ZAPI® S.p.A.

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EN

User Manual

ECO 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

Eco 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: Eco Smart Display itself, Traction controller, Pump controller, Valves controller.
Eco Smart Display has an alphanumeric liquid crystal display, built-in backlight.
Access to Eco Smart Display menu structure is provided by five operator buttons.
Furthermore Eco Smart Display has five built-in red LED, which provide the operator with a easy information about the status of some truck devices.

2 GENERAL CHARACTERISTICS

2.1 Technical specifications

2.1.1 Dashboard

Voltage:.....24/36/48/80 V
Can interface [n°]:.....1
Keyboard buttons [n°]:.....5
LED [n°]:.....5
Protection:.....IP65
External temperature range: standard version.....0÷50 °C
External temperature range: frozen cell version.....-35÷50 °C

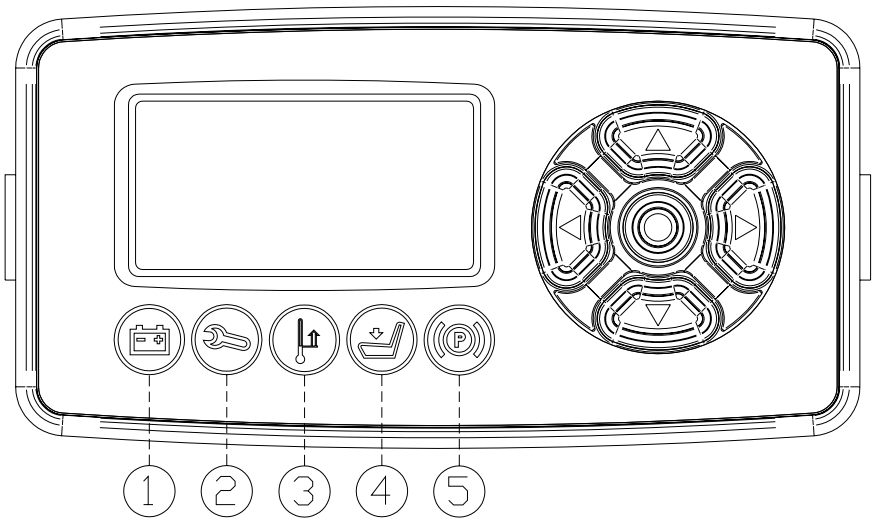
2.1.2 Alphanumeric LCD (Liquid Crystal Display)

Viewing area (WxH).....50.0x25.0 mm
Number of pixels [n°].....128x64
Pixel size.....0.33x0.33 mm
White LED backlight average luminous intensity.....250 cd/m^2

2.2 Functional descriptions

2.2.1 LED function

The Eco Smart Display has five built-in red LED, which provide the operator with an easy information about the status of some truck devices.



Battery (1)
This led lights when the measured battery voltage is equal or less than 40% nominal battery voltage.

Wrench (2)
This led blinks when truck is in alarm condition.

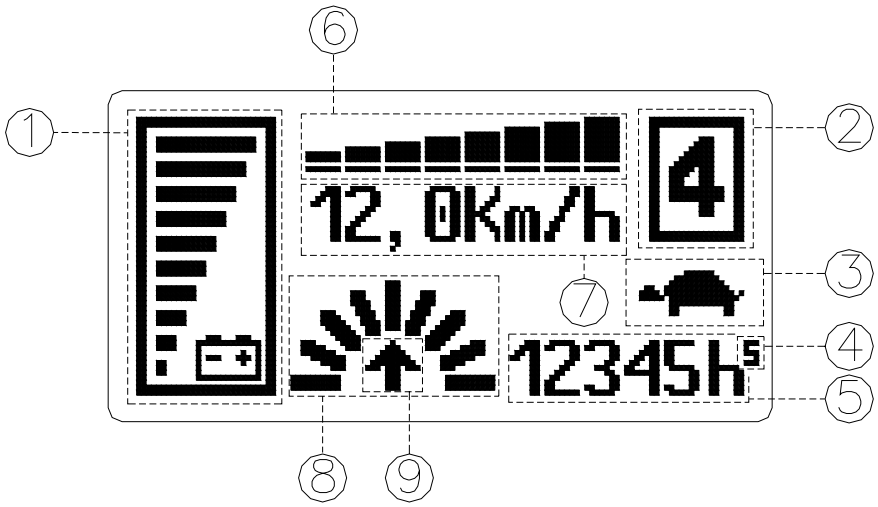
Thermometer (3)
This led blinks when one truck's controller is in alarm due IMS high temperature.

Seat (4)
This led lights when the operator is on the seat.

Handbrake (5)
This led lights when the handbrake is activated.

When the Key Switch is closed, the Eco Smart Display makes a general test lighting and switching off all the LED in sequence.

2.2.2 Display function



Battery's state of charge
The battery's state of charge indication (number 1 in figure) is displayed on the left side of the unit; it is shown by ten notches. Each notch represents the 10% of the battery charge. As the battery becomes discharged, the notches turn off progressively, one after the other, in proportion to the value of the residual battery charge. When the residual battery charge is ≤ 40 % the notches displayed start to blink. When BATTERY LOW alarm appears on the traction controller, the battery symbol which is near the notches also blinks.

Performance
The number which appears in the rectangle displayed in the top right side of the unit (number 2 in figure) shows the performance mode which is being used in the controller.
Performances can be scrolled pressing button ◀. When one performance is selected, the related information will be sent via can-bus 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:
- 4 corresponds to highest performance;
- 3 corresponds to medium performance;
- 2 corresponds to low performance;
- 1 corresponds to minimum performance.

Turtle
The turtle symbol (number 3 in figure) is normally off; when it appears (fixed) it shows activation of the “soft” mode of the truck, in which maximum speed and acceleration are reduced.

Hour meter
The number displayed on the bottom right side of the unit (number 5 in figure) shows the Hours Worked.
The letter present over the hour meter (number 4 in figure) shows which hour meter is displayed:
- K: the key hour meter is displayed;
- S: the seat hour meter is displayed;
- M: the machine hour meter is displayed; it increases if traction or pump control is working.

Accelerator
The accelerator level indication (number 6 in figure) is displayed on the central top side of the unit; it is shown by eight notches. When the accelerator level is minimum only a notch is displayed, when the accelerator level is maximum all the eight notches are displayed. Each notch represents 1/8 of the difference between maximum and minimum accelerator level.

Speed
The number displayed under the accelerator notches on the center of the unit (number 7 in figure) shows the truck speed. The unit can be km/h or mph depending on the SPEED UNIT parameter setting (see 7.4).

Wheel position and running direction
The notch displayed on the left of the hour meter (number 8 in figure) represents the wheel (only one of the nine notches is displayed) and shows the steering angle (it corresponds to the relative truck direction if the truck is running).
The arrow (number 9 in figure) shows the set truck running direction. The arrow point is up when the truck is forward running; the arrow point is down when the truck is reverse running. If the truck doesn’t run a dot is displayed instead of the arrow.

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.

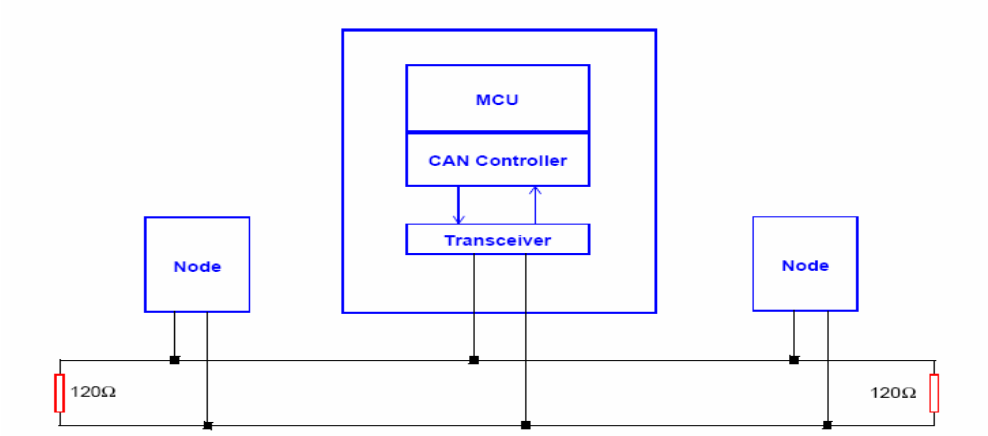
Do not connect the module to a battery with a nominal voltage different than the value indicated on the label. A higher battery voltage may cause a logic failure. A lower voltage may prevent the logic operating.

3.2.1 Controller heating

Eco 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.

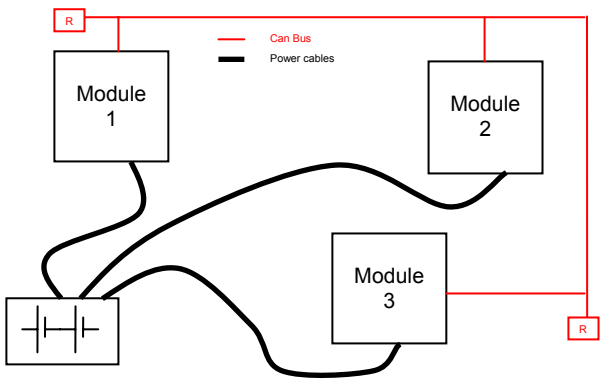
3.2.2 Wirings: CAN connections and possible interferences

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.

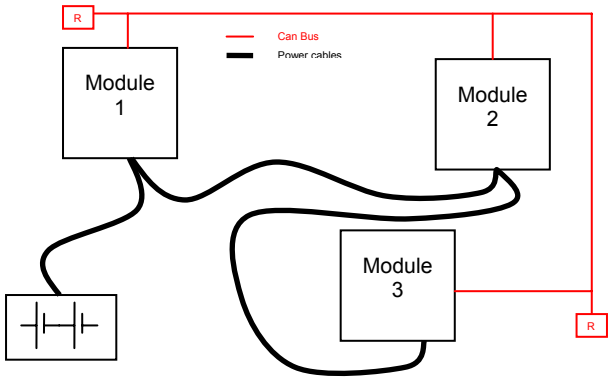
Wrong Layout:



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.

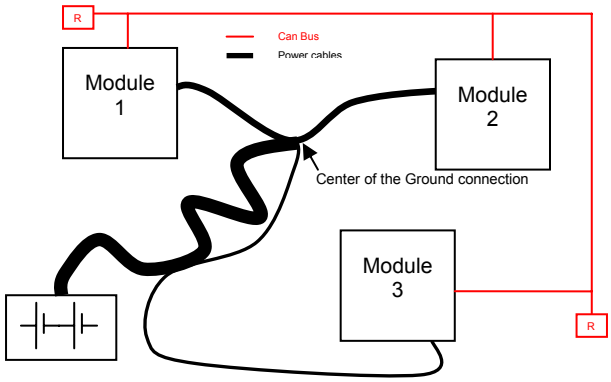
Correct Layout:



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 responsibility 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

Main fault diagnostic function concern: parameter and password memory and canbus interface.

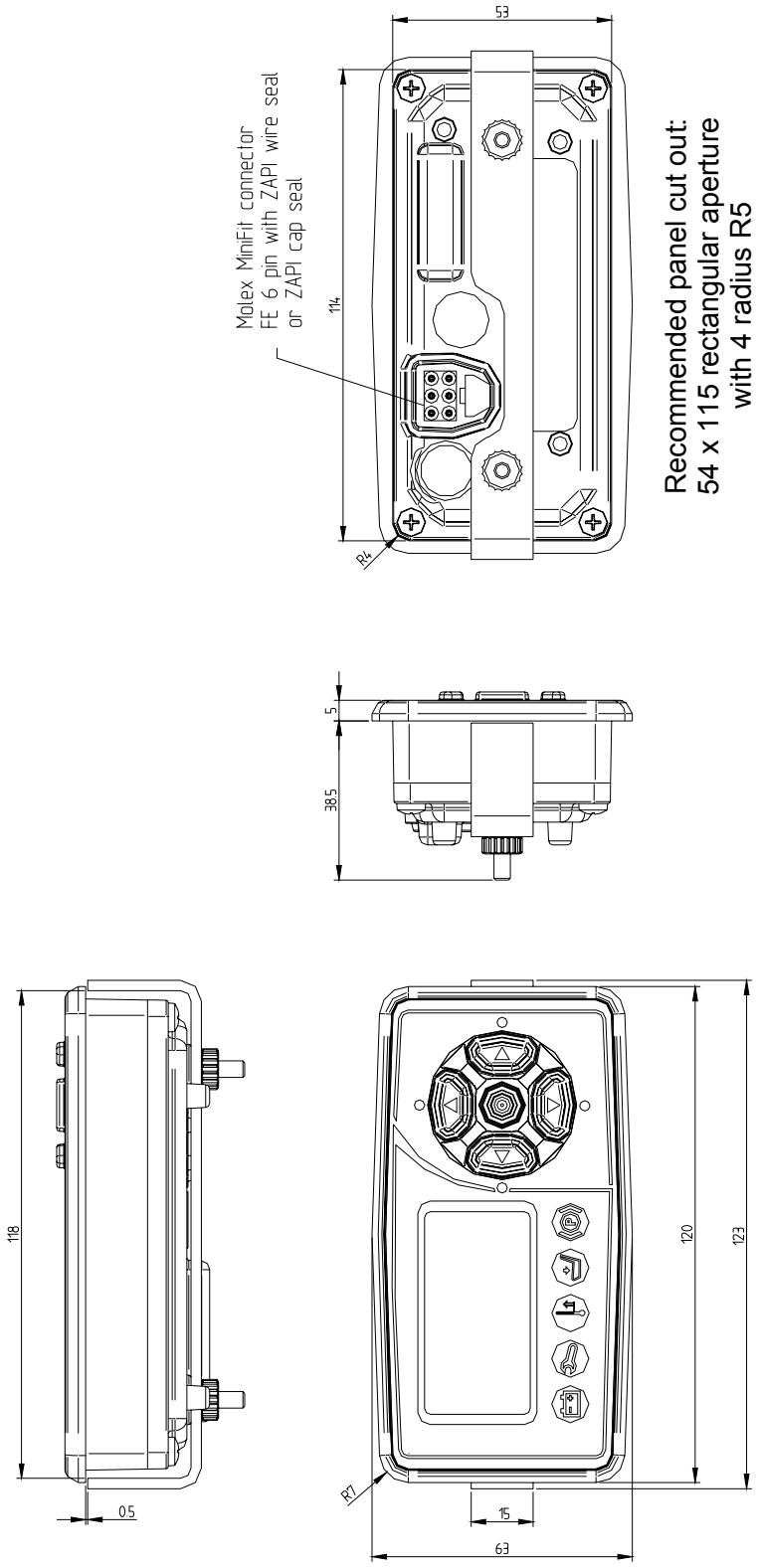
5 DESCRIPTION OF CONNECTORS

5.1 CNA connector: Molex Minifit 6 pins

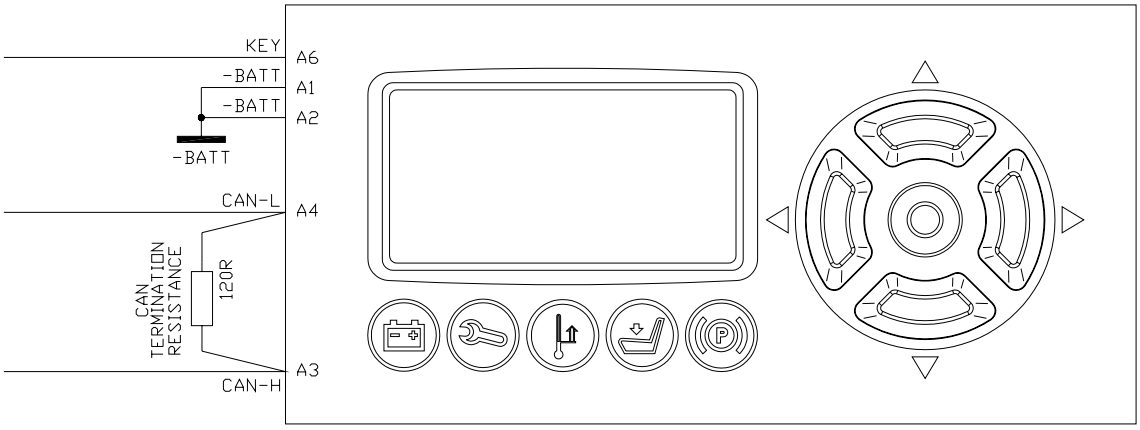
A1	-BATT	Eco Smart Display negative supply.
A2	-BATT	Eco Smart Display negative supply.
A3	CAN-H	Can signal high.
A4	CAN-L	Can low signal.
A5	FREE	Not used.
A6	KEY	Eco Smart Display positive power supply.

6 DRAWINGS

6.1 Mechanical drawing



6.2 Connection drawing



ECO SMART DISPLAY

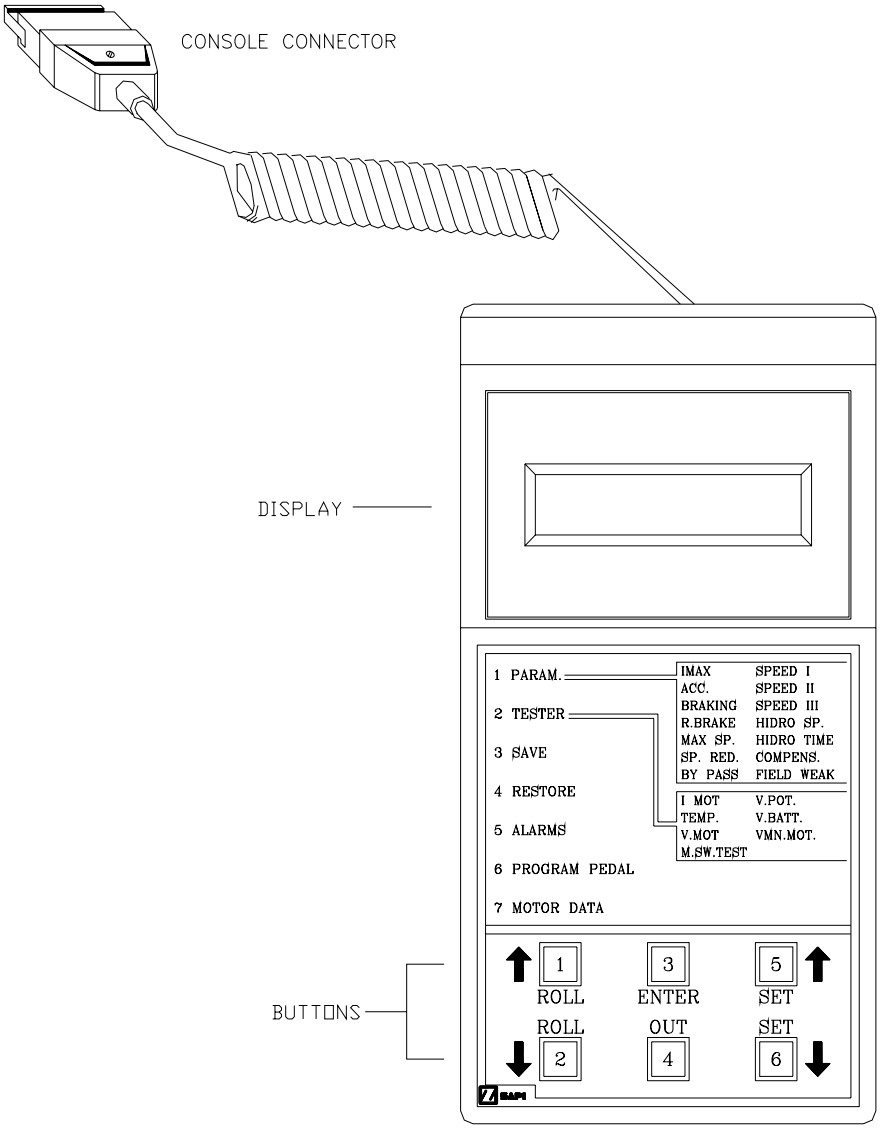
CONN A = MOLEX MINIFIT 6 POLES

7 PROGRAMMING AND ADJUSTMENTS USING ZAPI HANDSET

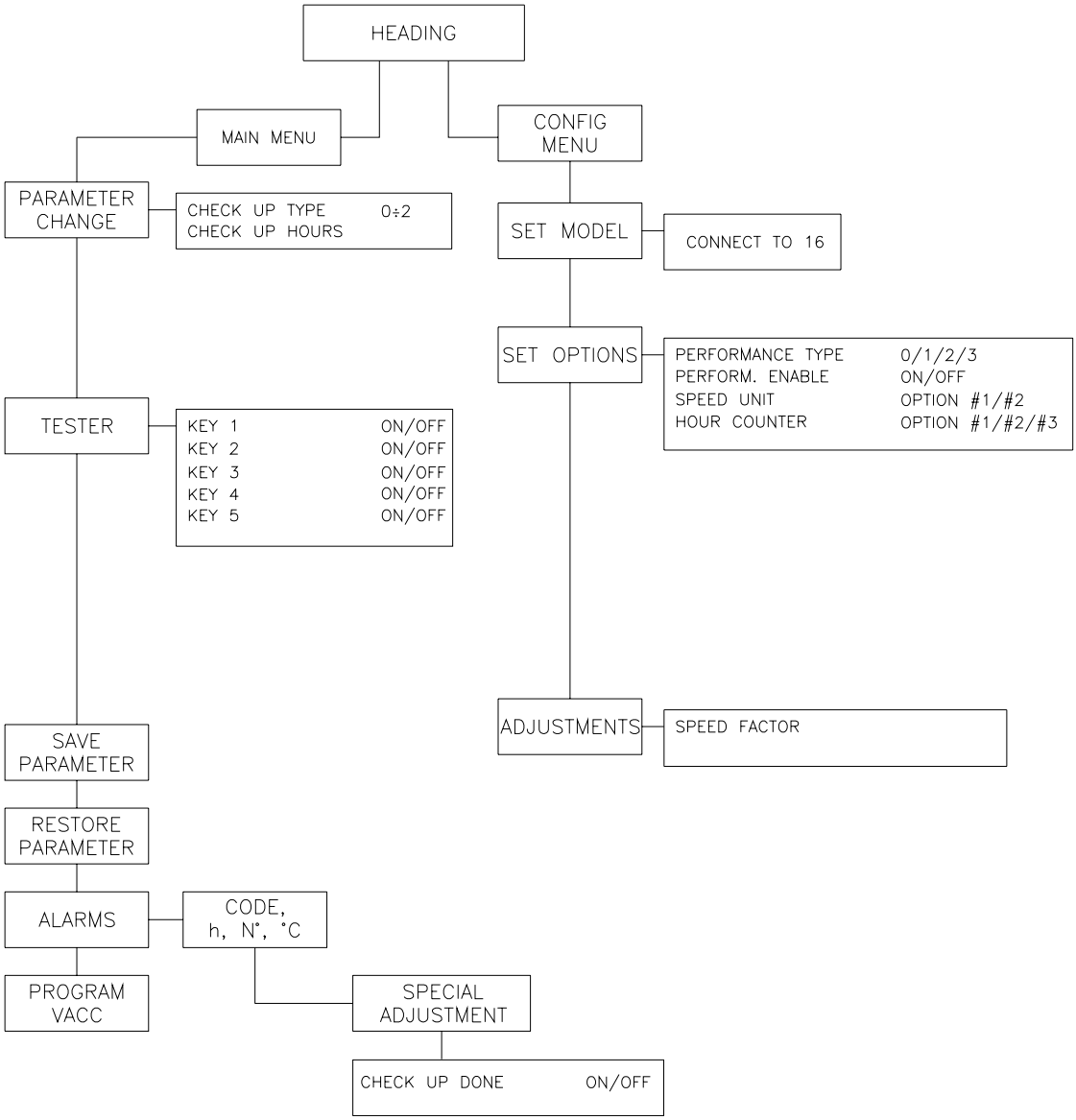
7.1 Adjustment via console

Adjustment of Parameters and changes to the display configuration are made using the Digital Console. Eco Smart Display dosen't have an external connector dedicated to the console: Zapi console must be physically connected to another controller in the CANBUS net, then virtually connected to Eco Smart Display (which is node 16 of the net).

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 hand 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.
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	ECO SMART DISPLAY

MENU SET OPTIONS

1) OPERATOR PASSW.

It enables or disables password request at key on.
- ON: Starting password requested
- OFF: Starting password not requested

2) CONSOLE ENABLE

It makes available or not console menu.
- ON: Zapi Console menu is available
- OFF: Zapi Console menu is not available

3) PERFORMANCE TYPE

It sets the traction mode.
- LEVEL 0: it sets traction mode #1
- LEVEL 1: it sets traction mode #2
- LEVEL 2: it sets traction mode #3
- LEVEL 3: it sets traction mode #4

4) PERFORM. ENABLE

It can enable or disable operator changing truck performances using button ◀.
- ON: Enabled operator
- OFF: Not enabled operator

5) SPEED UNIT

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

6) HOUR COUNTER

It sets the hour counter displayed.

- OPTION #1: the traction hourcounter is displayed
- OPTION #2: the machine hourcounter managed by the display is displayed

MENU ADJUSTMENTS

1) 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)

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) 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.

2) RESET HOURMETER

It can be ON/OFF. If it is ON it is possible to reset the machine hour-counter (managed by display – HOUR COUNTER set to OPTION #2).

7.6 Parameter change menu

Following parameters can be configured in this menu:

1) CHECK UP TYPE

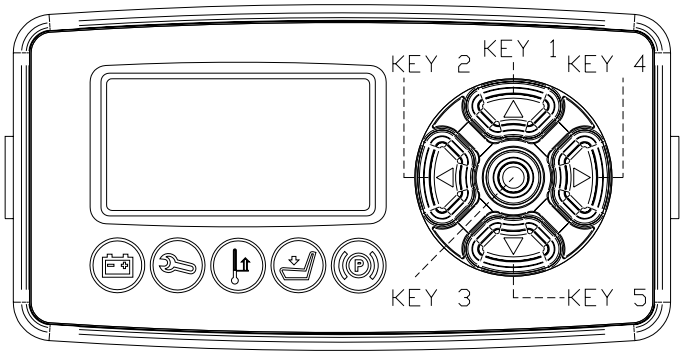
It defines the truck behaviour when a maintenance is required.
- LEVEL 0: the “SERVICE REQUIRED” alarm doesn’t appear
- LEVEL 1: the “SERVICE REQUIRED” alarm appears after a time equal to the hours set in the CHECK UP HOURS parameter
- LEVEL 2: the “SERVICE REQUIRED” alarm appears after a time equal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

2) 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).

7.7 Tester menu

Status of keyboard buttons can be monitored in real time in the TESTER menu.



1) KEY 1
Status of (▲) keyboard button:
- ON = Input active, button pushed
- OFF = Input not active, button released

2) KEY 2
Status of (◀) keyboard button:
- ON = Input active, button pushed
- OFF = Input not active, button released

3) KEY 3
Status of (☉) keyboard button:
- ON = Input active, button pushed
- OFF = Input not active, button released

4) KEY 4
Status of (▶) keyboard button:
- ON = Input active, button pushed
- OFF = Input not active, button released

5) KEY 5
Status of (▼) keyboard button:
- ON = Input active, button pushed
- OFF = Input not active, button released

7.8 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

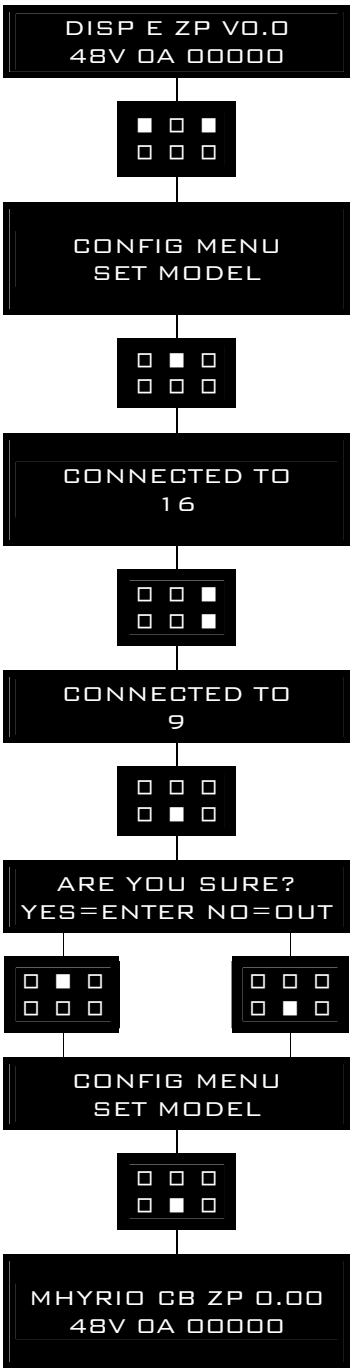
9) The Display will ask “ARE YOU SURE?”

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

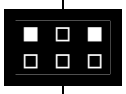
13) Display now shows the Opening Zapi Menu of the ZAPI product corresponding to option selected at point 7)



Flow chart showing how to make changes to Option Menu:

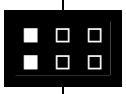
1) Opening Zapi Menu

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



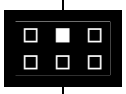
3) The Display will show: SET MODEL

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



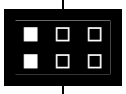
5) SET OPTIONS menu appears

6) Press ENTER to go into the SET OPTIONS menu



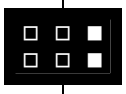
7) The Display will show the first option

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



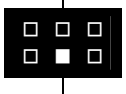
9) Desired option appears

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

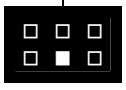


13) Confirmation request appears

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

15) SET OPTIONS menu appears

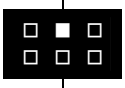
16) Press OUT again. Display now shows the Opening Zapi Menu



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

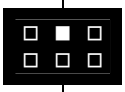
1) Opening Zapi Menu

2) Press ENTER to go into the MAIN MENU



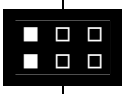
3) The Display will show: PARAMETER CHANGE

4) Press ENTER to go into the Parameter Change facility



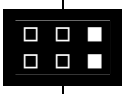
5) The Display will show the first parameter

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



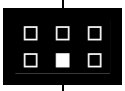
7) The names of the desired parameter appears on the Display

8) Press either SET UP or SET DOWN buttons to change the value



9) The Display will show the new value

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



11) The Display asks “ARE YOU SURE?”

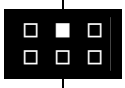
12) Press ENTER to accept the changes, or press OUT if you do not accept the changes

15) The Display will show: PARAMETER CHANGE

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

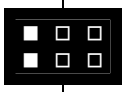
1) Opening Zapi Menu

2) Press ENTER to go into the MAIN MENU



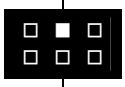
3) The Display will show: PARAMETER CHANGE

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



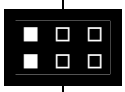
5) The Display will show: TESTER

6) Press ENTER to go into the TESTER function



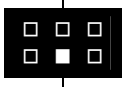
7) The first variable to be tested is shown on the display

8) Press either ROLL UP or ROLL DOWN buttons



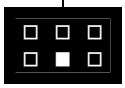
9) Next variable for measurement appears

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.

7.9 Other functions

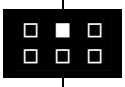
SAVE function allows to transfer controller parameters to the Pc console memory (using Zapi PcWin console). With this function, a copy of the controller set of parameters can be retained in a Pc and downloaded to another controller (see RESTORE).
RESTORE function allows to download controller parameters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

7.10 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 and the Hour Meter count. 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:

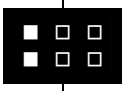
1) Opening Zapi Menu

2) Press ENTER to go into the MAIN MENU



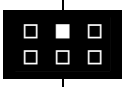
3) The Display will show:

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



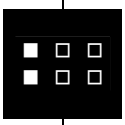
5) The Display will show:

6) Press ENTER to go into the ALARMS menu



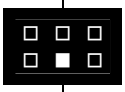
7) The display will show the most recent alarm

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



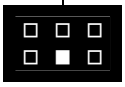
9) If an alarm has not occurred, the display will show: NONE

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

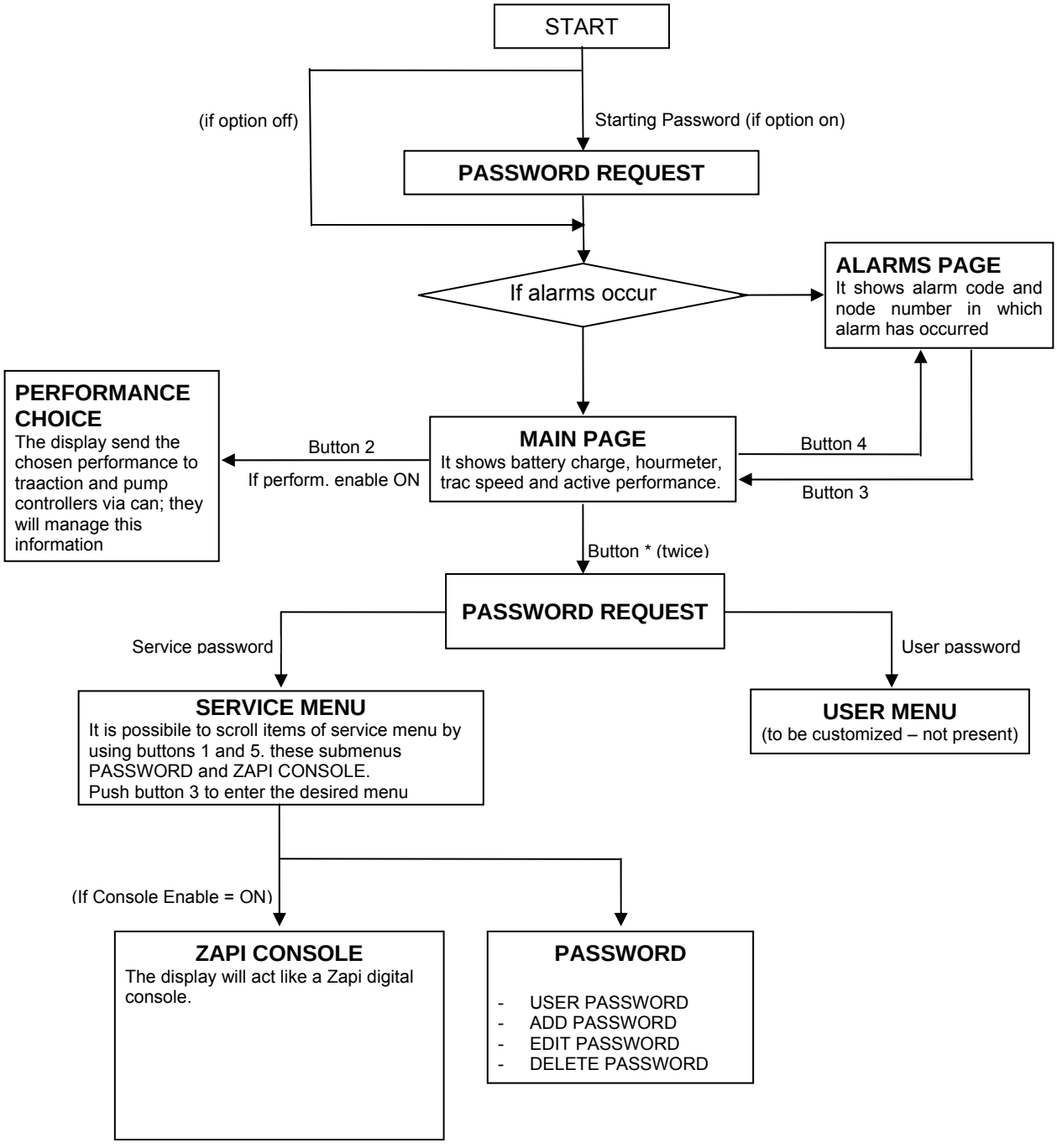


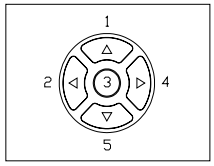
8 STRUCTURE OF DISPLAY MENU

Eco Smart Display present a software structure made by menus and submenus. It is possible to have access to Eco Smart Display menu structure by the 5 operator buttons on the right of the screen.

At turn on the display asks the starting password to have access to the main page (if “OPERATOR PASSW.” option is ON), otherwise it shows directly the main page (if “OPERATOR PASSW” option is OFF).
By using user password it’s possible to activate the display and have access to the USER MENU (to be customized, and not present in Zapi software version).
By using service password it’s possible to activate the display and enter SERVICE MENU which presents two items: “password” and “zapi console”.
The main page, if there aren’t alarms, shows battery charge, truck speed (in Km/h or mph, it depends on “SPEED UNIT” parameter) and truck/traction hour meter (see “HOUR COUNTER” option); if alarms are present it will show alarm code and node in which alarm has occurred.
From the main page it is possible to have access to the ALARM page (if alarms occur) and to MENUS page.
The “password” submenu allows to manage passwords of Eco Smart Display software structure. It’s possible to edit, add and delete passwords.
All passwords are optional (ON/OFF option).
The “zapi console” submenu can be accessible 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.

It follows flow chart diagram of software structure.


START
(if option off)
Starting Password (if option on)
PASSWORD REQUEST
If alarms occur
ALARMS PAGE
It shows alarm code and node number in which alarm has occurred
PERFORMANCE CHOICE
The display send the chosen performance to traaction and pump controllers via can; they will manage this information
Button 2
If perform. enable ON
MAIN PAGE
It shows battery charge, hourmeter, trac speed and active performance.
Button 4
Button 3
Button * (twice)
PASSWORD REQUEST
Service password
User password
SERVICE MENU
It is possibile to scroll items of service menu by using buttons 1 and 5. these submenus PASSWORD and ZAPI CONSOLE.
Push button 3 to enter the desired menu
USER MENU
(to be customized – not present)
(If Console Enable = ON)
ZAPI CONSOLE
The display will act like a Zapi digital console.
PASSWORD
- USER PASSWORD
- ADD PASSWORD
- EDIT PASSWORD
- DELETE PASSWORD


1
2
3
4
5

8.1 Performance rolling

From MAIN PAGE using one keyboard button, it is possible to select the performance mode which must be used in traction and pump controllers. Performance can be chosen with button 2, and it is displayed in the top right side of the unit.
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 high performance mode (4) to economy performance mode (1).
This is possible only if “PERFORM. ENABLE” option is ON.

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

Button 2 selects in sequence the truck performance (1 → 2 → 3 → 4).

8.2 Using of Password menu

By entering the service password from MAIN PAGE it’s possible to have access to SERVICE MENU. Here with roll buttons (button 1 and 5) it’s possible to scroll the submenu items.
With ENTER button (button 3) is possible to enter PASSWORD submenu where the operator can manage Eco Smart Display passwords. In particular it could enable/disable password entering, add, edit and remove passwords.
Inside the PASSWORD menu, use buttons ENTER (3) and OUT (2) to enter or exit submenus and to confirm or cancel operations.
When new password is added, insert:

- the 5 digits password in place of “11111” that appear on the left side of screen;
- the alphanumeric user id in place of “------“;
- the performance type 1/2/3/4 (M) related to the password.
- password type (U): S-service / O-user.

To edit or add passwords use these buttons:

Button 1 / Button 5	change the digit marked by cursor
Button 2	cancels all changing and out from submenu
Button 3	saves all changing
Button 4	shifts cursor on following digit

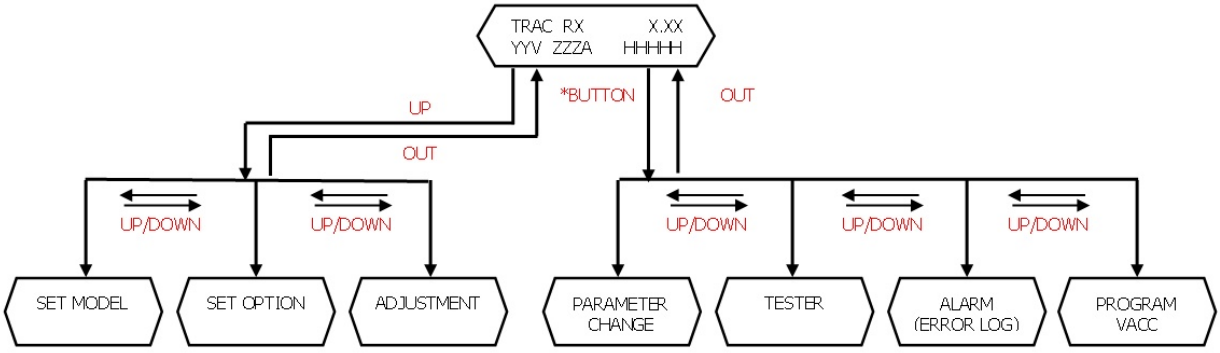
When there isn’t service password in eeprom, it can be used default password “55555” that is deactivated when at least one service password is saved, and it is reactivated when all service passwords are deleted, then it is not possible save the default password.

To delete passwords use these buttons:

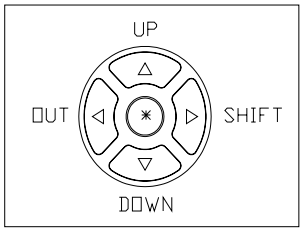
Button 1 / Button 5	scroll the passwords saved
Button 2	out from submenu
Button 3	confirm cancellation

8.3 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 5) it's possible to scroll the submenu items.
If option CONSOLE ENABLE is ON, with button 3, it is possible to enter ZAPI CONSOLE submenu, which allows user to use dashboard as a real Zapi digital console connected to one module of canbus net.
Here with roll buttons (button 1 and 5 of keyboard) and enter button (button 3), it is possible to choose which module of canbus net has to be connected to the display.
When the display has been connected, it works exactly like a Zapi digital console (see the example in the following figure)



UP/DOWN: ROLL BETWEEN PARAMETER
OUT: DECREASE PARAMETER VALUE
SHIFT: INCREASE PARAMETER VALUE
*: EXIT AND/OR SAVE



9 ANALYSIS OF ECO SMART DISPLAY RELATED ALARMS

9.1 Eco Smart Display alarms

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

2) **“CAN BUS KO TRAC”**
Eco Smart Display doesn’t receive messages from canbus line.
Troubleshooting:
- If this fault code is displayed together with other alarm messages, the fault is probably to be looked for in the Eco Smart Display can interface, since the Display seems to be unable to receive any can message. So it is suggested to check Eco 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.

9.2 Alarms visualisation

When an alarm condition occurs, Eco Smart Display gives the information showing the alarm code and the module in which the alarm occurred.
For example, the information:

A60 ON PUMP

means that the alarm 60 occurred in the pump controller.
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 Eco Smart display (nodo 16)

161 CAN BUS KO TRAC
163 SERVICE REQUIRED

10 RECOMMENDED SPARE PARTS FOR INVERTER

Part number	Description
C12359	Molex Minifit Connector 6 pins Female
C12777	Female Molex Minifit 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

IMPORTANT NOTE ABOUT WASTE MANAGEMENT:
This controller has both mechanical parts and high-density electronic parts (printed circuit boards and integrated circuits). If not properly handled during waste processing, this material may become a relevant source of pollution. The disposal and recycling of this controller has to follow the local laws for these types of waste materials.
Zapi commits itself to update its technology in order to reduce the presence of polluting substances in its product.