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ZAPIMOS H2B

USER'S MANUAL

CONTENTS

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

APPROVAL SIGNATURES

COMPANY DEPT. SERVICES	MANAGEMENT EXECUTIVE
ENGINEERING SECTION EXECUTIVE	
EXPORT MANAGER	

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LEGEND

1^V = 1st lift speed request
AV = Forward
CH = Key
DF = Brake diode
DV = Flywheel diode
IN = Backward
IND = Weakening
MA = Forward speed microswitch
MCL = Horn microswitch
MD = Descent microswitch
MEF = Electric brake switch
MI = Backward microswitch
MS = Rise microswitch
MT = Handle microswitch
MUM = Dead man microswitch
NT = Contactor negative
RV = Speed reduction
VMN = Negative motor voltage

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 final 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.
- Logic and power units are fitted in a sealed container (IP54), to guarantee protection against splashes (water, acid, etc.) and dust, chips, or small particles.
  Access to the logic for replacement or checks, however, is very easy.
- The H2B chopper is the top-of-the-line model of the Zapimos family. It is suitable for operating at voltages from 24 to 96 V with maximum currents of 400 or 600 amp. Suitable for use with series motors with powers from 2000 W to 15 kW.

2 GENERAL H2B CHARACTERISTICS

2.1 TECHNICAL SPECIFICATIONS

Voltage: ..... 24V (14 ÷ 32V)
..... 36 / 40 / 48V (22 ÷ 55V)
..... 60 / 72 / 80V (36 ÷ 90V)
..... 96V (57 ÷ 120V)
Maximum current: ..... short size = 400 A
..... long size = 600 A (80 V model: 500 A)

SYSTEM VOLTAGE	H2 400 (SHORT)	H2 600 (LONG)	H2 601
24V	400A	600A	/
48V	400A	600A	/
80V	400A	/	500A / 600A
96V	400A	/	500A / 600A

Frequency: ..... 16 kHz
Motors (characteristics): ..... DC wire wound serie 4 cables
Operating ambient temperature: ..... -30 to +40°C
Maximum allowable temperature for chopper body: ..... 85°C
Drop voltage with I=200 A:

SYSTEM VOLTAGE	H2 400 (SHORT)	H2 600 (LONG)	H2 601
24V	250mV	200mV	/
48V	350mv	280mV	/
80V	1.00V	550mV	550mV

Microprocessor logic unit.
4 different configurations that can be set from the console:

1 traction control and energy regeneration
2 5-speed pump control
3 4-speed pump control + hydrodrive contactor handling

There are two H2B models, based on the maximum current (400 A and 600 A), which also differ in size.

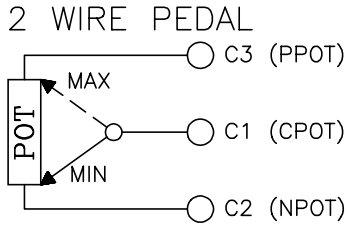
2.2 CONTROL UNIT

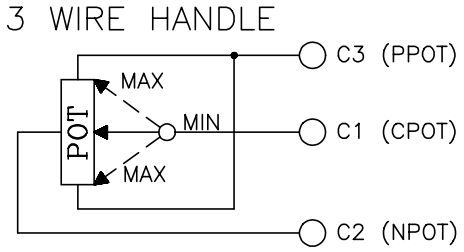
2.2a Microswitches

Microswitches send a voltage signal when the request for startup or desired function is made. Microswitches for forward, backward, and rapid inversion (if present) are dimensioned for carrying the current of one contactor (3 amp).

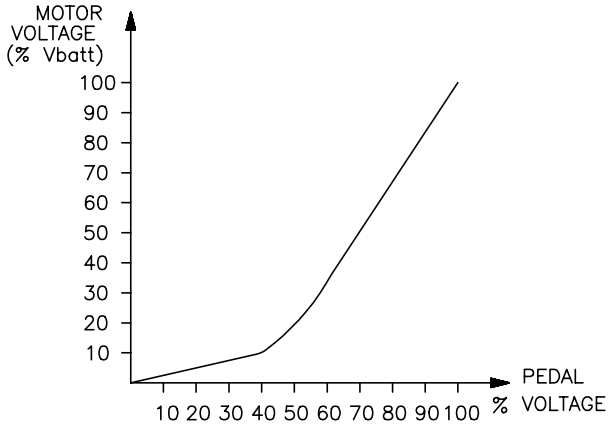
2.2b Potentiometer

In the 3-wire configuration, the CPOT (C1) useful input signal goes from 0V to 10V. The resistive value of the potentiometer must be between 500 ohm and 10 kohm, as lower values overload the power supply.





2-wire potentiometer (please request while ordering):
It is possible to use the potentiometer in the 2-wire configuration but you should state its ohmic value since a resistor on the logic boars must be installed accordingly.
Correspondence between the voltage signal to pin C1 and motor voltage.



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 which in certain cases, if made in the traditional way, requires a calibration that is laborious and costly, but very often gives unsatisfactory results.
The sequence of procedures is described in the programming console manual.

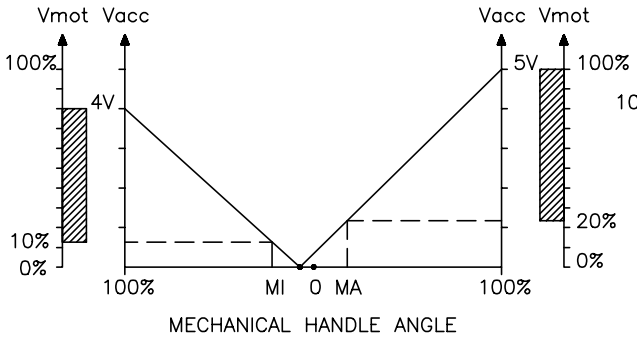


fig. 8a

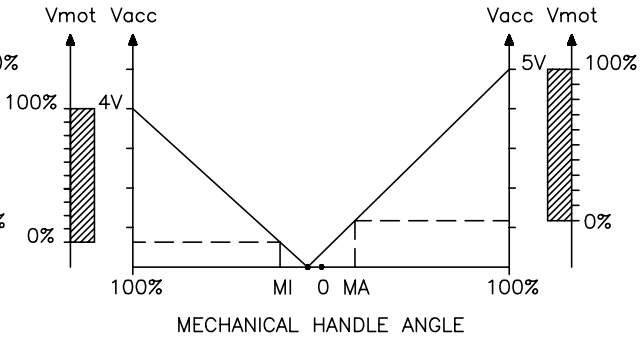


fig. 8b

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 (Fig. 8a) shows the correspondence of the motor voltage without having made the acquisition, while the second graph (Fig. 8b) shows the same correspondence after signal acquisition by the potentiometer. The acquisition procedure is invalidated by the machine if the difference between the maximum value and the minimum value is less than 2V.

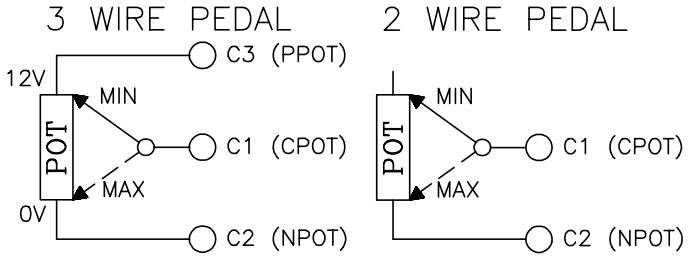
This acquisition procedure makes it possible:

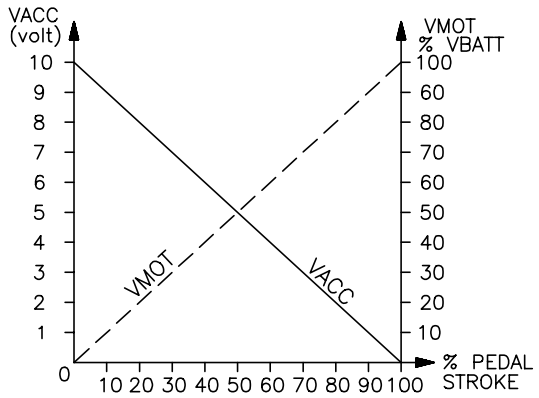
- to use “reversed” potentiometric signals, i.e. those which are carried from a high initial value to a low final value.
- to use a normal potentiometer instead of one with central zero.

For the correct functioning of signal acquisition, it is absolutely necessary that the running microswitches be activated by the same shaft that moves the potentiometer.

Application examples.

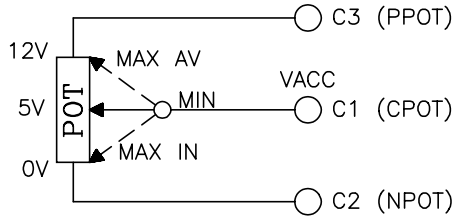
- Signal overturn.

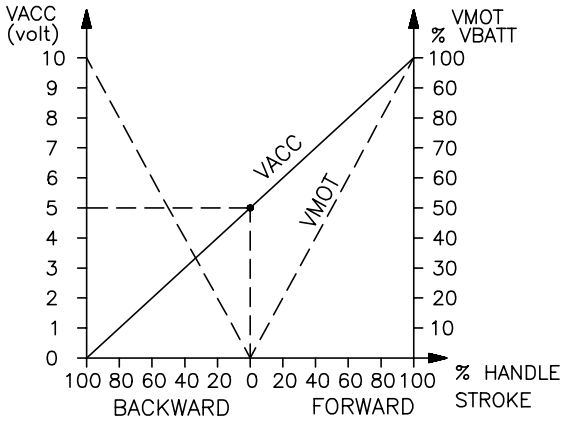




VACC = accelerator signal voltage to pin C1.
VMOT = percentage of batt. voltage on the motor.

- Central zero signal.





2.3 PROTECTION FEATURES

- **Battery inversions:**

  It is necessary to respect the connections indicated in the diagrams in order to avoid damage to the power unit. In the lifting versions, a general contactor may be connected which is handled by the logic against any polarity inversions.
  The logic is intrinsically protected against polarity inversions.

- **Connection errors:**

  All the inputs are protected against connection errors.
  The contactors do not accept loads greater than 3 amp, and are in any case protected against overloads and short circuits.

- **Thermal protection:**

  If the temperature exceeds 80°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%, and in the lifting version all functions except hydrodrive (and descent) are blocked.
  This feature may be excluded by the console.

- **External agents:**

  The chopper body is completely sealed, and thus is protected against splashes of liquid (IP54).

- **Protection against accidental start-up:**

  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 and handle microswitch (or seat microswitch).

- **Protection against uncontrolled movements:**

  The contactors do not close if:

  - the power unit is not functioning
  - the accelerator does not go below the minimum value stored increased by 2 V
  - the logic is not perfectly functional
  - one running microswitch is stuck.

2.4 PERFORMANCE FEATURES

- Optimum sensitivity to low speeds.
- Self-diagnosis with indication of the type of anomaly by an optional LED.
- Configurable from the console (traction or lifting).
- Modification of parameters from the console.
- Internal hour-meter with values that can be displayed on the console.
- Memorisation 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, battery, etc.
- Absence of arc on the contactors
- Internal arc suppressor of the contactors coils.
- High motor and battery efficiency thanks to high frequency commutation.

2.5 H2B CHOPPER DIAGNOSIS

The microprocessor carries out diagnostic procedures on the main chopper functions, involving 4 basic points.

1) Diagnosis on key start-up which includes: watchdog test, current sensor test, VMN test, contactor pilot test, test for running request present, high accelerator test.
2) Standby diagnosis which includes: watchdog test, VMN test, contactor pilot test, current sensor test.
3) Diagnosis while running which includes: watchdog test, VMN test, current test, contactor test, VMN test in complete conduction, contactor opening-closing test.
4) Continuous diagnosis: temperature check, battery charge check.

The diagnostic message is indicated by a certain number of blinks of the LED connected to connector A.
The current alarm message code can be displayed on the programming console.
A description of the alarm codes, possible causes and solutions is given for each configuration in the following sections.

2.6 THERMAL CONSIDERATIONS

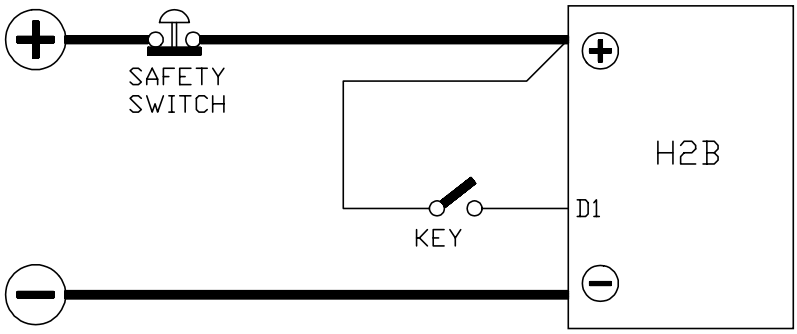
- The heat generated by the control unit must be dissipated. For this to be possible, the compartment must be ventilated and the cooling surfaces ample.
- The cooling system is dimensioned on the basis of the performance required of the machine.
  For situations in which ventilation is poor and heat exchange difficult because of the materials used, we suggest to use forced air ventilation.
- The power dissipated by the module varies depending on the current and the work cycle.

2.7 GENERAL NOTES AND PRECAUTIONS ⚠

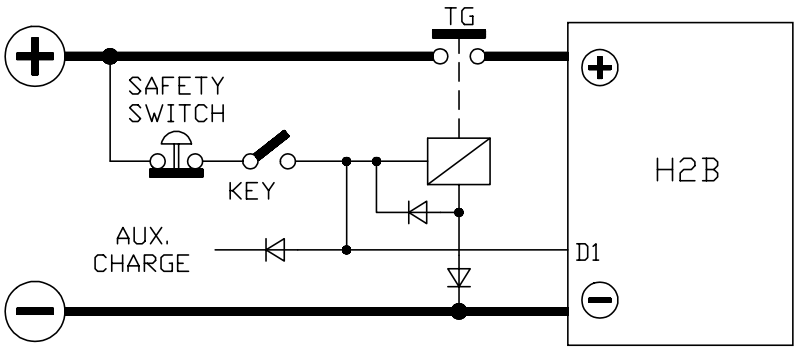
- Never combine SCR low frequency choppers with H2B modules, as the filter condensers contained in the H2B module alter SCR chopper functioning, subjecting it to excessive workloads.
  Thus, if you wish to use two or more control units (e.g. lift + traction), they must all be of the high frequency ZAPIMOS family.
- Do not connect the chopper to a battery with a different nominal voltage than that indicated on the chopper identification plate. A higher battery voltage can cause MOS failure. A lower battery voltage prevents the module from functioning.
- During battery recharge, the H2B module must be completely disconnected from the battery, as, in addition to altering the charge read by the battery charger, the module can be damaged by the overload voltages generated by the charger.
- The H2B module must only be supplied using a traction use battery; do not use outputs of converters or power suppliers. For special applications, please consult the nearest ZAPI service centre.
- Start the machine the first time with the wheels raised, to ensure that connection errors do not create safety risks.
- With the key off, the filter condensers inside the module may remain charged for several minutes.
  For safe operation, we recommend that you disconnect the battery and short circuit the power positive and negative on the chopper for a few seconds with a resistance of between 10 ohm and 100 ohm.
- The susceptibility and the electromagnetic emission are remarkably influenced by the installation conditions. Take particular care of the length, of the electrical connections and of the braided wires.
  Therefore ZAPI declines any responsibility for badrunnings that can be attributed to the above mentioned circumstances, above all if the manufacturer of the machine doesn't carry out the tests required by the regulations in force (conducted emissions, irradiated emissions, IEC 801 - 2 (ESD), IEC 801 - 3 (irradiated susceptibility), IEC 801 - 4 (burst), IEC 801 - 5 (surge), IEC - 6 (conducted immunity)).

2.8 GENERAL CONTACTORS AND SAFETY SWITCH FOR REGENERATIVE MODEL ⚠

- The connection of eventual interruption systems of the battery must be executed scrupulously respecting one of the following wirings.
- With safety switch



- With switch and general contactor



- These circuital solutions are necessary to avoid the chopper fail when the connection to the battery is opened during the phase of regenerative braking.
  The chopper intrinsic protection is active when the voltage on the pin D1 exceeds by 30% the battery normal voltage or when the key is excluded before the opening of the battery connection.

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.
Despite the protection provided against external agents, the continuous attack of corrosive substances may cause the connector contacts to oxidise, thus jeopardising good functioning. Keep this in mind when choosing the installation position on the vehicle.
Use the special holes on the base-plate for fastening the chopper.
Make sure that the wiring of the cable terminals and connectors is carried out correctly.
Fit anti-jamming filters on the horn, solenoid valves, and contactors not connected to the chopper such as those for activating the pump motor or hydrodrive motor, if the latter is not handled by the chopper itself.

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 35 - 50mm².
For the best chopper performance, the cables to the battery should be run side by side and be as short as possible.

3.2 CONTACTORS

Choose the type of contactors on the basis of the maximum operating current of the motor and the specific chopper configuration.

- The current absorbed by the coil must not be greater than 3 amp.
- The coil suppressors are inside the chopper; do not use contactors with arc suppressors.
- For contactors with magnetic suppressors, make sure you respect the polarity indicated on the cap.

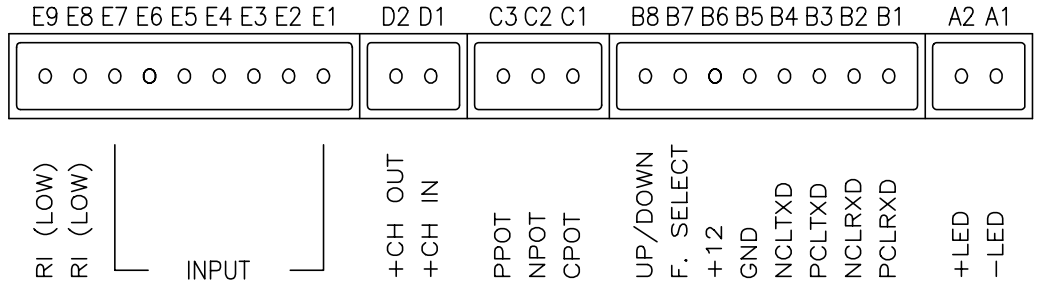
3.3 FUSES

- Use a 10 amp fuse for auxiliary circuit protection.
- 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.

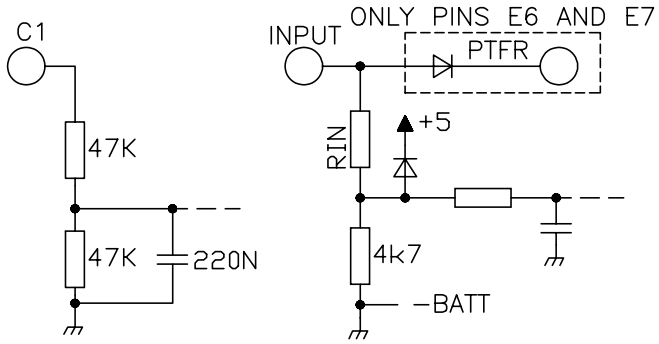
3.4 H2B CONNECTORS



pin	*function*	*description*
A1	-LED	Alarm LED negative: to be connected to the cathode
A2	+LED	Alarm LED positive: to be connected to the anode Output current 12mA, for standard type LED
B1	PCLRXD	Serial reception positive
B2	NCLRXD	Serial reception negative
B3	PCLTXD	Serial transmission positive
B4	NCLTXD	Serial transmission negative
B5	GND	Console supply negative
B6	+12	Console supply positive
B7	FUNCTION SELECT	Channel for mini-console (speed signal)
B8	UP/DOWN	Channel for mini-console (speed ref.)
C1	CPOT	Potentiometer central pin: connected to the potentiometer cursor. For speed regulation, the useful signal ranges from 0 Volt (minimum speed) to 10 V (maximum speed).
C2	NPOT	Potentiometer negative: a battery negative.
C3	PPOT	Potentiometer positive: a 12 V output. Do not short circuit this terminal toward the battery negative or apply a resistive load of less than 500 ohm.
D1	+CH IN	To be connected to the key.
D2	+CH OUT	The positive, to be sent to the function request micros-witches, is taken from this pin. This positive is taken after the internal diode.
E1 E2 E3 E4 E5 E6 E7	INPUT	Pins to which the signals for function request are sent; their meanings varies according to the model selected and pin programming. A detailed description is given in the chapters dedicated to the specific models. Pin E4, if forced to low level, inhibits the effect of pins E8 and E9.
E8	RI (low)	Activates the same request as for pin E4 with a low capacity level (less than 10 V).
E9	RI (low)	Like E8 but electrically disconnected.

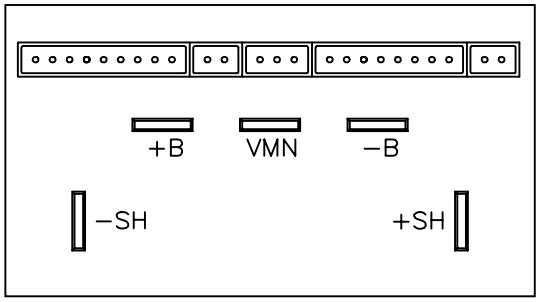
ELECTRICAL CIRCUIT OF INPUT PINS

Pin C1 Pins E1, E2, E3, E4, E5, E6, E7



SYSTEM VOLTAGE	RIN	INPUT SIGNAL LEVEL	
		HIGH	LOW
24	10K	>10V	<50V
48	27K	>20V	<10V
80	47K	>35V	<18V

3.5 H2B POWER CONNECTORS



-SH Output current sense

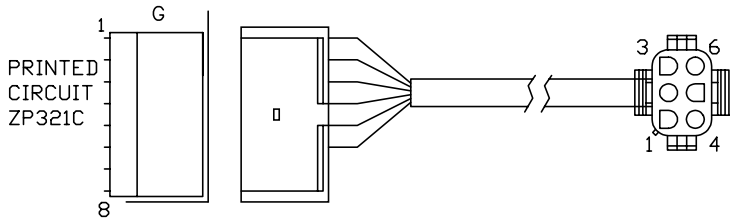
+B Battery positive

VMN Connected to the power mosfet drain, it supplies a negative to the motor with variable duty cycle

-B Battery negative

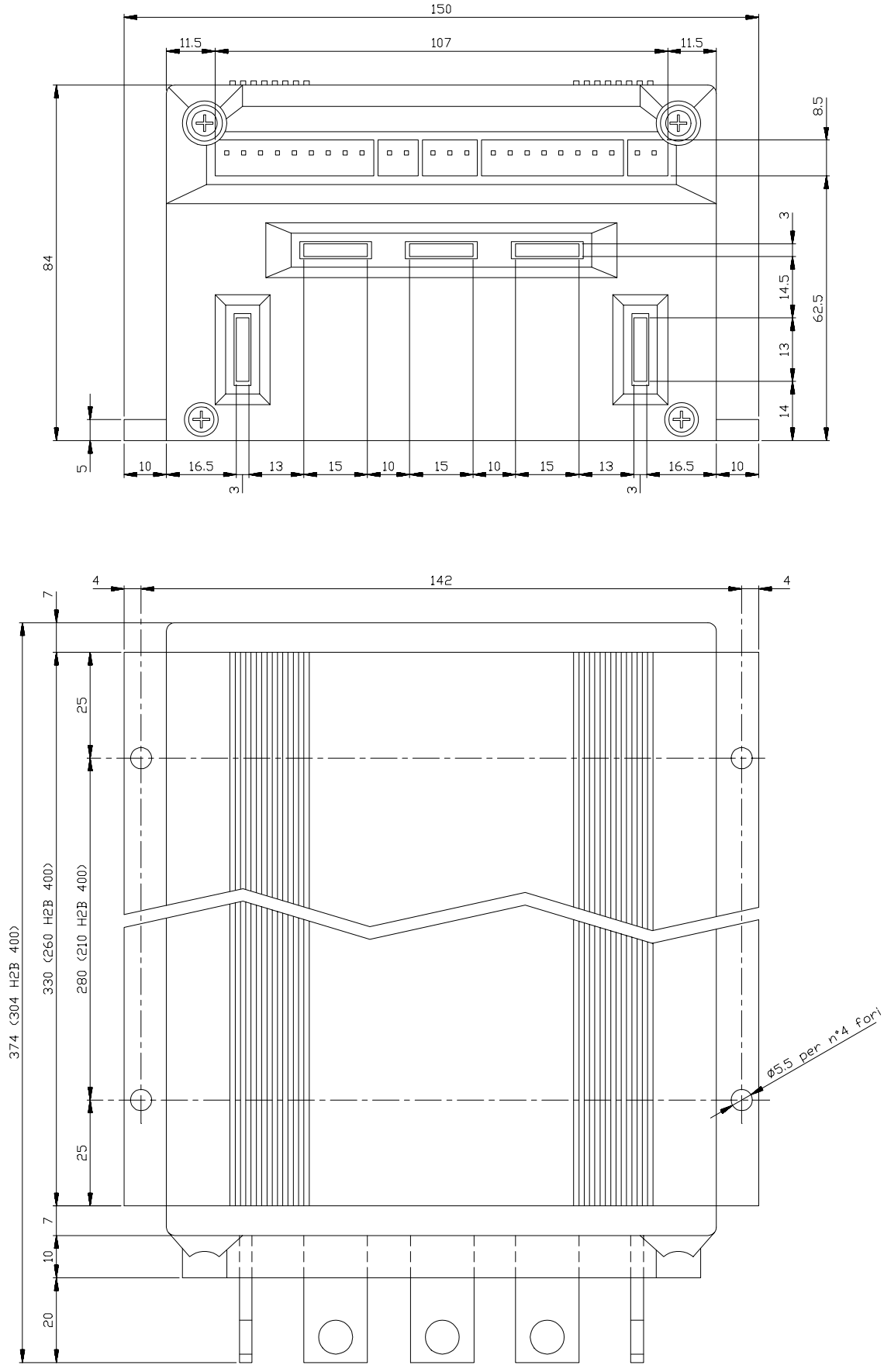
+SH Input current sense

3.6 CONTACTORS CONNECTOR



CONN. G	WIRE COLOUR	CONN.	TRACTION FUNCTION	PUMP FUNCTION
1	white-green	4	Positive of braking contactor PTFR	/
2	red-black	1	Contactors positive PT	Contactors positive PT
3	grey-black	2	Negative field weakening contactor coil NTIND	Negative field weakening contactor coil NTIND
4	blue-black	2	Negative backward contactor coil NTI	Negative main contactor coil NTG
5	red-green	6	Negative braking contactor coil NTFR	Negative proportional electrovalve coil NEVP
6	yellow-black	5	Negative forward contactor coil NTA	Negative hydro contactor coil NTIDR
7	optional	-	Negative of auxiliary contactor AUX G7	/
8	optional	-	Battery negative pole	/

3.7 H2B CHOPPER MECHANICAL DRAWING



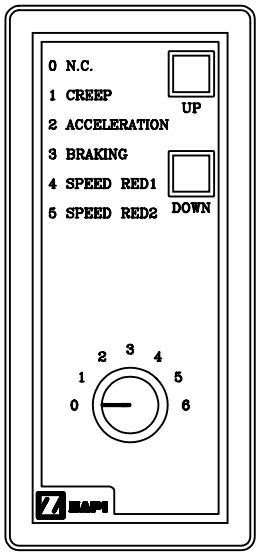
4 . PARAMETER MODIFICATIONS

Modification of the parameters, in addition to the configuration of the inputs, is made directly by ZAPI on customer specifications, or the customer may make adjustments himself using the programming console or the mini-console, (with the later only certain parameters can be modified). 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 (RESTORED) on another chopper, thus allowing fast and standardised calibration (see console manual for details).
Pay special attention to the polarity of the console connector when it is hooked up to the chopper.
HOOKING UP MUST ONLY BE DONE WITH THE MACHINE OFF.

4.1 MODIFYING PARAMETERS USING THE MINI-CONSOLE

The parameters that can be modified are:

	Traction		*Lifting*
1	CREEP SPEED	**1**	1ST SPEED
2	ACCELERATOR DELAY	**2**	2ND SPEED
3	BRAKING	**3**	3RD SPEED
4	CUT BACK SPEED 1	**4**	HYDRO SPEED
5	CUT BACK SPEED 2	**5**	HYDRO COMP.
0	NOT CONNECTED	**0**	NOT CONNECTED



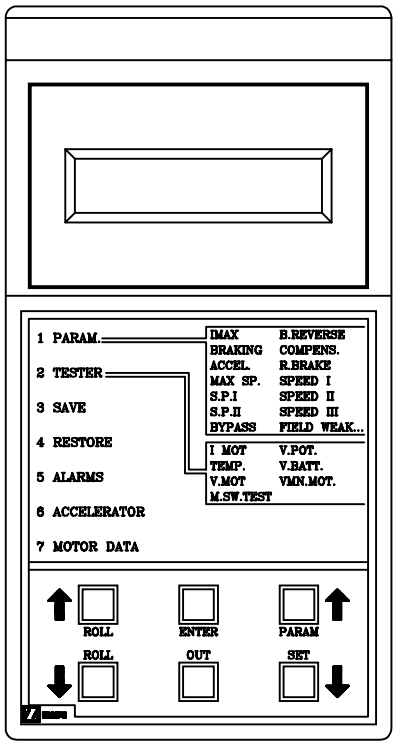
The adjustments are possible within 10 intermediate levels.

- Connect the mini-console to connector (B) on the chopper. (the hook-up MUST BE MADE WITH THE KEY OFF).
- Supply the machine by activating the key.
- Position the dial selector on the function to be modified.
  The SET-UP button increases the value of the parameter, while SET-DOWN decreases it.
  Note: the variations are made through a count of the number of impulses sent from the buttons; thus for increasing or decreasing more than one point, you need to release and then repress the button.
  Keeping the button pressed continuously does not provide continuous variation of the parameters.
- The parameters are modified in real time, making it possible to check the values set immediately.
  The modified parameters are automatically stored by the control logic without the need for confirmation before switching off or disconnecting the console.

Important note: the console does not function if connected when the motor is running. Switch the machine off and on again for activating the console functions.

4.2 MODIFYING PARAMETERS USING THE DIGITAL-CONSOLE

The digital console displays the model type and its built-in hourmeter.



- SEL MODEL
  - REGENER
  - STANDARD TR.
  - STANDARD PUMP
  - PUMP + HYDRO

- SEL OPTION:

PIN G3	bypass / weak
SPEED	free / check
BATTERY	free / check
ARB	free / check
RELEASE	free / braking
HOURS	running / keyon
PIN E1	cut b. 3 / quick I
PIN E4	seat / handle
PIN E2	cut b. 2 / backing
BRAKING	normal / soft

- SEL BATTERY: 24V, 36/40/48V, 60/72/80V, 96V
  fine adjustment

- AUX FUNCTION:
  - CURRENT GAIN
  - HYDRO CONTACTOR
  - BIMOTOR CONTACT.

	traction	**pump**
- PROGRAM:	ACCELERATION DELAY	ACCELERATION DELAY
	INVERS. BRAKING	EV. ACCELER DELAY
	RELEASE BRAKING	DECELER. DELAY
	PEDAL BRAKING EV.	DECELER DELAY
	CUTBACK SP1/SP2/SP3	I MAX.
	AUXILIARY TIME	HYD SPEED COARSE
	COMPENSATION	HYD SPEED FINE
	BRAKING MODULATION	HYDRO COMPENS.
	I MAX.	CREEP SPEED
	MAX SPEED FORW	WEAK DROPOUT
	MAX SPEED BACK	HYDRO TIME
	CREEP SPEED	SPEED COARSE 1/2/3/4
	WEAK DROPOUT	SPEED FINE 1/2/3/4
	CURVE BRAKING	SPEED COMP. 1/2/3/4
	CURVE TIME	MIN VALVE VOLT
	BACKING TIME	MAX VALVE VOLT

		traction	**pump**
-	TESTER:	VMN 30% VMN 80% DIRECTION E7/E6 ACCELERATOR CURRENT TEMPERATURE CUTBACK E1/E2/E3 BRAKE E5 SEAT / HANDLE BATTERY MOTOR VOLTAGE	VMN 30% VMN 80% DIRECTION E7/E6 ACCELERATOR CURRENT TEMPERATURE SPEED E5/E3/E2 SPEED E1/E4 E4 BATTERY MOTOR VOLTAGE

- SAVE : Chopper parameters are stored in the console memory. 10 different memories are available for each chopper model.

- RESTORE : Transfer of parameters from console memory to chopper memory.
  10 different memories are available for each chopper model.

- ALARM : Display of in-chopper memory alarms.

- PROGRAM VACC: Potentiometer stroke parameter.

4.3 CHOPPER CONFIGURATION AND CONNECTIONS DESCRIPTION

The choices made regarding power connections must be communicated to the chopper.
In order to supply this information, you have to connect the chopper to the programming console and access the set model, set options, and set battery menus (see specific configuration descriptions).

- CONFIGURATION OF THE MODEL: SEL MODEL MENU
  Allows chopper to operate in one of the 4 possible modes.
  1) REGENER. TR = regenerative traction
  2) STANDARD TR = standard traction
  3) STANDARD PUMP = standard lifting
  4) PUMP+HYDRO = lifting with hydrodrive contactor handling
- CONFIGURATION OF OPTIONS: SEL OPTIONS MENU

function/pin	option	meaning
PIN G3	**Bypass**	Bypass contactor
	Weak	Weakening contactor.
SPEED	**Free**	No speed check.
	Check	Speed check activated.
BATTERY	**Free**	No low battery charge alarm.
	Check	Low charge alarm with 50% max. current if less than 10% of charge.
ARB	**Free**	No Anti-rollback.
	Check	Anti-rollback handled.
RELEASE	**Free**	No regenerative braking at release.
	Braking	Release braking.
HOURS	**Running**	Hour-metre active only when running.
	Key on	Hour-metre active with key on.
PIN E1	**Cut b.#3**	E1 = Reduction of speed no.3.
	Quick I	E1 = Rapid inversion input.
PIN E4	**Seat**	E4 = Seat microswitch.
	Handle	E4 = Handle microswitch.
PIN E2	**Cut b.#2**	E2 = Speed reduction no.2.
	Backing	E2 = Back request with speed relative to cutback speed #2 and timing of backing time parameter.

- SELECTION OF BATTERY VOLTAGE: SEL BATTERY MENU
  Makes it possible to set the nominal voltage of the battery for handling the charge status and tester functions.
  With ROLL UP/ROLL DOWN buttons it is possible to select battery nominal voltage.
  With SET UP/SET DOWN buttons it is possible to make fine adjustments of battery voltage.

- AUXILIARY FUNCTION: It allows the aux output of the connector G7 to be active under certain conditions. We can set it in the following way:

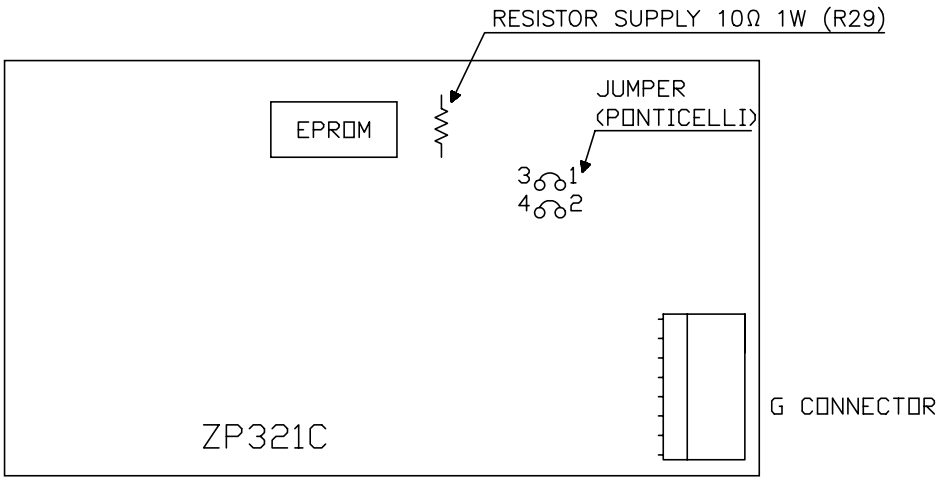
1) CURRENT GAIN: It is the logic board standard way of working. The output AUX G7 is not used. (Jumper setting: 1-3; 2-4)

2) HYDRO CONTACTOR: The output AUX G7 commands the hydrodrive contactor. It should be active during both forward and backward directions and during release braking. The turning OFF delay is programmable at "AUXILIARY TIME". (Jumper setting: 1-2; 3-4)

3) BIMOT. CONTACTOR: AUX G7 output is activated when turning from off status to running status and at the beginning of regenerative braking, and it is switched off when PWM is greater than 20%, both statuses.

NOTE: It is necessary to adjust the jumper configuration on the chopper electronic board depending upon previous program set. Mismatchings cause the power section of the chopper to be damaged as well as mis functioning.

- For each setting we should set the jumpers (J 1, 2, 3, 4) configuration on the logic board.

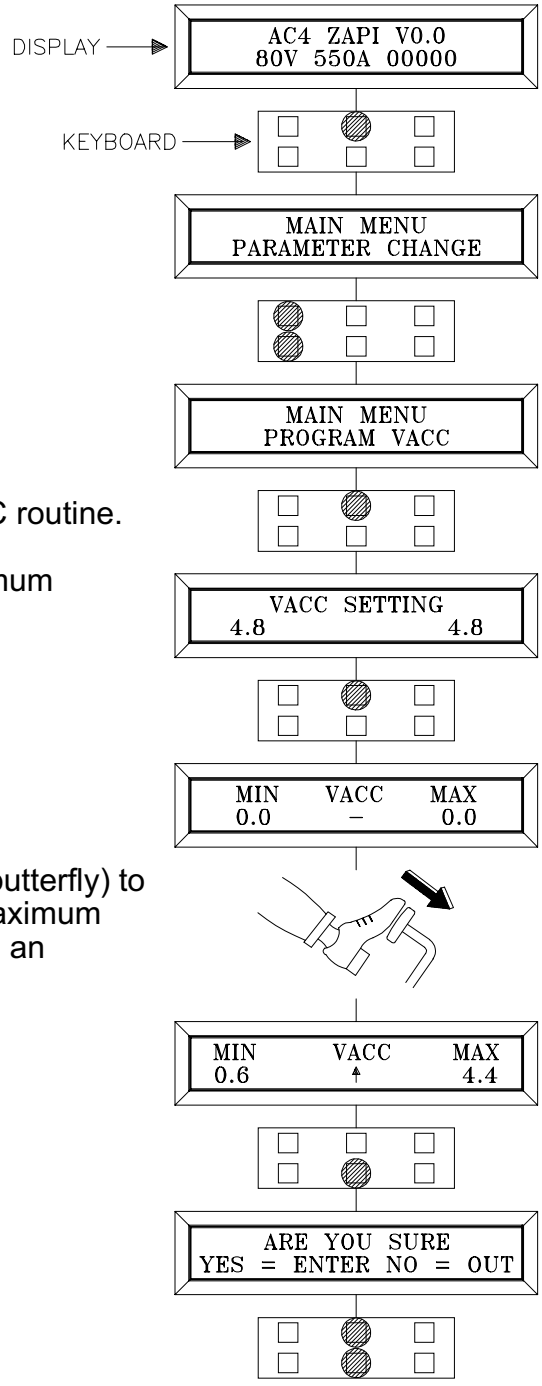


DESCRIPTION OF CONSOLE PROGRAM VACC FUNCTION

This function looks for and remembers the minimum and maximum potentiometer wiper voltage over the full mechanical range of the pedal. It enables compensation for non symmetry of the mechanical system between directions.
The operation is performed by operating the pedal after entering the PROGRAM VACC function.

Flow Chart showing how to use the PROGRAM VACC function of the Digital Console.

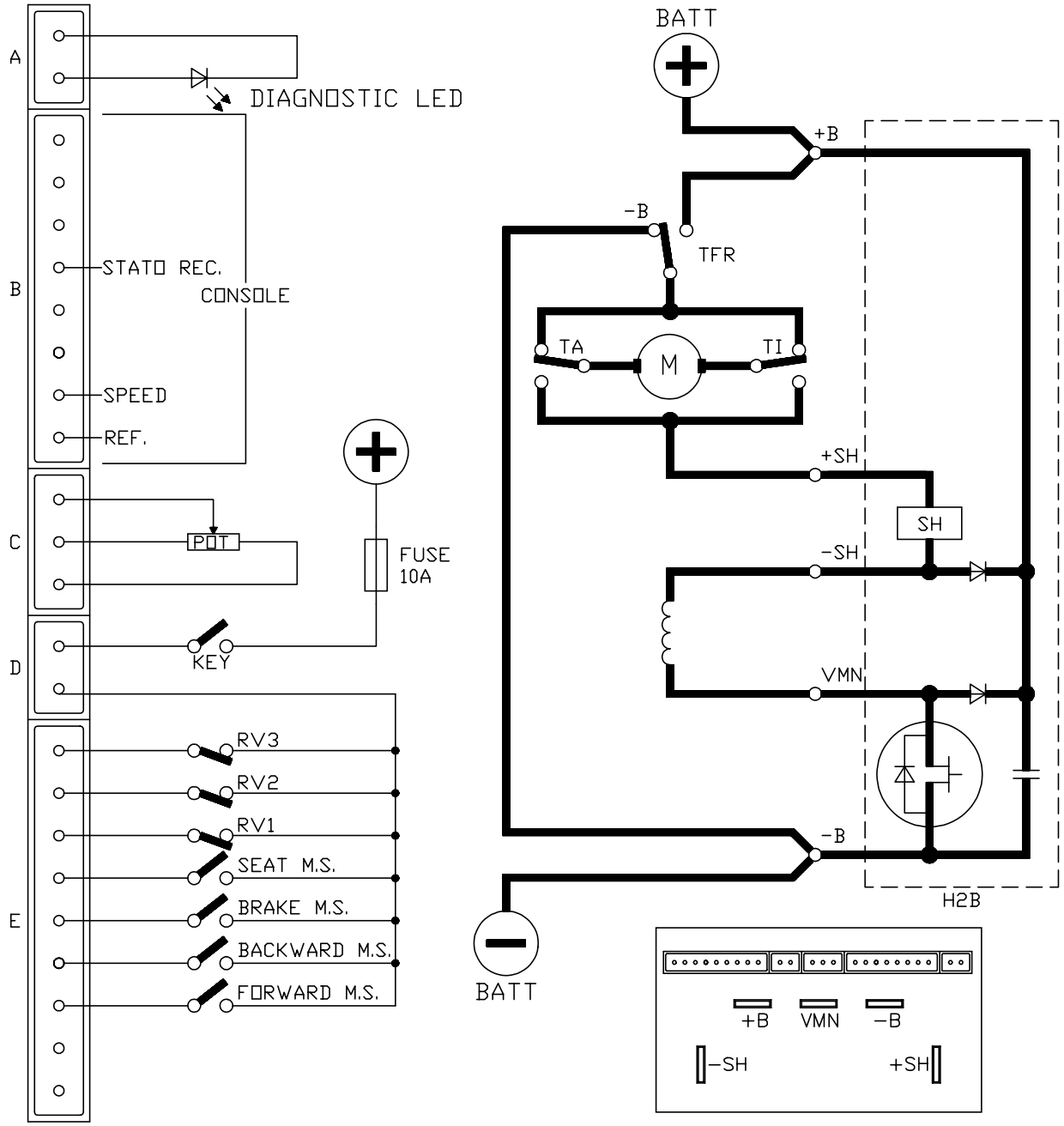
1) Opening Zapi Display.
2) Press ENTER to go into the General Menu.
3) The Display will show :
4) Press ROLL UP or ROLL DOWN button until PROGRAM VACC appears on the display.
5) Tthe Display will show :
6) Press ENTER to go into the PROGRAM VACC routine.
7) The Display will show the minimum and maximum values of potentiometer wiper output. Both directions can be shown.
8) Press ENTER to clear these values. Display will show 0.0.
9) Select Forward Direction, close any interlock switches that may be in the system.
10) Slowly depress the accelerator pedal (or tiller butterfly) to its maximum value. The new minimum and maximum voltages will be displayed on the Console plus an arrow indicating the direction.



5 TRACTION

5.1 H2B REGENERATIVE TRACTION

- Input for 3-wire potentiometer (optional 2-wire on request)
- 3 speed reductions
- Input for handle microswitch or seat microswitch (delayed 2 sec)
- Input for rapid inversion signal
- Input for brake pedal microswitch
- Weakening or bypass contactor handling
- Maximum speed control
- Backing request with associated speed and programmable timing



5.1.1 Input connector description

E1	RV3 / QUICK I	Input for 3rd speed reduction request. The request is active when the pin is disconnected. To disconnect link to +CH or adjust to level 9 the corresponding speed. This pin can be programmed as input for rapid inversion signal, the safety is active when pin is opened.
E2	RV2 / BACKING	Input for 2nd speed reduction request. The request is active when the pin is opened (low level) and disconnected if the pin is positive (high level) or the speed is programmed to level 9. If it is programmed as back request (backing), when the pin is taken to a low level combined with a running request, the running is activated with setted speed through the parameter "CUTBACK 2" according to the values defined at the point "BACKING SPEED" of the adjustment chart and for a time with the parameter "BACKING TIME". When this function is required it isn't necessary to active the pin E4 (SEAT MICROSWITCH)
E3	RV1	Input for 1st speed reduction request which is active when pin is opened. The activation of this reduction is combined with an intensity braking and programmable length (curve braking) It is possible to eliminate the braking in curve programming curve time as 0.
E4	MSED / HANDLE	Input for seat microswitch signal (delayed 2 sec.) if the pin is taken to a high potential the running is active, the delay isn't executed if the pin is programmed as tiller-handle.
E5	MF	Input for brake pedal microswitch when the pin is taken high (+VB) during a release braking phase the braking current is the one programmed at the parameter "PEDAL BRAKING" plus a value that is proportional to the accelerator signal and to the parameter "BRAKING MODUL", If the brake is pressed during the usual running the current is reduced by 50% and the speed No. 2 reduction is activated.
E6	MI	Input for backward request signal. The request is active when the signal is high (+VB)
E7	MA	Input for forward request signal. The request is active when the signal is high (+VB)
E8		Same as pin E4 but active when signal is low
E9		Same as E8

B4	STATE REC.	During the energy recovery phase the output is activated (that's to say that the output is taken to a low level). It is used for the control of the state of the battery charge level of the instrument "ZILB 93".
B7	SPEED SIGNAL*	Input for the speed signal caming from a trasducer speed / voltage. The range admitted by the signal is from 0V to 5V.
B8	SPEED REF*	Input for the reference speed signal. On this pin it is fixed the voltage corresponding to the relative speed which must not be exceeded on the pin B7, range admitted from 0V to 5V.

* This function is active when the option "speed" is programmed in the "check" way.

5.1.2 Programmable functions (OPTIONS)

- The options can be programmed from the console using the “sel options” menu

function/pin	***option***	***description***
1) PIN G3	**bypass**	The contactor connected to connector G3 is handled as a bypass, with activation current = 80%Imax., output current = 90%Imax., activation delay=800 msec.
	weak	The contactor connected to connector G3 is handled as weakening, with activation current = 50% of the programmable output current (WEAK DROP OUT) from 10% to 100% Imax. Activation delay=800 msec.
2) SPEED	**free**	Speed check not active. The mini-console can be used with this option.
	check	Speed check active. At input “B8”, a reference potential between 1 and 5 V is applied, at “B7” an analogue signal proportional to the speed is applied. When the signal on connector B7 exceeds that of reference on B8, the machine begins to reduce the motor voltage or brakes if the difference persists. This braking state remains until the signal on B7 becomes less than that of B8. Sampling is made once every 60 msec. Note: when the speed check option is active, the mini-console cannot be used.
3) BATTERY	**free**	No low battery charge alarm.
	check	Activates the check that reads the battery voltage in standby. When the residual charge is less than 10%, the maximum current is halved and the LED blinks continuously.

4)	**ARB**	**free**	No anti-rollback.
		check	Anti-rollback.
5)	**RELEASE**	**free**	No regenerative braking at release.
		check	Braking active at the moment of pedal release with increment of the braking current by means of the brake pedal.
6)	**HOURS**	**running**	Hour-metre only active when running.
		key on	Hour-metre active with the key on.
7)	**PIN E1**	**cut b.#3**	Associates the function of no.3 speed reduction request to the E1 connector.
		quick I	Associates at the connector E1 with the following characteristics: plugging with 1.2 x Imax, restart in forward direction with 0.5 x Imax and slower acceleration (to avoid wheel slippering). Also the truck will stop if the safety button is released and a forward or reverse request is present. The QUICK I function is active if the request of motion in the direction opposite to the forks is present and if the safety button pushes on the operator. Associates the function for rapid inversion to connector E1.
8)	**PIN E4**	**seat**	The input of running enable by the seat microswitch is associated to connector E4: the seat microswitch - running microswitch temporal sequence is requested. Delay of 2 seconds on deactivation.
		handle	Like the “seat” option but without delay.
9)	**PIN E2**	**cut b.#2**	Associates the speed reduction no.2 to the pin E2.
		backing	Associates the pin E2 to the backward request. It enables to execute a timed movement with no seat microswitch. The backing request and a forward/backward request should be simultaneous. Under these conditions the acceleration pedal has no effect. Also the system has a fixed speed that is defined and the "BACKING SPEED" chart, programmable through the CUT BACK SP.2 parameter for a time programmable with the BACKING TIME parameter.
10)	**BRAKING**	**Normal**	Every braking current is handled at normal values as showed on the adjustments chart.
		Soft	Every braking current is reduced by 25% when the soft way is selected it is necessary that the jumpers in the card are configured 1-3 and 2-4, and that the maximum current level (IMax) is programmed to a value not inferior to Six.

5.1.3 Parameter modification (PROGRAM MENU)

The parameters can be modified with the chopper in standby or running.
In the latter case, you must return to standby before switching off the chopper so that the modifications are stored in the nonvolatile memory.
Regenerative traction parameters.

1) **ACCELER DELAY** = acceleration time, i.e. the minimum time during which the motor voltage varies from 0V to the maximum.
2) **INVERS BRAKING** = basic braking current in direction inversion. A value is added to this value based on the accelerator plus a fixed increment every second.
3) **RELEASE BRAKING = release** braking current (should have the lowest value).
4) **PEDAL BRAKING** = release braking current with brake pedal pressed.
5) **CUTBACK SP.1** = reduction of speed no.1 (relative to input E3). A braking is also associated (curve braking); the accelerator is reduced.
6) **CUTBACK SP.2** = reduction of speed no.2 associated to input E2.
   If the pin E2 input option is configured in the backing way , this parameter defines the backing speed whose adjustment values are defined at the point "BACKING SPEED" of the adjustment chart.
7) **CUTBACK SP.3** = reduction of speed no.3 associated to input E1.
8) **AUXILIARY TIME =** Auxiliary contactor activating time connected to the G7 output (request option or hardware modifications are necessary, see p.18)
9) **COMPENSATION** = compensation of the speed (motor voltage) on the basis of the current when the speed reductions are active.
10) **BRAKING MODULATION** = defines the maximum current in inversion braking with the acelerator pedal pressed. When the accelerator is pressed all the way down in inversion, braking becomes more brusque the higher the value of the parameter.
11) **IMAX** = defines the maximum current of the chopper both when running and in braking. All the current adjustments are expressed as a percentage of this value. The adjustment interval is from 50% (level 0) to 100% (level 9).
12) **MAX SPEED FORW** = Max speed wit forward direction on. This speed reduction goes under adjustable compensation with the COMPENSATION parameter.
13) **MAX SPEED BACK =** Max speed wit backward direction on. This speed reduction goes under adjustable compensation with the COMPENSATION parameter.
14) **CREEP SPEED** = defines the minimum voltage applied to the motor with the running request activated. Provides a more immediate response in starting off.
15) **WEAK DROPOUT** = threshold of current for opening the weakening contactor (if programmed as such and not as bypass, in which case the output threshold is fixed and not programmable).
16) **CURVE BRAKING** = current for curve braking, activated with RV1 request, if the PWM is greater than 80% and the motor current less than 40%Imax.
17) **CURVE TIME** = curve braking time associated to RV1. If 0, braking is not carried out.
18) **BACKING TIME =** backing request activating time delay. If programmed at level 9 there is no time delay and the on status is present if a request is present.

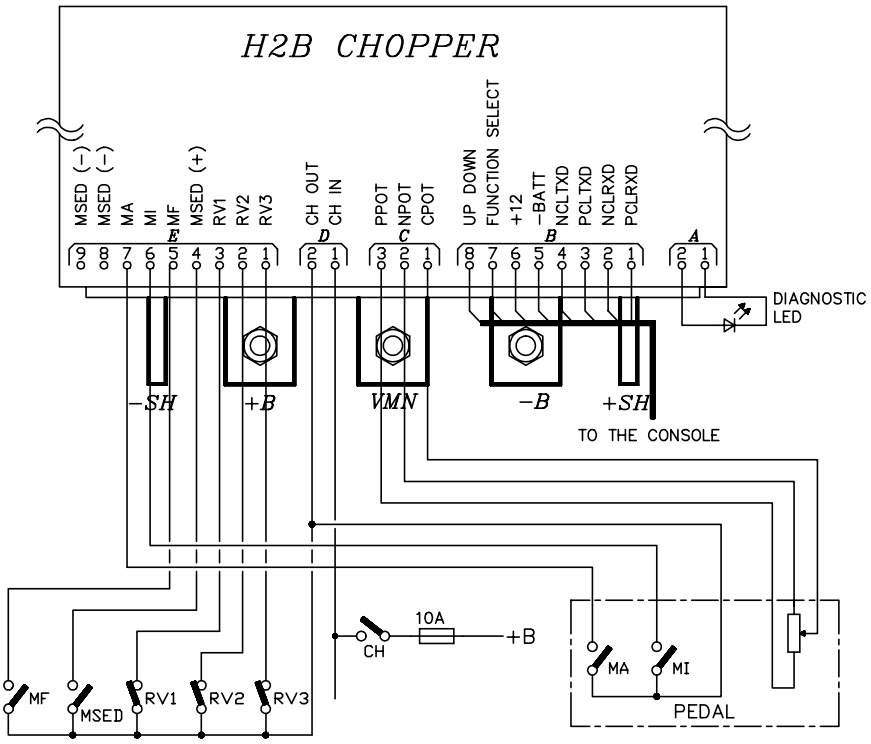
5.1.4 Adjustments chart

PARAMETER	UNIT	PROGRAMMED LEVEL									
		0	1	2	3	4	5	6	7	8	9
ACCELERATION DELAY	Sec.	0.41	0.82	1.2	1.6	2	2.4	2.9	3.3	3.7	4.1
INVERS BRAKING	% IMax.	19	23	28	32	37	41	46	50	55	59
RELEASE BRAKING	% IMax.	15	19	23	27	31	34	38	42	46	50
PEDAL BRAKING	% IMax.	25	31	37	43	49	56	62	68	74	80
CUTBACK SP. (1-2-3)	% VBatt.	10	22	33	45	53	60	69	78	86	100
COMPENSATION	K (I)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
BRAKING MODUL	% IMax.	0	3	5	8	11	14	17	20	22	25
I MAX. (H2 600)	Amp.	300	333	367	400	433	467	500	533	567	600
I MAX. (H2 500)	Amp.	250	278	306	333	361	388	416	444	472	500
I MAX. (H2 400)	Amp.	200	222	244	266	289	311	333	355	378	400
MAX. SPEED FORW-BACK	% VBatt.	20	29	38	47	56	64	73	82	91	100
CREEP SPEED	% VBatt.	0	1.9	3.9	5.9	7.8	9.8	11.7	13.7	16.6	17.6
WEAK DROPOUT	% IMax.	10	20	30	40	50	60	70	80	90	100
CURVE BRAKING	% IMax.	15	19	23	27	31	34	38	42	46	50
CURVE TIME	sec.	0	0.2	0.3	0.4	0.6	0.8	1	1.2	1.6	2
AUXILIARY TIME	sec.	0.1	0.5	2	4	7	9	12	14	17	20
BACKING TIME	sec.	0.05	0.2	0.35	0.5	0.75	1	1.5	2	2.5	cont.
BACKING SPEED	% VBatt	2	4	8	10	15	20	25	30	40	50

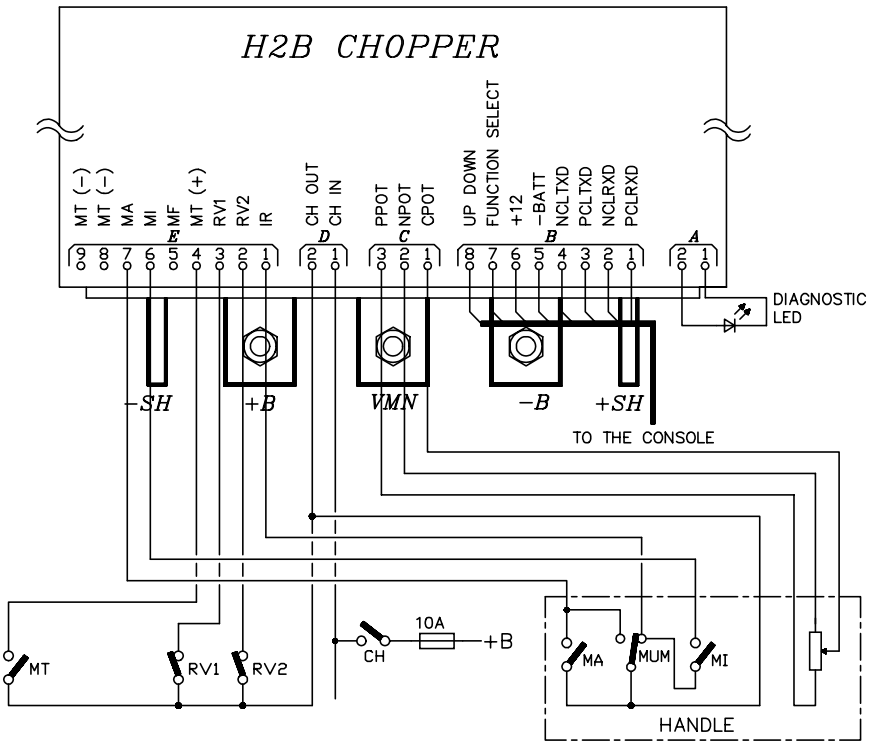
Variant for braking soft

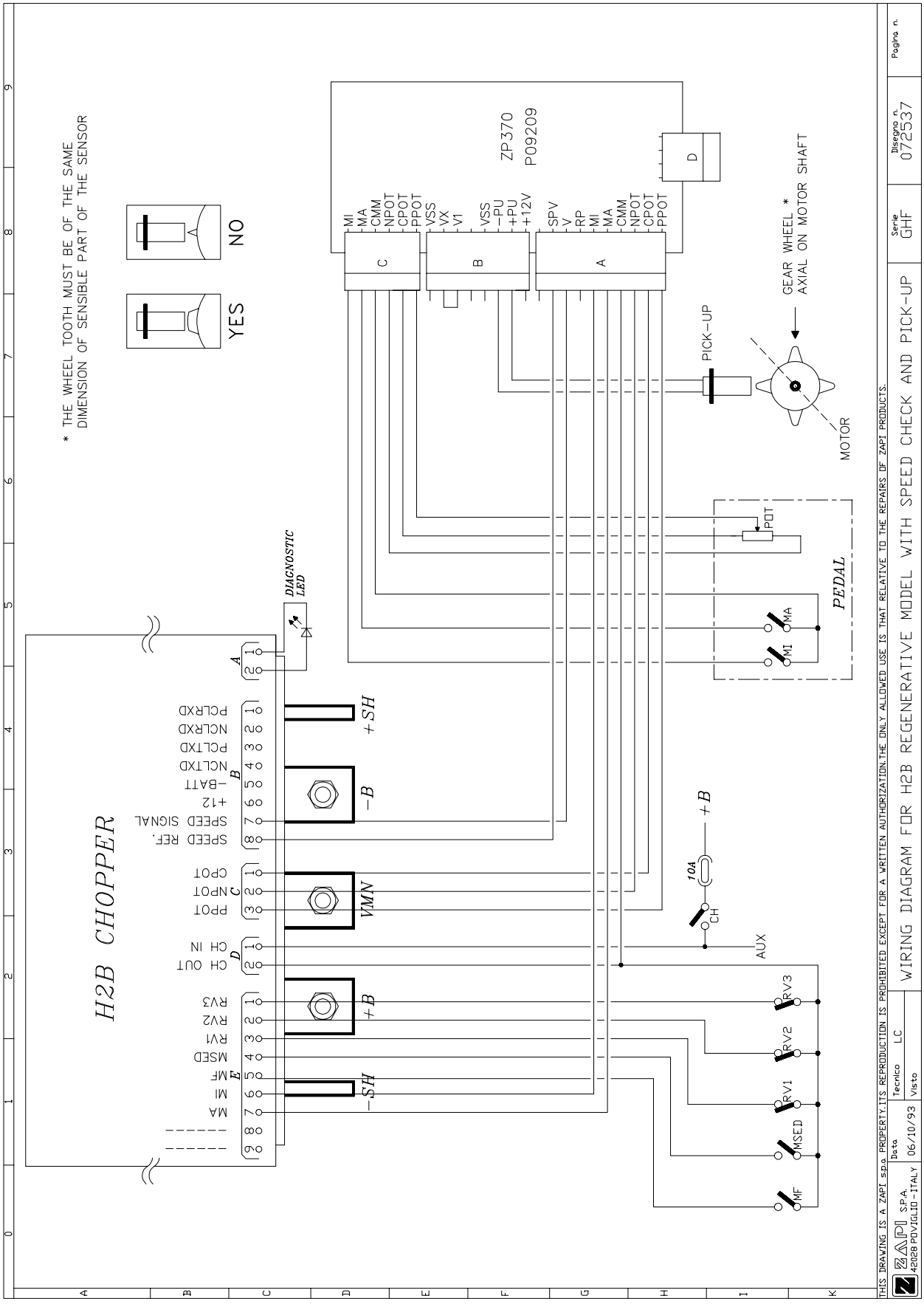
PARAMETER	UNIT	PROGRAMMED LEVEL									
		0	1	2	3	4	5	6	7	8	9
RELEASE BRAKING	% IMax.	7	11	15	19	23	26	30	34	38	42
INVERS BRAKING	% IMax.	14	17	21	24	28	31	35	37	41	37
PEDAL BRAKING	% IMax.	19	23	28	32	37	42	46	51	55	60
BRAKING MODUL	% IMax.	0	2	4	6	8	10	13	15	16	19
CURVE BRAKING	% IMax.	11	14	17	20	23	25	28	31	34	37

5.1.5 Wiring diagram for H2B regenerative model with pedal



5.1.6 Wiring diagram for H2B regenrative model with handle




WIRING DIAGRAM FOR H2B REGENERATIVE MODEL WITH SPEED CHECK AND PICK-UP
H2B CHOPPER
ZP370
P09209
PEDAL
PICK-UP
MOTOR
GEAR WHEEL *
AXIAL ON MOTOR SHAFT
* THE WHEEL TOOTH MUST BE OF THE SAME
DIMENSION OF SENSIBLE PART OF THE SENSOR
YES
NO
DIAGNOSTIC LED
+SH
-B
VMN
+B
-SH
104
AUX
RV1
RV2
RV3
MSED
MF
MA
MI
POT
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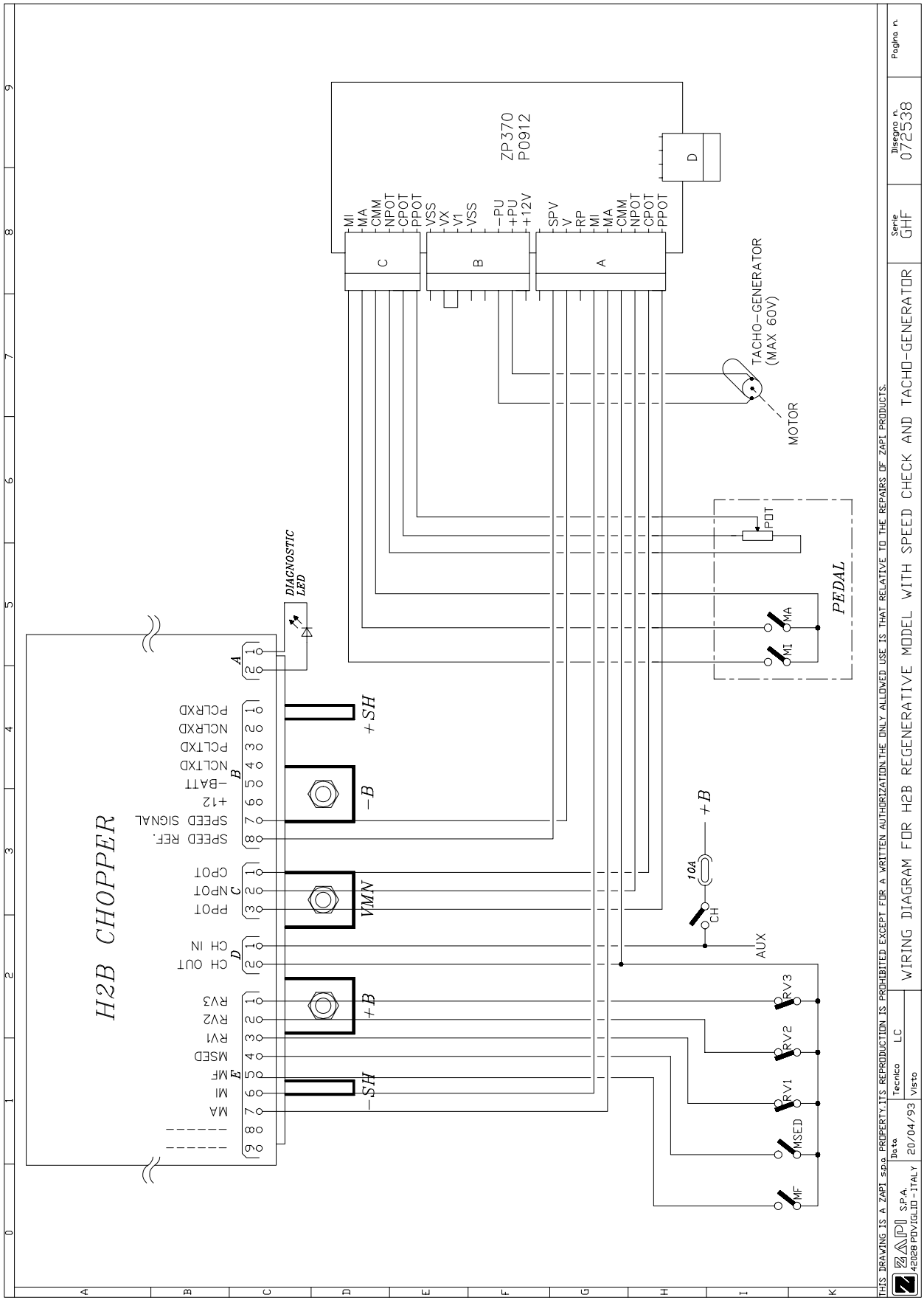
Data 06/10/93
Tecnico LC
Visto
Serie GHF
Disegno n. 072537
Pagina n.


H2B CHOPPER
DIAGNOSTIC LED
+SH
-B
VMN
+B
-SH
+B
10A
CH
AUX
TACHO-GENERATOR (MAX 60V)
MOTOR
PEDAL
POT
MA
MI
RV3
RV2
RV1
MSED
MF
ZP370 P0912
WIRING DIAGRAM FOR H2B REGENERATIVE MODEL WITH SPEED CHECK AND TACHO-GENERATOR
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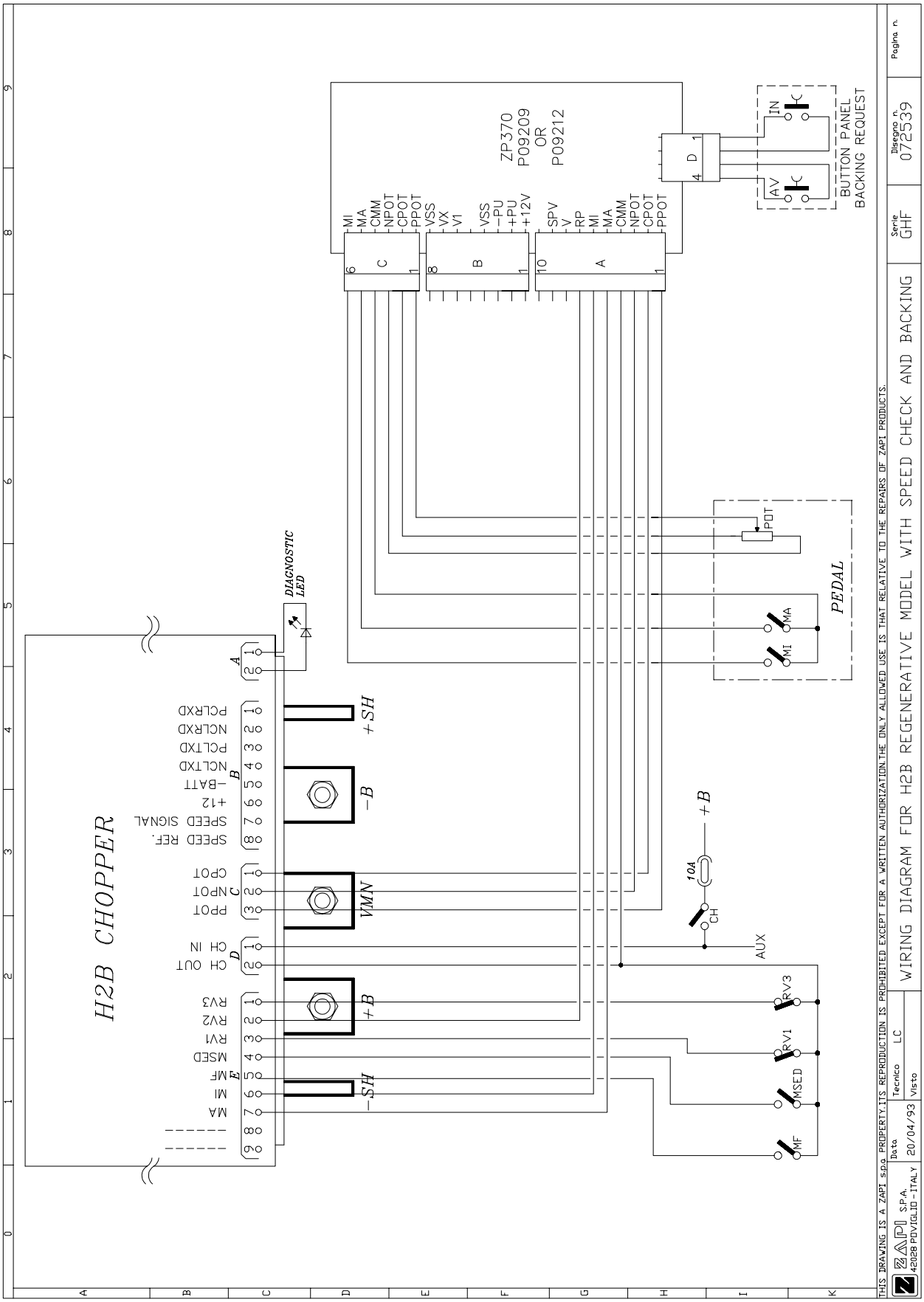
H2B CHOPPER
WIRING DIAGRAM FOR H2B REGENERATIVE MODEL WITH SPEED CHECK AND BACKING
PEDAL
BUTTON PANEL
BACKING REQUEST
ZP370
P09209
OR
P09212
DIAGNOSTIC LED
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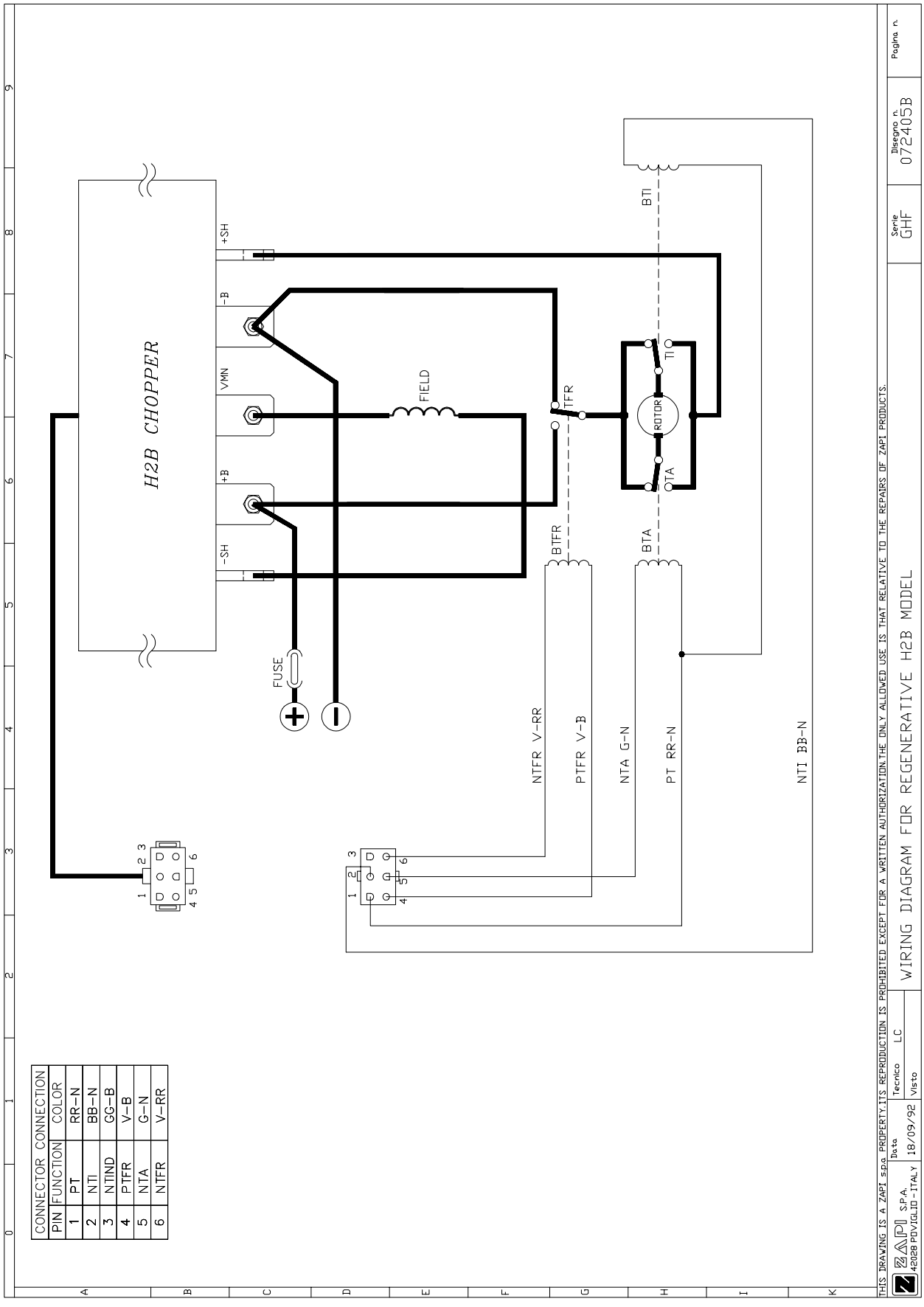
CONNECTOR CONNECTION
PIN FUNCTION COLOR
1 PT RR-N
2 NTI BB-N
3 NTIND GG-B
4 PTFR V-B
5 NTA G-N
6 NTFR V-RR
H2B CHOPPER
+SH
-B
VMN
+B
-SH
FUSE
FIELD
TFR
BTFR
BTA
BTI
ROTOR
TI
TA
NTFR V-RR
PTFR V-B
NTA G-N
PT RR-N
NTI BB-N
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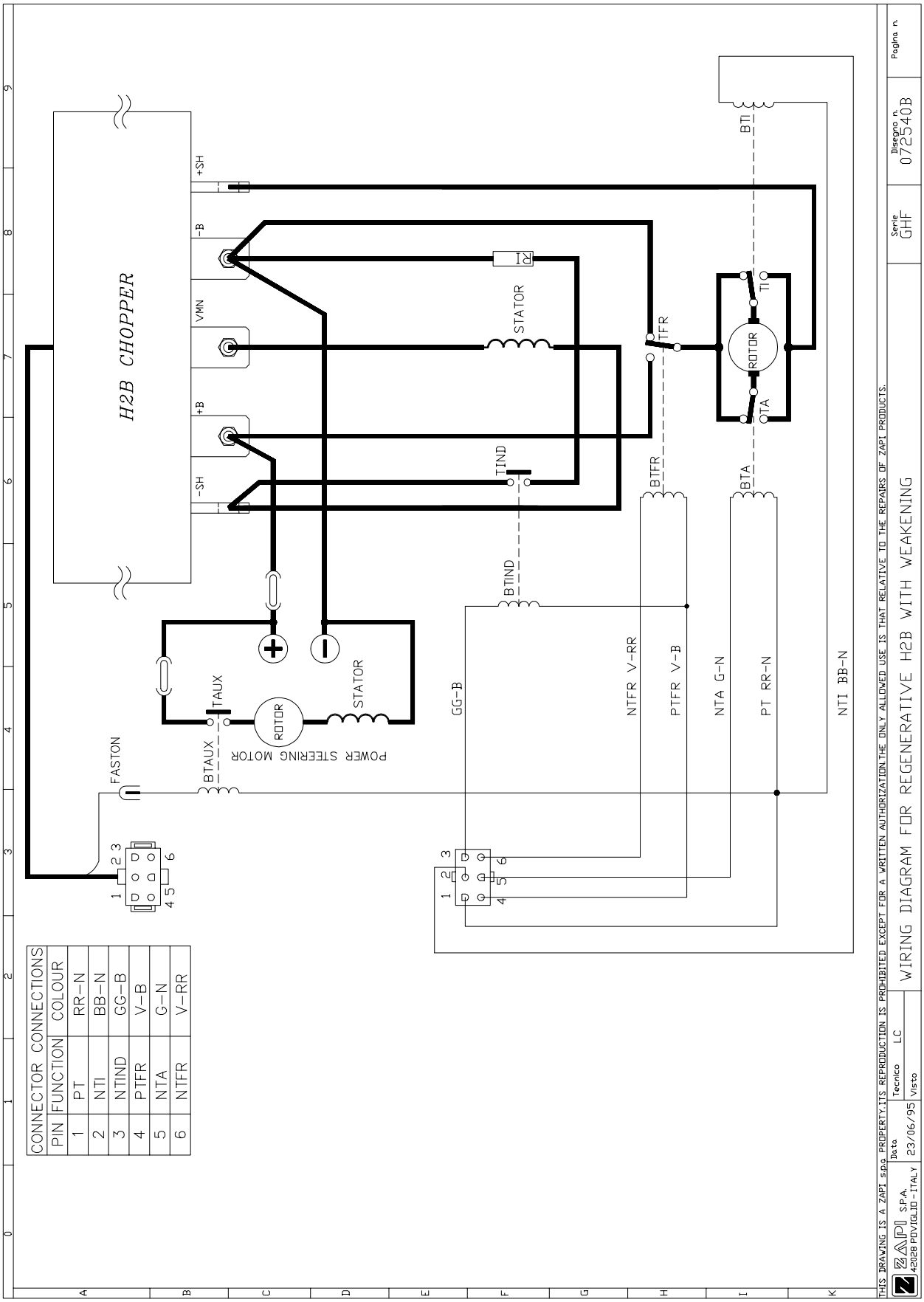
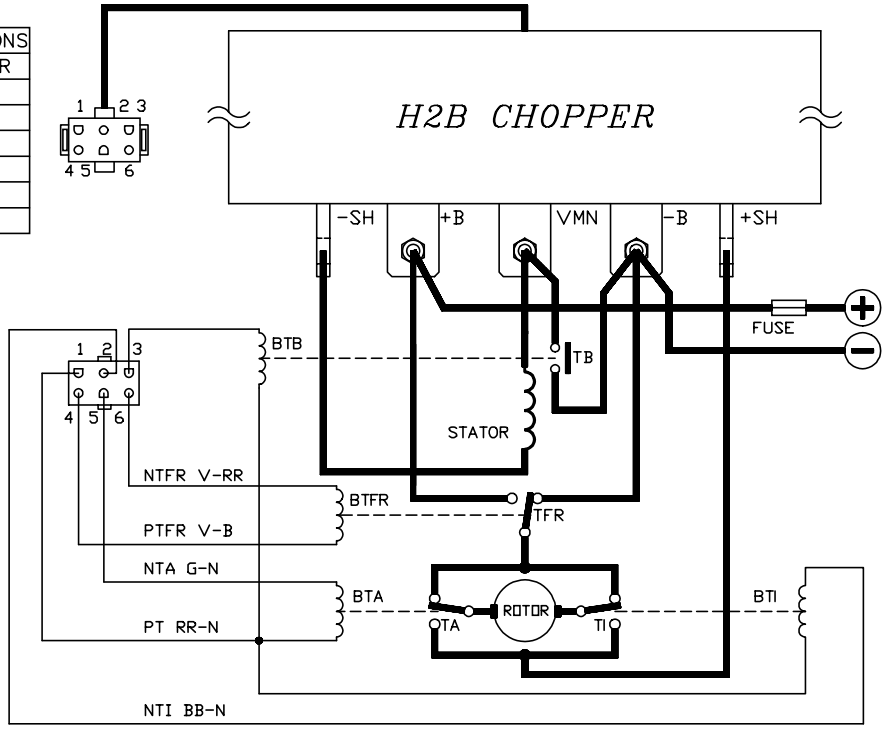
42028 POVIGLIO-ITALY
Data 18/09/92
Tecnico LC
Visto
WIRING DIAGRAM FOR REGENERATIVE H2B MODEL
Serie GHF
Disegno n. 072405B
Pagina n.


H2B CHOPPER
+SH
-B
VMN
+B
-SH
STATOR
RI
TFR
BTI
TI
ROTOR
TA
TIND
BTFR
BTA
BTIND
BTAUX
TAUX
ROTOR
STATOR
POWER STEERING MOTOR
FASTON
GG-B
NTFR V-RR
PTFR V-B
NTA G-N
PT RR-N
NTI BB-N
1 2 3
4 5 6
CONNECTOR CONNECTIONS
PIN FUNCTION COLOUR
1 PT RR-N
2 NTI BB-N
3 NTIND GG-B
4 PTFR V-B
5 NTA G-N
6 NTFR V-RR
THIS DRAWING IS A ZAPI s.p.a. PROPERTY. ITS REPRODUCTION IS PROHIBITED EXCEPT FOR A WRITTEN AUTHORIZATION. THE ONLY ALLOWED USE IS THAT RELATIVE TO THE REPAIRS OF ZAPI PRODUCTS.
ZAPI S.P.A. 42028 PIVIGLIO -ITALY
Data 23/06/95
Tecnico LC
Visto
WIRING DIAGRAM FOR REGENERATIVE H2B WITH WEAKENING
Serie GHF
Disegno n. 072540B
Pagina n.

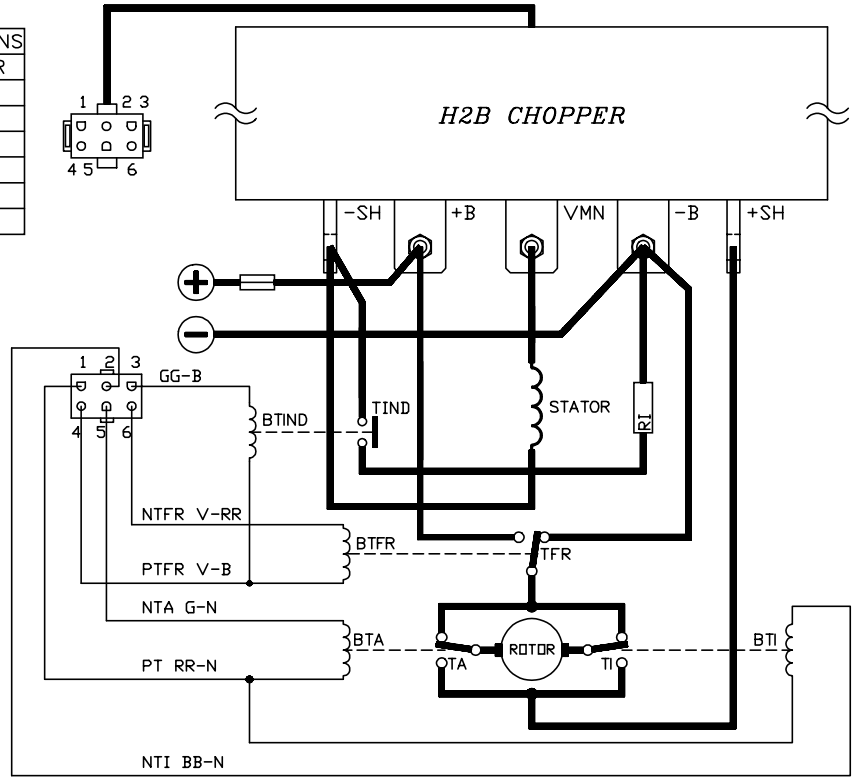
5.1.12 Wiring diagram for H2B power unit regenerative with by-pass

CONNECTOR CONNECTIONS		
PIN	FUNCTION	COLOUR
1	PT	RR–N
2	NTI	BB–N
3	NTB	GG–B
4	PTFR	V–B
5	NTA	G–N
6	NTFR	V–RR



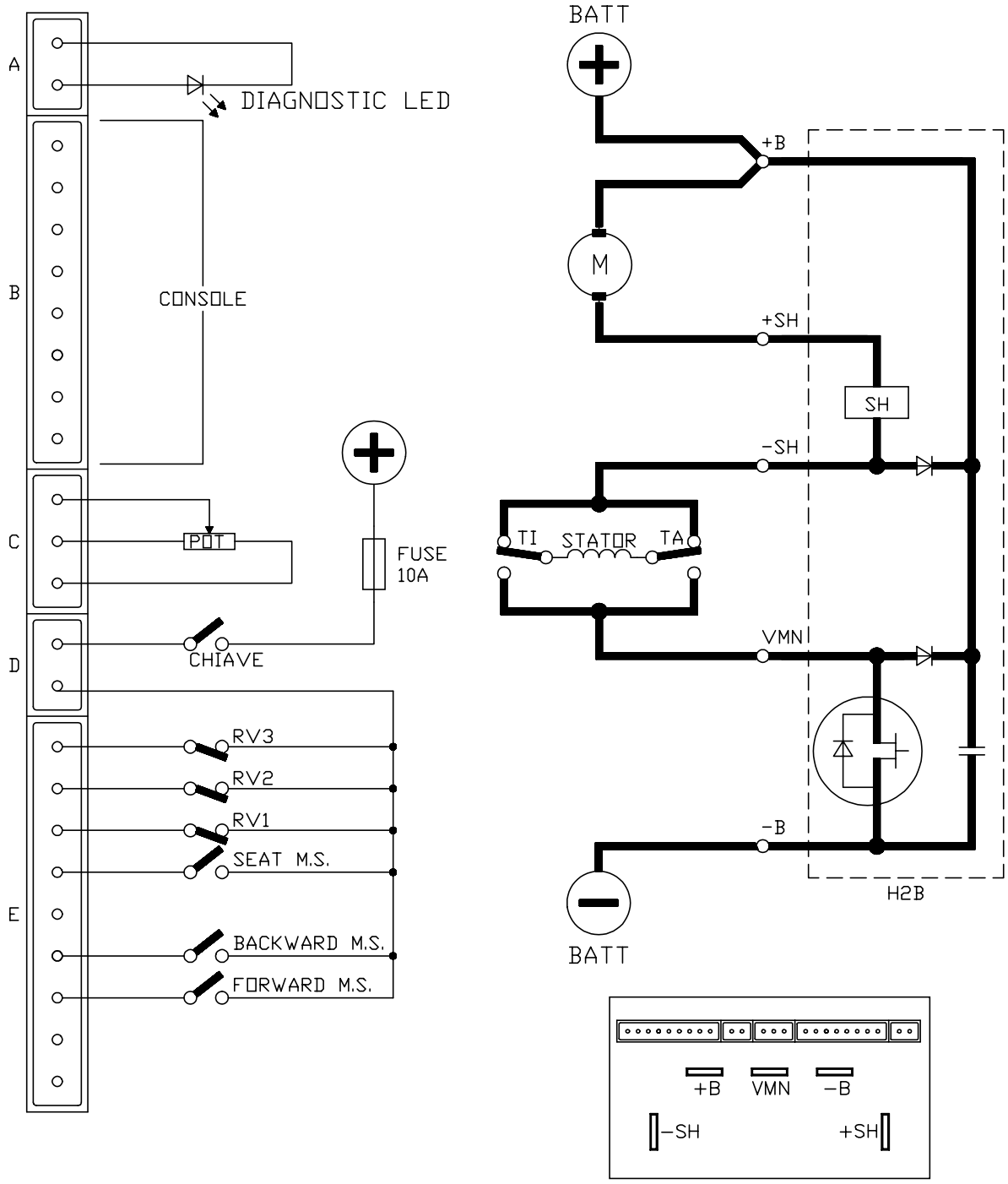
5.1.13 Wiring diagram for H2B power unit regenerative with weakening

CONNECTOR CONNECTIONS		
PIN	FUNCTION	COLOUR
1	PT	RR–N
2	NTI	BB–N
3	NTIND	GG–B
4	PTFR	V–B
5	NTA	G–N
6	NTFR	V–RR



5.2 H2B STANDARD TRACTION

- Input for speed controlled by 3-wire potentiometer
- N. 3 reduction speeds.
- Handle or seat (2 sec. delayed) switches input.
- Quick inversion input.
- Bypass or weakening contactor handling.



5.2.1 Input connectors

Pin	*Function*	*Description*
E1	RV3	Input for 3rd speed reduction or rapid inversion request.
	QUICK I	Rapid inversion request.
E2	RV2	Input for 2nd speed reduction request.
	BACKING	Back request.
E3	RV1	Input for 1st speed reduction request with curve braking combined.
E4	MSEAT	Input for seat microswitch signal (delayed 2 sec.) or handle signal.
E5	MF	Input for brake pedal microswitch: when the pin is taken (+VB) the speed No. 2 reduction is actived and the maximum current halved.
E6	MI	Input for backward request.
E7	MA	Input for forward request.
E8		Like pin E4 but active low.
E9		Like pin E4 but active low.

N.B. A detailed description of these pins is given on point 5.1.1.

5.2.2 Programmable functions (OPTIONS)

The options can be programmed from the console using the "SEL OPTIONS" menu

Function	option	description
PIN G3	by pass	Contactor with bypass
	weak	Contactor with weakening
BATTERY	free	No low battery charge alarm
	check	Low charge alarm with maximum current reduced at 50%
ARB	free	No antirollback
	check	Antirollback
HOURS	running	Hour-metre only active when running
	key on	Hour-metre active with the key on
PIN E1	cutb. #3	E1 = 3rd speed reduction
	quick I	E1 = Input for rapid inversion
PIN E4	seat	E4 = Seat microswitch
	handle	E4 = Handle microswitch
PIN E2	cutb #2	E2 = No. 2 speed reduction
	backing	E2 = Backing request

A detailed description of these pins is given on point 5.1.2.

5.2.3 Parameter modifications (TRACTION)

The parameters can be modified with the chopper standby or running. In the latter case, you must return to standby before switching off the chopper so that the modifications are stored in the chopper's nonvolatile memory.

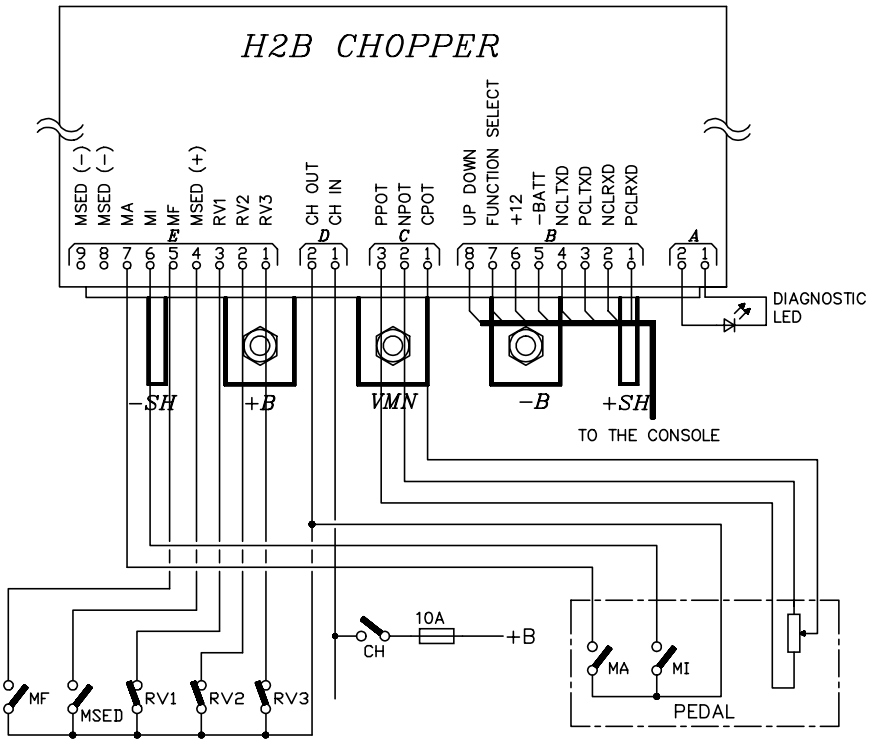
1 ACCELER.DELAY Acceleration time
2 BRAKING Braking current - base value
3 CUT BACK SP.1 1st speed reduction
4 CUT BACK SP.2 2nd speed reduction
5 CUT BACK SP.3 3rd speed reduction
6 AUXILIARY TIME Time delay to activate the auxiliary function
7 COMPENSATION Compensation for speed reductions
8 BRAKING MODUL. Braking current increment in inversion with accelerator
9 IMAX. Maximum chopper current
10 MAX SPEED FORW Maximum forward speed
11 MAX SPEED BACK Maximum backward speed
12 CREEP SPEED Minimum acceleration threshold
13 WEAK DROPOUT Weakening output current threshold
14 CURVE BRAKING Curve braking current (RV1)
15 CURVE TIME Curve braking time
16 BACKING TIME Time delay to activate the back request, 9 = continuous

A detailed description of these parameters is given on point 5.1.3.

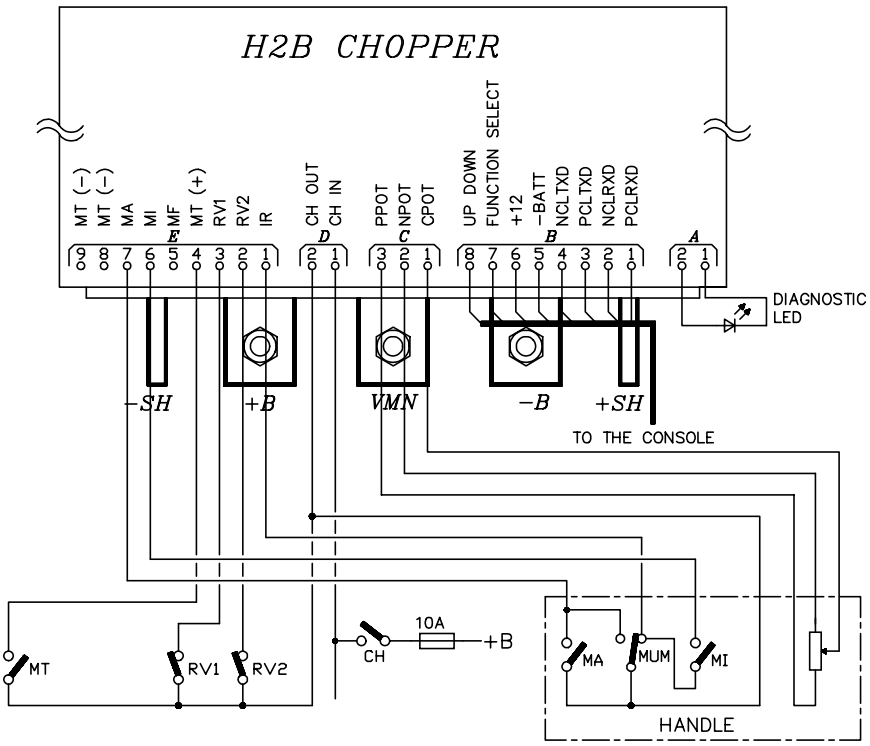
5.2.4 Adjustment chart

PARAMETER	UNIT	PROGRAMMED LEVEL									
		0	1	2	3	4	5	6	7	8	9
ACCELERATION DELAY*	Sec.	0.41	0.82	1.2	1.6	2	2.4	2.9	3.3	3.7	4.1
BRAKING	% IMax.	10	20	30	40	50	60	70	80	90	100
CUTBACK SP. (1-2-3)	% VBatt.	10	22	33	45	53	60	69	78	86	100
COMPENSATION	K (I)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
BRAKING MODUL	% IMax.	0	3	5	8	11	14	17	20	22	25
I MAX. (H2 600)	Amp.	300	333	367	400	433	467	500	533	567	600
I MAX. (H2 500)	Amp.	250	278	306	333	361	388	416	444	472	500
I MAX. (H2 400)	Amp.	200	222	244	266	289	311	333	355	378	400
MAX. SPEED FORW-BACK	% VBatt.	20	29	38	47	56	64	73	82	91	100
CREEP SPEED	% VBatt.	0	1.9	3.9	5.9	7.8	9.8	11.7	13.7	16.6	17.6
WEAK DROPOUT	% IMax.	10	20	30	40	50	60	70	80	90	100
CURVE BRAKING	% IMax.	10	20	30	40	50	60	70	80	90	100
CURVE TIME	sec.	0	0.2	0.3	0.4	0.6	0.8	1	1.2	1.6	2
AUXILIARY TIME	sec.	0.1	0.5	2	4	7	9	12	14	17	20
BACKING TIME	sec.	0.05	0.2	0.35	0.5	0.75	1	1.5	2	2.5	cont.
BACKING SPEED	% VBatt	2	4	8	10	15	20	25	30	40	50

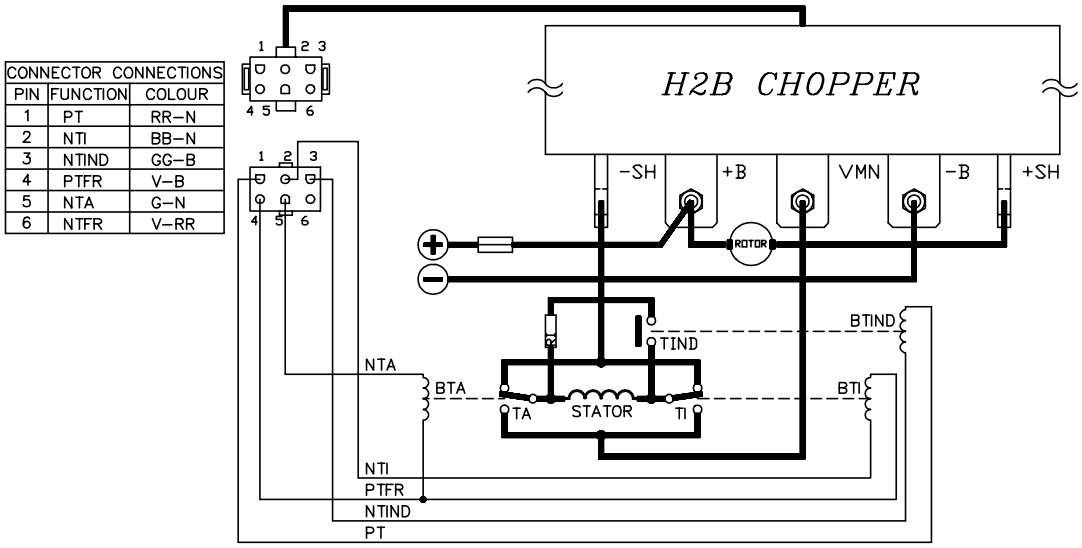
5.2.5 Wiring diagram for H2B standard traction with pedal



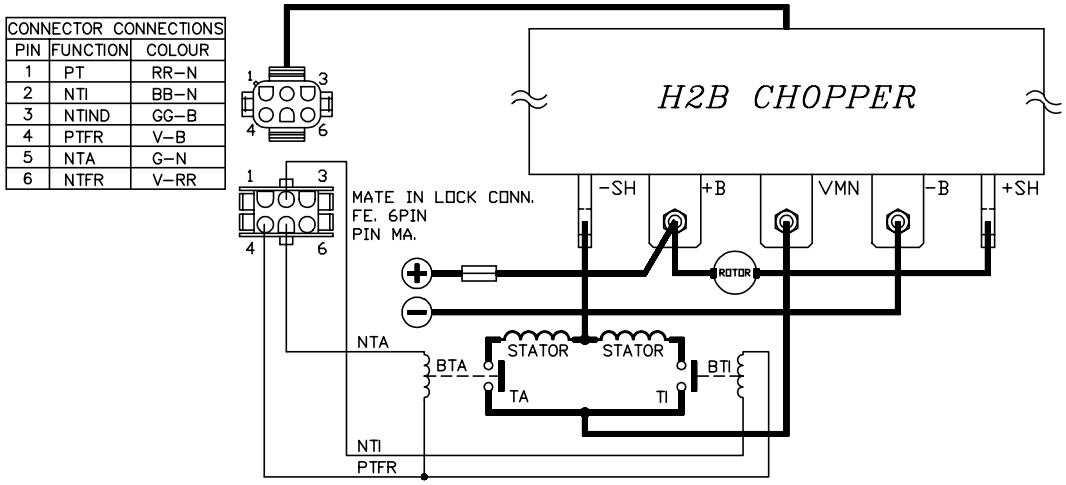
5.2.6 Wiring diagram for H2B standard traction with handle



5.2.7 Wiring diagram for H2B power unit standard traction with weakeening



5.2.8 Wiring diagram for H2B power standard with 5 cables motor



5.3 TABLE OF MODIFICATIONS
SEQUENCE OF SETTINGS FOR REGENERATIVE / STANDARD TRACTION

- With the machine switched off, connect the programming console and then switch on. If no wiring errors or component defects are found, the display shows the manufacturer's name, programme release, configuration, and hour-metre value.
  If the module has already been configured, the procedure passes directly to step four. Otherwise, proceed in order as follows.

Consult the console manual for further procedure details.

1) Configure the chopper model.

2) Select the desired options.

3) Select and set battery voltage.

4) Check the functioning of all the wired inputs, including the potentiometer, by means of the tester functions on the console.

5) Carry out accelerator signal acquisition on the "PROGRAM VACC" menu.

6) Set the maximum current by selecting the level corresponding to the desired value shown on the table of modifications (point 5.1.4 and 5.2.4).

7) Set accleration by moving the machine forward and backward.

8) Set the CREEP speed starting from level 0. With the machine stopped, press the pedal lightly in order to trip the running microswitch, leaving the potentiometer at the minimum value, and then raise the level of the CREEP until the machine begins to move.

9) To set the speed reductions, activate the desired reduction request microswitch, take the compensation level to 0, set the speed (CUTBACK SP.l, etc.) with machine in standby on a flat surface and the acclerator pedal pressed all the way down. Then, apply a load on the machine or put it on a slope, and in these conditions set the compensation level until you reach the desired speed.

10) RELEASE BRAKING is set by running the machine and then completely releasing the accelerator pedal without pressing other pedals.

11) For INVERSION BRAKING, first set the MODUL BRAKING level at 0, run the machine and invert the direction with the pedal pressed down, then regulate the braking level.

12) MODUL BRAKING with accelerator. A parameter that increments the inversion braking according to the level of the accelerator signal; set it by inverting the direction with the pedal pressed all the way down.

13) Release braking with brake pressed (PEDAL BRAKING). Set by pressing the brake pedal lightly during a release.

5.4 H2B TRACTION DIAGNOSIS

Description of the alarms signalled by the diagnostic LED.
The alarm code is shown in parentheses. A detailed description is given in the section "DECODING THE ALARMS DISPLAYED ON CONSOLE" on point 5.5.

1 BLINK = Logic anomaly (EEPROM DATA KO, EEPROM PAR. KO, EEPROM CONF. KO, EEPROM OFF-LINE, CHOPPER NO CONF, WATCH-DOG).

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

3 BLINKS = Error on VMN test (NO FULL CONDUCTION, VMN LOW).

4 BLINKS = Accelerator high in standby - this error inhibits operation (VACC NOT OK).

5 BLINKS = Error in reading current - this error inhibits operation (I HIGH AT STAND, I=0 EVER).

6 BLINKS = Malfunctioning of the contactor driver circuit (DRIVER SHORTED, COIL SHORTED).

7 BLINKS = Excessive temperature, greater than 80°C (TH. PROTECTION).

8 BLINKS = Contactors do not open or VMN high in standby (BRAKE CONT. OPEN, DIR CONT. OPEN, VMN HIGH).

9 BLINKS = Contact stuck (BRAKE CON CLOSED) only for regenerative; (DIR. CON CLOSED) only standard traction.

CONTINUOUS BLINKING (32 BLINKS) = Low battery charge, battery with <10% of residual charge (BATTERY).

LED REMAINS ON = Double running request (FORW BACK).

5.5 DECODING CONSOLE DISPLAYED ALARMS

1) BRAKE CON CLOSED (only regenerative version)

Test carried out in the passage from running to initial regenerative braking.
If, on running contactor closure, the VMN is > 2/3 VBATT, an alarm is issued.
Possible causes:

a) The normally open contact of the braking contactor is stuck. Unlock the contact and clean it; if it is too much damaged replace the contactor.

b) The braking contactor remains excited for a defect in the logic board or because the NTFR wire is in short towards the negative.
For understanding if the defect is produced by one of these causes, select the running and press the pedal without giving the seat or tiller request, if the activation only of the braking contactor is in synchrony with the pedal (or selector) command verify what follows: disconnect the wire from the NTFR connector and do again the test above, if the contactor remains disactivated replace the logic, otherwise if the contactor moves check that there is not a wire in short with a metallic part.

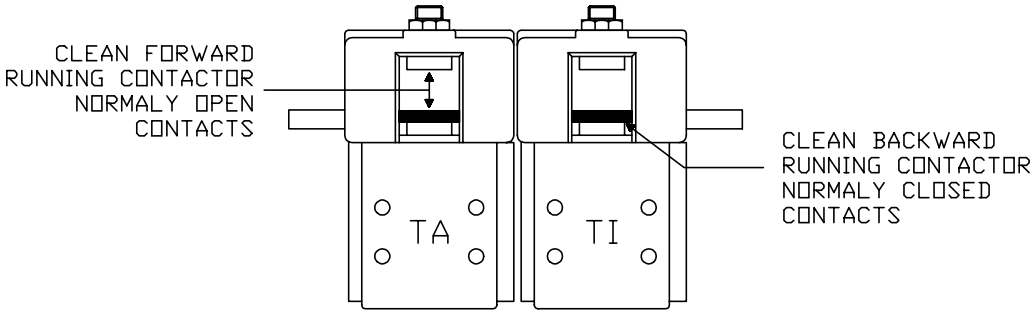
2) DIR. CONT. OPEN

Test carried out at running request: running contactor closure is verified by checking that the VMN signal is consistent. Possible causes:

a) For finding out the causes follows the diagnosis procedure herefollowing:

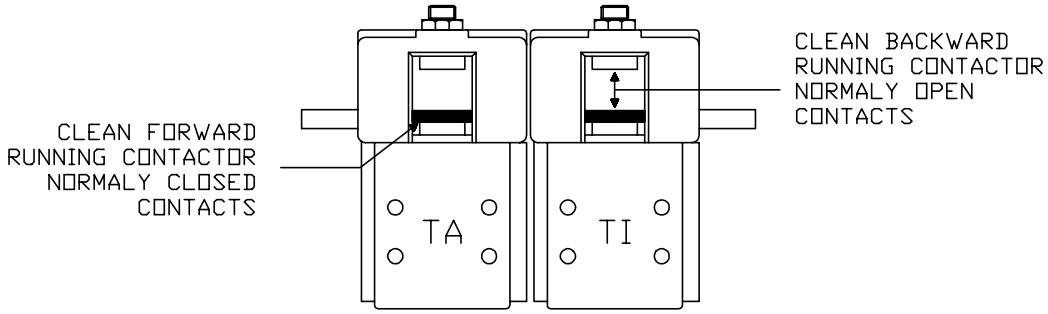
<table>
<tr><th>CONDITION UNDER WHICH FAULT IS DETECTED</th><th>TEST</th><th>RESULT</th><th>TEST</th><th>RESULT</th><th>FAULT DESCRIPTION AT POINT:</th></tr>
<tr><td rowspan="3">ONLY AT FORWARD RUNNING REQUEST</td><td rowspan="3">YOU SEE FORWARD CONTACTOR (TA) CLOSING FOR 0.3sec. THEN OPENING?</td><td>YES</td><td>→</td><td>→</td><td>A1</td></tr>
<tr><td rowspan="2">NO</td><td rowspan="2">WHEN REQUESTING FORWARD RUNNING YOU FIND ANY VOLTAGE AT COIL CONTACTS FOR 0.3 sec.?</td><td>YES</td><td>B1</td></tr>
<tr><td>NO</td><td>C1</td></tr>
<tr><td rowspan="3">ONLY AT BACKWARD RUNNING REQUEST</td><td rowspan="3">YOU SEE BACKWARD CONTACTOR (TI) CLOSING FOR 0.3sec. THEN OPENING?</td><td>YES</td><td>→</td><td>→</td><td>A2</td></tr>
<tr><td rowspan="2">NO</td><td rowspan="2">WHEN REQUESTING BACKWARD RUNNING YOU FIND ANY VOLTAGE AT COIL CONTACTS FOR 0.3sec.?</td><td>YES</td><td>B2</td></tr>
<tr><td>NO</td><td>C2</td></tr>
<tr><td rowspan="3">AT BOTH RUNNING REQUEST</td><td rowspan="3">YOU SEE FORWARD OR BACKWARD CONTACTOR (TA OR TI) CLOSING FOR 0.3sec. THEN OPENING</td><td>YES</td><td>→</td><td>→</td><td>A3</td></tr>
<tr><td rowspan="2">NO</td><td rowspan="2">WHEN REQUESTING FORWARD RUNNING YOU FIND ANY VOLTAGE AT TA COIL'S CONTACTS (OR AT BACKWARD CONTACTOR COIL'S CONTACTS (BTI)) FOR 0.3sec.?</td><td>YES</td><td>B3</td></tr>
<tr><td>NO</td><td>C3</td></tr>
</table>

A1) There is not a good contact either on TA (=forward contactor) NA (normally open) or on TI (=backward contactor) NC (normally closed), due to dust, dirt or any particles which prevent a valid contact.
Clean contacts by means of compressed air; if necessary remove dirt applying a soft abrasive movement.



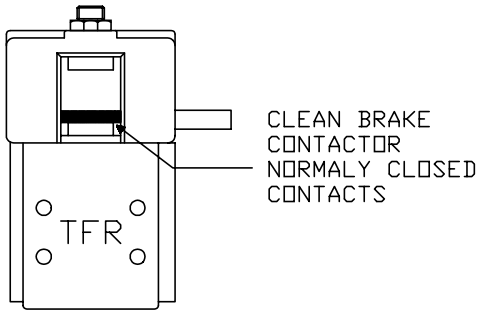
It could be necessary changing both contactors.

A2) There is not a good contact either on TI NA or on TA NC, due to dust, dirt or any particles which prevent a valid contact.
Clean contacts by means of compressed air; if necessary remove dirt applying a soft abrasive movement.



It could be neccessary changing both contactors.

A3) The most probably reason is that the normally closed contact of the braking contactor doesn't make a good contact towards the battery negative for dust, dirt or because the contact doesn't lean completely for a mechanical defect of the contactor.



It could be necessary to replace the contactor.

It may be due to 1 of following causes of motor connecting interruption:

a) brushes lift up from collector (fig.1).
b) brushes' cable burn up (fig.2).
c) Missing the braking contactor negative cable (fig. 3)
d) Interruption either on motor winding or on motor itself cabling.

Fig. 1

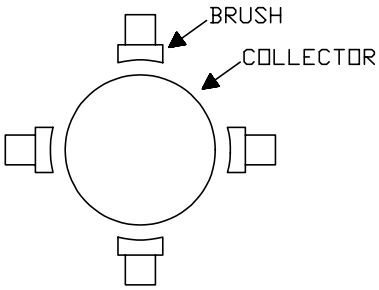


Fig. 2

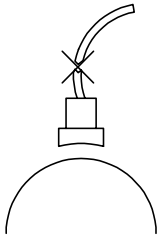
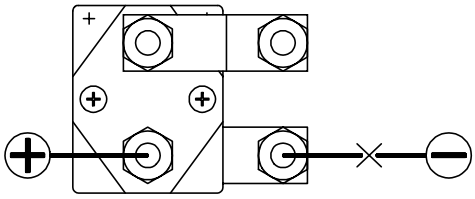


Fig. 3



B1) Forward contactor (TA) is supplied with a correct voltage but it doesn't close. Possible causes:

1) Contactor coil is interrupted, verify its resistance using an ohmmeter.
2) Contact can't move due to mechanic block.
3) Nominal working coil voltage is greater than battery one.

B2) Backward contactor (TI) is supplied with a correct voltage but it doesn't close; everything said at point B1 for TA is valid here.

B3) Backward and forward contactor are supplied with a correct voltage but they don't close; see point B1.

C1) Supply don't come up to TA, please check cabling and connections from TA coil to connectors PT and NTA.

C2) Supply don't come up to TI, please check cabling and connections from TI coil to connectors PT and NTI.

C3) Supply don't come up to TA and TI, please check cabling and connections from the coils to connectors PT, NTA and NTI.

- For points C1, C2, C3 replacing controller may be necessary.

For H2B standard configuration the solutions at point A1-A2-A3-B1-B2-B3-C1-C2-C3 are valid; for the last two points please respect the different connections rather than the regenerative configuration.

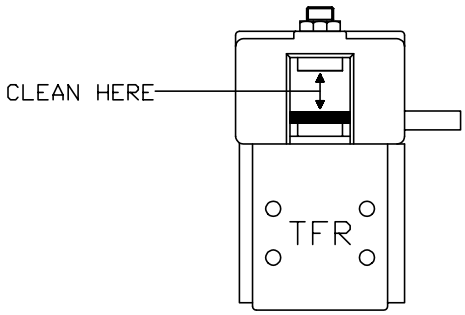
3) BRAKE CONT. OPEN (regenerative only)

Test carried out during the passage to running. After closure of the running contact, the braking contactor closes, verifying that the VMN goes from < 1/3 to > 2/3. If this does not occur, an alarm is shown.

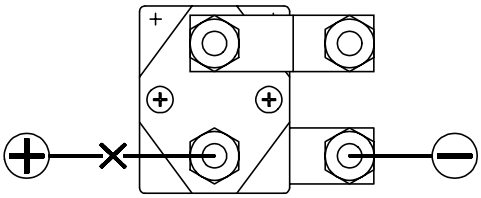
For finding out the causes follows the diagnosis procedure herefollowing:

<table>
<tr><th>TEST</th><th>RESULT</th><th>2° TEST</th><th>RESULT</th><th>3° TEST</th><th>RESULT</th><th>FAULT DESCRIPTION AT POINT</th></tr>
<tr><td rowspan="5">AT RUNNING REQUEST THE TFR CLOSES FOR 0.3sec?</td><td rowspan="2">YES</td><td rowspan="5">→</td><td rowspan="2">→</td><td rowspan="5">→</td><td rowspan="2">→</td><td>A4</td></tr>
<tr><td>A5</td></tr>
<tr><td rowspan="3">NO</td><td rowspan="3">WHEN THERE'S THE RUNNING REQUEST, IS THERE A VOLTAGE AT PIN BTFR FOR A TIME OF 0.3sec?</td><td rowspan="3">YES</td><td>YES</td><td>B4</td></tr>
<tr><td rowspan="2">CHECK WITH AN OHMMETER OF THE TFR COIL IS INTERRUPTED</td><td rowspan="2">NO</td><td>B5</td></tr>
<tr><td>B6</td></tr>
<tr><td>NO</td><td>→</td><td>→</td><td>C4</td></tr>
</table>

A4) There is not a good contact on the NA of TFR, clean the contact, if it is too much damaged replace the contactor.



A5) Missing the positive cable on the braking contactor.



B4) Replace the contactor coil or the complete contactor.

B5) Contactor mechanically locked, unlock it and replace it.

B6) Contactor with working nominal voltage bigger than the feeding one.

C4) Supply doesn't come up to the contactor coil, please check the cabling and the connections from the coil to the connector C1(PTFR) and C5(NTFR).

4) DIR.CON.CLOSED

Test carried out during the passage to standby or braking.
Checks that the running contactor opens by comparing the consistent status of the VMN potential. Possible causes:

a) Running contactor stuck or slow to open.

b) Logic failure.

5) VMN LOW

The test is carried out at standby and in running up to 80% of PWM. If the VMN voltage is lower than 1/3 of the battery voltage, an alarm is shown.
For finding out the causes follows the diagnosis procedure herefollowing:

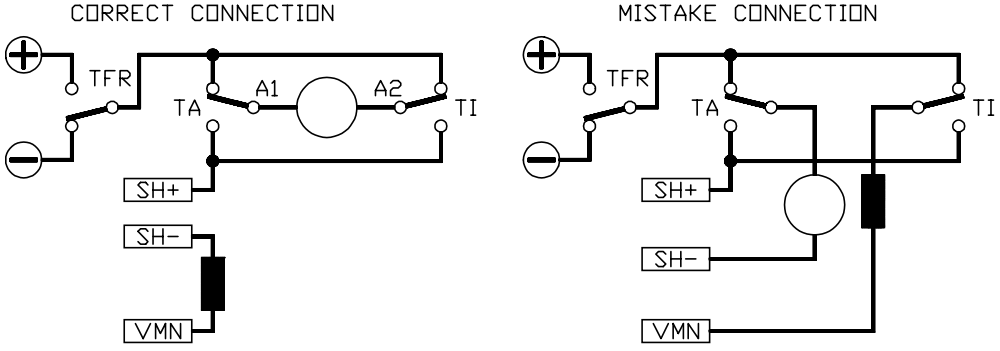
<table>
<tr><th>CONDITIONS UNDER WHICH FAULTS IS DETECTED</th><th>1° TEST</th><th>RESULT</th><th>2° TEST</th><th>RESULT</th><th>3° TEST</th><th>RESULT</th><th>FAULT DESCRIPTION POINT:</th></tr>
<tr><td rowspan="4">AT THE KEY ON</td><td rowspan="4">DISCONNECT THE MOTOR CABLE CONNECTED TO THE BATTERY AND THEN VERIFY IF THE ALARM STILL PRESENT</td><td>YES</td><td>→</td><td>→</td><td>→</td><td>→</td><td>C5</td></tr>
<tr><td rowspan="3">NO</td><td rowspan="3">A RUNNING CONTACTOR IS LOCKED IN WORKING POSITION</td><td rowspan="2">YES</td><td rowspan="2">THE STUCK CONTACTOR COIL IS SUPPLIED?</td><td>YES</td><td>B7</td></tr>
<tr><td>NO</td><td>B8</td></tr>
<tr><td>NO</td><td colspan="2"></td><td>D1
D2
D3</td></tr>
<tr><td>RUNNING WITH CONTACTORS ON RUNNING POSITIONS</td><td>→</td><td>→</td><td>→</td><td>→</td><td>→</td><td>→</td><td>C5</td></tr>
<tr><td rowspan="2">AS SOON AS THE ACCELERATOR PEDAL IS COMPLETLY RELEASED FOR DOING A RELEASE BRAKING</td><td rowspan="2">IS IT PRESENT THE BYPASS OR THE WEAKENING CONTACTOR?</td><td>YES</td><td>→</td><td>→</td><td>→</td><td>→</td><td>E1</td></tr>
<tr><td>NO</td><td>→</td><td>→</td><td>→</td><td>→</td><td>C5</td></tr>
</table>

B7) If the running contactor remains stuck, you can verify:

1) if the wire going from NTA to NTI is casually in short with a metallic part connected to the battery negative;
2) disconnecting the contactor wire always excited from board connector if the contactor is no longer excited, replace the logic board.

B8) A running contactor is stuck on working position, unlock the contact, it could be possible to replace the contactor.

D1) Wrong connections of the motor cables. The stator and the armature are crossed.



D2) There is a current dispersion in the motor between the stator winding and the armature one otherwise there are some electric parts of these windings that makes a contact inside the motor.

D3) Check that there are not metallic parts inside the contactor board that cause a short towards the negative in the points connected to SH- and SH+.

C5) The most probably reason is that the failure is inside the controller, replace it.

E1) If there's the bypass contactor check that it is not stuck or it is too much slow in opening.
For verifying this possibility, disconnect the bypass and check if the failure disappears: if this happens, replace the logic.

PAY ATTENTION: the contactors connected to the controller must not have arc suppressers on the contactor coils because these are inside the controller and then the external ones modify the contactor opening times.

6) VMN HIGH

Test carried out in standby. If the VMN voltage is greater than 2/3 VBATT, an alarm is shown. Possible causes:

a) Contactor stuck (only standard traction).

b) Short circuit between +BATT and VMN, please check if there are any metallic parts causing short circuit in the contactor board.

c) Logic failure, probably the braking diode are broken, replace the power.

7) NO FULL COND.

The test is carried out in full conduction. If, in this condition, the VMN is found to be greater than 1/3 VBATT, the diagnostic circuit is faulty, causing a safety risk, and thus machine operation is inhibited. If the defect persists, replace the logic.

8) THERMAL PROTECTION

An indication that the controller temperature has exceeded 80° C.
The maximum current is gradually reduced, reaching 0 at a temperature of 85° C.

a) If the alarms occurs while cold, the most probably reason is the failure of the thermic diagnosis circuit on the power or on the logic board, replace on of the two parts or replace the complete controller.

b) If the alarm often occurs after short time the machine is working, probably it is due to inadequate heat sink, check the fixing nuts tightening and the correct installation.

9) BATTERY

The battery charge is low.
The alarm is signalled only if the "battery check" option has been selected from the serial console (default). When this alarm occurs, the maximum current is reduced to 50%.

10) INCORRECT START

An incorrect starting sequence.
The machine only starts if the sequence is followed: key-handle (or seat) - running.
Possible causes:

a) Running microswitch or handle microswitch stuck.

b) Error in sequence made by the operator, pedal pressed at the key on.

c) Incorrect wiring if there is not any defects externally is necessary to replace the logic..

11) 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 there is not external defects, replace the logic.

12) 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 or the potentiometer negative has not been connected to the PIN C2 of the logic board. In this case it is generated an alarm because the logic don't find the load on the pin C2.

b) The potentiometer is not correctly calibrated.

c) The potentiometer is defective (interrupted).

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

14) I=0 EVER

Test carried out in running.
Checks that the current during running is greater than a minimum value. If not, an alarm is signalled and the machine is shut down. Possible causes:

a) The current sensor is faulty. Replace the power unit.

b) Wrong connections of the motor cables to the power bars SH- and SH+.

15) 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.

16) EEPROM CONF.KO

Fault in the area of memory in which the special chopper configuration data is stored. If the defect persists when the key is switched off and on again, replace the logic. Otherwise, keep in mind that the chopper configuration has been reset to the default values (regeneration version, etc.); thus it must be reprogrammed.
Consult the console manual.

17) 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.

18) EEPROM OFF LINE

Fault in the nonvolatile memory that contains data relative to the area for the hour-metre, the alarms stored and the programming parameters.
If the alarm persists when the key is switched off and on again, replace the logic.

19) CHOP NO CONF.

An alarm similar to no. 16, except that here, even though the data is correct, it does not correspond to a hardware configuration recognised by the H2B. The considerations are the same as for alarm 16 “EEPROM CONF.KO”.

20) WATCHDOG

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.

21) SHORTED COIL

An overload or a short circuit toward +BATT on the contactor negative driver outputs. Possible causes:

a) The contactor coils are short circuited or absorb more than 6 A continuous.

b) Short circuit with +BATT of the wiring that comes from the contactor connector. The alarm indicates the occurrence of an overload, not the breakdown of a chopper component. Once the external cause is removed, the chopper can be restarted.

22) DRIVER SHORTED

The test is carried out in standby, and checks that the voltage of the drivers that control the contactors is consistent with the preset value.
Possible causes:

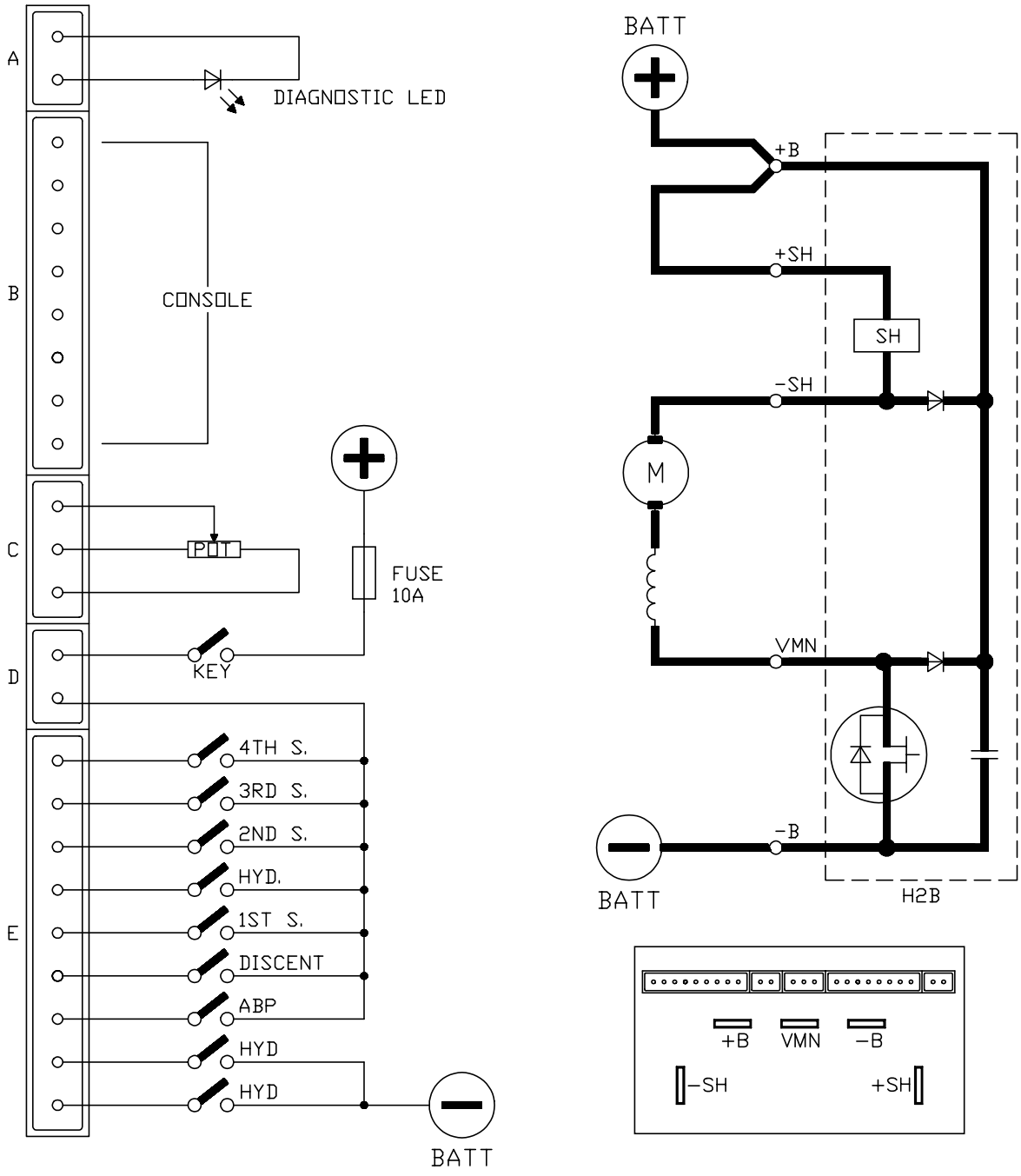
a) Logic failure.

b) Driver breakdown caused by overvoltage in the contactor negative wiring. Replace the logic after having removed the cause.

6 PUMP

6.1 H2B STANDARD LIFTING

- Input for speed controlled by 3-wire potentiometer
- 4 speeds with separately adjustable compensation
- 1 speed with associated delay (for hydrodrive) and adjustable compensation
- Main contactor handling
- Weakening or bypass contactor handling
- Proportional solenoid valve handling for descent

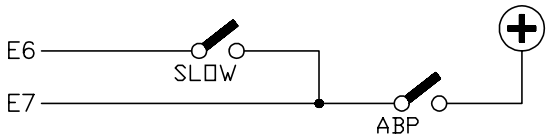


6.1.1 Input connectors

pin	*function*	*description*
E1	4TH S.	Input for 4th speed request. The speed is active when the pin is high, connected to +Batt.
E2	3RD S.	Input for 3rd speed request. The speed is active when the pin is high, connected to +Batt.
E3	2ND S.	Input for 2nd speed request. The speed is active when the pin is high, connected to +Batt.
E4	HYD. S.	Input for hydrodrive speed request. The speed is active when the pin is high, connected to +Batt. The programmable timing (HYDRO TIME) is associated to this input.
E5	1ST S.	Input for 1st speed request. The speed is active when the pin is high, connected to +Batt.
E6	DOWN	Only input DOWN: function descent with proportional EV connected to connectors PT and NEVP. Input DOWN + Hydro: both functions are activated. Input Down+ABP: function slow lifting. The value of parameter is reduced in function of the parameter "VMN VALVE VOLTAGE" that in this case has the following values:

Prog.	0	1	2	3	4	5	6	7	8	9
%pwm max.	2	4	8	10	15	20	25	30	40	50

In this case the function descent is not carried out.
N.B. for avoiding the activation descent is not when the lift request comes off the slow lift microswitch must be cable in series with the ABP microswitch.



E7	UP	Input for speed request handled by potentiometer, active high..
E8	HYD. S.	Same function as E4 but active when forced to -BATT.
E9	HYD. S	Like pin E8.

6.1.2 Programmable functions (OPTIONS)

These options can be programmed from the console with the “SEL OPTIONS” menu

pin/function	*option*	*description*
PIN G3	**bypass**	The contactor connected to connector G3 is handled as bypass. Activation current = <80% IMAX. Output current = <90% IMAX. Activation delay = 800 ms.
	weak	The contactor connected to connector G3 is handled as weakening. Activation current 50% of the output current. Output current is programmable. (WEAK DROP OUT) from 10% to 100% IMAX.
BATTERY	**free**	No low battery charge alarm.
	check	Activates the test that reads the battery charge in standby at intervals of 1 second. This value constitutes the level of residual battery charge and is compared with a table in memory. When the charge is less than 10%, all functions are blocked except for the hydrodrive, and the LED signals this condition by blinking continuously.
HOURS	**running**	Hour-metre active only in running.
	key on	Hour-metre active with key.
PIN G5	**status**	The output relative to pin G5 is active when the chopper is carrying out any function (except descent).
	main c.	The output relative to pin G5 handles a main contactor.

6.1.3 Parameter modifications

The parameters can be modified with the chopper in standby or running. In the latter case, you must return to standby before switching off the chopper so that the modifications are stored in the chopper’s nonvolatile memory.

1) ACCELER.DELAY = Pump motor acceleration time

2) EV. ACCELER DELAY = Acceleration time relative to descent (proportional solenoid valve).

3) DECELER DELAY = Deceleration time, i.e. to annul the voltage on the motor upon release.

4) EV.DECELER DELAY = Deceleration time relative to descent.

5) AUXILIARY TIME = Not used in the pump configuration.

6) IMAX. Defines the maximum chopper current. All current adjustments are expressed as a percentage of this value. The adjustment range is from 50% (level 0) to 100% (level 9).

7) HYD SPEED COARSE = Coarse hydrodrive speed (from 0 to 100% Vbatt on the motor).

8) HYD SPEED FINE = Fine hydrodrive speed (a value from 0 to 10% Vbatt is added to the coarse speed value). The speed is given by:
motor voltage = [(coarse speed) x 10 + (fine speed)] x Vbatt /100
The interval of values ranges from 0 to total conduction.

9) HYDRO COMPENS = Compensation in current for hydrodrive request.

10) CREEP SPEED = Defines the minimum value of voltage applied to the motor with running request active. Allows a more immediate response at start up.

11) WEAK DROPOUT = Threshold of current for opening the weakening contactor (if programmed as such and not as bypass, in which case the output threshold is fixed and not programmable).

12) HYDRO TIME = Hydrodrive delay time. If set at 0, there is no delay; thus the hydrodrive input can be handled as a 5th speed.

13) 1ST SPEED COARSE = Speed no. 1, coarse adjustment.

14) 1ST SPEED FINE = Speed no. 1, fine adjustment.

15) 1ST SPEED COMP. = Compensation speed no.1.

16) 2ND SPEED COARSE = Speed no. 2, coarse adjustment.

17) 2ND SPEED FINE = Speed no. 2, fine adjustment.

18) 2ND SPEED COMP. = Compensation speed no.2.

19) 3RD SPEED COARSE = Speed no. 3, coarse adjustment.

20) 3RD SPEED FINE = Speed no. 3, fine adjustment.

21) 3RD SPEED COMP. = Compensation speed no.3.

22) 4TH SPEED COARSE = Speed no. 4, coarse adjustment.

23) 4TH SPEED FINE = Speed no. 4, fine adjustment.

24) 4TH SPEED COMP. = Compensation speed no.4.

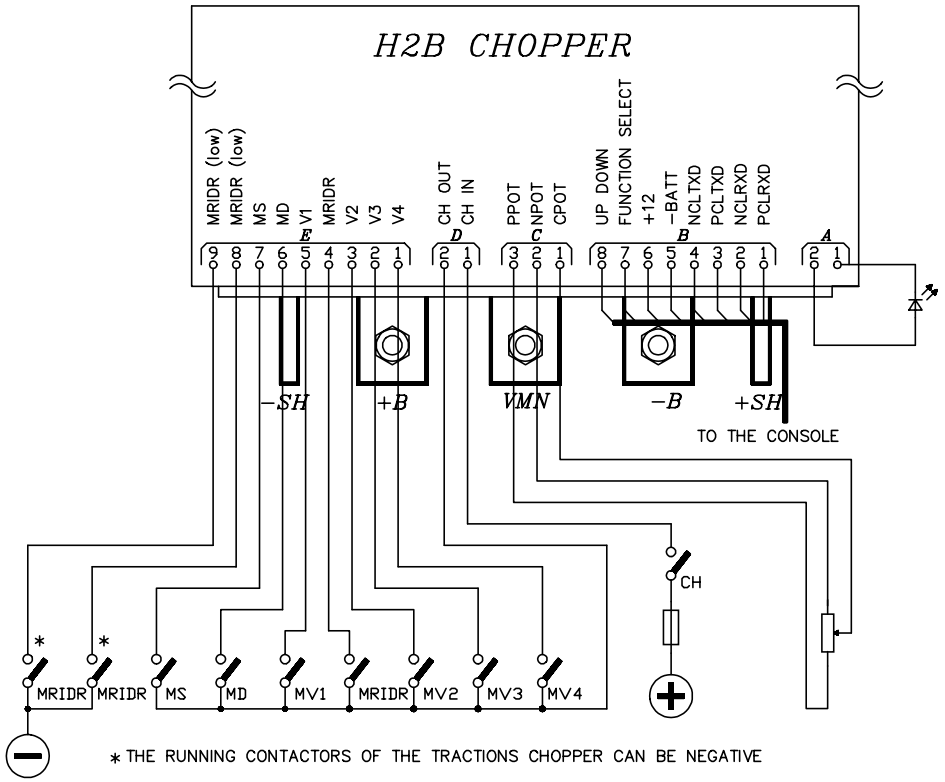
25) MIN. VALVE VOLT. = Minimum voltage applied on the proportional solenoid valve.

26) MAX. VALVE VOLT. = Maximum voltage applied on the proportional solenoid valve.

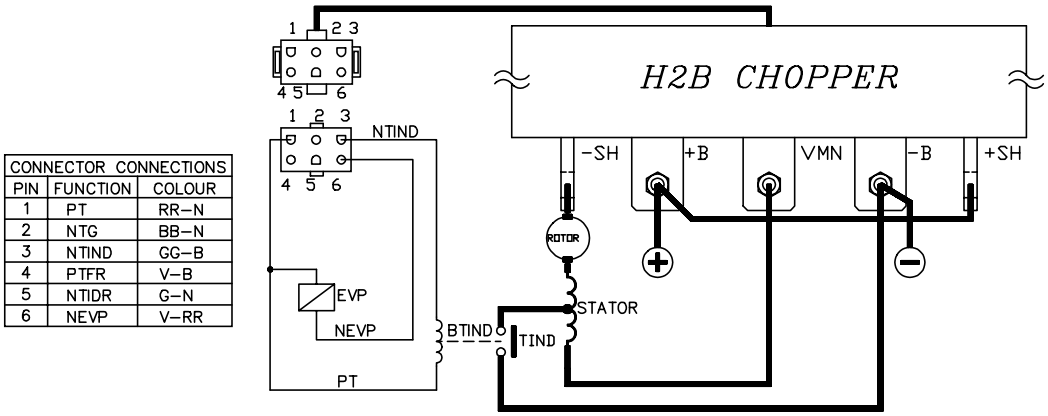
6.1.4 ADJUSTMENT CHART

PARAMETER	UNIT	PROGRAMMED LEVEL									
		0	1	2	3	4	5	6	7	8	9
ACCELERATION DELAY*	Sec.	0.15	0.24	0.39	0.50	0.63	0.74	0.86	0.97	1.09	1.22
EV. ACCELER DELAY	Sec.	0.39	0.63	0.71	0.81	0.97	1.05	1.27	1.36	1.46	1.54
DECELER DELAY	Sec.	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50	0.56	0.62
EV. DECELER DELAY	Sec.	0.30	0.60	0.70	0.78	0.95	1.04	1.26	1.36	1.43	1.53
I MAX. (H2 600)	Amp.	300	333	367	400	433	467	500	533	567	600
I MAX. (H2 500)	Amp.	250	278	306	333	361	388	416	444	472	500
I MAX. (H2 400)	Amp.	200	222	244	266	289	311	333	355	378	400
SPEED COARSE (ALL)	% VBatt.	0	11	22	33	44	55	66	77	88	100
SPEED FINE (ALL)	% VBatt.	0	1.2	2.4	3.6	4.8	6.05	7.3	8.5	9.7	10.9
COMPENSAZIONE (ALL)	K (I)	10	20	30	40	50	60	70	80	90	100
CREEP SPEED	%VBatt.	0	1.9	3.9	5.9	7.8	9.8	11.7	13.7	16.6	17.6
WEAK DROPOUT	%IMax.	10	20	30	40	50	60	70	80	90	100
HYDRO TIME	sec.	0	0.5	2	4	7	9	12	14	17	20
MIN VALVE VOLT	%VBatt.	7.4	11.3	15.2	19.2	23.1	27.0	31	35	39	43
MAX VALVE VOLT	%VBatt.	56	60	64.5	70	74	78.5	83.5	88	92.5	97.5

6.1.5 H2B electrical connection diagram standard lifting

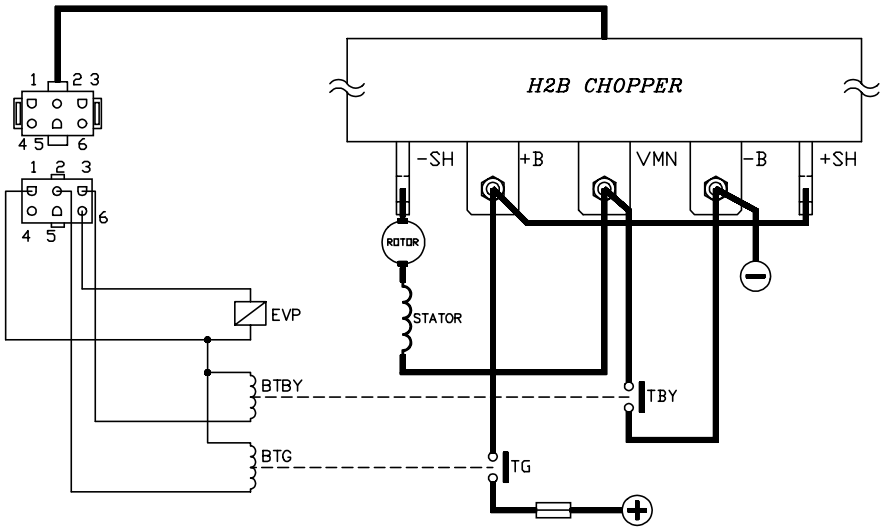


6.1.6 Connection diagram for H2B pump unit with weakening

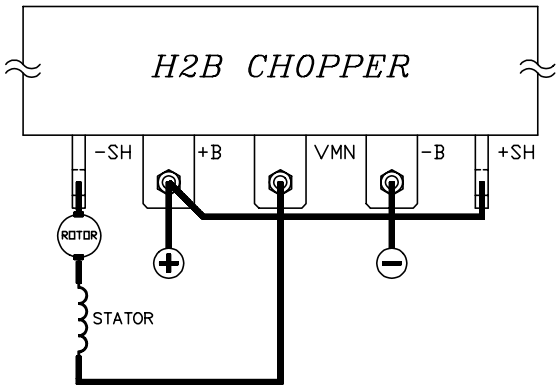


CONNECTOR CONNECTIONS		
PIN	FUNCTION	COLOUR
1	PT	RR–N
2	NTG	BB–N
3	NTIND	GG–B
4	PTFR	V–B
5	NTIDR	G–N
6	NEVP	V–RR

6.1.7 Connection diagram for H2B pump unit, with by-pass contactor and main contactor

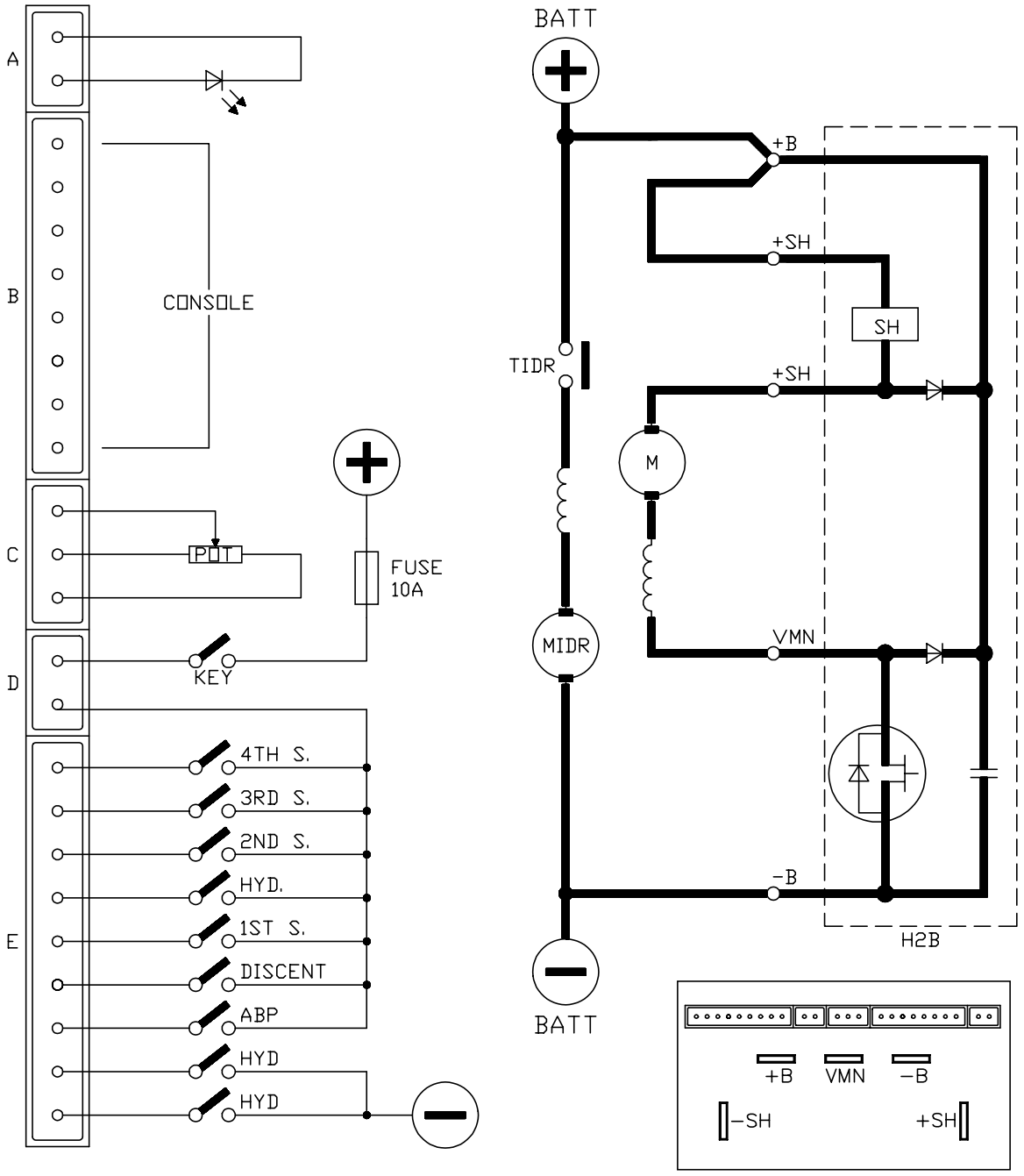


6.1.8 H2B power unit standard connection diagram



6.2 H2B LIFTING + 3rd MOTOR

- Input for speed control by potentiometer
- 4 speeds with separately adjustable compensation
- Contactor handling with programmable delay (3rd hydrodrive motor) and adjustable compensation
- Main contactor handling
- Weakening or bypass contactor handling
- Proportional solenoid valve handling for descent



6.2.1 Input connectors

pin	*function*	*description*
E1	4TH S.	Input for 4th speed request. The speed is active when the pin is connected to +Batt.
E2	3RD S.	Input for 3rd speed request. The speed is active when the pin is connected to +Batt.
E3	2ND S.	Input for 2nd speed request. The speed is active when the pin is connected to +Batt.
E4	HYD. R.	Input for hydrodrive request. When the request is active, a contactor for controlling the hydrodrive pump motor with programmable delay is handled. Hydr time function is actived by this pin.
E5	1ST S.	Input for 1st speed request. The speed is active when the pin is connected to +Batt.
E6	DOWN	Input for descent request. When this input is active, it is possible for the potentiometer to handle a proportional solenoid valve connected to connectors G1 and G4.
E7	UP	Input for speed request handled by potentiometer, active high.
E8	HYD. S.	Same function as E4 but active when forced to -BATT.
E9	HYD. S.	Like pin E8.

6.2.2 Programmable functions (OPTIONS)

- The options can be programmed from the console with the “SEL OPTIONS” menu

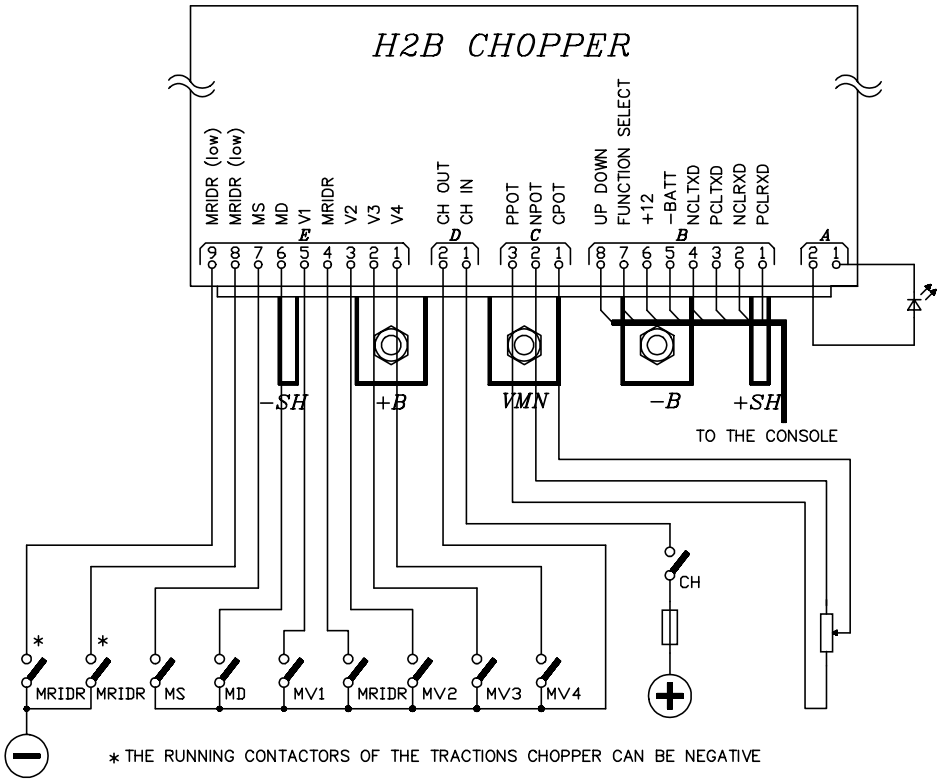
function/pin	*option*	*meaning*
PIN G3	**Bypass**	Bypass contactor.
	Weak	Weakening contactor.
BATTERY	**Free**	No low battery charge alarm.
	Check	Low battery charge alarm which blocks all functions except hydrodrive.
HOURS	**Running**	Hour-metre active only in running.
	Key on	Hour-metre active for the entire chopper startup time.
PIN G5	**Status**	Output G5 = Lifting status (0=running).
	Main C.	Output G5 = Main contactor.

A detailed description of the meanings is given on point 6.1.2 as per the H2B standard lifting model.

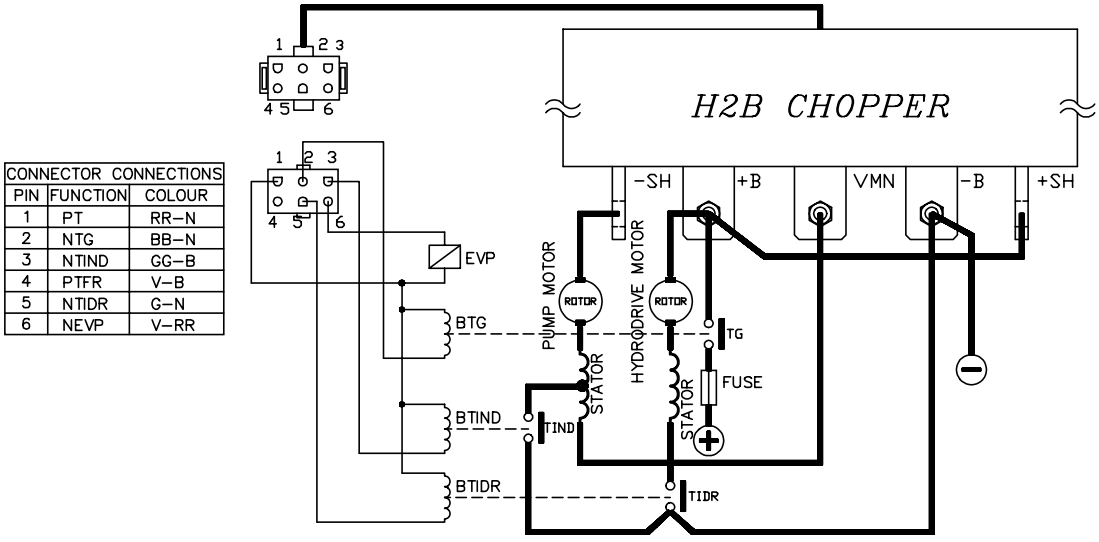
6.2.3 Parameter modifications h2b configuration pump + 3rd motor

The parameters is same a the point 6.1.3 and the chart 6.1.4.

6.2.4 H2B electrical connection diagrams pump + hydro



6.2.5 H2B power unit wiring lifting + hydroguide + weakening



6.3 SEQUENCE OF SETTINGS FOR LIFTING

- With the machine switched off, connect the programming console and then switch on. If no wiring errors or component defects are found, the display shows the manufacturer's name, programme release, configuration, and hour-metre value.
  If the module has already been configured, the procedure passes directly to step four. Otherwise, proceed in order as follows.

Consult the console manual for further procedure details.

1) Configure the chopper model.

2) Select the desired options.

3) Select and set battery voltage.

4) Check the functioning of all the wired inputs, including the potentiometer, by means of the tester functions on the console.

5) Carry out accelerator signal acquisition on the "PROGRAM VACC" menu.

6) Set the maximum current by selecting the level corresponding to the desired value.

7) Set the speed of the respective functions with the machine in standby, and the level of compensation set at "0". Then apply a load and set the compensation until it reaches the desired speed.
As the adjustments of speed and compensation are interdependent, further adjustments must be made before reaching the optimum condition.

8) Set the hydrodrive speed in the same way as the others, with the only difference being that the speed is set with the steering in standby, while the compensation is set with the steering under load.

9) Set acceleration, deceleration, and creep as necessary.

6.4 SETTING THE PROPORTIONAL SOLENOID VALVE

- For handling the solenoid valve, it is necessary to fit the potentiometer and the descent request microswitch.

1) Carry out the potentiometer signal acquisition using the "PROGRAM VACC" function.

2) With the lever in minimum speed position, set the "MIN VALUE VOLT" parameter by incrementing the level until it begins to descend.

3) With the lever in maximum speed position, set the "MAX VALUE VOLT" parameter by decreasing the level until you notice that the descent speed begins to reduce.

4) Acceleration and deceleration are set by obtaining the right compromise between response speed and smoothness of movement.

6.5 H2B LIFTING DIAGNOSIS

Description of the alarms signalled by the diagnostic LED.
The alarm code is shown in parentheses. A detailed description is given in the section "DECODING THE ALARMS DISPLAYED ON CONSOLE".

1 BLINK = Logic anomaly (EEPROM DATA KO, EEPROM PAR. KO, EEPROM CONF. KO, EEPROM OFF-LINE, CHOPPER NO CONF, WATCHDOG).

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

3 BLINKS = Error on VMN test (NO FUL CONDUCTION).

4 BLINKS = Accelerator high in standby - this error inhibits machine operation (VACC > 1 V).

5 BLINKS = Error in reading current - this error inhibits machine operation (1 HIGH AT STAND, I=0 EVER).

6 BLINKS = Malfunctioning of the contactor driver circuit (DRIVER SHORTED, COIL SHORTED).

7 BLINKS = Excessive temperature, greater than 80°C (TH. PROTECTION).

CONTINUOUS BLINKING (32 BLINKS) = Low battery charge, battery with < 10% of residual charge (BATTERY).

6.5.1 Decoding the alarms displayed on console (H2B LIFTING)

1) STAND BY VMN LOW
The test is carried out in standby. If the VMN voltage is lower than 1/3 of the battery voltage, an alarm is signalled. Possible causes:

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

b) Chopper broken, replace.

2) NO FULL COND.
The test is carried out in full conduction.
If, in this condition, the VMN is found to be greater than 1/3 VBATT, the diagnostic circuit is faulty, causing a safety risk, and thus machine operation is inhibited. If the defect persists, replace the logic.

3) TH.PROTECTION
An indication that the chopper temperature has exceeded 80°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 interrupted (check the connector that connects the logic to the power unit).

d) Logic failure.

4) BATTERY

The battery charge is low.
The alarm is signalled only if the BATTERY CHECK option has been selected.
All functions except hydrodrive are inhibited.

5) INCORRECT START

A running request is present on key startup.
Possible causes:

a) Operator error.

b) Request microswitch stuck.

6) 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 shuts down the machine.
Possible causes:

a) Current sensor broken and logic failure.

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

7) I=0 EVER

Test carried out in running.
Checks that the current during running is greater than a minimum value. If not, an alarm is signalled and the machine is shut down. Possible causes:

a) The current sensor is faulty. Replace the power unit.

8) 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.

9) EEPROM CONF.KO

Fault in the area of memory in which the special chopper configuration data is stored. If the defect persists when the key is switched off and on again, replace the logic. Otherwise, keep in mind that the chopper configuration has been reset to the default values (regeneration voltage, etc.); thus it must be reprogrammed. Consult the console manual.

10) EEPROM DATA KO

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

11) EEPROM OFF LINE

Fault in the nonvolatile memory that contains data relative to the area for the hour-metre, the alarms stored and the programming parameters.
If the alarm persists when the key is switched off and on again, replace the logic.

12) CHOP. NO CONF.

An alarm similar to no.9, except that here, even though the data is correct, it does not correspond to a hardware configuration recognised by the H2B. The considerations are the same as for alarm 9 “EEPROM CONF.KO”.

13) WATCHDOG

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.

14) COIL SHORTED

There is an overcharge or a short circuit towards the positive of the battery on the during negative contactor output.
Possible causes:

a) The coils of the contactors are in short circuit or they absorb more than 6A continue.

b) Short circuit with +batt of the cabling which cores out from the contactor connector

The alarm shows an occurred overcharge and not the fail of a chopper component.
When the external cause is removed it is possible to restart again.

15) DRIVER SHORTED

The test is carried out in standby. It checks that the during voltage of the drivers commanding the contactors is at a coherent value with the forecasted state.
Possible cause:

a) Logic failure

b) Drivers broken because of an overvoltage in the cabling of the negative contactors. Replace the logic after having removed the cause.

7 RECOMMENDED SPARE PARTS

ARTICLE CODE NO.	DESCRIPTION
E07008	Potentiometer 5 kohm 330
C22000	Microswitch 10A 250V 1-way
C16506	Protected power fuse 425A
C16507	Protected power fuse 500A
C12373	9-way molex female connector
C12371	3-way molex female connector
C12370	2-way molex female connector.
C12769	Female connector (molex)
C12203	6-way female lok connector
C12768	Male connector (for female lock)
C12229	6-way male lok connector.
C12767	Female connector (for male lock)
C29508	Contactor SW 180 24V
C29524	Contactor SW 181 24V
C29528	Contactor SW 182 24V
C29548	Contactor SW 80 24V
C29521	Contactor SW 180 36V
C29525	Contactor SW 181 36V
C29529	Contactor SW 182 36V
C29504	Contactor SW 80 36V
C29522	Contactor SW 180 48V
C29526	Contactor SW 181 48V
C29530	Contactor SW 182 48V
C29506	Contactor SW 80 48V
C29523	Contactor SW 180 80V
C29527	Contactor SW 181 80V
C29531	Contactor SW 182 80V
C29514	Contactor SW 80 80V
P00085	Logic Board ZP321C (24V)
P00086	Logic Board ZP321C (36/40/48V)
P00087	Logic Board ZP321C (60/72/80V)
-	Logic Board ZP321C (96V)

8 PERIODIC MAINTENANCE TO BE REGULARLY REPEATED

Check outwear of electric contacts: they should be replaced when matchboard is too strong and worn-out. **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 mechanical 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 rises from using wiring solutions different from the ones suggested on this manual.

Any cause which is visible or realizable by an ordinary technician who periodically checks the equipment, that can create damages or defects to the device should be transmitted to the ZAPI's technician or to the technical commercial net.
They will take the responsibility for possible decisions regarding the functioning safety of the electric vehicle.

DO NOT USE A VEHICLE WITH A FAULTY ELECTRONIC CONTROLLER