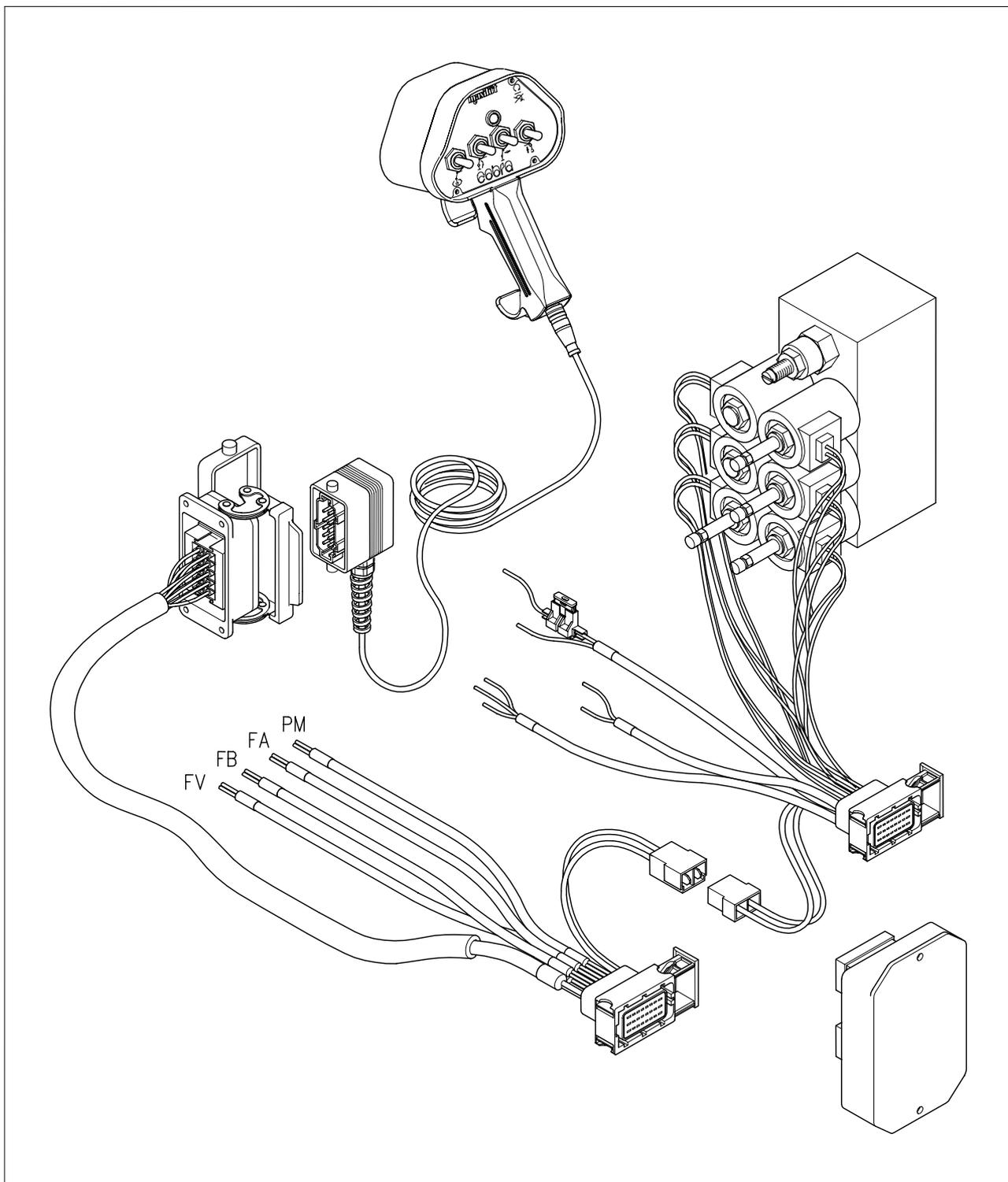


# MICROPROCESSOR REMOTE CONTROL FOR WARN SYSTEM



*SERVICE MANUAL*

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## Foreword

WARN version crane models 3300W and 4400W have the following features:

- They are equipped with WARN electric winches only
- The oil flow is supplied by power pack only
- The crane operation is achieved by a specific cable remote control with microprocessor logic.  
The outputs handled by its control unit are not only related to solenoid operated valves, because the winch functions are managed by three wires connected to winch electric motor contactor.

It is important to underline that this version of remote control for WARN systems can replace without problems the electro-mechanical one on old cranes 3303W and 3304W.

The manual is divided in two sections. The first concerning the hydraulic unit, the second concerning the electric and electronic section.

Section **1** describes the hydraulic unit and their components. It explains the two possible operating conditions by showing the oil paths inside the hydraulic unit, and the solenoids energized. The last paragraph shows the sectional views of the two components for a better comprehension of their function. Both of them are also coupled with the relevant hydraulic symbol used in the hydraulic diagram, and the reference numbers related to the different orifices, in order to quickly understand the paths for the oil flow inside the component.

The section is integrated with some useful informations including a table with pressure and flow requirement specifications.

Further, it includes the instructions for the inspection and cleaning procedures for the components, and the instructions for the emergency procedure.

Section **2** is dedicated to electronic section and wirings layouts. The section begins with a realistic representation of the whole electric/electronic section for the identification of the main components. The subsequent paragraphs include table of safety lockouts, behaviour of the system for diagnostic considerations, and control unit specifications.

The last part of the manual is dedicated to wiring layouts of the main components, integrated with pictures, explanation, and description of the connections.

# 1 HYDRAULIC UNIT

## 1.1 Solenoid-operated valve bank (description and features)

The solenoid-operated valve bank of WARN system consists of an aluminium block, on which are carried out the paths for the oil flow, equipped with proper components that are classified in:

- Directional valves
- Pressure control valves

Directional valves, (implemented as function valves) are responsible of the direction of the oil flow inside the aluminium block. They are always operated by means of solenoids that belong to the wiring of the electric/electronic section.

The configuration of which solenoids are energized, in relation of each operating condition, is handled by the electronic unit.

The pressure inlet (P port) and the tank outlet (T port) are always on the same side of the functions ports, that is opposite to the solenoid side.

The unit is equipped with a relief valve VM, which rating is adjustable.

The ON/OFF section can control only one function at a time, and only in an ON/OFF mode. Each of the solenoid operated ON/OFF function valve is connected with only one of the two directions (e.g.: extension out) of a function (e.g.: boom extension). The opposite direction is controlled by the valve horizontally aligned. Since this kind of valve can be only completely closed or only completely open, this is the reason why this unit is called ON/OFF. The valves EV1A, EV1B, EV2B, EV3B are equipped with manual operator for emergency. Therefore, it is possible to operate the functions necessary to put the crane in transport position, in case of controller or control unit breakdown.

When the solenoids are not energized, all the ports of the functions are connected to tank line.

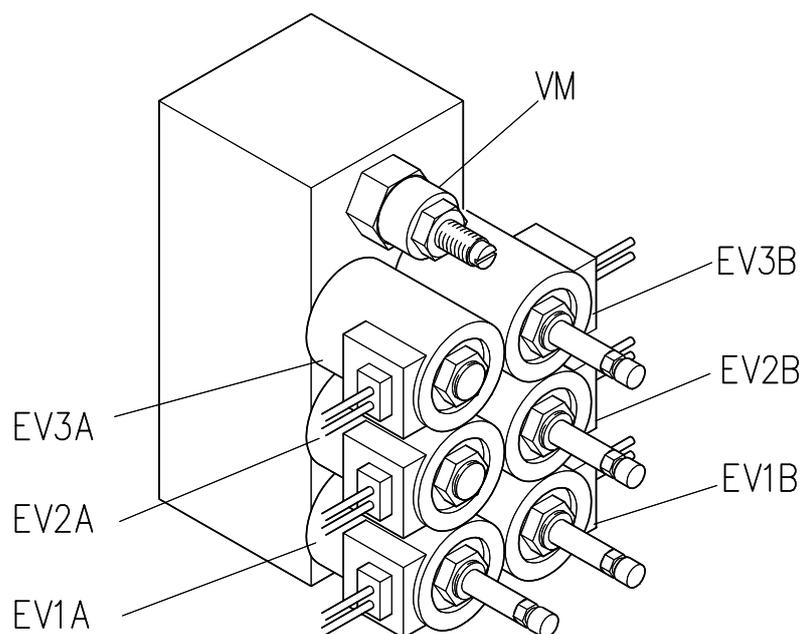
If one of the two directions of a function is operated, the relevant solenoid is energized, but the solenoid of the other direction of the function, together with all the other function valves, remains de-energized.

This unit is never equipped with EV9 because it is dedicated to WARN system only that is always on driven by a power pack.

The WARN winch is electrically driven; so, its electric motor is operated by the relevant contactor. This is the reason why EV4A and EV4B are not present on the hydraulic unit.

The cranes equipped with this valve bank are all the WARN version models produced from the beginning:

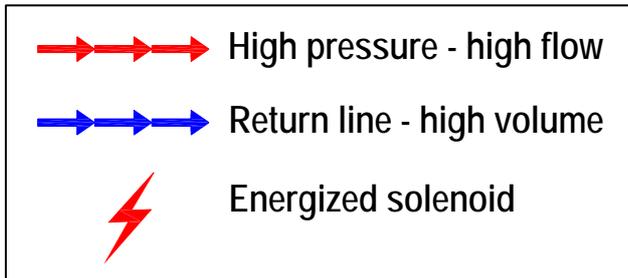
3303W  
3304W  
3300W  
4400W



## 1.2 Schematics of standard operating conditions

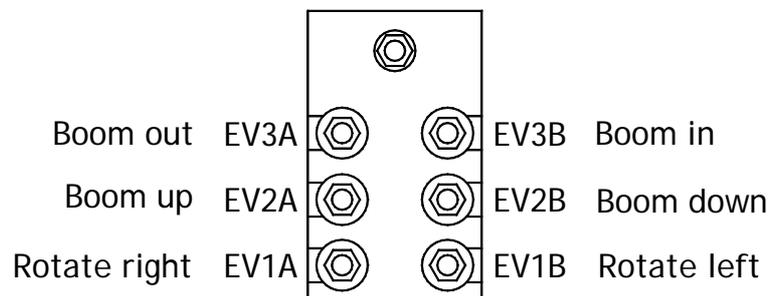
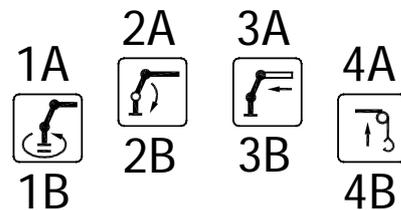
All the foreseeable operating conditions of the hydraulic unit are shown in this section, by means of hydraulic diagrams.

The legend below explains the colour symbols on the diagrams:



The position B of each toggleswitch carries out the function represented on the relevant symbol applied on the front panel of the hand held controller.

Action	Function
Rotate Right	1A
Rotate Left	1B
Boom Up	2A
Boom Down	2B
Boom Out	3A
Boom In	3B
Winch Down	4A
Winch Up	4B



### 1.2.1 Pressure and flow requirements specifications

Ensure that the hydraulic supply parameters are within the range indicated in the table below.

#### IMPORTANT

Many problems involving function speed, are due to wrong hydraulic supply parameters.

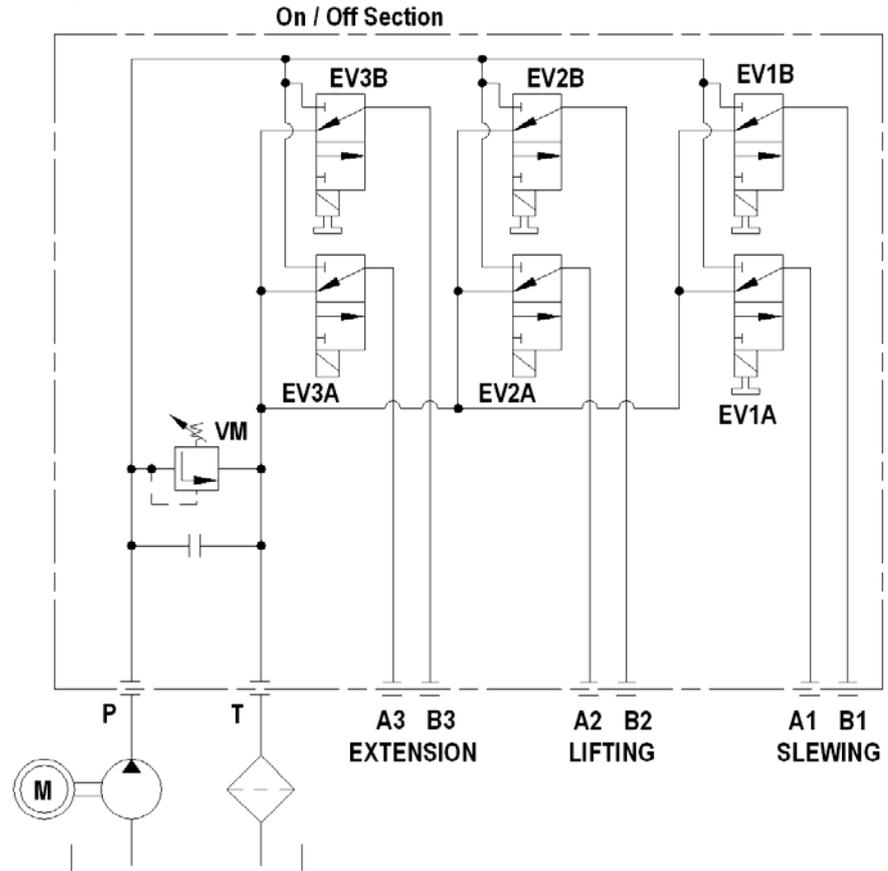
Model	Pressure		Flow	
	PSI	bar	US GPM	l/min
3303 W	2320	160	0.5 ÷ 1.2	2 ÷ 4.5
3304 W	2540	175	0.5 ÷ 1.2	2 ÷ 4.5
3300 W	2320	160	0.4 ÷ 0.9	1.5 ÷ 3.5
4400 W	2830	195	0.5 ÷ 1.2	2 ÷ 4.5

## 1.2.2 Standard operating conditions

### 1.2.2.1 No functions engaged/Safety condition

When no functions are engaged, no solenoid valves are energized, and no oil flows inside the hydraulic unit.

The behaviour is the same if a safety switch is tripped, when the electric motor of the power pack is not supplied in order to prevent movement of the crane.

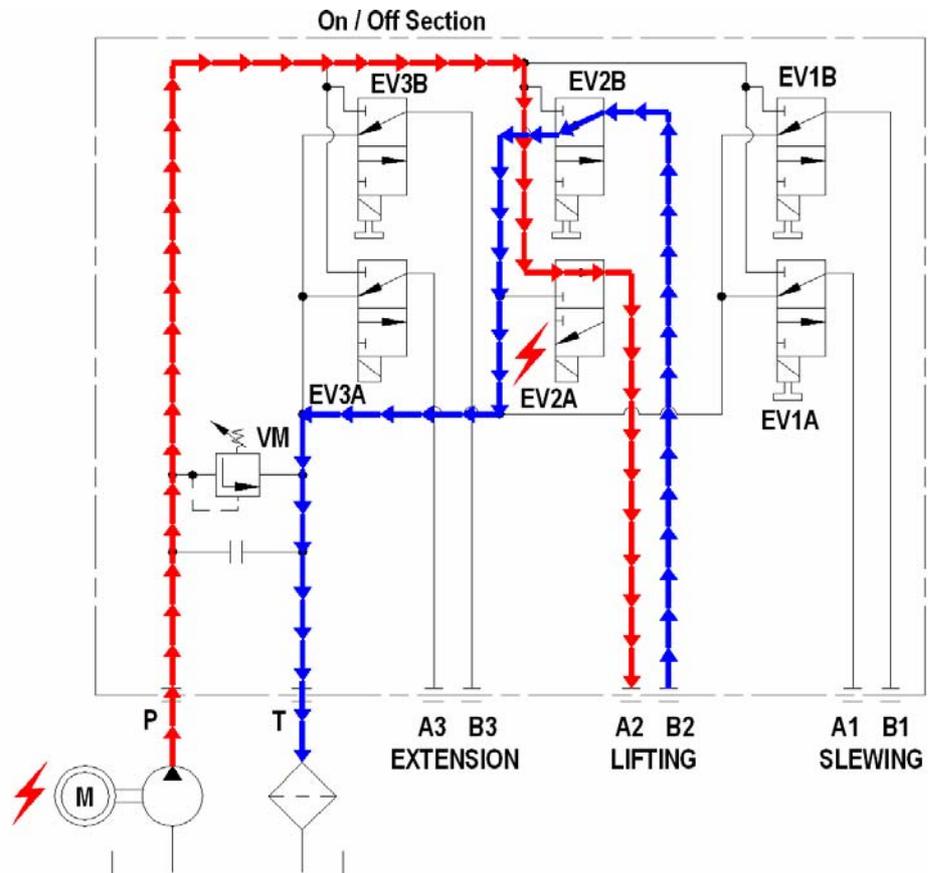


### 1.2.2.2 Function engaged

For this example, we'll use function 2A, which is for boom up. When 2A is selected, valve EV2A (energized) opens and the electric motor of the power pack starts (relay is energized) supplying oil.

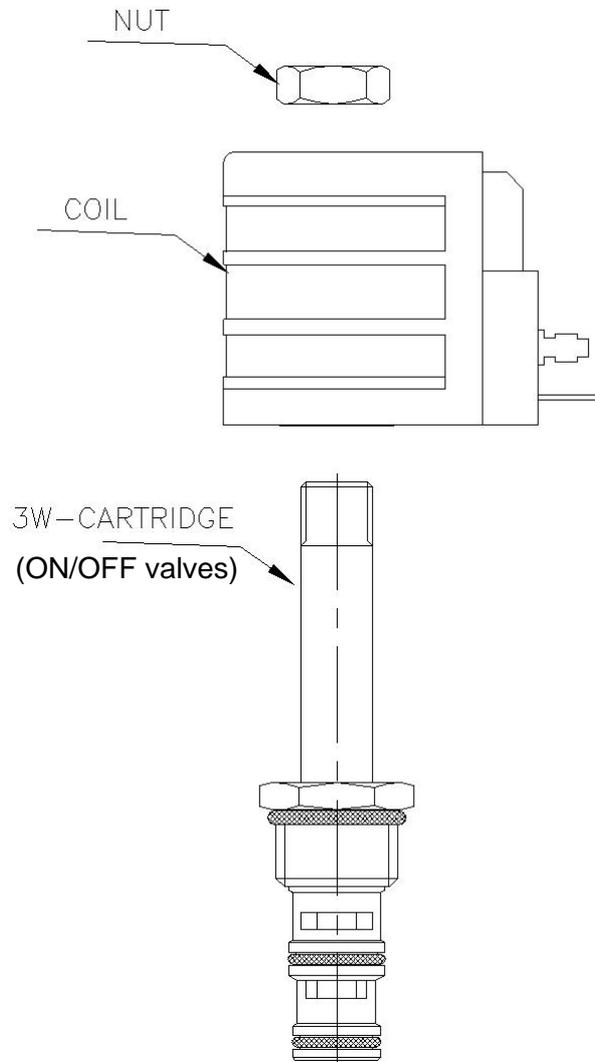
The corresponding valve EV2B remains de-energized to provide a return path for the oil.

Oil flows to the lift cylinder via valve EV2A and port A2. Oil returning from the cylinder enters the block through port B2, flows through EV2B, and returns to tank via port "T".



### 1.3 Inspection and cleaning procedure for the solenoid operated ON-OFF valves

- Remove the nut and the coil (19mm/3/4"hex)
- Remove the cartridge valve from its cavity (22mm/7/8" hex)
- Check if the O-rings are complete
- Check for correct perpendicularity of the cylindrical tube assembly: deflections or distortions of the tube prevent the internal plunger from sliding free in response to electrical signals
- Install the coil on the tube assembly
- Energize the coil by activating any lever of the control box: the internal spool must shift with an audible "click"

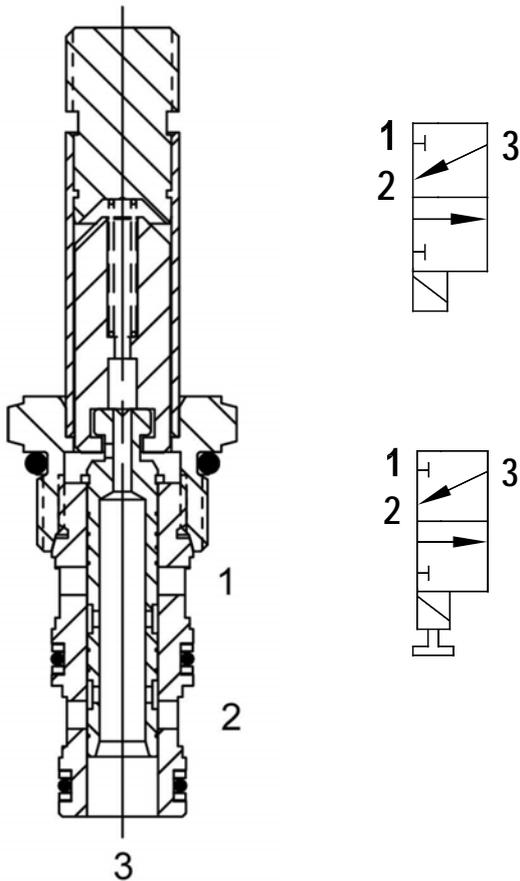


### 1.4 Emergency procedure

For emergency manouvres, fully turn counter-clockwise the manual control of the function valve coupled with the desired mouvement, and let the electric power pack motor run temporarily, supplying directly relevant relay by the prepared cable from the positive power terminal to the positive solenoid connection, momentarily replacing the existing cable. This way, the motor runs until the emergency cable is connected. Keep the motor running only for the short periods required to carry out the emergency manouvres. Afterwards, restore the original connection.

## 1.5 Valves

### 1.5.1 EV1A-EV1B-...-EV3A-EV3B (solenoid operated ON/OFF directional valve)



#### Description:

Solenoid operated, 3 ways 2 positions, spool valve

#### Operation:

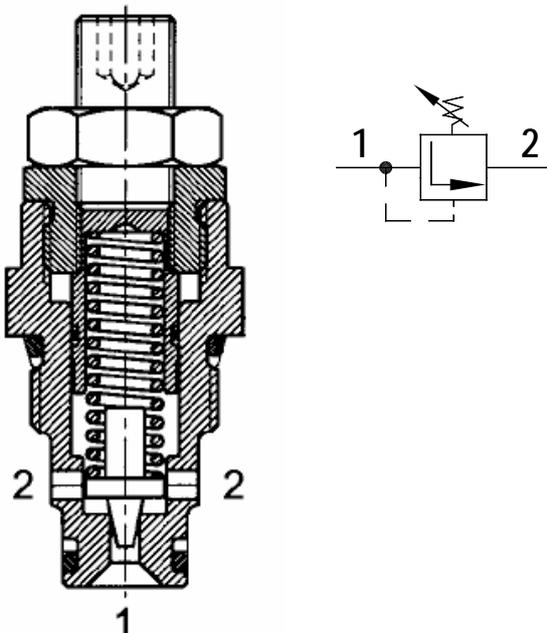
When de-energized, it allows flow from **3** to **2**, and blocks flow at port **1**. When energized, the valve allows flow from **1** to **3** and blocks flow at port **2**.

#### Manual override option:

The valve can be equipped with a manual override, for emergency.

To override, turn the manual override screw counter-clockwise. To release, turn the manual override screw clockwise.

### 1.5.2 VM (relief valve)



#### Description:

Differential area relief valve

#### Operation:

The valve blocks flow from **1** to **2** until sufficient pressure is present at **1** to force the poppet to open and allow metered flow from **1** to **2**.

The cartridge offers smooth transition in response to load changes in common hydraulic circuits.

The rating is adjustable by the screw. Turn clockwise to increase, or counter-clockwise to decrease.

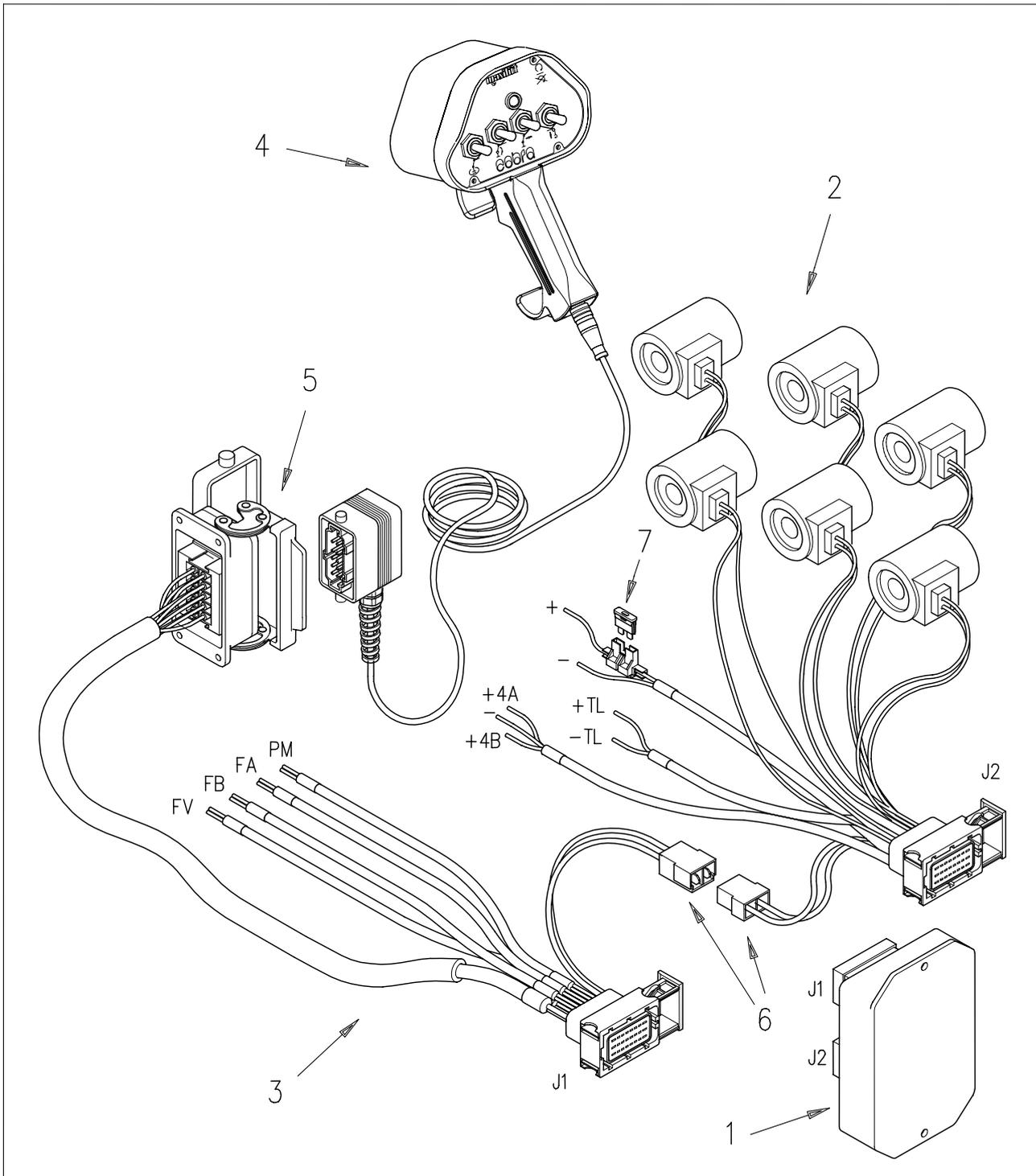
## 2 ELECTRIC/ELECTRONIC SECTION

### 2.1 Main components description

The electric/electronic section consists of the following units:

- Control unit (1). It is fully sealed and contains all the electronic parts with microprocessor logic; two connectors J1 and J2 for the two external wirings and a red LED jut out of the same side.
- Outputs/voltage supply wiring section (2). The outputs are the solenoids for the function valves, and the signal wires for power pack relay (+TL, -TL) and winch electric motor contactor (+4A, +4B, -). This wiring has to be connected to connector J2 on the control unit.
- Inputs wiring section (3). The inputs are the safety switches contacts and the signals coming from the hand held controller. This wiring has to be connected to connector J1 on the control unit.
- Hand held controller (4). It carries the toggleswitches and a green LED on the front panel, and a push and hold power ON button on the rear side of the handle. It is connected to the Inputs wiring section by the 10 poles connector (5).

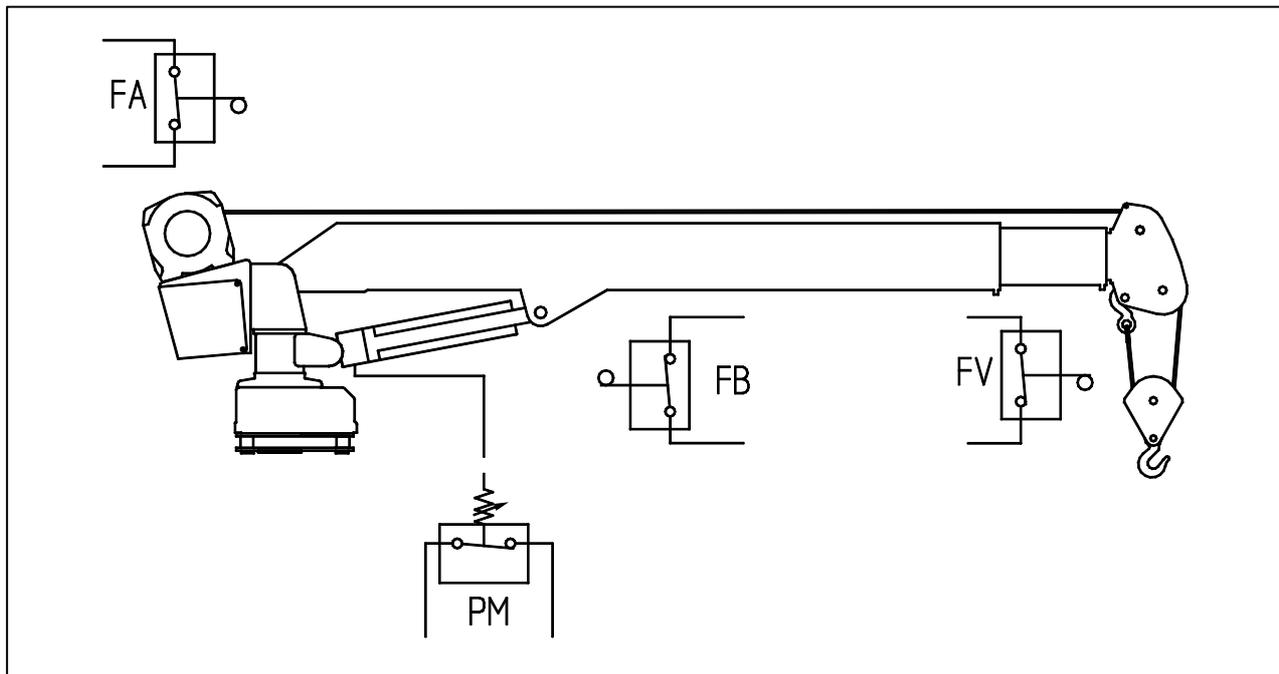
The two wiring sections have to be connected each other by connectors (6). The system is protected against inverted polarity and short circuits by a 10 Ampere fuse (7) laid on the positive voltage wire.



## 2.1.1 Limit switches: layout and connections

All safety systems have two important functions:

- Stop the operation that is causing the hazard
- Only permit operations that will not worsen the hazard



### 2.1.1.1 FA: Low cable switch

The low cable switch is mounted to the winch at the back of the crane (except 3304W). Its purpose is to prevent the operator from spooling the winch cable out too far. If the cable is spooled out too far it may separate from the winch or begin to wrap in reverse on the drum.

- If this switch is tripped, the winch will cease to spool out. All other functions are unaffected.
- The spring tension of the switch pushes the switch arm and roller against the winch drum.
- Set the switch to trip once the roller contacts the bare drum of the winch, with approximately three wraps remaining.
- The switch has to be **Normally Open** connected
- During normal crane operation the switch contacts are closed.

### 2.1.1.2 FV: Anti-two block switch

This switch is at the end of the boom. Its purpose is to prevent the two-part block or load hook from being pulled into the sheave head at the end of the boom. Doing so can cause serious damage to the crane or injury due to a falling load.

- If this switch is tripped the winch will not spool in, and the boom will neither lift nor extend.
- The weight that hangs from the switch keeps the switch arm down.
- Set the switch arm to be in line with the boom when the weight is lifted, and check that the switch contacts close when the weight is lowered.
- The switch has to be **Normally Open** connected
- During normal crane operation the switch contacts are closed.

### 2.1.1.3 PM: Pressure switch

The pressure switch reads the pressure in the lower part of the lift cylinder. This pressure corresponds to the load on the crane structure. When this pressure reaches a specific value, the switch opens. The control system then locks out any movements that would further increase the load on the crane structure.

- If this switch is tripped, all functions will be locked out except for winch out, boom in, and boom down.
- Setting this switch requires the use of a test weight and special procedure.
- The switch has to be **Normally Closed\*** connected
- During normal operation the switch contacts are closed\*.

### 2.1.1.4 FB: Low boom switch

This switch prevents the lift cylinder from reaching bottom. If the cylinder reaches bottom, then the pressure switch will not read the load.

- If this switch is tripped, all functions except boom up are locked out.
- This switch must be set no lower than the specified minimum boom elevation of the crane (i.e.: - 10° for 8805).
- This switch may be set higher than the specified minimum boom elevation if required for a particular application.
- **The switch has to be Normally Closed connected**
- **During normal operation the switch contacts are closed**

### 2.1.1.5 Table of safety lockouts

The following table is a quick reference of which functions are locked out by any given safety switch:

X=LOCKOUT		Rotation	Boom Up	Boom Down	Extension Out	Extension In	Winch Up	Winch Down
FA	Low Cable							X
FV	Anti-Two Block			X	X		X	
PM	Pressure	X	X	X	X		X	
FB	Low Boom	X		X	X	X	X	X

## 2.2 Behaviour of the system and diagnostic considerations

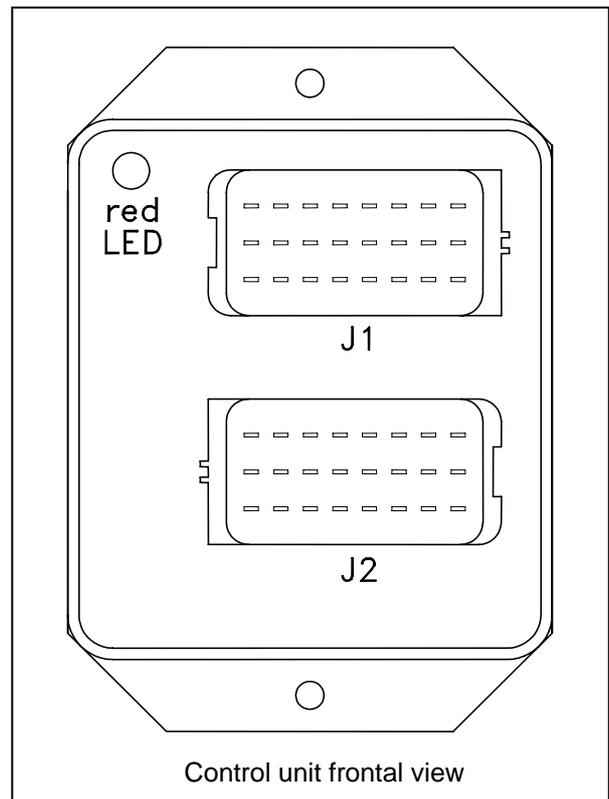
Both the hand held controller and the control unit can be supplied only if the controller is connected. With the power ON button of the hand held controller pushed, its power ON LED (green) lights up continuously, and the red LED on the control unit (see picture on the right) blinks slowly, even without selecting any function by toggleswitch. If a toggleswitch contact doesn't work, these LEDs cannot help in indicating the failure.

Until the button is not pressed, the whole system is not supplied.

Also if one of the two external wirings is disconnected, the whole system is not supplied. Moreover, the system is also not supplied if the two wirings are not connected each other by the proper connectors, even if both are connected to the control unit.

#### Control unit specifications:

- Voltage supply: 9 ÷ 24 Vdc
- Max current consumption: 200 mA (no load applied)
- Operating temperature: -40°C ÷ +100°C
- Environmental protection grade: IP67
- Max power consumption/channel: 30 W
- Connector type: FRAMATOME-SICMA 2 24 pin configuration



The only anomaly the system can detect is the open contact on the pressure switch PM. The alarm code used by control unit is the red LED blinking fast.

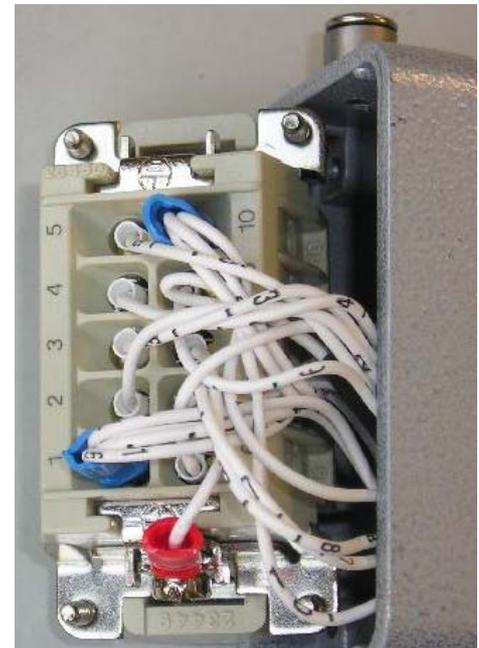
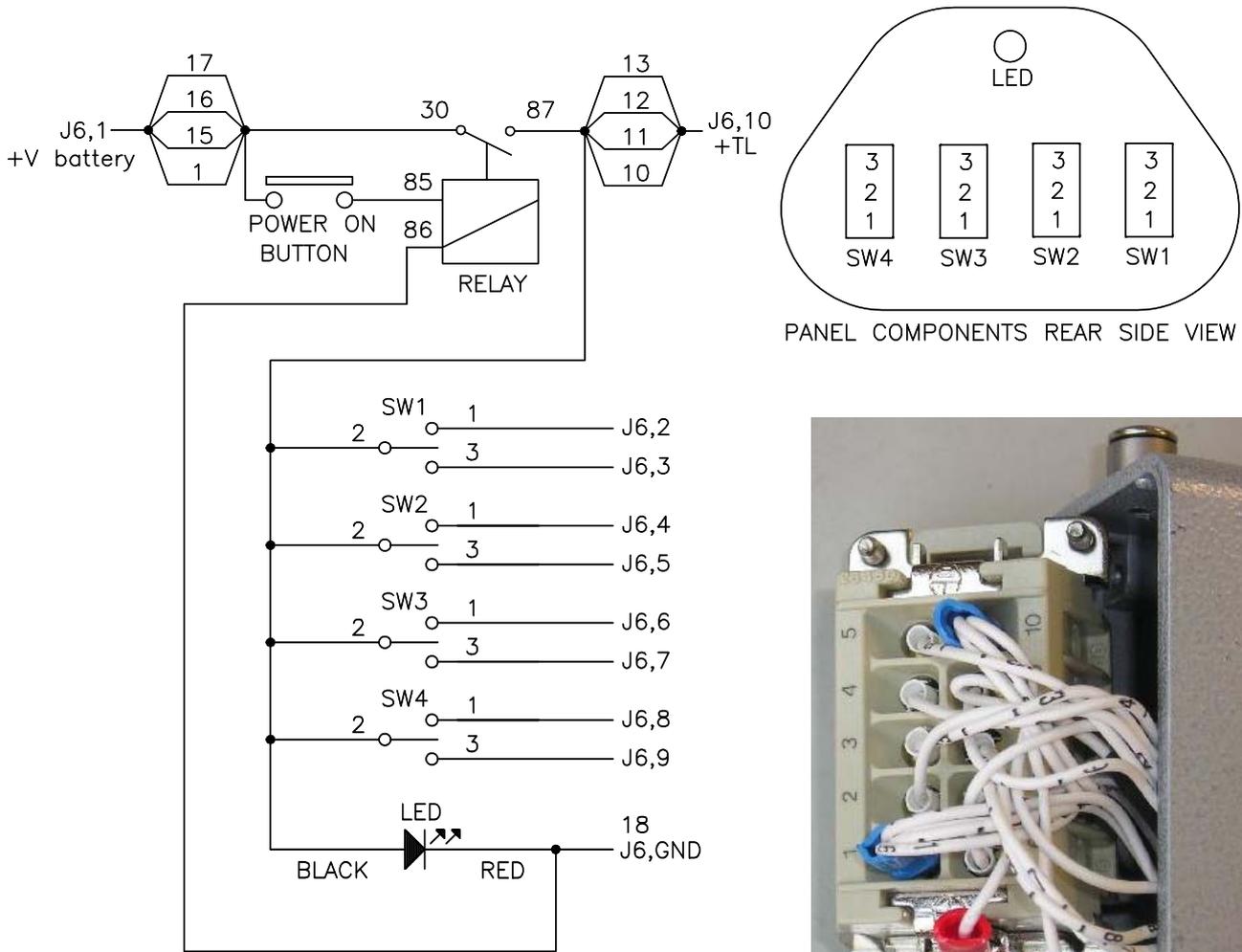
If the signal wire (+TL) for supplying the power pack relay is interrupted, all the function valve solenoids and the winch are supplied if selected, but the power pack never starts.

If a function is locked, both the relevant valve solenoid and the power pack are not supplied. It can never happen that the power pack starts but not the function.

The layouts represented in the paragraphs below are only those of the hand held controller and of the two external wiring sections. No schemes are available for the control unit board. These schematics want to be a reference for the identification and the tracing of every single wire connection, for troubleshooting purposes.

## 2.3 Wirings layouts and connections

### 2.3.1 Hand held controller wiring

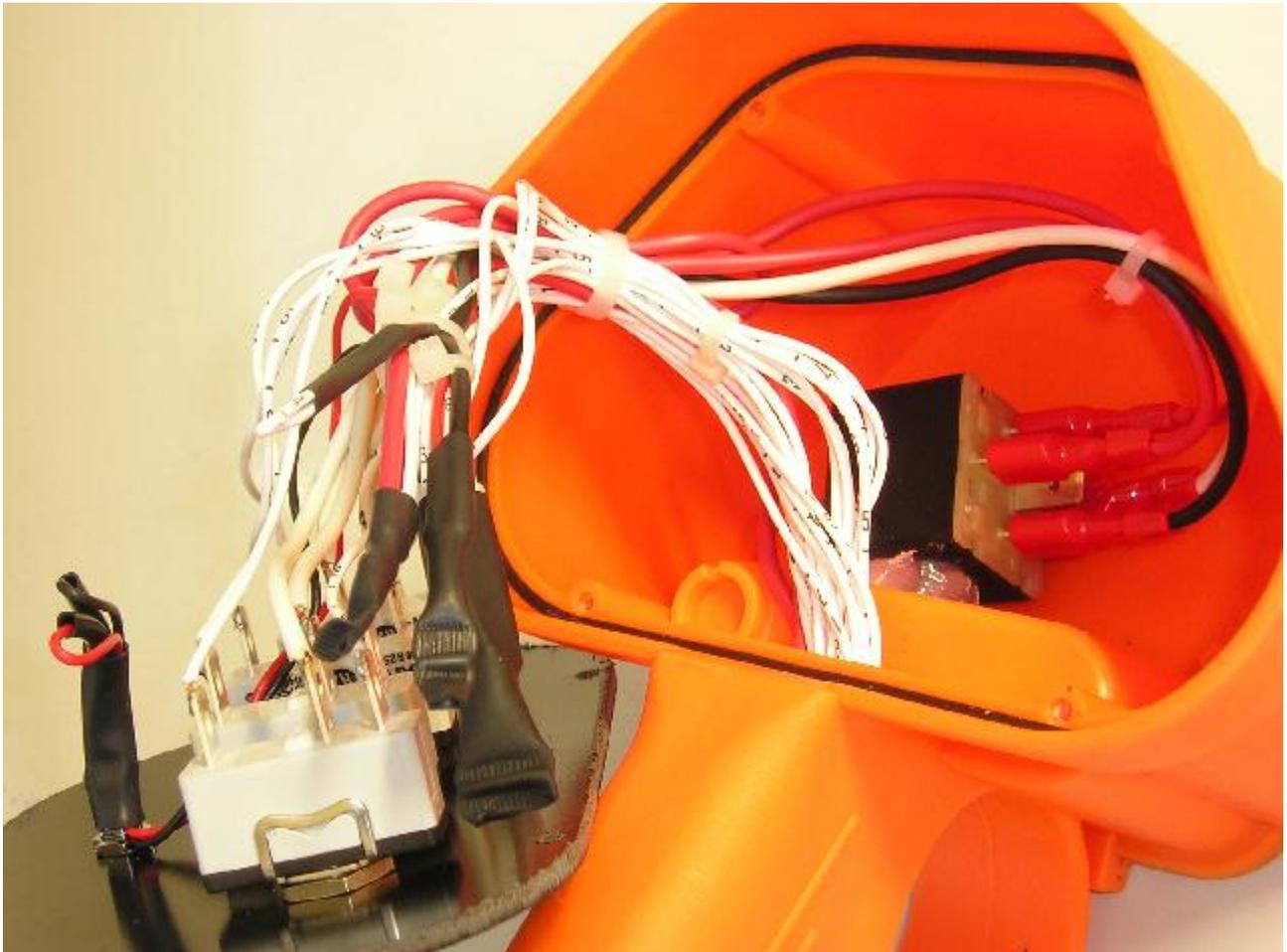


Pict.1 10 poles male connector

The wires represented in the layout are those of the connections of the components in the hand held controller, and those connecting the controller to the 10 poles male connector (identified with J6). The wires 10, 11, 12, 13, are connected together to terminal 10 on J6, like wires 1, 15, 16, 17 to terminal 1. This is because the system, in our application, doesn't need wires 11, 12, 13, 15, 16, 17. These wires are present in the standard wiring because the system is foreseen to be implemented in many other applications different from ours. They could even be not represented in the scheme, but since they are present in practice, it is more correct to represent them as they are really connected. The wire 18, instead, is connected to ground on the screw in the lower position (Pict. 1). Every wire connected to the male connector J6, is identified in the scheme with J6 followed by the number of the terminal it is connected to on the connector. This number corresponds with that marked on the wire (except for the ground wire). The wires connected to the male connector are white (Pict. 1).

Any of the toggleswitches has three contacts that are identified with numbers 1, 2 and 3. The common contact is that in the central position (identified with number 2 on the scheme). The wires connected to the common contacts are not marked, and have a section bigger than those connected to contacts 1 and 3 (Pict. 2).

The relay has 4 contacts. Two for supplying the solenoid and two for the switch.



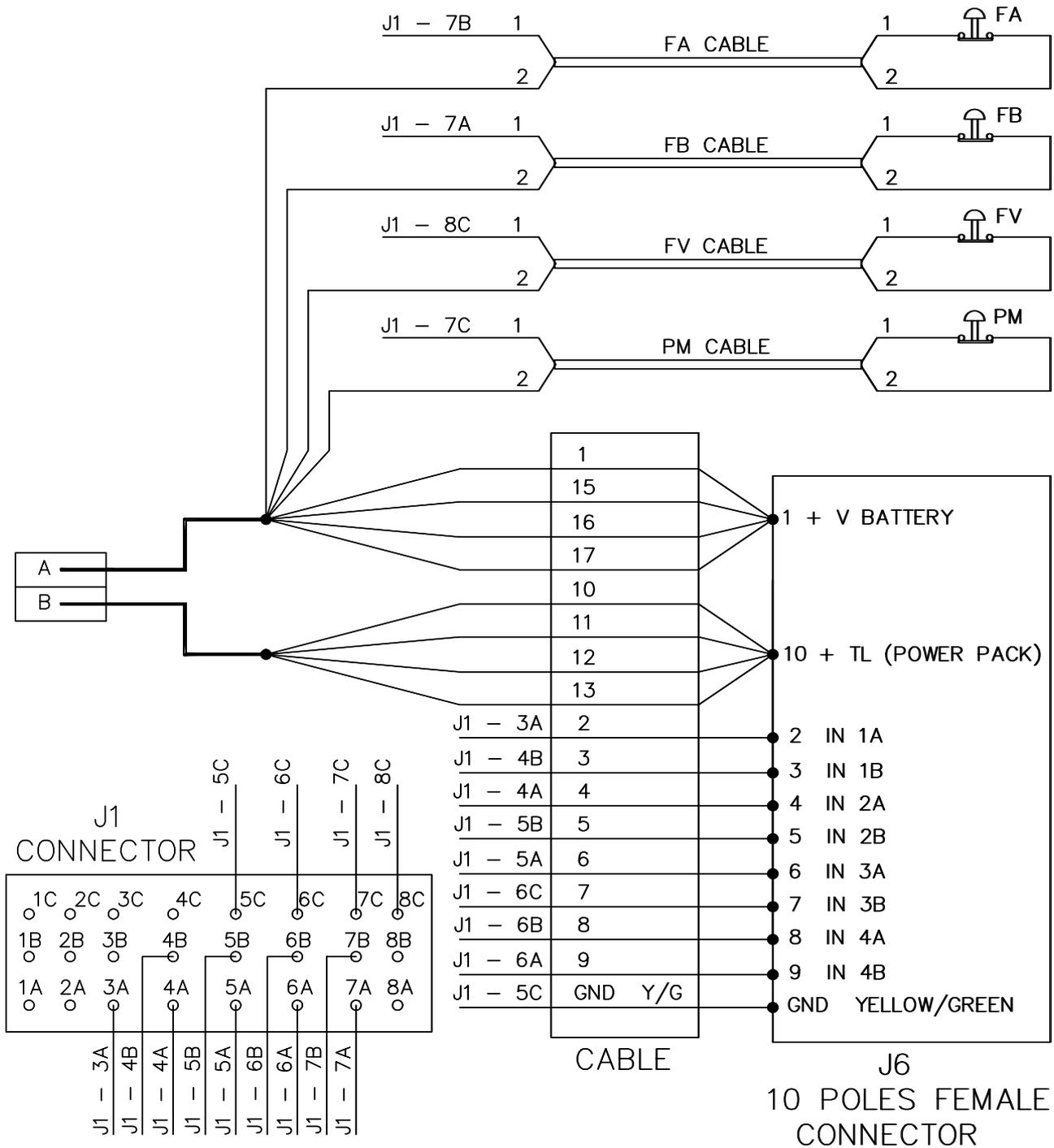
Pict. 2 Hand held controller

The wires connected to J6 female connector (Pict. 3), that belongs to Inputs wiring section, are black (except for the ground that is yellow/green) and marked with numbers corresponding with those of the male connector.



Pict. 3 10 poles female connector

### 2.3.2 Inputs wiring section

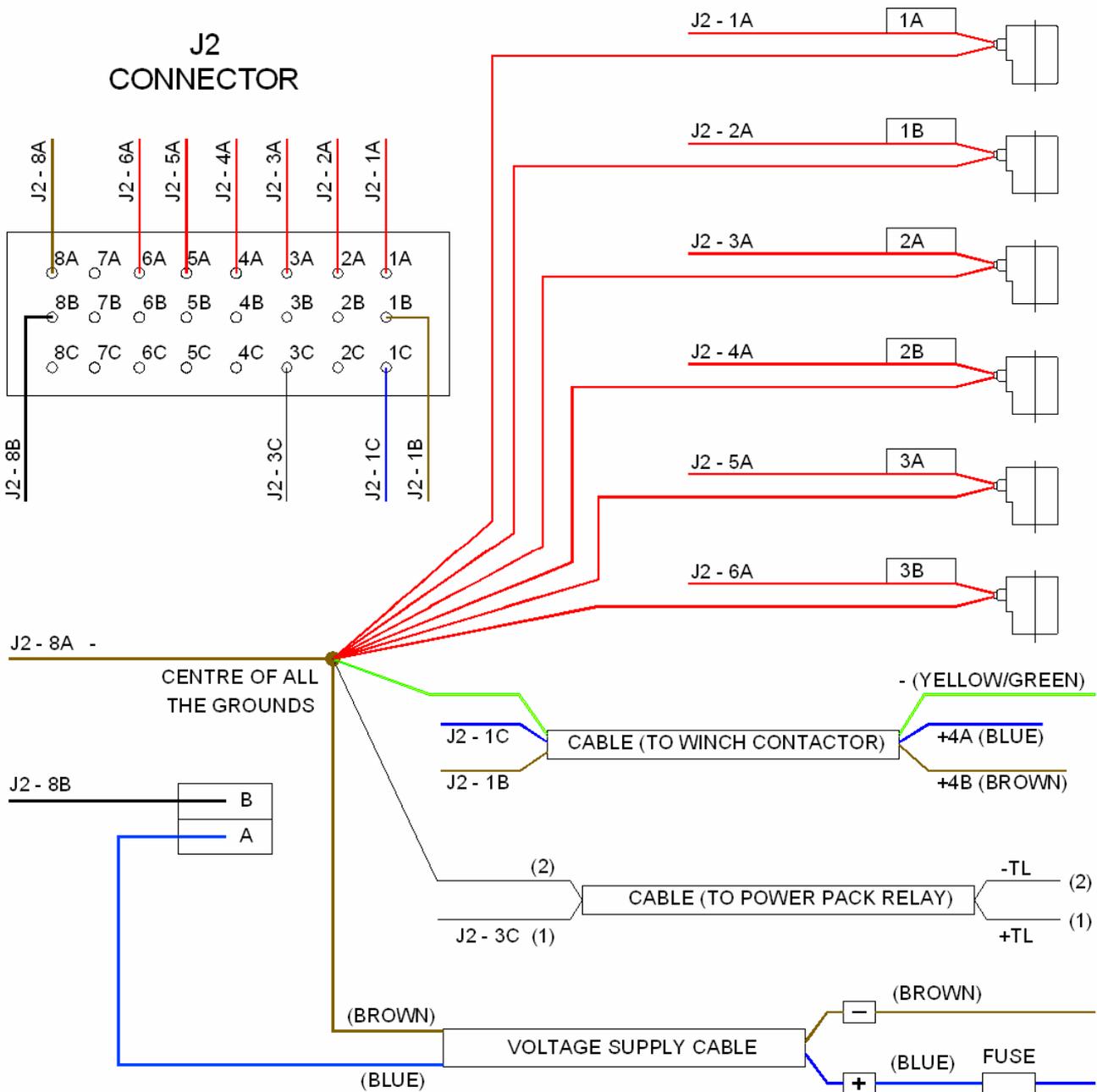


The J6 female connector is represented with reference to picture 3. The wires connected to terminal 1 are connected together to terminal A of the plastic connector.

Terminal A is connected to the positive by means of the corresponding terminal on the other connector that belongs to the Output/Voltage supply wiring section (see 2.3.3). So, terminal A is the one that allows the system to be supplied by voltage. To the positive, are also connected the wires marked with number 2 of the safety switches. All the other wires are connected on connector J1 (to be coupled with the corresponding one on the control unit); each of them is identified with J1 followed by the number of the terminal it is connected to.

Terminal B of the plastic connector (connected with terminal 10 of J6) is the one that allows the signal for the power pack to reach the control unit. This signal is processed by the microprocessor logic in relation to the input signals (safety switches contacts and toggleswitches contacts).

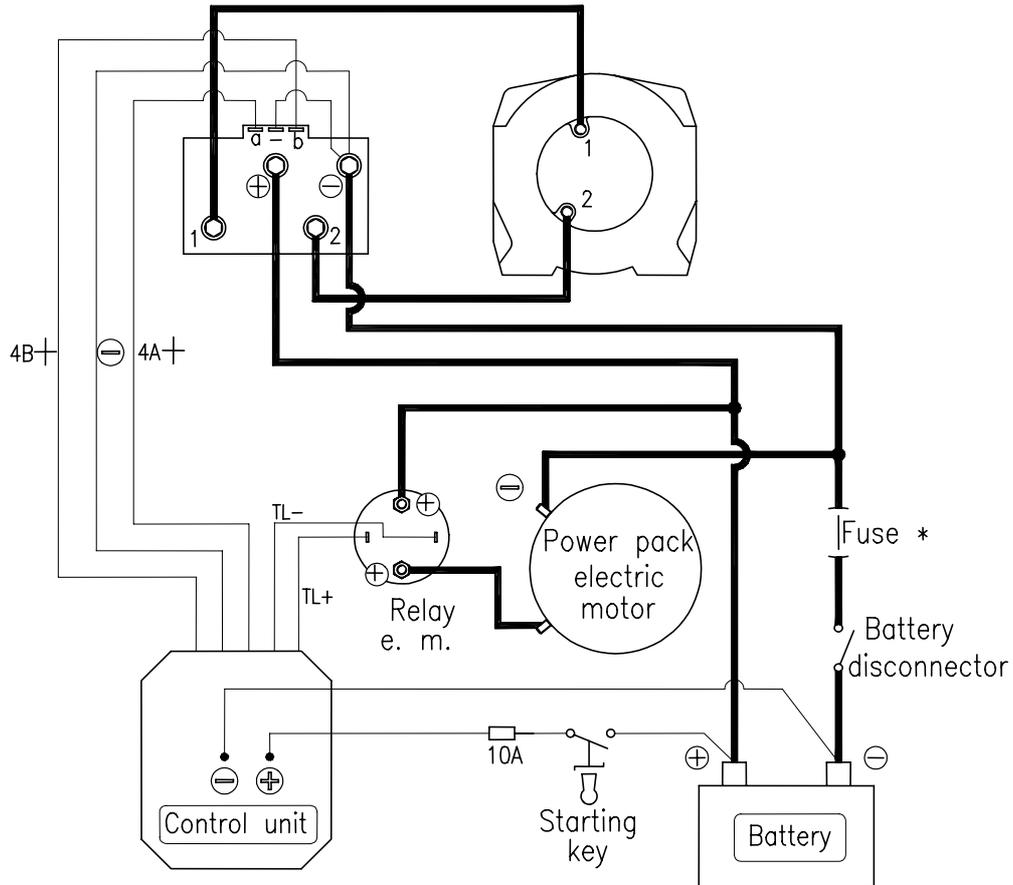
### 2.3.3 Outputs/voltage supply wiring section



Any of the wires connected to connector J2 of (to be coupled with the corresponding one on the control unit) is identified with J2 followed by the number of the terminal it is connected to. Terminal 8A on connector J2 is dedicated to voltage negative supply line.

## 2.3.4 Winch wiring details

### 2.3.4.1 3300 W and 4400 W current winch wiring connections



### 2.3.4.1 4400 W previous winch wiring connections (with winch model DC2250)

