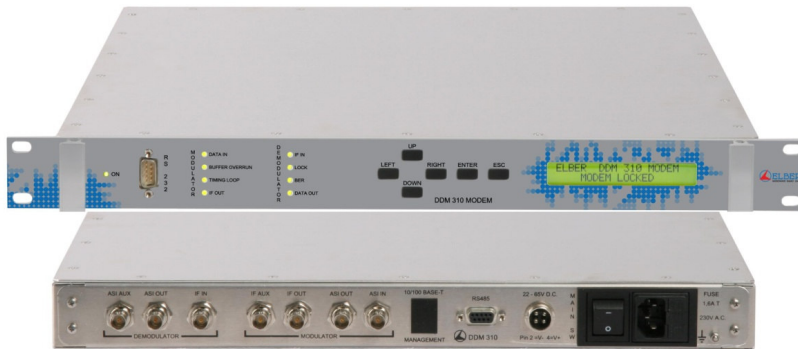




# DDM-310

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## User Manual

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## 1 Introduction.

The **DDM310** is a high speed, highly reconfigurable modem. Configuration regards the functionality (modulator only, demodulator only, modem), the data-interfaces installed (DVB-ASI and E1), the data rates (up to 310 Mbits/sec), the modulation schemes, FEC codes and spectrum filter shaping factors.

An advanced 24 taps adaptive equalizer is responsible for the **DDM310** robustness to dispersive multipath notch of up to 50dB.

DDM310 is the ideal equipment to be coupled with digital radio for digital communications in difficult situations.

## 2 Technical Specification.

### 2.1 Modulator.

Table 1

<b>Data Interface</b>	DVB-ASI TS Opt. STM-1, STS-1, DS3, E3
<b>Auxiliary data channel</b>	E1 2.048 Mbit/s (only in DVB-ASI version of DDM310)
<b>Data rate *</b>	Up to 160 Mbit/s
<b>Modulation Schemes*</b>	QPSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM
<b>FEC Coding*</b>	Inner: Convolutional, PTCM Code rate $\frac{1}{2} \div 13/14$ . Outer: Reed-Solomon (M,N) M < 256, N<17
<b>IF Frequency</b>	70 MHz
<b>IF Level</b>	Adjustable: -22 dBm $\div$ 1 dBm Default : -5dBm
<b>IF Impedance</b>	75 Ohm
<b>Bandwidth *</b>	3 $\div$ 28 MHz
<b>Shaping filter roll-off *</b>	0.15 $\div$ 0.30

\* depending on configurarion

## 2.2 Demodulator.

Table 2

<b>Data Interface</b>	DVB-ASI TS Opt. STM-1, STS-1, DS3, E3
<b>Auxiliary data channel</b>	E1 2.048 Mbit/s (only in DVB-ASI version of DDM310)
<b>Data rate *</b>	Up to 160 Mbit/s
<b>Modulation Schemes*</b>	QPSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM
<b>FEC Coding*</b>	Inner: Convolutional, PTCM Code rate $\frac{1}{2} \div 13/14$ . Outer: Reed-Solomon (M,N) $M < 256, N < 17$
<b>Equalizer</b>	24 tap adaptive equalizer, T/2 spaced. T = Symbol rate
<b>IF Frequency</b>	70 MHz
<b>IF Level</b>	-10 ÷ +5 dBm
<b>IF Impedance</b>	75 Ohm
<b>Bandwidth *</b>	3 ÷ 28 MHz
<b>Shaping filter roll-off *</b>	0.15 ÷ 0.30

\* depending on configurarion

## 2.3 General Specifications.

**Table 3**

<b>Remote control</b>	RS-485  SNMP (optional)
<b>Firmware upgrade</b>	RS-232
<b>Supply</b>	Automatic Switch between:  1. AC 230V $\pm 10\%$ or 115V $\pm 10\%$ (specified at order placement)  2. DC 22 to 65 V, galvanically isolated
<b>Power consumption</b>	30 W

## 2.4 Mechanical Specifications.

**Table 4**

<b>Rack</b>	Standard 19" 1U
<b>Width</b>	482 mm
<b>Height</b>	44 mm
<b>Depth</b>	480 mm

### 3 Installation.

- Open the package box. Using a cutting tool be careful not to damage the content of the package content.
  
- Check the package content. The package should contain:
  - The DDM-310 modem
  - One AC power cord
  - One DC power cord with connector at one end
  - The User Manual
  
- Install the DDM 310 in a cabinet rack. The space required is 1 rack unit. Verify that:
  - There is sufficient clearance on both sides of the equipment in order not to restrict air flow.
  - The air flowing through the apparatus must be dry and dust free.
  - No heat sources should be placed too close to the equipment: the proper functioning is warranted for ambient temperature between -5°C to +60°C.
  
- Install the power cord and connect to the primary power source.
  
- Make the ground connection to the screw located on the rear of the apparatus, to meet the EMC directives.
  
- Switch on the power switch located on the rear of the apparatus. Last configuration setup will be recalled and loaded. The proceeding of such operation will be indicated by the display.

- At the end of the operation a general check will be made. In absence of input signal, or in presence of a wrong input signal, or in any case of an alarm conditions, the corresponding leds will be lit and the message "ALARMS: PLEASE CHECK" will appear on the LCD display.

## 4 Theory of Operations.

### 4.1 Block Diagram.

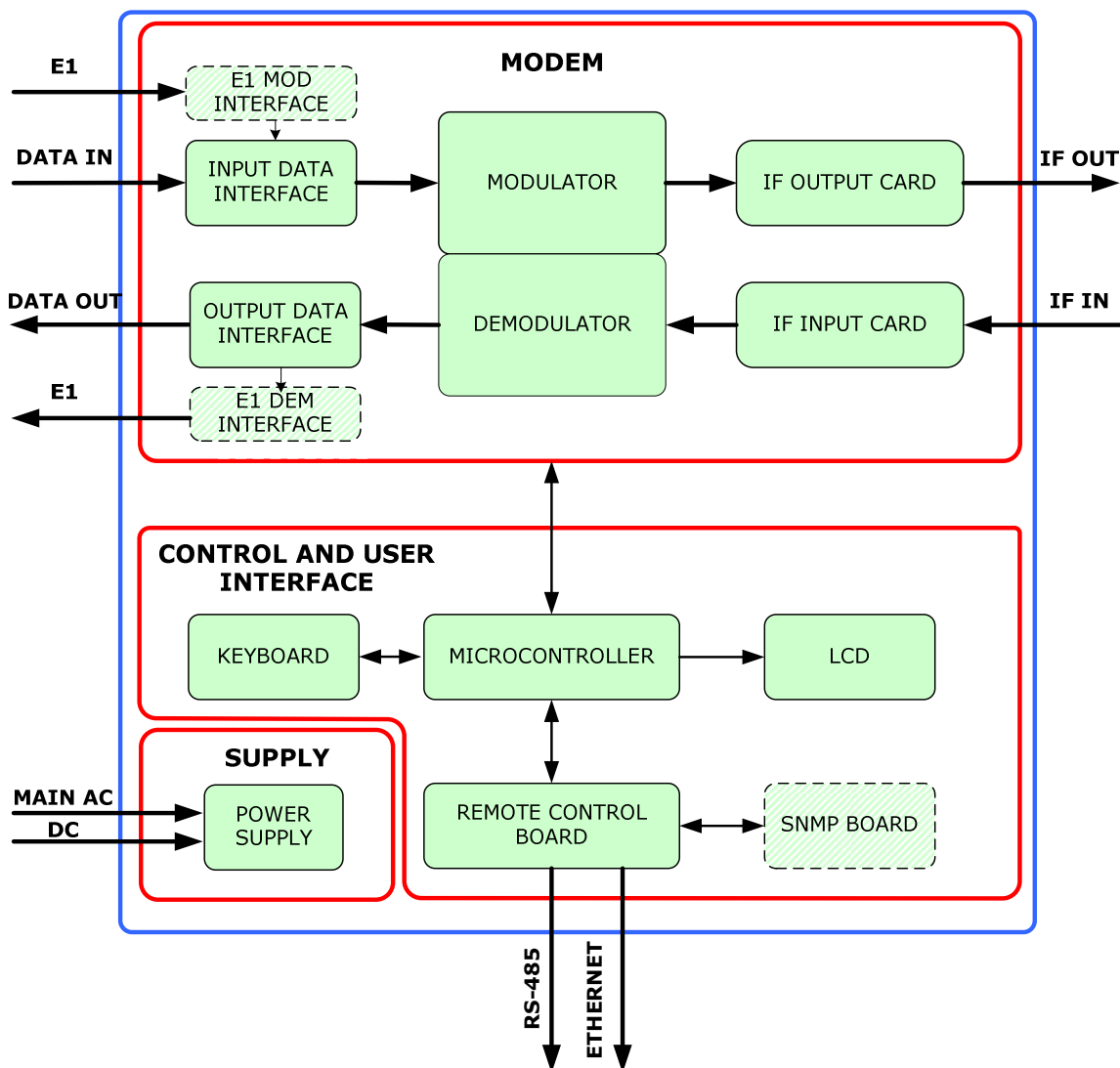


Figure 1 – DDM310 block diagram

As results from Figure 1, the DDM310 consists of 11 different functional blocks:

- IF Output Card
- IF Input Card
- Modulator
- Demodulator
- Input Data Interface
- Output Data Interface
- E1 Mod Interface
- E1 Dem Interface
- Power Supply
- Microcontroller
- Remote Control Board
- SNMP Board
- User Interface (LCD + Keypad)

Some of these blocks are implemented on a specific board. Different boards can be installed to make the modem comply with different standards or requirements. Some boards could also be absent: in effect the equipment can be configured as modulator only or demodulator only.

In the first case the IF Input Card, the Output Data Interface and the E1 Dem Interface will not be installed, the led alarms related to the demodulator section will remain switched off and the menu sections regarding the programming and monitoring of the demodulator will not be accessible.

Similarly in the second case the IF Output Card, the Input Data Interface and the E1 Mod Interface will not be installed, the led alarms related to the modulator section will remain switched off and the menu sections regarding the programming and monitoring of the modulator will not be accessible.

The controller, the remote control board, the supply and manual user interface will be in any case present.



## 4.2 Modulator.

### 4.2.1 Input Data Interface.

The Input Data Interface board accepts an external DVB-ASI signal and an internal E1 signal from the E1 Mod Interface.

The streams are processed by the module: They are converted to a synchronous data stream having the correct format to be presented and handled by the modulator block.

The processing is made by a single board. Different boards can be installed depending on the input data line electrical and coding standard. All the boards are mechanically compatible, in order to allow, if needed, to change the type of input data to the modulator simply by replacing that board.

### 4.2.2 E1 Mod Interface.

The input E1 stream is processed by the module E1 Mod Interface: the input data stream is deserialized and sent to the Input Data Interface where it will be multiplexed to the DVB-ASI data input stream.

### 4.2.3 Modulator.

The digital data coming from the Input Data Interface are scrambled, encoded, mapped and filtered according to the configuration parameters sent by the controller. Moreover a set of control signals are exchanged with the Input Data Interface and the IF Input Card and the controller. Finally the bit stream to be sent to the IF Input Card is generated.

### 4.2.4 IF Output Card.

The main purpose of this interface is to convert the bit stream given by the modulator section to the analogue IF signal.

This processing is made on a single board. The maximum IF bandwidth and correspondingly the maximum baud rate that can be accepted is approximately 28 MHz and 23 Mbaud for the 70 MHz IF.

## 4.3 Demodulator.

### 4.3.1 IF Input Card.

The IF Output Card accepts as input the IF signal to be demodulated and adds to it, under the control of the demodulator block, the right gain to be presented with the correct level at the input of the ADC. This latter digitizes the analogue IF signal and generates the digital parallel data stream to be sent to demodulator block.

The maximum IF bandwidth and correspondingly the maximum baud rate that can be accepted matches that of the corresponding IF Input Cards, i.e. is approximately 28 MHz and 23 Mbaud for the 70 MHz IF.

### 4.3.2 Demodulator.

The bit stream coming from the IF Output Card is filtered, demodulated, decoded, descrambled, remapped and error corrected according to the configuration parameters sent by the controller. Moreover a set of control signals are exchanged between the Output Data Interface and the IF Output Card and the controller. The output synchronous bit stream can then be sent to the Output Data Interface.

### 4.3.3 Output Data Interface.

The output data stream is generated by the module Output Data Interface: the synchronous data stream coming from the demodulator is converted to the output data stream having the correct format.

The processing is made on a single board. Different boards can be installed depending on the output data line electrical and coding standard. All the boards are mechanically compatible, in order to allow, if needed, to change the type of output data interface simply by replacing that board.

The Output Data Interface board gives externally the original DVB-ASI signal and internally (to the E1 Dem Interface board) the E1 rough data.

### 4.3.4 E1 Dem Interface.

The supply to the E1 DEM Interface is passed from the Data Out Interface on connector J20. The E1 clock and E1 data and the other control signals are passed on connectors J4 and J19.

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The E1 Dem Interface processes these data to generate the original G.703 E1 stream.

#### 4.4 Controller.

The controller is responsible for several tasks. A brief description of these tasks follows:

- Handshaking the manual user interface. That is decoding and executing the commands given by the keypad and presentation on the display.
- Storing and recalling the configuration files in its e2prom memory. The controller receives through the serial port the configuration binary file and stores it in one of the 12 available memory positions (6 for modulator and 6 for demodulator). The operational configuration is then recalled, the working set up parameters are extracted and sent to the modulator/demodulator section. This recall process will be performed any time the equipment is turned on or when the operational configuration is changed. The controller allows the scroll of the configurations present in memory, displaying the values of the most relevant parameters, that is: Modulation scheme, bandwidth, baud rate, maximum bit rate, FEC, filters roll off...
- Supervise the working conditions of the apparatus. This requires:
  - the acquisition and presentation of the alarm conditions on the modulator, demodulator and data interfaces;
  - the acquisition and the presentation on the display of the equipment working parameters (MSE, BER, data rates);
  - Handshaking the RS485 communication with the SNMP\_BRD to update the database for remote control. The relative protocol will be handed to customer on request. Via RS485 or Ethernet (SNMP) it is possible to read remotely the DDM310 status, that is:
    - The modulator alarm conditions (loss of ASI input, input buffer overrun, modulator unlocked, no IF out);
    - the demodulator alarm conditions (low/high IF input, demodulator unlocked, BER, no ASI data at output );

- The configuration actually running on modulator/demodulator;
- Demodulator MSE, BER, and DVB-ASI bit-rate;
- Modulator DVB-ASI bit-rate.

#### 4.5 User Interface.

The setup, control, and monitoring of the **DDM310** is provided through the navigation in the embedded software menu presented on a 24x2 alphanumeric display and operated by a six way keypad.

The six way keypad enables navigation through the various menus of the embedded system. The function of the keypad depends on the menu position. A short description follows:

Table 5

Keypad	Configuration Menu		Status Menus
	<i>Position 1</i>	<i>Other Position</i>	
<b>UP</b>	Previous Menu		Previous Menu
<b>DOWN</b>	Next Menu		Next Menu
<b>RIGHT</b>	Cursor scrolls one position to the right	Cursor scrolls one position to the right	No use
<b>LEFT</b>	No use	Cursor scrolls one position to the left	No use
<b>ENTER</b>	Next Menu	Saves and applies changes	Next Menu
<b>ESC</b>	Displays Main Menu	Discard any changes	Displays Main Menu

Figure 2 shows the menu tree structure, while Table 6 gives a brief description on each option

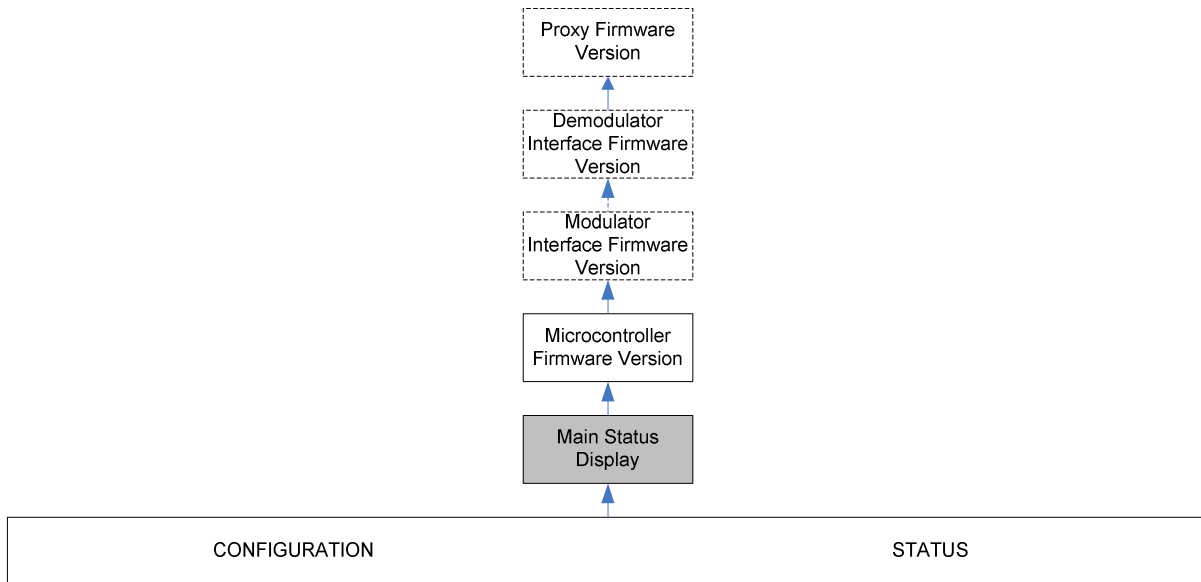


Figure 2 Menu Tree Structure

*(Dotted menu indicates that such menu is only available for specific configurations)*

Table 6 Menu Options Description

<b>Main Status Display</b>	The Main Status Display presents the type of equipment (Modulator/Demodulator/Modem) on the first line while on the second "ALARM: PLEASE CHECK" if there are any alarms else "LOCKED".
<b>Microcontroller Firmware Version</b>	Provides the embedded system's version number. This menu is displayed for 3 seconds.
<b>Modulator Interface Firmware Version</b>	This menu is displayed if equipment is configured either as Modulator or Modem. The firmware version number for the modulator's interface is presented.
<b>Demodulator Interface Firmware</b>	This menu is displayed if equipment is configured either as Demodulator or

<b>Version</b>	Modem. The firmware version number for the demodulator's interface is presented
<b>Configuration</b>	The Configuration Menu option permits access to the System, Modulator, and Demodulator configuration parameters.  <i>Refer to Paragraph 4.5.1 for a detailed description of the DDM310 Configuration Menu.</i>
<b>Status</b>	The Configuration Menu option permits access to the System, Modulator, and Demodulator status parameters.  <i>Refer to Paragraph 4.5.2 for a detailed description of the DDM310 Status Menu.</i>

#### 4.5.1 Configuration Menu.

The Configuration Menu let the user to modify the parameters of the modulator/demodulator/modem. Figure 3 shows the Configuration Menu tree with available options while Table 7, Table 8, Table 9 gives a brief description of Configuration/System; Configuration/Modulator; Configuration/Demodulator options respectively.

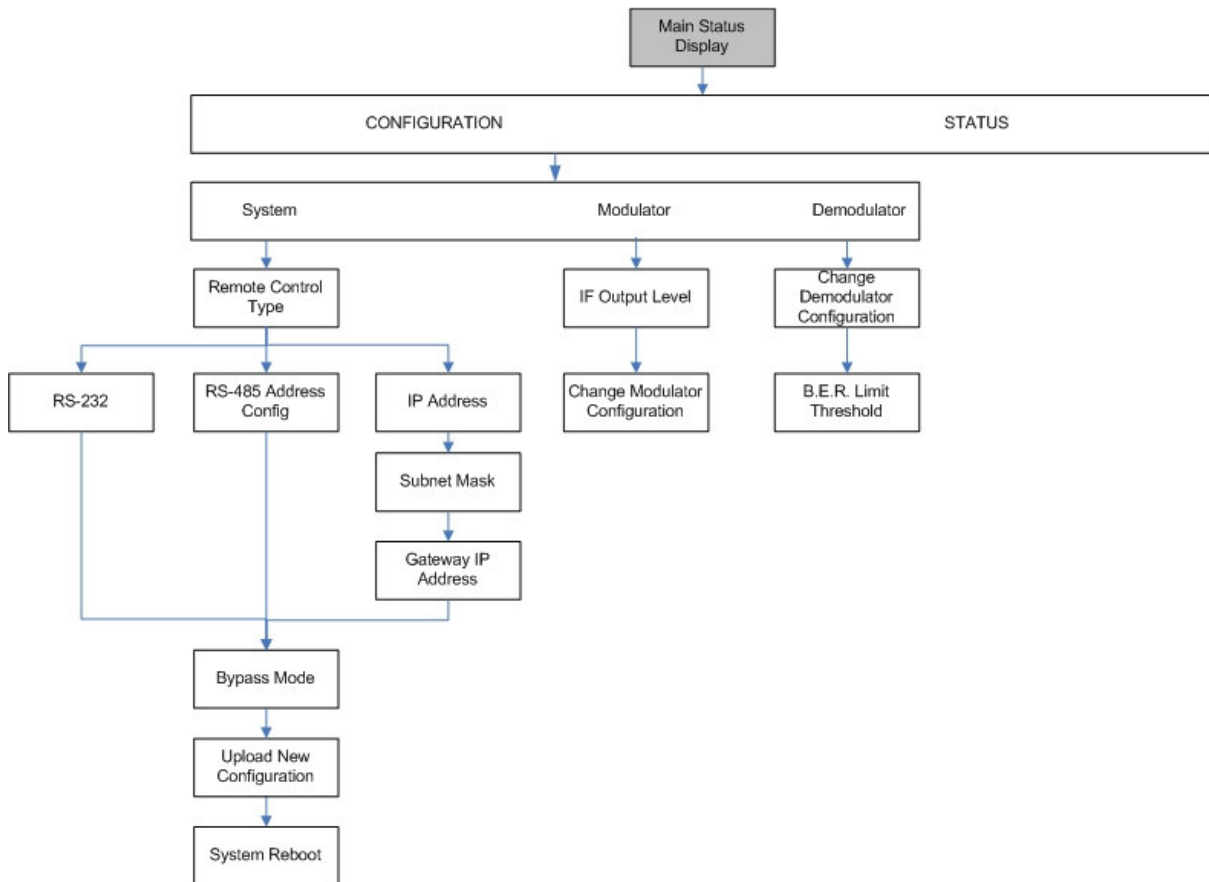


Figure 3 - Configuration Menu Tree

*(Note that Modulator options are only available if system is Modulator and/or Modem; while Demodulator options are only available if system is Demodulator and/or Modem)*

Table 7 – System Configuration Menu Options

Option	Description
<b>Remote Control Type</b>	Selection of the remote control type enabled (RS-485 or Ethernet SNMP).
<b>RS-485 Address Config</b>	Setting of RS-485 Address (0-31)
<b>IP Address</b>	Setting of IP Address for remote control via SNMP of the equipment.
<b>Gateway IP Address</b>	Setting of IP Address for Gateway IP for the network.
<b>Subnet Mask</b>	Setting of Subnet Mask for the right identification of the equipment on the network.
<b>Bypass Mode</b>	For testing use.
<b>Upload New Configuration</b>	<p>YES/NO Choose YES to upload a new configuration in internal EEPROM. Depending on the configuration, the user should select between modulator and demodulator. Then the memory location on which the configuration will be saved is to be chosen. A message will confirm the correct operation.</p> <p><i>See par.6.1 for setting of RS-232 port.</i></p>
<b>System Reboot</b>	YES/NO Reboot of the system.

**Table 8 – Modulator Configuration Menu Options**

<b>Option</b>	<b>Description</b>
<b>IF Output Level</b>	IF output level can be varied between -22dBm and 1dBm
<b>Change Modulator Configuration</b>	Through this option the user can change the configuration utilized by the modulator. The user chooses one of the available configurations in memory. If the user confirms the operation, a reboot of the system is performed and the new configuration is loaded.

**Table 9 – Demodulator Configuration Menu Options**

<b>Option</b>	<b>Description</b>
<b>Change Demodulator Configuration</b>	Through this option the user can change the configuration utilized by the demodulator. The user chooses one of the available configurations in memory. If the user confirms the operation, a reboot of the system is performed and the new configuration is loaded.
<b>B.E.R. Limit Threshold</b>	This parameter let change the B.E.R. threshold before the Reed-Solomon Decoder above which the led and the relay will change state.

### 4.5.2 Status Menu.

Status Menu let the user monitor the main parameters of the system, of the modulator and of the demodulator. Status menu tree is shown in Figure 1Figure 4 and Table 10 gives a brief description of every available option for the system, the modulator and the demodulator.

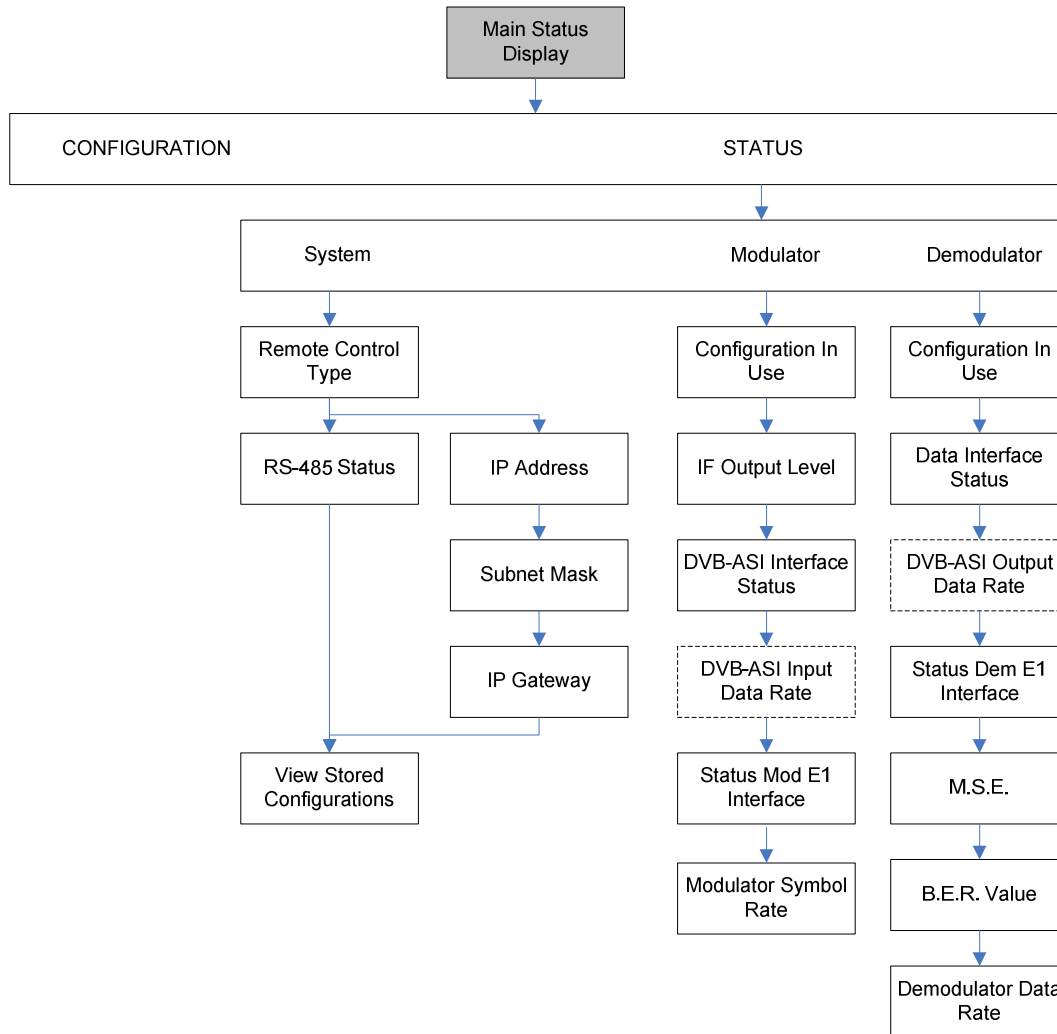


Figure 4 - Status menu tree

*(Note that Modulator options are only available if system is Modulator and/or Modem; while Demodulator options are only available if system is Demodulator and/or Modem)*

Table 10 – System Status Menu Options

Option	Description
<b>Remote Control Type</b>	Shows the remote control interface selected in the configuration menu.
<b>RS-485 Status</b>	Shows the RS-485 address.
<b>IP Address</b>	Shows the IP address of the equipment.
<b>Subnet Mask</b>	Shows the subnet mask selected in the configuration menu.
<b>Default Gateway</b>	Shows the IP address of the Gateway.
<b>View Stored Configurations</b>	The user can see the main parameters of the configurations stored in the on-board EEPROM. The choice is between Modulator/Demodulator if the equipment is a modem and the position of the configuration to be checked (1 to 6).The parameters are shown in three subsequent slide. Parameters shown are: modulation scheme; bandwidth; net payload; FEC coding utilized; Symbol-rate; shaping filter roll-off factor; file code and version.

Table 11 - Modulator Status Menu Options

Option	Description
<b>Configuration In Use</b>	If the user select <i>YES</i> , main parameters of the configuration used are shown.
<b>IF Output Level</b>	IF output level is shown
<b>Data Interface Status</b>	<p>Depending on data interface installed, following messages are shown.</p> <p><i>DVB-ASI Interface:</i></p> <p><b>No Signal Present:</b> No signal at the input.</p> <p><b>Unknown Format:</b> A DVB-ASI stream is present at the input but its format is wrong</p> <p><b>Locked at 188-byte:</b> The DVB-ASI signal has a 188 byte format</p> <p><b>Locked at 204-byte</b> The DVB-ASI signal has a 204 byte format</p>
<b>DVB-ASI Input Data Rate</b>	<p>This menu is available if the data interface is a DVB_ASI.</p> <p>Total bit-rate (null-packets included) is shown</p>
<b>Status Mod E1 Interface</b>	<p><b>No Signal Present:</b> Either a LOS of signal alarm is received from the E1 Mod Inteface or a Code Violation is encountered.</p> <p><b>Locked:</b> E1 signal is locked.</p>
<b>Modulator Symbol Rate</b>	Modulator Symbol Rate is shown.

Table 12 Demodulator Status Menu Options

Option	Description
<b>Configuration In Use</b>	If the user chooses YES, the main parameters of the configuration used are shown. They show: modulation scheme; bandwidth; net payload; FEC coding used; Symbol-rate; shaping filter roll-off factor; file code and version number.
<b>Data Interface Status</b>	Depending on data interface installed, following messages are shown.  <i>DVB-ASI Interface:</i>  <b>No Signal Present:</b> No signal at the input.  <b>Unknown Format:</b> A DVB-ASI stream is present at the input but its format is wrong  <b>Locked at 188-byte:</b> The DVB-ASI signal has a 188 byte format  <b>Locked at 204-byte</b> The DVB-ASI signal has a 204 byte format
<b>DVB-ASI Output Data Rate</b>	This menu is available if the data interface is a DVB_ASI.  Total bit-rate (null-packets included) is shown
<b>Status Dem E1 Interface</b>	<b>No Signal Present:</b> No E1 signal is present in the received DVB-ASI signal.  <b>Locked:</b> E1 signal is locked.
<b>M.S.E.</b>	Mean Square Error (M.S.E.); it shows the quality of the received signal.
<b>B.E.R.</b>	B.E.R. at Reed-Solomon decoder input.
<b>Demodulator Data Rate</b>	This menu shows the data rate of the link.

## 4.6 Supply.

Primary supply for **DDM310** can be:

Table 13

<b>AC</b>	230 V $\pm 20\%$ 50/60Hz or 115 V $\pm 10\%$ 50/60Hz
<b>DC</b>	22 to 65 V
<b>Power consumption</b>	30 W

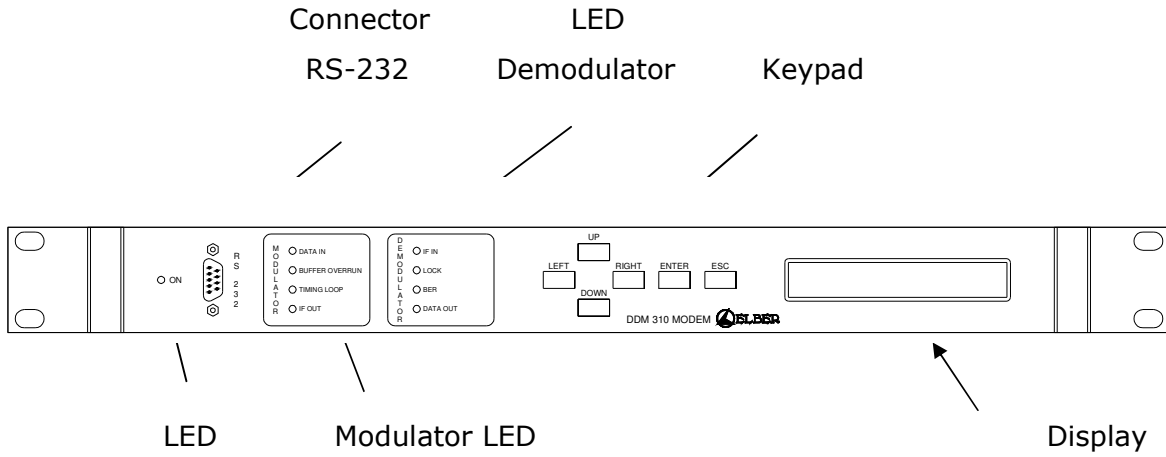
Fuse installed on the input AC is a 1.6A fuse.

An automatic switch between the two sources is present: in case of AC supply decreasing below threshold, the input is switched to the DC input. The switch between the two sources is instantaneous.

DC input connector is a 4 pin; supply cable should be connected to pin 2 and 4. DC input is galvanically isolated from the equipment ground earth.

## 5 Panels.

### 5.1 Front Panel.



### 5.1.1 Controls and monitoring.

Table 14

Item	Description		
<b>LED</b>	Green: Equipment on Off: Equipment off		
<b>Leds Modulator</b>	<b>LED</b>	<b>GREEN</b>	<b>RED</b>
	<b>DATA IN</b>	Data present and locked	Data not present or not correct
	<b>BUFFER OVERRUN</b>	Data Rate acceptable	Data Rate too high
	<b>TIMING LOOP</b>	Symbol Rate Locked	Symbol Rate Unlocked
	<b>IF OUT</b>	IF Output OK	No IF Output
<b>Leds Demodulator</b>	<b>LED</b>	<b>GREEN</b>	<b>RED</b>
	<b>IF IN</b>	Input IF in correct range	IF signal Low/High
	<b>Lock</b>	Demodulator Locked	Demodulator Unlocked
	<b>B.E.R.</b>	B.E.R. before Reed-Solomon decoder below threshold	B.E.R. before Reed-Solomon decoder above threshold
	<b>DATA OUT</b>	Output data correct	No data at the output
<b>Keypad</b>	Keypad used to browse the menu of control software		
<b>LCD</b>	Display alphanumeric 24x2		

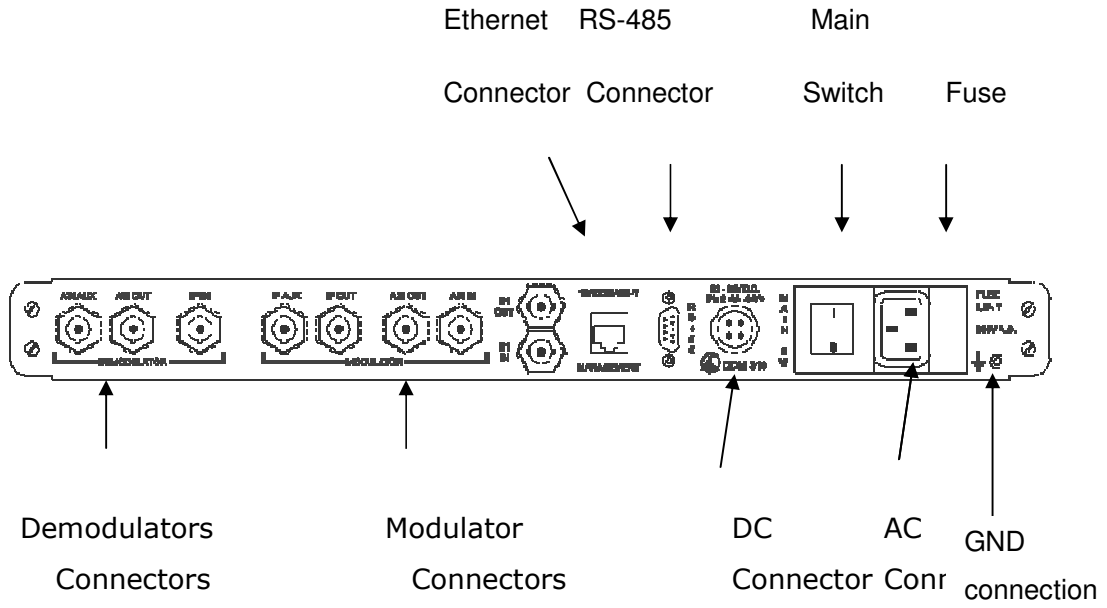
### 5.1.2 Connectors.

Serial communication is performed by the RS-232 connector on the front panel.

The connector is a DB9 standard with following pinout:

- Pin 2: Rx
- Pin 3: TX
- Pin 5: GND
- Other pins unused

### 5.2 Back Panel (DVB-ASI Version).



## 5.2.1 Connectors.

Table 15

Connectors	Description	
<b>Demodulators connectors</b>	<b>Connector</b>	<b>Description</b>
	<b>IF IN</b>	IF Input Signal
	<b>ASI OUT</b>	DVB-ASI Main Output
	<b>ASI AUX</b>	DVB-ASI Auxiliary Output
	<b>E1 OUT</b>	G.703 E1 Output
<b>Modulators Connectors</b>	<b>Connector</b>	<b>Description</b>
	<b>ASI IN</b>	DVB-ASI Input
	<b>ASI OUT</b>	Active Loop of DVB-ASI signal
	<b>E1 IN</b>	G.703 E1 Input
	<b>IF OUT</b>	IF Main Output
	<b>IF AUX</b>	IF Auxiliary Output
<b>RS-485</b>	DB9 connector for remote control and monitoring: Pin 1: A 485 Pin 2: B 485 Pin 3: +5V Pin 4: Not connected Pin 5: RESET Pin 6: ALARM NORM OPEN Pin 7: ALARM NORM CLOSED Pin 8: ALARM COM Pin 9: Massa	
<b>10/100 Base-T</b>	Utilized per Remote Control and monitoring via Ethernet, using SNMPv2 protocol.	
<b>DC Connector</b>	DC Input 22-65V	

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<b>Main Switch</b>	Switch on/off the equipment
<b>Fuse</b>	220V 1.6 A
<b>AC Connector</b>	220V 50/60Hz or 115V 50/60Hz
<b>Ground Earth Connector</b>	Connect equipment to ground earth

## 6 Programming.

### 6.1 Configuration.

In order to configure the **DDM310** both the modulator and demodulator section are to be programmed.

To configure each section is needed to recall one of the six configurations stored on the on board memory.

This operation can be performed manually by user interface (keypad + LCD) as described in par. 4.5. Through the menu can be viewed the main parameters of the configurations saved in memory.

Configurations stored in memory can be changed sending the file of the new configuration through the RS-232 connection managed by user interface. A configuration file is a binary file prepared and checked off-line by Elber's technical department. Communication parameters are:

- Baud                    9600
- Bits                    8
- Parity                    None
- Stop bits                1
- Flux control            None

The state of the following parameters can be changed in every moment through user interface:

- Modulator Output Level (from -22 dBm to 1 dBm in 1 dB step; default = -5 dBm),
- BER alarm threshold (from 1e-2 to 1e-9; default = 1e-3)

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- RS-485 address (from 0 to 31)
- IP Address, Subnet Mask and Gateway IP Address.

## 6.2 Configuration files generation.

The preparation of configuration files is performed by Elber and it involves some step.

Capacity of the link, channel spacing, modulation scheme, internal and external FEC coding, shaping filters roll-off factors are used as data input.

The other parameters (such as loop time constants) are calculated and optimized considering the modulator output spectrum, the robustness to fading, to distortions and so on.

Finally the testing of the configuration is performed.

Configurations to be installed on the modem memory are to be decided before the delivery of the equipment.

Elber can also supply customized configurations in a second time.