

# **BLUE OCEAN VDR / S-VDR**

## **Chapter 3 Hardware Manual**

## **Introduction**

The hardware of Blue Ocean VDR / S-VDR consists of 3 major parts:

- Main unit, with control and measurements sub-units. All these items are placed in a single metal rack with dimensions: H x W x D : (745 x 575 x 600)mm with gross weight approximately 35kg.
- Power supply, which is placed in an metal enclosure with dimensions H x W x D : (400 x 300 x 180) and two 12V, 50AH batteries.
- The Capsule, to be described elsewhere.

### 3.1 Main Unit

The main unit rack has two openings. The front glass door that provides access to the alarms and the computer, and the back door that provides access to all the electrical / electronic equipment and cables. The cables are inserted into the rack from the rear bottom side.



Front View of the Rack (to be changed!)

#### Front View

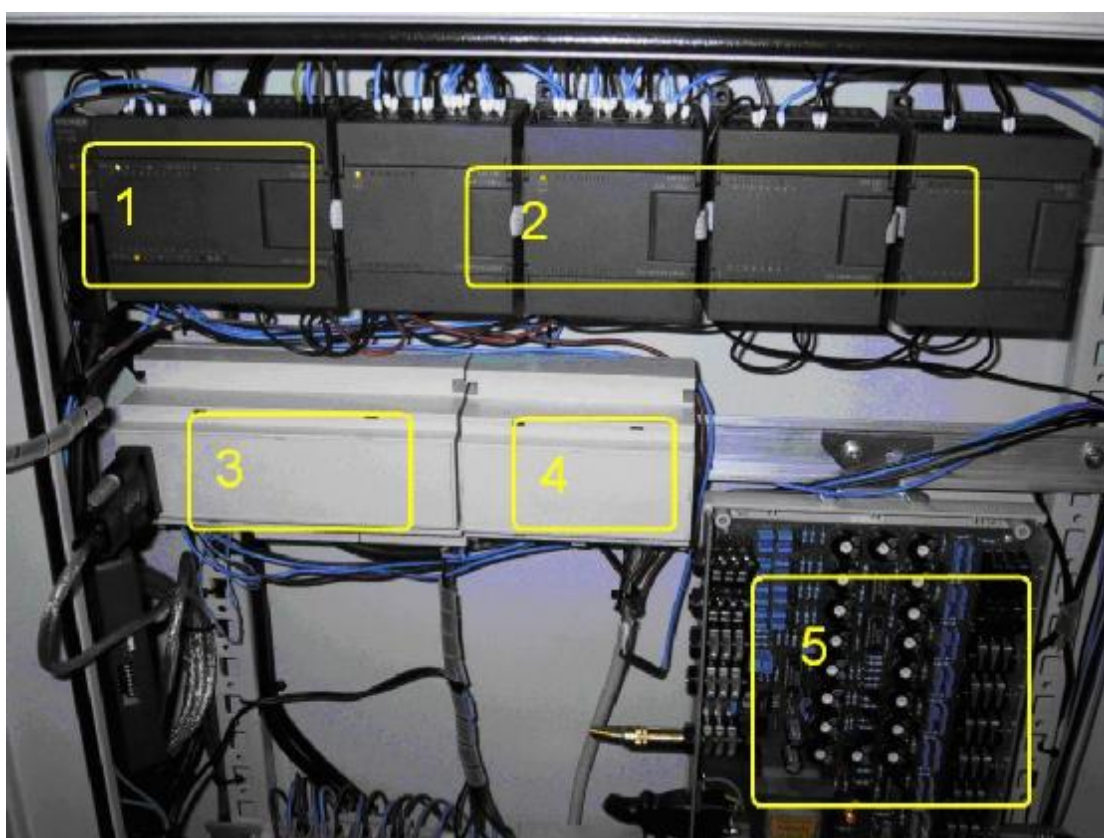
This is the front side of the main unit with the door open. In normal operation the door is closed, as it is the small door of the main control unit (where you can see the keyboard).

1. Monitor
2. Over the control unit there are 2 buttons/lamps: the green one is the "auxiliary power on" and the red one is the main control unit "malfunction alarm". The last one when pressed resets the audible alarm.

The third, yellow button, similar with the others, is the alarm test: when pressed the red lamp is lit and the buzzer sounds. The green lamp is tested by pressing it.

3. Main Unit. There is a small door on the right hand side of the unit that reveals two USB ports that ports are used to connect a mouse and a keyboard in order to access the system during setup and maintainace..
4. The keyboard and the mouse are for setup and maintenance only and are not needed in normal operation.

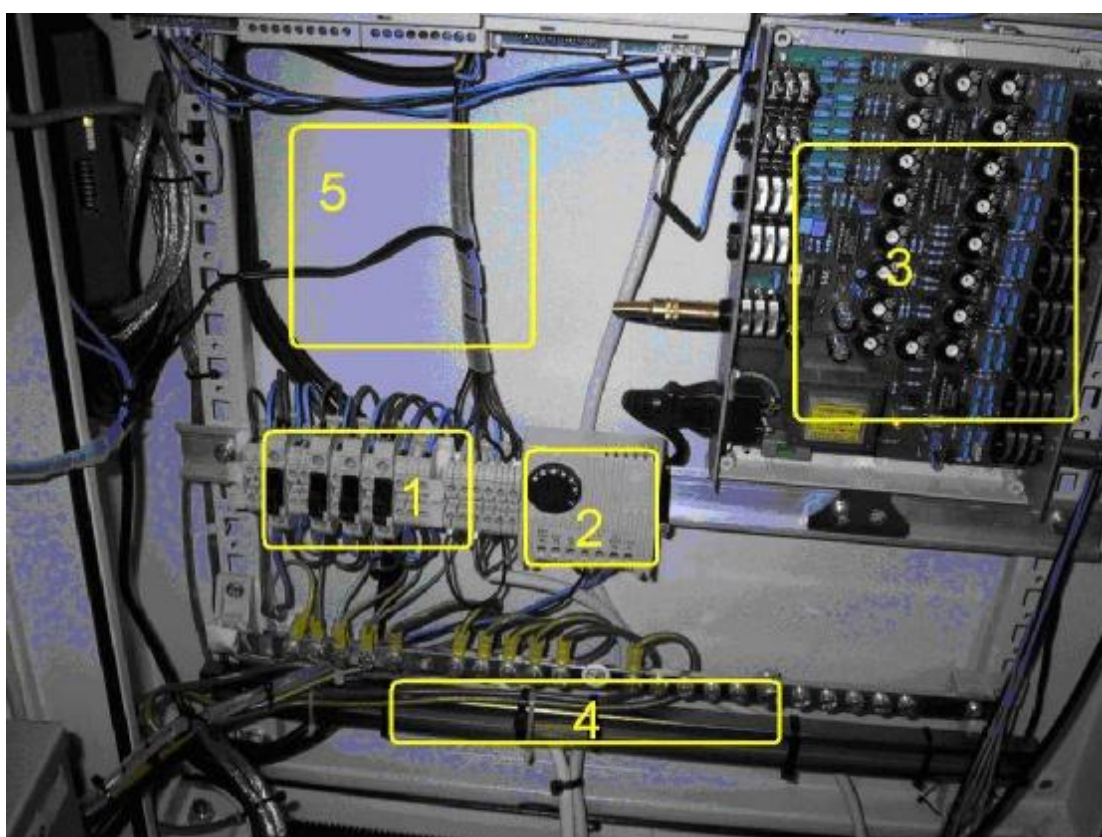
### Rear Block – I/O Units



Top Rear View

1. The PLC main unit. It collects data from its modules and transmits them to the VDR main unit whenever scanned, through a serial connection. The green light “RUN” on the top left corner indicates when lit, that the unit is functioning. To force the unit to stop or to restart it, find the switches under the small lid on the right side of unit. The PLC supervises the Main Unit and sounds an audible (and visible) alarm if the main unit stops for more than 60 seconds.
2. The PLC modules. They may be digital or analog according to the needs of the specific installation.

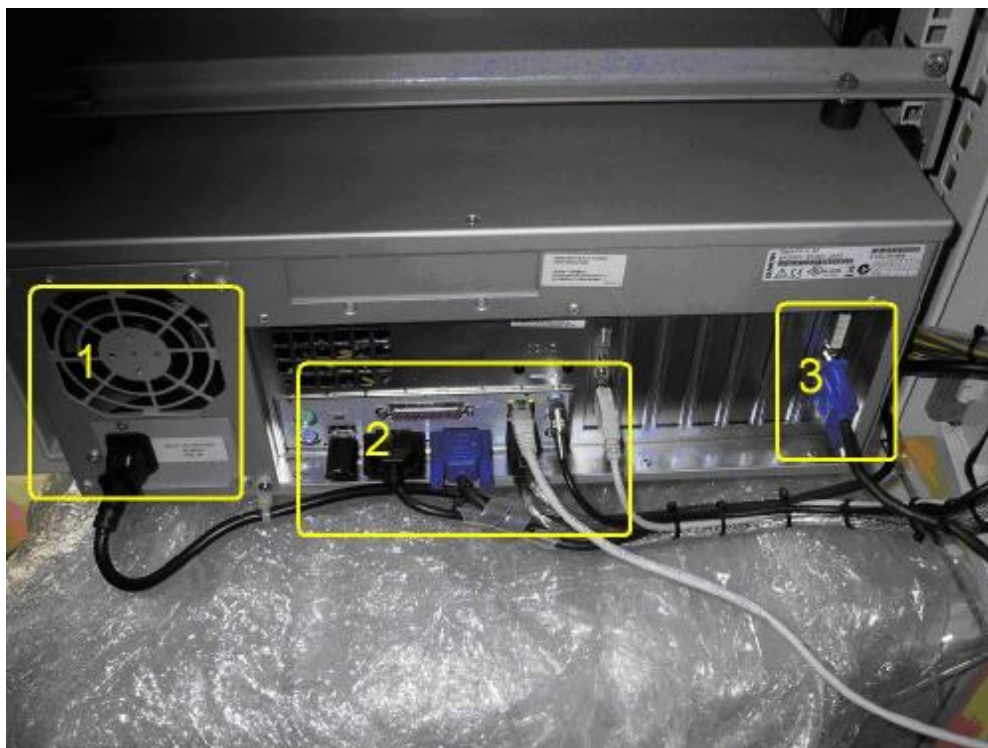
3. The Multi Serial adapter unit. Each of these devices multiplexes the data coming from 8 NMEA transmitters (IEC61162-1) or an IEC61162-2 transmitter into a single serial output line. The serial output is connected to the VDR main unit.
4. Adaptation unit that provides power to the system microphones, lamp dimming control and signal conditioning for analog inputs.
5. Microphone and VHF Mixer. This module has 8 microphone and 4 Line inputs (for the VHF units) with independent volume for each input and bass-tremble setting for each output. All microphone signals are mixed into the Left channel and all the line signals are mixed into the Right channel of the stereo output.



Voltage distribution and grounding

1. 4 Power Fuses.
2. Rack-Fan Thermostat set to conduct at 30 degrees C. The two fans are placed on the sides of the rack.
3. The audio mixer with its cover removed.
4. Ground Bar
5. Space for additional modules.





Back of main control unit

1. Main Unit supply and fan.
2. Main Unit Connections from left to right:
  - USB Hasp for software and data security,
  - Serial input from the PLC main unit,
  - VGA output to the monitor,
  - Ethernet cable for capsule and network communications,
  - USB to Serial converter that is connected to the NMEA adapter,
  - Audio In coming from the Sound Mixer,
3. Video Grabber card input for the radar output.

### 3.2 Power Supply Unit

- Power supply

The power supply receives power from the ship, either 230 Vac or 24 Vdc. Connects to a battery with enough capacity for at least 2 hours of operation (normally longer). The battery is charged either from the internal charger or from the ship's 24V, if the voltage is adequate.

The power supply generates 230 Vac for the main unit from any of the 3 sources:

- the Ship 230 Vac,
- the Ship 24 Vdc, or
- the back up batteries.

A control cable brings to main unit the signals "230 V OK", "24 Vdc OK", "battery voltage".



Power Supply Enclosure

1. Inverter
2. Filter

3. Charger
4. Switching and Connections

The connections, from left to right are:

- 230V from the ship
- 230V to main unit
- Control signals: GND, 230V OK, 24V OK, Battery voltage
- 24V from or to the Batteries,
- 24V from ship.



## 3.3 PLC INSTALLATION

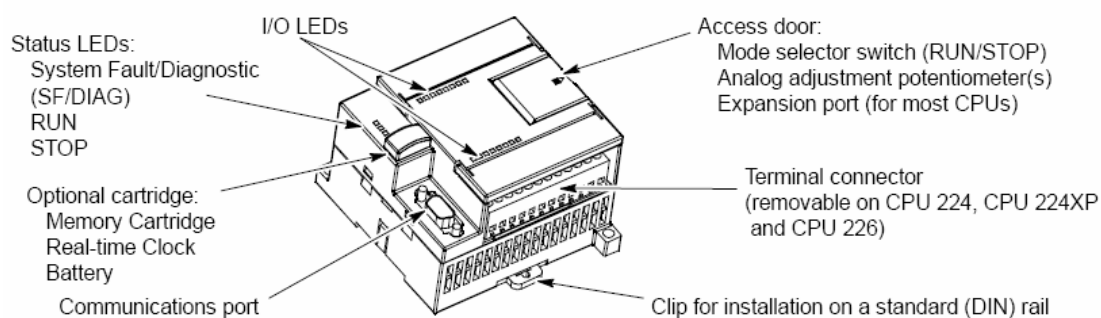
### 3.3.1 Purpose of the manual

This product (VDR / S-VDR) uses a PLC (Programmable Logic Controller) that belongs to the Siemens S7-200 series. It is a line of micro-programmable logic controllers (Micro PLCs) that due to their compact design, low cost and powerful instruction set can control a variety of small, medium or large scale automation applications.

This manual provides information about installing and programming the S7-200 Micro PLCs, as well as the analogue and digital modules that might need, and is designed for engineers, programmers, installers, and electricians who have a general knowledge of programmable logic controllers.

### 3.3.2 S7-200 CPU

The S7-200 CPU, illustrated in figure 2.1, combines a microprocessor, an integrated power supply, input circuits, and output circuits in a compact housing to create a powerful Micro PLC. After the user has downloaded his/her programme, the S7-200 contains the logic required to monitor and control the input and output devices in your application.



**Figure 3.1:** S7-200 Micro PLC.

Siemens provides different S7-200 CPU models with a diversity of features and capabilities that help you create effective solutions for your varied applications. This product (SVDR) uses either a PLC with CPU 224 DC/DC/DC - 14 digital inputs and

10 digital outputs (order num.: 6ES7 214-1AD23-0XB0) or a PLC with CPU 224 AC/DC/Relay - 14 digital inputs and 10 digital outputs (order num.: 6ES7 214-1AD23-0XB0). Table 2.1 describes briefly some of the main features of the CPU 224.

Feature	CPU 224
Physical size (mm)	120.5 x 80 x 62
Program memory: with run mode edit without run mode edit	8192 bytes 12288 bytes
Data memory	8192 bytes
Memory backup	100 hours typical
Local on-board I/O Digital Analog	14 In/10 Out --
Expansion modules	7 modules <sup>1</sup>
High-speed counters Single phase Two phase	6 at 30 kHz 4 at 20 kHz
Pulse outputs (DC)	2 at 20 kHz
Analog adjustments	2
Real-time clock	Built-in
Communications ports	1 RS-485
Floating-point math	Yes
Digital I/O image size	256 (128 in, 128 out)
Boolean execution speed	0.22 microseconds/instruction

<sup>1</sup> You must calculate your power budget to determine how much power (or current) the S7-200CPU can provide for your configuration. If the CPU power budget is exceeded, you may not be able to connect the maximum number of modules.

**Table 3.1:** Main features of S7-200 CPU 224 module.

### 3.3.3 S7-200 Expansion Modules

To better solve your application requirements, the S7-200 family includes a wide variety of expansion modules. You can use these expansion modules to add additional functionality to the S7-200 CPU.

This product (SVDR) makes extensive use of different digital and analogue modules. The most commonly used expansion modules are the EM221 Digital Input – 16 x 24VDC digital inputs (order num.: 6ES7 221-1BH22-0XA0) and the EM231 Analogue Input – 4 analogue inputs (order num.: 6ES7 231-0HC22-0XA0).

Table 2.2 provides a list of the expansion modules that are currently available.

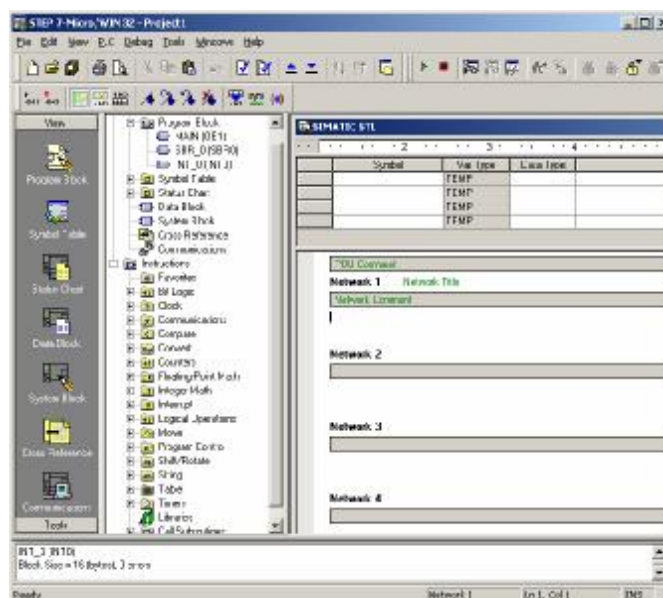
Expansion Modules	Types		
Discrete modules: Input	8 x DC In	8 x AC In	16 x DC In
Output	4 x DC 8 x DC Out	4 x Relays 8 x AC Out	8 x Relay
Combination	4 x DC In/4 x DC Out 4 x DC In/4 x Relay	8 x DC In/8 x DC Out 8 x DC In/8 x Relay	16 x DC In/16 x DC Out 16 x DC In/16 x Relay
Analogue modules: Input Output Combination	4 x Analogue In 2 x Analogue Out 4 x Analogue In/1 x Analogue Out	4 x Thermocouple In	2 x RTD In
Intelligent modules	Position Ethernet	Modem Internet	PROFIBUS-DP
Other modules	AS—Interface		

**Table 3.2:** S7-200 expansion modules.

### 3.3.4 Programming an S7-200 CPU 224

The programming of the S7-200 CPU 224 is done in assembly using Siemens STEP 7 -Micro/WIN programming package. The steps for downloading a programme onto the PLC are as follows:

- Ø Run Siemens STEP 7 - Micro/WIN. A window like the one in figure 2.2 will appear on the screen.



**Figure 3.2:** Main window of Siemens STEP 7 - Micro/WIN

- Ø Open the file you wish to download. The file has extension .mwp.

- Ø Force PLC from Run mode to Term mode using the mode selector switch hiding under the access door on the PLC. This is done by firstly putting the PLC to Stop mode and then to Term mode.
- Ø The user then establishes if there are any communications between the computer (PC or laptop) and the PLC. This is done by simply pressing the button marked as Communications on the Navigation Bar. If the Navigation Bar is not visible then make it visible by selecting View→Frame→Navigation Bar. When the Communications button is clicked a window labelled as Communications will appear. See figure 2.3.



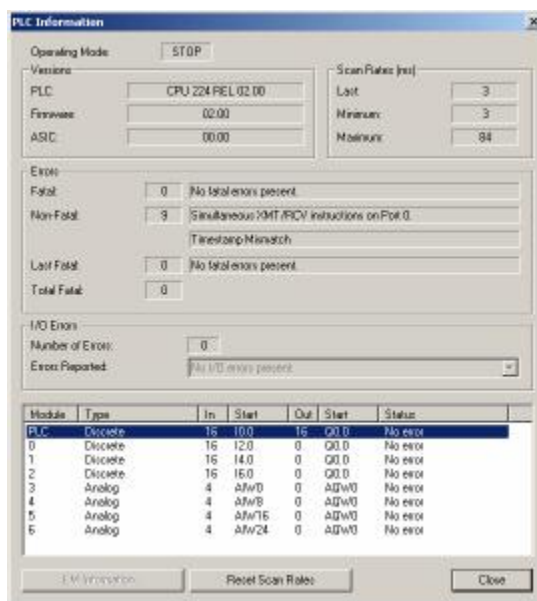
**Figure 3.3:** Communications window before the Refresh button is pressed.

- Ø On the Communications window double click where it says Double-Click to Refresh. If the RS-232 on the computer, the PPI Multi-Master Cable and the PLC are all right, then on the Communications window should appear the PLC used in the system. See figure 2.4.



**Figure 3.4:** Communications window after the Refresh button is pressed.

- Ø Double clicking on the PLC image on the Communications window another window should appear containing all the necessary information about the PLC and the expansion modules attached to it. See figure 2.5.



**Figure 3.5:** PLC information window.

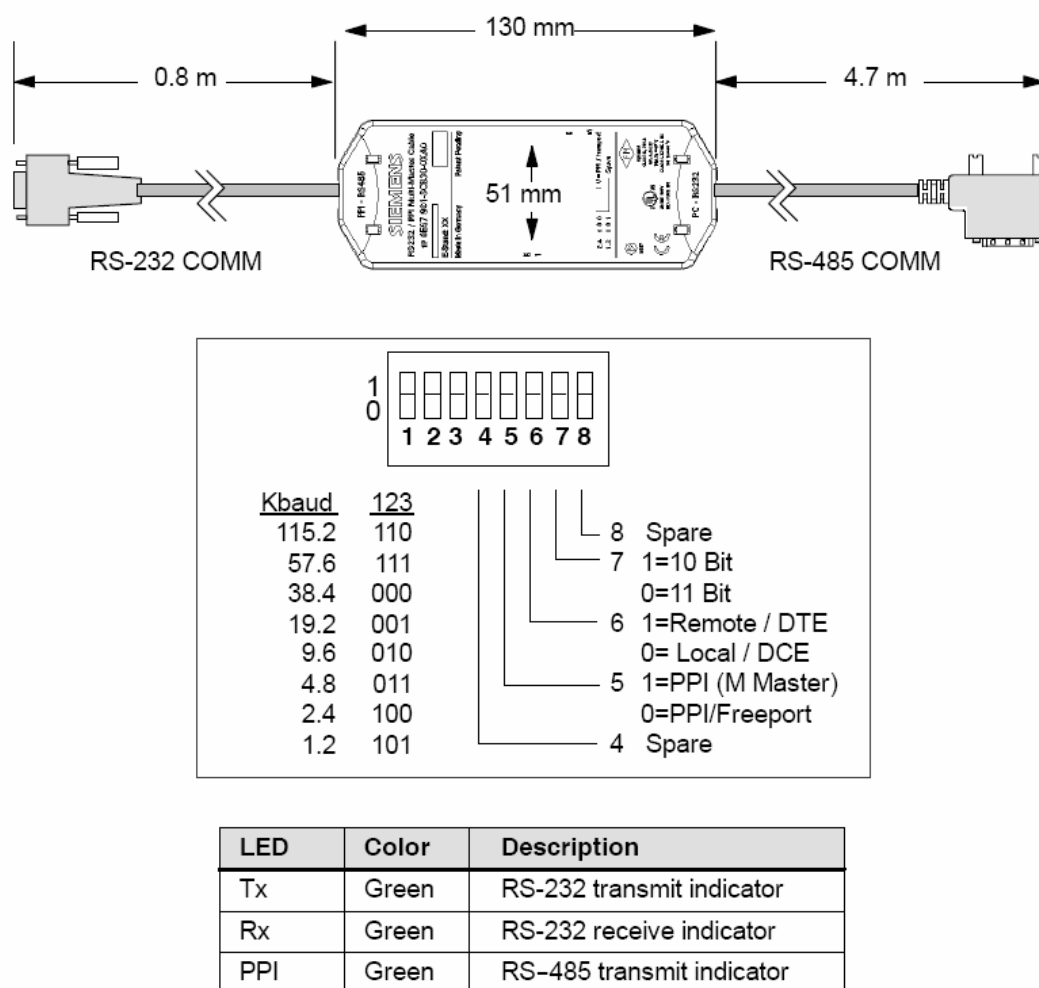
- Ø If the user has established communication with the PLC and all the expansion modules, then the only thing remaining to do is to return to the Main window.
- Ø Once on the Main window, select PLC→Clear..., then select PLC→Compile All, and finally press the Download button placed on the Main Tool bar to download the programme to the PLC.
- Ø The PLC must be forced back to the Run mode using the mode selector switch hiding under the access door on the PLC. This is done by simply putting the PLC from the Term mode that it is to the Run mode.

### 3.3.5 Communication Options

Siemens provides two programming options for connecting your computer to your S7-200: a direct connection with a PPI Multi-Master Cable, or a Communications Processor (CP) card with an MPI cable.

This product (SVDR) uses a PPI Multi-Master programming cable operating on 38.4kbpersec, illustrated in figure 2.6, to connect your computer to the S7-200. This cable connects the communications port of the S7-200 to the serial communications of

your computer. The PPI Multi-Master programming cable can also be used to connect other communications devices to the S7-200.



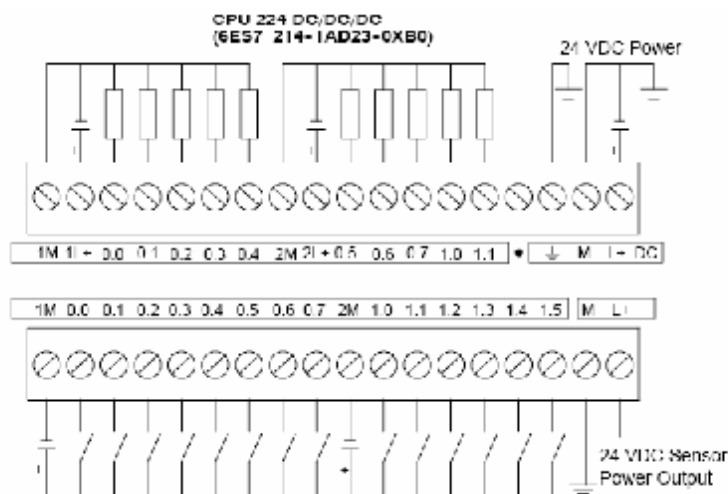
**Figure 3.6:** S7-200 RS-232/PPI Multi-Master Cable Dimensions, Label and LEDs.

The above shown Dip switch, which is actually positioned on the PPI Multi-Master programming cable, must have all its switches positioned to zero.

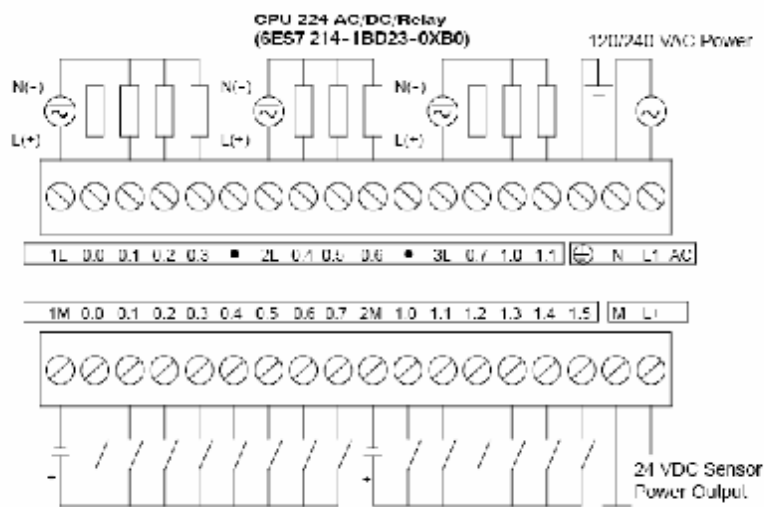
### 3.3.6 Wiring an S7-200 CPU 224

As it has already been mentioned this product (SVDR) uses either a PLC with CPU 224 DC/DC/DC - 14 digital inputs and 10 digital outputs (order num.: 6ES7 214-1AD23-0XB0) or a PLC with CPU 224 AC/DC/Relay - 14 digital inputs and 10 digital outputs (order num.: 6ES7 214-1AD23-0XB0). The following two figures (figures 2.7 and 2.8) illustrate how those two PLCs are wired.





**Figure 3.7:** S7-200 CPU 224 DC/DC/DC wiring diagram.



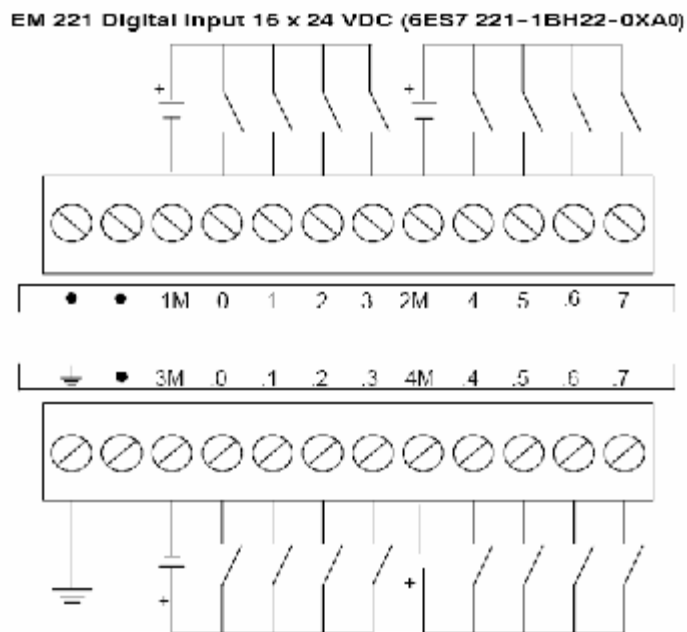
**Figure 3.8:** S7-200 CPU 224 AC/DC/Relay wiring diagram.

A very important note for the person who will wire up the system is that he/she should start wiring the PLC, as well as any expansion modules, from the least significant bits to the most significant bits (looking at figures 2.7 or 2.8, that is from the screw labelled 0.0 to the screw labelled 1.5).

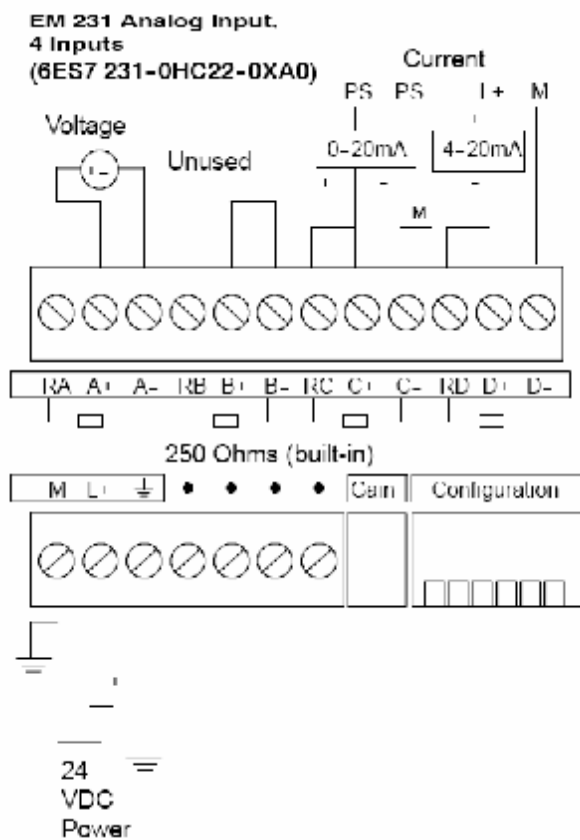
### 3.3.7 Wiring the Expansion Modules

As it has already been mentioned this product (SVDR) uses the following two expansion modules, the EM221 Digital Input – 16 x 24VDC digital inputs (order num.: 6ES7 221-1BH22-0XA0) and the EM231 Analogue Input – 4 analogue inputs

(order num.: 6ES7 231-0HC22-0XA0). The following two figures (figures 2.9 and 2.10) show how those two modules are wired.



**Figure 3.9:** Wiring diagram Digital Input expansion module.



**Figure 3.10:** Wiring diagram Analogue Input expansion module.

A very important note for the person who will wire up the system is that he/she should place next to the PLC first the Digital expansion modules and then the Analogue expansion modules. The wiring of the expansion modules should also be done from the least significant bits to the most significant bits (looking at figures 2.9, that is from the screw positioned on the top left hand corner, labelled .0 to the screw on the bottom right hand corner labelled .7, and looking at figures 2.10, that is from the screw positioned on the top left hand corner, labelled A+ to the screw on the top right hand corner labelled D+).

### Configuration for EM231

Table 2.3 shows how to configure the EM231 module using the configuration DIP switches. Switches 1, 2, and 3 select the analogue input range. All inputs are set to the same analogue input range. In this table, ON is closed, and OFF is open. The switch settings are read only when the power is turned on.

Unipolar			Full-Scale Input	Resolution
SW1	SW2	SW3		
ON	OFF	ON	0 to 10V	2.5mV
	ON	OFF	0 to 5V	1.25mV
			0 to 20mA	5 $\mu$ A
Bipolar			Full-Scale Input	Resolution
SW1	SW2	SW3		
OFF	OFF	ON	$\pm$ 5V	2.5mV
	ON	OFF	$\pm$ 2.5V	1.25mV

**Table 3.3:** EM231 Configuration Switch Table to Select Analogue Input Range.

According to Table 2.3 the Dip switch placed on the Analogue extension modules should be configured as follows. Switch SW1 (labelled 1) should be ON $\uparrow$ , switch SW2 (labelled 2) should be OFF $\downarrow$  and switch SW3 (labelled 3) should be ON $\uparrow$ . Switches SW4, SW5, and SW6 (labelled 4, 5, and 6) should be OFF $\downarrow$ .

## PLC Connections

Some PLC inputs/outputs are reserved for system use and the rest are available for field signals. The used signals are:

The reserved outputs of the main unit are used as following:

- Q0.0 Auxiliary alarm (for testing purposes)
- Q0.1 Red alarm lamp. Can be used for external alarm.
- Q0.2 Buzzer
- Q0.3
- Q0.4 Microphone test, group 1
- Q0.5 Microphone test, group 2
- Q0.6 Microphone test, group 3
- Q0.7 Microphone test, group 4
- Q1.0 Microphone test, group 5
- Q1.1 Microphone test, group 6

The reserved inputs of main unit are:

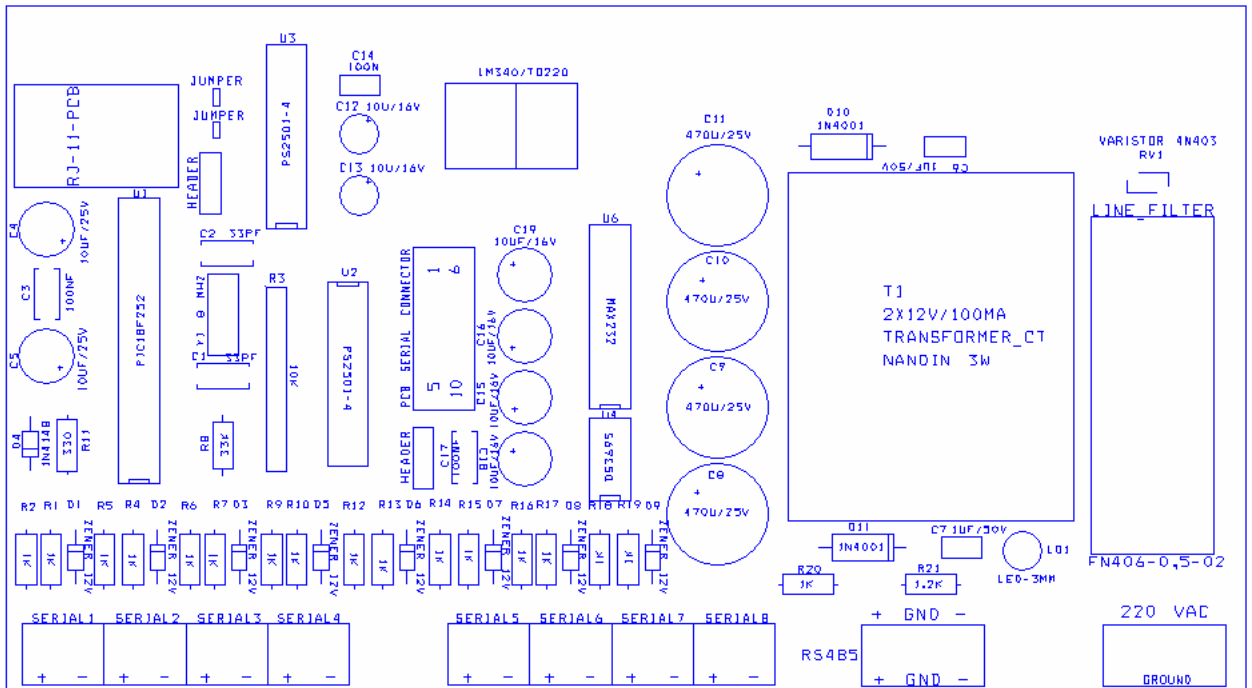
- I0.0 Cancel alarm
- I0.1 24V O.K.
- I0.2 230V O.K.

The inputs of the first analogue module:

- A Battery voltage
- B Dimming control

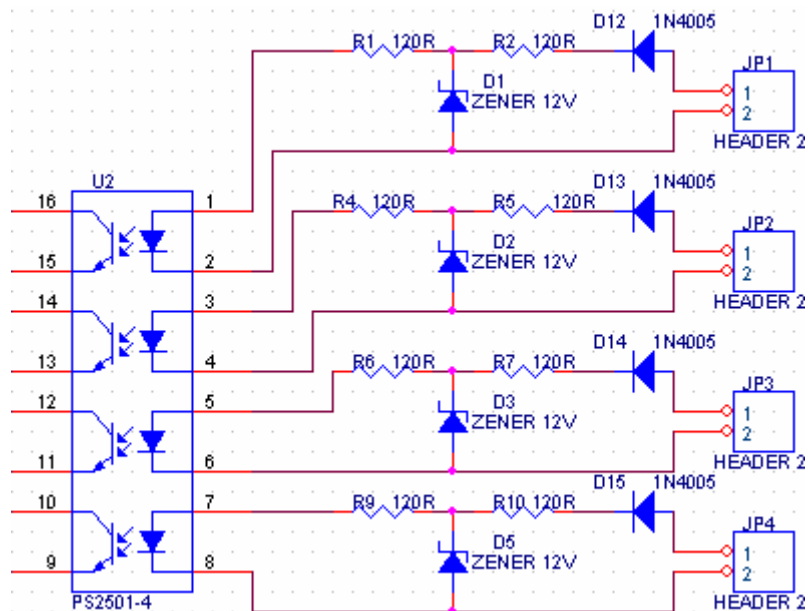
### 3.4 NMEA Concentrator

The Multi Serial adapter unit. Each of these devices multiplexes the data coming from 8 NMEA transmitters (IEC61162-1) or an IEC61162-2 transmitter into a single serial output line. The serial output is connected to the VDR main unit.



The eight inputs are the two more lefts groups of connection. The connections labeled RS485 are optional and are not used in this configuration. At the right side is the supply input.

The inputs are protected for overvoltage and reverse polarity. Below a simplified diagram of the inputs is depicted.

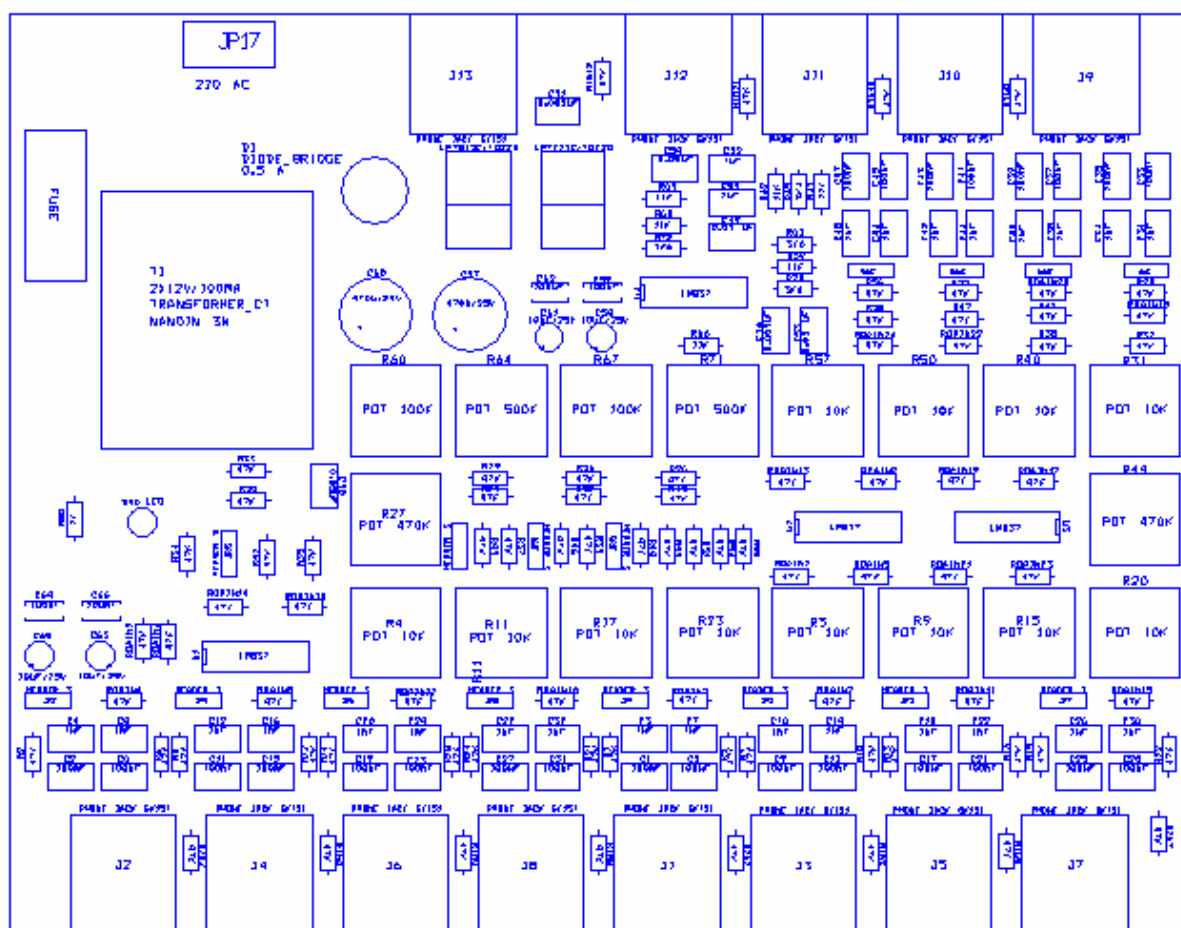


The outputs of the concentrator are on a DB9 connector on the top of the unit.



### 3.5 Mixer

Microphone and VHF Mixer. This module has 8 microphone and 4 Line inputs (for the VHF units) with independent volume for each input and bass-treble setting for each output. All microphone signals are mixed into the Left channel and all the line signals are mixed into the Right channel of the stereo output.



The 8 microphone inputs are on the bottom side of the diagram. The 4 right inputs are for VHF audio. The fifth connector is the stereo output.

The unit is shipped in a standard configuration: all controls are set at the levels requested by the standard. The usual setup is all inputs at the middle, groups at full, tone at middle (flat).

The controls should be adjusted only by qualified personnel in cases the environment is not normal and the recorded sound quality is not satisfactory.

The controls are:

Mike tremble	Mike bass	VHF tremble	VHF bass	VHF 1 Volume	VHF 2 Volume	VHF 3 Volume	VHF 4 Volume
Left volume							Right volume
Mike 1 Volume	Mike 2 Volume	Mike 3 Volume	Mike 4 Volume	Mike 5 Volume	Mike 6 Volume	Mike 7 Volume	Mike 8 Volume

The cases adjustments are recommended (and allowed!) are:

- High pitched noise or low frequency rumble comes from an input and obscures the voices that should be recorded.
- The VHF volume is very high or very low
- A microphone picks up loud external noise and deteriorates recording quality
- A microphone cannot be placed near enough a commanding station and needs amplification

Note that all input volume controls are not gain controls but attenuation – turn in the opposite direction of that of a gain control. The group volume are gain control, turn clockwise to increase volume.

To test the quality of recording you can use the COMAS player – or simply the Windows Media Player. Remember that the later has an oscilloscope mode. Clipping and other artifacts can be easily detected.

### **Mixer – specifications**

All inputs:

Normally unbalanced, can be configured as balanced

Maximum impedance 47K

Lower impedance on order (for example 1200R or 600R for low impedance microphones)

8 microphone inputs

sensitivity:

Max. 8mV rms unbalanced (jumper 1-2)

Max. 60mV rms balanced (jumper 2-3)

max. sensitivity deviation in all 8 inputs: better than 0,1db

4 VHF (line) inputs

sensitivity:

Max. 75mV rms unbalanced (jumper 1-2)

Max. 290mV rms balanced (jumper 2-3)

max. sensitivity deviation in all 4 inputs: better than 0,1 db

Sensitivity for output of 0dbm (774mV rms @ 600Ω ) @1KHZ

SINAD specified at 120 mV RMS

## **3.6 Adaptation Unit**

The adaptation unit provides power to the system microphones, lamp dimming control and signal conditioning for analog inputs.