Index

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

SIGNATURES TABLE

COMPANY DEPT. SERVICES	MANAGEMENT EXECUTIVE	
ENGINEERING SECTION EXECUTIVE		
EXPORT MANAGER		

1 GENERAL CHARACTERISTICS
1.1 TECHNICAL SPECIFICATIONS

Motor Types (Traction): .... DC SEM
Motor Types (Pump): .... DC SERIES
Power ratings (Traction): .... 1 to 2 kW
Supply Voltage: .... 24V / 48V
Armature Switching frequency: .... 16 kHz
Field Switching frequency: .... 800 Hz
Temperature range: .... -30 °C to +40 °C
Maximum controller temperature: .... 75 °C

Version	Maximum Traction current	Maximum Pump current
200+250	200 A	250 A
300+300	300 A	300 A
400+250	400 A	250 A

1.2 GENERAL DESCRIPTION

ZAPI COMBI SEM-1 controller performs all the electric functions that are usually presents in transpallet, stacker, low order picker etc.
The controller can perform the following functions:

- Traction controller for SEM motor; full-bridge on the field, half-bridge on the armature.

- Lifting controller for series excited motors.

- Drivers for ON/OFF electrovalves and for one proportional valve (electrodistributor)

- Interface for serial tiller head

- MDI interface (Multifunction Digital Instrument) battery discharge indicator, hourmeter, alarms, programmed maintenance.

1.3 MAIN FEATURES

- High frequency MOSFET controller (high efficency, silent, etc.).

- Speed control with regenerative braking (controls the truck also on the slope)

- Idraulic functions control with different programmable speeds and ramps, It is possible to use proportional functions.

- Lowering speed control through proportional valve.

- All the parameters are programmable by means of the ZAPI console.

- Complete diagnosis through console or MDI.

- High temperature protection with current reduction.

- Drivers real time diagnosis (electro-brake, general contactor and proportional valve.

- Electrobrake and general contactor are controlled with a PWM.

- Drivers protected against short-circuits.

1.4 SAFETY & PROTECTION FEATURES

- **Reverse Battery Polarity.**

  Electrical Circuit diagrams must be followed in order to avoid damage to the power unit. A Main contactor, controlled by the logic unit, is necessary to protect the system against reverse battery polarity.

- **Connection errors**

  All inputs are protected against connections errors. Contactor drivers are suitable for loads up to 2 Amps, and are protected against overload.

- **Thermal protection**

  If the controller temperature exceeds 77°C, the maximum current will be reduced proportionaly to the thermal increase. The temperature can never exceed 90°C.

- **Low Battery charge**

  When the battery charge is low, the maximum current is reduced.

- **External Agents**

  The chopper is protected against dust and spray of liquid to a degree of protection meeting IP64.

- **Protection against accidental Start Up**

  A precise sequence of operations is necessary before the machine starts. If these operations are not carried out correctly the machine stops. Driving requests must be made after closing the Key Switch.

- **Protection against uncontrolled movements.**

  The Main Contactor will not close if:

  - The Power Unit is not operating correctly
  - The Logic Unit is not operating correctly
  - The Serial Tiller is not operating correctly

1.5 THERMAL CONSIDERATIONS

- The heat generated by the power block must be dissipated. For this to be possible, the compartment must be ventilated and the heat sink materials ample.

- The heat sink material and system should be sized on the performance requirement of the machine. Abnormal ambient air temperatures should be considered. In situations where either ventilation is poor, or heat exchange is difficult, forced air ventilation should be used.

- The thermal energy dissipated by the power block module varies and is dependent on the current drawn and the duty cycle.

1.6 COMBI SEM-1 CHOPPER DIAGNOSIS

The microprocessor continually monitors the chopper and carries out diagnostic procedures on the main functions.
The diagnosis is made in 4 points:

1) Diagnosis on key switch closing that checks: watch-dog, Current Sensors, VMN point, contactor drivers, presence of a start requirement, and connection with the Serial Tiller ok.

2) Standby Diagnosis that checks: watch-dog, VMN Point, Contactor Drivers, Current Sensors.

3) Driving diagnosis that checks: Watchdog, VMN Point, Current, Contactor(s).

4) Continuos Diagnosis that checks: Chopper temperature, Battery Voltage.

1.7 MAIN CONTACTOR AND SAFETY BUTTON ⚠

- Battery disconnection should be made according to the Diagram below.

- In order to avoid damage to the controller during the regenerative phase, the supply to the Key Switch must be cut off at the same time.
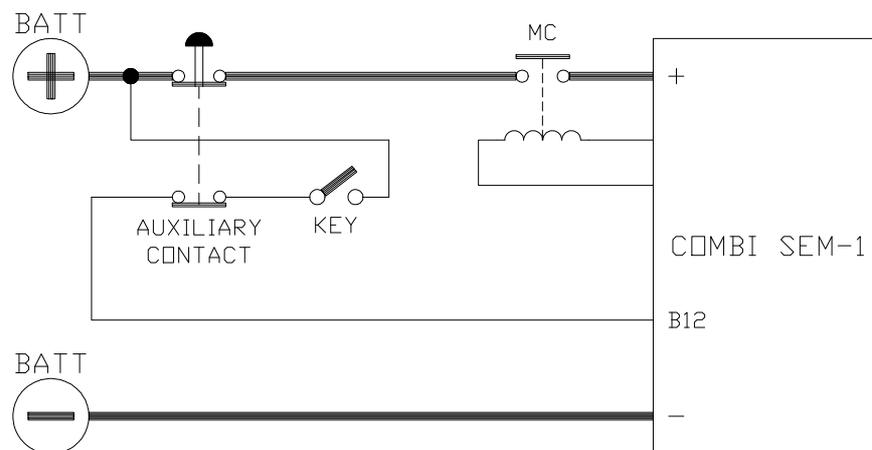
Wiring with cut off in series to positive supply.

- An internal protection is activated when the voltage on B12 connector is greater than 30% of battery voltage, or when the key switch is opened before the battery is opened.

1.8 GENERAL INSTRUCTIONS AND PRECAUTIONS ⚠️

- Never combine SCR low frequency choppers with COMBI SEM-1 modules. The filter capacitors contained in the COMBI SEM-1 module would change the SCR chopper operation and subject it to excessive workload. If it is necessary to use two or more control units, the choppers should both be of the High Frequency Zapi family.

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

- During battery recharge, the COMBI SEM-1 must be completely disconnected from the battery. Beside changing the charging current seen by the battery charger, the module can be damaged by higher than normal voltages supplied via the charger.

- The COMBI SEM-1 module should only be connected to a traction battery. Do not use converters outputs or power supplies. For special applications please contact the nearest Zapi Service Centre.

- In the first instance, start the machine with the drive wheels raised from the floor to ensure that any installation error do not compromise safety.

- After operation, even with the Key Switch open, the internal capacitors may remain charged for some time. For safe operation, we recommend that the battery is disconnected, and a short circuit is made between Battery Positive and Battery Negative power terminals of the chopper using a Resistor between 10W and 100W. Minimum 5 W.

- The susceptibility and electromagnetic emmission levels are seriously influenced by installation conditions. Take particular care with the length of cables and wires, types of electrical connections, and braided/screened wires. Zapi declines any responsibility for incorrect or bad operation that can be attributed to the above circumstances. Above all, the manufacturer of the machine must ensure that the requirements of EN 50081-2 are met.

2 INSTALLATION

Install the chopper baseplate onto a flat metallic surface that is clean and unpainted. Apply a very thin 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 elements and substances may cause oxidization of contacts, resulting in bad operation. Remember this point when deciding the installation position on the vehicle.

Fix the chopper using the special holes located on the baseplate (maximum screwing torque: 3 Nm for M5 and 4Nm for M8 screws).

Verify that the wiring of the cable terminals and connectors has been carried out correctly.

2.1 CONNECTION CABLES

For the auxiliary circuits use cables bigger or equal to 0.5mm^2 section.

For power connections to the motor (pump and traction rotor) and to the battery use cables of 16÷25 mm^2 section. The cables from chopper to battery should be run side by side and be as short as possible.

2.2 CONTACTORS

A Main Contactor, designed for Continuous Operation should be installed. This contactor should be fitted with a coil corresponding to the battery voltage. The current absorbed by the coil must not be greater than 2A.

Suppression for this contactor coil is inside the chopper logic. **Do not use any additional external suppression.**

2.3 FUSES

- Use a 10A fuse for protection of the auxiliary circuits.

- The power fuse is alrady installed on the chopper by Zapi. For special applications or requirements this value can be reduced.

2.4 COMBI SEM-1 CONTROLLER MECHANICAL DRAWING

MINIMUM HEIGHT WITH HARNESS CONNECTED = 35mm

CONN. C
MOLEX MINI
FIT
6P VERT.

CONN. D
MOLEX MINI
FIT
2P VERT.

CONN. A
MOLEX MINI
FIT
10P VERT.

CONN. B
MOLEX MINI
FIT
14P VERT.

4 X Ø4.3 +0 -0.1

101

110

4.5

36

4.5

45
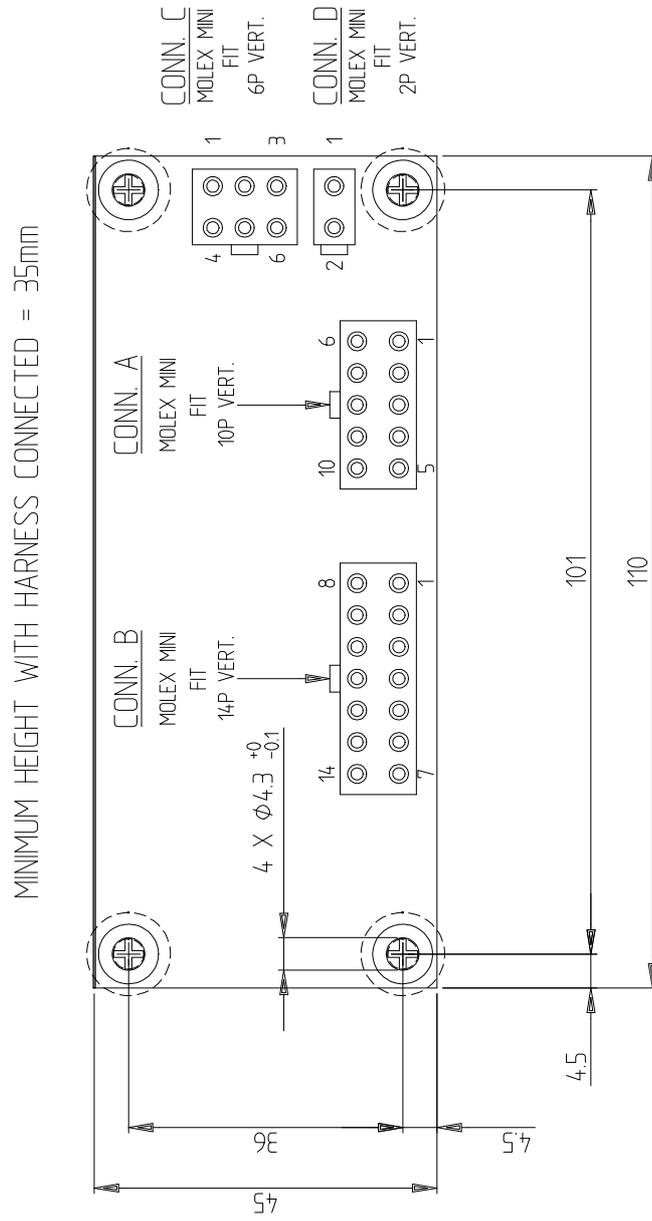
3 CONNECTION
3.1 COMBI SEM-1 CONNECTION DRAWING
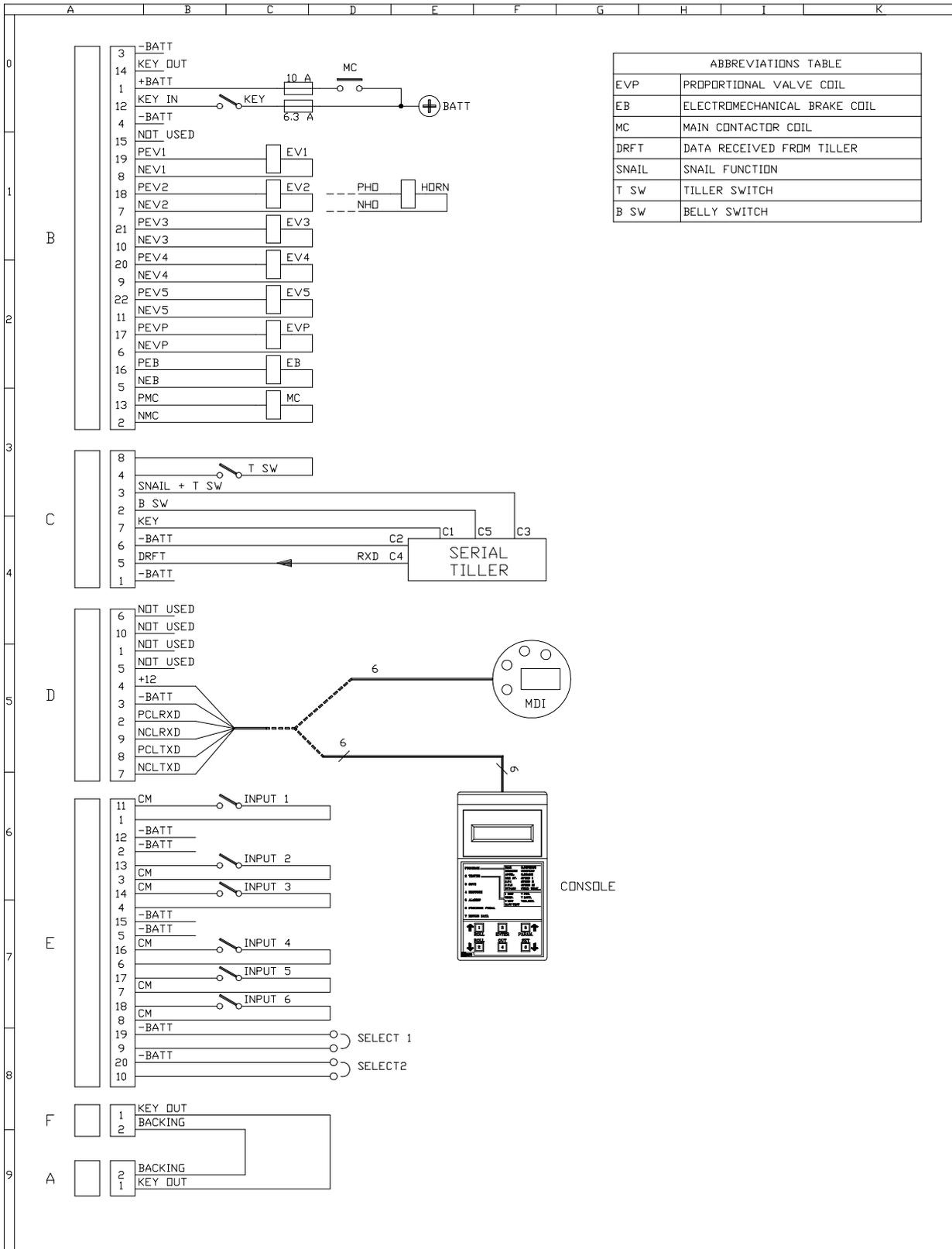
ABBREVIATIONS TABLE	
EVP	PROPORTIONAL VALVE COIL
EB	ELECTROMECHANICAL BRAKE COIL
MC	MAIN CONTACTOR COIL
DRFT	DATA RECEIVED FROM TILLER
SNAIL	SNAIL FUNCTION
T SW	TILLER SWITCH
B SW	BELLY SWITCH

WIRING DIAGRAM COMBI SEM-1

ZAPI s.p.a. 42028 POVIGLIO-ITALY	Data 08/09/00	Tecnico SD	File XXXXXX	Serie COM	Numero AD3ZP40A	Pagina 1:1
		Visto				

3.2 SERIAL TILLER CONNECTION DRAWING

The folllowing drawing is an example of typical tiller head functions.
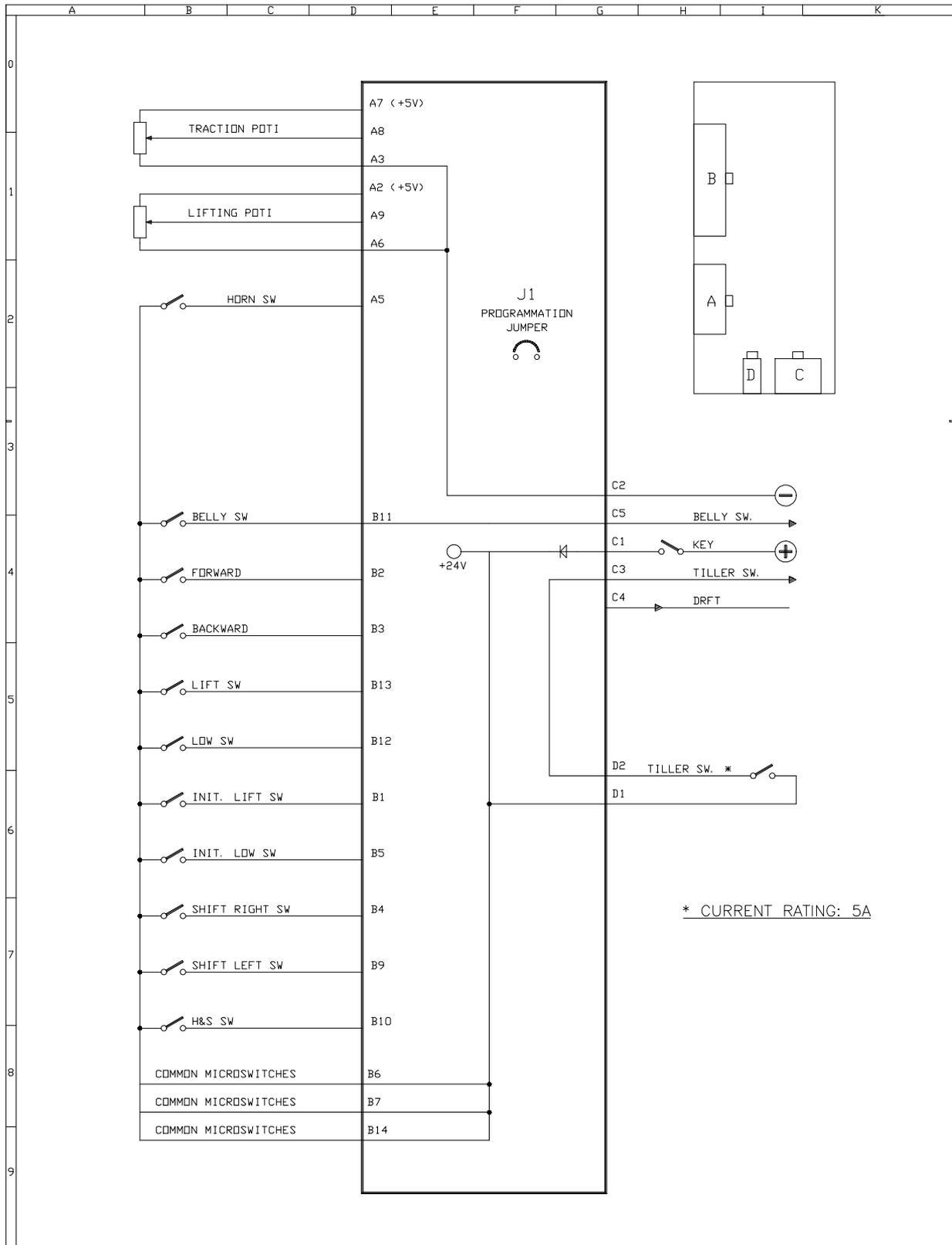
TRACTION POTI — A7 (+5V) / A8 / A3

LIFTING POTI — A2 (+5V) / A9 / A6

HORN SW — A5

J1
PROGRAMMATION JUMPER

B

A

D   C

C2

BELLY SW — B11   C5   BELLY SW.

+24V   C1   KEY

FORWARD — B2   C3   TILLER SW.

BACKWARD — B3   C4   DRFT

LIFT SW — B13

LOW SW — B12

INIT. LIFT SW — B1   D2   TILLER SW. *

INIT. LOW SW — B5   D1

SHIFT RIGHT SW — B4

SHIFT LEFT SW — B9   * CURRENT RATING: 5A

H&S SW — B10

COMMON MICROSWITCHES — B6

COMMON MICROSWITCHES — B7

COMMON MICROSWITCHES — B14

WIRING DIAGRAM SERIAL TILLER ZAPI

| | ZAPI s.p.a. 42028 POVIGLIO—ITALY | Data/Date 02/03/00 | Tecnico/Technician SD | | File/File XXXXXX | Serie/Series TIMONI | Disegno n./Drawing n. ADBZP1AA | Pagina/Page 1/1 |
| | | | Visto/Visa | | | | | |

3.3 DESCRIPTION OF COMBI SEM-1 CONNECTORS
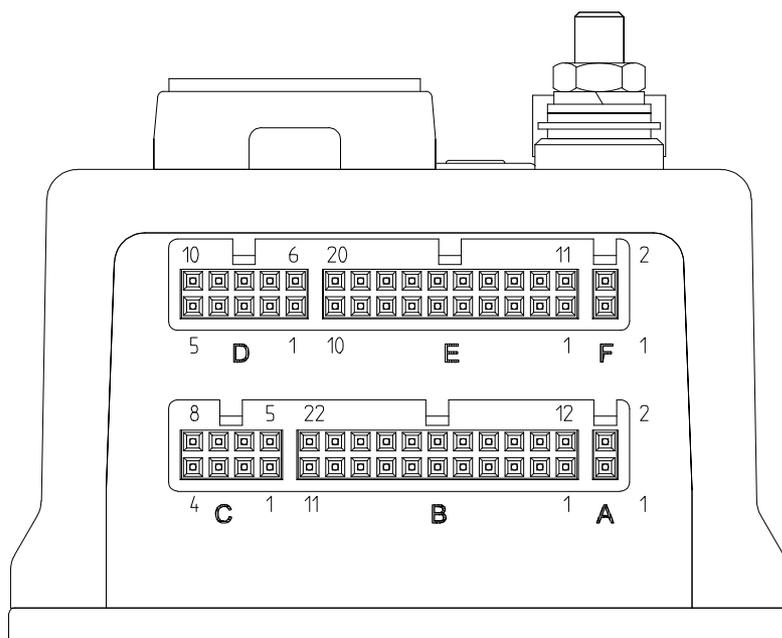
3.3.1 Connector "A" description

The "A" connector is connected by Zapi.

A1 KEY OUT   This pin is connected to the pin1 of the F connector; is a key signal.

A2 BACKING   This pin is connected to the pin2 of the F connector; is a backing signal.

3.3.2 Connector "B" description

The "B" connector managed the main contactor, the brake and the electrovalves coils.

B1 + BATT   Positive after the main contactor; is the electrovalves positive.

B2 NMC   Negative of the main contactor

B3 -BATT   Negative free for the customer.

B4 -BATT   Negative free for the customer.

B5 NEB   Negative of the electromechanical brake.

B6 NEVP   Negative of the proportional electrovalve.

B7 NEV2-NHO   Negative of the electrovalve 2; (option: negative of the horn).

B8 NEV1   Negative of the electrovalve 1.

B9 NEV4   Negative of the electrovalve 4.

B10 NEV3   Negative of the electrovalve 3.

B11 NEV5   Negative of the electrovalve 5.

B12 KEY IN   Input of the Key switch signal.

B13 PMC   Positive of the main contactor.
B14 KEY OUT   Output of the Key switch signal.
B15 NOT USED   Free.
B16 PEB   Positive of the electromechanical brake.
B17 PEVP   Positive of the proportional electrovalve.
B18 PEV2   Positive of the electrovalve 2.
B19 PEV1   Positive of the electrovalve 1.
B20 PEV4   Positive of the electrovalve 4.
B21 PEV3   Positive of the electrovalve 3.
B22 PEV5   Positive of the electrovalve 5.

Note:
Proportional valve can be programmed by console as proportional or ON/OFF: if proportional the valve has an acceleration and deceleration ramp and its current is controlled by the lifting potentiometer.
If ON/OFF the valve is completely opened/closed without ramps.
The positive supply to the main contactor is provided from the key (pin 12) trough a diode against polarity inversion. The positive supply for the electrobrake is available in the pin 16 only if the tiller switch is closed.
The positive for the brake and all the other ON/OFF valves comes from the main contactor, so these loads do not affect the key input but only the auxiliary fuse.

3.3.3 Connector "C" description

The "C" connector manages the serial link of the tiller card.

C1 -BATT   Negative free for the customer.
C2 BELLY   Quick inversion microswitch input. This signal is directly connected with the Combi for safety reason.
C3 SNAIL + T   Snail microswitch input. It is necessary that the tiller microswitch is cabled in the serial tiller card; in this case it is possible to run the truck also with the handle released at a slow speed.
C4 TILLER   Tiller microswitch input. In this case the tiller is directly connected with the Combi.
C5 DRFT   Data from the serial tiller
C6 -BATT   Negative for the serial tiller card.
C7 KEY OUT   Positive for the serial tiller card (is a key switch signal).
C8 KEY OUT   Positive for the tiller microswitch (is a key switch signal).

Note:
The tiller microswitch can be cabled in the serial tiller (see 'serial tiller' drawing) or directly in the controller (PIN 4 and 8 for the key in the serial tiller).

3.3.4 Connector "D" description

The "D" connector manages the MDI instrument or a Zapi console.

D1   NOT USED Free.

D2   PCLRXD   Positive of the reception from the console or the MDI instrument.

D3   -BATT   Negative of the console or the MDI instrument.

D4   +12   Positive of the console or the MDI instrument.

D5   NOT USED Free.

D6   NOT USED Free.

D7   NCLTXD   Negative of the transmission to the console or the MDI instrument.

D8   PCLTXD   Positive of the transmission to the console or the MDI instrument.

D9   NCLRXD   Negative of the reception from the console or the MDI instrument.

D10 NOT USED Free.

Note:

The console must be connected to "D" at the place of MDI by means of an adaptor (follow the table for the right connections).

"D" CONNECTOR	SIGNAL	MDI CONNECTOR	CONSOLE CONNECTOR
MOLEX MINIFIT MALE 10 POLE FEMALE RECEPTACLE	-	MOLEX MIINIFIT MALE 6 POLE FEMALE RECEPTACLE	MOLEX SPOX MALE 8 POLE MALE RECEPTACLE
2	PCLRXD	1	1
3	GND	2	5
4	+12V	3	6
7	NCLTXD	4	4
8	PCLTXD	5	3
9	NCLRXD	6	2

3.3.5 Connector "E" description

The "E" connector manages the inputs from the chassis of the truck.

E1   INPUT 1   This is a digital input free for customer request. The meaning depends on the software installed (made by Zapi) and the model selected with the input E9 and E10.

E2   -BATT   Negative free for the customer.

E3   CM   Positive for the "Input 2"; is a key switch signal interrupted by a diode for safety reason.

E4	INPUT 3	This is a digital input free for customer request. The meaning depends on the software installed (made by Zapi) and the model selected with the input E9 and E10.
E5	-BATT	Negative free for the customer.
E6	INPUT 4	This is a digital input free for customer request. The meaning depends on the software installed (made by Zapi) and the model selected with the input E9 and E10.
E7	CM	Positive for the "Input 5"; is a key switch signal interrupted by a diode for safety reason.
E8	CM	Positive for the "Input 6"; is a key switch signal interrupted by a diode for safety reason.
E9	SELECT 1	This is a digital input for model configuration.
E10	SELECT 2	This is a digital input for model configuration.
E11	CM	Positive for the "Input 1"; is a key switch signal interrupted by a diode for safety reason.
E12	-BATT	Negative free for the customer.
E13	INPUT 2	This is a digital input free for customer request. The meaning depends on the software installed (made by Zapi) and the model selected with the input E9 and E10.
E14	CM	Positive for the "Input 3"; is a key switch signal interrupted by a diode for safety reason.
E15	-BATT	Negative free for the customer.
E16	CM	Positive for the "Input 4"; is a key switch signal interrupted by a diode for safety reason.
E17	INPUT 5	This is a digital input free for customer request. The meaning depends on the software installed (made by Zapi) and the model selected with the input E9 and E10.
E18	INPUT 6	This is a digital input free for customer request. The meaning depends on the software installed (made by Zapi) and the model selected with the input E9 and E10.
E19	-BATT	Negative of the "Select 1" input.
E20	-BATT	Negative of the "Select 2" input.

Note:
For the inputs is acceptable a PNP sensor with a 24V output. The maximum load for single inputs is less than 5mA.

3.3.6 Connector "F" description

The "F" connector is connected by Zapi.

F1   KEY OUT   This pin is connected to the pin1 of the A connector; is a key signal.

F2   BACKING   This pin is connected to the pin2 of the A connector; is a backing signal.

3.4 COMBI SEM-1 POWER CONNECTION
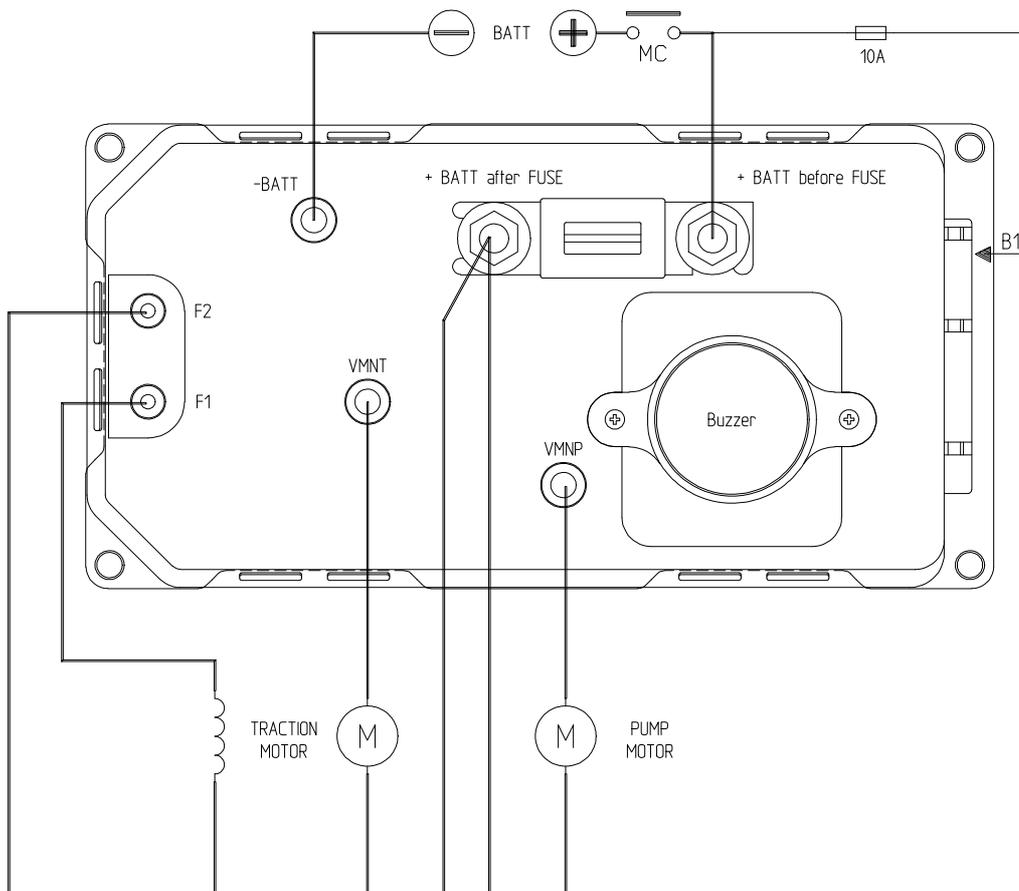
+BATT before FUSE   Positive of the battery after the main contactor

+BATT after FUSE   Positive of the battery after the main cont. and after the fuse.

-BATT   Negative of the battery.

F1, F2   Field connections for traction motor.

VMNT   Traction motor current sensor input.

VMNP   Pump motor input (without the current sensor).

4 REGULATION
4.1 ZAPI PROGRAMMING HANDLY CONSOLE

In Combi Sem-1 controller is possible to program several functions through the console. In this way is possible to modify the performances of the truck following the customer needings.

The console can remain connected to the controller while running and the parameters can be changed in real time. In this case it is important to go in stand by condition before switch off the controller in order to give the possibility to store the new values in the Eeprom.

This section describes the ZAPI console functions.
Six buttons provide the capability of changing or reading the parameter of the Combi:

1   Roll-Up   push to scroll up the submenu and to select a parameter;

2   Roll-Down   push to scroll down the submenu and to select a parameter;

3   Enter   push to have access to the selected submenu or to confirm a changement;

4   Out   push to exit the selected menu or to refuse a changement;

5   Set-Up   push to increase a parameter;

6   Set-Down   push to decrease a parameter;

Note: After a modify, memoriz the new value pushing the "4" (Out) button and the "3" (Enter) button. Double pushing of the "4" (Out) button doesn't save the value.

Numbers inside the triangles in the following map correspond to the same number on the console keyboard buttons shown in the figure below. The orientation of the triangle indicates the way to the next function.
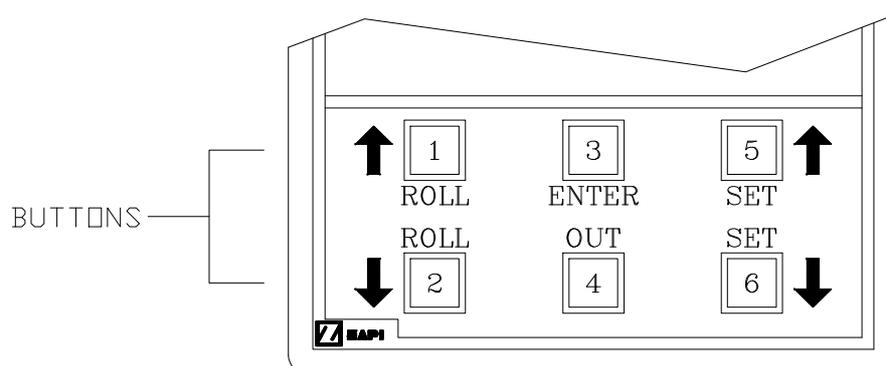
Important
CONNECT AND DISCONNECT THE CONSOLE ONLY WITH THE CONTROLLER SWITCHED OFF.

4.2 DESCRIPTION OF STANDARD CONSOLE MENU

```
          ┌─────────────────┐
          │     HEADING      │
          └─────────────────┘
                                    1▷ + 5▷
  △4  ▽3                                          4◁
          ┌──────────────┐  3▷                              ┌──────────────┐  3▷       ┌─────────────────────────────┐
          │  PARAMETER   │      ACCELER DELAY    0÷9        │   SET MODEL  │           │        NOT AVAILABLE         │
          │   CHANGE     │  4◁  FLD ACCELERATION 0÷9    4◁  └──────────────┘       4◁  └─────────────────────────────┘
          └──────────────┘      DECELER DELAY    0÷9
                                RELEASE BRAKING  0÷9        △2  ▽1
                                INVERS. BRAKING  0÷9
                                CUTBACK SPEED    0÷9        ┌──────────────┐  3▷       ┌─────────────────────────────┐
                                CUTBACK SPEED 1  0÷9        │  SET OPTIONS │           │ HOUR COUNTER   KEY ON/RUNNING│
                                MAX SPEED FORW   0÷9        └──────────────┘       4◁  │ BATTERY CHECK    ON/OFF      │  △2
                                MAX SPEED BACK   0÷9                                   │ AUX FUNCTION 2   PRESENT/ABSENT
                                TRACTION I MAX   0÷9                                   │ QUICK INVERSION  BELLY/TIMED │
                                ARMA NOM CURR.   0÷9                                   │ SHIFT FUNCTION   PRESENT/ABSENT
                                WEAK DROPOUT     0÷9    △2  △2  ▽1                     │ AUX FUNCTION 1   ON/OFF      │  ▽1
                                FIELD CURR. MAX  0÷9                                   │ CHECK UP ENABLE  ON/OFF      │
                                FIELD NOM CURR.  0÷9                                   │ CHECK UP DONE    ON/OFF      │
                                CREEP SPEED      0÷9                                   └─────────────────────────────┘
                                SOFT WORKING     0÷9    ▽1
  △2  ▽1                        PU. ACCELER. DEL 0÷9
                                PU. DECELER. DEL 0÷9        ┌──────────────┐  3▷       ┌─────────────────────────────┐
                                PUMP CREEP       0÷9        │ ADJUSTMENTS  │           │ ADJUST BATTERY   ...V        │  △2
                                1ST SPEED COARSE 0÷9        └──────────────┘       4◁  │ ADJUSTMENT #01   0÷9         │
                                FORK LIFT SPEED  0÷9                                   │ ADJUSTMENT #02   0÷9         │  ▽1
                                FORK DOWN SPEED  0÷9                                   └─────────────────────────────┘
                                R- SHIFT SPEED   0÷9
                                L- SHIFT SPEED   0÷9
                                MIN EVP COARSE   0÷9                    ┌──────────────────────────────────────────┐
                                MAX EVP COARSE   0÷9                    │ △5                                        │
                                MIN EVP FINE     0÷9                    │    WITH THIS TWO BUTTONS THE USER CAN SET │
                                MAX EVP FINE     0÷9                    │    THE AVAILABLE OPTION..                 │
                                EVP ACC DELAY    0÷9                    │ ▽6                                        │
                                EVP DEC DELAY    0÷9                    └──────────────────────────────────────────┘
                                BACKING SPEED    0÷9
                                BACKING TIME     0÷9
```
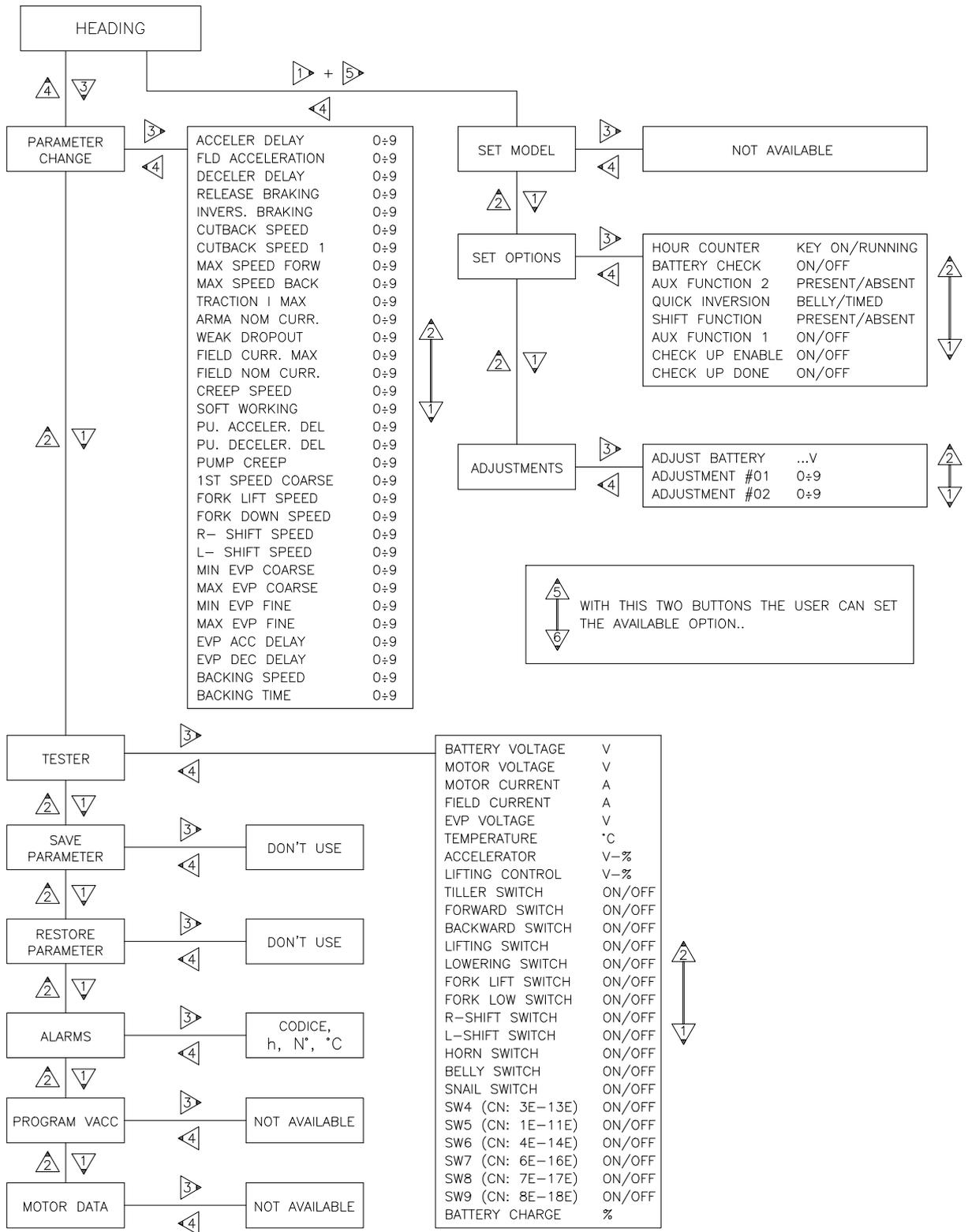
```
          ┌──────────────┐  3▷                              ┌─────────────────────────────┐
          │    TESTER    │                                  │ BATTERY VOLTAGE     V        │
          └──────────────┘  4◁                              │ MOTOR VOLTAGE       V        │
                                                            │ MOTOR CURRENT       A        │
  △2  ▽1                                                     │ FIELD CURRENT       A        │
                                                            │ EVP VOLTAGE         V        │
          ┌──────────────┐  3▷       ┌──────────────┐       │ TEMPERATURE         °C       │
          │     SAVE     │           │  DON'T USE   │       │ ACCELERATOR         V-%      │
          │  PARAMETER   │  4◁       └──────────────┘       │ LIFTING CONTROL     V-%      │
          └──────────────┘                                  │ TILLER SWITCH       ON/OFF   │
                                                            │ FORWARD SWITCH      ON/OFF   │
  △2  ▽1                                                     │ BACKWARD SWITCH     ON/OFF   │
                                                            │ LIFTING SWITCH      ON/OFF   │
          ┌──────────────┐  3▷       ┌──────────────┐       │ LOWERING SWITCH     ON/OFF   │  △2
          │   RESTORE    │           │  DON'T USE   │       │ FORK LIFT SWITCH    ON/OFF   │
          │  PARAMETER   │  4◁       └──────────────┘       │ FORK LOW SWITCH     ON/OFF   │
          └──────────────┘                                  │ R-SHIFT SWITCH      ON/OFF   │
                                                            │ L-SHIFT SWITCH      ON/OFF   │
  △2  ▽1                                                     │ HORN SWITCH         ON/OFF   │  ▽1
                                                            │ BELLY SWITCH        ON/OFF   │
          ┌──────────────┐  3▷       ┌──────────────┐       │ SNAIL SWITCH        ON/OFF   │
          │    ALARMS    │           │   CODICE,    │       │ SW4 (CN: 3E-13E)    ON/OFF   │
          └──────────────┘  4◁       │  h, N°, °C   │       │ SW5 (CN: 1E-11E)    ON/OFF   │
                                     └──────────────┘       │ SW6 (CN: 4E-14E)    ON/OFF   │
  △2  ▽1                                                     │ SW7 (CN: 6E-16E)    ON/OFF   │
                                                            │ SW8 (CN: 7E-17E)    ON/OFF   │
          ┌──────────────┐  3▷       ┌──────────────┐       │ SW9 (CN: 8E-18E)    ON/OFF   │
          │ PROGRAM VACC │           │ NOT AVAILABLE│       │ BATTERY CHARGE      %        │
          └──────────────┘  4◁       └──────────────┘       └─────────────────────────────┘

  △2  ▽1

          ┌──────────────┐  3▷       ┌──────────────┐
          │  MOTOR DATA  │           │ NOT AVAILABLE│
          └──────────────┘  4◁       └──────────────┘
```

4.3 "PARAMETER CHANGE" MENU

The following parameters are an example of a typical Parameter Change menu; some of this parameters could be changed from customer requests.
The parameters with (p) symbol are related to the pump, those with (t) are related to the traction motor.

1) **ACCELERATION DELAY (t) =** Sets the acceleration ramp.

2) **FLD ACCELERATION (t) =** Field acceleration ramp: is the time needed to lower the field till to the weakened value, is a function of "Acceler. delay".

3) **DECELERATION DELAY (t) =** Sets the deceleration ramp according to the accelerator potentiometer position.

4) **RELEASE BRAKING (t) =** Sets the deceleration ramp when the driving request is released.

5) **INVERS BRAKING (t) =** Sets the deceleration ramp when is inverted the driving direction.

6) **CUTBACK SPEED 1 (t) =** Speed reduction 1.

7) **CUTBACK SPEED 2 (t) =** Speed reduction 2.

8) **MAX. SPEED FORW. (t) =** Maximum Forward speed, obtained by weakening the field current after reaching 100% conduction on the armature. With the parameter set at level 0, the armature is in full conduction but the field current does not decrease below the nominal value (low speed).

9) **MAX SPEED BACK (t) =** Maximum Reverse speed, obtained by weakening the field current after reaching 100% conduction on the armature. With the parameter set at level 0, the armature is in full conduction but the field current does not decrease below the nominal value (low speed).

10) **TRACTION I MAX (t) =** Sets the maximum current of the Chopper (Armature).

11) **ARMA NOM. CURR (t) =** Nominal armature current. This parameter fixes a limit for the armature current above which the field current is at least the nominal value (FIELD NOM. CURR.), regardless of accelerator position.

12) **WEAK DROPOUT (t)=** This parameter fixes a limit on the armature current above which the field current is increased linearly up to the nominal field current (proportionally to the armature current).

13) **FIELD CURR. MAX. (t) =** Maximum field current. This parameter fixes the maximum field current when the armature reaches the maximum value.

14) **FIELD NOM. CURR. (t)=** Nominal field current. This parameter fixes the minimum field current when the accelerator is between 0% and 60% without full conduction on the armature. Adjustment should be made with reference to the data on the motor label. (The indication of Nominal Field Current).

15) **CREEP SPEED (t)=** Minimum speed. This parameter sets the minimum start voltage applied to the motor.

16) **SOFT WORKING (t) =** Sets the entity of the acceleration and deceleration curves with the Snail (H&S) function selected.

17) PUMP ACC DELAY (p) = Pump motor acceleration time:during this time the voltage on the pump motor goes to the desired value.

18) PUMP DEC DELAY (p) = Pump motor deceleration time:during this time the voltage on the pump motor decreases to the desired value..

19) PUMP CREEP (p) = This parameter sets the minimum voltage applied to the pump motor.

20) 1ST SPEED COARSE (p) = Main lift maximum speed.

21) FORK LIFT SPEED (p) = Forks lift maximum speed.

22) FORK DOWN SPEED (p) = Forks down maximum speed.

23) R - SHIFT SPEED (p) = Right shift maximum speed.

24) L - SHIFT SPEED (p) = Left shift maximum speed.

25) MIN EVP COARSE (p) = Sets the minimum voltage applied to the EVP. This is a big regulation.

26) MAX EVP COARSE (p) = Sets the maximum voltage applied to the EVP. This is a big regulation.

27) MIN EVP FINE (p) = Sets the minimum voltage applied to the EVP. This is a fine regulation.

28) MAX EVP FINE (p) = Sets the maximum voltage applied to the EVP. This is a fine regulation.

29) EVP ACC. DELAY (p) = Sets the acceleration time of the EVP.

30) EVP DEC. DELAY (p) = Sets the deceleration time of the EVP.

31) BACKING SPEED (t) = Sets the maximum backing (inching) speed.

32) BACKING TIME (t) = Sets the duration of the backing function.

4.4 "TESTER" MENU

The most important input or output signals can be measured in real time using the TESTER function of the console. The Console acts as a multimeter able to read voltage, current and temperature.

4.5 "ADJUSTMENT" MENU

1) **ADJUST BATTERY =** Battery voltage reading adjustment according with the real battery voltage.
2) **ADJUSTEMENT #01 =** Sets the maximum value of the battery discarge curve.
3) **ADJUSTEMENT #02 =** Sets the minimum value of the battery discarge curve.

4.6 "SET OPTION" MENU

1) **HOUR COUNTER**

   Keyon   hourmeter always updated.

   Running   hourmeter updated only if traction, lifting or hydraulics functions are activated.

2) **BATTERY CHECK**

   On   the battery discharge level check is carried on; when the battery level reaches 10% (or 20% depending on customer request), an alarm is signaled and the maximum current is reduced to the half of the programmed value, and the tilt function is blocked.

   Off   the battery discharge level check is carried on but no alarm is signaled.

3) **AUX FUNCTION 2**

   Present   Proportional electrovalve present.

   Absent   Proportional electrovalve not present. Will be driven like an On/Off electrovalve.

4) **QUICK INVERSION**

   Belly   the truck goes backward direction (at 50% of maximum speed) till the belly button is pressed.

   Timed   the truck goes backward direction (at 50% of maximum speed) only for some seconds.

5) **SHIFT FUNCTION**

   Present   The Shift function is enabled.

   Absent   The Shift function is not used. In this case the output for the shift left valve can be used to drive an external horn. The Combi buzzer will be driven in parallel with the horn.

6) AUX FUNCTION #1

On   the Combi hour-meter is immediately over-written by that of MDI instrument.

Off   In this configuration the alarm "AL98" will be displayed on the MDI for 1 minute. If during this minute the user doesn't set ON the "Aux function #1", the MDI hour-meter will be over-written by that of the controller.

7) CHECK UP ENABLE

On   This function sets an alarm (AL99, Check Up Needed) after 300 hours which informs the operator that it is necessary to make assistance service on the machine.

Off   This function is disabled.

8) CHECK UP DONE

On   This option enables to reset the check-up hour-meter and the alarm "Check Up Needed".

Off   This function is disabled.

5 ALARMS

"ZAPI CONSOLE"   **"MDI"**

1) POWER FAILURE #1   **73**

Short-circuit on the ON/OFF valves, or in the main contactor coil, or in the electrobrake coil.

2) EEPROM KO   **13**

Fault in the area of memory where the parameters are stored. This alarm inhibits machine operation. If the fault continues when the Key switch is turned off and on again, replace the logic. If the fault disappears, the previously stored parameters will be replaced by the default parameters.

3) INCORRECT START   **79 (Traction), 95 (Pump)**

Alarm generated by an incorrect starting sequence. Possible reasons:

a) The Enable microswitch has welded or failed.

b) Error in the starting sequence from the operator.

c) Error in the wiring.

d) Lifting operation awaiting when the key is turned on.

4) CAPACITOR CHARGE   **60**

This check is made during the initial diagnosis. This Alarm is generated if the capacitors are not charged within 500 mSec after the Key switch on. Probable cause is a failure within the power block.

5) VMN NOT OK   **32**

This test is performed at rest, with the Main Contactor closed, and also during operation. This Alarm is generated if the VMN is lower than battery voltage in stand-by. This alarm is generated if VMN does not follow the duty-cycle of the chopper while driving. Possible causes:

a) Incorrect motor connection.

b) Frame fault of motor to chassis.

c) Defect in the power unit.

6) VACC NOT OK   **78**

This Alarm is generated if the accelerator output voltage from the serial tiller is higher than 1V. Possible causes to be checked on the serial tiller:

a) the track of the potentiometer has become open.

b) the potentiometer is not wired correctly.

c) the potentiometer itself is defective.

d) the values set during the acquisition procedure are wrong.

7) VFIELD NOT OK   3

This test is made in standby with the Main Contactor open. In this condition the voltage on both the connections of field must be around ½ VBatt. This alarm is generated if the field voltage is different from this value. Possible causes:

a) Frame fault on the motor to chassis.

b) Incorrect connection of the field winding to the chopper.

c) Failure of the chopper in the section relative to the field.

8) PUMP VACC NOT OK   4

This alarm is generated if the lifting potentiometer output voltage from the serial tiller is higher than 1V. Possible causes to be checked on the serial tiller:

a) the track of the potentiometer has become open.

b) the potentiometer is not wired correctly.

c) the potentiometer itself is defective.

d) the values set during the acquisition procedure are wrong.

9) I = 0 EVER   49

This check is made while driving. If the current is not higher than a preset minimum value, this alarm is generated and the machine disabled. Possible causes: see "STBY I HIGH" alarm.

10) HIGH FIELD CURRENT   57

Problem detected with the field current sensor. Possible causes:

a) Failure of the field current sensor.

b) Failure of the field power unit.

11) NO FIELD CURRENT   58

Problem detected with the field winding current. Possible causes:

a) Failure of the field current sensor.

b) Field cables not connected or incorrectly connected.

c) Failure of the field power unit.

12) DRIVER SHORTED   74

The test is carried out with Main Contactor open. The logic unit verifies that the coil of the Main Contactor is not shorted. Possible causes:

a) Driver shorted.

b) Problems in the feed back circuit of the Main Contactor coil.

c) Wiring error.

d) Fault in the protection circuit.

13) COIL SHORTED   76

When the key is turned on, the microprocessor tests the overloads protection circuit of the contactor driver. If a problem is detected, this alarm is generated. Possible causes:

a) Failure within the contactor coil.

b) Incorrect wiring.

c) Failure of the protection circuit.

14) CONTACTOR DRIVER   75

This alarm is generated if there is a problem with the Main Contactor. Possible causes:

a) The Main Contactor coil driver is open-circuit.

c) Defect in the Main Contactor coil voltage feed back circuit.

15) CONTACTOR CLOSED   37

This check is made before closing Main Contactor. It checks that the driver is not open. Possible causes:

a) the contactor's power poles are not welded.

b) This alarm could be generated if the line contactor is opened, but there is a problem within the field circuit.

16) FORW + BACK   80

This check is made continuosly. The Alarm is generated when forward and reverse directions are requested simultaneously. Possible causes:

a) Incorrect Wiring.

b) Welding or failure of a direction switch.

c) Incorrect operation from the operator.

17) BATTERY LOW   66

This Alarm is generated when the battery becomes 90% discharged from the nominal value. If there is the alarm and the battery is not discharged, check the battery value in the "Tester" menu of the console; if it is incorrect, re-adjust via the "Adjustment" menu.

18) STBY I HIGH   53

This test is made during the initial diagnosis and in standby. The test verifies that the currents are zero. This alarm disables the machine. Possible causes:

a) Defective current sensor.

b) Feed back circuit failure or logic failure or power unit failure.

19) BRAKE DRIVER KO   2

The alarm is present when there is a problem on the electrobrake driver. Possible causes:

a) driver in short-circuit

b) driver broken, cannot drive the brake;

c) current feedback circuit for the brake coil faulted

20) EVP NOT OK   **1**

At stand: proportional valve opened. Running: the proportional valve doesn't follow the applied PWM.

21) SERIAL ERROR #1   **6**

Wrong message or no message from serial tiller

22) INPUT ERROR #1   **99**

No belly switch on the tiller card

23) INPUT ERROR #2   **98**

No belly switch on the controller

24) THERMAL PROTECTION   **67**

This alarm is generated if the chopper temperature rises above 77°C, . If this alarm is displayed when the chopper's temperature is the same as ambient:

a) check the connection of the temperature sensor.

b) the temperature sensor may be defective.

c) the logic may be defective.

25) WATCHDOG   **8**

The test is executed at key on, in stand-by and on running. Possible causes:

a) Watch-dog hardware circuit not OK;

b) Software not OK.

26) CHARGING BATTERY   **68**

Battery charger connected

6 RECOMMENDED SPARE PARTS

PART NUMBER	DESCRIPTION
C12442	2 pins Molex Minifit connector.
C12414	8 pins Molex Minifit connector.
C12500	10 pins Molex Minifit connector.
C12408	20 pins Molex Minifit connector.
C12499	22 pins Molex Minifit connector.
C12777	Female receptacle 5556 for Molex Minifit
C16530	250A protected fuse
C16505	355A protected fuse
C16506	425A protected fuse
C29564	SW 200 24V contactor
E60305	Buzzer

7 PERIODIC MAINTENANCE TO BE REPEATED AT TIMES INDICATED

Check the wear and condition of the Contactors' moving and fixed contacts.
Electrical Contacts should be checked every; _____**3 MONTHS**

Check the Foot pedal or Tiller microswitch. Using a suitable test meter, confirm that there is no electrical resistance between the contacts by measuring the volt drop between the terminals. Switches should operate with a firm click sound.
Microswitches should be checked every; _____**3 MONTHS**

Check the Battery cables, cables to the chopper, and cables to the motor. Ensure the insulation is sound and the connections are tight.
Cables should be checked every; _____**3 MONTHS**

Check the mechanical operation of the pedal or tiller . Are the return springs ok. Do the potentiometers wind up to their full or programmed level.
Check every; _____**3 MONTHS**

Check the mechanical operation of the Contactor(s). Moving contacts should be free to move without restriction.
Check every; _____**3 MONTHS**

Checks should be carried out by qualified personnel only and each replacement part used should be original. Beware of NOT ORIGINAL PARTS. The installation of this electronic controller should be made according to the diagrams included in this Manual. Any variations or special requirements should be made after consulting a Zapi Agent. The supplier is not responsible for any problem that arises from wiring methods different from information included in this Manual. During periodic checks, if a technician finds any situation that could cause damage or compromise safety, the matter should be brought to the attention of a Zapi Agent immediately. The Agent will then take the decision regarding operational safety of the machine. Remember that Battery Powered Machines feel no pain.

NEVER USE A VEHICLE WITH A FAULTY ELECTRONIC CONTROLLER

ZAPI

ELECTRONIC INDUSTRIAL DEVICES

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COMBI SEM-1
OPERATING AND USER
MANUAL