ELECTRONIC INDUSTRIAL DEVICES
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4Q CONTROLLER OPERATING AND USER MANUAL

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= The informations included into the marked paragraphs by this symbol are essential for the safety.

SIGNATURES TABLE

COMPANY DEPT. SERVICES	MANAGEMENT EXECUTIVE
ENGINEERING SECTION EXECUTIVE	
EXPORT MANAGER	

1 MAIN FEATURES

The 4Q is the smallest permanent magnet motor controller:
it is designed for use at 24Vor 36V with a maximum armed current of 70A or 90A.
The controller is constructed with a full bridge: no changeover necessary.

1.1 FIELD OF APPLICATION

Power	500W (800W)
Voltages	24V, 36V
Max. current	70A (90A)
Continuos current	30A

The following inputs are foreseen:
- tiller / seat microswitch
- quick inversion
- forwards
- reverse
- potentiometer with 3 wires
- speed reduction 1
- speed reduction 2

The controller has 2 outputs:
- EV1 (solenoid valve)
- EV2 (electric brake)

The main contactor (relay) is internal.

The 4Q controller can be configured in two different ways:
- Pallet truck (Model 1)
- Floor washer (Model 2)

The parameters, tester and options may vary according to the model chosen with ZAPI console.

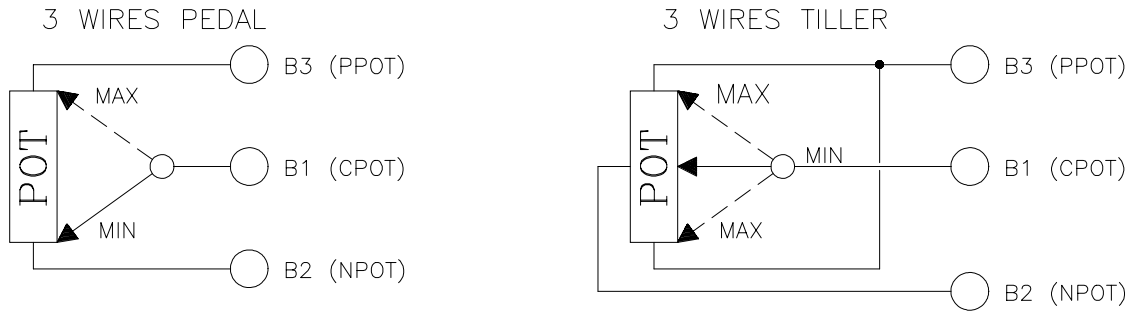
1.2 CONTROL UNITS

1.2.a Microswitches

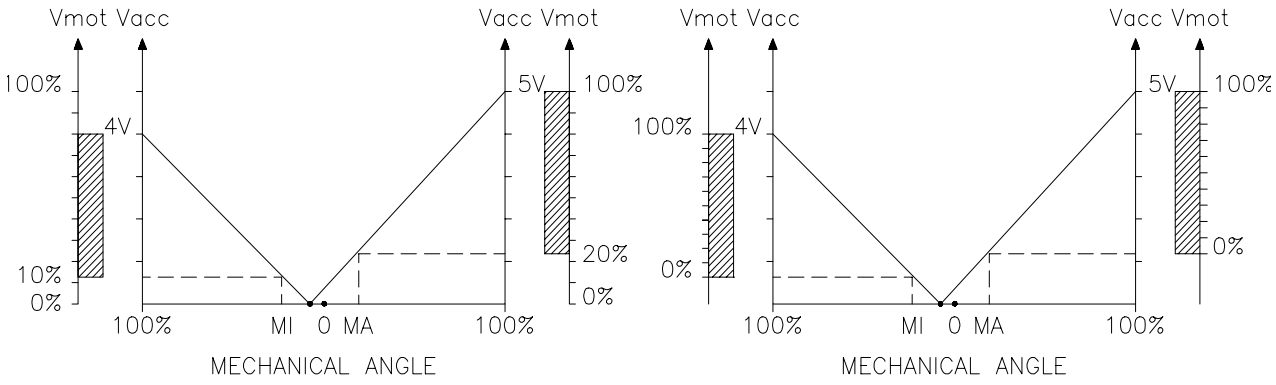
- A contact resistance of less than 0.1Ω and a current leakage of less than 100µA is required.
- The key contact must be able to take all the current of the loads without causing a voltage drop of more than 01.V between contacts.
- Send a voltage signal to the microchip when a function is requested (e.g. start running).

1.2.b Potentiometer

Potentiometer configured with 3 wires.
The CPOT range varies from 0 to 10V.
Minimum resistance: 500 Ω
Maximum resistance: 10KΩ



Automatic minimum and maximum signal acquisition must be carried out (PROGRAM VACC function) using the programming console and in both directions. This function is indispensable when compensating an eventual asymmetry in the mechanical components of the potentiometer and for minimum level adjustment in particular.



The above graphs show the output voltage of a potentiometer that has not been calibrated compared to the mechanical “zero” of the tiller knob (MI and MA indicate the closing points of the microswitches, 0 represents the mechanical angle of rotation of the throttle).
The first graph shows the corresponding motor voltage without acquisition; the second graph shows the corresponding voltage after potentiometer signal acquisition.

1.3 SAFETY FEATURES

- **Inverted battery polarity:**
  Connections must be made as indicated in the wiring diagrams to avoid damaging the power unit.

- **Connection errors:**
  All the inputs are protected against wrong connection.

- **Thermal protection:**
  If the temperature of the 4Q exceeds 75°C, the maximum current is automatically reduced in proportion to the temperature increase. The temperature cannot exceed 90°C, at this temperature the maximum current is zeroed. If the temperature drops to below –10°C, the maximum current is reduced by 20%.

- **Battery low:**
  When the battery runs down (<= 10%) the maximum current is reduced by 50%. This function can be excluded using the console (“Battery Check” option).

- **External agents:**
  The chopper has IP54 protection.

- **Protection against accidental starting:**
  A precise sequence of operations is required to start the machine, if the sequence is not carried out correctly the machine will not start.
  The start running command must be given after key-on and activating the seat microswitch, if configured. If on the other hand the tiller is configured, it must be activated with a predefined minimum delay time compared to the activation of a start running microswitch.

- **Protection against uncontrolled movement:**
  The electromagnetic switch does not close if:
  - the power unit is not in function,
  - the output voltage of the accelerator does not drop to below the recorded minimum value increased by 1V,
  - the potentiometer negative is disconnected,
  - the logic is not in good working order,
  - one of the start microswitches is closed.
  - the controller fulfil the requirements specified on the EN1175 (point 5.9.4). The requirements specified on point 5.9.5 have to be fulfil by external solutions.

1.4 OPERATING FUNCTIONS

- Speed control.
- Excellent sensitivity at low speeds.
- Maximum speed reduction: the maximum speed in both directions can be adjusted using the programming console.
- Regenerative braking based on deceleration ramps, release braking, inversion braking.
- Speed control in descent: the motor speed is controlled by the accelerator pedal and regenerative braking is activated automatically if the motor speed exceeds the required speed; this results in excellent ramp performance.
- Even without the use of an electric brake anti roll-back.
- Electric brake control (optional).
- Diagnosis with optional led to indicate type of fault.
- Parameter adjustment using console.
- Internal hour-counter, displayed on the console.
- The last 5 alarms are recorded together with the relative hour-counter reading and chopper temperature.
- Tester function using the console to check in real time: inputs, motor voltage, battery, etc.
- Good motor and battery efficiency thanks to high frequency switching.
- Watchdog circuit to check the µC operations.
- An MDI indicator can be connected to display: software version, hour counter, alarms, speed reduction and battery charge.

1.5 CONTROLLER DIAGNOSIS

The µC diagnoses the main chopper functions.

Diagnosis consists of 4 main stages and includes the following tests:

1) Key turned on: test current sensor, test VMN, test main relay, test presence of start command, test accelerator high, test potentiometer connection, test watchdog, test power devices.
2) At rest: test VMN, test main relay, test current sensor, test potentiometer connection, test watchdog, test accelerator up in absence of start microswitch.
3) Running: test VMN, test main relay, test current sensor, test negative wire of potentiometer, test watchdog, test electric brake (if configured).
4) Permanent: check temperature and battery voltage.

Diagnostic messages are coded by counting the number of times the led flashes or by a 2 digit code on the MDI.

The full alarm message can be visualised using the programming console.

1.6 THERMAL CONSIDERATIONS

- Since the heat generated by the controller must be dissipated, it is important to install it in a well ventilated area with adequate cooling surfaces.
- The cooling system must be scaled according to the use required of the machine; forced ventilation may be necessary in some cases if air circulation is insufficient and heat exchange is limited by the type of materials used.
- The power dissipated by the module varies according to the current and the duty cycle.

1.7 GENERAL WARNINGS AND PRECAUTIONS

- Do not connect the 4Q module to a battery with a different rated voltage to the one indicated on the module's rating plate. A higher battery voltage can cause irreparable damage the MOSFETs. With a lower battery voltage the module will not work.
- The 4Q module must be disconnected when the battery is being charged as the module can be damaged by overvoltages generated by the battery charger and ripple currents generated in the capacitors if a low frequency battery charger is used.
- The 4Q module should be powered by batteries for traction only. Do not use rectifier outputs or power supply units. For special applications contact the nearest ZAPI technical service centre.
- When starting the machine for the first time keep the wheels raised to avoid hazardous situations due to possible connection errors.
- When the key is turn off the filter capacitors in the module can stay charged for several minutes. For safety purposes it is advisable to disconnect the battery and short circuit the positive and negative power lines of the chopper for a few seconds using a resistor of between 10Ω and 100Ω .
- The electromagnetic susceptibility and emission is strongly influenced by the method of installation; particular attention should be paid to the length and lay-out of electrical connections and to shielding.
  Zapi declines all responsibility for malfunctions caused by the above mentioned factors, particularly if the machine manufacturer fails to carry out the tests required by current legislation.

2 INSTALLATION

If possible, assemble the chopper with its base on a flat metal surface that has not been painted or cleaned. It is advisable to spread a layer of thermo-conductive grease between the two surfaces to improve the transmission of heat.
Although the chopper is protected against external agents, the connector contacts may become oxidised due to the presence of corrosive substances. This factor should be taken into consideration when choosing where to install the chopper on the vehicle.
Secure the chopper using the pre-drilled holes on the aluminium fixing plate. Check to make sure that the cable terminals and connectors are wired correctly. Remember to install a snubber circuit on the horn, relays, solenoid valves and electromagnetic switches not connected to the chopper, such as the motor pump contactor.

2.1 CHOICE OF CONNECTING CABLES

Use cables with a cross section of 0.5mm^2 for auxiliary circuits.
Use 6mm^2 cables for power connections to the motor and to the battery.
The cables connecting the chopper to the battery should be laid side-by-side and be as short as possible.

2.2 FUSES

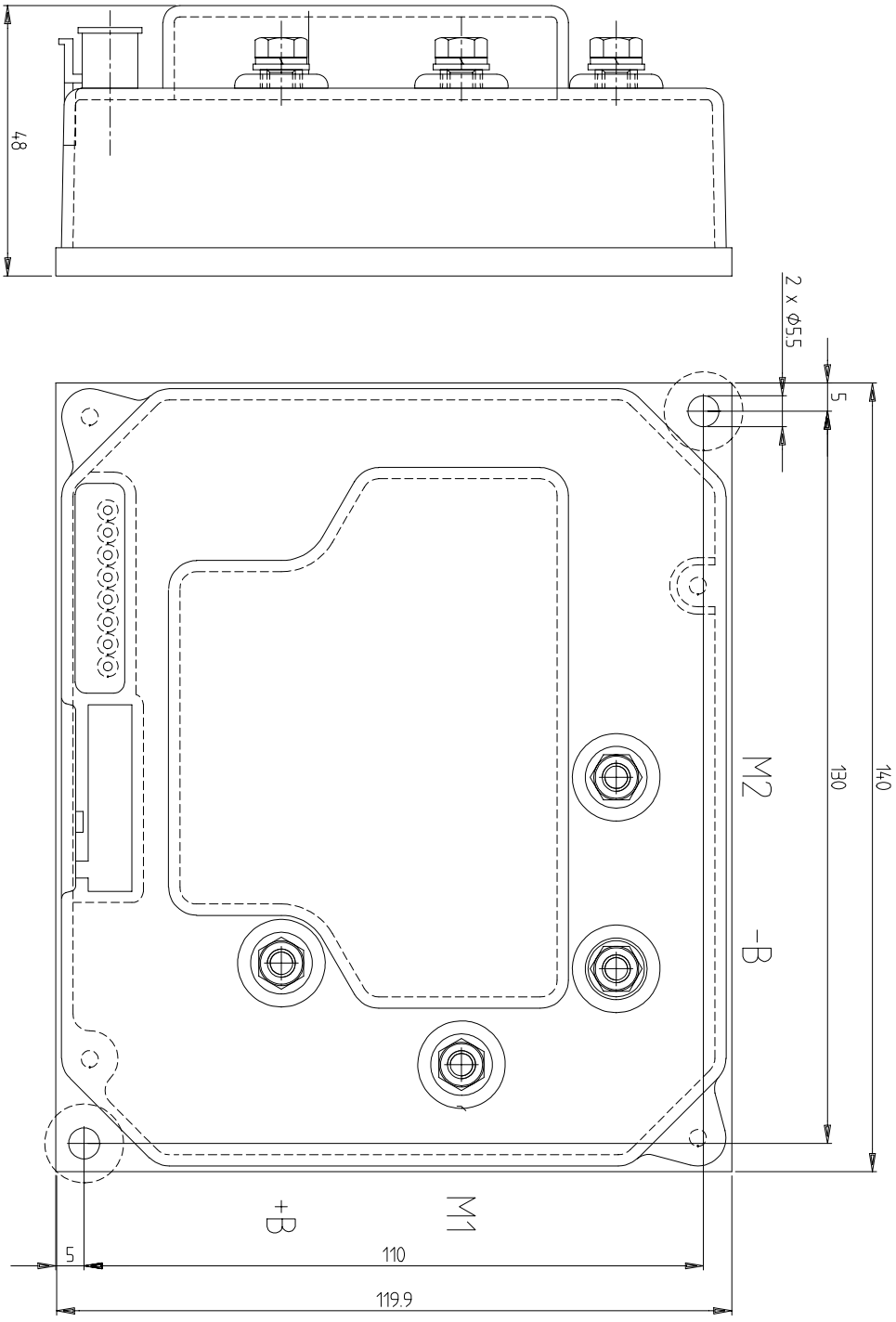
- Use a 6A fuse to protect auxiliary circuits.
- Use a 50A fuse to protect the power unit.

The values given are the maximum permitted values and can be reduced for special applications or requirements.
For safety purposes is it advisable to use shielded fuses to prevent molten particles being scattered in the event of a blowout.

2.3 DESCRIPTION OF CONNECTORS

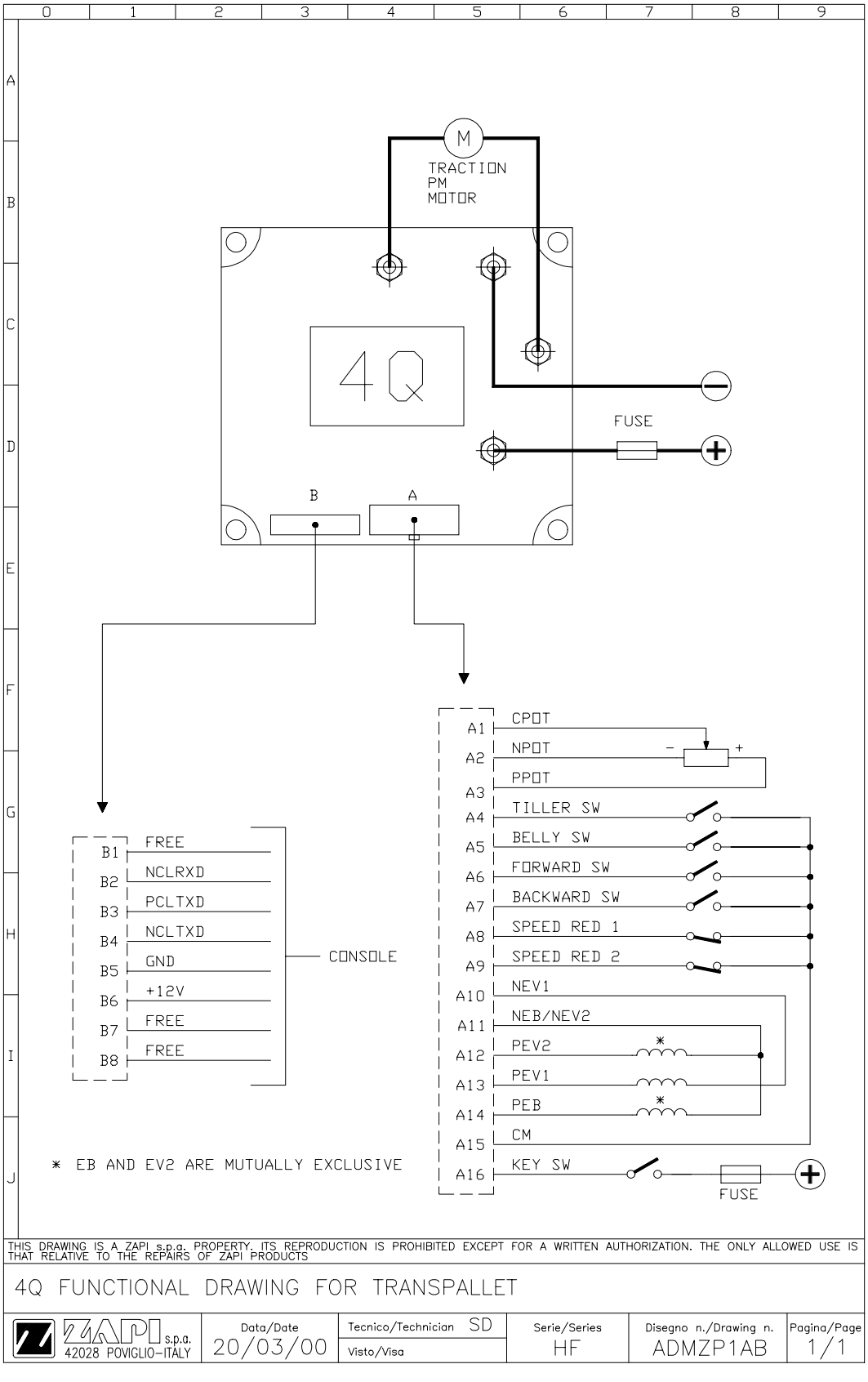
pin	*function*	*description*
A1	CPOTT	Potentiometer unit: connect to the cursor of the accelerator potentiometer.
A2	NPOTT	Negative pole of accelerator potentiometer.
A3	PPOTT	Positive pole of accelerator potentiometer.
A4	TILLER	Tiller/seat switch signal input (or hydro request input if the chop per is configured as a floor washer).
A5	BELLY	Quick inversion switch input.
A6	FORWARD	Forward switch input.
A7	BACKWARD	Reverse switch input.
A8	RV1	Cutback switch 1 input
A9	RV2	Cutback switch 2 input
A10	NEV1	Negative pole of solenoid valve 1
A11	NEB/NEV2	Negative pole of electric brake or solenoid valve 2.
A12	PEV2	Positive pole of solenoid valve 2.
A13	PEV1	Positive pole of solenoid valve 1.
A14	PEB	Positive pole of electric brake.
A15	CM	Common switch (voltage output using battery potential).
A16	KEY	Key input.
B1	PCLRXD	Serial reception positive.
B2	NCLRXD	Serial reception negative
B3	PCLTXD	Serial transmission positive.
B4	NCLTXD	Serial transmission negative.
B5	GND	Negative for powering console.
B6	+12	Positive for powering console.
B7	---	
B8	---	

2.4 DIMENSIONS



2.5 CONNECTIONS

2.5.a Pallet truck



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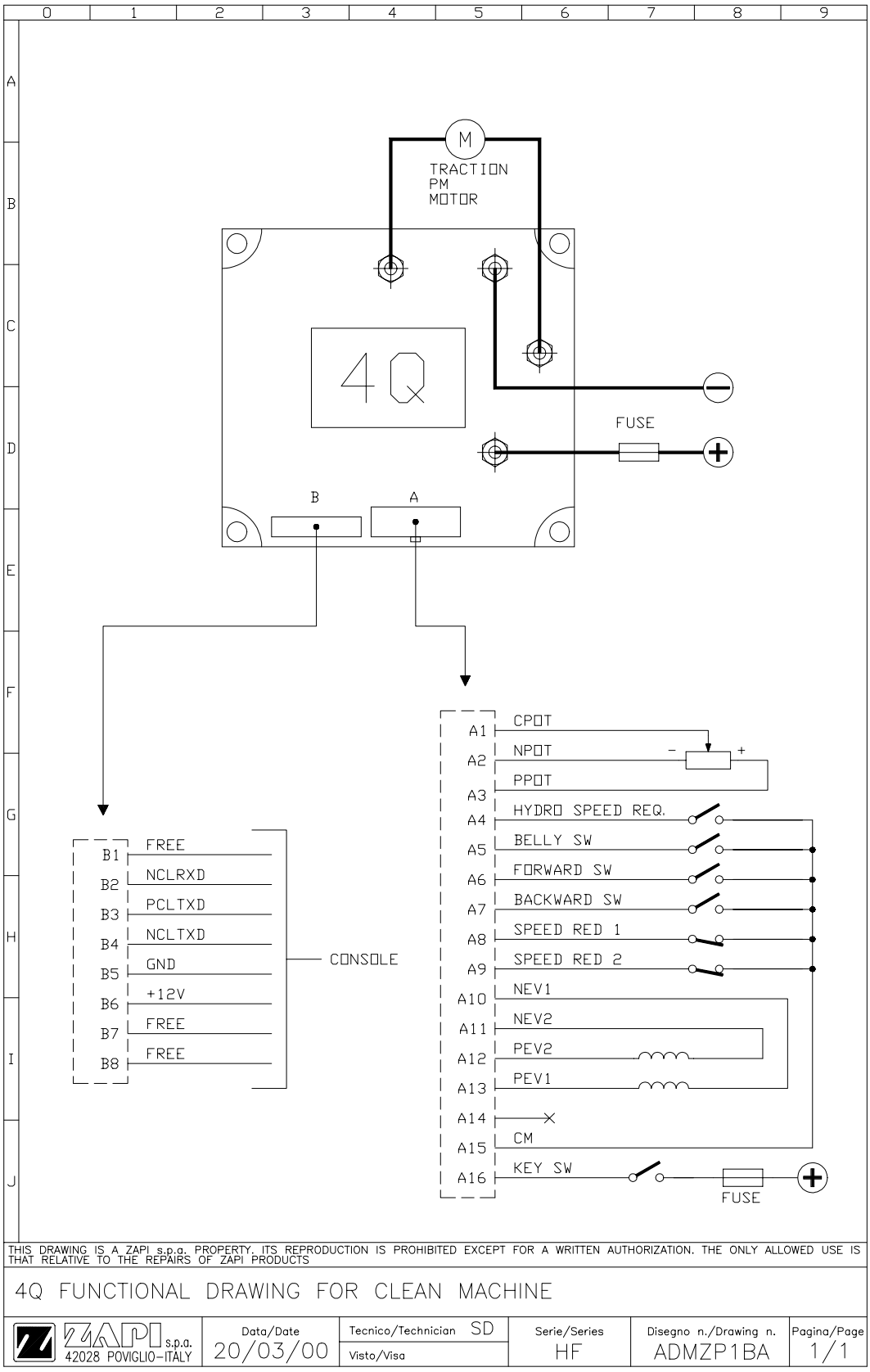
4Q FUNCTIONAL DRAWING FOR TRANSPALLET

ZAPI s.p.a. 42028 POVIGLIO-ITALY	Data/Date 20/03/00	Tecnico/Technician SD / Visto/Visa	Serie/Series HF	Disegno n./Drawing n. ADMZP1AB	Pagina/Page 1/1

2.5.b Floor washer



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4Q FUNCTIONAL DRAWING FOR CLEAN MACHINE

ZAPI s.p.a. 42028 POVIGLIO-ITALY	Data/Date 20/03/00	Tecnico/Technician SD / Visto/Visa	Serie/Series HF	Disegno n./Drawing n. ADMZP1BA	Pagina/Page 1/1

3 CONSOLE MENU

3.1 PROGRAMMING WITH THE CONSOLE

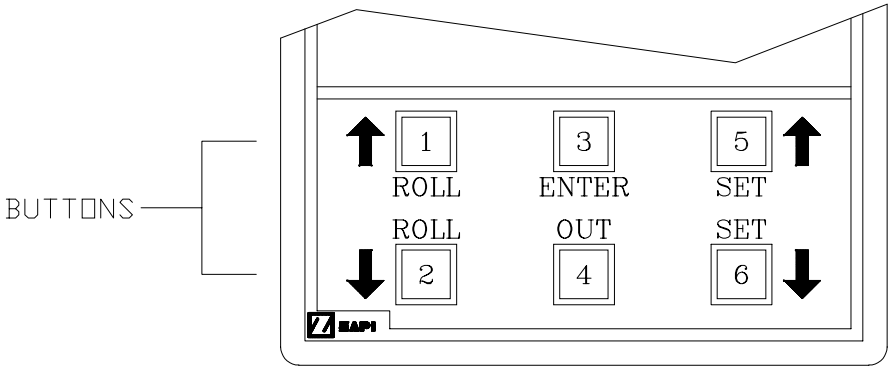
The Zapi console can be used to program various 4Q chopper functions. It is therefore possible to adapt the truck performance to suit the client's requirements.
The console can be left connected to the controller when it is in use and the parameters can be modified in real time. In this case, if you wish to save the new data entries, get into rest mode and save the data in the controller memory (E^2prom) before turning the key off.

This section describes the functions of the Zapi console.
The console has six push-buttons that can be used to modify or visualise the chopper parameters as described below:

1	Roll-up	press to scroll sub-menus or parameters upwards.
2	Roll-down	press to scroll sub-menus or parameters downwards.
3	Enter	press to access sub-menus. Also used to confirm a new parameter.
4	Out	press to exit sub-menus. Also used for non-confirmation of a new parameter.
5	Set-Up	press to increase the value of a parameter.
6	Set-Down	press to decrease the value of a parameter.

N.B.: When a parameter has been modified, the new value can be recorded by pressing key 4 (Out) followed by key 3 (Enter). By pressing key 4 (Out) twice, the new value is not recorded.

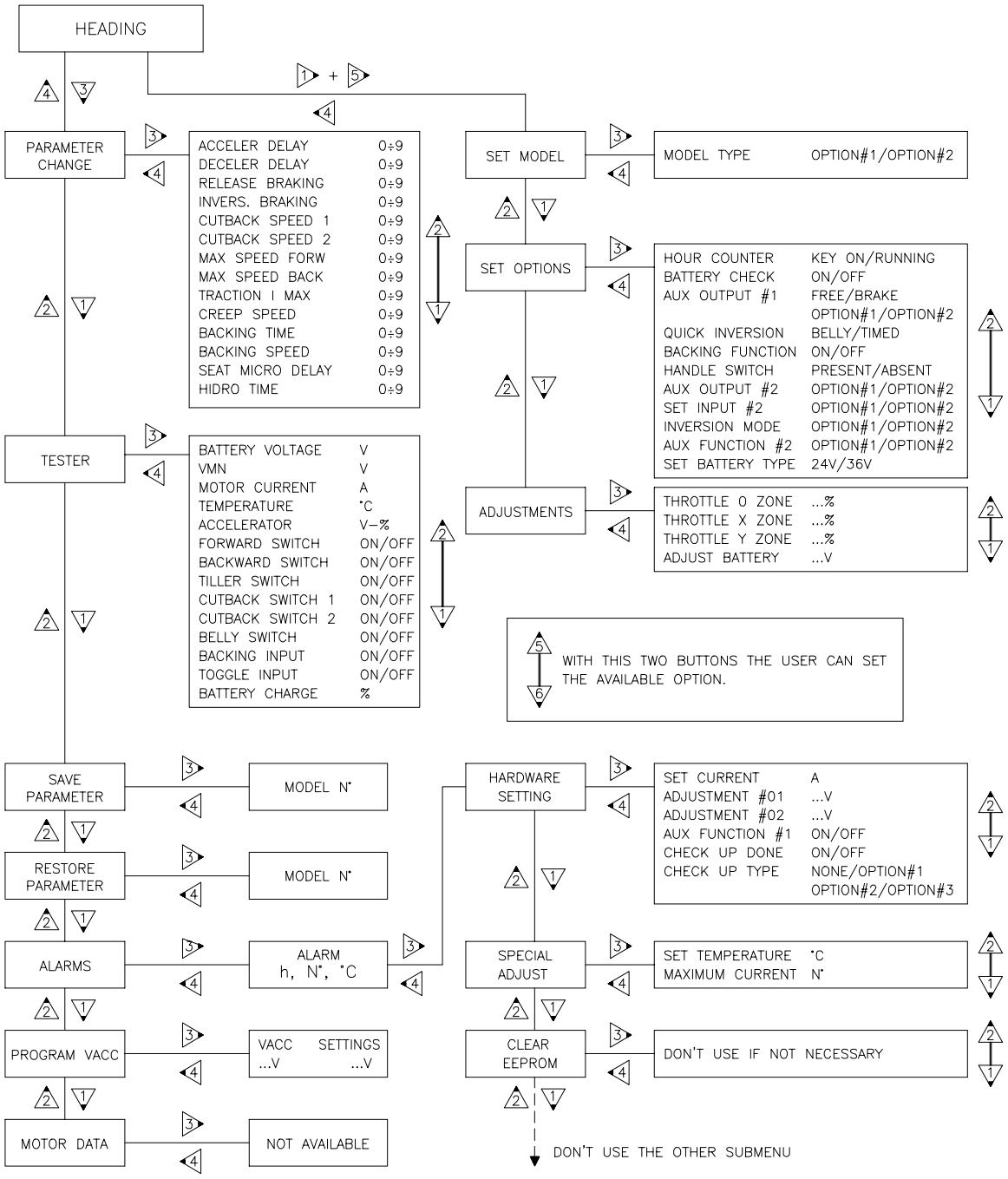
The numbers printed in the triangles on the following console map correspond to the numbers on the keyboard of the console shown in the diagram below. The position of the triangle indicates to which sub-menu or parameter the key refers.



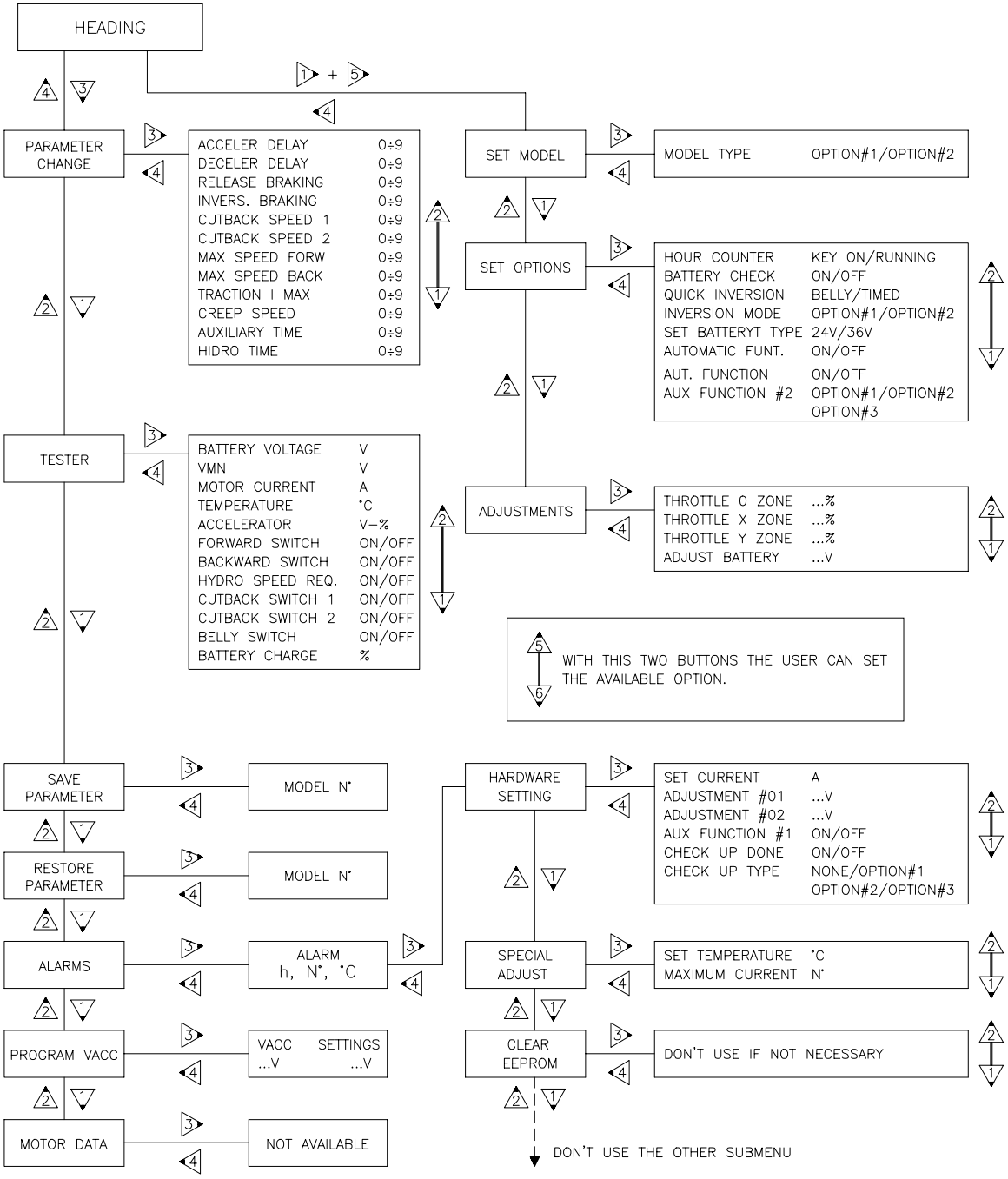
Important
THE CONSOLE SHOULD ONLY BE CONNECTED AND DISCONNECTED WITH THE PLANT TURNED OFF!

3.2 CONSOLE MAP

3.2.a Pallet truck



3.2.b Floor washer



3.3 "TESTER" MENU

3.3.a Pallet truck

BATTERY VOLTAGE	battery voltage
VMN	VMN voltage
MOTOR CURRENT	motor current
TEMPERATURE	chopper temperature
ACCELERATOR	accelerator
FORWARD SWITCH	forward input
BACKWARD SWITCH	reverse input
TILLER SWITCH	tiller switch input
CUTBACK SWITCH 1	speed reduction 1 input
CUTBACK SWITCH 2	speed reduction 2 input (if configured)
BELLY SWITCH	quick inversion input
BACKING INPUT	backing input (if configured)
TOGGLE INPUT	toggle input (if configured)
BATTERY CHARGE	charge status of battery

3.3.b Floor washer

BATTERY VOLTAGE	battery voltage
VMN	VMN voltage
MOTOR CURRENT	motor current
TEMPERATURE	chopper temperature
ACCELERATOR	accelerator
FORWARD SWITCH	forward input
BACKWARD SWITCH	reverse input
HYDRO SPEED REQ.	request exclusive hydro (if configured)
CUTBACK SWITCH 1	speed reduction 1 input
CUTBACK SWITCH 2	speed reduction 2 input (if configured)
BELLY SWITCH	quick inversion input
BATTERY CHARGE	charge status of battery

3.4 "PARAMETER CHANGE" MENU

3.4.a Pallet truck

ACCELER. DELAY	Acceleration time; 9 = maximum time
DECELER. DELAY	Deceleration time; 9 = maximum time
RELEASE BRAKING	Release braking time; 9 = max. braking power, minimum time
INVERS. BRAKING	Inversion braking time; 9 = max. braking power, minimum time
CUTBACK SPEED 1	Speed reduction 1
CUTBACK SPEED 2	Speed reduction 2
MAX FORW. SPEED	Maximum forward speed
MAX BACK. SPEED	Maximum reverse speed
TRACTION IMAX	Maximum current (it's a function of the parameter MAXIMUM CURRENT)
CREEP SPEED	Initial step voltage
BACKING TIME	Backing time
BACKING SPEED	Fixed speed during backing function
SEAT MICRO DELAY	Seat microswitch release delay time (if the “Handle Switch option” is configured as “Seat”); or delay between direction request and tiller (if the “Handle Switch option” is configured as “Present”).
HYDRO TIME	Delayed disengaging of hydro output.

3.4.b Floor washer

ACCELER. DELAY	Acceleration time; 9 = maximum time
DECELER. DELAY	Deceleration time; 9 = maximum time
RELEASE BRAKING	Release braking time; 9 = max. braking power, minimum time
INVERS. BRAKING	Inversion braking time; 9 = max. braking power, minimum time
CUTBACK SPEED 1	Speed reduction 1
CUTBACK SPEED 2	Speed reduction 2
MAX FORW. SPEED	Maximum forward speed
MAX BACK. SPEED	Maximum reverse speed
TRACTION IMAX	Maximum current (it's a function of the parameter MAXIMUM CURRENT)
CREEP SPEED	Initial step voltage
AUXILIARY TIME	Delayed disengaging of auxiliary output NEV2.
HYDRO TIME	Delayed disengaging of hydro output (NEV1).

3.5 "SET MODEL" MENU

Model Type

Option #1	The 4Q is configured as a transpallet.
Option #2	The 4Q is configured as a floor washer.

3.6 "SET OPTION" MENU

3.6.a Pallet truck

Hour counter

Running	The hour counter is active during running only.
Key on	The hour counter is active at all times.

Battery check

Off	Battery alarm disengaged.
On	Low battery alarm engaged (plus current limiting device).

Aux output #1 (NEV2 - NEB output)

Free	Unused output
Brake	Output used to control an electric brake that receives the positive from the tiller switch (with relative diagnosis).
Option #2	Output used to control an electric brake that does not receive the positive from the tiller switch (diagnosis disengaged).
Option #3	Output used to enable the electric brake during release braking. The brake is controlled as in the option "brake".

Quick inversion

Belly	Quick inversion active while the belly button remains pressed.
Timed	Timed quick inversion (fixed duration).

Backing function

This option is effective only if the “Set input #2” is set to “Option #1”

Off	The backing function is disengaged; the RV2 input is a speed reduction.
On	The backing function is enabled; the RV2 input is used to activate the backing function, the direction is chosen using the gears.

Handle switch

Present	Tiller present: incorrect start if pressed at key-on and movement jammed if released during running. A maximum delay time between selecting the running direction and selecting the tiller can be programmed using the “Seat micro delay” parameter.
Seat	Seat present: no incorrect start is pressed at key-on, delay if released during running (program the delay time using the “Seat micro delay” parameter). The seat-running sequence is compulsory.

Aux output #2 (NEV1 output)

This option is only effective if “Set input # 2” is set to “Option #1”.

Option #1	The NEV1 output acts as a hydro: it is active during running and is set at rest with a programmable delay time after running.
Option #2	The NEV1 output is activated when a thermal alarm is present (e.s. can be used to activate a fan)

Set input #2

Option #1	The “Aux output #2” and “Backing function” options can be used.
Option #2	The “Aux output #2” and “Backing function” options have no effect. The “RV2” input is not a speed reduction but is used as a button (Toggle); the NEV1 output is activated by an “RV2” impulse and disengaged by a second impulse.

Inversion Mode

Option #1	The quick inversion input is configured as normally open.
Option #2	The quick inversion input is configured as normally closed.

Aux function #2

Option #1	The potentiometer is configured with an electric range of 0V-5V. Forward and backward micros are present.
Option #2	The potentiometer is configured with an electric range of 0V-2.5V-5V (2.5V is the ‘at rest’ value). Forward and backward micros are not used; the direction is given by the voltage on the potentiometer unit: 2,5V 5V = backward

Set battery type

Sets the battery nominal value

24V	24V battery.
36V	36V battery.

3.6.b Floor washer

Hour counter

Running	The hour counter is active during running only.
Key on	The hour counter is active at all times.

Battery check

Off	Battery alarm disengaged.
On	Low battery alarm enabled (plus current limiting device).

Quick inversion

Belly	Quick inversion is active while the button remains
Timed	Timed quick inversion (set duration).

Inversion Mode

Option #1	The quick inversion input is configured as normally open.
Option #2	The quick inversion input is configured as normally closed.

Automatic function

Off	To be defined.
On	The NEV2 output is active during running and is disengaged with a programmable delay time. The output is always disengaged when a low battery alarm is present.

Aux function #2

The tiller/seta switch is not used by cleaning machine, so the input can be used for other purpose.

Option #1	The “Tiller/Seat” input is a switch that activates the NEV1 output. When the switch is opened the output is disengaged with a delay time that is programmed by the “Hydro Time” parameter.
Option #2	The “Tiller/Seat” input is a button that activates the NEV1 output when pressed once. Pressing a second time disengages the output with a delay time that is programmed by the “Hydro Time” parameter.

Option #3	If the “Tiller/Seat” input is activated without traction it activates NEV1 for a duration that is programmed by the “Hydro Time” parameter. If the input is activated with traction then the NEV1 output is permanently active. If traction stops, NEV1 remains active for a certain length of time that can be programmed by the “Hydro Time” parameter. If the “Tiller/Seat” input is disengaged, NEV1 disengages immediately. The low battery alarm disengages NEV1 (used to drive brushes).

Set battery type

Sets the battery nominal value

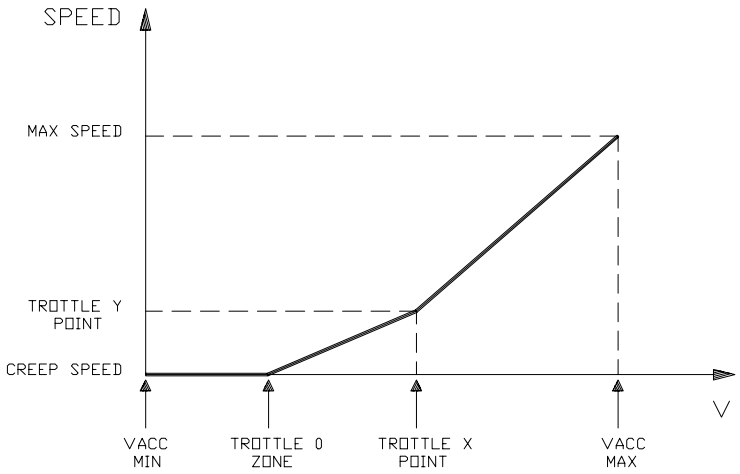
24V	24V battery.
36V	36V battery.

3.7 "ADJUSTMENT" MENU

Throttle 0 zone This parameter is used to set the dead zone of the traction potentiometer. See graph below.

Throttle X zone This parameter is used to adjust the characteristic of the traction potentiometer signal.

Throttle Y zone This parameter is used to adjust the characteristic of the traction potentiometer signal.



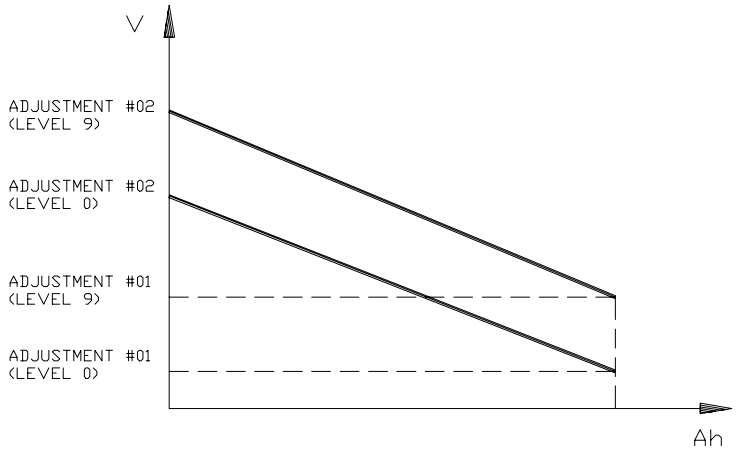
Adjust battery Fine adjustment of the battery voltage.

3.8 "HARDWARE SETTING" MENU

Set current — Adjust the bottom of the scale setting of the current reading visualised on the console.

Adjustment #01 — Adjust the maximum value of the low battery curve.

Adjustment #02 — Adjust the minimum value of the low battery curve.



Aux function #1

On — The hour counter of the chopper loads the MDI hour counter.

Off — If the hour counter of the chopper and the MDI have different values, alarm “98” is displayed for one minute; if the option is not set to “On” within the minute then the chopper hour counter overwrites the MDI hour counter (0 hours if the chopper is new).

Check up done

On — the programmed check-up has been carried out; the maintenance hour counter and the “Check up needed” alarm are reset.

Off — checkup not done.

Check up type

None	Programmed maintenance function disengaged; no alarm, no reduction, no shut down.
Option #1	Programmed maintenance function enabled; an alarm message is visualised after 300 hours.
Option #2	Programmed maintenance function enabled; an alarm message is visualised after 300 hours and a speed reduction is enabled after 340 hours
Option #3	Programmed maintenance function enabled; an alarm message is visualised after 300 hours, speed reduction is enabled after 340 hours and the traction is blocked after 380 hours.

3.9 "SPECIAL ADJUST" MENU

Set temperature	Fine adjustment of chopper temperature (the chopper temperature is calibrated by Zapi during testing and should not be modified by the client).
Maximum Current	Adjust the maximum chopper current. A password is required in order to modify this setting and remains active until the key is turned off.

3.10 "CLEAR EEPROM" MENU

Clear EEprom can be effected from this menu; this virtually resets the plant and cancels the settings entered up to that moment. At the end of the Clear EEprom operation the original settings (default values) are reloaded. Clear EEprom has no effect on the following settings:

- Model Type
- Maximum Current
- Set temperature
- Adjust Battery

4 ALARMS

4.1 DIAGNOSIS

1) POWER FAILURE #1 AL 73 MDI 1 LED FLASH

Short circuit on main relay or on auxiliary outputs (NEV1, NEV2).

2) CAPACITOR CHARGE AL 60 MDI 3 LED FLASHES

This alarm is signalled if the capacitors have not begun re-charging after a certain amount of time has lapsed.
Possible causes:
fault in the potentiometer unit.

3) DRIVER SHORTED AL 74 MDI 6 LED FLASHES

Short circuit on driver of main relay.

4) VMN NOT OK AL 32 MDI 3 LED FLASHES

Test at rest with the main relay open and running. If the VMN is very low and the main relay is open, the chopper goes into alarm. When running, an alarm is signalled if the VMN does not move from the half battery value according to the direction of the duty cycle: for forward running the VMN value should go from Vbatt/ 2 to zero, in reverse the VMN should go from Vbatt/2 to Vbatt.
Possible causes:

a) incorrect motor connection;
b) motor leak to earth;
c) fault in the power unit.

5) STBY I HIGH AL 53 MDI 5 LED FLASHES

Test during initial diagnosis and at rest with main relay open. Check to ensure that current signals are nil. If not the chopper goes into alarm and prevents machine functions.
Possible causes:

a) faulty current sensor;
b) fault in the feedback circuit, in the logic or in the power board.

6) LOW BATTERY AL 66 MDI 32 LED FLASHES

Reduces the traction current to Imax/2. The low battery alarm is activated when the residual charge falls to 10%. If the alarm is activated with the battery fully charged, check the battery value reading in the “TESTER” menu on the console; if the reading is incorrect, carry out fine adjustment in the “CONFIG MENU/ ADJUSTMENT” menu. This alarm can be present only with "battery check" option ON.

7) CONTACTOR CLOSED AL 37 MDI 6 LED FLASHES

Test before closing the main relay, only if the VMN is at approx. Vbatt/2. Check that the contact of the main electromagnetic switch is open and has not jammed.

8) CONTACTOR DRIVER AL 75 MDI 6 LED FLASHES

Test with the main relay closed, check that the driver is not open.
Possible causes:

a) driver open;
b) fault in the feedback circuit of the main relay coil voltage.

9) I=0 EVER AL 49 MDI 5 LED FLASHES

Test whilst running. Check that the current value is higher than the minimum threshold value. If not the chopper will go into alarm and prevent machine functions.
Possible causes:

a) faulty current sensor;
b) fault in the feedback circuits, in the logic or in the power board.

10) EB DRIVER KO AL 02 MDI 8 LED FLASHES

The alarm is activated when a problem in the driver of the electric brake is detected (only for transpallets with brake present and diagnosis enabled).
Possible causes:

a) shorted driver;
b) the driver is faulty and cannot control the electric brake;
c) fault in the feedback circuit of the electric brake coil voltage.

11) WATCHDOG AL 08 MDI 1 LED FLASHES

Test both at rest and running: this is an internal self-diagnosis of the logic. If this alarm is signalled, replace the logic.

12) CHECK-UP NEEDED AL 99 MDI 0 LED FLASH

Indicates that it is time to carry out programmed maintenance; this alarm is activated 300 hours after the last time maintenance was carried out unless the “Check up type” option is set to “None”; cancel by setting “Check-up done” to ON.

13) FORW + BACK AL 80 MDI 2 LED FLASHES

Test carried out continuously. The alarm is activated when 2 running requests are given simultaneously. The alarm is reset if one of the two requests is cancelled.
Possible causes:

a) check wiring;
b) if fault persists, replace the logic.

14) VACC NOT OK AL 78 MDI 4 LED FLASH

This alarm indicates that the traction accelerator voltage is 1V higher that the minimum programmed voltage at key-on and when at rest.
Possible causes:

a) a potentiometer wire is disconnected;
b) the potentiometer is not wired correctly;
c) the potentiometer is faulty;
d) potentiometer programming has not been carried out correctly.

15) INCORRECT START AL 79 MDI 2 LED FLASHES

Forwards/reverse, tiller, quick inversion present at key-on; traction running request given before tiller/seat.

16) THERMAL PROTECTION AL 62 MDI 7 LED FLASHES

Temperature alarm activated if the temperature is >+75°C in which case the maximum armature current is reduced linearly until it reaches nil at a threshold temperature of 90°C; the speed is reduced to 60%; the alarm is reset only if the temperature drops to below 70°C. If the temperature falls to below –10°C the maximum armature current is reduced by 20%.

17) EEPROM OK AL 13 MDI 1 LED FLASH

Fault in the memory area where configuration parameters are recorded. If the fault persists when the key is turned off and turned on again, replace the EEPROM and check the connections between the EEPROM and the µP. If the alarm no longer occurs, remember that the previously recorded parameters have now been cancelled and replaced with default values.

18) PEDAL WIRE KO AL 86 MDI 4 LED FLASHES

Indicates that the negative wire of the potentiometer is disconnected.
Possible causes:

a) one of the potentiometer wires is disconnected;
b) the potentiometer is not wired correctly;
c) the potentiometer is faulty.

19) CURR. PROTECTION AL 96 MDI 5 LED FLASHES

Current protection; if for any reason the current exceeds the calibrated values, the microprocessor disengages the functions until the current drops to the required value.

AL 98 on MDI: MDI and chopper have different counter.

5 RECOMMENDED SPARE PARTS FOR THE 4Q

ITEM CODE	DESCRIPTION
C12404	16 way Molex Minifit female connector
C12777	Molex Minifit female crimp terminal
C00077	Console connector plug
C18556	Outer gasket for Molex Minifit connector
C18557	Inner gasket for Molex Minifit connector

6 REGULAR MAINTENANCE AT SET INTERVALS

Check the pedal microswitch: use a tester to check for the absence of resistance on the contact by measuring the voltage drop at the terminals, also check that the switch clicks clearly; ..... **EVERY 3 MONTHS**

Check the power cables to the battery and to the motor, both cables and the sheathing must be in good condition; ..... **EVERY 3 MONTHS**

Check the efficiency of the pedal springs; ..... **EVERY 3 MONTHS**

All work must be carried out by qualified staff and original spare parts only should be used.
Follow the assembly diagrams carefully when installing the machine, any modifications must be agreed to with the supplier. The supplier declines all responsibility for problems caused by failure to comply to the proposed solutions.

Any cause for concern that is visible or apparent to the average technician when carrying out the regular check-ups on the equipment, and that could result in damage or faults to the equipment itself, must be reported to ZAPI technicians or to the technical sales network who are responsible for any decisions concerning the safety of the electric vehicle.

THE USER IS PROHIBITED FROM USING THE VEHICLE SHOULD THERE BE ANY FAULTS IN THE ELECTRICAL EQUIPMENT THAT REPRESENT A HAZARD.