the main functions.
Main fault diagnostic function concern: parameter and password memory, canbus interface, output drivers.

5 DESCRIPTION OF CONNECTORS

5.1 CNA connector: Ampseal 23 pins

A1	KEY	Smart Display positive power supply.
A2	CMM	Positive supply of digital input devices.
A3	-BATT	Smart Display negative supply.
A4	-BATT	Smart Display negative supply.
A5	DI0	Digital Input, range (-BATT, +BATT); function: pump motor brushes sensor input, active level set by console.
A6	DI1	Digital Input, range (-BATT, +BATT); function: hoist motor temperature sensor input, active level set by console.
A7	CAN_L	Can low signal.
A8	CANPOS	Positive of isolated CANBUS interface; used in case of optoisolated CANBUS.
A9	DI2	Digital Input, range (-BATT, +BATT); function: hydraulic oil level sensor, active level set by console.
A10	AI	Analog Input, range (0, 12 V); internal pull-up to +12 V provided; function: free input if AUX FUNCTION 10 option is set to OFF; if AUX FUNCTION 10 option is set to ON A10 is connected to an other module which controls the alarms LED (see chapter 7.4).
A11	DI3	Digital Input, range (-BATT, +BATT); function: spare input, active level set by console.
A12	DI4	Digital Input, range (-BATT, +BATT); function: hand brake, active level set by console. Handbrake LED is lighted when this input become active or when active handbrake information is present on CANBUS line.
A13	DI5	Digital Input, range (-BATT, +BATT); function: seat, active level set by console. Seat LED is lighted when this input become not active or when missing seat information is present on CANBUS line.
A14	DI6	Digital Input, range (-BATT, +BATT); function: seatbelt switch input, active level set by console.
A15	CAN_T	CAN termination; connect to CAN_H (A22) to insert 120 ohm can termination resistance.
A16	OUT LOW CURR	Low current, open collector output, driving to -BATT; max current: 100 mA. It is a free output.
A17	+BATT IN	Positive supply input; this input has to be connected to +BATT, taking the signal before key switch. A17 supplies the Smart Display when key is OFF (service time) and supplies the built-in heater (frozen cell version).
A18	-BATT	Smart Display negative supply.
A19	OUT1	Power open collector output, driving to -BATT; max

		current 2,5 A. Function: output activated in case of backward request read from CANBUS line. Function present only if option OUTPUTS ENABLE is set ON (see chapter 7.4).
A20	OUT2	Power open collector output, driving to -BATT; max current 2,5 A. Function: output activated in case of alarm read from CANBUS line. Function present only if option OUTPUTS ENABLE is set ON (see chapter 7.4).
A21	+BATT OUT	Positive supply for loads / switches, max current 3 A.
A22	CAN_H	Can signal high.
A23	CANNEG	Negative of CAN circuit, to be used in case of optoisolated CANBUS.

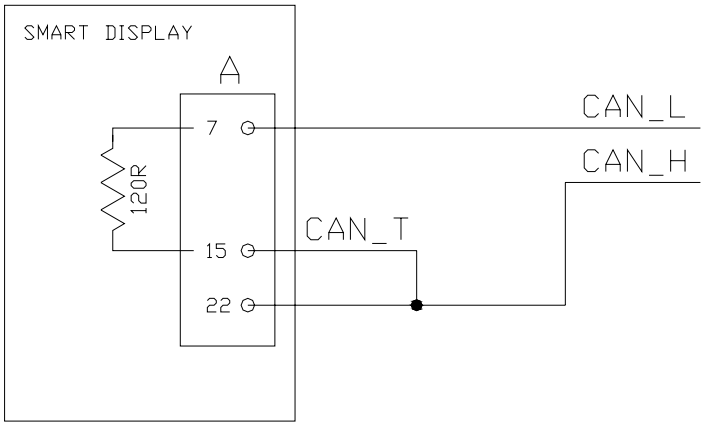
5.2 CNB connector: MOLEX SPOX

B1	PCLRXD	Serial reception positive.
B2	NCLRXD	Serial reception negative.
B3	PCLTXD	Serial transmission positive.
B4	NCLTXD	Serial transmission negative.
B5	GND	Console negative power supply.
B6	+12	Console positive power supply.
B7	FLASH	Flash memory programming via serial link.
B8	FLASH	Flash memory programming via serial link.

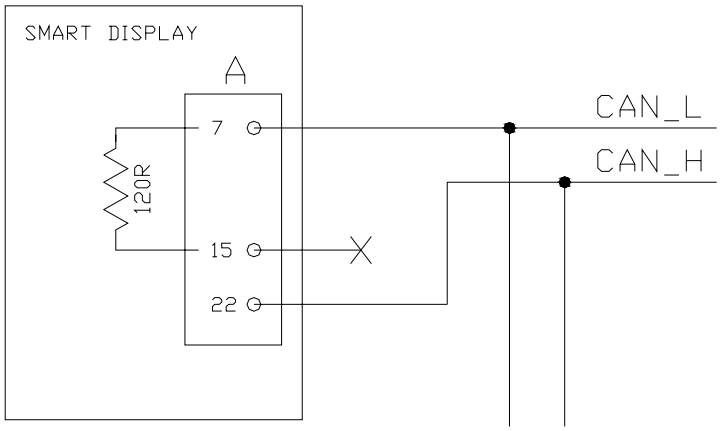
5.3 Canbus connections

Smart Display has a canbus interface; it has been designed to work in a can network together with other electronic modules, exchanging information over the canbus network.
Smart Display provides built-in termination resistance, which can be connected in different ways, as described here following:

Smart Display is a termination module in the canbus net.

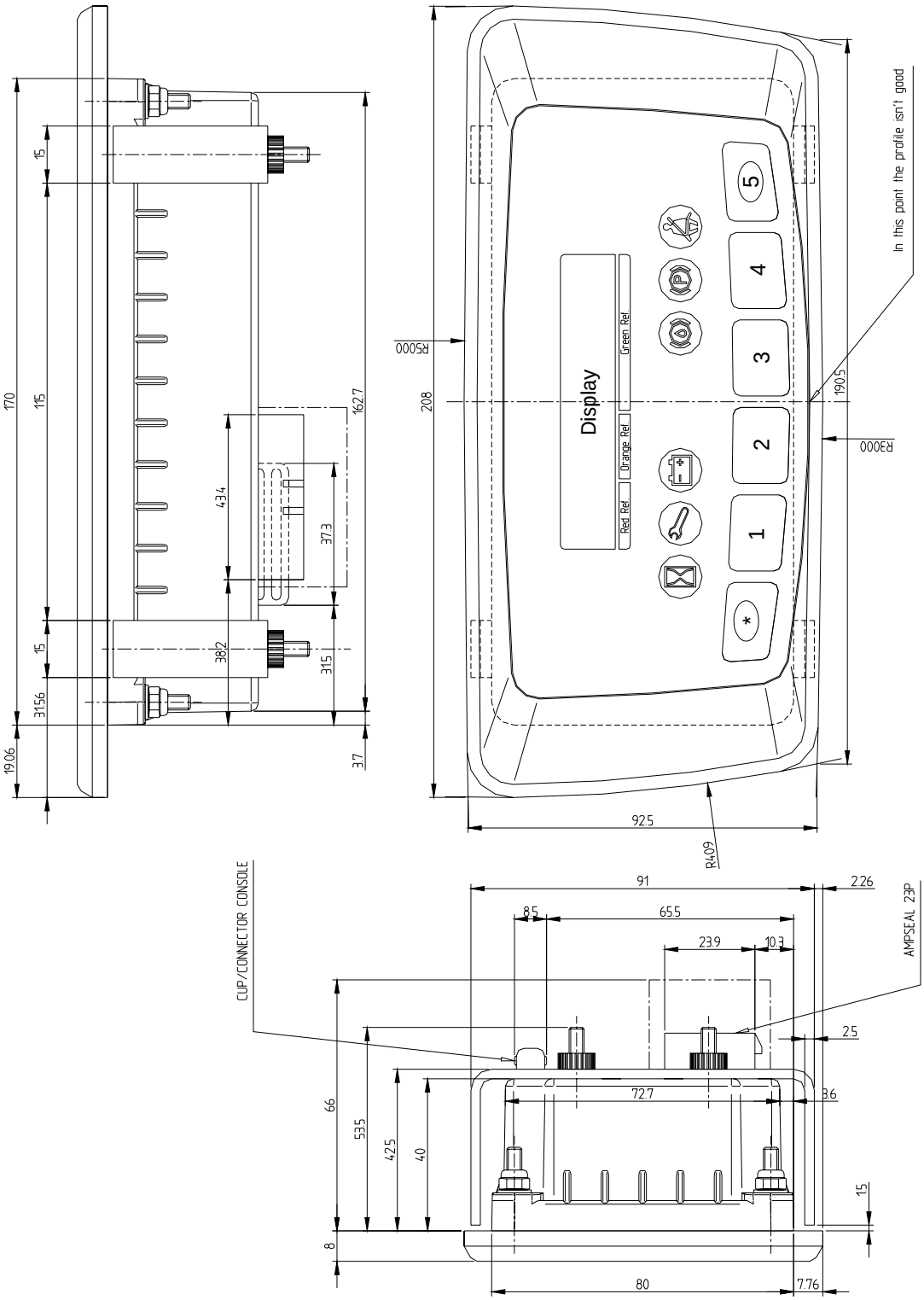


Smart Display is a repetition module in the canbus net.

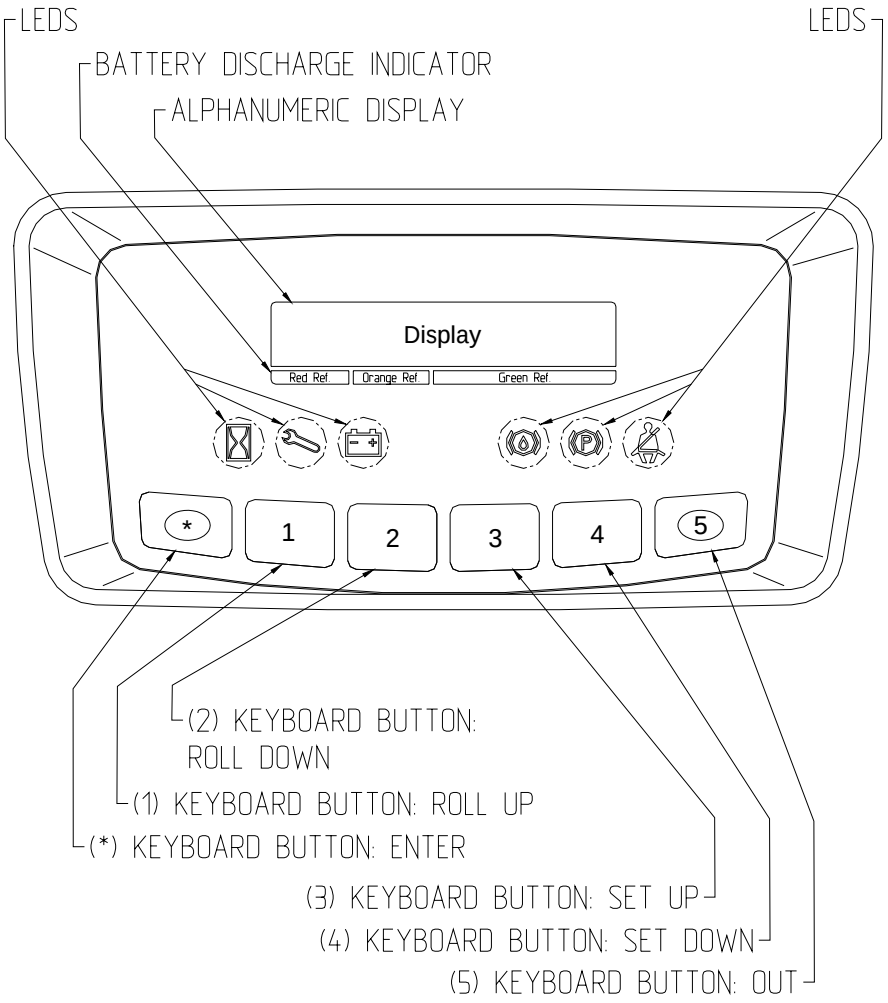


6 DRAWINGS

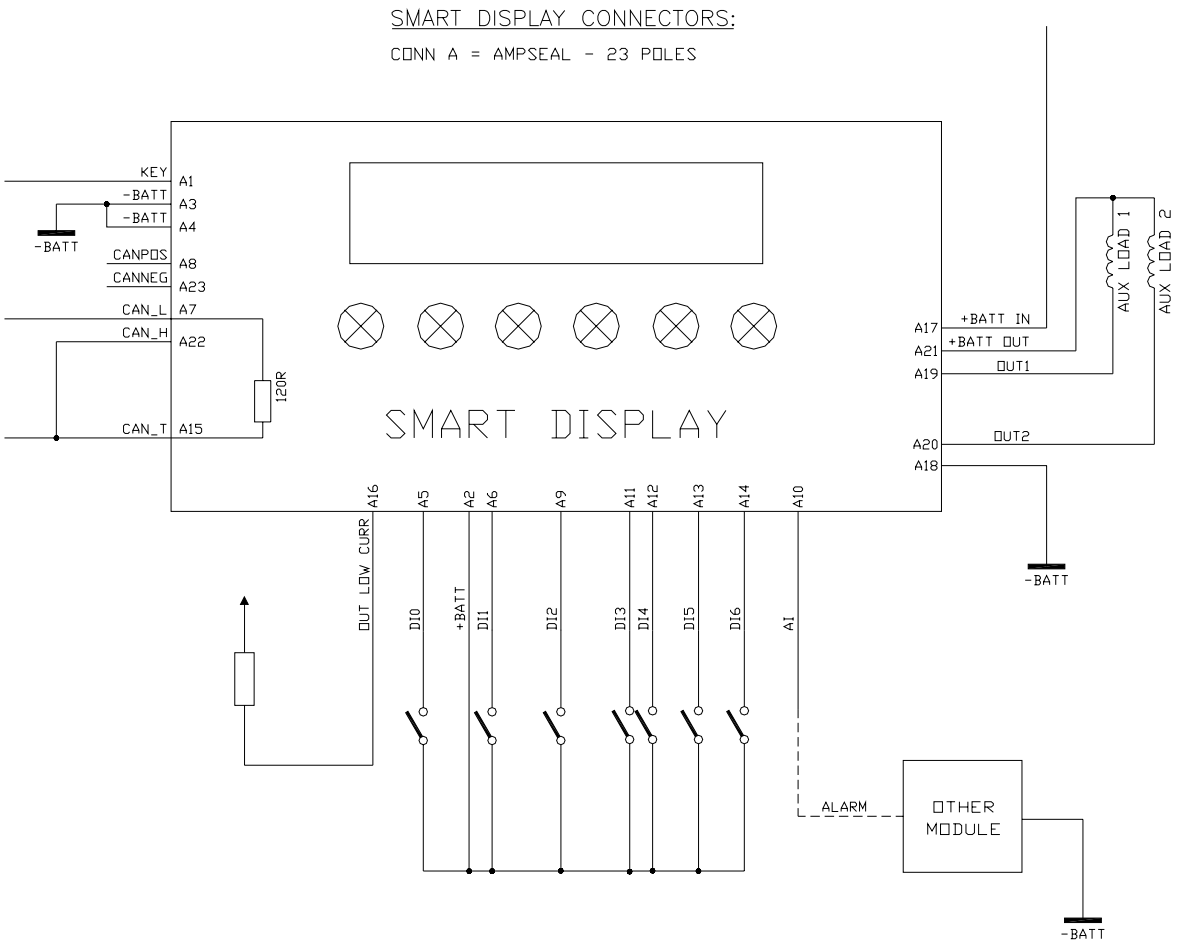
6.1 Mechanical drawing



6.2 Face layout



6.3 Connection drawing



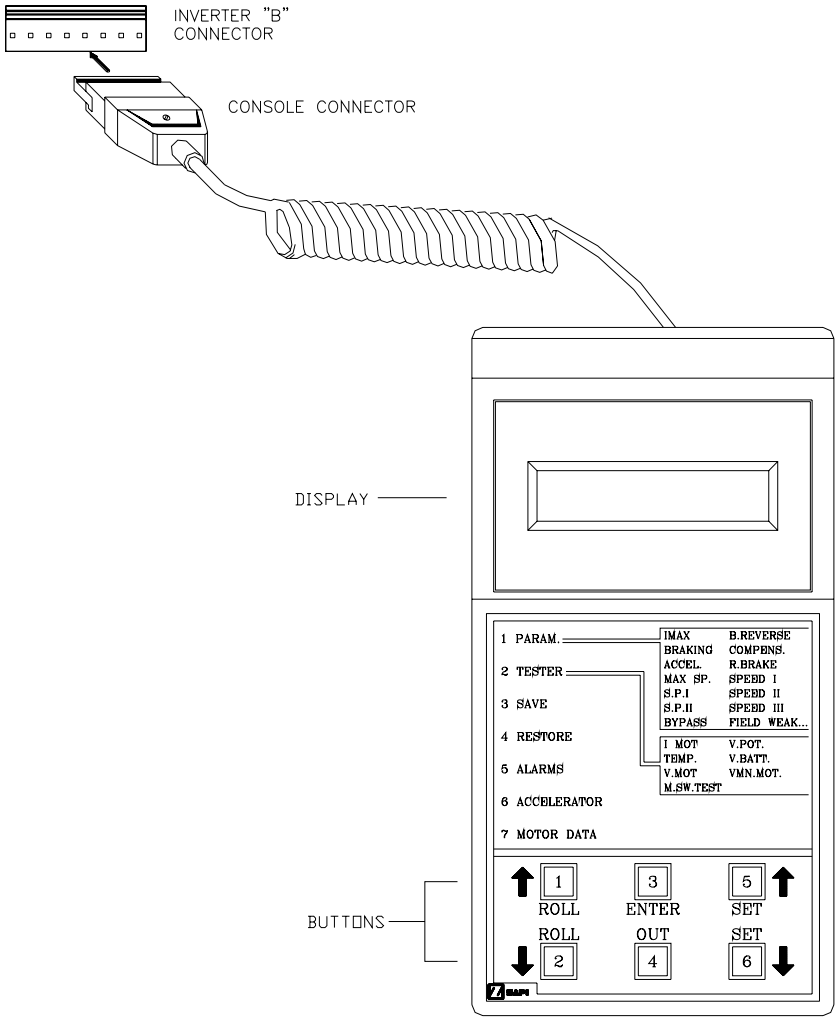
7 PROGRAMMING AND ADJUSTMENTS USING ZAPI HANDSET

7.1 Adjustment via console

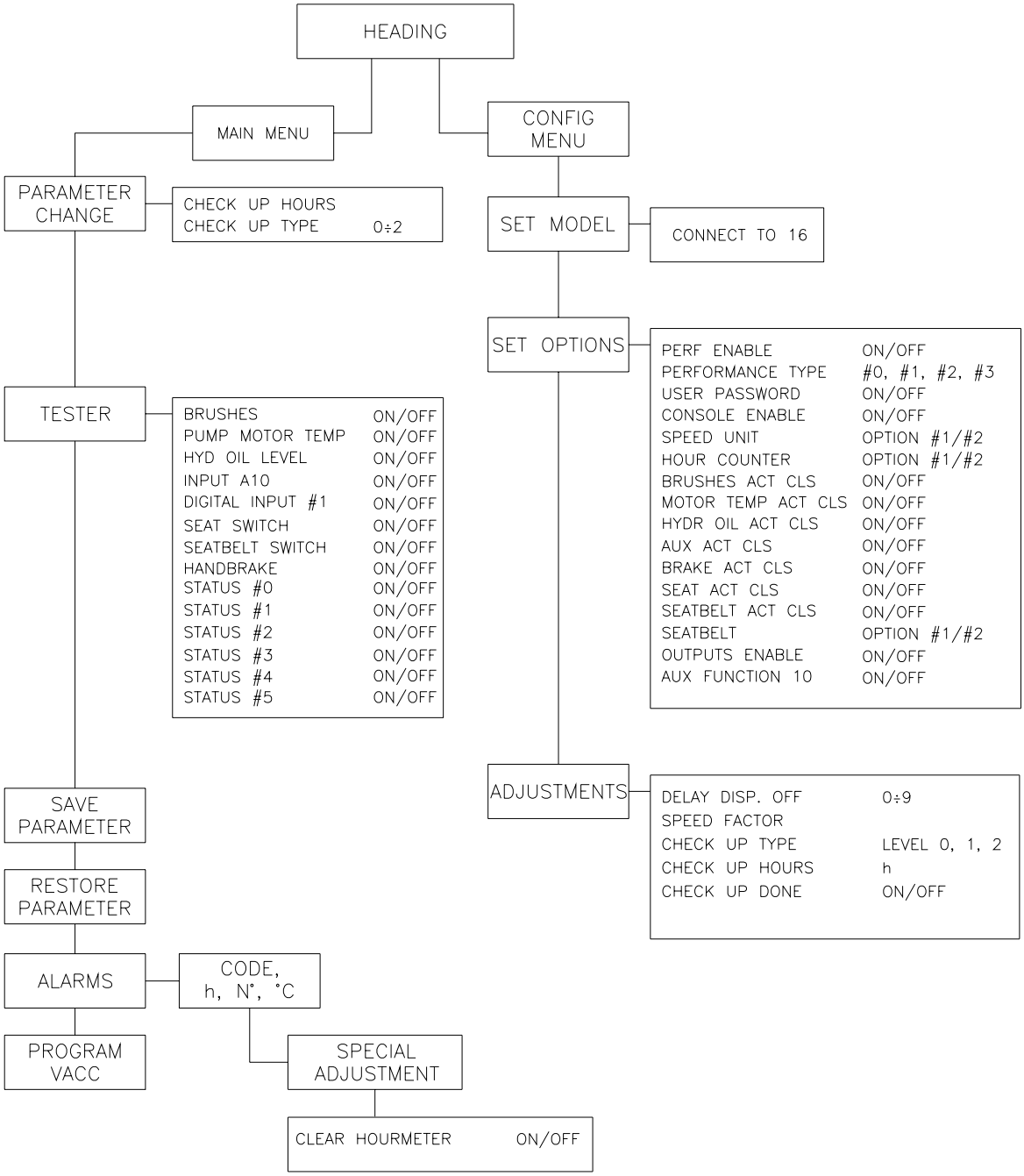
Adjustment of Parameters and changes to the display configuration are made using the Digital Console. Zapi console can be connected directly to Smart Display (connector B); or it can be physically connected to another controller in the CANBUS net, then virtually connected to Smart Display (which is node 16 of the net).

Pay attention to the polarity of the Console Connector when connecting to the chopper. The bevel on the connector should be uppermost.

7.2 Description of console and connection



7.3 Description of standard console menu



7.4 Description of programmable functions

MENU SET MODEL

1) CONNECT TO

Using CANBUS link, every module connected to can net can act as the "access node" to the canbus net for the external world.
For example the ZAPI handy console (or the PC-Win console) can be physically connected to one module and, by the canbus, virtually connected to any other module of the net.
This parameter is used to select the module to which the user wishes to be connected, but it is only if CONSOLE ENABLE option is set OFF.
Following the numbers associated to each module in Zapi canbus system are showed.

Number associated in canbus net	MODULE
01	SICOS
02	TRACTION
03	TRACTION MASTER
04	TRACTION SLAVE
05	PUMP
06	EPS-AC
09	MHYRIO/HVC
16	SMART DISPLAY

MENU SET OPTIONS

1) PERF ENABLE

It can enable or disable operator changing the truck performances using buttons 1, 2, 3, 4.
- ON: Enabled operator
- OFF: Not enabled operator

2) PERFORMANCE TYPE

- It sets the traction modes #1, #2, #3, #4.

3) USER PASSWORD

It sets using of the starting password to main page access.
- ON: Starting password requested
- OFF: Starting password not requested

4) CONSOLE ENABLE

It can activate or disable using of console function.
- ON: Console function active
- OFF: Console function disabled

5) SPEED UNIT

It sets speed unit.
- OPTION #1: km/h
- OPTION #2: mph

6) HOUR COUNTER

It sets the hour counter displayed.
- OPTION #1: the traction hours are displayed
- OPTION #2: the displayed hours represent the machine hour counter managed by the display

7) BRUSHES ACT CLS

It sets active logic level of motor brushes input (A5).

- ON: Active high input
- OFF: Active low input

8) MOTOR TEMP ACT CLS

It sets active logic level of pump motor temperature input (A6).

- ON: Active high input
- OFF: Active low input

9) HYDR OIL ACT CLS

It sets active logic level of hydraulic oil level input (A9).

- ON: Active high input
- OFF: Active low input

10) AUX ACT CLS

It sets active logic level of spare input (A11).

- ON: Active high input
- OFF: Active low input

11) BRAKE ACT CLS

It sets active logic level of handbrake input (A12).

- ON: Active high input
- OFF: Active low input

12) SEAT ACT CLS

It sets active logic level of seat input (A13).

- ON: Active high input
- OFF: Active low input

13) SEATBELT ACT CLS

It sets active logic level of seatbelt input (A14).

- ON: Active high input
- OFF: Active low input

14) SEATBELT

It manages the use of LED1.

- OPTION#1: LED1 shows the state of the seat belt
- OPTION#2: LED1 shows the state of the seat (cabled or through can-bus)

15) OUTPUTS ENABLE

It can activate or disable using of outputs A19 and A20.

- ON: Outputs used as A19 = backward, A20 = alarm signal
- OFF: Commands to drive A19 and A20 comes from canbus net.

16) AUX FUNCTION 10

It manages the use of the alarms LED, which depends by the use of A10 analog input.

- ON: A10 is connected to an other module and the alarms LED is managed in the following way:
  - if there isn't any alarm the LED is always switched off
  - if there is an alarm coming via can or a display alarm the LED is always lighted
  - depending by the A10 input signal level, the LED is lighted (high level) or switched off (low level)
- OFF: A10 is a free input and the LED blinks if there is an alarm

MENU ADJUSTMENTS

1) DELAY DISP. OFF

This parameter sets the display ON "Service time". The display is still supplied for a programmable time (in seconds).

DELAY DISPLAY OFF LEVEL	0	1	2	3	4	5	6	7	8	9
SERVICE TIME [Sec]	1	3	5	7	9	11	13	15	17	20

2) SPEED FACTOR

It adjusts speed coefficient to have the correct truck speed value shown on the display. This coefficient has to be regulated depending on truck mechanic characteristics. It is the result of following formula:

Speed Factor = (88 * rr * p) / Ø

Where:

rr = total gearbox reduction ratio

p = number of pair pole of the motor

Ø = traction wheel diameter expressed in centimeters (cm)

3) CHECK UP TYPE

It defines the truck behaviour when a maintenance is required.

- LEVEL 0: the “SERVICE REQUIRED” alarm doesn’t appear
- LEVEL 1: the “SERVICE REQUIRED” alarm appears after a time equal to the hours set in the CHECK UP HOURS parameter
- LEVEL 2: the “SERVICE REQUIRED” alarm appears after a time equal to the hours set in the CHECK UP HOURS parameter and after 50 additional hours the truck speed is reduced

4) CHECK UP HOURS

It defines the hours after which a maintenance is required. It can be adjusted in the 100 to 1000 hours. The resolution is 100 hours (it can be adjusted in steps of 100 hours).

5) CHECK UP DONE

It can be ON/OFF. If it is ON it is possible to reset the last maintenance hour-counter, the “SERVICE REQUIRED” alarm and possible reductions.

7.5 Special Adjustment menu

To enter this Zapi hidden menu a special procedure is required. Ask this procedure directly to a Zapi technician.

Following parameter can be configured in this menu:

1) CLEAR HOURMETER

It can be ON/OFF. If it is ON it is possible to reset the machine hour-counter.

7.6 Tester menu

Following parameters can be measured in real time in the TESTER menu:

1) BRUSHES

Level of DI0 input – Pump motor brushes (A5).

- ON = Input active
- OFF = Input not active

2) PUMP MOT TEMP

Level of DI1 input – Pump motor temperature (A6).

- ON = Input active
- OFF = Input not active

3) HYD OIL LEVEL

Level of DI12 input – Hydraulic oil level (A9).

- ON = Input active
- OFF = Input not active

4) INPUT A10

Level of AI input – (A10).

- ON = Input active
- OFF = Input not active

5) **DIGITAL INPUT #1**
   Level of DI3 input – Spare input (A11).
   - ON = Input active
   - OFF = Input not active

6) **SEAT SWITCH**
   Level of DI5 input – Seat input (A13).
   - ON = Input active
   - OFF = Input not active

7) **SEATBELT SWITCH**
   Level of DI6 input – Seatbelt input (A14).
   - ON = Input active
   - OFF = Input not active

8) **HANDBRAKE**
   Level of DI4 input – Handbrake input (A12).
   - ON = Input active
   - OFF = Input not active

9) **STATUS #0**
   Status of (*) keyboard button:
   - ON = Input active, button pushed
   - OFF = Input not active, button released

10) **STATUS #1**
    Status of (1) keyboard button:
    - ON = Input active, button pushed
    - OFF = Input not active, button released

11) **STATUS #2**
    Status of (2) keyboard button:
    - ON = Input active, button pushed
    - OFF = Input not active, button released

12) **STATUS #3**
    Status of (3) keyboard button:
    - ON = Input active, button pushed
    - OFF = Input not active, button released

13) **STATUS #4**
    Status of (4) keyboard button:
    - ON = Input active, button pushed
    - OFF = Input not active, button released

14) **STATUS #5**
    Status of (5) keyboard button:
    - ON = Input active, button pushed
    - OFF = Input not active, button released

7.7 Description of console using

Access to SET MODEL menu.
The only parameter present in SET MODEL function is CONNECTED TO.
By setting this parameter, operator can connect ZAPI Console to every ZAPI product connected to CAN-BUS line. This functionality allows completely control of every ZAPI product without changing the position of the Console connector.

1) Opening Zapi Menu

2) Press ROLL UP & SET UP Buttons to enter CONFIG MENU

3) The Display will show: SET MODEL. If another menu is displayed, press ROLL UP or ROLL DOWN until SET MODEL appears

4) Press ENTER to go into the SET MODEL

5) The display will shows the first option, only CONNECTED TO option is present in this menu

6) Press SET UP or SET DOWN buttons in order to select the desired value for selected option

7) New desired value appears

8) Press OUT to exit the menu

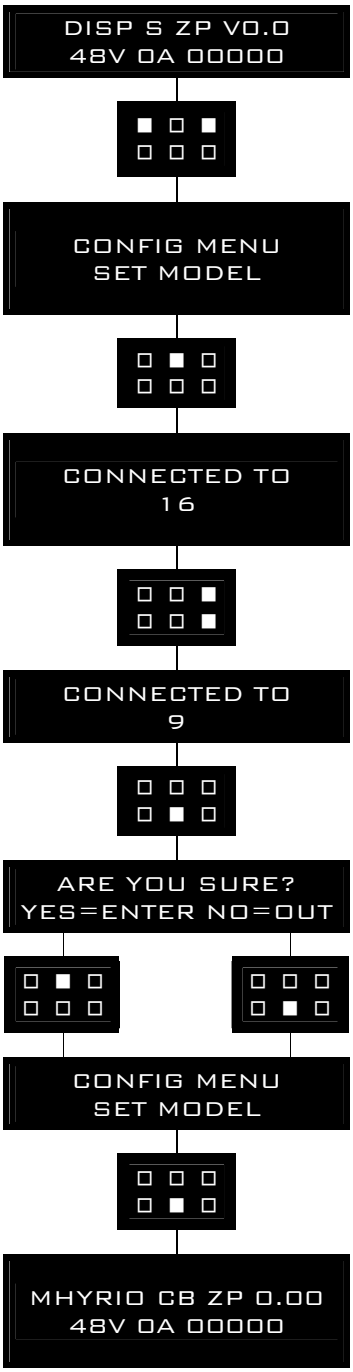
9) The Display will ask “ARE YOU SURE?”

10) Press ENTER for YES, or OUT if you do not accept the changes

11) SET MODEL menu appears

12) Press OUT again. Console now disconnects and reconnects

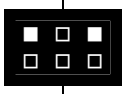
13) Display now shows the Opening Zapi Menu of the ZAPI product corresponding to option selected at point 7)



Flow chart showing how to make changes to Option Menu:

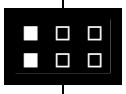
1) Opening Zapi Menu

2) Press ROLL UP & SET UP Buttons to enter CONFIG MENU



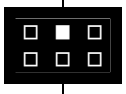
3) The Display will show: SET MODEL

4) Press ROLL UP or ROLL DOWN until SET OPTIONS appears



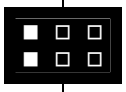
5) SET OPTIONS menu appears

6) Press ENTER to go into the SET OPTIONS menu



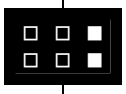
7) The Display will show the first option

8) Press ROLL UP or ROLL DOWN buttons until desired option appears



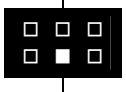
9) Desired option appears

10) Press SET UP or SET DOWN buttons in order to modify the value for selected option



11) New value for selected option appears

12) Press OUT to exit the menu

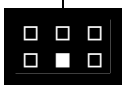


13) Confirmation request appears

14) Press ENTER to accept the changes, or press OUT if you do not accept the changes

15) SET OPTIONS menu appears

16) Press OUT again. Display now shows the Opening Zapi Menu



Flow chart showing how to make Program changes using Digital Console:

1) Opening Zapi Menu

2) Press ENTER to go into the MAIN MENU

3) The Display will show: PARAMETER CHANGE

4) Press ENTER to go into the Parameter Change facility

5) The Display will show the first parameter

6) Press either ROLL UP and ROLL DOWN to display the next parameter

7) The names of the Parameter appears on the Display

8) When the desired Parameter appears, the Display will show a Level Number. Press either PARAM (Top Right) or SET (Bottom Right) buttons to change the Level value

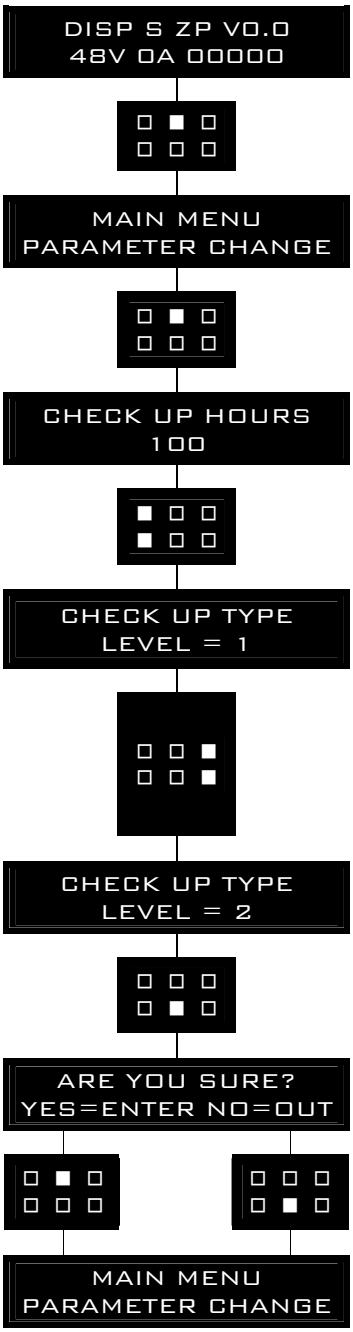
9) The Display will show the New Level

10) When you are satisfied with the results of the changes you have made, press OUT

11) The Display asks “ARE YOU SURE?”

12) Press ENTER to accept the changes, or press OUT if you do not accept the changes

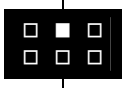
15) The Display will show: PARAMETER CHANGE



Flow chart showing how to use the TESTER function of the Digital Console:

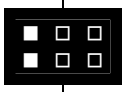
1) Opening Zapi Menu

2) Press ENTER to go into the GENERAL MENU



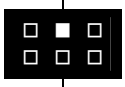
3) The Display will show: PARAMETER CHANGE

4) Press ROLL UP or ROLL DOWN until TESTER menu appears on the display



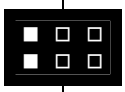
5) The Display will show: TESTER

6) Press ENTER to go into the TESTER function



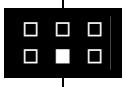
7) The first variable to be tested is shown on the display

8) Press either ROLL UP or ROLL DOWN buttons



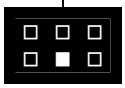
9) Next variable for measurement appears

10) When you have finished press OUT



11) The Display will show: TESTER

12) Press OUT again and return to Opening Zapi Menu



Remember it is not possible to make any changes using TESTER.
All you can do is measure as if you were using a pre-connected multimeter.

7.8 Other functions

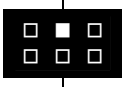
SAVE function allows to transfer controller parameters to the Pc console memory (using Zapi PcWin console). With this function, a copy of the controller set of parameters can be retained in a Pc and downloaded to another controller (see RESTORE).
RESTORE function allows to download controller parameters from the Pc console memory to the controller Eeprom. Thus, a copy of the parameters stored in a Pc can be downloaded in a controller avoiding the parameter setting operation.

7.9 Description of Alarm menu

The microprocessor in the controller records the last five Alarms that have occurred. Items remembered relative to each Alarm are: the code of the alarm, the number of times the particular Alarm occurred, the Hour Meter count, and the chopper temperature. This function permits deeper diagnosis of problems as the recent history can now be accessed.
Flow Chart showing how to use the ALARMS function via the Digital Console:

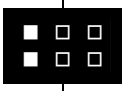
1) Opening Zapi Menu

2) Press ENTER to go into the GENERAL MENU



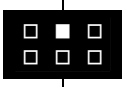
3) The Display will show:

4) Press ROLL UP or ROLL DOWN until ALARMS menu appears on the display



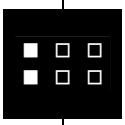
5) The Display will show:

6) Press ENTER to go into the ALARMS menu



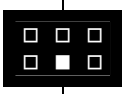
7) The display will show the most recent alarm

8) Each press of ROLL UP button brings up following alarms. Pressing ROLL DOWN returns to the most recent



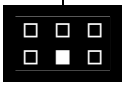
9) If an alarm has not occurred, the display will show: NONE

10) When you have finished looking at the alarms, press OUT to exit the ALARMS menu



11) The Display will ask: “CLEAR LOGBOOK?” Press ENTER for Yes, or OUT for No

12) Press OUT again and return to Opening Zapi Menu

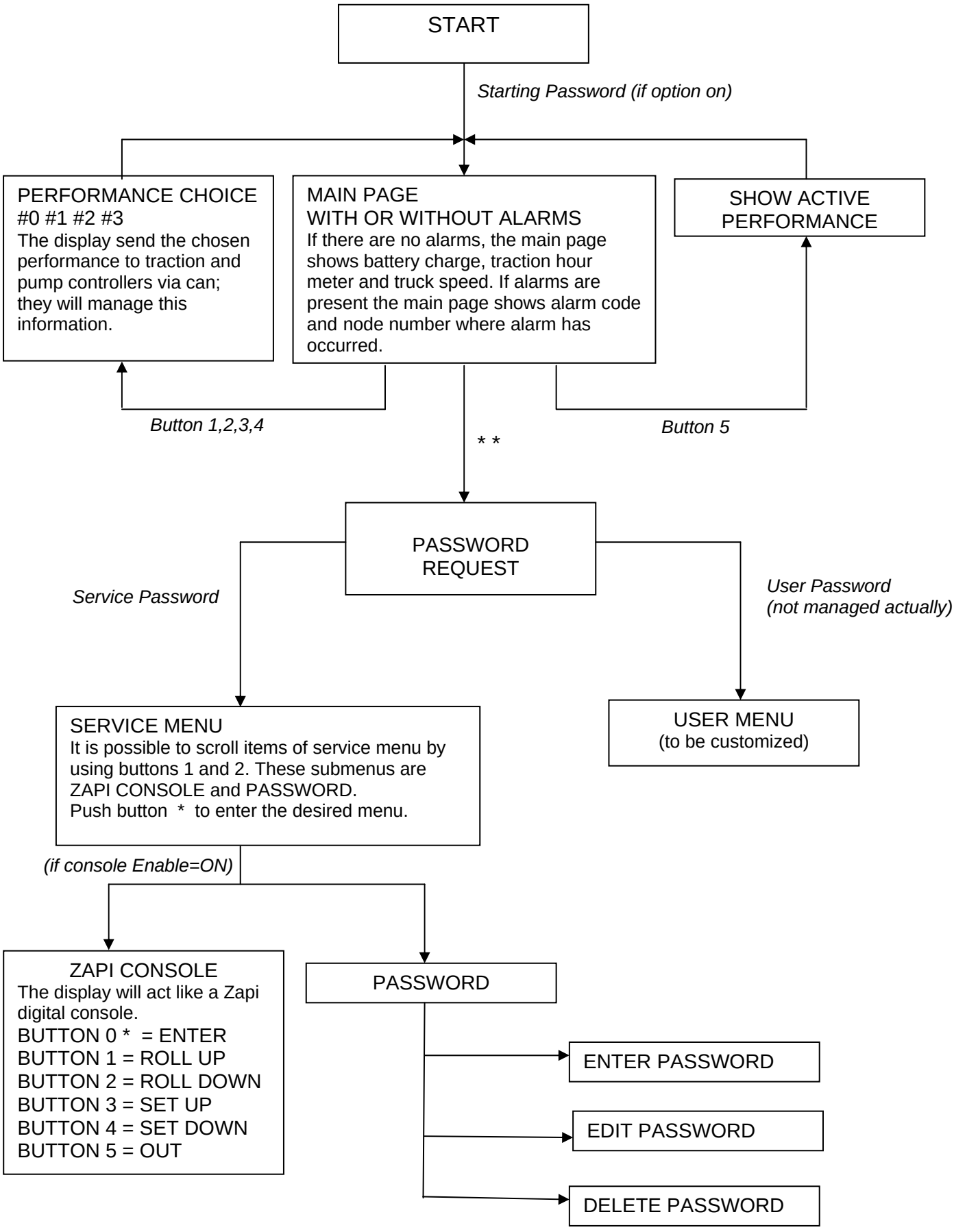


8 STRUCTURE OF DISPLAY MENU

Smart Display present a software structure made by menus and submenus. It is possible to have access to Smart Display menu structure by the six operator buttons integrated in a membrane keyboard.

At turn on the display shows the software release for some seconds, then asks the starting password to have access to the main page (if “USER PASSWORD” option is ON), otherwise it shows directly the main page (if “USER PASSWORD” option is OFF).
The main page, if there aren’t alarms, shows battery charge, truck speed (in Km/h) and traction hour meter; if alarms are present it will show alarm code and node number in which alarm has occurred.
From the main page it is possible to have access to two different functions: USER MENU and SERVICE MENU. Both functions are accessible by entering different passwords: user password and service password. To enter a password is necessary to push twice the first button (*) of membrane keyboard; this will show a entering password page.
By using service password it’s possible to enter SERVICE MENU which presents two items: “zapi console” and “password”.
The “zapi console” submenu can be entered only if CONSOLE ENABLE option is ON. This menu allow user to use dashboard as a real Zapi digital console connected to one module of canbus net.
The “password” submenu allow to manage passwords of Smart Display software structure. It’s possible to edit, add and delete passwords.
By using user password it’s possible to enter USER MENU which will be customized depending on customer requests.
All passwords are optional (ON/OFF option).

It follows flow chart diagram of software structure.


START
Starting Password (if option on)
PERFORMANCE CHOICE
#0 #1 #2 #3
The display send the chosen performance to traction and pump controllers via can; they will manage this information.
MAIN PAGE
WITH OR WITHOUT ALARMS
If there are no alarms, the main page shows battery charge, traction hour meter and truck speed. If alarms are present the main page shows alarm code and node number where alarm has occurred.
SHOW ACTIVE PERFORMANCE
Button 1,2,3,4
Button 5
* *
PASSWORD REQUEST
Service Password
User Password
(not managed actually)
SERVICE MENU
It is possible to scroll items of service menu by using buttons 1 and 2. These submenus are ZAPI CONSOLE and PASSWORD.
Push button * to enter the desired menu.
USER MENU
(to be customized)
(if console Enable=ON)
ZAPI CONSOLE
The display will act like a Zapi digital console.
BUTTON 0 * = ENTER
BUTTON 1 = ROLL UP
BUTTON 2 = ROLL DOWN
BUTTON 3 = SET UP
BUTTON 4 = SET DOWN
BUTTON 5 = OUT
PASSWORD
ENTER PASSWORD
EDIT PASSWORD
DELETE PASSWORD

8.1 Performance choice

From MAIN PAGE using membrane keyboard numbers, it is possible to select the performance mode which must be used in traction and pump controllers. Performance can be chosen with buttons 1, 2, 3, 4. With button 5 is possible to show the active performance.
When one performance is selected, the related information will be sent via canbus to traction and pump controllers that will manage this data. The standard functioning reduces truck performance passing from performance mode #4 to performance mode #1.

The real meaning, in terms of parameters level of these performances, depends on software present on pump and traction controllers.

Button 5 shows on display the active performance
Button 4 selects Mode #4. It corresponds to highest performance
Button 3 selects Mode #3. It corresponds to medium performance
Button 2 selects Mode #2. It corresponds to low performance
Button 1 selects Mode #1. It corresponds to minimum performance

8.2 Using dashboard like a console

By entering the service password from MAIN PAGE it's possible to have access to SERVICE MENU. Here with roll buttons (button 1 and 2 of membrane keyboard) it's possible to scroll the submenu items.
If option CONSOLE ENABLE is ON (see chap. 7.4) with ENTER button (button * of membrane keyboard) it is possible to enter ZAPI CONSOLE submenu. From this menu is possible to choose which module of canbus net (use buttons 1 and 2 to scroll and * to enter) has to be connected to the display.
When the display has been connected it works exactly like a Zapi digital console. Buttons of membrane keyboard do the same functions of Zapi console keys.

Button 5 performs function of the OUT console key
Button 4 performs function of the SET DOWN console key
Button 3 performs function of the SET UP console key
Button 2 performs function of the ROLL DOWN console key
Button 1 performs function of the ROLL UP console key
Button * performs function of the ENTER console key

8.3 Using of Password menu

By entering the service password from MAIN PAGE or at key on, it's possible to have access to SERVICE MENU. Here with roll buttons (button 1 and 2 of membrane keyboard) it's possible to scroll the submenu items.
With ENTER button (button * of membrane keyboard) is possible to enter PASSWORD submenu where the operator can manage Smart Display passwords. In particular it could enter, edit and remove passwords.
Inside the PASSWORD menu use buttons ENTER (*) and OUT (5) to enter or exit submenus and to confirm or cancel operations.

To edit or add passwords use these buttons:

ROLL UP / ROLL DOWN	change the digit marked by cursor
SET UP	shifts cursor on previous digit
SET DOWN	shifts cursor on following digit
ENTER	saves all changing
OUT	cancels all changing

When there is no service password saved, default password “55555” is active. At saving of the first service password, the default one becomes invalid password.

9 ANALYSIS OF SMART DISPLAY RELATED ALARMS

9.1 Smart Display alarms

1) **“EEPROM KO”**
Fault in the area of memory where the adjustment parameters are stored. This Alarm does not inhibit machine operation but operation goes on with default values; if fault is still present when the Key Switch is re-cycled, replace the Smart Display. If the fault disappears, the previously stored Parameters will have been replaced by the default parameters.

2) **“CAN BUS KO MAST”**
Smart Display does not receive messages from canbus line.
Trouble shooting:
- If this fault code is displayed together with other alarm messages, the fault is probably to be looked for in the Smart Display can interface, since the Display seems to be unable to receive any can message. So it is suggested to check Smart Display canbus wiring and connection.
- Otherwise, the fault is in the can interface of other modules present on canbus net.

3) **“SERVICE REQUIRED”**
The maintenance time is elapsed, service intervention required.

4) **“COIL SHORTED”**
Load connected to one of the power output (A19 and A20) is shorted, thus providing a overcurrent on the related drivers.
Trouble shooting:
- Check the loads connected, if they are burnt or shorted.
- Check the related wiring.
- If the alarm is present even with open connections (no loads connected), the Smart Display high current protection circuit is damaged; replace the Smart Display.

5) **“HYDRAULIC OIL”**
Hydraulic oil level input is active at start-up.
Trouble shooting:
Check if the related digital input on the display (A9) is active (see TESTER menu).
Check also which active level (+VB or GND) is selected for this input (SET OPTIONS menu).
- If this input is active, check the related switch status, the wiring and oil level.
- If the input is not active the failure is probably in the Smart Display input circuit.

6) **“PU MOTOR TEMPER”**
Hoist motor temperature device signal an hot temperature in the motor windings.
Trouble shooting:
Check if the related digital input on the display (A6) is active (see TESTER

menu).
Check also which active level (+VB or GND) is selected for this input (SET OPTIONS menu).

- If the fault message is present when the input is active check hoist motor temperature, wiring, and motor temperature sensor, it is probably failed opened.
- If, on the contrary, the input is not active, probably Smart Display input circuit is damaged.

7) "PUMP BRUSHES"

Hoist motor brushes wear sensor signal brushes wearing.
Trouble shooting:
Check if the related digital input on the display (A5) is active (see TESTER menu).
Check also which active level (+VB or GND) is selected for this input (SET OPTIONS menu).

- If the fault message is present when the input is active check brushes wearing, wiring, and brushes wear sensor.
- If, on the contrary, the input is not active, probably Smart Display input circuit is damaged.

9.2 Alarms visualisation

When an alarm condition occurs, Smart Display gives the information showing the alarm code in the first row and the module number in the second row.
For example, the information:

A	L	A	R	M		6	0											
O	N		N	O	D	E		5										

means that the alarm 60 occurred in the module N.5 (pump).
Here the table with the alarm codes and the respective meaning is shown.

The meaning of alarms with a code higher than 99 can change depending on the purpose of the application (see following tables).

00	NONE
01	CHOPPER RUNNING
02	NO COMMUNICATION
03	UNKNOWN CHOPPER
04	CONSOLE EEPROM
05	SERIAL ERROR #2
06	SERIAL ERROR #1
07	CHOPPER NOT CONF
08	WATCHDOG
09	FIELD FF FAILURE
10	EEPROM DATA KO
11	EEPROM PAR. KO

12	EEPROM CONF. KO
13	EEPROM KO
14	EEPROM OFFLINE
15	LOGIC FAILURE #5
16	LOGIC FAILURE #4
17	LOGIC FAILURE #3
18	LOGIC FAILURE #2
19	LOGIC FAILURE #1
20	FORW VMN LOW
21	FORW VMN HIGH
22	BACK VMN LOW
23	BACK VMN HIGH
24	LEFT VMN LOW
25	LEFT VMN HIGH
26	RIGHT VMN LOW
27	RIGHT VMN HIGH
28	PUMP VMN LOW
29	PUMP VMN HIGH
30	VMN LOW
31	VMN HIGH
32	VMN NOT OK
33	NO FULL COND.
34	RGT NO FULL COND
35	LFT NO FULL COND
36	PU NO FULL COND
37	CONTACTOR CLOSED
38	CONTACTOR OPEN
39	BRAKE CON CLOSED
40	BRAKE CONT. OPEN
41	DIR CONT. CLOSED
42	DIR CONT. OPEN
43	RIGHT CON CLOSED
44	RIGHT CONT. OPEN
45	LEFT CONT CLOSED
46	LEFT CONT. OPEN
47	MAIN CONT CLOSED
48	MAIN CONT. OPEN
49	I=0 EVER
50	LEFT I=0 EVER
51	RIGHT I=0 EVER
52	PUMP I=0 EVER
53	STBY I HIGH

54	LEFT STBY I HIGH
55	RGT STBY I HIGH
56	PUMP STBY I HIGH
57	HIGH FIELD CUR.
58	NO FIELD CUR.
59	HIGH BRAKING I
60	CAPACITOR CHARGE
61	HIGH TEMPERATURE
62	TH. PROTECTION
63	THERMIC LEVEL #2
64	PUMP TEMPERATURE
65	MOTOR TEMPERAT.
66	BATTERY LOW
67	BATTERY LEVEL #2
68	BATTERY LEVEL #1
69	CURRENT SENS. KO
70	HIGH CURRENT
71	POWER FAILURE #3
72	POWER FAILURE #2
73	POWER FAILURE #1
74	DRIVER SHORTED
75	CONTACTOR DRIVER
76	COIL SHORTED
77	COIL INTERRUPTED
78	VACC NOT OK
79	INCORRECT START
80	FORW + BACK
81	BAD STEER 0-SET
82	ENCODER ERROR
83	BAD ENCODER SIGN
84	STEER SENSOR KO
85	STEER HAZARD
86	PEDAL WIRE KO
87	PEDAL FAILURE
88	TRACTION BRUSHES
89	PUMP BRUSHES
90	DRIVER 1 KO
91	DRIVER 2 KO
92	DRIVER 1 SIC. KO
93	DRIVER 2 SIC. KO
94	INPUT ERROR #6
95	INPUT ERROR #5

96 INVERTION
97 POSITION HANDLE
98 INPUT ERROR #2
99 INPUT ERROR #1

Here the tables of the alarms with a code higher than 99 for modules which can be connected to the net nodes are shown.

9.2.1 Traction (node 02)

242 MOT. TH. SENSOR KO
244 SAFETY KO
245 WRONG SET BAT.
246 SAFETY
247 CAN BUS KO
248 CHECK UP NEEDED
249 THERMIC SENS. KO
250 HANDBRAKE
251 WAITING FOR NODE
253 AUX OUTPUT KO

9.2.2 Traction master (node 03)

241 DATA ACQUISITION
242 PUMP WARNING
244 SLAVE WARNING
245 WRONG SET BAT.
246 SLAVE KO
247 NO CAN MSG N. 4
248 CHECK UP NEEDED
249 THERMIC SENS. KO
250 HANDBRAKE
251 WAITING FOR NODE #4
253 AUX OUTPUT KO

9.2.3 Traction slave (node 04)

241 DATA ACQUISITION
242 PUMP TEMPERATURE
243 PUMP INCOR. START
244 PUMP VACC NOT OK
245 PUMP TH. SENS. KO
246 MASTER KO
247 NO CAN MSG N. 3
249 THERMIC SENS. KO
250 INPUT MISMATCH
251 WAITING FOR N. 3

9.2.4 Pump (node 05)

241 DATA ACQUISITION
245 WRONG SET BAT.
246 SAFETY
249 THERMIC SENS. KO
250 CAN BUS KO
251 WAITING FOR NODE
252 SEAT KO
253 AUX OUTPUT KO

9.2.5 EPS-AC (node 06)

EPS-AC

239 LINE SHORTED
240 KEY OFF
241 WAITING DATA
242 D LINE SENSOR KO
243 Q LINE SENSOR KO
244 GAIN EEPROM KO
245 DATA ACQUISITION
246 MICRO SLAVE KO
247 CAN BUS KO
248 S.P OUT OF RANGE
249 F.B OUT OF RANGE
250 MICRO SLAVE
251 KM OPEN
252 KS OPEN
253 KM CLOSED
254 KS CLOSED

EPS-AC0

216 MICRO SLAVE #8
217 MICRO SLAVE #3
218 CLOCK PAL NOT OK
219 STEPPER MOT MISM
220 MOTOR LOCKED
221 MICRO SLAVE #4
222 FB POT LOCKED
223 JERKING FB
225 CURRENT GAIN
226 NO SYNC
227 SLAVE COM. ERROR
228 POSITION ERROR
237 WAITING DATA

238 EPS NOT ALIGNED
239 WAITING FOR TRAC
240 KEYOFF
241 ENCODER ERROR
242 Q LINE SENSOR KO
243 D LINE SENSOR KO
244 GAIN EEPROM KO
245 DATA ACQUISITION
246 MICRO SLAVE KO
247 CAN BUS KO
248 S.P OUT OF RANGE
249 F.B OUT OF RANGE
250 MICRO SLAVE
251 KM OPEN
252 KS OPEN
253 KM CLOSED
254 KS CLOSED

EPS-AC WG

211 MICRO SLAVE #7
212 MICRO SLAVE #8
213 MICRO SLAVE #3
214 SLAVE ANGLE
215 SL. LATERAL OUT
216 SL. ANT. MISSING
217 ANTENNA FAILURE
218 AUTO INPUT MISM.
219 STEPPER MOT MISM
220 MOTOR LOCKED
221 MICRO SLAVE #4
222 FB POT LOCKED
223 JERKING FB
225 CURRENT GAIN
226 SLAVE WATCH DOG
227 SLAVE COM. ERROR
228 POSITION ERROR
229 LOOK. FOR PATH
230 PATH OUT
231 LATERAL OUT
232 ANGLE
233 LOSING PATH
234 LOSING STRAIGHT
235 ANTENNA STUFF.

236 ANT. MISSING
237 WAITING DATA
238 EPS NOT ALIGNED
239 WAITING FOR TRAC
241 FB SENSOR LOCK.
242 Q LINE SENSOR KO
243 D LINE SENSOR KO
244 GAIN EEPROM KO
245 DATA ACQUISITION
246 MICRO SLAVE KO
247 CAN BUS KO
248 S.P OUT OF RANGE
249 F.B OUT OF RANGE
250 MICRO SLAVE
252 KS OPEN
253 KM CLOSED
254 KS CLOSED

9.2.6 Valves controller (node 09)

MHYRIO CB

228 EVPG1 DRIV SHORT
229 EVPG2 DRIV SHORT
230 EVPG3 DRIV SHORT
231 EVPG4 DRIV SHORT
232 EVP DRIVER SHORT
233 EV DRIVER SHORT
239 WAITING FOR PEV
241 CAN BUS KO
242 COIL SHORTED
243 EV DRIVER KO
244 EVPG1 DRIVER KO
245 EVPG2 DRIVER KO
246 EVPG3 DRIVER KO
247 EVPG4 DRIVER KO
248 UNDER VOLTAGE
249 EVP DRIVER KO
250 HI SIDEDRIVER KO
251 WRONG SET BAT.
252 FF VALVES

MHYRIO FLASH

241 CAN BUS KO
242 SHUNT VALVES

243 DRIVER OPENED
244 DRIVER EVP GR1
245 DRIVER EVP GR2
246 DRIVER EVP GR3

HVC

241 CAN BUS KO
242 COIL SHORTED
243 EV DRIVER KO
244 KEY-OFF
245 EVP DRIVER KO
246 POSITIVE NOT OK
247 FF VALVES
248 EVP DRIV SHORTED
249 EV DRIV SHORTED

9.2.7 Smart display (nodo 16)

159 HYDRULIC OIL
160 PU MOTOR TEMPER
161 CAN BUS KO MAST
163 SERVICE REQUIRED

10 RECOMMENDED SPARE PARTS FOR INVERTER

Part number	Description
C12531	Ampseal Connector 23 pins Female
C12796	Female Ampseal pin harness side

11 PERIODIC MAINTENANCE TO BE REPEATED AT TIMES INDICATED

Checks should be carried out by qualified personnel only and any replacement parts used should be original. Beware of NON ORIGINAL PARTS.
The installation of this electronic controller should be made according to the diagrams included in this Manual. Any variations or special requirements should be made after consulting a Zapi Agent.

The supplier is not responsible for any problem that arises from wiring methods that differ from information included in this Manual. During periodic checks, if a technician finds any situation that could cause damage or compromise safety, the matter should be bought to the attention of a Zapi Agent immediately.
The Agent will then take the decision regarding operational safety of the machine. Remember that Battery Powered Machines feel no pain.

NEVER USE A VEHICLE WITH A FAULTY ELECTRONIC CONTROLLER