INDEX

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

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LEGEND

AV	Forward
IN	Backward
VMN	Negative motor voltage
MA	Forward microswitch
MI	Backward microswitch
NT	Negative contactor
CH	Key

1. INTRODUCTION TO THE ZAPIMOS FAMILY

The ZAPIMOS chopper family is ZAPI's answer to the needs of users of the '90s.
To ensure that the product stays on the market without running the risk of becoming technologically obsolete, ZAPI has designed the ZAPIMOS family to offer the following features:

- Advanced technology and economical costs
- Maximum safety
- Maximum flexibility
- Open to future technological innovations
- Optimum level of protection.

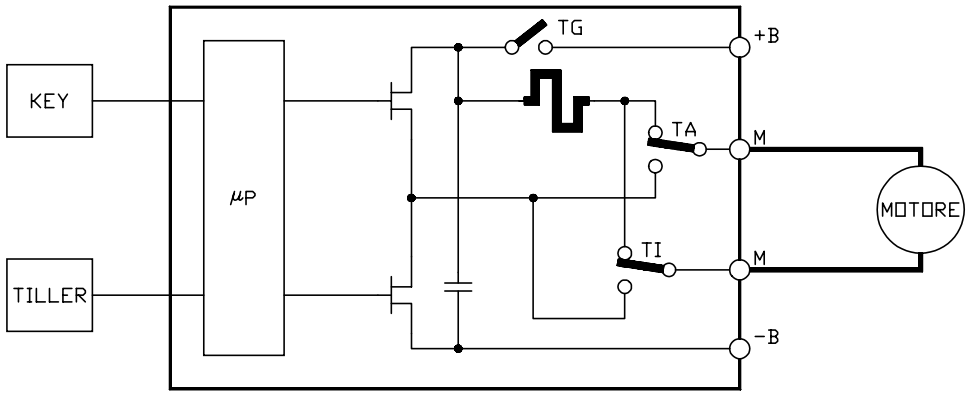
This implies:

- High frequency Mos technology
- Real-time control over the internal and external parts that can influence the behaviour of the machine, with self-diagnosis of the checking circuits themselves.
- Stored programme machine (SPC) where the hardware is completely separate from the functions to be configured. The programme is parametric and can also be modified by the end user.
- Various chopper functional configurations can be selected by the user, without the need for hardware modifications.
- Any future technological updates are made clear to the user.
  The communication protocol will continue to evolve, thus offering increasing possibilities of interaction.
  For this reason, the ZAPIMOS family offers a standard dialogue mode with external systems, for easy interfacing with commercially available machines.
  ZAPI offers a range of programming consoles with various features and prices.
- Within the ZAPIMOS family, the MX choppers are the models suitable for operating at voltages from 24-36-48V with permanent magnet motors with powers from 200 to 1000 W.

2. SPECIFICATIONS

Operating voltage: 24V - 36V - 48V
Maximum current: 70A (2 minutes); 40A by removing the bridge on the SHUNT (see page 11).
Operating frequency: 8 KHz
External temperature range: -30°C - 40°C
Max chopper temperature: 85°C
Regenerative braking function
Voltage drop on the full conduction MOS: 0.35V at 50A (24V - 36V).
0.50V at 50A (48V).

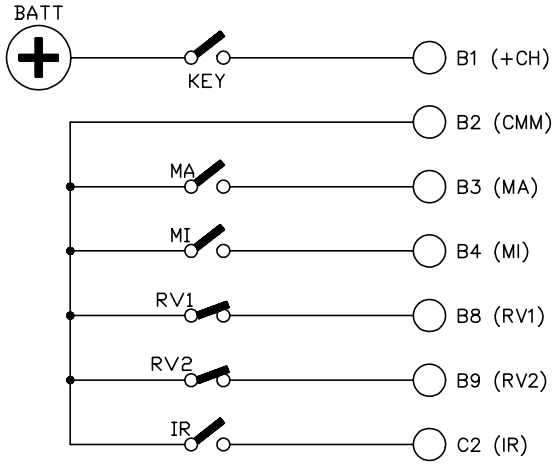
2.1 BLOCK DIAGRAM



2.2 CONTROL UNITS

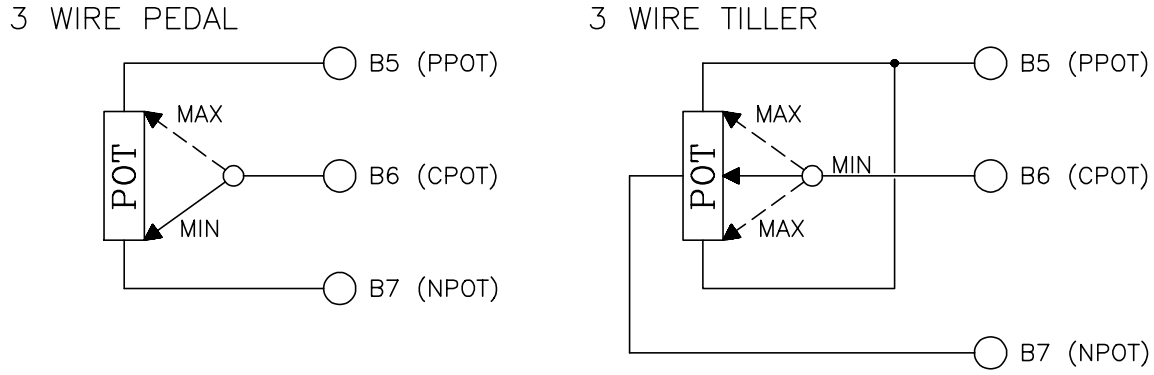
2.2a Microswitches

The microswitches send a voltage signal when a function request (for example: running request) is made.

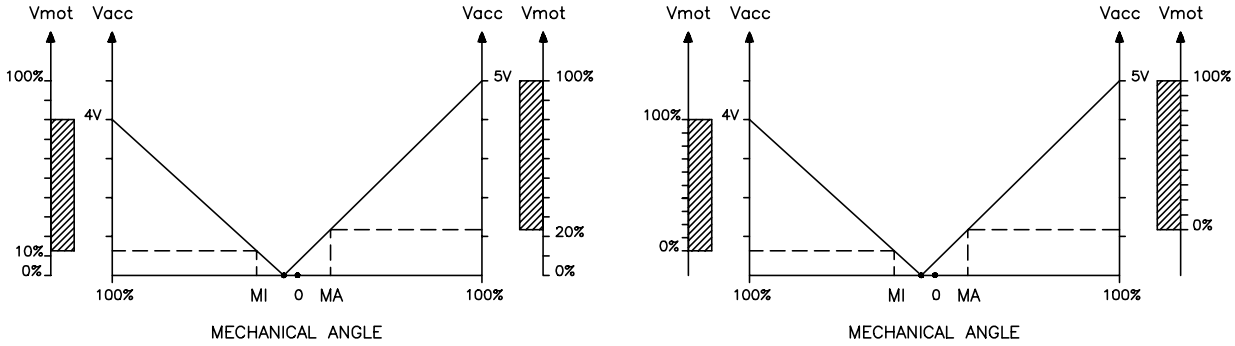


2.2b POTENTIOMETER

- Potentiometer should be in the 3-wire configuration.
  CPOT (B6) signal ranges from 0 to 10V.
  Pot. value should be in the 0.5 - 10 Kohm range. Faults can occour if it is outside this range.

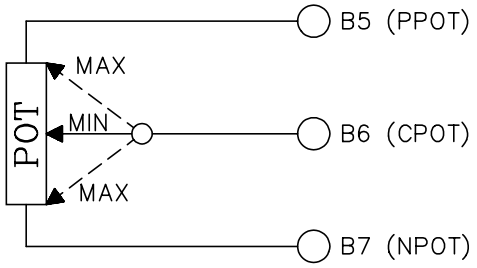


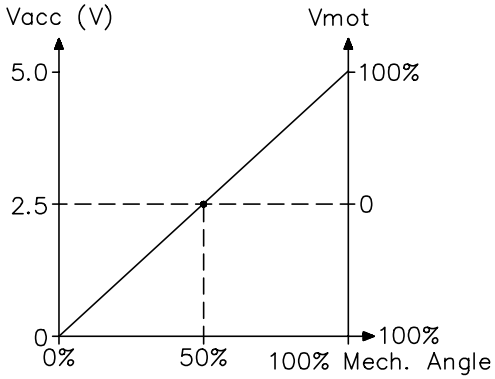
The procedure for automatic potentiometer signal acquisition is carried out from the console. This makes it possible to adjust the minimum and maximum useful signal in the respective directions.
This function is indispensable when it is necessary to compensate for asymmetry in the mechanical workings that control the potentiometer, especially as regards the adjustment of the minimum.
The sequence of procedures is described in the programming console manual.



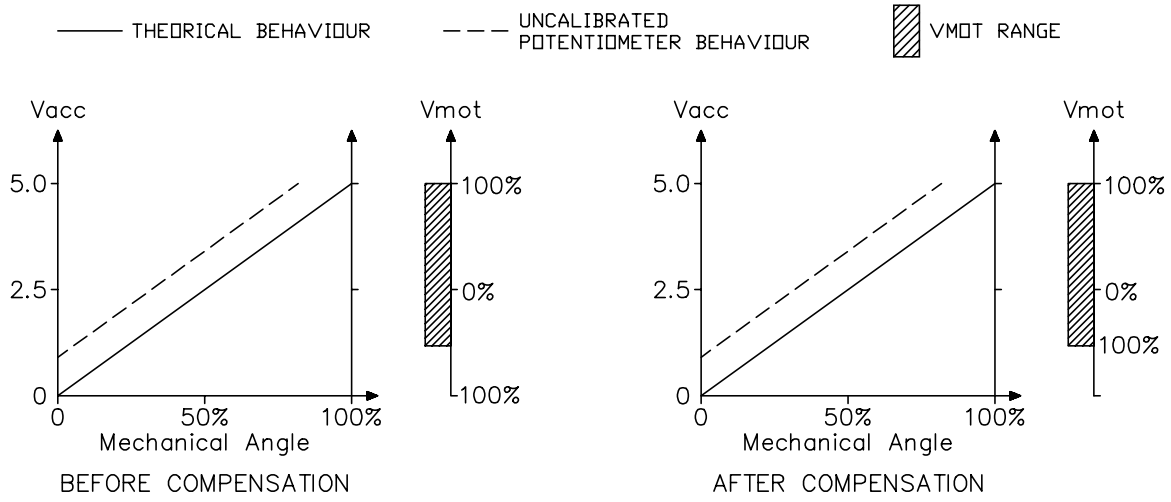
The two graphs show the output voltage from an uncalibrated potentiometer with respect to the mechanical "zero" of the knob of one handle (MI and MA indicate the point at which the speed microswitches close, 0 is the mechanical zero of the handle rotation).The first graph shows the correspondence of the motor voltage without having made the acquisition, while the second graph shows the same correspondence after signal acquisition by the potentiometer.The acquisition procedure is invalidated by the machine if the signals do not reach at least 3V.

- On request it is possible to configure the logic to supply the potentiometer with +5V and use a normal 3 wire potentiometer regulated on the medium value of it's total range, instead of using a central-zero potentiometer.
  In this case the signal on CPOT (B6) ranges from 0V to +5V and the zero is at 2.5V.





The procedure for automatic potentiometer signal acquisition is carried out from the console.
This makes it possible to adjust the maximum useful signal.
This function is indispensable when it is necessary to compensate for asymmetry in the mechanical workings that control the potentiometer.
The sequence of procedures is described in the programming console manual.



The two graphs show the output voltage from an uncalibrated potentiometer with respect to the mechanical "zero" of the knob of one handle (the mechanical "zero" corresponds to a 2.5V).
The first graph shows the correspondence of the motor voltage without having made the acquisition, while the second graph shows the same correspondence after signal acquisition by the potentiometer.

2.3 SPEED ADJUSTMENT AND REDUCTION

- The maximum speed can be adjusted from a minimum of 10% to 100% using the programming console.

2.4 PERFORMANCE FEATURES

- Speed control with energy regeneration in the slowdown phases.
- Optimum sensitivity to low speeds.
- Anti-rollback.
- Regenerative braking with current control; release and inversion.
- Self-diagnosis with indication of the type of anomaly shown by an optional LED.
- Modification of parameters from the console (see the specific description).
- Internal hour-meter with values that can be displayed on the console.
- Memorization of the last 5 alarms tripped, with relative hour-meter value and temperature that can be displayed on the console.
- Console tester for real time checking of the main parameters such as inputs, motor voltage, and battery.
- Contactors fitted inside the enclosure.
- Electromechanical brake.
- Quick inversion.
- It is possible to modify the shunt value removing a bridge. That allows to halve the maximum current and to double the current signal resolution.

2.5 PROTECTION FEATURES ⚠

- Connection errors:
  All the inputs are protected against connection errors.
- Potentiometer wires interrupted:
  If the NPOT or PPOT wire are interrupted, the chopper is stopped and an alarm is signalled; if the CPOT wire is interrupted, the chopper stops.
- Thermal protection:
  If the temperature exceeds 75°C, the maximum current is reduced in proportion to the thermal increase. The temperature may never exceed 85°C.
- Low battery charge:
  When the battery charge is low, the maximum current is reduced by 50%.
- Protection against accidental startup:
  A precise sequence of operations is necessary for starting the machine.
  If these operations are not carried out correctly, the machine will not start.
  The request for running must be activated after the key.

- Protection against uncontrolled movements:
  - The contactors do not close if:
  - the power unit is not functioning.
  - the accelerator is not within an interval around the zero (2.5V).
  - the logic is not perfectly functional.
  - one running microswitch is stuck.
- Main contactor:
  It is installed for protecting against battery polarity inversions.

3 INSTALLATION

Install the chopper with the base-plate on a flat metallic surface that is clean and unpainted. Apply a light layer of thermo-conductive grease between the two surfaces to permit better heat dissipation.
Make sure that the wiring of the cable terminals and connectors is carried out correctly.
Fit anti-jamming filtres on the horn, solenoid valves, and contactors not connected to the chopper such as those for activating the pump motor or hydrodrive motor.

3.1 CONNECTION CABLES

For the auxiliary circuits, use cables of 0.5mm2 section.
For power connections to the motor and to the battery, use cables having sections of 10 mm².

3.2 CONTACTORS

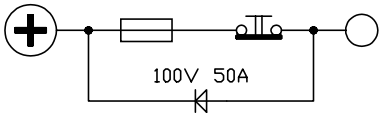
Contactors are installed on the logic board.

3.3 FUSES

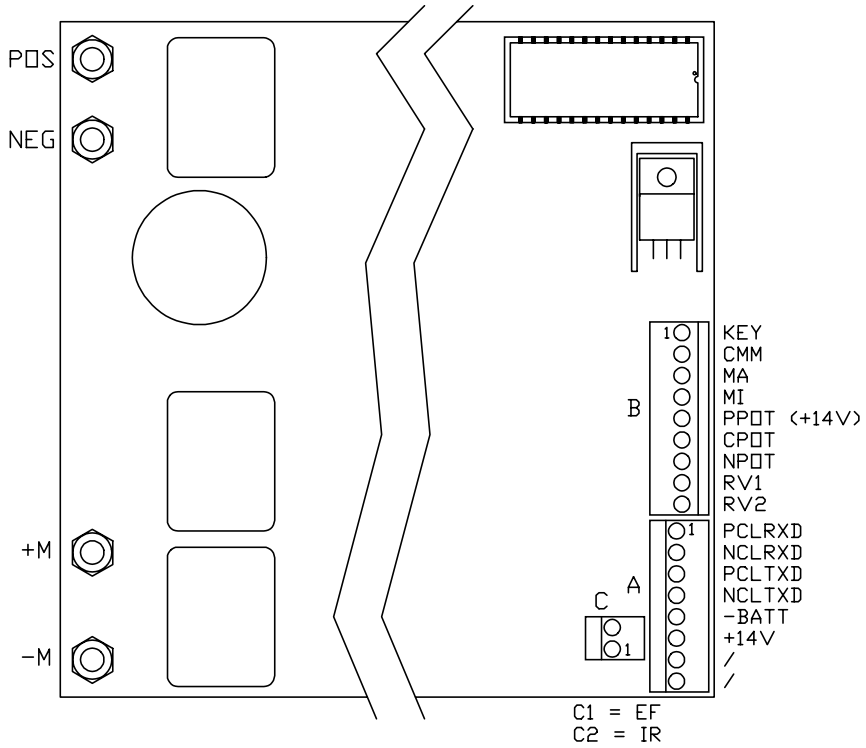
- For auxiliary circuit protection, use a fuse of 6.3A max.
- For protecting the power unit, see the diagrams.
  The value shown is the maximum allowable. For special applications or requirements, this value can be reduced.
  For safety reasons, we recommend that you use protected fuses in order to prevent the spread of fused particles in the event of blowout.

3.4 EMERGENCY PUSH-BUTTON ⚠

If an emergency push-botton in series with the battery positive is needed for safety reasons, follow this diagram:



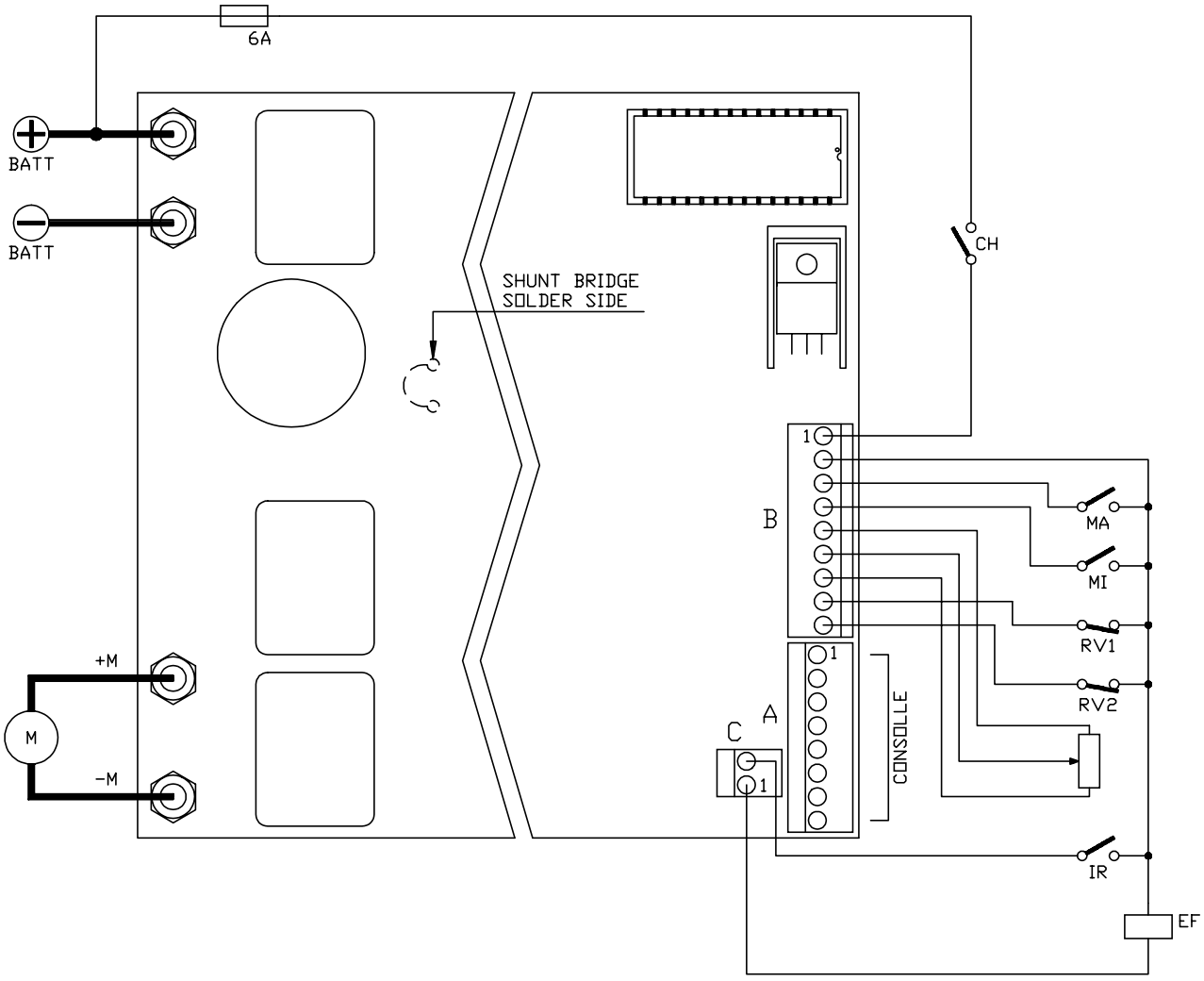
3.5 CONNECTORS DESCRIPTION



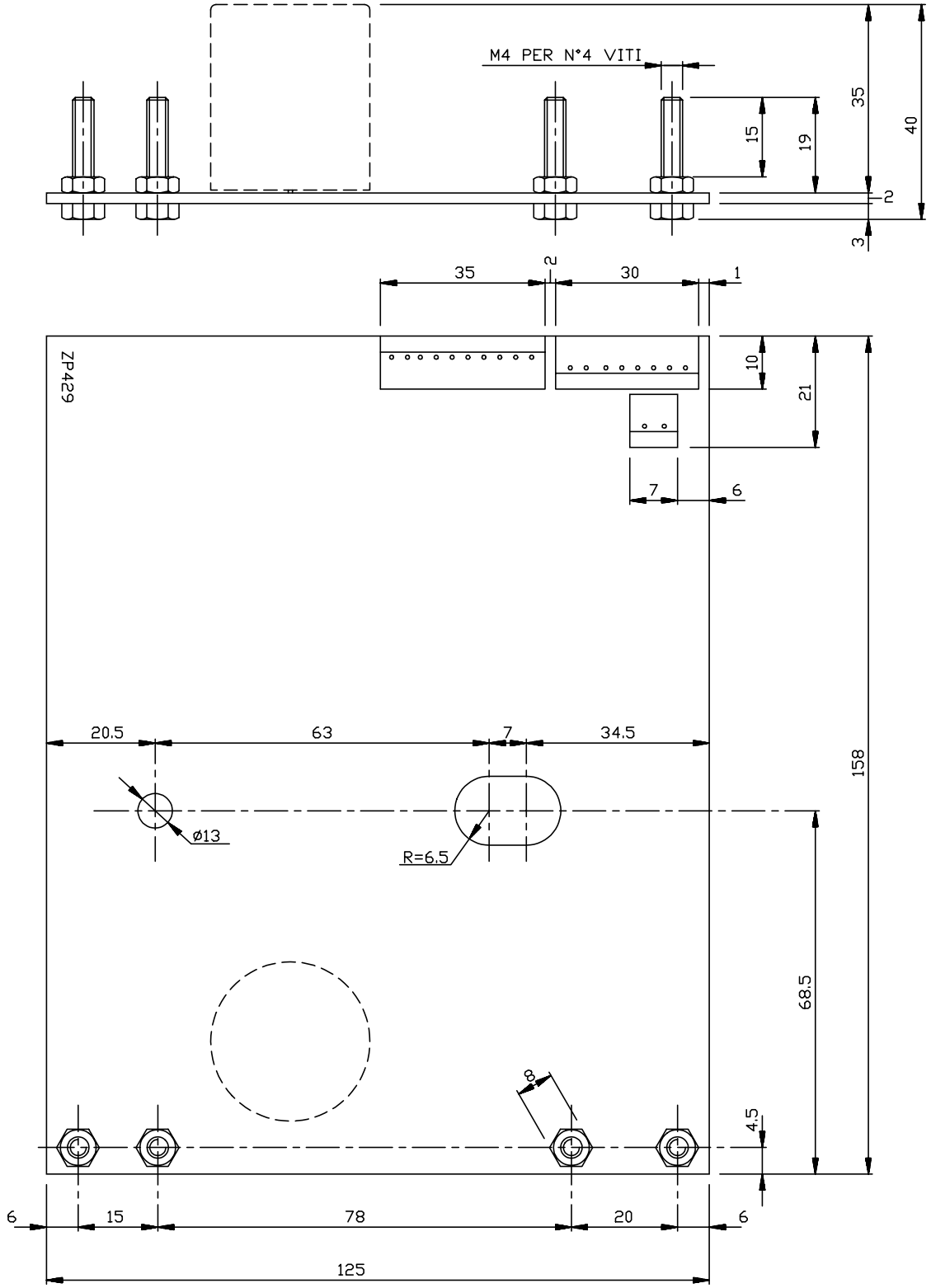
Pin	*Function*	*Description*
A1	PCLRXD	Positive serial reception.
A2	NCLRXD	Negative serial reception.
A3	PCLTXD	Positive serial transmission.
A4	NCLTXD	Negative serial transmission.
A5	GND	Negative console power supply
A6	+14V	Positive console power supply
A7	/	Not used.
A8	/	Not used.
B1	+ KEY	It should be connected to the power supply key
B2	CMM	Common Forward/Backward microswitch (+ BATT)
B3	MA	Forward direction microswitch. It should be connected to the forward microswitch, active high.
B4	MI	Backward direction microswitch. It should be connected to the beckward microswitch, active high.
B5	PPOT	Potentiometer positive: 14V output. Keep load > 500 ohms
B6	CPOT	Potentiometer central terminal: it should be connected to potentiometer cursor. For regulation purposes the signal ranges from 0V (min. speed) to 5V (max. speed).

B7	NPOT	Negative potentiometer.
B8	RV1	Input for speed reduction operation (RV1). If connected to a potential more than 12V reduction is inhibited while if left free or connected to battery negative, the reduction function operates.
B9	RV2	Input for speed reduction operation (RV2). If connected to a potential of more than 12V, reduction is inhibited . If left free or connected to battery negative, the reduction function operates.
C1	EF	Electromechanical brake
C2	IR	Quick inversion.

3.6 ASSEMBLY DIAGRAM



3.7 MECHANICAL DRAWING



4 REGULATIONS

In addition to the configuration of the inputs, parameter modification is made directly by ZAPI on customer specifications, or the customer may make adjustments himself using the programming console.

PARAMETERS	UNIT	PROGRAMMED LEVEL									
		0	1	2	3	4	5	6	7	8	9
ACCELERATION DELAY	Sec.	0.30	0.65	1.00	1.25	1.73	2.07	2.39	2.71	3.08	3.44
BRAKING	% IMax.	7.5	12	15	22	30	32	34	38	44	47
CREEP SPEED	%VBatt.	2.5	4.8	7.2	9.9	11	12.3	14.6	17	21.6	30
MAX. SPEED FORW. AND BACK.	%VBatt.	8.0	11	22	31	41	50	62	73	80	100
IMAX.	Amp.	35	39	43	47	51	54	58	62	68	70
RELEASE BRAKING	%IMax.	7.5	12	15	22	30	32	34	38	44	47
RV1 AND RV2	%VBatt.	17.7	27	35	40	46.4	50.2	61.6	66.4	73.5	85
COMPENSATION	K (I)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
INV. BRAKING	%IMax.	7.5	12	15	22	30	32	34	48	44	47

The console can remain connected to the chopper when running and the parameters can also be varied in real time during operation.
To confirm data, press ENTER when requested by the message on the console.
The parameters thus modified and optimised on one unit can be stored from the console (SAVE) and then reloaded (RESTORE) on another chopper, thus allowing fast and standardised settings (see console manual for details).

4.1 MX PROGRAMMING CONSOLE FUNCTIONS

- Chopper model and hourmeter
- Parameter programming : Acceleration
  Slowdown braking
  1st speed reduction
  2nd speed reduction
  Minimum speed (1st ramp)
  Maximum current
  Maximum forward speed
  Maximum backward speed
  Release braking
  Compensation
  Inversion braking

- Tester : VMN 30%
  Status of inputs B3 (MA), B4 (MI)
  Status of inputs B8 and B9 (RV1 and RV2)
  Accelerator voltage (B6 CPOT)
  Motor current (amperes)
  Module temperature (degrees centigrade)
  Battery voltage (volts)
  Mean voltage applied to motor (volts)

- SAVE function (for storing data)
- RESTORE function (for loading parameters on another chopper)
- Display of the last 5 alarms tripped including hour-meter value and temperature at the moment of the alarm
- Accelerator stroke programming, records the minimum and maximum useful accelerator stroke values for both directions of running.
- See the console manual for a detailed description of functions and procedures.

5 DIAGNOSIS

Description of the alarms signalled by the diagnostic LED.
The alarm code is shown in parentheses. A detailed description is given in section 5.1.

1 Blink = Logic anomaly (WATCHDOG, EEPROM DATA KO, EEPROM PAR. KO, EEPROM OFF-LINE).

2 Blinks = Running request on startup or error in handle/speeds sequence (INCORRECT START)

3 Blinks = Error on VMN test (VMN LOW, VMN HIGH).

4 Blinks = Accelerator high in standby (VACC NOT OK).

5 Blinks = Current transducer anomaly (I HIGH AT STAND).

6 Blinks = Anomaly on negative of potentiometer (NPOT NOT OK)

7 Blinks = Excessive temperature, greater than 75°C (TH PROTECTION)

8 Blinks = Anomaly on positive or negative of general contactor (DRIVER SHORTED, COIL SHORTED).

Continuous blinking = Low battery charge, <65% of residual charge (BATTERY).

LED remains on = Double running request (FORW BACK).

5.1 ALARMS DISPLAYED ON CONSOLE

1) WATCH-DOG

The test is made in both running and standby. It is a self-diagnosis test within the logic. If an alarm should occur, replace the logic.

2) EEPROM DATA KO

The data in the area of memory for the hour-metre is incorrect. This alarm does not shut down the machine. If the alarm disappears when the key is switched off and on again, keep in mind that the hour-metre data has been reset to zero.

3) EEPROM PAR.KO

Fault in the area of memory in which the adjustment parameters are stored. This alarm inhibits machine operation.
If the defect persists when the key is switched off and on again, replace the logic.
If the alarm disappears, remember that the parameters stored previously have been cancelled and replaced by the default values.

4) EEPROM OFF LINE

Fault in the area of memory that contains data on the hour-metre and alarms stored. This alarm inhibits machine operation.
If the alarm persists when the key is switched off and on again, replace the logic.
If the alarm disappears, remember that the hour-metre starts again from zero and the alarm memory area is cancelled.

5) INCORRECT START

Error in the starting sequence. The machine starts only if the Key-march request sequence is OK. Possible causes:

a) March microswtich stuck.

b) Error in the sequence.

c) Error in the wiring.

6) VMN LOW

The test is carried out during the initial diagnosis. If the VMN voltage is lower than 1/4 of the battery voltage, an alarm is signalled. Possible causes:

a) Check motor wiring to make sure it is correct.

b) Check that the motor does not have insulation dispersions toward the body.

c) Chopper broken; replace.

7) VMN HIGH

This test is carried out during the initial diagnosis. The alarm is segnalled when VMN is shorted to the battery positive. Possible causes:

a) The power electronic is broken.

b) The logic that drives the MOS is broken.

8) VACC NOT OK

The test is made in standby. The alarm indicates that the accelerator voltage is greater than 1V with respect to the minimum value stored. Possible causes:

a) A potentiometer wire is interrupted.

b) The potentiometer is not correctly calibrated.

c) The potentiometer is defective (interrupted).

9) I HIGH AT STAND

Test carried out in standby. Checks that the current is nil.
If this is not verified, an alarm is signalled. This alarm inhibits machine operation.
Possible causes:

a) Current sensor broken or logic failure.

First replace the logic, and if the defect persists, replace the power unit.

10) NPOT NOT OK

The test is carried out continuously. The alarm is signalled when the voltage on NPOT (B7) is equal to zero. Possible causes:

a) A potentiometer wire is interrupted.

b) The potentiometer is defective.

11) TH PROTECTION

An indication that the chopper temperature has exceeded 75_C.
The maximum current is gradually reduced, reaching 0 at a temperature of 85_C.
If the alarm occurs while cold:

a) Check the thermal sensor connection.

b) Thermal sensor failure.

c) Connection on the power unit interrupted (check the connector that connects the logic to the power unit).

d) Logic failure.

12) COIL SHORTED

The test is carried out during the initial diagnosis.The alarm is signalled when the check of the general contactor coil voltage fails. Possible causes:

a) The general contactor positive driver is shorted.

b) The general contactor positive driver is open.

13) DRIVER SHORTED

The test is carried on during the initial diagnosis. The alarm is signalled when the check of the general contactor coil voltage fails. The possible cause is that the general contactor negative driver is broken.

14) BATTERY

The battery charge is low. When this alarm is signalled, machine operation is inhibited, and the maximum current is reduced to 50%.

15) FORW - BACK

The test is carried out continuously. An alarm is signalled when two requests for running are made simultaneously. Possible causes:

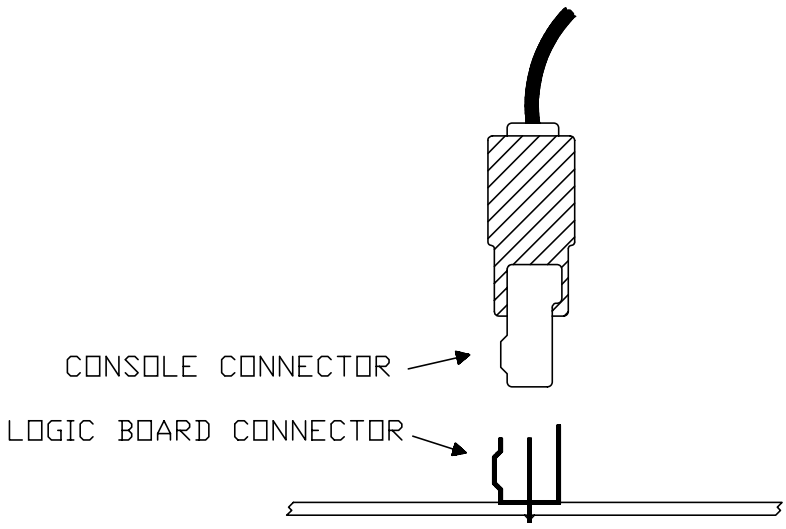
a) Defective wiring.

b) Running microswitch stuck.

c) Incorrect manoeuvre.

d) If the defect persists, replace the logic.

5.2 CORRECT POSITION OF THE CONSOLE CONNECTOR



ALWAYS PLUG-IN THE CONNECTOR ONLY IF KEY IS OFF, OR THE INTEGRATED CIRCUIT INSIDE THE CONSOLE (CNY17) WILL CRASH

6 MAINTEINANCE

Check outwear of electric contacts: they should be replaced when matchboard is too strong and wornout.
Electric contacts should be checked every 3 months.

Check pedal microswitch: verify with a tester that there is no electric resistance between the contacts by measuring the voltage drop between its terminals. Also the release should have a firm sound.
The pedal microswitch should be checked every 3 months.

Check motor-battery power links: they should be in excellent shae as well as the wires' claddings. Wires should be checked every 3 months.

Control of the pedal and contactors springs. They should be able to extend to its full extention and checked every 3 months.

Check contactors mecanical movements. They should be frictionfree and not stick. Mechanical movements of the contactors should be checked every 3 months.

Checks should be done by skilled personnel only and, all spare parts should be original. Installation of this electronic controller should be done according to the diagrams included in this manual and any variation should be done accordingly with the supplier. The supplier is not responsible for any problem that rose from using wiring solutions different from the ones suggested on this manual.

DO NOT USE A VEHICLE WITH A FAULTY ELECTRONIC CONTROLLER

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ZAPIMOS MXB

USER's MANUAL