

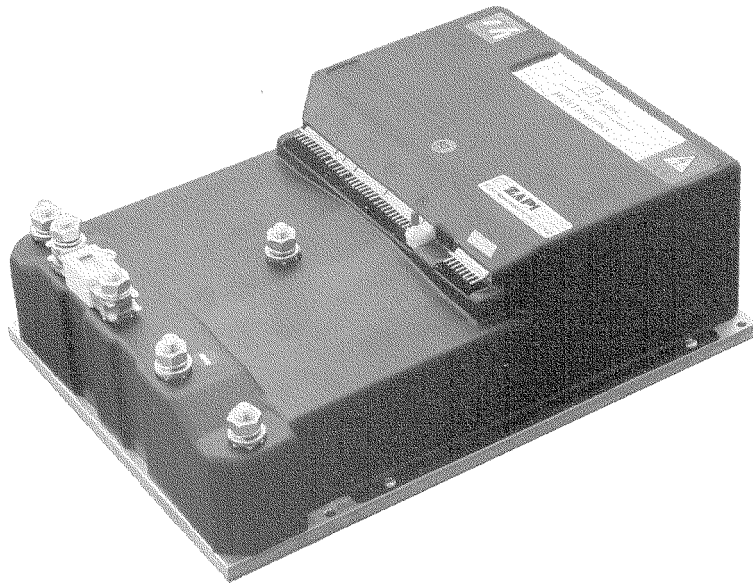


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H3D 800A / H3D 1000A

OPERATING HANDBOOK AND


FUNCTION DESCRIPTION



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 = Information included in marked paragraphs by this symbol is essential for the safety

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LEGEND

AUX	=	Auxiliaries (load)
AV	=	Forward
BTA	=	Forward direction contactor coil
BTBY	=	By-pass contactor coil
BTFR	=	Braking contactor coil
BTI	=	Reverse direction contactor coil
BTIDR	=	Power Steering contactor coil
BTIND	=	Weakening contactor coil
CH	=	Key
DF	=	Braking diode
DV	=	Flywheel diode
HYD	=	Power Steering speed request
IN	=	Reverse
MA	=	Forward direction microswitch
MCL	=	Horn microswitch
MD	=	Descent microswitch
MEF	=	Electric brake microswitch
MI	=	Reverse direction microswitch
MS	=	Lift microswitch
MSED	=	Seat microswitch
MSIC	=	Safety microswitch
MT	=	Tiller microswitch
MUM	=	Dead man microswitch
MV	=	Speed request microswitch
NT	=	Negative of the contactor
PRPAV	=	Button for forward direction in backing mode
PRPIN	=	Button for reverse direction in backing mode
RV	=	Speed reduction
TA	=	Forward direction contactor
TBY	=	By-pass contactor
TFR	=	Braking contactor
TI	=	Reverse direction contactor
TIDR	=	Power Steering contactor
TIND	=	Filed weakening contactor
VMN	=	Negative voltage of the motor

1 GENERAL CHARACTERISTICS

1.1 TECHNICAL SPECIFICATION

- Voltage: 48V/72V/80V/96V/120V/144V (36V-140V) DC
Maximum current: 800A/1000A
Frequency: 18 kHz
Type of motor: DC Series Wound , 4 cables
Operating ambient temperature: -30 to +40° C
Maximum allowable temperature for chopper body: 85° C
Voltage drop across MOS with I = 300A: 630mV (800A); 410mV (1000A)
Microprocessor logic unit
4 different configurations;
1 regenerative traction control;
2 standard traction control;
3 5 - speed lifting pump control;
4 4 - speed lifting pump control + power steering contactor handling.

1.2 CONTROL UNIT

1.2a Microswitches

Microswitches send a voltage signal when the rapid request for start-up or desired function is made. Microswitches for forward, reverse and rapid inversion (if present) are selected for carrying the current of one contactor.

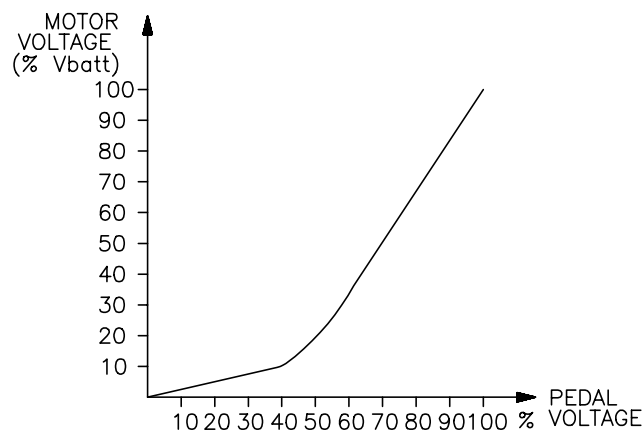
1.2b Potentiometer

In the 3 - wire configuration, the CPOT (D1) 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.

You can use also an inductive pedal having voltage 12 V and an uptake of current between 2mA and 30mA.



Relationship between the voltage signal on pin D1 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 necessary when required to compensate for asymmetry in the mechanical operations that control the potentiometer.

The sequence of procedures is described in the programming manual console.

The acquisition procedure is invalidated by the controller if the difference between the minimum and the maximum value is less than 2 V.

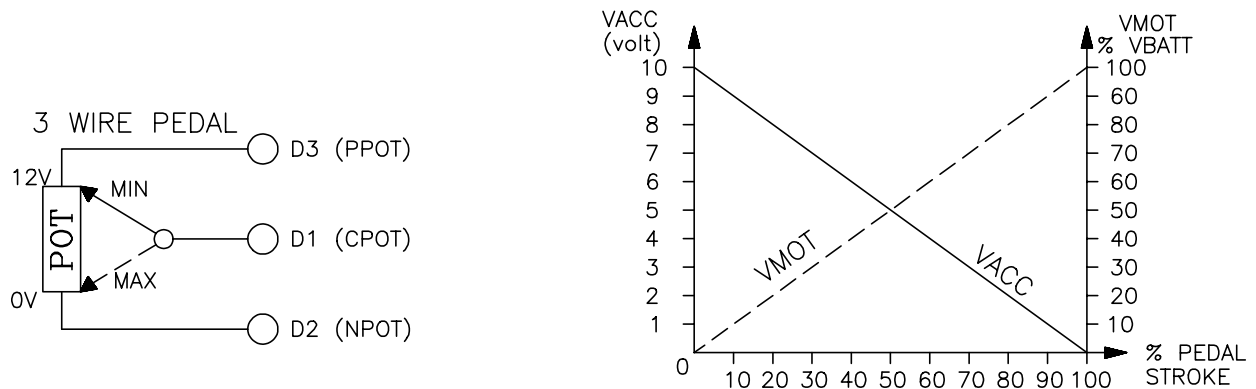
This acquisition procedure allows:

- the use of "reversed" potentiometer signals i.e. those which reduce from a high initial value to a low final value;
- the use of a normal potentiometer instead of one with central zero.

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

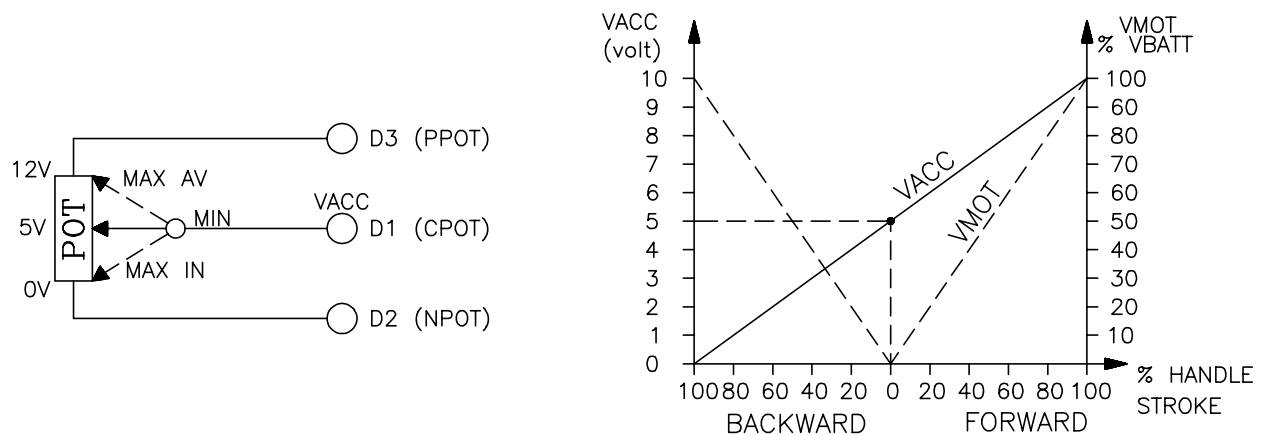
Application examples

- Reversed signal



VACC = accelerator signal voltage on pin D1;
VMOT = percentage on battery voltage on the motor.

- Central zero signal



1.3 PROTECTION FEATURES

- **Battery Inversion:**
It is necessary to observe the connections indicated in diagrams in order to prevent damage to the power unit. Protection against polarity reversal can be achieved by an external main contactor. In lifting versions, a main contactor can be connected and controlled by the logic against polarity inversion. The logic is intrinsically protected.
- **Connections errors:**
All the inputs are protected against connections errors.
The contactors do not accept loads greater than 2 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 too low (greater than 75%) the maximum current is reduced by 50%. In the lifting version all functions except power steering (and descent) are disabled.
This feature may be excluded by the Console.
- **External Agents:**
The controller case has a protection level meeting IP 32.
- **Protections 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 seat microswitches have operated.
- **Protection against uncontrolled movements:**
The contactors will not close if:
 - the power unit is not operating connecting;
 - the accelerator does not go below the minimum value stores increased by 2 Volt, or if there is not the connection to the pin NPOT;
 - the logic is not perfectly operational;
 - one running microswitch has failed.

1.4 PERFORMANCE FEATURES

- Optimum sensitivity to low speeds.
- Self-diagnosis with indication of the type of fault by an optional LED.
- Configuration by console (traction or lifting).
- Modification of the parameters by console.
- Internal hour-meter with values that can be displayed on the console.
- Memory of the last five alarms with relative hour-meter value and temperature displayed on the console.

- Tester by console for real time checking of the main parameters such as inputs, motor voltage, battery, etc..
- Arc less operation of contactors.
- Internal arc suppression of the contactors coils.
- High motor and battery efficiency due to high frequency commutation.

1.5 THERMAL CONSIDERATIONS

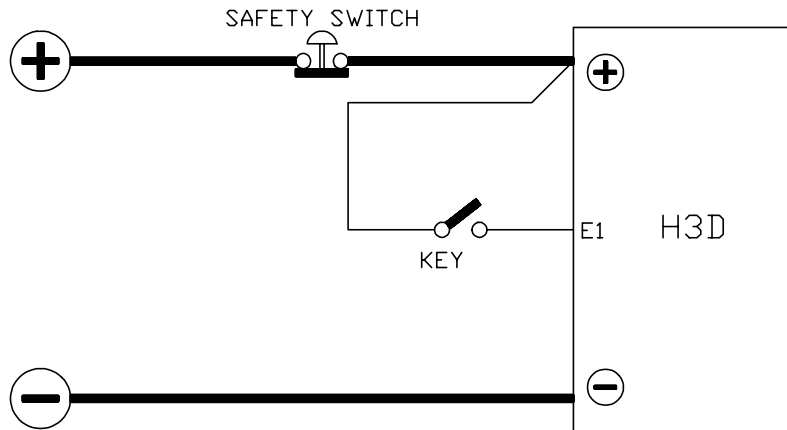
- The heat generated must be dissipated. For this reason the location place in the machine must be ventilated and the cooling surfaces adequate.
- The cooling system is dimensioned on the basis of the performance required for the machine. For situations in which ventilation is poor and heat exchange difficult for the materials used, we suggest the use of forced air ventilation.
- The dissipation of power by the module varies depending on the current and the duty cycle.

1.6 GENERAL NOTES AND PRECAUTIONS

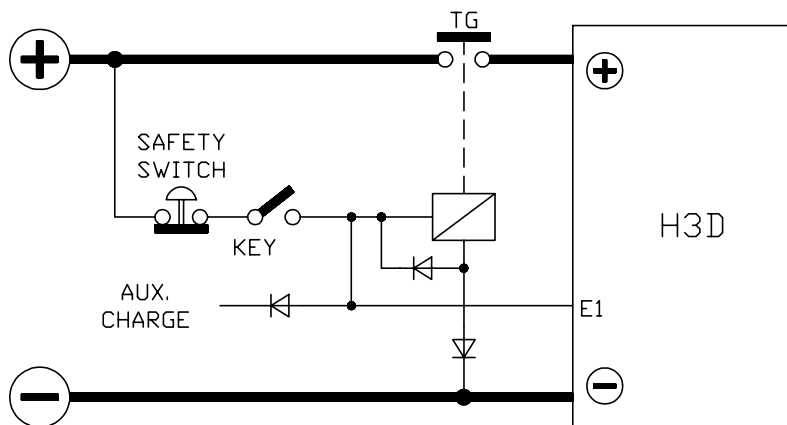
- Never combine SCR low frequency choppers with H3D modules, as the filter capacitors contained in the H3D module alter SCR chopper operation, subjecting it to excessive loads.
If you wish to use two or more control units (e.g. lift + traction), they must all be of the high frequency ZAPIMOS family.
- Do not connect the chopper to a battery with a different nominal voltage to that indicated on the chopper identification plate. A higher battery voltage can cause MOS failure. A lower battery voltage prevents the module from operating.
- During battery recharge, the H3D module must be completely disconnected from the battery. In addition to altering the charge read by the battery charger, the module can be damaged by the overload voltages generated by the charger and by the ripple current generated in the capacitors if the battery charger works at low frequency.
- The H3D module must only be supplied with a traction 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, in order to ensure that any connection errors do not create safety risks.
- With the key off, the filter capacitors inside the module may remain charged for several minutes.
For safe operation, we recommend that after disconnecting the battery, short circuit the power positive and negative on the chopper for a few seconds with a resistance of between 10 ohm and 100 ohm min 5 watt.

1.7 MAIN CONTACTOR AND SAFETY SWITCH

- The connection of eventual interruption systems of the battery must be executed correctly respecting one of the following wiring diagrams.
- With safety switch:



- With switch and general contactor:



- One of the above solutions are necessary to ensure safety should the controller fail when the connection to the battery is opened during the phase of regenerative braking. The controller falls out automatically from braking if the battery voltage is exceeded by 30% of the normal battery voltage.

1.8 SUSCEPTIBILITY AND ELECTROMAGNETIC EMISSION

Susceptibility and electromagnetic emission are considerably influenced by the installation. Take care with the length and the path of the electrical connections and to the braided wires.

Zapi declines any responsibilities for badrunning caused by the circumstances above mentioned, above all if the manufacturer of the machine doesn't carry out the tests required by the regulations in force (EN50081-2).

2 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 operation. 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 suppression filters on the horn, solenoid valves, and contactors not connected to the chopper such as those for activating the pump motor or steering motor, if the latter is not handled by the chopper itself.

2.1 CONNECTION CABLES

For the auxiliary circuits, use cables of 0,5 mm².

For power connections to the motor and to the battery use cables 50mm² - 70mm².

For the best controller performance, cables to the battery should be run side by side and be as short as possible.

2.2 CONTACTORS

Choose the type of contactors relative to the maximum operating current of the motor and the specific chopper configuration.

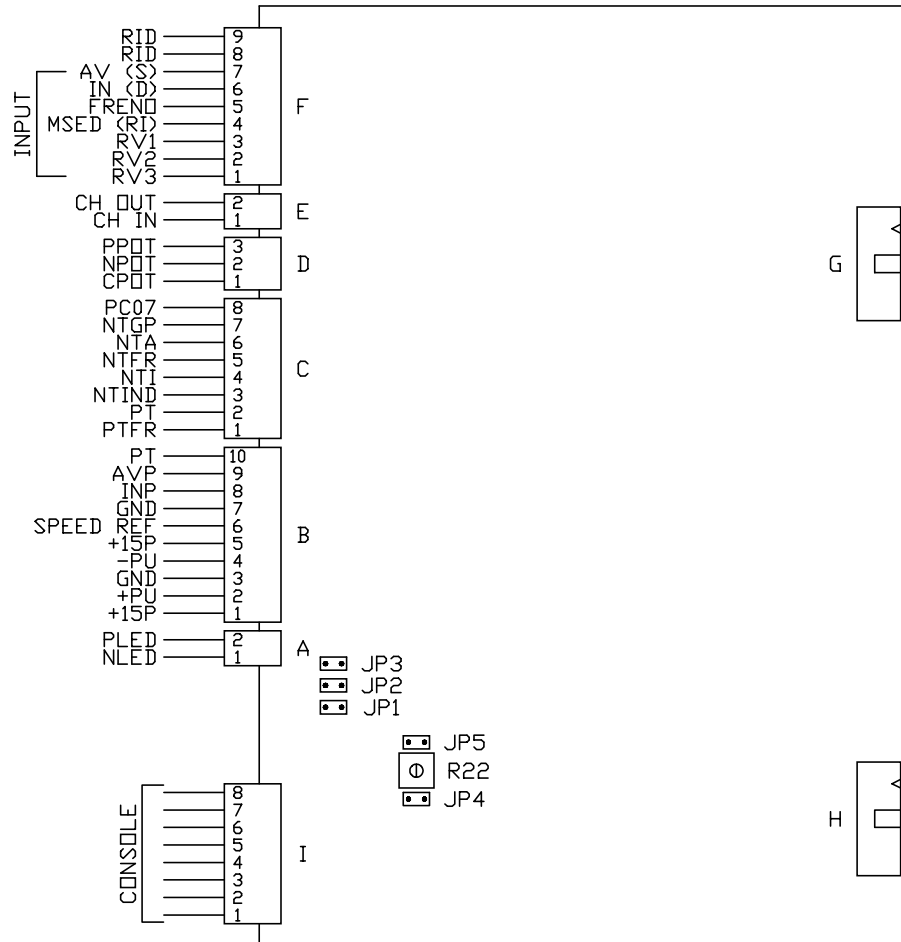
- The current absorbed by the coil must not be greater than 3 amps.
- The coil suppressors are inside the chopper; do not use contactors with arc suppressors.
- For contactors with magnetic suppressors, make sure you respect the polarity indicated on the cap.
- Protect contacts against dust, dirty, external agents which could lead to loss of performance and good operation.

2.3 FUSES

- Use a 10A fuse for auxiliary circuit protection.
- Protect the power unit with a power fuse 1000A.
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 enclosed fuses in order to prevent the spread of fused particles in the event of blowout.

2.4 H3D CONNECTORS

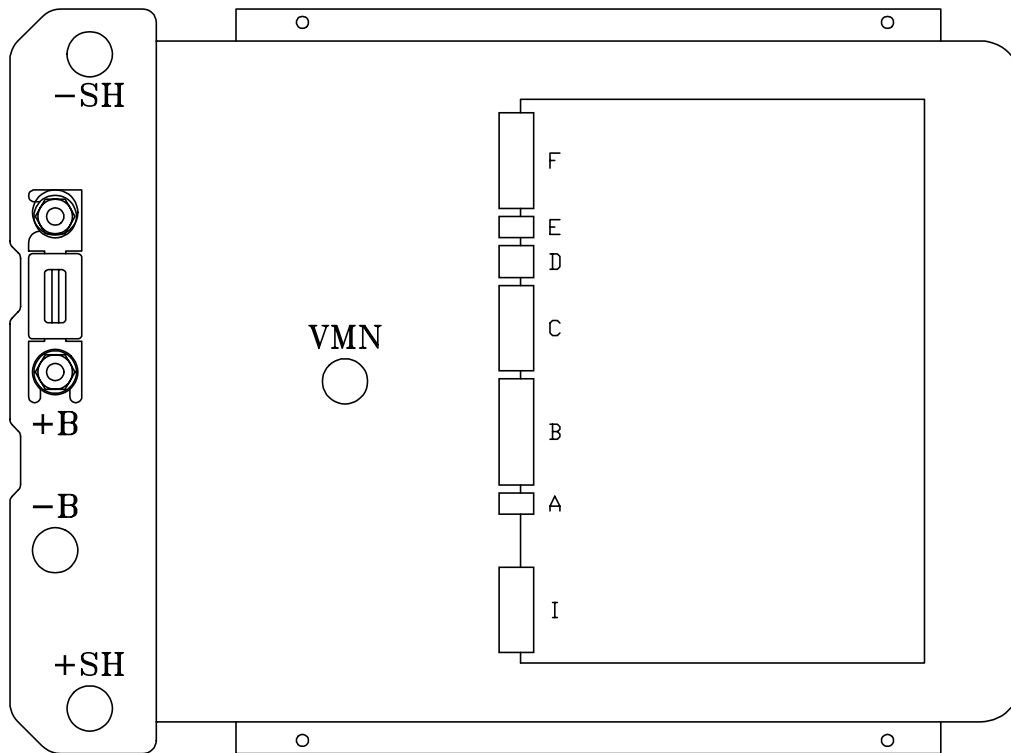


<i>pin</i>	<i>functions</i>	<i>description</i>
A1	-LED	Alarm LED negative: to be connected to the cathode
A2	+LED	Alarm LED positive: to be connected to the anode Output current 12mA, for standard type LED
B1	+15P	Output +15V for feeding speed sensor
B2	+PU*	Input positive voltage speed sensor
B3	GND	Negative for feeding speed sensor (0V)
B4	-PU*	Negative of speed sensor
B5	+15P	Auxiliary output +15V
B6	REF.*	Input for speed set point checked with external potentiometer, voltage range is from 0V to 5V. When you use this input the JP5 jump on the logic must be opened.
B7	GND	Negative of the auxiliary (0V)
B8	INP	Reverse of running input for backing function
B9	AVP	Forward of running input for backing function
B10	PT	Output on voltage for common wire of buttons for backing function

C1	PTFR	Positive of braking contactor coil
C2	PT	Positive of weakening and direction contactor coil
C3	NTIND/NTB	Negative of weakening or by-pass contactor coil
C4	NTI	Negative of Reverse contactor coil
C5	NTFR	Negative of braking contactor coil
C6	NTA	Negative of forward contactor coil
C7	NTGP	Negative of auxiliary contactor coil
C8	PC07	Open collector output for small auxiliary loads (max. 200mA, 24V)
D1	CPOT	Potentiometer central pin: connected to the potentiometer cursor. For speed regulation, the useful signal ranges from 0V (minimum speed) to 10V (maximum speed)
D2	NPOT	Potentiometer negative: (with load circuit)
D3	PPOT	Potentiometer positive: it is a 12 V output. This output is protected against short circuit. The maximum current load is 30 mA, which is equivalent to a 500 Ohm resistance.
E1	+CH IN	Input to the logic. Connect to the key.
E2	+CH OUT	The positive to be sent to the function request microswitches, is taken from this pin. This pin is disconnected from the pin E1 with a diode. Maximum output current 3A.
F1	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 F4, if forced to low level, inhibits the effect of pins F8 and F9.
F2		
F3		
F4		
F5		
F7		
F8	RI (low)	Activates the same request as for pin F4 with a low capacity level (less than 10V) .
F9	RI (low)	Like F8, but electrically disconnected .
I1	PCLRXD	Serial reception positive.
I2	NCLRXD	Serial reception negative.
I3	PCLTXD	Serial transmission positive.
I4	NCLTXD	Serial transmission negative(regenerative state output for ILBB).
I5	GND	Console supply negative.
I6	+12	Console supply positive.
I7	FUNCTION SELECT	Channel for mini-console (speed signal).
I8	UP/DOWN	Channel for mini-console (speed ref.).

* = The functions relative to the maximum speed check are activated only if you have programmed the Option "SPEED" at "CHECK" mode.

2.5 H3D POWER CONNECTORS



- B Battery Negative

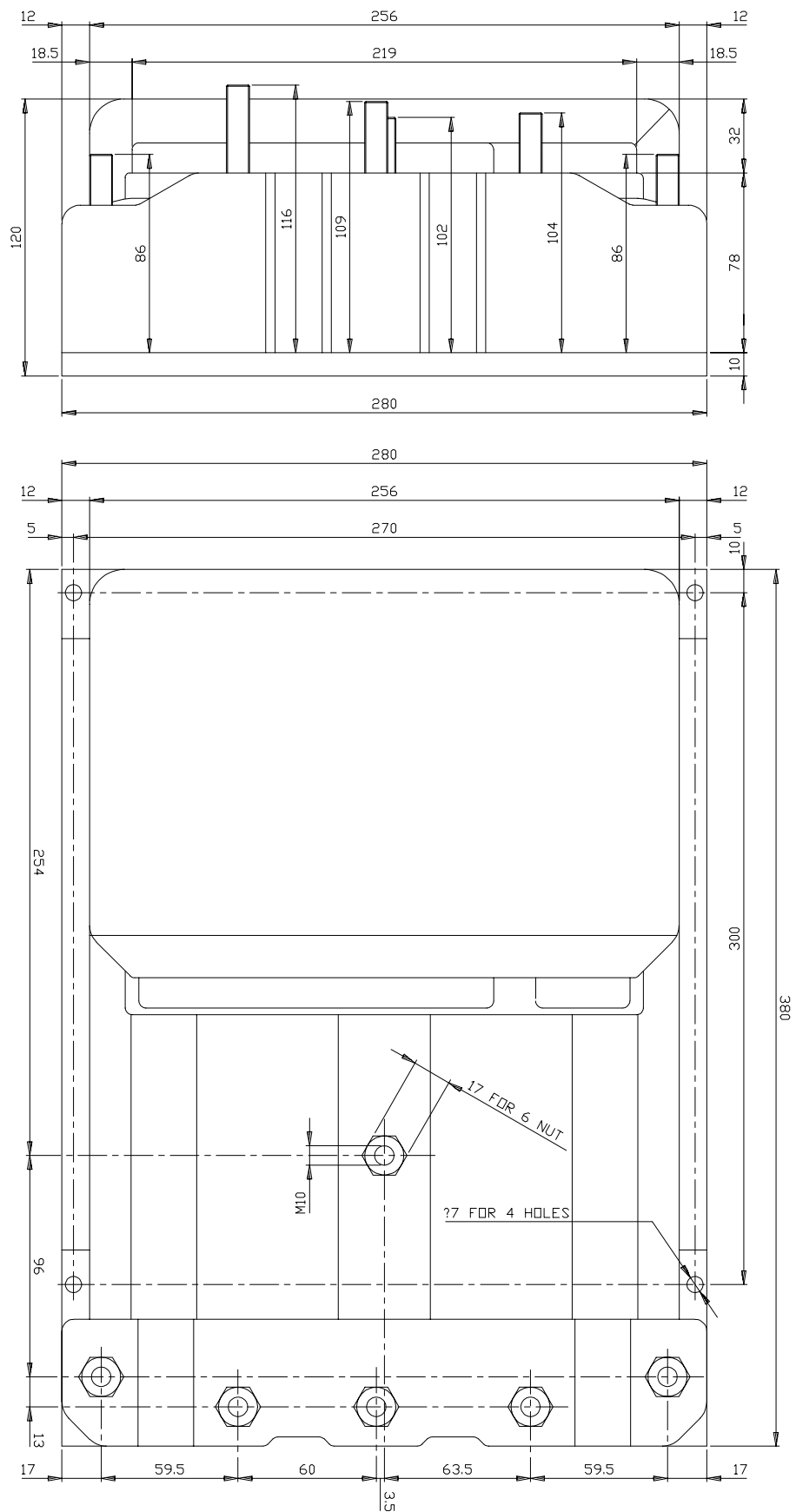
+SH Current sensor Input

-SH Current sensor output

+B Battery Positive

VMN Is connected to the Power MOSFET drain, and supplies a negative to the motor with variable duty cycle.

2.6 H3D CONTROLLER MECHANICAL DRAWING



3 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. Parameters 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 connected to the chopper.**

CONNECTION MUST ONLY BE DONE WITH THE BATTERY DISCONNECTED OR THE KEY OFF.

3.1 MODIFYING PARAMETERS USING THE MINI-CONSOLE

Parameters that can be modified are:

<i>Traction</i>		<i>Lifting</i>	
1	CREEP SPEED	1	1ST SPEED
2	ACCELERATOR DELAY	2	2ND SPEED
3	INVERSION 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 (I) 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.

ATTENTION: 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.

Modified parameters are automatically stored by the control logic without the need for confirmation before switching off or disconnecting the console.

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

3.2 MODIFYING PARAMETERS USING THE DIGITAL CONSOLE

- Display of the model type, hourmeter and release of the Eprom installed in the controller.
- Model selection: REGENER
(SEL MODEL) STANDARD TR.
STANDARD PUMP
PUMP + HYDRO
- Option selection: PIN C3 bypass / weak
(SEL OPTION) SPEED free / check
BATTERY free / check
ARB free / check
RELEASE free / braking
HOURS running / keyon
PIN F1 cut b. 3 / quick I
PIN F4 seat / handle
PIN F2 cut b. 2 / backing
- Battery selection: 24V, 36/40/48V, 60/72/80V, 96V
(SEL BATTERY) fine adjustment
- Auxiliary function: CURRENT GAIN
(AUX FUNCTION) HYDRO CONTACTOR
BIMOTOR CONTACT.

- | | <u>traction</u> | <u>pump</u> |
|--------------------------------------|--|--|
| - Progr. of parameters:
(PROGRAM) | ACCELERATION DELAY
INVERS. BRAKING
RELEASE BRAKING
PEDAL BRAKING
CUTBACK SP1/SP2/SP3
AUXILIARY TIME
COMPENSATION
BRAKING MODULATION
I MAX.
CREEP SPEED
WEAK DROPOUT
CURVE BRAKING
CURVE TIME
BACKING TIME | ACCELERATION DELAY
EV. ACCELER DELAY
DECELER. DELAY
EV. DECELER DELAY
I MAX.
HYD SPEED COARSE
HYD SPEED FINE
HYDRO COMPENS.
CREEP SPEED
WEAK DROPOUT
HYDRO TIME
SPEED COARSE 1/2/3/4
SPEED FINE 1/2/3/4
SPEED COMP. 1/2/3/4
MIN VALVE VOLT
MAX VALVE VOLT |

- | | <u>traction</u> | <u>pump</u> |
|---------------------------------|---|---|
| - Tester functions:
(TESTER) | VMN 30%
VMN 80%
DIRECTION E7/E6
ACCELERATOR
CURRENT
TEMPERATURE
CUTBACK E1/E2/E3
BRAKE E5
SEAT / HANDLE
BATTERY
MOTOR | VMN 30%
VMN 80%
DIRECTION E7/E6
ACCELERATOR
CURRENT
TEMPERATURE
SPEED E5/E3/E2
SPEED E1/E4
E4 BATTERY
MOTOR VOLTAGE
VOLTAGE |
| - Function SAVE: | Chopper parameters are stored in the console memory. 10 different memories are available for each chopper model. | |
| - Function RESTORE: | Transfer of parameters from console memory to chopper memory.
10 different memories are available for each chopper model. | |
| - ALARM: | Display of chopper memory alarms. | |
| - Program VACC: | Potentiometer stroke parameter. | |

3.3 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 C3	Bypass	Bypass contactor
	Weak	Weakening contactor.
	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.
RELEASE	Free	No regenerative braking at release.
	Braking	Release braking.
HOURS	Running	Hour-meter active only when running.
	Key on	Hour-meter active with key on.

PIN F1	Cut b.#3	F1 = Reduction of speed no.3.
	Quick I	F1 = Rapid inversion input.
PIN F4	Seat	F4 = Seat microswitch.
	Handle	F4 = Handle microswitch.
PIN F2	Cut b.#2	F2 = Speed reduction no.2.
	Backing	F2 = 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:** allows the aux output of the connector C7 to be active under certain conditions. We can set it in the following way:

- 1) **CURRENT GAIN:** Is the logic board standard way of working. The output AUX C7 is not used. (Jumper setting: 1-3; 2-4)
- 2) **HYDRO CONTACTOR:** The output AUX G7 controls the hydrodrive contactor. It should be active during forward, and reverse directions and during release braking. The turning OFF delay is programmable at "AUXILIARY TIME". (Jumper setting: 1-2; 3-4)
- 3) **BIMOT. CONTACTOR:** AUX C7 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.

4 H3D 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. Potentiometer connection control.

The diagnostic message is indicated by a certain number of flashes of the LED connected to connector A.

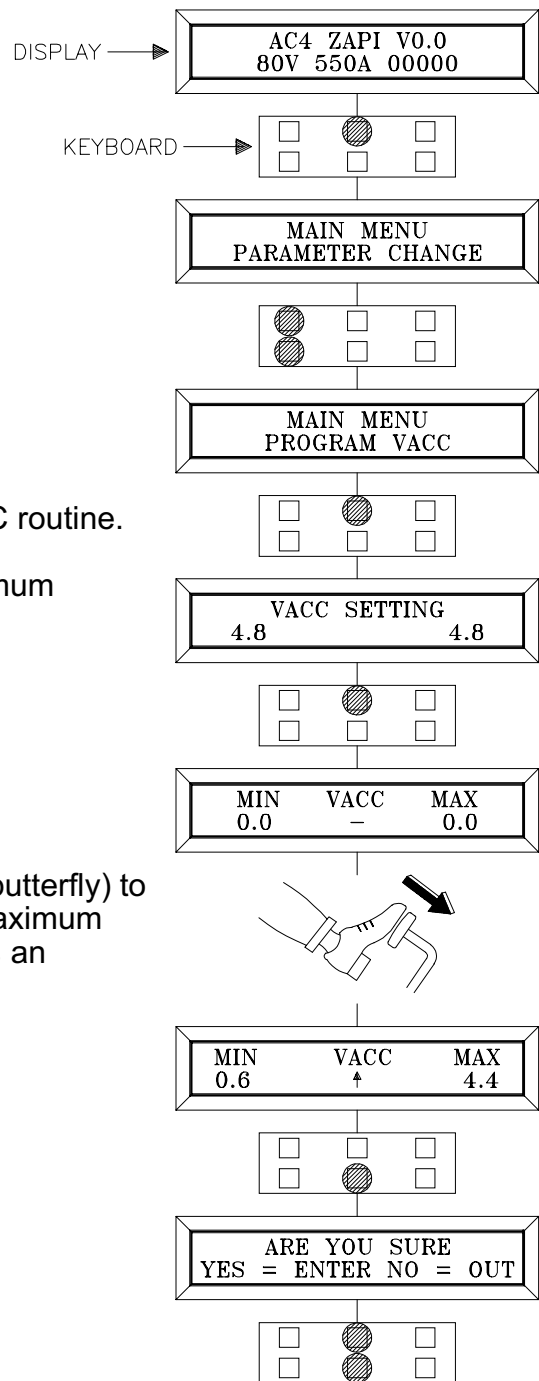
The current alarm message code can be displayed on the programming console. A description of the alarm codes, possible causes and solutions is given for each configuration in the following sections.

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.

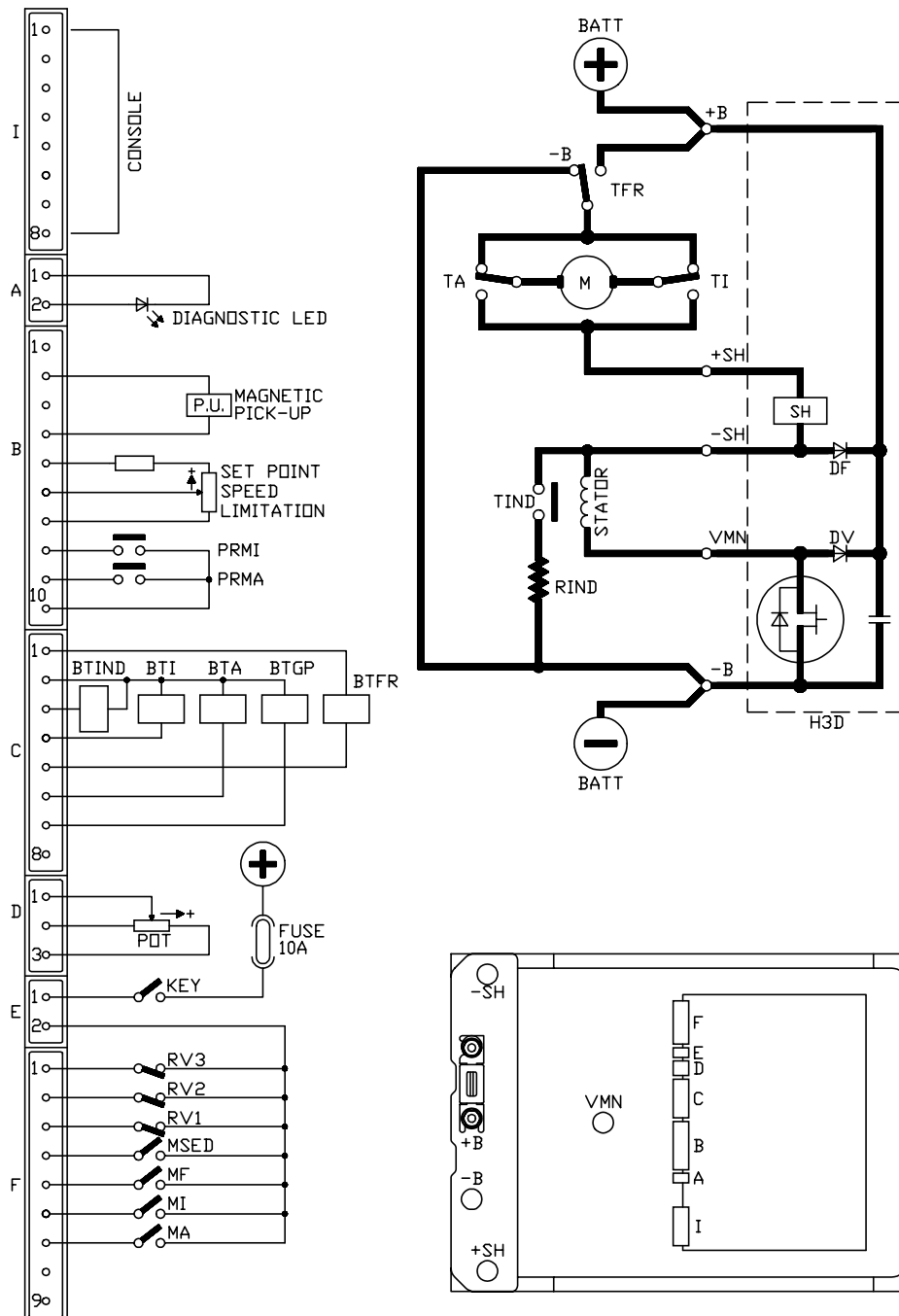
Flow Chart showing how to use the PROGRAM VACC function of the Digital Console.

- 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 H3D REGENERATIVE TRACTION

- Input for 3-wire potentiometer (optional 2-wire on request)
- 3 speed reductions
- Input for handle microswitch or seat microswitch (delayed)
- 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 INPUT CONNECTORS DESCRIPTION

pin	function	description
F1	RV3/QUICK1	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.
F2	RV2/BACKING	Input for 2nd speed reduction request. The request is active when the pin is opened (low level) and disactivated if the pin is positive (high level) or the speed is programmed to level 9. If programmed as reverse request (backing), the pin must be free, because the logic drives automatically when you use the inputs B8 and B9, the running is setted with the parameter CUTBACK 2 and for a time programmable with the parameter BACKING TIME, when you require this function it is not necessary to active the pin F4 (seat microswitch).
F3	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) and (CURVE TIME). It is possible to eliminate the braking in curve programming curve time as 0.
F4	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.
F5	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.
F6	MI	Input for backward request signal. The request is active when the signal is high (+VB)
F7	MA	Input for forward request signal. The request is active when the signal is high (+VB)
E8		Same as pin F4 but active when signal is low
F9		Same as F8
I6	REF*	Input for speed set-point signal with external potentiometer, on this pin it is set up the voltage relative to the maximum speed, the range is 0V - 5V. Open the jumper JP5 for rendering operative this input.

* = The functions relative to the maximum speed check are activated only if you have programmed the Option "SPEED" at "CHECK" mode.

5.2 PROGRAMMABLE FUNCTIONS DESCRIPTION (OPTIONS)

function/pin	option	description
1) PIN G3	by-pass	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 Imax. The disabling current is programmable from 10% to 100% of Imax. (WEAK DROP OUT). Activation delay=800 msec.
2) SPEED	free	Speed check not active. The mini-console can be used with this option.
	check	Speed check active. By the trimmer R22 and or the signal to pin B6 it is set up the maximum speed. When the speed exceeds this value the controller reduces the motor voltage or brakes if the difference persists. The braking goes on until the speed is less than the maximum value set. Sampling is made every 60 sec. Please note that when the speed check option is activated the miniconsole can not 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 roll back
	check	Anti-roll back
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	free	Hour meter only active when running
	check	Hour meter active when the key is on
7) PIN F1	cut b.#3	It associates the function of n° 3 speed reduction request to the F1 connector
	quick I	It associates the function for rapid inversion to the connector F1 with the following characteristics: plugging braking with 1.2 x Imax, restart in forward direction with 0.5 x Imax, slower acceleration (to avoid wheel slip). Also the machine will stop if the safety button is released and a forward or backward request is present. The rapid inversion request is accepted only when it is present with the forward request. The function is active when the pin is free or connected to battery negative.

- | | | |
|-----------|-----------------|---|
| 8) PIN F4 | seat | The input of running enable by the seat microswitch is associated to connector F4: A microswitch temporal sequence is requested.
Delay of 2 seconds on deactivation.
The function is active if the pin is connected to the positive |
| | handle | Like the “seat” option but without delay |
| 9) PIN F2 | cut b.#2 | It associates the speed reduction n° 2 to the pin F2. |
| | backing | It associates the backing request F2 connector. In this selection please leave the pin free because the connections are inside the logic board. |

5.3 ADJUSTMENT PARAMETER DESCRIPTION (MENU PROGRAM)

The parameters can be modified with the controller both in standby and in running. For storing the modifications in the nonvolatile memory, you must go out from the menu program and confirm the “ENTER” request.

Regenerative traction parameters:

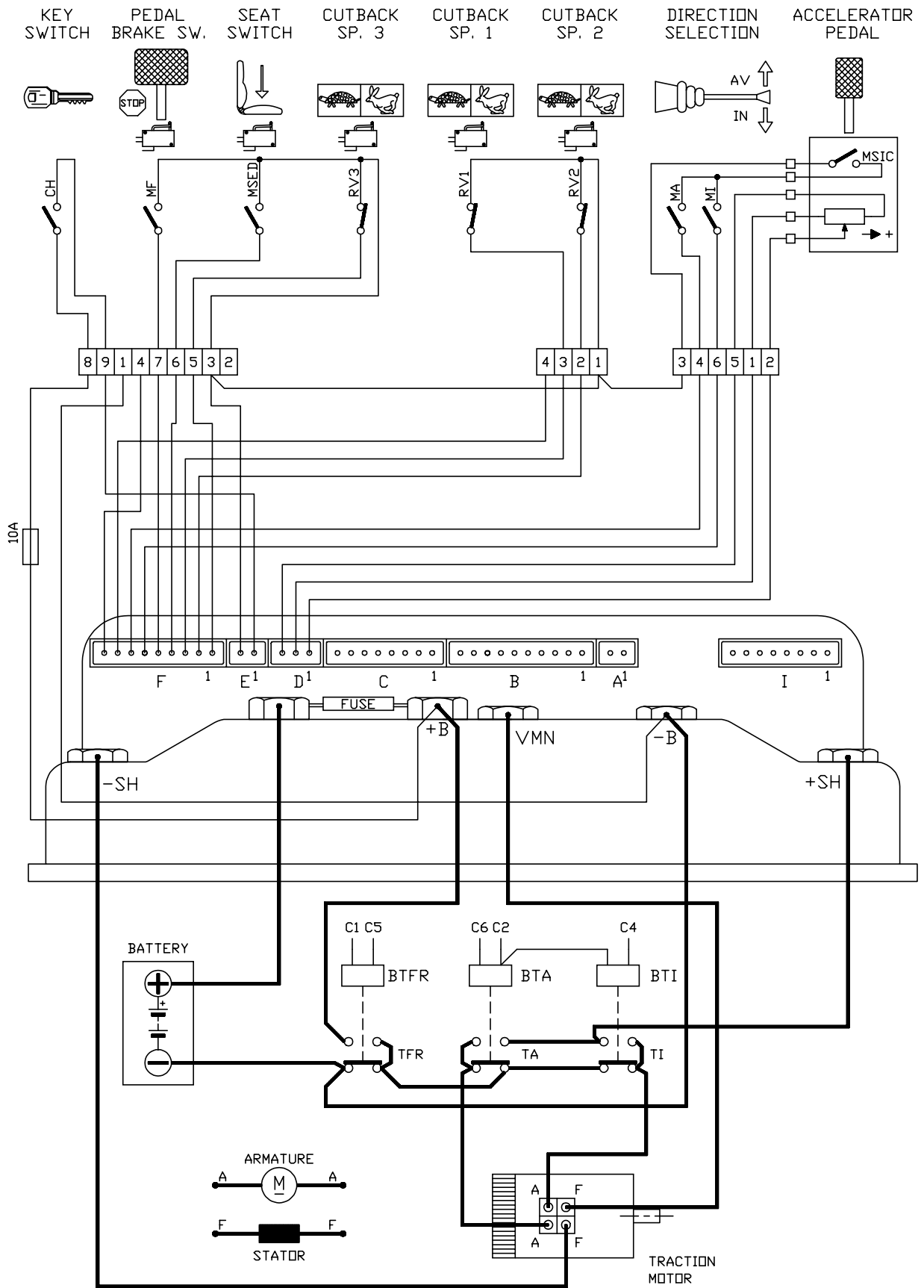
- 1) **ACCELER DELAY** = acceleration time, i.e. the minimum time during which the motor voltage varies from 0V to the maximum.
- 2) **INVERS BRAKING** = basic braking current in direction inversion. A value is added to this value based on the accelerator plus a fixed increment every second.
- 3) **RELEASE BRAKING** = release braking current.
- 4) **PEDAL BRAKING** = release braking current with brake pedal pressed.
- 5) **CUTBACK SP.1** = reduction of speed n° 1 associated to the input F3. The accelerator is reduced.
- 6) **CUTBACK SP.2** = reduction of speed n° 2 associated to the input F2 and to the input F5 if activated on running. It defines the speed to be set up in the BACKING mode.
- 7) **CUTBACK SP.3** = reduction speed n° 3 associated to the input F1.
- 8) **AUXILIARY TIME** = auxiliary contactor activating time connecting to the C7 (NTGP) output.
- 9) **COMPENSATION** = compensation of the speed (motor voltage) on the basis of the current when the speed reductions are active. It is activated only with the pedal pressed over 80%.
- 10) **BRAKING MODULATION** = defines the maximum current in inversion braking with the accelerator pedal pressed. When the accelerator is pressed all the way down in inversion, braking becomes more severe 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 75% (level 0) to 100% (level 9).
- 12) **MAX SPEED FORW** = Max speed with forward direction on. This speed reduction goes under adjustable compensation with the COMPENSATION parameter.
- 13) **MAX SPEED BACK** = Max speed with 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% I_{max}.
This braking level is used also for the speed check.
- 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.

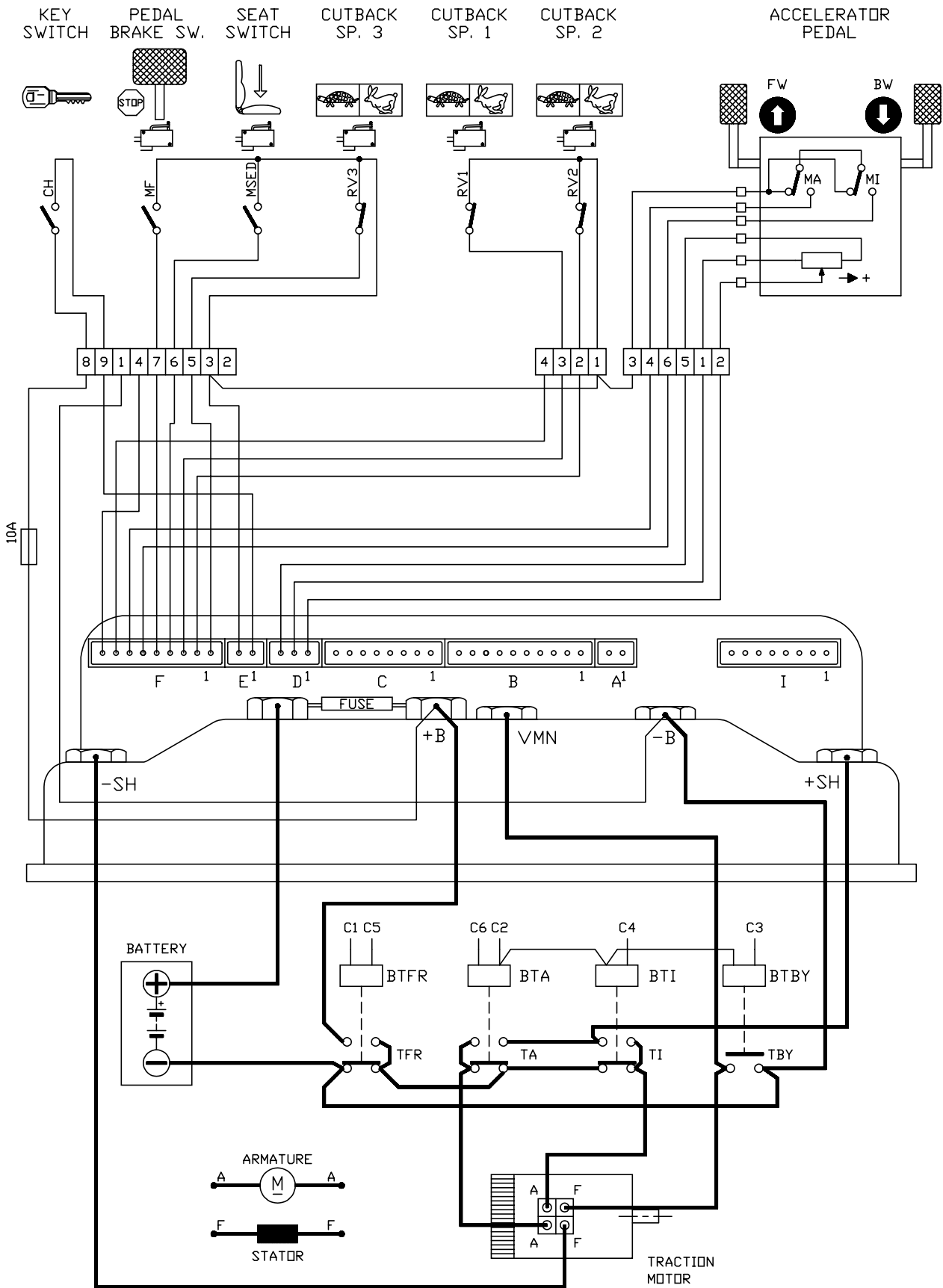
5.4 ADJUSTMENT CHART

PARAMETERS	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	% I _{Max} .	19	23	28	32	37	41	46	50	55	59
RELEASE BRAKING	% I _{Max} .	15	19	23	27	31	34	38	42	46	50
PEDAL BRAKING	% I _{Max} .	25	31	37	43	49	56	62	68	74	80
CUTBACK SP. (1-2-3)	% VBatt.	10	22	33	45	53	61	69	78	88	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	% I _{Max} .	0	3	5	8	11	14	17	20	22	25
I MAX. (VERSION 800A)	Amp.	600	622	644	667	689	711	733	755	778	800
I MAX. (VERSION 1000A)	Amp.	750	778	806	833	861	889	916	944	972	1000
MAX. SPEED FORW-BACK	% VBatt.	10	22	33	45	53	61	69	78	88	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	% I _{Max} .	10	20	30	40	50	60	70	80	90	100%
CURVE BRAKING	% I _{Max} .	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	1.0	1.5	2.0	2.5	cont.

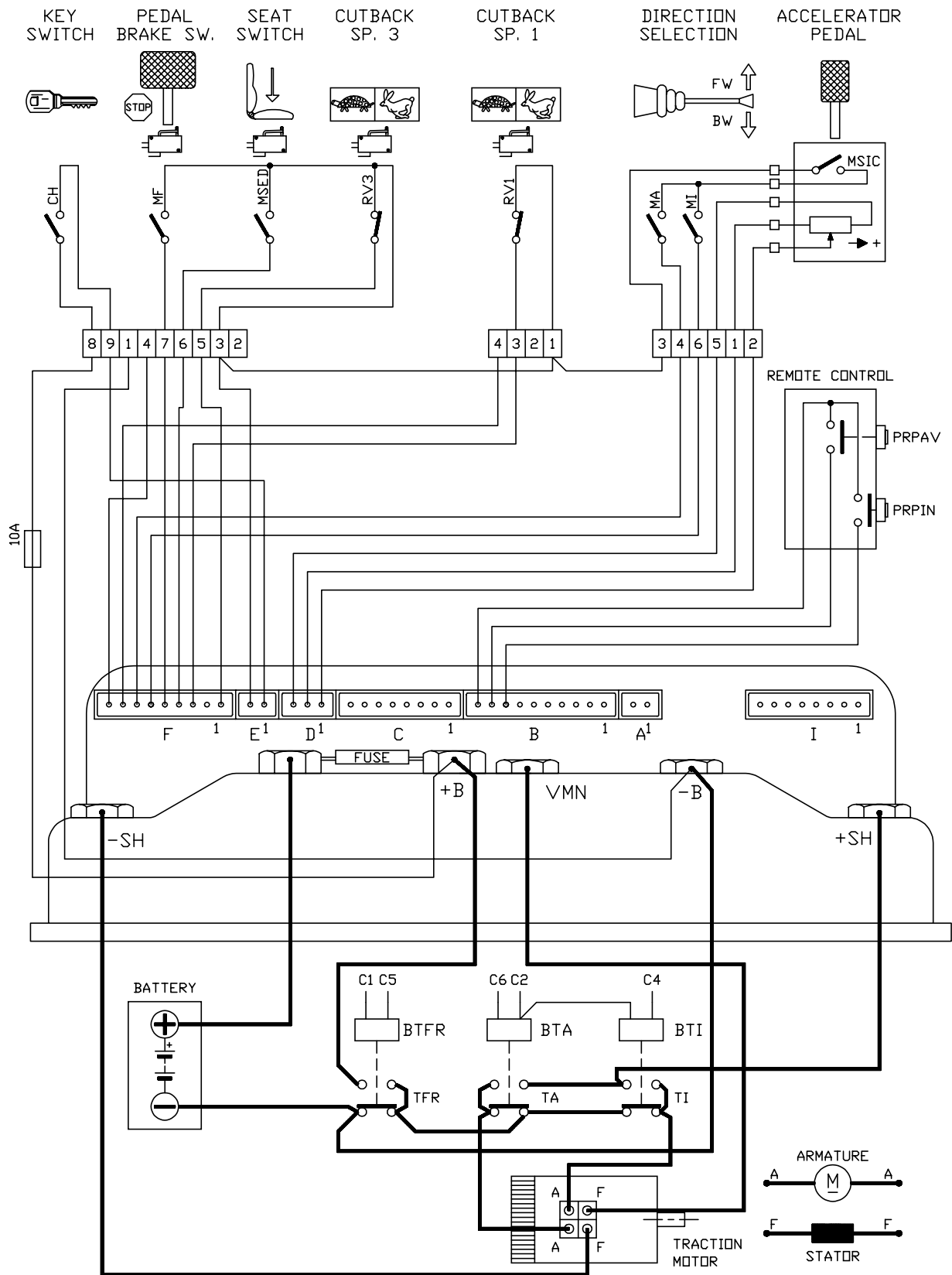
5.5 WIRING DIAGRAM FOR H3D REGENERATIVE



5.6 WIRING DIAGRAM FOR H3D REGENERATIVE WITH BYPASS AND DOUBLE LEVER PEDAL



5.8 WIRING DIAGRAM FOR H3D REGENERATIVE WITH BACKING



⚠ N.B.: For the operating of the backing request, program the option PIN F2 in the BACKING mode.
DON'T use the input F2 with this cabling configuration.

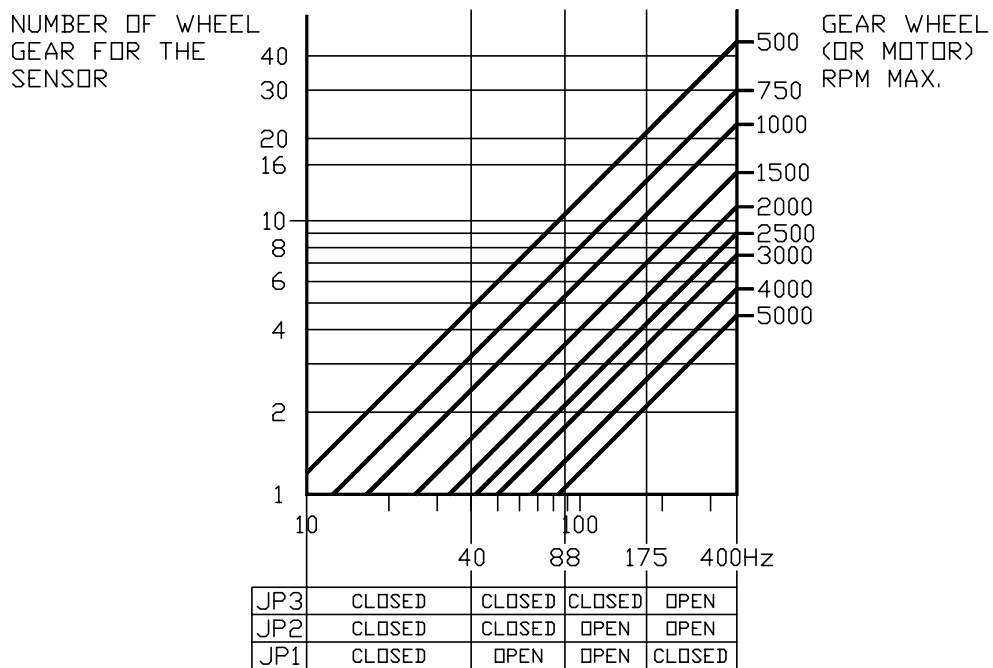
5.9 H3D REGENERATIVE WITH SPEED CHECK

The speed or the revolutions of the Motor are measured by a gear wheel and a magnetic sensor (pick-up). The frequency of the signal sent to the logic is changed in to a voltage signal for the processing. The speed check is activated even if there is not the running request, therefore affording a descent without pressing the accelerator pedal the machine begins to brake automatically if it exceeds the minimum speed which is the 10% of the maximum speed set.

N.B.: The speed check in standby is not operating in case the option RELEASE OF the menu SEL OPTION is programmed FREE.

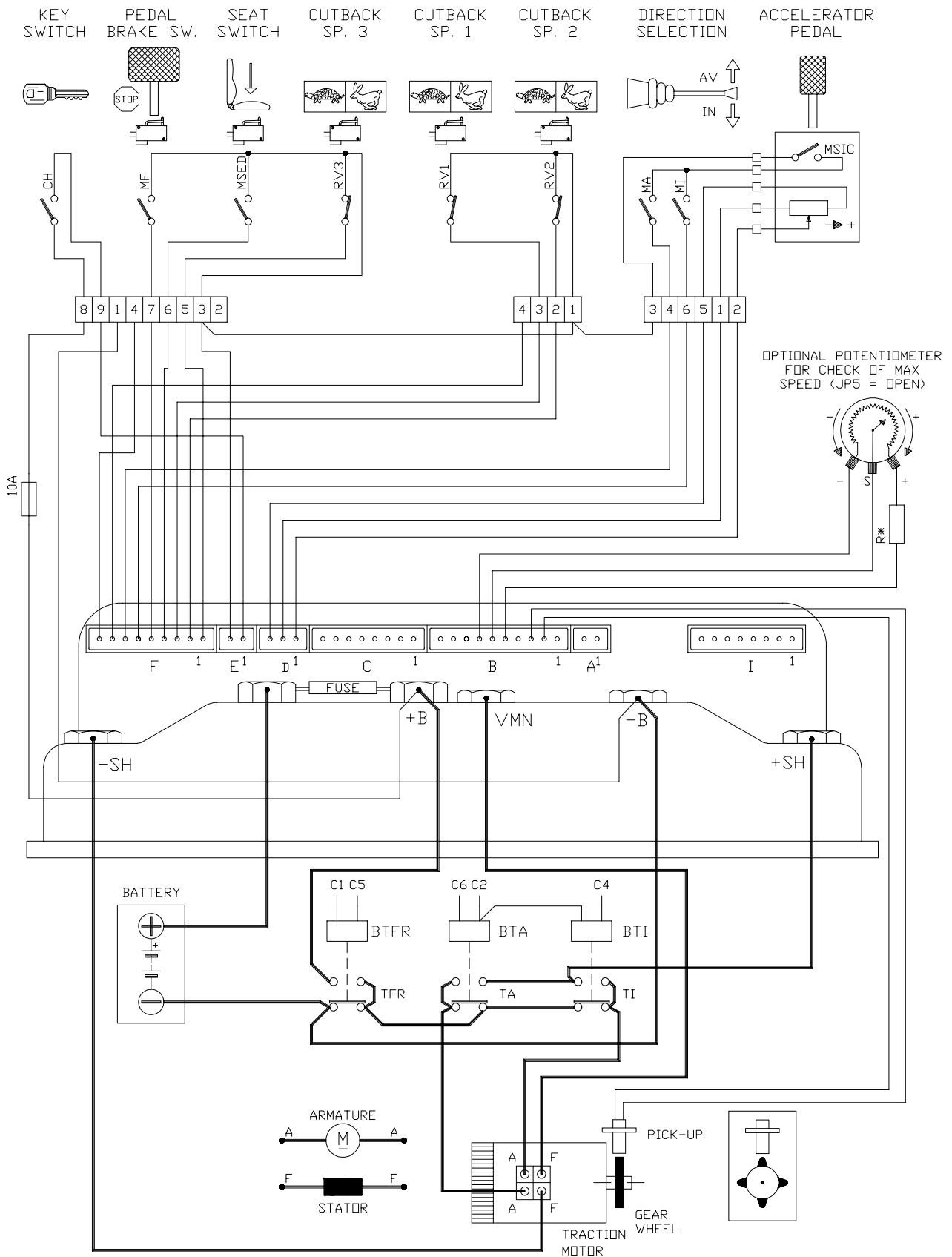
For configuring the controller follow these instructions:

- To have active the speed check function active you have to select by console the option SPEED of the menu SEL OPTION and program it to the check mode, then close on the logic board the jumper JP4. For working on the jumpers you have to equip yourself of a tin solder (25W - 40W), tin wire for electronic components and some lengths rheophores or copper wire not enamelled for making the jumper.
Pay attention: disconnect the battery and discharge the power capacitors before working on the electric parts.
- For setting the maximum speed with the trimmer R22 fitted on the logic board, you have to select the jumper JP5 = close.
- If instead of the internal trimmer it is used an external potentiometer for setting the maximum speed, select the jumper JP5 = open.
- For obtaining the maximum precision from the reading of the Motor revolutions it is necessary to select the jumper JP1, JP2, JP3 according to the scheme below:



Example: The requests are revolutions 2500 RPM max and on the drive shaft is connected with a 4 - gear wheel. For the selection of the jumpers positions point from the scheme where the 2500 rpm line crosses the 4 - gear line, then modify the jumpers like as in the table under the scheme; in our case it has to be used the table from 88 kHz to 175 kHz.

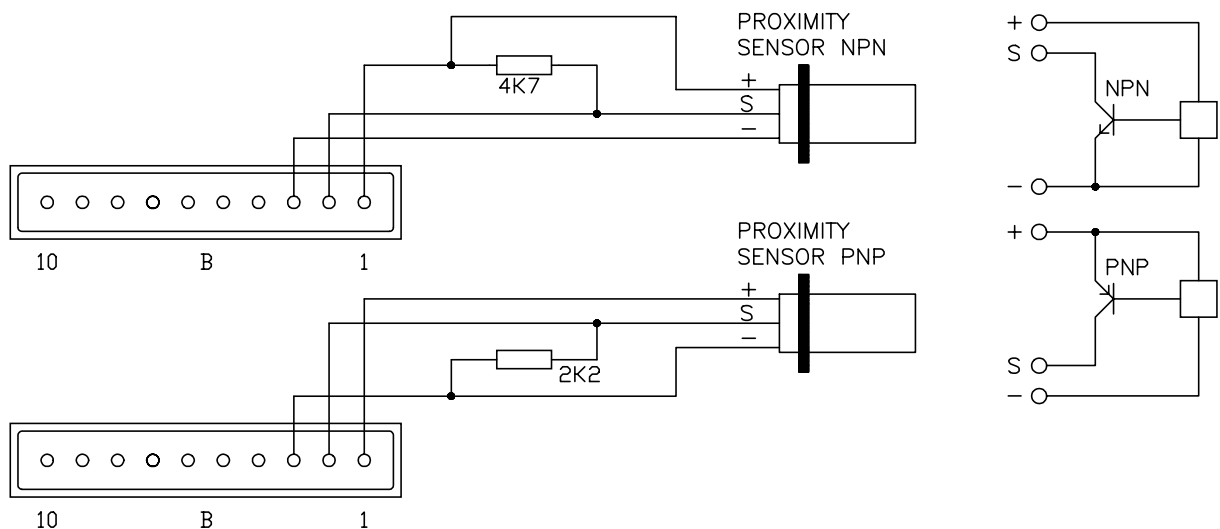
5.10 WIRING DIAGRAM FOR H3D REGENERATIVE WITH PICK-UP



⚠ R* = The value of the resistance is double than the one installed in the potentiometer; it is necessary for limiting the regulation range.

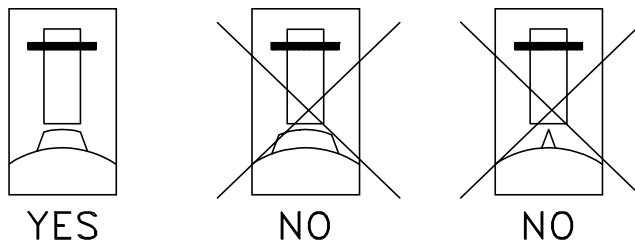
5.10.1 Wiring modification when using a proximity sensor

With OPEN COLLECTOR proximity sensors it is necessary to fit a resistance in the external cabling like indicated in the scheme.

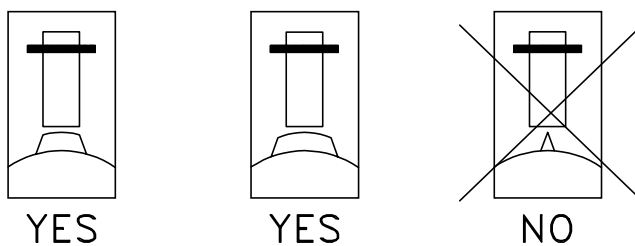


5.10.2 Notes on the gear wheel dimensions

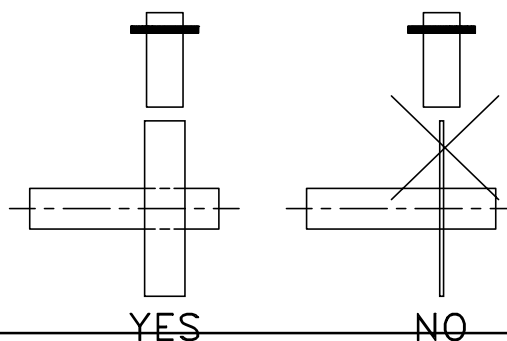
- Using a magnetic pick-up the gear must have the same dimensions as the facing part of the sensors.



- With a proximity sensor the gear must have equal or bigger dimension than the facing part.

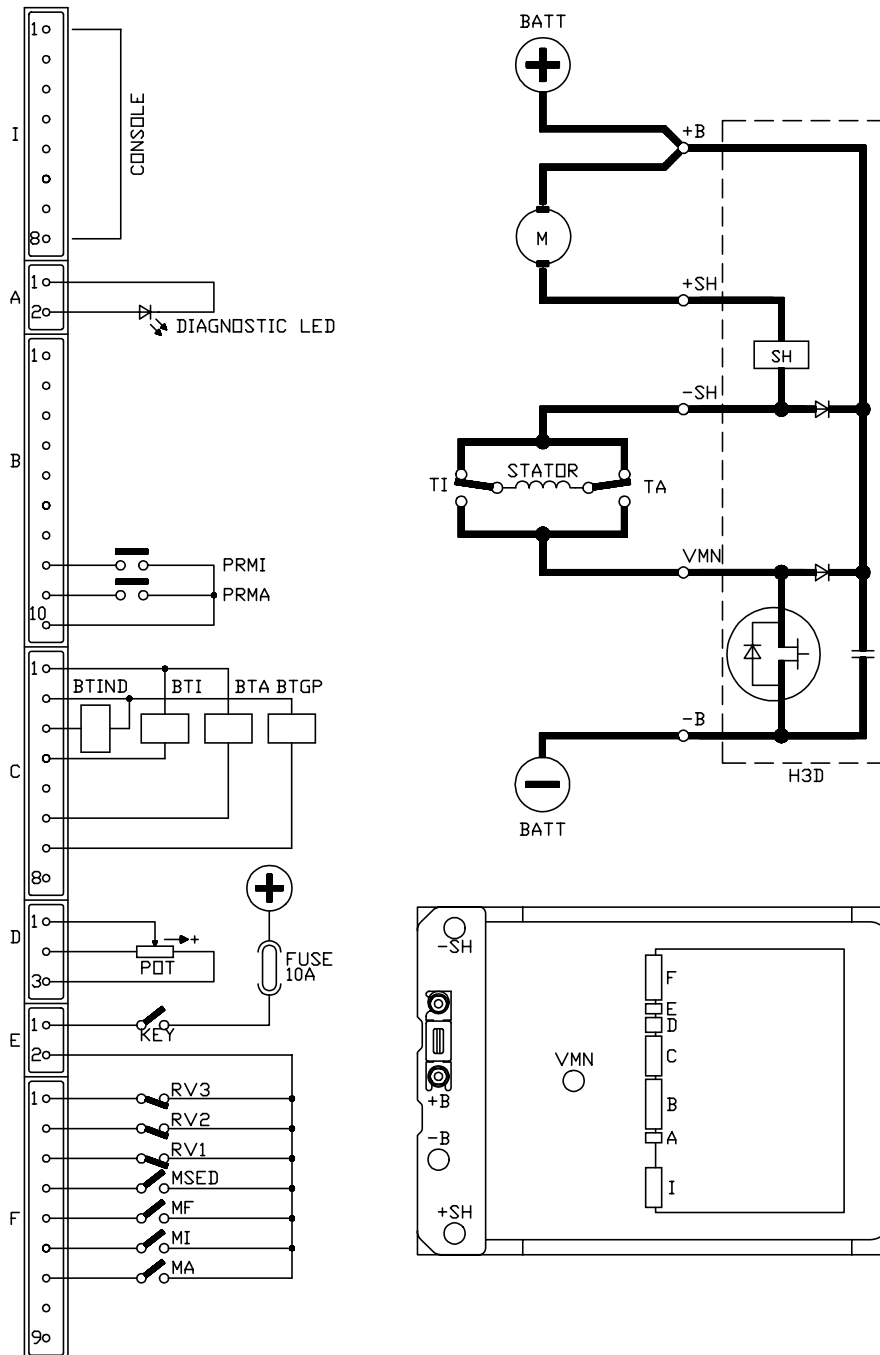


- In both cases the thickness of the plate must be bigger than the facing part.



6 H3D STANDARD TRACTION

- Input for 3 - wires potentiometer.
- N. 3 speed reductions.
- Handle or seat (delayed) microswitches input.
- Rapid inversion input.
- Pedal braking microswitch input.
- Bypass or weakening contactor handling.
- Handling of backing request with associated programmable speed.



6.1 INPUT CONNECTORS DESCRIPTION

<i>pin</i>	<i>function</i>	<i>description</i>
F1	RV3 QUICK	Input for 3rd speed reduction. Rapid inversion request.
F2	RV2 BACKING	Input for 2nd speed reduction. Backing request.
F3	RV1	Input for 1st speed reduction with combined curve braking.
F4	MSEAT	Input for seat microswitch signal (delayed 2 sec.) or handle signal.
F5	MF	Input for brake pedal microswitch: when the pin is taken (+VB) the speed No. 2 reduction is activated and the maximum current halved.
F6	MI	Input for backward request.
F7	MA	Input for forward request.
F8	RID	Like pin F4 but active low.
F9	RID	Like pin F4 but active low.

A detailed description of these pins is given on page 19.

6.2 PROGRAMMABLE FUNCTIONS DESCRIPTION (OPTIONS)

- The options can be programmed from the Console using the “SEL OPTIONS” menu.

Function	option	description
PIN G3	by pass	Contacteur with bypass
Physically (C3)	weak	Contacteur 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-meter only active when running
	key on	Hour-meter 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 page 20.

6.3 ADJUSTMENT PARAMETER DESCRIPTION (MENU PROGRAM)

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.

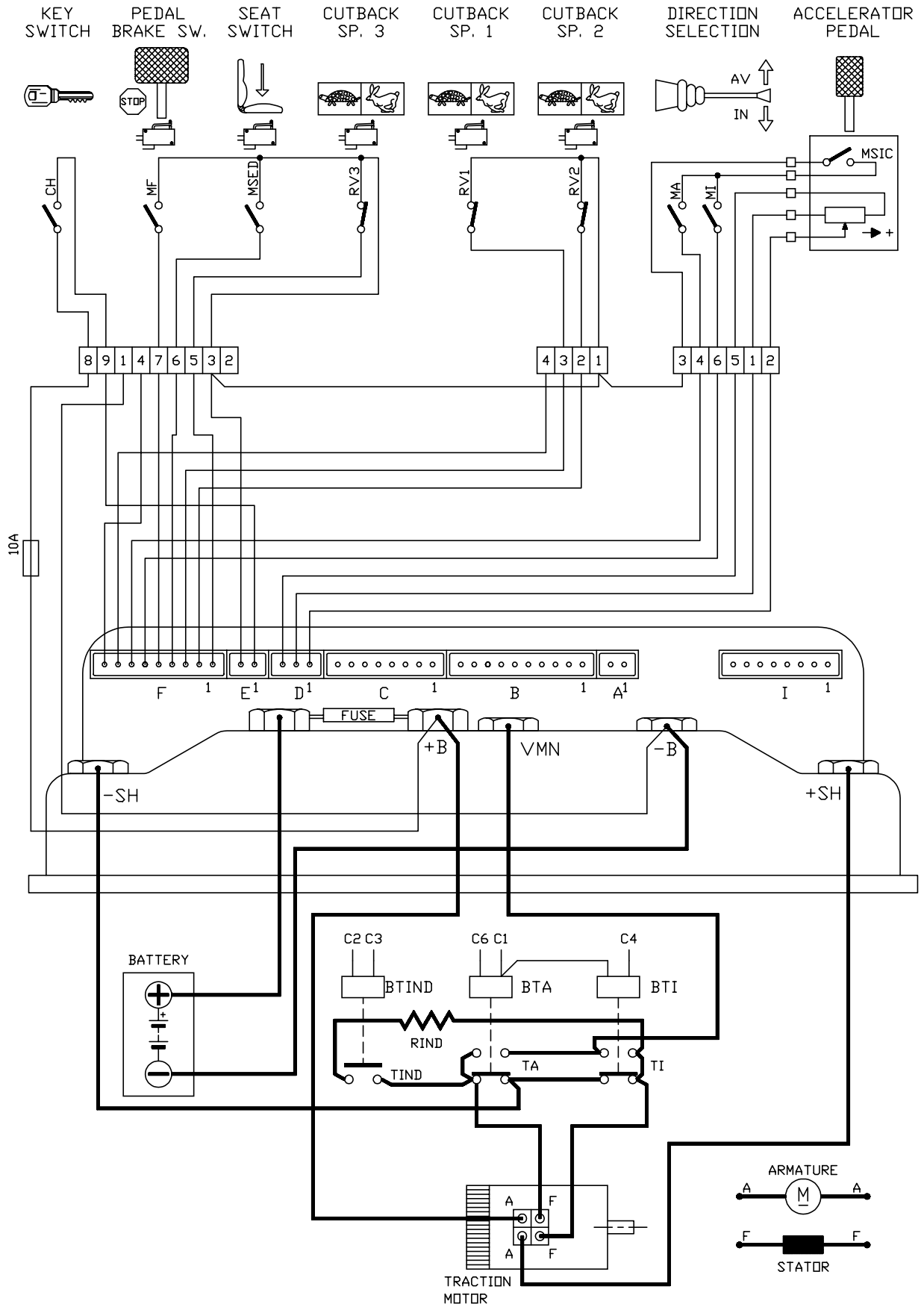
- 1 ACCELER.DELAY Acceleration time
- 2 BRAKING Braking current - base value
- 3 CUT BACK SP.1 1st speed reduction
- 4 CUT BACK SP.2 2nd speed reduction
- 5 CUT BACK SP.3 3rd speed reduction
- 6 AUXILIARY TIME Time delay to activate the auxiliary function
- 7 COMPENSATION Compensation for speed reductions
- 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 reverse 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 0 = no braking
- 16 BACKING TIME Time delay to activate the back request, 9 = continuous

A detailed description of these parameters is given on page 21.

6.4 ADJUSTMENT CHART

PARAMETERS	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	61	69	78	88	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. (VERSION 800A)	Amp.	600	622	644	667	689	711	733	755	778	800
I MAX. (VERSION 1000A)	Amp.	750	778	806	833	861	889	916	944	972	1000
MAX. SPEED FORW-BACK	% VBatt.	10	22	33	45	53	61	69	78	88	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	1.0	1.5	2.0	2.5	cont.

6.5 WIRING DIAGRAM FOR H3D STANDARD WITH FIELD WEAKENING



7 TRACTION ADJUSTMENT AND DIAGNOSIS

7.1 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-meter 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 (page 16-17).
- 2) Select the desired options (page 16-17).
- 3) Select and set battery voltage (page 16-17).
- 4) Check the operation 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 (page 22).
- 7) Set acceleration 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 close 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.I, etc.) with machine in standby on a flat surface and the accelerator pedal pressed all the way down. Apply a load on the machine or put it in a slope keeping completely pressed the accelerator pedal, 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 increases 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. It is operating also with pedal braking equipped with a potentiometer.
- 13) Release braking with brake pressed (PEDAL BRAKING). Set by pressing the brake pedal lightly during release.

7.2 H3D 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 page 36.

- 1 FLASH = Logic anomaly (EEPROM DATA KO, EEPROM PAR. KO, EEPROM CONF. KO, EEPROM OFF-LINE, CHOPPER NO CONF, WATCH-DOG).
- 2 FLASHES = Running request on startup or error in handle/speeds sequence (INCORRECT START).
- 3 FLASHES = Error on VMN test (NO FULL CONDUCTION, VMN LOW).
- 4 FLASHES = Accelerator high in standby or failures in its connection: this error inhibits the operation (VACC NOT OK).
- 5 FLASHES = Error in reading current - this error inhibits operation (I HIGH AT STAND, I=0 EVER).
- 6 FLASHES = Malfunction of the contactor driver circuit (DRIVER SHORTED, COIL SHORTED).
- 7 FLASHES = Excessive temperature, greater than 80°C (TH. PROTECTION).
- 8 FLASHES = Contactors do not open or VMN high in standby (BRAKE CONT. OPEN, DIR CONT. OPEN, VMN HIGH).
- 9 FLASHES = Contactor closed (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).

7.3 DECODING CONSOLE DISPLAYED ALARMS

1) BRAKE CONT. 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 closed. Free the contact and clean it; if it is 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 circuit toward negative.

To understand 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 repeat the test above, if the contactor remains deactivated replace the logic, otherwise if the contactor moves check that there is not a wire shorted to a metallic part.

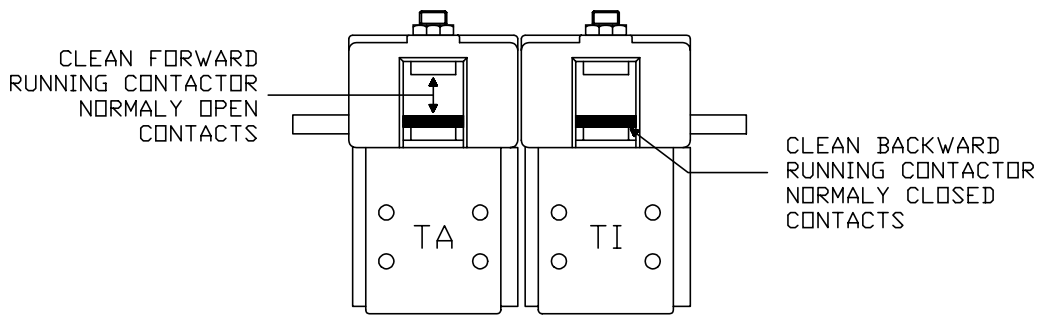
2) DIR. CONT. OPEN

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 is as follows:

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

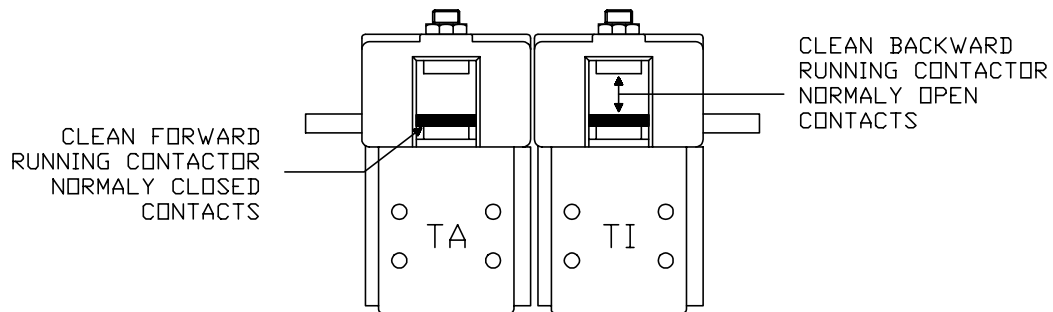
A1) There is not a good contact either on TA (=forward contactor) NA (normally open) or on TI (=backward contactor) NC (normally closed), due to dust, dirt or any particles which prevent a good contact.
Clean contacts by means of compressed air; if necessary remove dirt applying a soft abrasive movement.



It could be necessary to change both contactors.

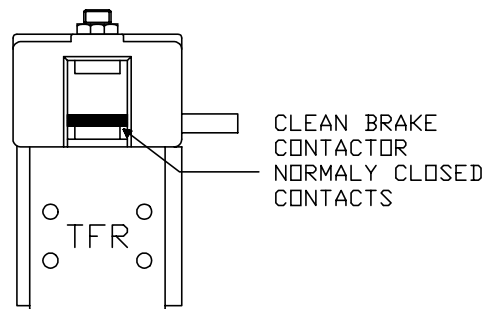
A2) There is not a good contact either on TI NA or on TA NC, due to dust, dirt or any particles which prevent a valid contact.

Clean contacts by means of compressed air; if necessary remove dirt applying a soft abrasive movement.



It could be necessary to change both contactors.

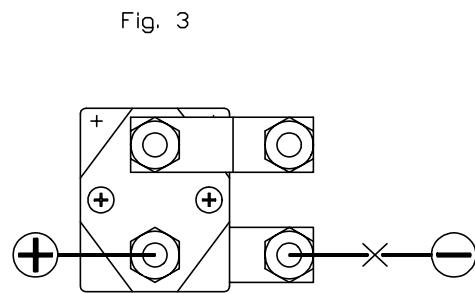
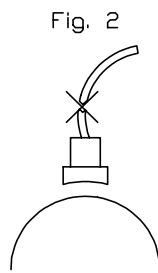
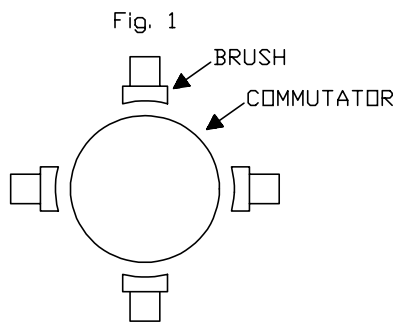
A3) The most likely reason is that the normally closed contact of the braking contactor doesn't make a good contact towards the battery negative for dust, dirt or because the contact doesn't locate completely for a mechanical defect of the contactor.



It could be necessary to replace the contactor.

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

- a) brushes open from the armature (fig.1).
- b) brush cable burn up (fig.2).
- c) Missing the braking contactor negative cable (fig. 3)
- d) Interruption either on motor winding or on motor cables.



B1) Forward contactor (TA) is supplied with a correct voltage but does not close.
Possible causes:

- 1) Contactor coil is open circuit, verify its resistance using an ohmmeter.
- 2) Contact can't move due to some mechanical restriction.
- 3) Nominal working coil voltage is greater than the battery voltage.

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

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

C1) Supply is not present at TA. Check cables and connections from TA coil to connectors C2 (PT) and C6 (NTA).

C2) Supply is not present at TI. Check cables and connections from TI coil to connectors C2 (PT) and C4 (NTI).

C3) Supply is not present at TA and TI. Check cables and connections from the coils to connectors C2 (PT), C6 (NTA) and C4 (NTI).

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

For H3D 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.

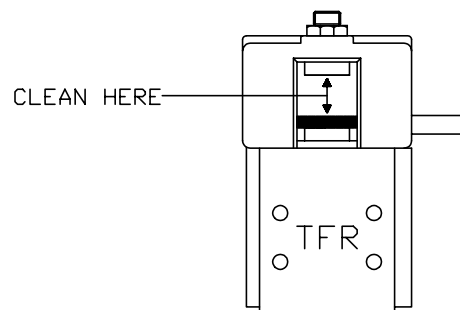
3) BRAKE CONT. OPEN (regenerative only)

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

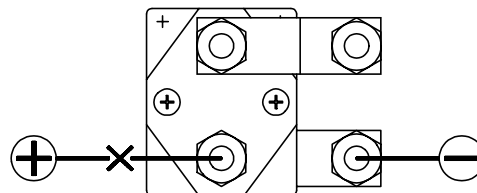
For finding the causes follow the diagnosis procedure as follows:

TEST	RESULT	2° TEST	ESITO	3° TEST	RESULT	FAULT DESCRIPTION AT POINT
AT RUNNING REQUEST THE TFR CLOSES FOR 0.3sec?	YES	→	→	→	→	A4
						A5
	NO	WHEN THERE'S THE RUNNING REQUEST, IS THERE A VOLTAGE AT PIN BTFR FOR A TIME OF 0.3sec?	YES	CHECK WITH AN OHMMETER IF THE TFR COIL IS INTERRUPTED	YES	B4
					NO	B5
			NO	→	→	C4

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



A5) The positive cable on the braking contactor is missing.



B4) Replace the contactor coil or the complete contactor.

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

B6) Contactor has a working nominal voltage higher than the supply.

C4) Supply does not appear at the contactor coil, please check the cables 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:

- Running contactor welded or slow to open.
- 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 follow the diagnosis procedure has follows:

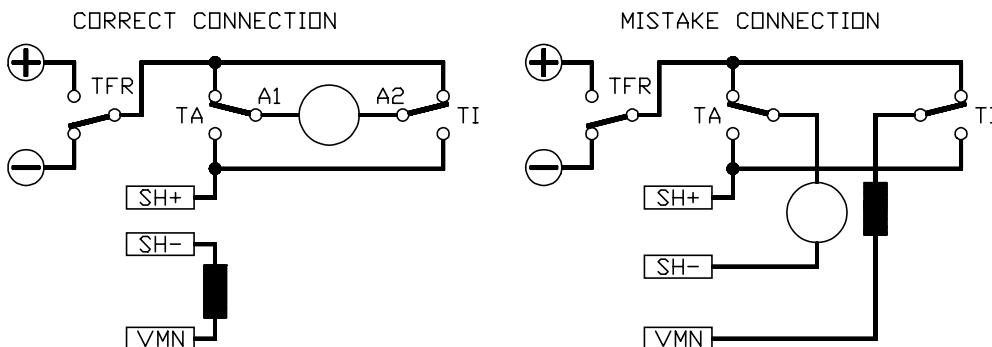
CONDITIONS UNDER WHICH FAULTS IS DETECTED	1° TEST	RESULT	2° TEST	RESULT	3° TEST	RESULT	FAULT DESCRIPTIO POINT:
AT THE KEY ON	DISCONNECT THE MOTOR CABLE CONNECTED TO THE BATTERY AND THEN VERIFY IF THE ALARM STILL PRESENT	YES	→	→	→	→	C5
		NO	A RUNNING CONTACTOR IS LOCKED IN WORKING POSITION	YES	THE STUCK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

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

- 1) if the wire going from NTA to NTI is shorted to 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 remains in the working position, free the contact, it may be necessary to replace the contactor.

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



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

D3) Check that there are no 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 a bypass contactor is present check that it is not welded or it is too slow opening.

To verify this possibility, disconnect the bypass and check if the failure disappears: if this happens, replace the logic.

ATTENTION: the contactors connected to the controller must not have arc suppression on the contactor coils. Suppression exists inside the controller. Any external suppression will 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 welded (only standard traction).

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

c) Logic failure, probably the braking diode has failed, replace the power board.

7) NO FULL COND.

The test is carried out in full conduction. In this condition, if 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 failure of the thermal diagnosis circuit on the power or on the logic board, replace one of the two parts or replace the complete controller.

b) If the alarm occurs frequently the machine has worked for a short time, it is probably due to inadequate heat sinking. Check the fixing nuts are tight and the installation is correct .

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 closed.
- b) Error in sequence made by the operator, pedal pressed at the key on.
- c) Incorrect wiring if there are not any defects externally it 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 closed.
- c) Incorrect manoeuvre.
- d) If there are no 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 open circuit or the potentiometer negative has not been connected to the PIN D2 of the logic board. In this case an alarm is generated because the logic does not find the load on pin D2.
- 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 zero.

If this is not verified, an alarm is signalled. This alarm inhibits machine operation.

Possible causes:

- a) Current sensor broken or logic failure.
First replace the logic. 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) Incorrect connection 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, remember 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-meter is incorrect. This alarm does not shut down the machine. If the alarm disappears when the key is switched off and on again, remember that the hour-meter 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-meter, 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 circuit or draw 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.

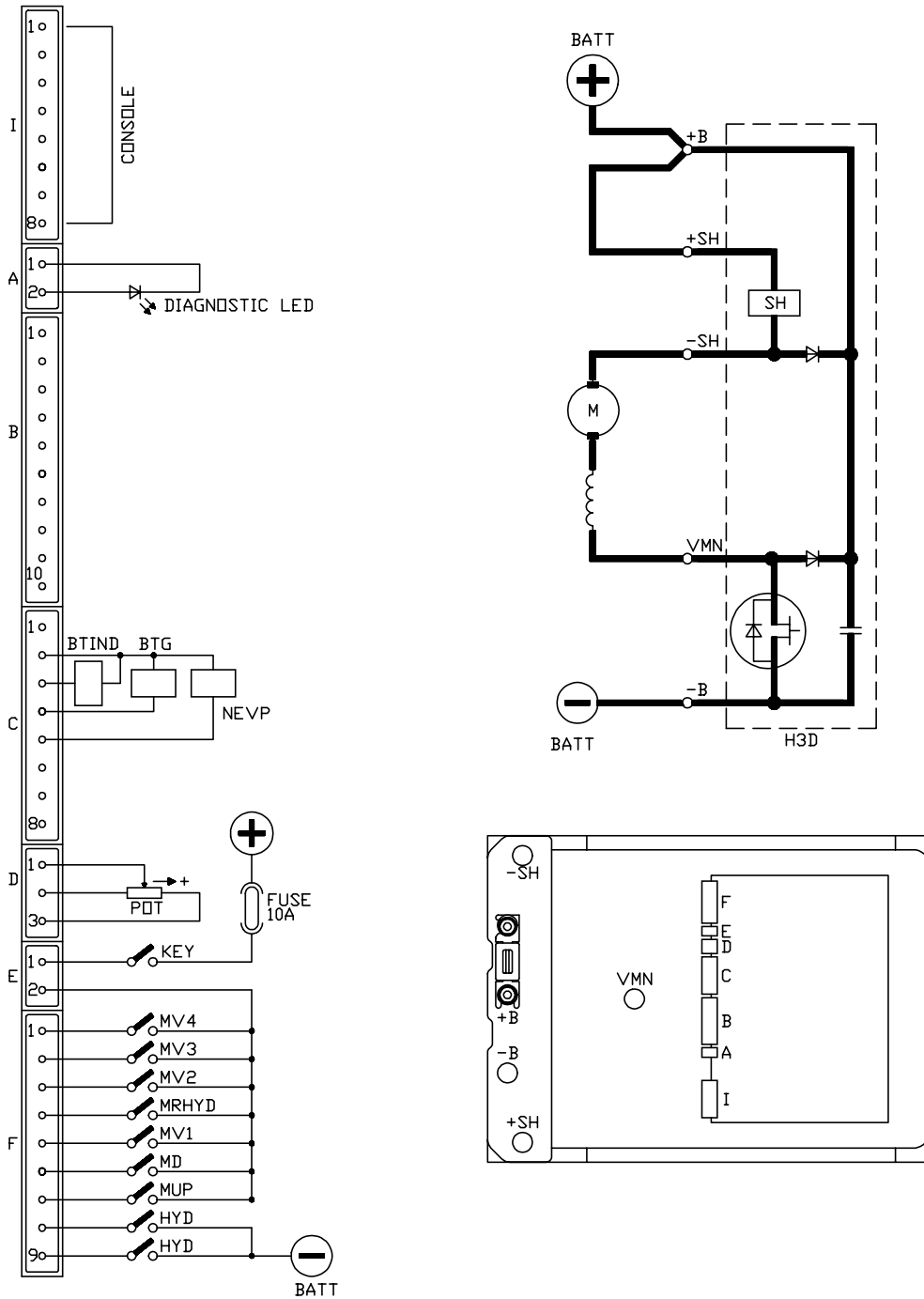
22) DRIVER SHORTED

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.

8 H3D 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



8.1 INPUT CONNECTORS DESCRIPTION

<i>pin</i>	<i>function</i>	<i>description</i>
F1	4TH S.	Input for 4th speed request. The speed is active when the pin is high, connected to +Batt.
F2	3RD S.	Input for 3rd speed request. The speed is active when the pin is high, connected to +Batt.
F3	2ND S.	Input for 2nd speed request. The speed is active when the pin is high, connected to +Batt.
F4	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 related to this input.
F5	1ST S.	Input for 1st speed request. The speed is active when the pin is high, connected to +Batt.
F6	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 C2 and C5.
F7	UP	Input for speed request handled by potentiometer, active high..
F8	HYD.S.	Same function as F4 but active when forced to -BATT.
F9	HYD.S.	Like Pin F8.

8.2 PROGRAMMABLE FUNCTIONS DESCRIPTION (OPTIONS)

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

<i>function/pin</i>	<i>option</i>	<i>description</i>
PIN G3 Physically (C3)	bypass	The contactor connected to connector C3 is handled as bypass. Activation current = <80% IMAX. Output current = <90% IMAX. Activation delay = 800 ms.
	weak	The contactor connected to connector C3 is handled as field 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. 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 flashing continuously.
HOURS	running	Hour-meter active only in running.
PIN G5 Physically (C4)	key on	Hour-meter active with key.
	status	The output relative to pin C4 is active when the chopper is carrying out any function (except descent).
	main c.	The output relative to pin C4 handles a main contactor.

8.3 H3D STANDARD LIFTING ADJUSTMENT PARAMETERS DESCRIPTION

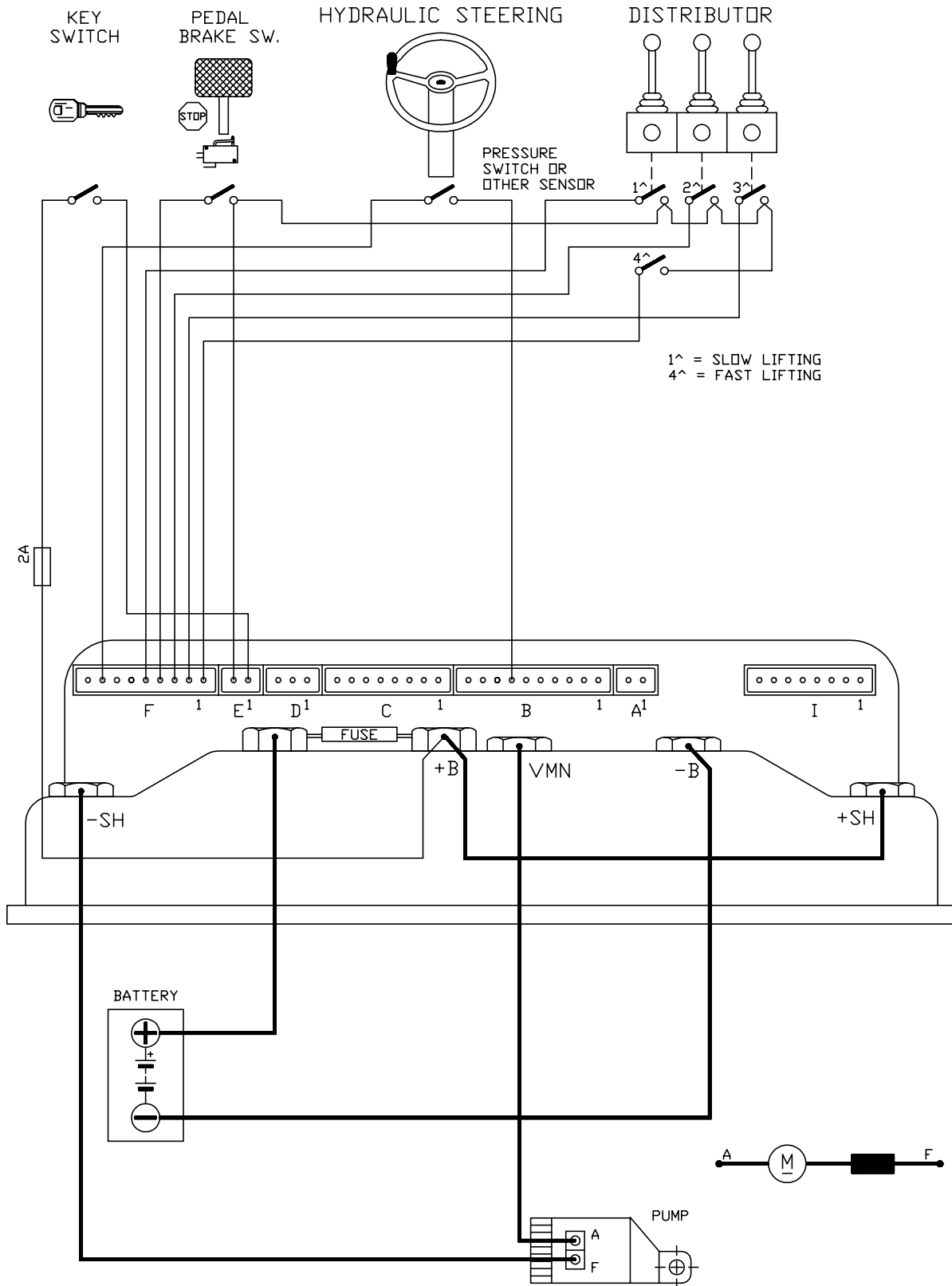
The parameters can be modified with the controller both in standby and in running. For storing the modifications in the nonvolatile memory, you must go out from the menu program and confirm the "ENTER" request.

- 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.

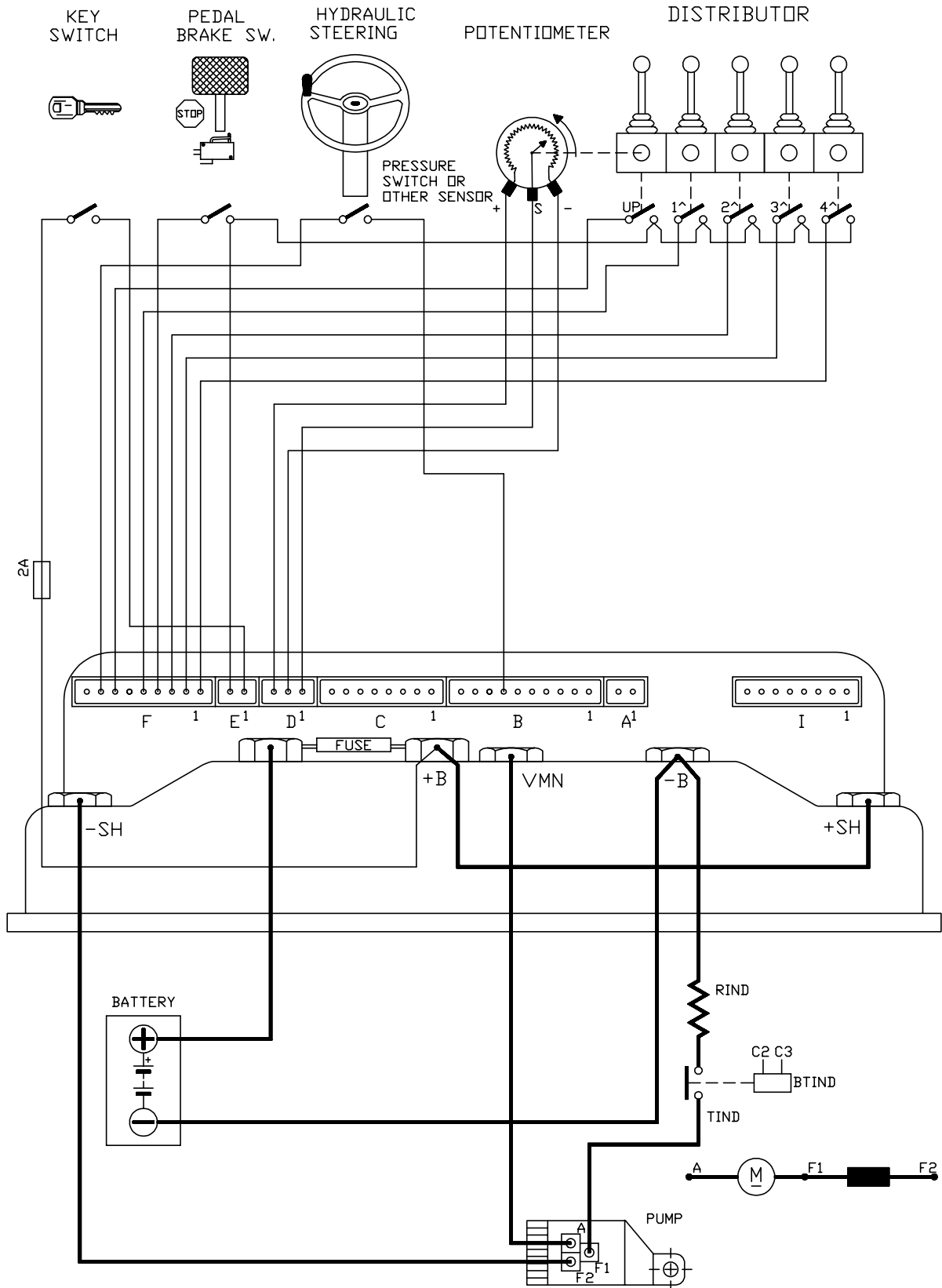
8.4 ADJUSTMENT CHART FOR H3D STANDARD LIFTING

PARAMETERS	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. (VERSION 800A)	Amp.	600	622	644	667	689	711	733	755	778	800
I MAX. (VERSION 1000A)	Amp.	750	778	806	833	861	889	916	944	972	1000
SPEED COARSE	% VBatt.	0	11	22	33	44	55	66	77	88	100
SPEED FINE	% VBatt.	0	1.2	2.4	3.6	4.8	6.05	7.3	8.5	9.7	10.9
HYDRO COMPENS	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

8.5 WIRING DIAGRAM FOR H3D STANDARD LIFTING

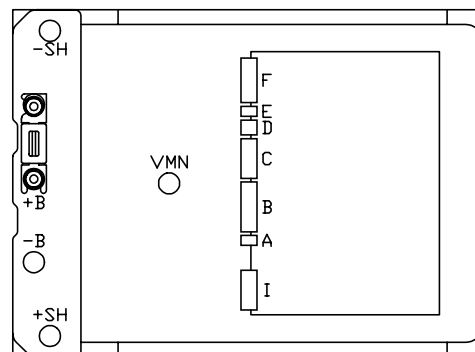
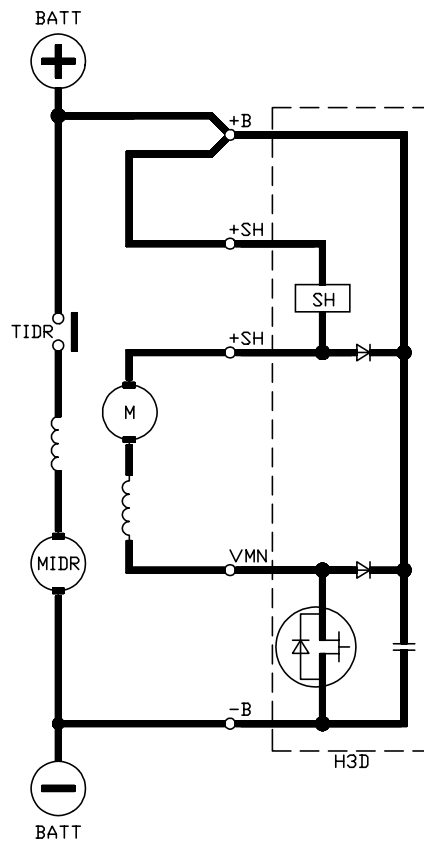
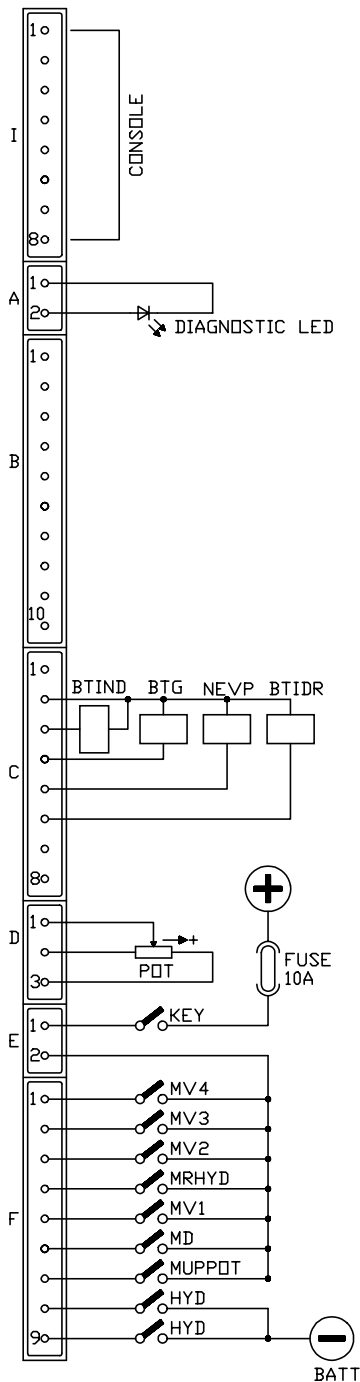


8.6 WIRING DIAGRAM FOR H3D STANDARD LIFTING WITH FIELD WEAKENING



9 H3D LIFTING + 3RD MOTOR

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



9.1 INPUT CONNECTORS DESCRIPTION

<i>pin</i>	<i>function</i>	<i>description</i>
F1	4TH S.	Input for 4th speed request. The speed is active when the pin is high, connected to +Batt.
F2	3RD S.	Input for 3rd speed request. The speed is active when the pin is high, connected to +Batt.
F3	2ND S.	Input for 2nd speed request. The speed is active when the pin is high, connected to +Batt.
F4	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.
F5	1ST S.	Input for 1st speed request. The speed is active when the pin is high, connected to +Batt.
F6	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 C2 and C5.
F7	UP	Input for speed request handled by potentiometer, active high..
F8	HYD.S.	Same function as F4 but active when forced to -BATT.
F9	HYD.S.	Like Pin F8.

9.2 PROGRAMMABLE FUNCTIONS DESCRIPTION (OPTIONS)

<i>unction/pin</i>	<i>option</i>	<i>meaning</i>
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-meter active only in running.
	Key on	Hour-meter active for the entire chopper startup time.
PIN G5	Status	Output C4 = Lifting status (0=running).
	Main C.	Output C4 = Main contactor.

A detailed description of the meanings is the same given on page 45 as per H3D standard lifting.

9.3 H3D LIFTING + 3RD MOTOR ADJUSTMENT PARAMETERS DESCRIPTION

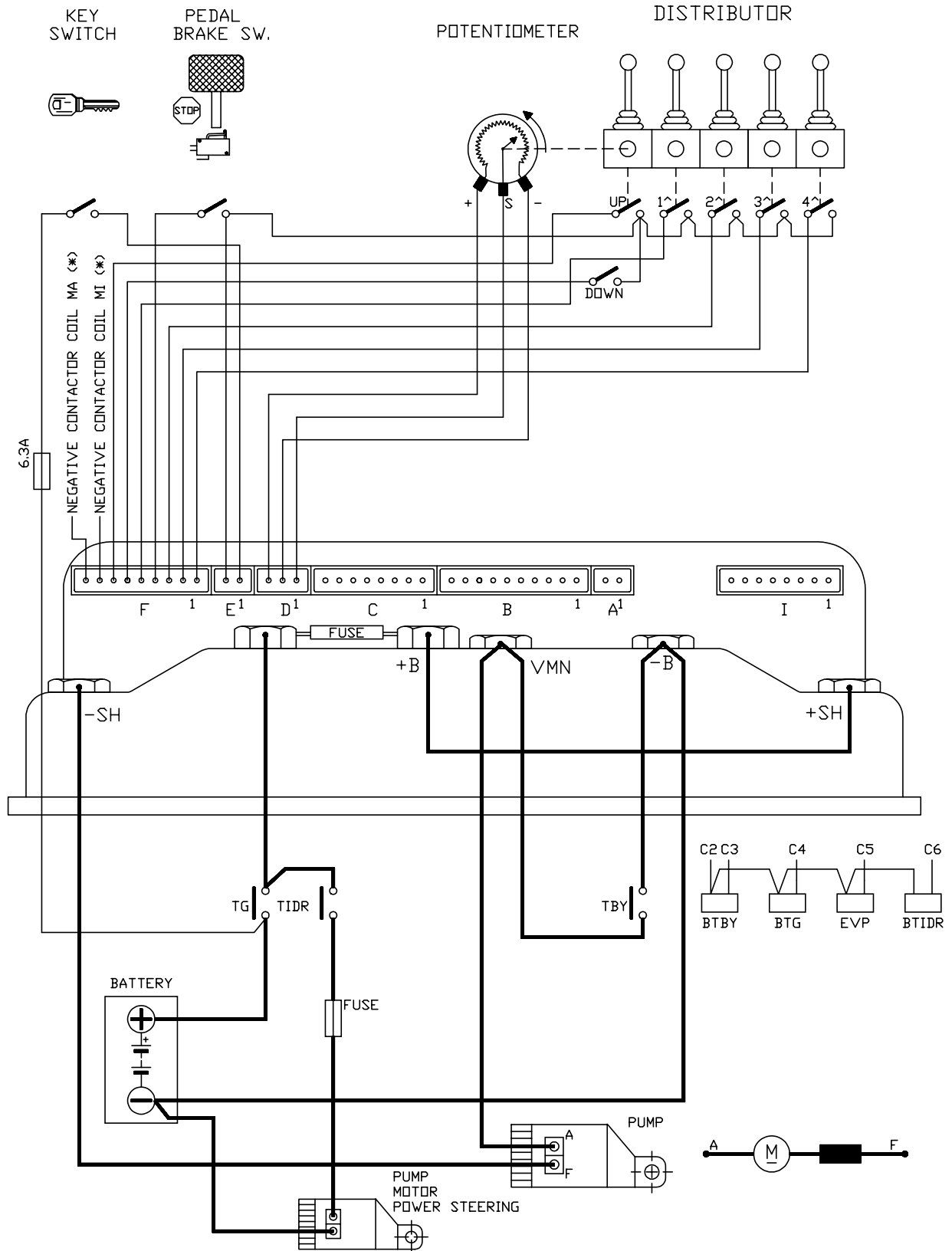
1	ACCELER.DELAY	(Pump acceleration time - rise/functions)
2	EV. ACCELER DELAY valve)	(Acceleration time descent proportional solenoid
3	DECELER DELAY	(Pump deceleration time)
4	EV.DECELER DELAY	(Deceleration time proportional solenoid valve)
5	AUXILIARY TIME	(Not used for the H3D in pump configuration)
6	IMAX.	(Maximum chopper current)
7	CREEP SPEED	(Minimum acceleration threshold)
8	WEAK DROPOUT	(Weakening output current threshold)
9	HYDRO TIME	(Hydrodrive delay)
10	1ST SPEED COARSE	(Speed no. 1 - coarse adjustment 0-100%)
11	1ST SPEED FINE	(Speed no. 1 - fine adjustment 10%)
12	1ST SPEED COMP.	(Compensation speed no. 1)
13	2ND SPEED COARSE	(Speed no. 2 - coarse adjustment 0-100%)
14	2ND SPEED FINE	(Speed no. 2 - fine adjustment 10%)
15	2ND SPEED COMP.	(Compensation speed no. 2)
16	3RD SPEED COARSE	(Speed no. 3 - coarse adjustment 0-100%)
17	3RD SPEED FINE	(Speed no. 3 - fine adjustment 10%)
18	3RD SPEED COMP.	(Compensation speed no. 3)
19	4TH SPEED COARSE	(Speed no. 4 - coarse adjustment 0-100%)
20	4TH SPEED FINE	(Speed no. 4 - fine adjustment 10%)
21	4TH SPEED COMP.	(Compensation speed no. 4)
22	MIN. VALVE VOLT.	(Minimum voltage on solenoid valve)
23	MAX. VALVE VOLT.	(Maximum voltage on solenoid valve)

A detailed description of the parameters is given at page 46 as per H3D standard lifting.

9.4 ADJUSTMENT CHART FOR H3D STANDARD LIFTING + 3RD MOTOR

PARAMETERS	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. (VERSION 800A)	Amp.	600	622	644	667	689	711	733	755	778	800
I MAX. (VERSION 1000A)	Amp.	750	778	806	833	861	889	916	944	972	1000
SPEED COARSE	% VBatt.	0	11	22	33	44	55	66	77	88	100
SPEED FINE	% VBatt.	0	1.2	2.4	3.6	4.8	6.05	7.3	8.5	9.7	10.9
COMPENSATION	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

9.5 WIRING DIAGRAM FOR CONNECTION LIFTING PUMP AND POWER STEERING WITH BYPASS AND MAIN CONTACTORS. POWER STEERING COMMAND FROM RUNNING CONTACTORS.



10 H3D LIFTING ADJUSTMENT AND DIAGNOSIS

10.1 SEQUENCE OF SETTING 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-meter 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 (page 16).
- 2) Select the desired options (page 53).
- 3) Select and set battery voltage (page 17).
- 4) Check the operation 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.

10.2 SETTING THE PROPORTIONAL SOLENOID VALVE

- For control of 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 best compromise between response speed and smoothness of movement.

10.3 H3D 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 FLASH = Logic anomaly (EEPROM DATA KO, EEPROM PAR. KO, EEPROM CONF. KO, EEPROM OFF-LINE, CHOPPER NO CONF, WATCH-DOG).

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

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

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

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

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

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

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

10.4 DECODING CONSOLE DISPLAYED ALARMS

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 failure, replace the unit.

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 of the power circuit has been 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 closed.

The presence of the power steering request at the key on does not generate the alarm.

6) **I HIGH AT STAND**

Test carried out in standby, checks that the current is zero.

If this is not verified, an alarm is signalled. This alarm shuts down the machine.

Possible causes:

a) Current sensor failure 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, remember 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-meter is incorrect. This alarm does not shut down the machine. If the alarm disappears when the machine is switched off and on again, remember that the hour-meter 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-meter, 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) SHORTED COIL

There is a short circuit towards the positive of the battery, somewhere on the negative contactor output.

Possible causes:

- a) The coils of the contactors are short circuit or they draw more than 6A continuously.
- b) Short circuit with +batt of the cables which come out from the contactor connector.

The alarm shows an that overchange has occurred and not the failure of a chopper component. When the external cause is removed it is possible to restart again.

15) SHORTED DRIVER

The test is carried out in standby. It checks that the voltage of the drivers controlling the contactors is within limits compared to previously stated values.

Possible cause:

- a) Logic failure
- B) Drivers failed because of an overvoltage in the cables of the negative contactors.
Replace the logic after having removed the cause.

RECOMMENDED SPARE PARTS FOR H3D

ARTICLE CODE NO	DESCRIPTION
E07008	Potentiometer 5Kohm 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
C12372	8-way molex female connector
C12370	2-way molex female connector
C12397	10-way molex female connector
C12769	Female connector (molex)
C12203	6-way mate-in-lock FE connector
C12205	4-way mate-in-lock FE connector
C12768	Male connector (for female lock)
C12228	4-way mate-in-lock MA connector
C12229	6-way mate-in-lock MA connector
C12767	Female connector (for male lock)
C12204	9-way mate-in-lock FE connector
C12230	9-way mate-in-lock MA connector
C29509	Contactactor SW 200 80V (300D)
C29537	Contactactor SW 201-6-80V (300R)
C29510	Contactactor SW 201-65-80V (300R)
C29523	Contactactor SW 180 B13-80V (180D)
C29514	Contactactor SW 80 80V
C15312	H3D black plastic cover
P00114	Logic Board H3D ABDZPA0B

PERIODIC MAINTENANCE TO BE REGULARLY REPEATED

Check the wear 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 condition as well as the cable insulation. **Wires should be checked every 3 months.**

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

Check contactor mechanical movements. They should be frictionfree and not restricted. **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 in this manual.

Any cause which is visible or recognized by an ordinary technician who periodically checks the equipment, that can create damage 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 operational safety of the electric vehicle.

**DO NOT USE A VEHICLE WITH A
FAULTY ELECTRONIC CONTROLLER**