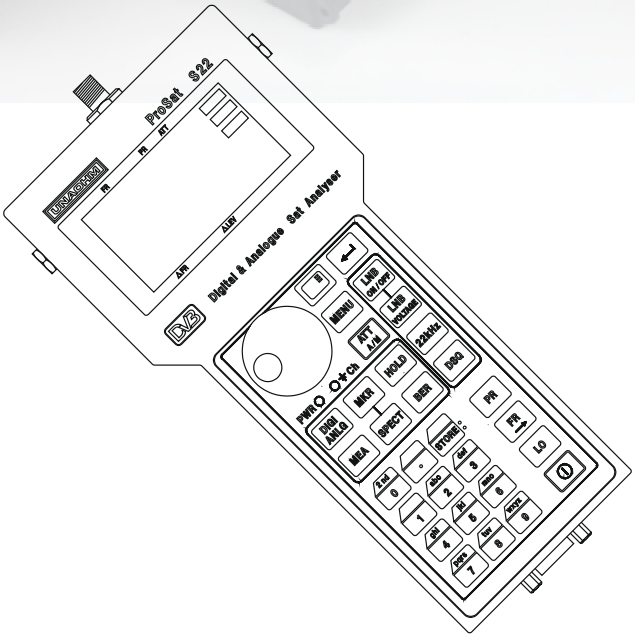
UNAOHM®

UNAOHM START S.r.l.

Satellite Digital & Analogue Meter

S 22 / S 22Plus



DVB Digital Video Broadcasting

Trade Mark of the DVB Digital Video Broadcasting Project (1863)

UNAOHM

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Unaohm Start S.r.l. reserve the right to change product specifications at any moment and without notice, regardless of whether the change is of technical or commercial nature or being implemented to comply with legal requirements of specific countries.

Data in this manual, therefore, may not be up-to-date.

CE MARK

This instrument is in conformity with the following standards and documents:

EMC : EN55011, EN61000-3-2, EN61000-3-3, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-8, EN61000-4-11, ENV50204.
Safety Regulations: EN 61010-1

1. SAFETY PRECAUTIONS AND GENERAL WARNING

The below-indicated safety precautions and general warnings must be carefully observed during all phases of use, maintenance and servicing of the instrument to avoid the possibility of injury to persons or animals, and damage to property.
UNAOHM START S.r.l. assumes no responsibility for incorrect use of the instrument or if the guidelines specified are not followed.

1.1. SAFETY PRECAUTIONS

- Supply the instrument with a voltage within the limits indicated in the specifications.
- This instrument has been designed for use in covered environments. Do not expose it to rain.
- Do not use the instrument in potentially explosive environments due to the presence of gas or inflammable fumes or dust.
- Do not turn the instrument on immediately after transferring it from a very cold place to a hot one to avoid condensation.
- Do not obstruct the instrument's cooling plate or place it near strong sources of heat.
- For prolonged use in the lab or in fixed places, the instrument should be removed from the carrying case to allow for improved heat dissipation.
- Do not apply DC or RF voltages to the input connectors that are higher than those indicated.
- We recommend periodic inspection of the carrying strap, the relative fasteners, and the clips as they could be damaged with use. Replace items as soon as a sign of wear is noticed.
- When the instrument is equipped with a battery, we recommend:
  1) Do not short-circuit the battery since it may explode.
  2) Do not immerse the battery in water or place it in a flame.
  3) Do not perforate or try to open the battery.
  4) When substituting the battery, use a similar type and dispose of the old one in a special ecological container.
  5) Do not reverse the battery connections.

⚠ **This symbol will appear when it is necessary for the user to consult the instruction manual for additional information and in order to protect the instrument from damage.**

1.2. GENERAL WARNING

- Do not expose the LCD to direct sunlight or to intense ultraviolet rays for a long time as they may cause its deterioration.
- The instrument must be kept in a place where the temperature is higher than the minimum storage temperature otherwise damage to the LCD may occur. It is also important not to exceed the maximum storage temperature, otherwise damage will occur to the LCD.
- Internal short-circuits caused by foreign objects is one of the most frequent needs for repair, in spite of all the precautions taken to prevent this possibility. We therefore highly recommend not to cut coaxial cables near the instrument since even very small pieces of wire from the shielding braid could fall into the instrument and cause short-circuits which may be difficult for service and repair technicians to locate.
- While the instrument is operating do not place it on thermal insulating material like cloth.

1.3. MAINTENANCE

The only maintenance permitted is: the connection or substitution of the battery and/or fuses and the insertion of internal accessories as specified in the manual.
The opening of the instrument and any further servicing must be carried out exclusively by qualified personnel or, in any case, operator's who have basic electronic technical knowledge.

- Before servicing disconnect the power supply cable.
- For instruments equipped with a battery please refer again to note 1.1.
- When substituting fuses maintain the same value and type.
- Take appropriate measures against the accumulation of electrostatic charges. Do not touch internal circuits unless wearing the special antistatic strap.
- To clean the exterior surfaces:
  1) Disconnect the power supply cable.
  2) Use soft cloth. Use non-abrasive liquid detergents avoiding hydrocarbon based products.
  3) Make sure liquids or other substances do not penetrate into the instrument.

1.4. NOTES

- The accuracy quoted refers to the temperature of the instrument reached approximately 10÷15 minutes after turn on.
- Be careful not to drop or subject the instrument to strong shocks.
- Before using the instrument we recommend carefully reading the instructions in this manual.
- Perform an operating check of the instrument regularly, at least once a year. We recommend to send it in for service if miscalibrated. As a good preventive measure for safety, replace worn out bags and straps by all means, to avoid accident. See also paragraph 1.1.

2. INTRODUCTION

The S22 is a hand held field strength meter for satellite signals, both digital and analogue.
Its sturdy case is further protected against falls and blows by the rubber holster.
The keyboard and the RF input connector have been designed for the typical construction site environment, where hostile elements like humidity and dust may be present.
The measurements performed: level, digital channel power (DCP), QPSK BER and QPSK MER, are shown on a wide graphic LCD, 128 x 64 pixels.
Several menus guide the user in the selection of the various options, such as the possibility of supplying the LNB and/or an external amplifier, the setting of the QPSK reception parameters, and that of the Data Logger.
100 program memories are available to store 100 possible instrument settings.
The internal Ni-MH battery ensures a long continuous operating run in the field.
The instrument recharges the internal battery while simultaneously being used via its external power supply.
The frequency range covers from 920 to 2150 MHz. Many routine measurements normally performed on SAT installations are carried out by the instrument in a totally automatic mode, others are considerably simplified.
Other important characteristics are:

- Spectrum analysis with a frequency range span from 10 MHz to full band.
- Two markers. Each one may be set for measurements on analogue or digital signals.
- Frequency or program tuning.
- Three Hold functions are available -MAX, MIN and FREEZE- for specific analyses on spurious signals .
- Analysis of up to 42 programs.
- Tilt function to determine maximum and minimum value among programs, up to 42.
- Data Logger. Each acquisition is carried out on a variable number of programs, from 1 to 42. For digital signals it is also possible to log the CH BER, pV BER and MER. A real time logging of what it is being measured is also possible.
- NIT module (standard equipment for S22 PLUS only). During antenna peaking, this function makes it possible to identify the satellites even if they are close to one another, while during signal distribution it provides transponder identification desired even after frequency conversions.
- Possibility of connecting to a PC or external serial printer via RS232.
- Automatic Satellite Locator (ASL, for S22 PLUS only). This function allows to automatically locate the satellite that is being peaked.

The standard accessories include the power supply/battery charger unit and the rubber holster.
The operational run of the instrument may conveniently be extended by means of one or more external auxiliary waistband-held battery packs -optional extra- to make for extra working hours in the field.

3. SPECIFICATIONS

Input	
Level	From 40 to 120 dBμV (-20.. 60 dBmV, -69..11 dBm)[1] in the band 920÷2150 MHz.
Measurement unit	dBμV, dBmV, dBm for absolute measurements, dB for relative measurements.
Attenuator	From 0 to 50 dB in 10 dB steps, autoranging or manual.
Attenuator accuracy	Within ± 2 dB.
Frequency response	Within ± 2 dB.
Indication	1. Numerical for Level with 4 digits and 0.1 dB resolution. 2. Numerical for Digital Channel Power with 4 digits and 0.1 dB resolution. 3. Analogue through a bar. 4. Analogue through a histogram.
Measurement bandwidth at 3dB	5 MHz.
Input impedance	75 Ω unbalanced (1).
Input connector	Female "F" type with protective external adapter.
Max. voltage applicable	100 Vdc and 5 Vac.
Frequency	
Frequency range	From 920 to 2150 MHz.
Tuning technique	1. By PLL frequency synthesis with 125 kHz steps. 2. By program.
Tuning indication	The frequency indicated is rounded off to the nearest 100 kHz in the 1st IF tuning mode and to the nearest MHz in LO mode.
Program Storage	100 programs.
Spectrum analyzer	
Frequency range	From 920 to 2150 MHz.
Functions	1. 42 user-defined programs in histogram mode. 2. Tilt function (up to 42 programs per group). 3. Hold Max, Hold Min, Freeze function.
Span	±10, ±20, ±50, ±100, ±200 MHz and Full Span.
Marker	2, independent markers.
Data Logger	
Storage capacity	Approximately 1500 acquisitions each consisting of a single program.

[1] The measurable dynamic range for level depends on the type of modulation and channel bandwidth which are set by means of the MAIN MENU (see Chap. 8.1.9). The one indicated (from 40 to 100 dBμV) is valid for analogue satellite signals or for 1 MHz digital channels. As a guideline, the measurable level dynamic range becomes from 44 to 104 dBμV for typical digital satellite transponders featuring a 30MHz bandwidth.

QPSK digital signal analysis	
Programmable parameters	1. Symbol Rate from 1.45 to 36 MS/s. 1 to 42 typical. 2. Code Rate automatic (1/2, 2/3, 3/4, 5/6, 7/8). 3. Spectrum Polarity automatic (Direct, Inverted).
Frequency range	950 to 2150 MHz.
DCP sensitivity	CH BER 1 x 10^{4} @ 27500 Ms/s, 3/4, INV: 950 to 2130 MHz: less than or equal to 40 dBµV.
Lock indication	"L"ocked, "U"nlocked on the display.
Channel BER measurement	From 0 to 1. Resolution $2*10^{-7}$.
post Viterbi BER measurement	0 to 5 $*10^{-2}$. Resolution 2 $*10^{-8}$, digital reading on the display.
MER	Digital, 5 to 20 dB.
Reed-Solomon error counting (RU)	Cumulative count of uncorrected errors. Maximum count 65535.
Time indication	Timer count in "hh, mm, ss" format of card locking time (24 hrs max.).
PWR index	Low (LOW), correct (OK) and high (HIGH) indication.
CFO	The offset in respect of the nominal frequency in MHz is indicated.
Auxiliary inputs and outputs	
LNB power supply	(On input connector output): 0 – 13 – 18 V ± 0.5V selectable, with maximum 350 mA current. Indications of overload and ohmic continuity of the external circuit.
Tone	(On input connector output): 22 kHz ± 1 kHz, 0.6 Vpp on a 15 Ω load, rectangular waveform.
DiSEqC[2]	Conforms to DiSEqC 1.1 and 1.2 protocol.
RS232 serial port	(By means of a 9 pole female "D" connector) for external data exchange (PC – printers).
LCD Readout	
Type	Graphic dot matrix LCD, 128x64 pixels,71x39mm.
Backlighting	LED; on/off.
Power supply	
Autopower off	Timer from 0 to 15 minutes, switchable.
Vdc, internal	By means of internal rechargeable 6V/3.8Ah Ni-MH battery. Approx. 1h 30' run (with 100 mA LNB absorption).
Battery charger	By means of an external power supply unit/adapter/charger (standard accessory). Approx. 8 h recharge time.
Vdc, external	From 7.5 to 8V/3A max for operation and battery recharge; from 5.5 to 8V/3A max for operation only.
Vac	100 to 240 Vac by means of an external power supply unit/adapter/charger (standard accessory).
Connector	∅ external 5.5 mm, positive internal pole ∅ 2.1 mm.

[2] DiSEqC is a EUTELSAT registered trademark.

Mechanical	
Dimensions	200x105x45 mm.
Weight	0.9 kg with battery and holster.
Presentation	The instrument is supplied in a protective rubber holster.
Environmental	
Calibration temperature	The specified accuracy refers to an ambient temperature of 23 °C ± 5 °C.
Operating temperature	From 5 to 40 °C
Warehousing temperature	From –10 to +60 °C.
Max. relative humidity	80 % for temperatures up to 31 °C (with 50% linear reduction at 40 °C).
Maximum altitude	2000 m.
Special features	
(1) input impedance 50 Ω.	

4. ACCESSORIES

4.1. LIST OF STANDARD ACCESSORIES

- N° 1 L-shaped F Adapter[3].
- N° 1 protective rubber holster.
- N° 1 shoulder strap.
- N° 1 Operator's manual.
- N° 1 Power supply unit BCH 7.5/3.3 or equivalent.
- N° 1 6V/3.8Ah. Ni-MH Battery Pack.
- N° 1 NIT Module on S22 PLUS only.

4.2. LIST OF OPTIONAL ACCESSORIES AND CARDS

- NIT module.
- Software Upgrade Kit (to upgrade instrument software).
- S22PLUS Kit (includes ASL function – see paragraph 8.2.3 and NIT module for non-equipped instruments. This Kit can only be factory-installed).
- BP6 Auxiliary waistband-held battery pack.
- STP165 external printer.
- C20 Soft nylon bag for transport.

[3] The L-shaped input adapter prevents rain water from reaching the instrument by making it flow down the downlead cable when the input is turned downwards. Furthermore, it protects the F connector of the instrument from wear without notably degrading the measurement.

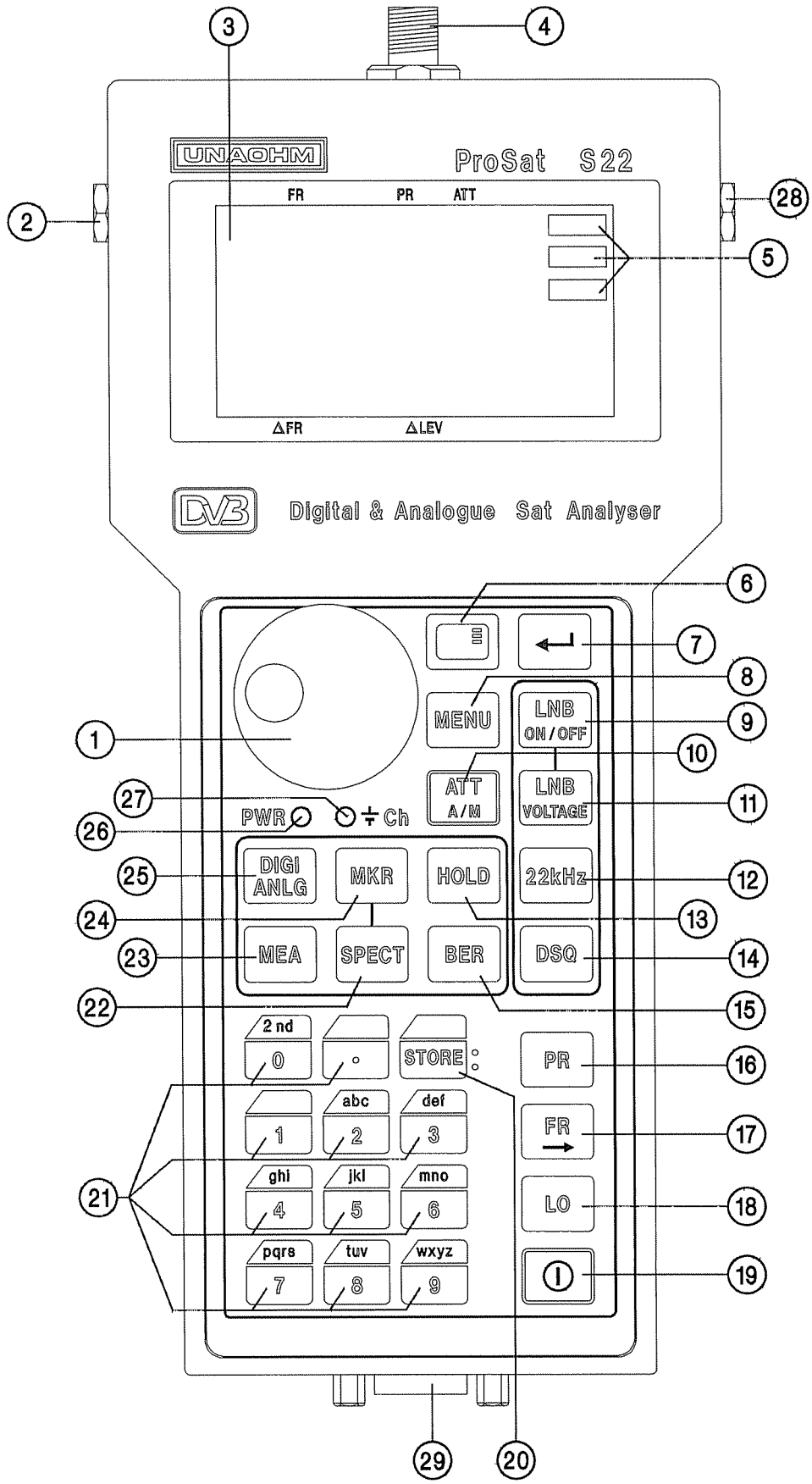

Figure 1 Front Panel

The Softkey functions are shown inside a small box, e.g. Back.

5. DESCRIPTION OF CONTROLS AND CONNECTIONS

Refer to Figure 1 on previous page for the numerical reference we recall on the following list:

5.1. FRONT PANEL

1. Shaft Encoder. To set parameters such as attenuation and frequency or to select options from the menus.
2. External power supply input socket (left side from the front panel). It is used for both operating the instrument and recharging the internal battery.
3. Graphic LCD readout, 128x64 point matrix.
4. RF signal input connector (at the top).
5. Softkey function windows. The indications vary according to functioning status of the instrument.
6. **SOFT KEY**. Recalls the soft key menus.
7. ↵ **(ENTER)**. Enters (or confirms) the selections carried out by soft key 6, shaft encoder (1) and numerical keypad (21).
8. **MENU**. Recalls the setting and the configuration menu (see section 8.1.9). In MENU mode some of the general operations to set the instrument are carried out.
9. **LNB ON/OFF.** Engages/disengages power to the LNB.
10. **ATT A/M**. Attenuator key. It enables the shaft encoder to engage attenuation from 0 to 30 dB in 10 dB steps. Pressing this key each time in MEAsurement function alternates between autoranging and manual mode.
11. **LNB VOLTAGE.** Selects the LNB voltage between 13 and 18 V (the actual power is available to the LNB when **LNB ON/OFF (9)** key is set to on).
12. **22 kHz.** Engages/disengages the 22 kHz tone.
13. **HOLD**. In the spectrum function, it alternately engages/disengages the HOLD mode. The operating mode (Normal, Max Hold, Min Hold and Freeze) is set via MAIN MENU (see 8.1.9 for details).
14. **DSQ**. Pressed once it alternately transmits two DiSEqC commands according to 1.1 protocol. When kept pressed it allows selection between 1.1 and 1.2. For further information on the use of the DiSEqC see chap. 8.1.11.
15. **BER**. Prompts the QPSK BER display to appear on the readout for CH BER, pV BER and MER measurements.
16. **PR**. Selects the program tuning function.
17. **FR→**. Selects the frequency tuning function. Pressing FR key again in frequency tuning function, shifts the cursor over the frequency digits for fine or gross tuning via shaft encoder (1).
18. **LO**. Alternately shows the down-converted frequency (First IF) or the actual frequency of the transponder giving the option of storing up to four LNB local oscillators (LO). For further information see chap. 8.1.9.
19. ⏻ **(ON/OFF)**. Turns the instrument on/off when kept pressed for a few seconds.
20. **STORE**. Pressing this key twice rapidly stores the current instrument setting into the selected program.
21. Alphanumerical keypad.
22. **SPECT**. Sets the instrument to spectrum function.

23. **MEA**. Pressed once, it sets the instrument to MEAsurement function. When kept pressed it does a real time acquisition.
24. **MKR**. Makes the desired marker , 1 or 2, available for operation.
25. **DIGI ANLG**. Allows the active marker to qualify the level reading, "**D**" for digital and **"A"** for analogue, according to whether the signal being measured is digital or analogue. Whenever the marker is set to digital, the instrument accounts for the carrier or transponder bandwidth the meter was set to.
26. **PWR**. Confirms that the instrument is powered.
27. **Ch**. Indicates that the internal battery is being recharged and that an external power supply voltage is present on jack **(2)**.
28. Power supply jack for optional external battery pack BP6.
29. RS232 connector.

6. BATTERY CONDITIONING

CAUTION

For safety purposes the instruments leave our factory with the battery fully discharged. Since a flat battery could limit the voltage of the instrument thereby making it impossible to turn it on, we suggest you leave the instrument connected to the power supply but turned off; ten/twenty minutes should be sufficient to raise the voltage to an adequate level to turn on the instrument.
If the instrument does not turn on after having been connected to the power supply for thirty minutes, contact our service center.

To return the battery to its nominal capacity recharge it in two 8 hour cycles, discharging it again between the two cycles, leaving the instrument turned on until it turns off automatically; then recharge it for the third time for another 8 hours.

Recharge takes place powering the instrument via the standard accessory power unit, leaving the instrument turned off. The recharge is progressing when the pilot light **Ch (27)** is illuminated.

To turn the instrument on/off keep the key ⏻ **ON/OFF (19)** pressed for a few seconds.
The above description is not fixed; the periods of charge and recharge do not necessarily have to follow one another immediately. If charge and recharge are not fully reached, there are no severe repercussions on the battery; it will just take longer for the instrument to reach maximum performance.
If necessary the instrument may also be used immediately, with a flat battery, if powered from the outside; the recharge however takes place only when the instrument has been turned off.

7. POWER SUPPLY

The instrument can be powered via an internal battery pack, an external PSU/charger provided, or via an external source of power between 7.5 and 8V @ 3A. Power input socket **(2)** is on the **left** side of the unit. Unit can operate with an external power from 5.5 to 7.5V but battery is not charged.

⚠ **WARNING!** Voltages higher than 8V may damage the instrument.

The protection against overloads is guaranteed by an automatic thermal fuse which does not require replacement.
The instruments automatically switches between the internal battery pack and the external power source connected to it.
Battery operating time is approximately 1 ½ hours continuously; this varies according to the facilities switched on. The bottom right corner of the readout features a battery icon which shows battery charge condition. Just before the battery drains, the icon starts blinking and an intermittent alarm sounds. Stop using the equipment as soon as you see the warning and recharge the battery. The instrument turns off by itself when the battery voltage goes below the threshold as otherwise damage to the instrument could result.

NOTE: when the instrument is not used for long periods of time we recommend recharging the battery at least once a month to avoid self discharge. Ni-MH batteries are not affected by capacitance memory effects so it is unnecessary to discharge them completely.

7.1. FITTING THE BATTERY

Instructions are given on Figure 2 below:

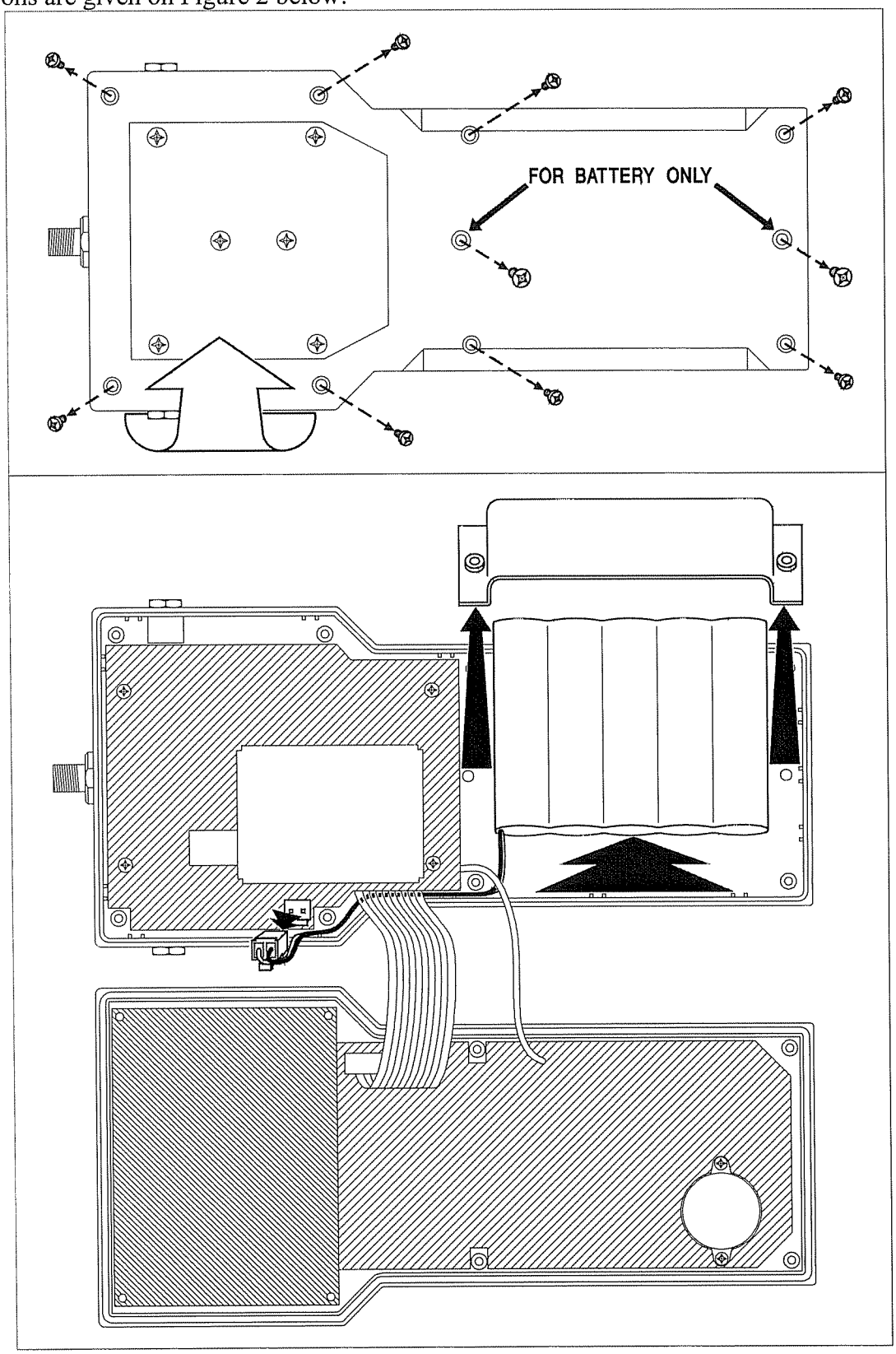

Figure 2 How to open the unit for battery replacement.

8. OPERATING INSTRUCTIONS

8.1. BASIC OPERATIONAL MODES AND KEYS

8.1.1. TURN ON/OFF

Keep the key ⏻ **ON/OFF (19)** pressed for a few seconds. By default, when turned on the instrument return to the same state it was when turned off.

If the instrument does not turn on, see the note under section 6, page 11.

8.1.2. TUNING

The instrument can be tuned in two different ways: by frequency and by program.
To tune by frequency press **FR→ (17)**, then enter the value by means of the numerical keypad **(21)** or by spinning Shaft Encoder **(1)**. The digit on which the Shaft Encoder operates can be changed pressing **FR→ (17)** to obtain fine or coarse tuning. Press ↵ **(ENTER) (7)** to confirm the chosen frequency without digitising the fractions of MHz.
To tune by program press **PR (16)**, then the number of the programs by means of the numerical keypad **(21)** or Shaft Encoder **(1)**. A lower-case "e" displayed near the program reading (see Figure 3) means the program has not been stored.

8.1.3. STORING

To store the status of the instrument in the program location shown on the upper line of the display, between the frequency and the attenuation readings (see Figure 3), press **STORE (20)** twice quickly. During storage the instrument will flash at you the type of tuning, either the 1st IF frequency reading or the LO reading, and the associated DiSEqC command (the last one transmitted).

8.1.4. ATTENUATION

The attenuation is meant to maintain the incoming signal level within the measuring range of the instrument. Manual or autoranging mode is alternately selected each time the **ATT A/M (10)** key is pressed.

- The autoranging mode is shown on the display with an "A" near the attenuation reading (see Figure 3).
- Manual mode is set via Shaft Encoder **(1)**.
- In spectrum function the attenuation is only manual.

Spinning Shaft Encoder **(1)** below 0 attenuation position, an "S" will appear. This operating position engages the maximum sensitivity of the instrument for dish peaking purposes. The "S" position is uncalibrated, therefore, level is not available. Very low signals, however, can be viewed in spectrum mode or through the bargraph dynamic response.

8.1.5. MARKER SELECTION

The instrument is equipped with two markers. The markers are alternately selected pressing **MKR (24)**. The markers gives the following operational options:

⇒ Either marker can be set as analogue or digital by pressing **DIGI ANLG (25)**.

⇒ Marker 2 can be tuned freely; however, if marker 1 is selected again, Marker 2 takes on the same frequency: in fact Marker 2 is only a reference index for the measurement of frequency deviations or changes.

8.1.6. POWER TO THE LNB

Power to the LNB is engaged/disengaged pressing **LNB ON/OFF (9)**. The voltage actually applied is alternated between 13 and 18V pressing key **LNB VOLTAGE (11)**.

8.1.7. 22kHz

The 22kHz tone is alternately engaged/disengaged pressing key **22kHz (12)**.

8.1.8. SOFT KEY

Key ▭ **SOFT KEY (6)** recalls on the LCD readout a specific list of options or commands related to the current function the instrument is in. For example, pressing **SOFT KEY (6)** while in spectrum function allows the selection among full or partial (spectrum) and 7-program sweep. The selection is carried out spinning shaft encoder **(1)** to move the cursor down the desired line, then pressing key ↵ **(ENTER) (7)**.

⇒ If a solid arrow tip (▶) follows the soft key item the selection is immediately effective. For example, in full (spectrum) function (see section 8.2.2), selecting soft key Spn ▶, makes the instrument takes on to partial spectrum expansion function.

⇒ If an open arrow tip **(>)** follows the soft key item a submenu is recalled.

8.1.9. MAIN MENU

Pressing **MENU (8)** recalls the main menu which is meant to set and configure the instrument. A cursor is available to scroll through the different setting and configuration items the main menu consists of. The cursor is moved down those items spinning the shaft encoder **(1)**, and then an item selected pressing key ↵ **(ENTER) (7)**.

The setting and configuration items of the main menu are as follows:

- DATA > Gives access to the Data Logger described in section 8.3.
- HOLD MOD: MAX (MIN, FREEZE). Allows shaft encoder to select one of the three hold modes (see 8.1.10), which are activated by **HOLD (13)**. Confirm the selection by pressing ↵ **ENTER**.
- PRINT: CURRENT (or TEXT, HISTOGRAM, TEXT+HIST). Allows Shaft Encoder to select one of the four printing modes. In CURRENT mode, frequency and level which are currently being used are printed; in TEXT mode frequency and level which are in the range displayed on the LCD readout are printed; in HISTOGRAM mode the spectrum or the histogram displayed on the LCD readout is printed; TEXT+HIST mode is a printing mode combination of the previous two. Confirm the selection by pressing ↵ **ENTER**.

- CONFIG > Allows access to the following configuration submenues:
  - CHBW: xx (xx between 01 and 50). Allows Shaft Encoder to set the channel bandwidth to use for DCP measurement. Confirm the selection by pressing ↵ **ENTER**.
  - LEV UNIT : dBμV (o dBm o dBmV). Allows Shaft Encoder to select one of the three units of measure available for level. Confirm selection by pressing ↵ **ENTER**.
  - LOC OSC : Gives access to the configuration submenu for the frequency setting of available four local oscillators. To set each oscillator move the cursor on to the oscillator to change by means of the shaft encoder, press ↵ **ENTER (7)**, key in the frequency via the numerical key **(21)**. To exit press EXIT then press ↵ **ENTER**.
  - EXIT : Pressing ↵ **ENTER** lets you exit this submenu.
- SYSTEM > Allows access to the following system setting submenu.
  - BUZZER : ON (OFF). Allows the Shaft Encoder to set buzzer ON/OFF status. Confirm the selection by pressing ↵ **ENTER**. The buzzer is an aural confirmation that a key has been pressed.
  - LCD > Gives access to the following LCD readout setting submenu:
    - CONTRAST : 150. Allows the Shaft Encoder to set readout sharpness between 10 and 250. The desired sharpness is set through the Shaft Encoder, while pressing ↵ **ENTER** confirms the setting.
    - BACKLIGHT : ON (or OFF). Allows the Shaft Encoder to set the readout retroillumination status. Confirm the setting by pressing ↵ **ENTER**.
    - PWRLIGHT : OFF. Allows the readout retroillumination to be put out after the instrument has been idle for some time. The retroillumination power off time is set by pressing ↵ **ENTER**, selecting the time to set (in seconds) via Shaft Encoder, then confirming the setting by pressing ↵ **ENTER**.
    - EXIT : Pressing ↵ **ENTER** allows one to exit this submenu.
  - RS232 > Gives access to RS232 parameter setting (see section 9.2).
  - LOGO : Gives access to the installer's logo setting. The installer's logo is printed along with data through an external printer (optional extra) connected to the RS232 port. (see section 9.3).
  - DiSEqC > Gives access to DiSEqC 1.1 command setting. See section 8.1.11 for more details.
  - PWROFF: OFF. Allows the instrument to switch itself off once it has been idle for some time. Press ↵ **ENTER**, select the desired time (in minutes) via Shaft Encoder, then confirm the selection by pressing ↵ **ENTER**.
  - EXIT: Pressing ↵ **ENTER** allows you to exit this submenu.
- EXIT: Pressing ↵ **ENTER** allows you to exit the main menu.

8.1.10. HOLD MODE SETTING

The HOLD mode can be engaged in both measurement and spectrum functions. It offers three different operating modes:

- MAX : the instrument continues to measure, but only the highest value is shown.
- MIN : the instrument continues to measure, but only the lowest value is shown.
- FREEZE : the instrument freezes the measurement at the moment this mode is engaged.

How to select the HOLD mode is described under 8.1.9. The key **HOLD (13)** alternately engages/disengages the mode. *Hmax, Hmin or Hfrz* appears on the bottom line of the display to indicate HOLD MAX, HOLD MIN or FREEZE modes respectively.

8.1.11. DiSEqC

The instrument handles DiSEqC commands to 1.1 and 1.2 protocols.

8.1.11.1. DiSEqC 1.1

To enter the DiSEqC 1.1 display press **MENU (8)**, select "SYSTEM>" and "DiSEqC>".
The first two items of the display, DSQ1 and DSQ2, shows the two commands which alternately are transmitted when key **DSQ (14)** is pressed slightly. To switch between DSQ1 and DSQ2 commands spin Shaft Encoder, then press ↵ **ENTER** to confirm.
The next four items, USR 1,2,3,4, allow four user-defined commands to be set. Each command must consists of an odd number of bytes, up to a maximum of 10, and they can be keyed in via the numerical keypad. Press ↵ **ENTER** to insert less than 10 characters. To exit the DiSEqC mode select EXIT through the Shaft Encoder, then press ↵ **ENTER**.

An alternative way to transmit DiSEqC 1.1 commands is as follows:

- Keeping key **DSQ (14)** pressed lets "1.1►" and "1.2►" notations appear on the right side of the display.
- Select "1.1►" and confirm your selection pressing ↵ **ENTER**.
- Select the first or the second command to transmit pressing key 0 or 1. Alternatively, the desired command can be selected by marking it via the Shaft encoder (the full designation of the command to transmit will appear), pressing ▭ **SOFT KEY (6)**,and confirming the selection by pressing ↵ **ENTER**.

8.1.11.2. DiSEqC table of commands in 1.1 protocol

COMMAND NAME	DESCRIPTION	Index	Composition (Hex)
Tone burst	Tone burst	00	--
Data burst	Data burst	01	--
Power ON	Power ON	02	E0 00 03 *
Reset	Reset	03	E0 00 00 *
Standby	Standby	04	E0 00 02 *
Write N0-10	SW1 OFF, l LO	05	E0 10 38 10 *
Write N0-01	SW1 ON, h LO	06	E0 10 38 01 *
Write N0-02	SW2 OFF, H	07	E0 10 38 02 *
Write N0-20	SW2 ON, V	08	E0 10 38 20 *
Write N0-40	SW3 OFF, LNB 1	09	E0 10 38 40 *
Write N0-04	SW3 ON, LNB 2	10	E0 10 38 04 *
Write N0-08	SW4 OFF, LNB 3 (Opt off)	11	E0 10 38 08 *
Write N0-80	SW4 ON, LNB 4 (Opt on)	12	E0 10 38 80 *
Write N0-10	SW5 OFF	13	E0 10 39 10 *
Write N0-01	SW5 ON	14	E0 10 39 01 *
Write N0-20	SW6 OFF	15	E0 10 39 20 *
Write N0-02	SW6 ON	16	E0 10 39 02 *
Write N0-40	SW7 OFF	17	E0 10 39 40 *
Write N0-04	SW7 ON	18	E0 10 39 04 *
Write N0-80	SW8 OFF	19	E0 10 39 80 *
Write N0-08	SW8 ON	20	E0 10 39 08 *
Set Lo	l LO	24	E0 10 20 *

UNAOHM

COMMAND NAME	DESCRIPTION	Index	Composition (Hex)
Set VR	V Pol	25	E0 10 21 *
Set Pos A	Sat Po A	26	E0 10 22 *
Set S0A	SW Opt A	27	E0 10 23 *
Set Hi	h LO	28	E0 10 24 *
Set HL	H Pol	29	E0 10 25 *
Set Pos B	Sat Po B	30	E0 10 26 *
Set S0B	SW Opt B	31	E0 10 27 *
Set S1A	Sel SW1 in A	32	E0 10 28 *
Set S2A	Sel SW2 in A	33	E0 10 29 *
Set S3A	Sel SW3 in A	34	E0 10 2A *
Set S4A	Sel SW4 in A	35	E0 10 2B *
Set S1B	Sel SW1 in B	36	E0 10 2C *
Set S2B	Sel SW2 in B	37	E0 10 2D *
Set S3B	Sel SW3 in B	38	E0 10 2E *
Set S4B	Sel SW4 in B	39	E0 10 2F *
Write N0-F0	Po 1 - V - l LO	40	E0 10 38 F0 *
Write N0-F1	Po 1 - V - h LO	41	E0 10 38 F1 *
Write N0-F2	Po 1 - H - l LO	42	E0 10 38 F2 *
Write N0-F3	Po 1 - H - h LO	42	E0 10 38 F3 *
Write N0-F4	Po 2 - V - l LO	44	E0 10 38 F4 *
Write N0-F5	Po 2 - V - h LO	45	E0 10 38 F5 *
Write N0-F6	Po 2 - H - l LO	46	E0 10 38 F6 *
Write N0-F7	Po 2 - H - h LO	47	E0 10 38 F7 *
Write N0-F8	Po 3 - V - l LO	48	E0 10 38 F8 *
Write N0-F9	Po 3 - V - h LO	49	E0 10 38 F9 *
Write N0-FA	Po 3 - H - l LO	50	E0 10 38 FA *
Write N0-FB	Po 3 - H - h LO	51	E0 10 38 FB *
Write N0-FC	Po 4 - V - l LO	52	E0 10 38 FC *
Write N0-FD	Po 4 - V - h LO	53	E0 10 38 FD *
Write N0-FE	Po 4 - H - l LO	54	E0 10 38 FE *
Write N1-FF	Po 4 - H - h LO	55	E0 10 38 FF *
Write N1-F0	Po 1 - V - l LO	56	E0 10 39 F0 *
Write N1-F1	Po 1 - V - h LO	57	E0 10 39 F1 *
Write N1-F2	Po 1 - H - l LO	58	E0 10 39 F2 *
Write N1-F3	Po 1 - H - h LO	59	E0 10 39 F3 *
Write N1-F4	Po 2 - V - l LO	60	E0 10 39 F4 *
Write N1-F5	Po 2 - V - h LO	61	E0 10 39 F5 *
Write N1-F6	Po 2 - H - l LO	62	E0 10 39 F6 *
Write N1-F7	Po 2 - H - h LO	63	E0 10 39 F7 *
Write N1-F8	Po 3 - V - l LO	64	E0 10 39 F8 *
Write N1-F9	Po 3 - V - h LO	65	E0 10 39 F9 *
Write N1-FA	Po 3 - H - l LO	66	E0 10 39 FA *
Write N1-FB	Po 3 - H - h LO	67	E0 10 39 FB *
Write N1-FC	Po 4 - V - l LO	68	E0 10 39 FC *
Write N1-FD	Po 4 - V - h LO	69	E0 10 39 FD *
Write N1-FE	Po 4 - H - l LO	70	E0 10 39 FE *
Write N1 FF	Po 4 - H - h LO	71	E0 10 39 FF *
USER1		72	XXXXXXXX
USER2		73	XXXXXXXX
USER3		73	XXXXXXXX
USER4		74	XXXXXXXX

Legenda:

COMMAND NAME	Name assigned to the command by the DiSEqC protocol.
Index	Progressive number associated to the command.
Composition (Hex)	Hexadecimal value of the bytes the transmitted message consists of.
SW	Switch.
Po	Position.
h LO	High Local Oscillator frequency.
l LO	Low Local Oscillator frequency.
Pol	Polarization.
H	Horizontal polarization
V	Vertical polarization.
Opt	Option.
Sel	Select.

8.1.11.3. DiSEqC 1.2

It is possible to send commands to steer a dish via a motor attached to it. Proceed as follows:

- Keeping key **DSQ (14)** pressed lets "1.1▸" and "1.2▸" notations appear on the right side of the display.
- Select "1.2▸" and confirm your selection pressing ↵ **ENTER**.

Pressing ▭ **SOFT KEY (6)** and spinning the Shaft encoder lets appear the full designation of each command to transmit, which can be sent selection by pressing ↵ **ENTER**.
The available operating commands are as follows:

- STOP MOTOR. Stops the motor and, therefore, the dish steering. Press 0 on the alphanumeric keypad.
- START MOTOR EAST. Starts dish steering towards east. Press 1 on the alphanumeric keypad.
- START MOTOR WEST. Starts dish steering towards west. Press 2 on the alphanumeric keypad.
- DISABLE LIMITS. Disengages the set steering limits towards both EAST and WEST. Press 3 on the alphanumeric keypad.
- SET EAST LIMIT. Allows a steering limit towards EAST to be set to the dish. Pressing key 1 steers the dish towards EAST, pressing 0 stops the dish at the desired limit, pressing 4 stores that limit.
- SET WEST LIMIT. Allows a steering limit towards WEST to be set to the dish. Pressing key 2 steers the dish towards WEST, pressing 0 stops the dish at the desired limit, pressing 5 stores that limit.
- STORE MTR SAT POS. Pressing key 6 allows the dish position to be stored inside the motor setting locations. Before pressing key 6, select the setting location of the motor where you wish to store the dish position, as follows:
  1. Mark STORE MTR SAT POS via the shaft encoder.
  2. Press ↵ **ENTER**.
  3. Mark the desired motor setting location via the shaft encoder.
  4. Press "6" to confirm.
- RECALL MTR SAT POS. Pressing key 7 allows any of the stored dish positions to be recalled. Before pressing key 7, select the motor setting location to recall the dish position from, as follows:
  1. Mark RECALL MTR SAT POS via the shaft encoder.
  2. Press ↵ **ENTER**.
  3. Mark the desired motor setting location via the shaft encoder.

4. Press "7" to confirm.

- START EAST TO. Pressing key 8 allows the dish to be steered towards EAST for a certain time or certain steps (regardless of the motor features).
  If TIME mode has been set, an arrow will be shown close to the letter T; likewise, the letter S will have an arrow shown close to it if STEP mode has been set. Before pressing key 8, set the seconds the dish should be steered for (TIME mode) or the number of steps to steer the dish for (STEP mode), as follows:
  1. Mark START EAST TO via the shaft encoder.
  2. Press ↵ **ENTER**. If the cursor is not on the desired line (TIME or STEP) press ↵ **ENTER** again.
  3. Spin the shaft encoder in order to set the desired TIME (from 1 to 99 seconds) or STEP (from step 1 to 99).
  4. Press "8" to confirm.
- START WEST TO. Pressing key 9 allows the dish to be steered towards WEST for a certain time or certain steps (regardless of the motor features).
  If TIME has been set, an arrow will be shown close to the letter T; likewise, the letter S will have an arrow shown close to it if STEP has been set. Before pressing key 9, set the seconds the dish should be steered for (TIME mode) or the number of steps to steer the dish for (STEP mode), as follows:
  1. Mark START WEST TO via the shaft encoder.
  2. Press ↵ **ENTER.** If the cursor is not on the desired line (TIME or STEP) press ↵ **ENTER** again.
  3. Spin the shaft encoder in order to set the desired TIME (from 1 to 99 seconds) or STEP (from step 1 to 99).
  4. Press "9" to confirm.
- RECALCULATE SAT POSITION. All sat positions stored inside any of the motor setting location can be recalculated simply by pressing the decimal point key.
- RESET. Pressing **RST** key the dish returns to 0° position.

8.2. FUNCTIONS

The unit offers three operating functions. Functions are selected by pressing the related yellow keys: **MEA**surement **(23)**, **SPECT**rum **(22)**, **BER** Bit Error Ratio **(15)**.

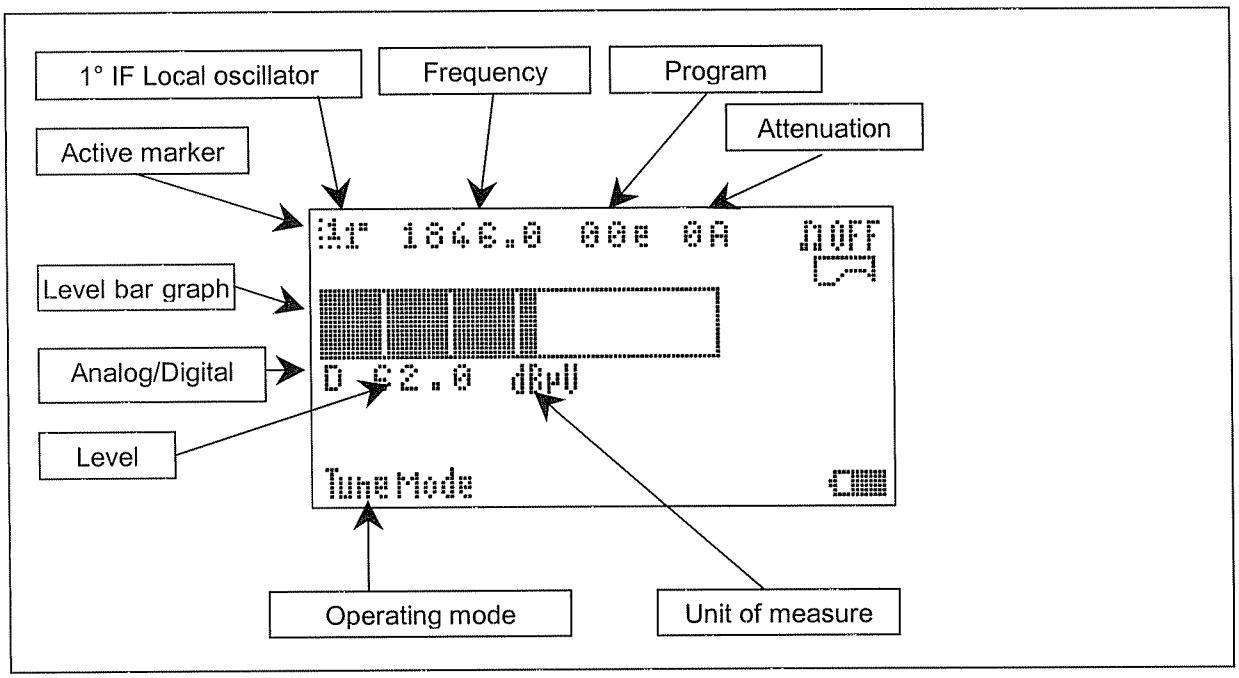

Figure 3 Typical MEAsurement display

8.2.1. MEASUREMENT (MEA)

This operating function measures either the signal level or the DCP (Digital Channel Power) of analogue carriers or digital transponders respectively. Figure 3 shows the typical readings found in the MEAsurement display. Measuring choices are as follows:

❒ *Level or power measurement.* Pressing key **DIGI ANLG (25)** sets the instrument for level or power measurement according to the signal being measured (digital or analogue).

⇒ **WARNING: while the level of typical analogue sat carriers (wide band FM modulated signals) are measured in analogue measurement setting (key 25 to ANLG), CW (unmodulated) signals can not be measured correctly.**

❒ *Aural tone.* Press **SOFT KEY (6)**, select OFF or ON via shaft encoder, then press ↵ **(ENTER) (7)** to alternately engage and disengage the tone. The tone, an aural duplication of signal strength -the higher the tone pitch the stronger the signal level-, can be used for dish steering without the need for the installer to being in visual reach of the display of the meter all the time.

❒ *Level or power printing via RS232.* Press **SOFT KEY (6)** select via shaft encoder, then press ↵ **(ENTER) (7)** to confirm.

8.2.2. SPECTRUM

Function Sweep Full (spectrum) offers a realistic pictorial representation of the full satellite spectrum (Sweep Full) or of a part of it (Sweep Span). Spectrum can be selected pressing **SPECT (22)**. DLPrg offers a histogram representation of a number of user-defined programs from the Softkey menu.

To select the desired function press **SOFT KEY (6),** mark the desired function through the Shaft Encoder and confirm the selection pressing ↵ **(ENTER) (7).**

SOFT KEY (6) allows you to select the spectrum function required (Full, Span or 7Prg) via shaft encoder. Press ↵ **(ENTER) (7).** to confirm your selection. The entire spectrum from 920 to 2150 MHz is displayed this way.

8.2.2.1.Sweep – Full

This functions allows the entire sat spectrum from 920 to 2150 MHz to be displayed.
Figure 4 shows the full spectrum function (920-2150 MHz) with two markers on. As shown, when markers are alternated via key **MKR (24)** the bottom line on the display reads the difference, both in MHz and dB, both in frequency and level or DCP, between two marked sat signals.
The other operations available with this function are:

- Analogue or digital setting. Make sure key **DIGI ANLG (25)** setting reflects the actual analogue or digital nature of the sat signals being marked.
- Sweep Span setting. Pressing **SOFT KEY (6)** and spinning the shaft encoder until the cursor hits the **Spn►**, on the right side of the display allows you to enter Sweep Span mode (see 8.2.2.2) mode for spectrum expansion analysis, which is started pressing key ↵ **(ENTER) (7).**

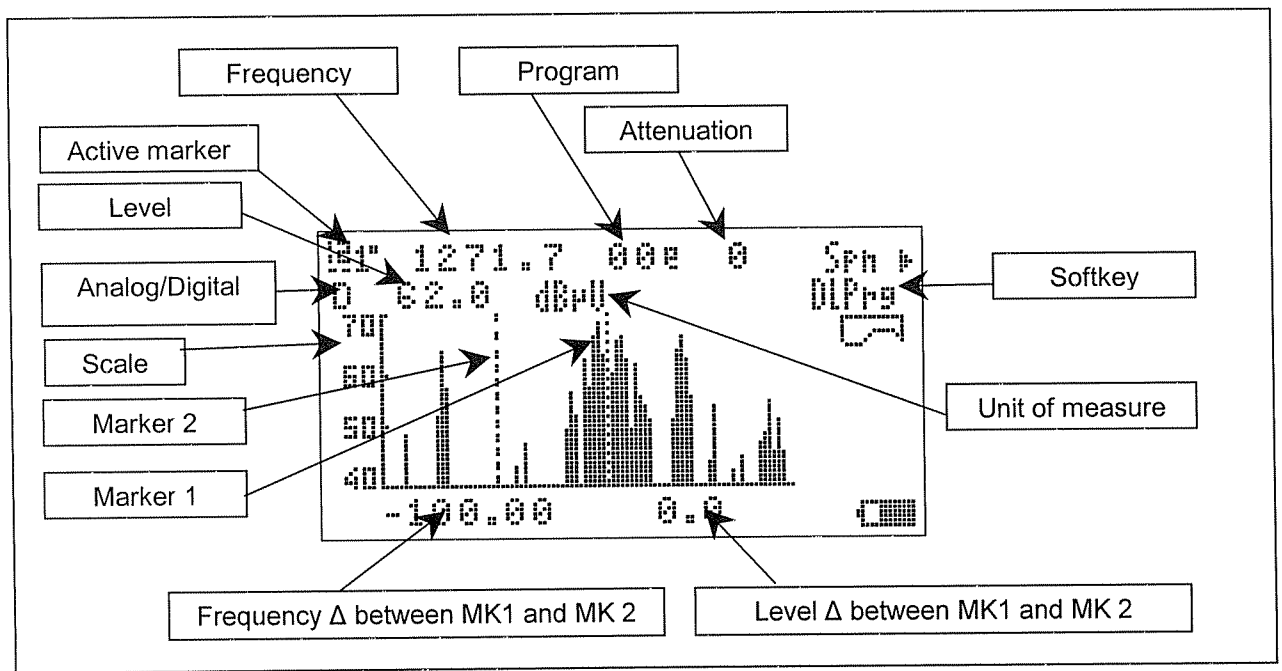

Figure 4 Typical Full Spectrum display (920-2150MHz) with two markers on at different frequencies

- DLPrg Engagement. Pressing **SOFT KEY (6)** and spinning the shaft encoder until the cursor hits the **DLPrg**, on the right side of the display allows you to enter the DLPrg (Data Logger Program) mode (see 8.2.2.3 for more details), which is started by pressing key ↵ **(ENTER) (7).**
- DCP or Level Printing via RS232. Pressing **SOFT KEY (6)** and spinning the shaft encoder until the cursor hits the icon on the right side of the display allows you to enter the printing mode through the RS232 port provided, which is started pressing key ↵ **(ENTER) (7).**

8.2.2.2.Sweep – Span

Zooming the desired area of the spectrum is made possible this way. As per Figure 4, when markers are alternated by means of the key **MKR (24)** the bottom line on the display will read the difference, both in MHz and dB, between the sat signals which the two markers refer to. The other operations available with this function are:

- ❒ Selection between analogue carriers and digital transponders through key **DIGI ANLG (25)**.
- ❒ Span (spectrum expansion) setting. Press **SOFT KEY (6)** to select **Spn►**, then key ↵ **(ENTER) (7)**, then select the desired amount of span via shaft encoder: the reading in MHz of the span thus set will appear on the bottom line of the display. The span can vary among 10, 20, 50, 100, 200 MHz.
- ❒ DLPrg Engagement. Pressing SOFT KEY (6) and spinning the shaft encoder until the cursor hits the **DLPgr**, on the right side of the display allows you to enter the DLPgr (Data Logger Program) mode (see 8.2.2.3 for more details), which is started by pressing key ↵ **(ENTER) (7)**.
- ❒ DCP or level printing by means of the RS232 socket. Pressing **SOFT KEY (6)** and spinning the shaft encoder until the cursor hits icon on the right side of the display allows you to enter the said printing mode, which is started by pressing key ↵ **(ENTER) (7)**.

8.2.2.3.Sweep – DLPrg

The representation format in Figure 5 is a histogram (where sat carriers or transponders are represented as upright bars of various lengths) of user-defined programs. When the DLPrg function is engaged from the full spectrum display (see section 8.2.2.1 for details on how to engage it), the LCD readout presents you first with a list of lines instead of the desired histogram. Each line is meant to be filled with a program frequency via shaft encoder before its histogram can be displayed.

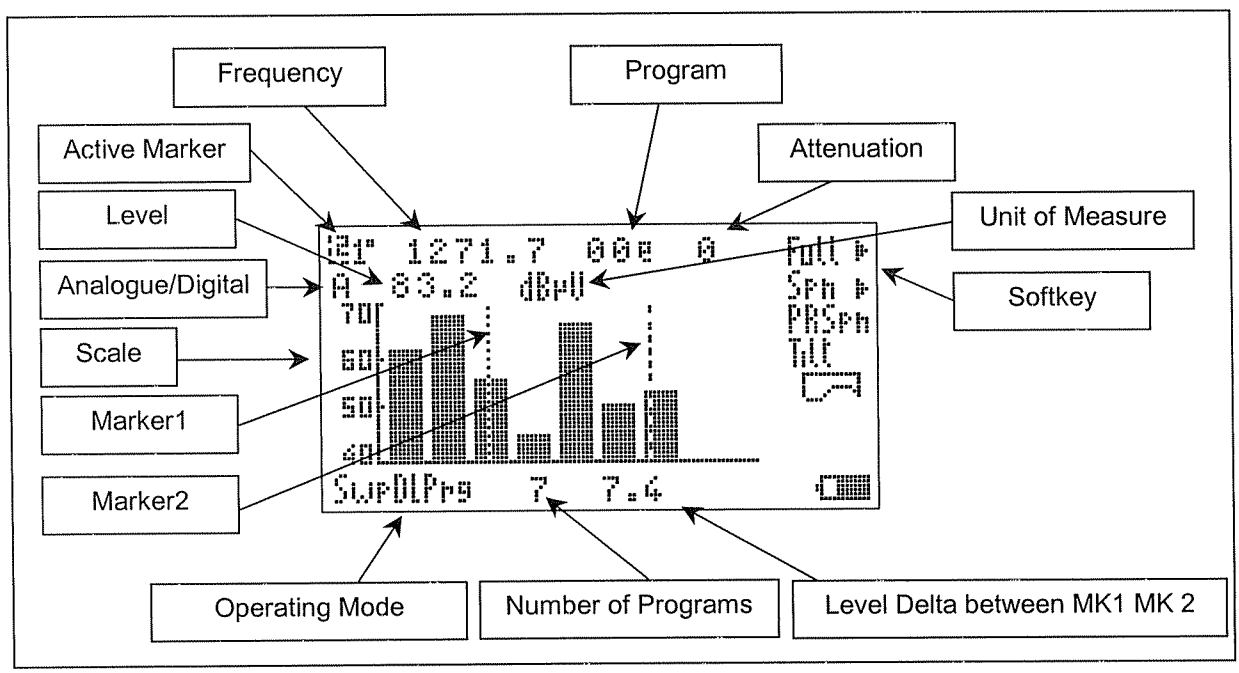

Figure 5 Typical DLPrg-program display. Simultaneous 7 program comparison.

If an empty program location is chosen, a dash will appear in the list instead of the program frequency. When any of the lines is filled with a program, selecting RUN via shaft encoder then pressing key ↵ **(ENTER) (7)** shows the histogram proper.
Notice that only the sat signals already stored in any of the 100 program locations (from 0 to 99) of the instrument qualify for the user-defined-program function.
To change the DLPrg setting:

- Go back to Full (spectrum) or Span (spectrum expansion) function.
- Select DLPrg function. The display with a list of lines will appear on the LCD readout. Lines are shown as seven line groups.
- Select one of the lines via Shaft Encoder to fill with a program.
- Press key ↵ **(ENTER) (7)**.
- Via shaft encoder take the desired program with which to fill the selected line.
- Press key ↵ **(ENTER) (7)** to confirm your selection.
- At this point you should decide whether or not you want the selected program to be displayed as a histogram. You may wish to select another of the seven lines to fill with a new program program via shaft encoder. A program is selected if an asteriscs is shown close to the program number.
- Press key ↵ **(ENTER) (7)**.
- Keep repeating the previous step as many times as it takes until all the seven lines available are completed with a program. Use the Shaft Encoder to scroll all the available pages for programs higher that the seventh one.
- Selecting RUN via shaft encoder then pressing key ↵ **(ENTER) (7)** lets you exit from the program list setting and view the histogram display.

The bottom line on the DLPrg display (Figure 5) shows the difference in DCP or level between the sat signals the two markers refer to.
The other operations available with this function are:

- ❒ Return to Sweep – Full function. Press **SOFT KEY (6)** then select **Full►** via Shaft Encoder, then press ↵ **(ENTER) (7)** to confirm (See section 8.2.2.1).
- ❒ Return to Sweep – Span function (spectrum expansion) setting. Press **SOFT KEY (6)** then select **Spn►** via Shaft Encoder, then key ↵ **(ENTER) (7)** to confirm (See section 8.2.2.2).
- ❒ Select the number of programs to display (with the maximum number being determined by how many programs have been selected). Press **SOFT KEY (6)** and spin the shaft encoder until the cursor hits the **PRSpn** icon. Press ↵ **(ENTER) (7)**.Spinning the Shaft Encoder lets you reach the desired number of programs. Press key ↵ **(ENTER) (7)** to confirm.
- ❒ Enter the Tilt function. Press **SOFT KEY (6)** and spin the shaft encoder until the cursor hits the **Tilt** icon (see section 8.2.2.4 for details). Press ↵ **(ENTER) (7)** to confirm.
- ❒ Enter DCP or level printing via the RS232 port. Pressing **SOFT KEY (6)** and spinning the shaft encoder until the cursor hits the icon on the right side of the display allows you to enter the said printing mode, which is started by pressing key ↵ **(ENTER) (7)**. The actual printing mode will depend on the selection made under the main PRINT menu.

8.2.2.4. Tilt

Tilt, the display of which is shown in Figure 6, is a very useful function as it allows the minimum and maximum level among user-defined programs to be compared for equalization.
The display shows the minimum, and maximum values, and their delta together with a graphical duplication of the same by means of a tilted segment whose slope is proportional to the averaged level. The other operations available with this function are:

- ❒ Return to Sweep – Full function setting. Press **SOFT KEY (6)** then select **Full►** via Shaft Encoder, then press ↵ **(ENTER) (7)** to confirm (See section 8.2.2.1).
- ❒ Return to Sweep – Span function. (spectrum expansion) setting. Press **SOFT KEY (6)** then select **Spn►** via Shaft Encoder, then key ↵ **(ENTER) (7)** to confirm (See section 8.2.2.2).
- ❒ Return to DLPrg function setting, Press **SOFT KEY (6)** then select **DLPrg** via Shaft Encoder, then key ↵ **(ENTER) (7)** to confirm (See section 8.2.2.3).
- ❒ Enter DCP or level printing via the RS232 port. Pressing **SOFT KEY (6)** and spinning the shaft encoder until the cursor hits the icon on the right side of the display allows you to enter the said printing mode, which is started by pressing key ↵ **(ENTER) (7)**. The actual printing mode will depend on the selection made under the main PRINT menu.

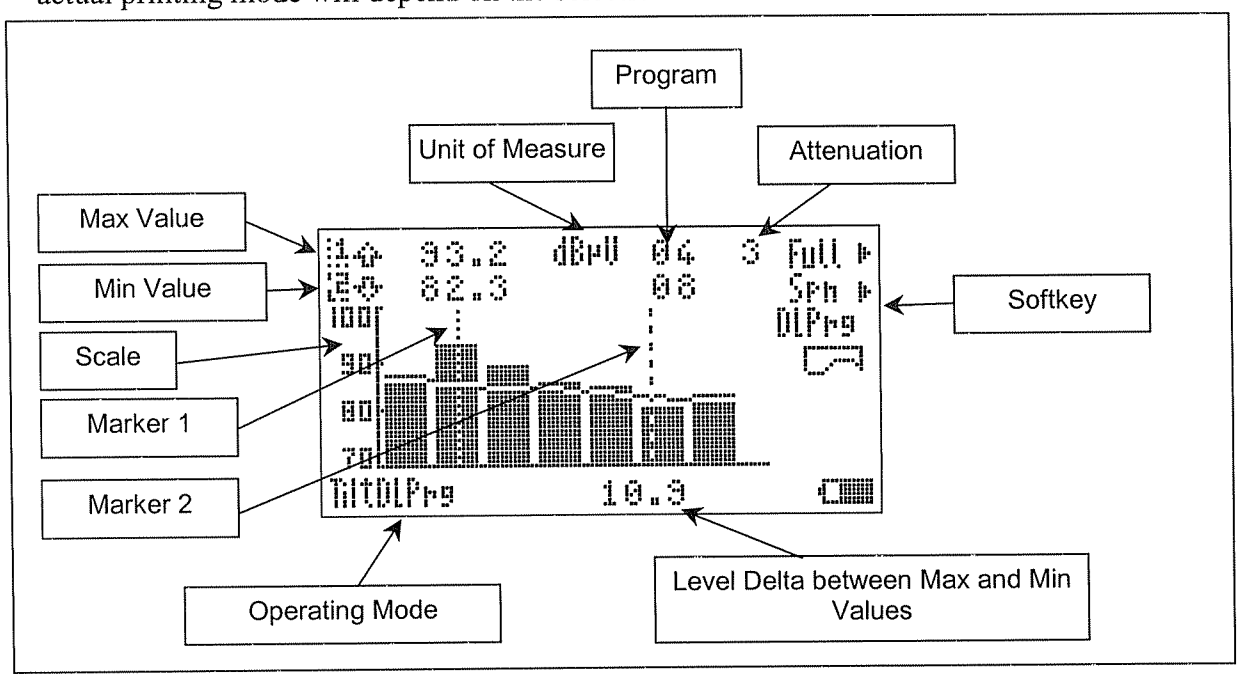

Figure 6 Typical Tilt display

NOTE: *In case user-defined programs include empty program locations, the Tilt function will not account for this. Only locations with program information will be displayed.*

8.2.3. ASL – Automatic Satellite Locator (ON S22 PLUS MODEL ONLY)

The ASL function – available on S22 PLUS model only – allows automatic location of the satellite to which the dish is to be peaked by means of comparison with a satellite that has been previously memorized. Up to twenty satellites can be memorized.

From MEASURE or SPECTRUM function press **SOFT KEY (6)** and select **ASL►** using Shaft Encoder. Press ↵ **ENTER (7)** to confirm.

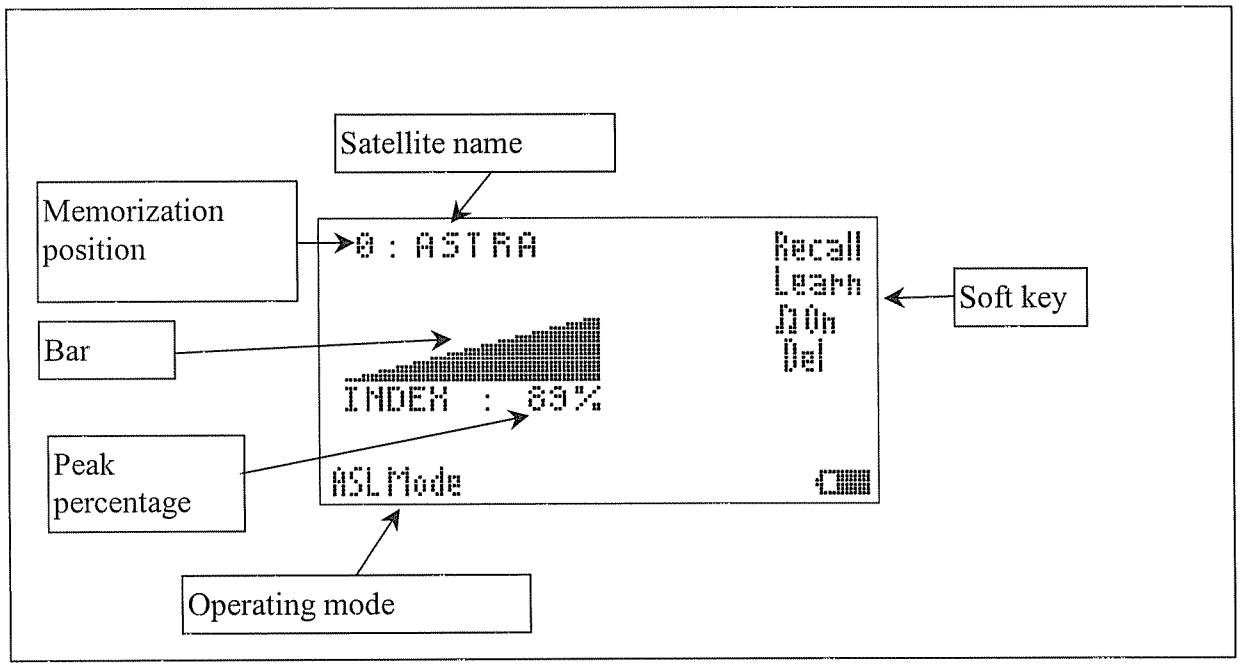

Figure 7 ASL screen

To make a comparison, the instrument requires data memorization of at least one satellite. This is obtained by pressing **SOFT KEY (6)** and selecting **Learn** by means of Shaft Encoder. Press ↵ **ENTER (7)** to confirm. The "Learning" procedure starts and a percentage reading shows progress status.
To save satellite data in one of ten possible positions proceed as follows:

- ❒ Press **SOFT KEY (6)** and select **Save** by means of Shaft Encoder. Press ↵ **ENTER (7)** to confirm.
- ❒ Rotate Shaft Encoder to select the position where to save. Press ↵ **ENTER (7).**
- ❒ Use the alphanumeric keyboard to digit the required name and Shaft Encoder to select digit position.
- ❒ Press ↵ **ENTER (7)** again.
- ❒ To go back to the screen in Figure 7, press **SOFT KEY (6)** and select **Back** by means of Shaft Encoder. Press ↵ **ENTER (7)** to confirm.

To compare with a satellite previously saved, press **SOFT KEY (6)** and select **Recall** by means of Shaft Encoder. Press ↵ **ENTER (7)** to confirm.
The cursor moves onto one of ten satellites memorized (when a position is free, a set of asterisks will appear). Select the satellite to be used for comparison by rotating Shaft Encoder. The result is given by bar length: a longer bar means greater opportunity that the wanted satellite has been peaked. This feature is shown as percentage beneath the bar.

To activate or de-activate the sound signal press **SOFT KEY (6)**, select OFF or On by Shaft Encoder then press ↵ **ENTER (7)** to activate or de-activate the signal alternately. When the bar exceeds a given length, i.e. when the wanted satellite peaking is being approached, the instrument gives out a sound proportional to bar length.

To delete a memorized position, press **SOFT KEY (6)** and select **Del** by means of Shaft Encoder. Press ↵ **ENTER (7)** to confirm.

8.2.4. BER

Digital signals are analysed for quality through measurements of BER (Bit Error Ratio), MER (Modulation Error Ratio) and other parameters. For more information on digital modulation to DVB standard refer to section 11. BER measurement has a display which looks like Figure 8.

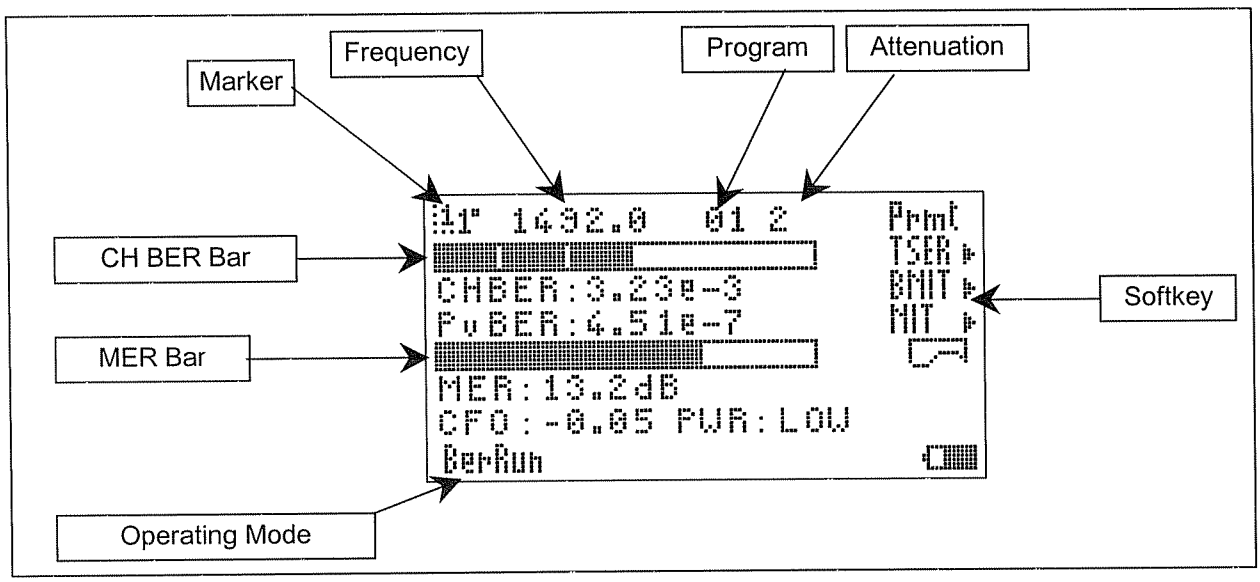

Figure 8 Typical pre and post Viterbi BER measurement display.

In addition to the indications on the top line of Figure 8 display regarding the marker being used, the local oscillator, the tuning frequency, the program and attenuation, the following information of the digital signal are shown:

- Ch BER bar. It is an analogue representation of the channel BER (Bit Error Ratio) reading: the longer the bar the better the BER. When you need to fix an installation, it is faster to watch the variations in bar length than the changes in BER numerical reading. To the right of the Ch BER bar, **L** for LOCKED and **U** for UNLOCKED will appear when the signal is respectively locked and unlocked , the unlocked status taking place when the locking parameters are not set properly or the dish is not peaked. The signal must be locked by the instrument before measurements get any meaning at all. When the signal is unlocked or missing, all measurements and readings become meaningless and, therefore, they are shown as dotted lines.
- Ch BER, or channel BER (or pre Viterbi) reading. The single most important digital measurement carried out by the instrument since it directly relates to digital signal quality. The BER measured is that of the channel, therefore sensitive to impairments that are difficult to detect otherwise. A good BER reading close to the LNB is less than 1 E-4, even better if 1E-5. A signal degradation down the installation is to be expected but a Ch BER worse than 2E-3 should be avoided at the user's tap in any case [4].

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[4] The exponential form normally used for BER reading may be difficult to understand at first.
Take for example, 3E-2. This notation should simply be interpreted as 3 errors out of 100 bits, since 2 is the exponent of 10. The following example may be useful:

- 1E-3 corresponds to 0.001 i.e., 1 bit in error out of 1,000 bits
- 2.7E-4 corresponds to 0.00027 i.e., 2.7 bits in error out of 10,000 bits
- A BER of 1E-4 is lower, therefore better than a BER of 1E-3
- A BER of 5E-3 is higher, therefore worse than a BER of 1E-3

- PvBER, or post Viterbi BER. The signal is considered quasi error free (QEF) when the BER reading is better than $2*10^{-4}$, but in this case you are dangerously closed to abrupt signal failure.
- MER (as a bar and reading). MER or Modulation Error Ratio evaluates signal quality within the range 5 to 20 dB. The better the signal, the longer the bar. MER is particularly useful in sat environment for LNB skewing optimisation and for keeping the cross-polarisation to a minimum.
- CFO or Centre Frequency Offset. Any reading other than zero show the difference between the nominal centre frequency of the transponder and the tuning frequency in MHz. Useful when the exact nominal centre frequency of a transponder is unknown and therefore, the need arises for the operator to tune the transponder by looking at its spectrum or when there is the need to check any shifting by the LNB frequency, within ± 3MHz, due to a temperature drift in the LNB local oscillator.
- PWR. It indicates signal power: OK if power is within the operating limits of the QPSK, LOW if too weak and HIGH if too strong. When signal power is too strong or too weak card behaviour may not be reliable. Engage or disengage the input attenuation cells until power is brought back to the OK reading.

The other operations available with this function are:

❒ Setting of locking parameters. Press **SOFT KEY (6)**, then select Prmt icon on the BER display (Figure 6) by means of the shaft encoder, then press ↵ **(ENTER) (7)** to confirm (see section 8.2.4.1).

❒ Selection of TSER (Transport Stream Error Ratio) display. Press **SOFT KEY (6)**, then select TSER▸ and press ↵ **(ENTER) (7)** (see section 8.2.4.2).

❒ Engaging the BNIT mode (a combination of BER and part of the NIT information). Press **SOFT KEY (6)**, select BNIT▸ then press ↵ **(ENTER) (7)** to confirm. (see section 8.2.4.4).

❒ Engaging the NIT card. Press **SOFT KEY (6)**, select NIT▸ then press ↵ **(ENTER) (7)** to confirm. (see section 8.2.4.3).

❒ Printing measured readings through RS232. Press **SOFT KEY (6)**, select icon via the shaft encoder, then press ↵ **(ENTER) (7)** to confirm.

8.2.4.1.How to set Symbol Rate

To set the symbol rate:

1. Press **SOFT KEY (6)**,
2. Select Symb via the shaft encoder then press ↵ **(ENTER) (7)**.
3. Set the symbol rate via the keyboard.
4. Press ↵ **(ENTER) (7)** to confirm.

The other operations available with this function are:

❒ Returning to BER measurement display. Press **SOFT KEY (6)**, then select Ber icon by means of the shaft encoder, then press ↵ **(ENTER) (7)**.

❒ Selection of TSER (Transport Stream Error Ratio) display. Press **SOFT KEY (6)**, then select TSER▸ and press ↵ **(ENTER) (7)** (see section 8.2.4.2).

❒ Engaging the NIT card. Press **SOFT KEY (6)**, select NIT▸ then press ↵ **(ENTER) (7)** to confirm. (see section 8.2.4.3).

❒ Printing measured readings through RS232. Press **SOFT KEY (6)**, select icon via the shaft encoder, then press ↵ **(ENTER) (7)** to confirm.

8.2.4.2. TSER (Transport Stream Error Ratio)

The following information is available under this operating mode, as per Figure 9.

- **RU**. It counts the errors the Reed Solomon stage has been able to detect but unable to correct (RU). They are likely to show on the screen of your TV set through the MPEG decompressor, thus causing unwanted freeze frames and the so called mosaic effect. The maximum count is 65535. Any error count is reset to zero in case of unlocking or tuning variations. The RU count is most useful medium to long term for system reliability and preventive maintenance.
- **TIME**: Shows how long the digital signal has been locked. It can be used in connection with the RU error count to estimate the average number of errors over time.
- **MER** in bargraph format. The bargraph reflects the MER reading, from 5 to 20 max.
- **MER** as a relative reading.

A satellite digital transponder must be locked by the instrument in BER mode before measurements get any meaning at all. If unlocked, all readings become meaningless and, therefore, they are replaced by dotted lines.

Proceed as follows to return to BER display:

1. Press **SOFT KEY (6)**
2. Select Ber icon , then press ↵ **(ENTER) (7)** to return to measurement display.

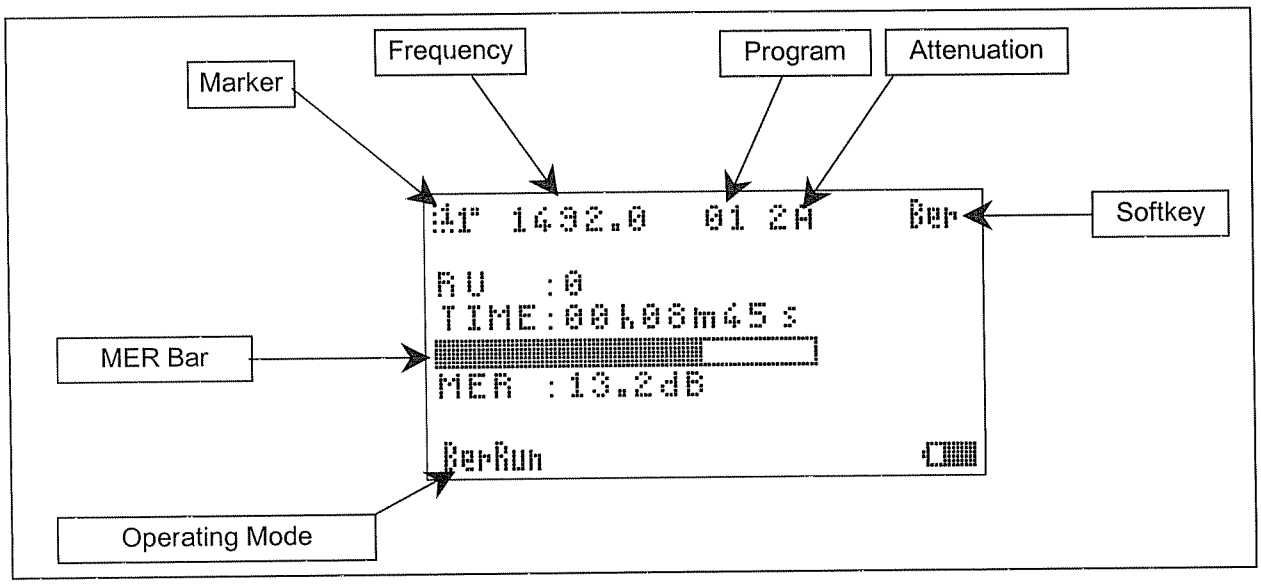


Figure 9 Typical TSER Transport Stream Error Ratio display with RU error count

8.2.4.3.NIT

NIT is the acronym of Network Information Table. Not only does this optional module show the network data but also the designations of the channels found in the transport stream analysed.
To download data from the NIT the instrument must be set to BER function and a digital transponder already locked.
Because NIT data are cyclically refreshed, as opposed to a continuous data stream, they may be shown with a certain delay, normally not exceeding 30 seconds.

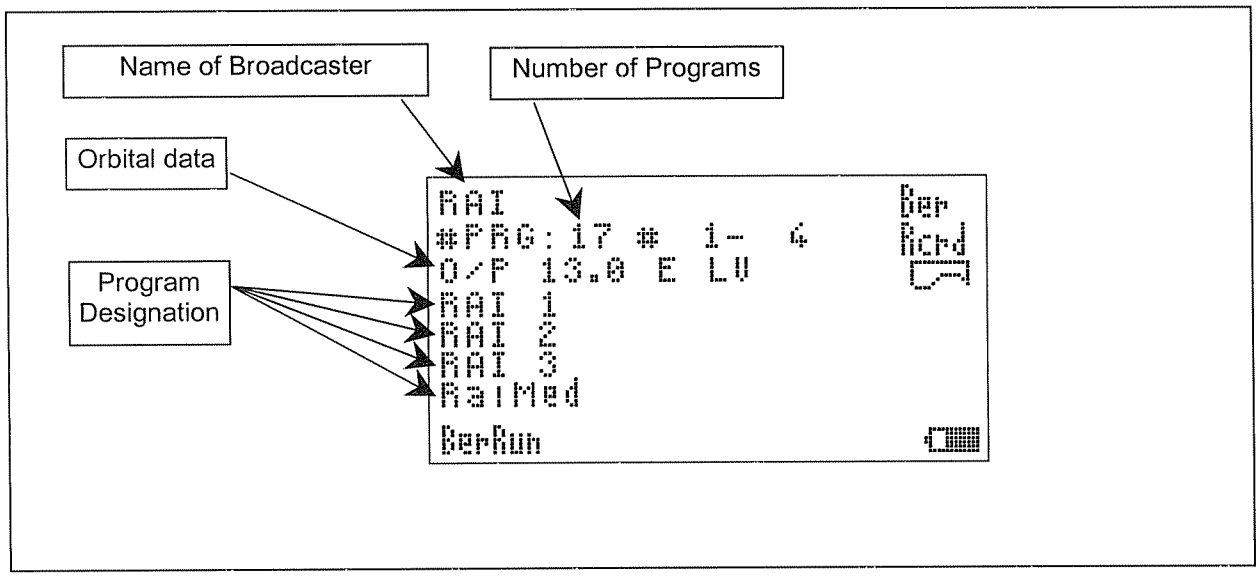


Figure 10 Typical NIT display

Figure 10 shows an example of the NIT display.
On the top line of the display the name of the network is shown, the number of programs transmitted on the second line down, with the third line down showing:

- O/P for the satellite orbital position, in degree.
- E or W for East or West.
- The type of polarisation viz, LV for linear vertical, LH for linear horizontal, CR for circular right and CL for circular left.

The designations of the first four programs found. When programs are encrypted, their designations are displayed with inverted printing field.

In case programs are more than four you can scroll all of them as follows:

❒ Press **SOFT KEY (6)**, then select **Rcrd** icon by means of the shaft encoder, then
❒ Press ↵ **(ENTER) (7)**.
❒ Spin the Shaft Encoder to display the designations of the programs.
Notice that at times data shown may be incorrect following transmodulation, transponder relaying or other signal reconditioning requirements of the distribution system.

The other operations available with this function are as follows:

❒ Returning to BER measurement display. Press **SOFT KEY (6)**, then select **Ber** icon by means of the shaft encoder, then press ↵ **(ENTER) (7)**.

❒ Printing the measured readings via RS232. Press **SOFT KEY (6)**, select icon via the shaft encoder, then press ↵ **(ENTER) (7)** to confirm.

To exit immediately from the operation, press any of the following operating mode keys: **BER (15)**, **SPEC (22)**, **MEA (23)**.

8.2.4.4. BNIT (BER and NIT display at the same time).

We can get the following information out of this function, as per Figure 11:

- **Ch BER** as bargraph.
- **Ch BER** as Bit Error Ratio numerical reading.
- **pVBER** or post Viterbi BER.
- The name of the network.
- The number of programs transmitted.
- The orbital position of the satellite, in degree.
- E or W for East or West.
- The type of polarisation viz, LV for linear vertical, LH for linear horizontal, CR for circular right and CL for circular left.

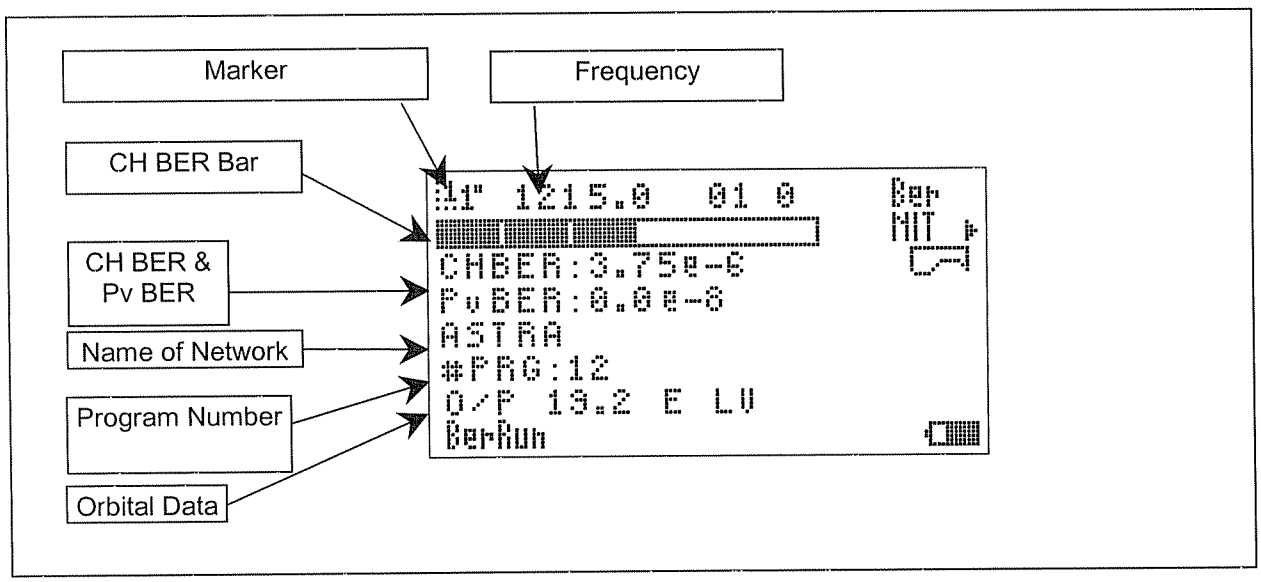


Figure 11 BNIT display

The other operations available with this function are as follows:

❒ Returning to BER measurement display. Press **SOFT KEY (6)**, then select **Ber** icon by means of the shaft encoder, then press ↵ **(ENTER) (7)**.

❒ Engaging the NIT card. Press **SOFT KEY (6)**, select **NIT►** then press ↵ **(ENTER) (7)** to confirm (see section 8.2.4.3).

❒ Printing measured readings through RS232. Press **SOFT KEY (6)**, select icon via the shaft encoder, then press ↵ **(ENTER) (7)** to confirm.

8.3. DATA LOGGER

The instrument is capable of logging (measuring and storing) a high number of measurements, each of which can consists of 42 programs. Programs which are analysed per measurement are those of the Sweep DLPrg in spectrum mode. It is also possible to capture (or acquire) the digital, or analogue, a measurement currently being taken simply by keeping key **MEA (23)** on pressing.

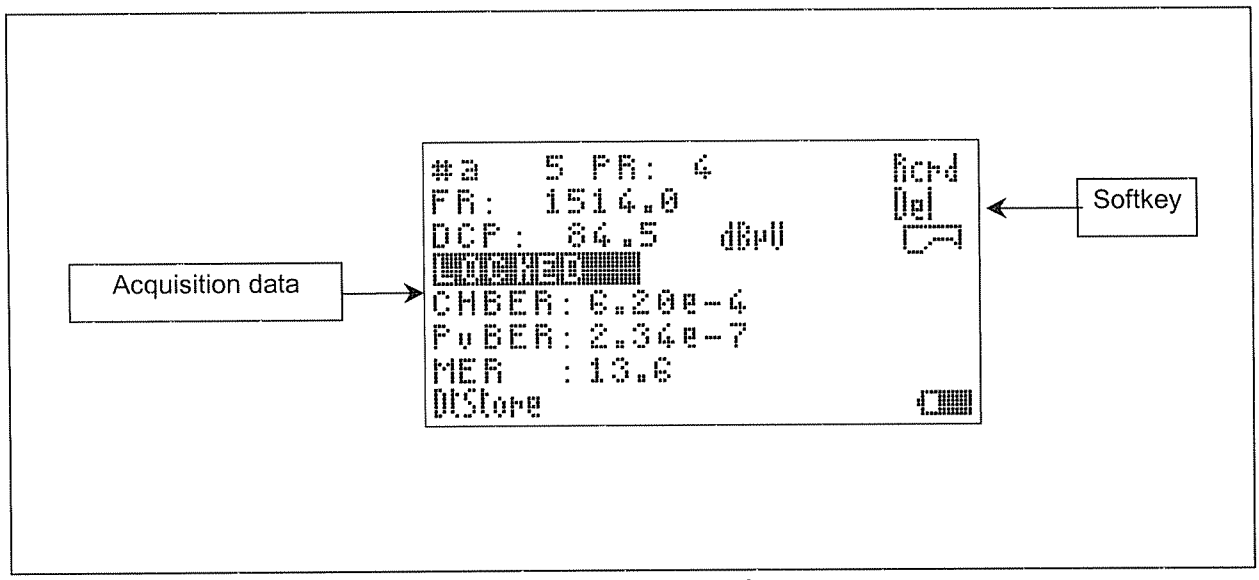


Figure 12 Typical program acquisition display. The 5th acquisition of the five carried out is shown

To enable the Data Logger press the key **MENU (8)**, select the item DATA>, press **ENTER**↵. The following menu is activated:

- ACQUIRE #a 2 . 1%. Initiates a program acquisition or capture. The same line indicates the number of the next program acquisition and the available storing capacity left in percentage.
  A real time acquisition (*instant capture*) can also be made at any time of the measurement being taken by simply keeping on pressing key **MEA (23)**, regardless of the measuring mode the instrument is set to.
- SHOW DATA LOGGED>. Shows the result of the program acquisitions. The page is shown first of the first program of the last acquisition which was carried out (see Figure 12).
  On top of the display list the acquisition and program numbers are shown. If the acquisition was carried out as an *instant capture* (see ACQUIRE #a 2 . 1% paragraph above for details), using key **MEA (23)**, then CV for "Current Value" is shown instead of the program.
  Other data follow on the display such as frequency and, depending on the type of signal being treated, DCP for digital and LEV for analogue signal, the locking status, the channel BER, post Viterbi BER and MER.
  To cancel an acquisition press **SOFT KEY (6)**, then select **Del** icon by means of the shaft encoder, then press ↵ **(ENTER) (7)**.
  To print data via RS232 press **SOFT KEY (6),** select icon via the shaft encoder, then press ↵ **(ENTER) (7)** to confirm.
  To exit straight away press **MENU (8)** or one of the three selection keys of the functioning mode, **MEA (23), SPECT (22), BER (15).**
- DELETE ALL. Cancels all stored data (the instrument will request confirmation before cancellation).

- DELETE LAST. Cancels the latest capture carried out (the instrument will request confirmation before cancellation).
- PRINT ALL. Prints all stored data.
- PRINT LAST. Prints data belonging to the latest capture carried out.
- EXIT. Exits the data logging menu.

NOTE: Acquire *and* **SHOW DATA LOGGED>** *modes are active when at least a program storage and a program acquisition have been carried out. No program storage, no data logging.*

9. RS232

9.1. INTRODUCTION

The unit comes fitted with a serial RS232 port. A female D-type 9-pole connector is shown in Figure 13.
The unit may be operated via a PC through a normal communications program (such as Hyperterminal, typically found in Windows environment).

9.2. RS232 PARAMETER SETTING

To use this connection it is necessary that both the instrument and the PC or the external printer are set to the same operating parameters. The instument settings are carried out by means of the Main Menu as follows:

1. Press **MENU (8)**. By means of the Shaft Encoder select submenu "SYSTEM>", then press ↵ **ENTER**.
2. By means of the Shaft Encoder select "RS232>", then press ↵ ENTER to access a submenu to select the typical transmission parameters.
3. By means of the Shaft Encoder select the parameter to be set/modified, then press ↵ **ENTER**. The available parameters are:
   - ♦ BAUDRATE: Enables the Shaft Encoder to select the Baud Rate from 600 to 38400. Confirm the selection by means of ↵ **ENTER**.
   - ♦ FORMAT :Enables the Shaft Encoder to select the format (8/7 bits, number of stop bits). Confirm the selection by means of ↵ **ENTER**.
   - ♦ PARITY :Enables the Shaft Encoder to select the parity (EVEN , ODD, DISABLE). Confirm the selection by means of ↵ **ENTER**.
   - ♦ DEVICE :Enables the Shaft Encoder to select the output device (PC or PRINTER = serial printer). Confirm the selection by means of ↵ **ENTER**.

   If the PC is selected as the output device only the data requested will be printed, while if the printer is selected, data are preceded by the heading and followed by the installer's logo.
4. By means of the Shaft Encoder select EXIT and press ↵ **ENTER** to exit the configuration submenu.
5. By means of the Shaft Encoder select EXIT again and press ↵ **ENTER** to exit the main menu.

9.3. LOGO SETTING

If the output device (see DEVICE, section. 9.2) is a serial printer, the installer's logo is added to the printed. The logo may be set as follows:

1. Press **MENU (8)**.
2. By means of the Shaft Encoder select "SYSTEM>" submenu, then press ↵ **ENTER**.
3. By means of the Shaft Encoder select LOGO>, then press ↵ **ENTER**.
4. By means of the Shaft Encoder select EDIT>, then press ↵ **ENTER**.
5. By means of the alphanumerical keypad **(21)** set the desired numbers or letters; the starting point for writing may be shifted by means of the shaft encoder. The writing area consists of 4 lines and 20 columns. Remember that setting a letter requires pressing the related key several times, as in many types of mobile phones.
6. When the logo has been set, press ↵ **ENTER**.

7. Select EXIT> by means of the shaft encoder and press ↵ **ENTER** to exit the logo-setting submenu. Select EXIT> again and press ↵ **ENTER** to exit the "SYSTEM>" submenu.
8. Select EXIT> again and press ↵ **ENTER** to exit the main menu.

Remember that nothing will be added at the end of the printing should the logo contain "space"-only characters.

9.4. RS232 CONNECTIONS

The RS232 connector is located on the lower part of the instrument **(29)**.
Figure 13 shows the connector pin locations.

1. **NC** Not connected
2. **Rx** Data reception. (Direction Instrument→ PC, printer).
3. **Tx** Data transmission. (Direction Instrument ← PC).
4. **DTR** Data Terminal Ready. (Direction Instrument ← PC, printer). When this line is operative the PC or printer signals the instrument that the two devices are ready for data exchange.
5. **GND** Ground.
6. **DSR** Data Set Ready (Direction Instrument → PC or printer). the instrument enables this line to signal the PC or printer that it is ready for data exchange.
7. **RTS** Request To Send. (Direction Instrument ← PC or printer). The instrument waits for this line to be enabled before transmitting the data to the PC or printer.
8. **CTS** Clear To Send. (Direction Instrument → PC or printer). When this line is brought to an operative level, it informs the PC that data transmission may initiate.
9. **NC** Not connected.

NOTE: *The apparent contradiction (Rx = Output, etc.) is due to the fact that the instrument is configured as DCE (Data Communication Equipment). This is the reason why the connecting cable to the computer is used without inversion.*

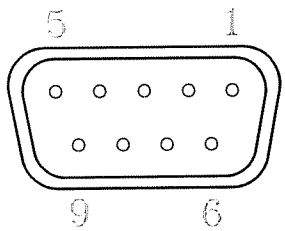


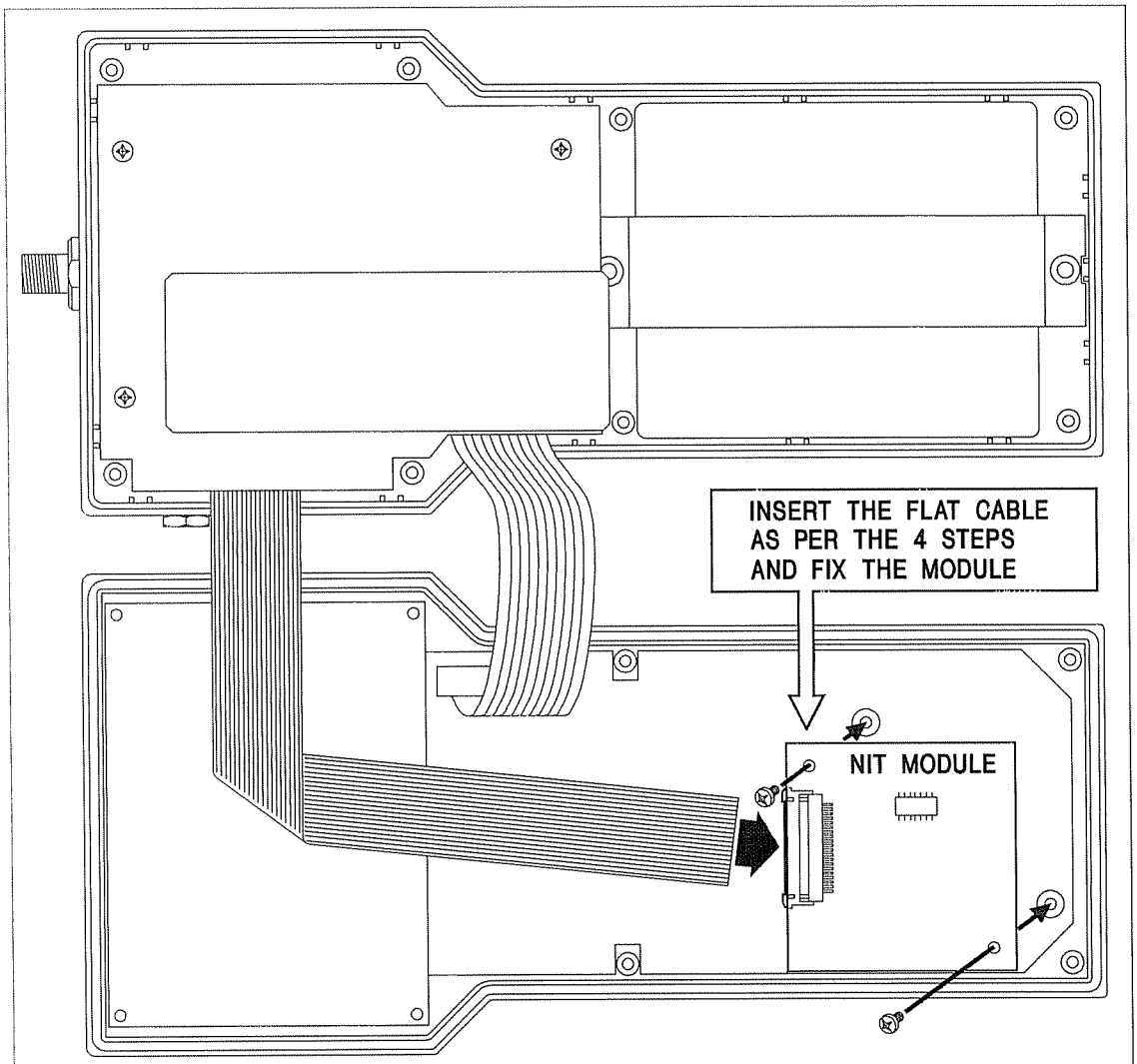
Figure 13 RS232 connector pin layout

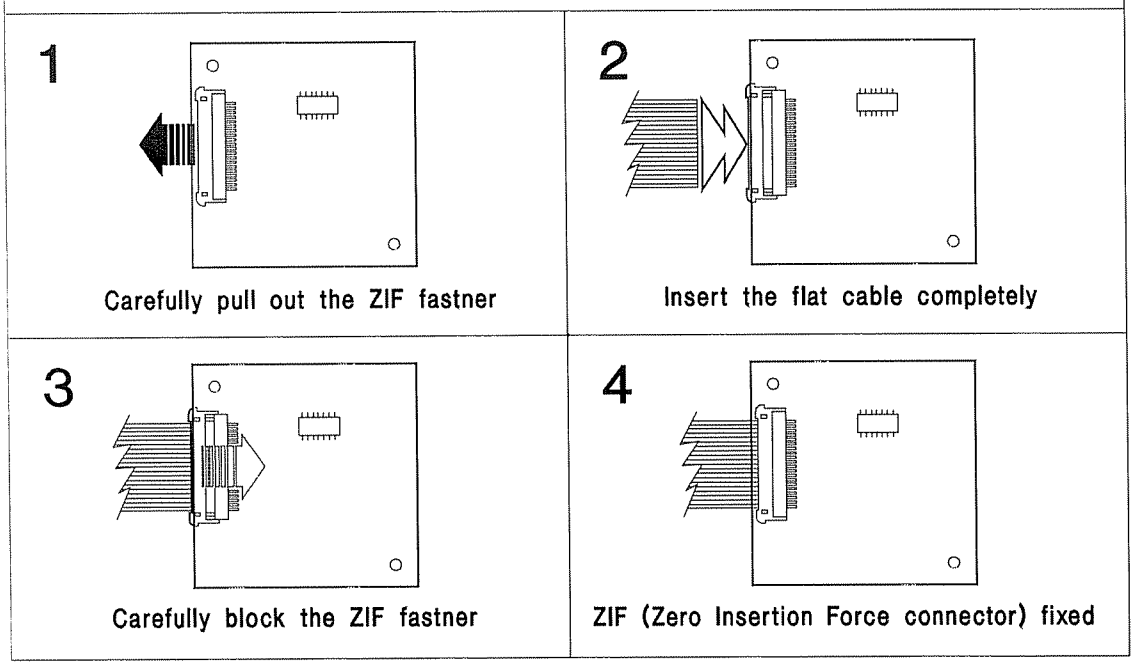
9.4.1. CONNECTING THE UNIT TO A PERSONAL COMPUTER

- The instrument is configured as a DCE (Data Communication Equipment).
- The connection should be carried out in the Full Duplex modality since, if configured for connection to a Personal Computer, the instrument supplies an echo of the input data, character by character.
- In case an error is made while digitizing, in the command line it is possible to use the backspace character "backspace".

- The command line is carried out on reception of the "Carriage Return" character (decimal 13, hexadecimal 0D).
- The instrument uses, when connected, the handshake lines RTS and CTS.
- A correction check of the command is carried out, but not including any data. For example:
  QX27<CR> is refused (the command QX does not exist).
  FREQ 560.25<CR> programs the tuning frequency to 560.25 MHz.
  FREQ 4yg.1a<CR> programs an unpredictable frequency.

10.HOW TO RETROFIT THE NIT MODULE





11. NOTES ON QPSK-MODULATED DIGITAL SIGNALS

11.1. TYPICAL QPSK PARAMETERS

A QPSK transmission appears as noise throughout the entire channel, normally 36 MHz. To decode the signal some transmission parameters must be known. Many of these parameters are standardized, but some may change from one channel to another and must be programmed on the receiver. They are :

1) Channel Frequency.

Tuning may seem banal at first sight but is not. As already mentioned, the transmission appears as a wide 36 MHz channel containing only "noise" and whose carrier frequency is not easy to find and whose allowed tolerance is only ±0.5 MHz. To assist the operator, the instrument is equipped with an automatic research circuit capable of tracking signals up to ±10 MHz offset from the nominal frequency.

2) Symbol Rate

This is the speed at which the digital data are transmitted. Each symbol corresponds to two bits. It is equivalent to the Baud Rate in telephone modems. Presently, for example, two of the most frequently used Symbol Rates are: 22.0 and 27.5 (MS/s Mega Symbol / second). The field strength meter is capable of tuning signals whose Symbol Rate varies from 1.45 to 36 MS/s.

3) Code Rate

This is also known as Viterbi rate (the name of the corrector circuit). Since the SAT signal is quite noisy, control bits are interlaced with the actual transmission data bits to allow the receiver to identify those received incorrectly and, if possible, to correct or eliminate them. The more control bits added, the safer the transmission is but the lower the quantity of data that may be transmitted at the same time. In terms of the transponder this means fewer TV channels and/or a poorer MPEG quality. Code Rates of 1/2, 2/3 and 3/4 are currently used, corresponding to one control bit following one data bit, one control bit following two data bits, one control bit following three data bits. The instrument sets code rate values from 1/2 to 7/8 automatically; i.e, up to one control bit following seven data bits.

4) Spectrum

Similar to the passage from K to C bands, the transmission spectrum may either be direct or inverted, depending on the frequency of the local oscillator if lower or higher than the reception frequency.

For example, a typical channel could be:

Carrier Frequency : 11283 MHz
Symbol Rate : 27.5 MS/s

Code Rate : 2/3
Spectrum : Inverted.

In digital receivers the signal must be acquired through various cascade stages: the tuner must first track not only the frequency but also the carrier phase and then the demodulator must track the frequency and the Symbol Rate phase. In the end, the error corrector must take on the digital data flow pitch. Naturally, we are far from the possibility of displaying a PAL or RGB video signal on a monitor. In fact, the error corrector output is always the MPEG digital signal which must then be decoded by the specific decoder. Therefore, the error corrector is not capable of allowing the operator to make a visual estimate of the signal, but may supply much more important information : the **BER (Bit-Error-Rate).**

11.2. QPSK BER (Channel BER, post Viterbi BER)

It is fundamental and essential, in the digital transmission field, to assimilate new methods of evaluating the signal (which, in turn, depends on the quality of the installation). Similar to terrestrial teletext, which is never "noisy", but rather wrong, the quality of the picture and sound of a digital transmission give no indication at all of the quality of the signal but only of its presence. While the deterioration of an analogue signal is visually noticeable in the form of noise, interference, distortion, a digital signal remains perfect until the decoder is capable of interpreting it, after which it disappears completely when the deterioration reaches the operating limit of any of the stages that compose the reception chain. The measurement of the quality of the digital signal is therefore quite difficult: the only really reliable method, in addition to highly professional systems, is the measurement of the ratio between the number of errors found and the quantity of data received. This ratio is called BER (Bit Error Ratio). A QPSK signal will rarely have no errors; if its quality is excellent it could have an error rate of less than 1 out of 100,000 (1E-5), while greater than 1 out of 1,000 (1E-3) the quality **(of the signal, not of the picture)** must be considered poor. In this case, the decoder could be on the verge of not functioning anymore even if the picture is perfect; a slight deterioration (due to rain, daytime heating of the cables...) could be enough to completely block reception, without any warning. The BER is indicated by the instrument in an exponential form; i.e., for example, 1 out of 10 becomes 1 E-1, 2 out of 10 becomes 2 E-1, 7.5 out of 10000 becomes 7.50E-4, etc.

At this point it is necessary to introduce a very important concept regarding QPSK modulated digital transmissions.

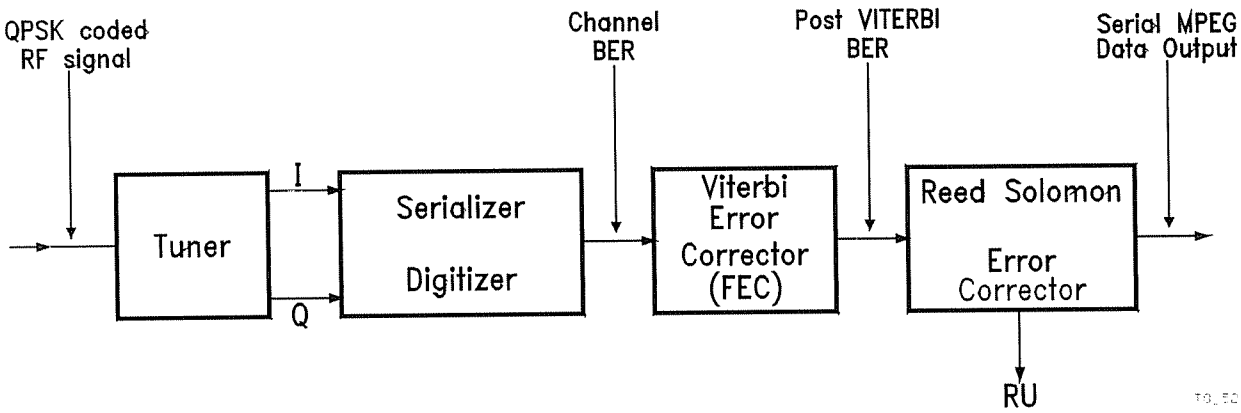


Figure 14 Simplified digital receiver demodulator block diagram

It is possible to measure the BER in different positions down the demodulating chain (see Figure 14); in particular before the Viterbi corrector, and in that case, it is known as Channel BER, or immediately after the Viterbi corrector, and in that case it is called post Viterbi (or pre Reed Solomon, the name of the next corrector). Since the two measurements are completely different it is necessary to understand how to interpret them and keep their limits in mind to carry out an optimal installation. The post Viterbi BER may be even a million times lower that the Channel BER (CH BER) and for this reason the pV BER is not always measurable since the count is carried out only if errors arise. To better understand the problem take the following example: if the pV BER is $1*10^{-12}$, to carry out the measurement it is necessary to wait for at least 1000 billion bytes to arrive which is equivalent in time to a few days. The norms establish that when a pV BER value is better than 1E-4 (one error out of 10000 bytes), the system is considered good and the 1E-4 threshold is called QEF (Quasi Error Free).
However:
especially in cases of communal installations (the most critical for the Sat QPSK signals) the pV BER may not be used because the values supplied for that parameter do not cover the needed measurement range and do not therefore supply information useful to establish whether the installation is correct from the digital signal reception point of view. In fact, to guarantee, in the worst case, that the pV BER is at least 1E-4, at the LNB output (or distribution exchange) should have a pV BER of at least 1E-12, but as mentioned before such a value is not measurable.

A very more significant indication is fortunately supplied by the Channel BER which :

1. Is immediately measurable with all signals present in the installation (from optimal to mediocre).
2. Always supplies an indication of the margin of the reception threshold (obviously if the installation is still in the condition to allow for even minimum reception).
3. Is a very sensitive index regarding ambient and meteorological conditions (temperature, humidity, cloudiness, cable efficiency, amplifiers, etc.).

The diagram in Figure 15 gives, instead, a useful comparison between different BER measuring points:"CH BER" vs "POST VITERBI BER" (pV BER).
This may be useful when comparing the "CH BER" values with the theoretical "pV BER" values indicated on the tables in publications dealing with QPSK digital transmissions.
For example: the broken line shows that for a "CH BER" of 10E-3 the corresponding "pV BER" falls between 10E-8 and 10E-11 approximately depending on the "CODE RATE" programmed.
Technical literature supplies, for such diagrams, the "X" axis indicated as Eb/No which is the ratio between the energy per bit and the noise per band unit.

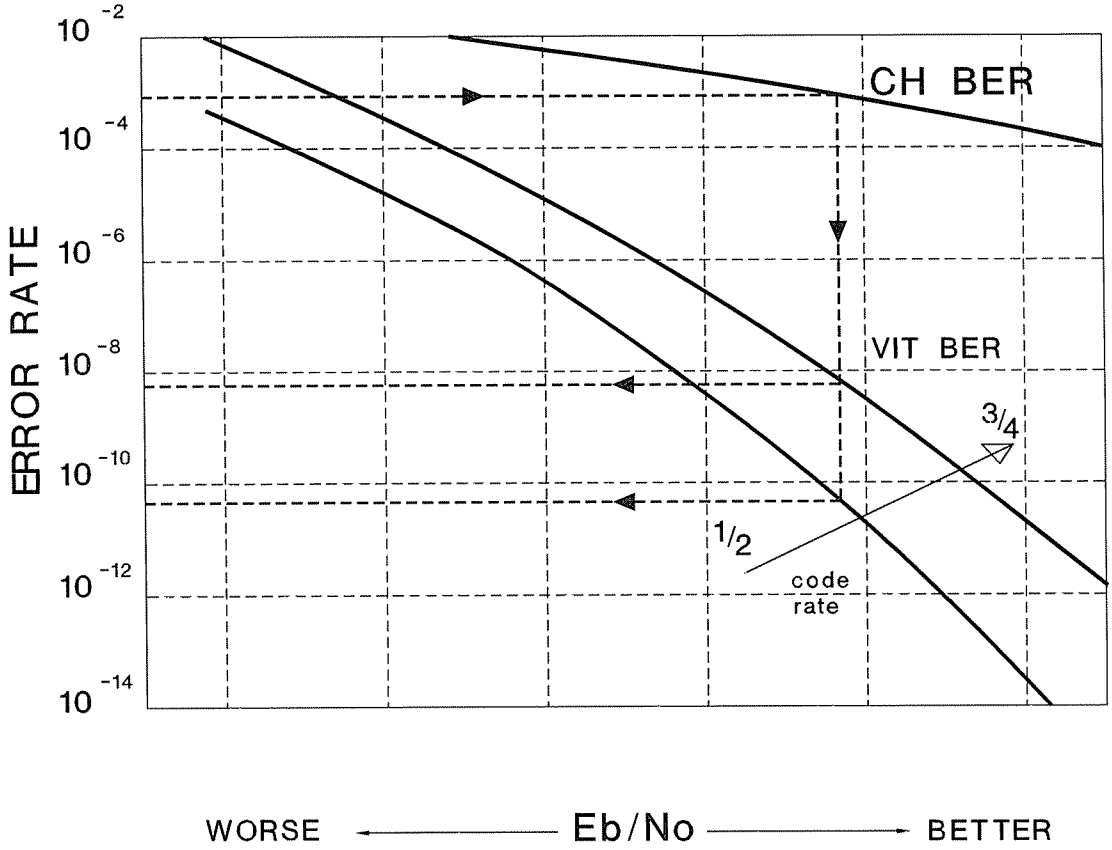


Figure 15 Different BER measuring points yield different results

11.3. RU (REED SOLOMON UNCORRECTED ERRORS)

The CH BER is actually the number of errors identified and corrected by means of a convolutional algorithm (Viterbi) and is an almost immediate indication of the signal quality.
Another parameter, instead, RU, gives an idea of the quality of the signal for medium and long periods of time. In particular, it is possible to observe the loss of signal "blocks" that appear on the television for example, as small mosaics squares that overlap the image.
RU (Reed Solomon Uncorrected - Identified errors that are not corrected) is a register that increases when these events occur.
Naturally, the worse the BER is, the more rapidly the RU will increase.
The value of the register increases from 0 to 65535 and is blocked at the maximum value. It is reset to zero each time there is a track loss of the signal.
This register gives an idea of the quality of the installation if controlled for medium/long periods of time.
Its increase depends in fact on the corrections carried out in the "Reed Solomon" stage but these are already numerically very low when the "Channel BER" is around 1.10^{-3} (in the order of one increase every 30 minutes).

11.4. SUMMARY

We recapitulate the above-mentioned points as follows:

1) **There is no relationship between the quality of the picture and the quality of the digital signal.**
2) **The only practical quality index is the BER.**
3) **The BER evaluation may be carried out only after all the phases of the receiver up to the error corrector have tracked the signal.**
4) **In order that all the stages can track the signal, the variable transmission parameters (Channel frequency, Spectrum, Symbol Rate, Code Rate) must first have been correctly programmed.**

12. OPTIONAL EXTERNAL BELT STRAP BATTERY

Since the instrument is equipped with a battery similar to the internal one, the option BP6 approximately doubles the operative duration of the instrument.
Technical characteristics:

- 6V 3.8Ah Ni-MH battery.
- Internal recharge control circuit.
- Dimensions 130x75x23mm.
- Weight 450gr.
- Nylon holder with belt loop.

Figure 16 shows the three typical power supply modes of the instrument and BP6 battery recharge.

12.1. MAINS POWER SUPPLY

As previously seen in Chap. 7, POWER SUPPLIES, the instrument may be supplied by means of mains with our model BCH7.5/3.3 or an equivalent (see top section of Figure 8).
We recommend the following for use by means of mains:

12.2. AUXILIARY EXTERNAL BATTERY PACK

Connect the BP6 plug to the **AUX DC IN (28)** jack of the instrument (see the middle section of Figure 16).
When BP6 is inserted, the internal battery is automatically excluded.
The instrument may be used exactly as if it were powered supplied by the internal battery.

12.3. INTERNAL AND EXTERNAL BATTERY RECHARGE

The BP6 battery may be recharged either individually or simultaneously with the instrument internal battery. To charge the BP6 battery only, connect the BCH 7.5/3.3 output plug to the BP6 **BATT IN** plug. To charge the instrument battery simultaneously, connect (see the bottom section of Figure 14), by means of the standard accessory cable, the BP6 output **Ch OUT** to the instrument external power supply jack **(2)** (the two jacks **BATT IN** and **Ch OUT** are parallel, in other words they may be exchanged without causing any problems).

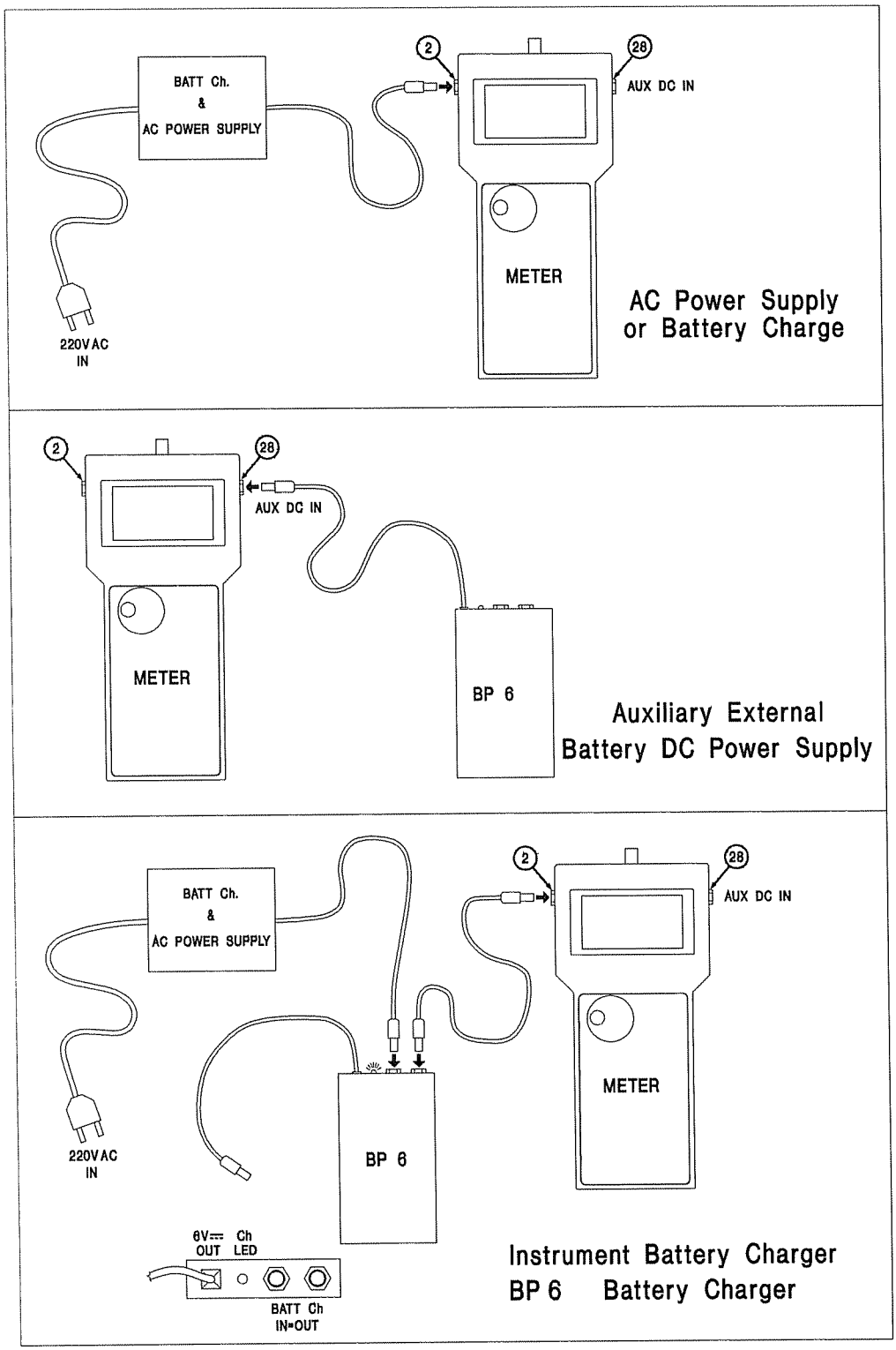


Figure 16 How to power the instrument via, and battery recharge with, BP6 pack

13.WARRANTY

This Unaohm instrument is guaranteed against defects in workmanship and materials for a period of one year. Any necessary adjustments or repairs will be provided from our works or our representatives' service centre where the instrument is to be delivered packed in adequate packing and fully insured, **AFTER an authorization for return has been received.**

The owner's responsibilities are to use the instrument in accordance with its written instructions, to provide transport to and from the factory or its service centre in the event service is required, and to provide proof of purchase if requested.

The warranty is considered void in case of tampering, changes or repairs carried out by unauthorized personnel.
Power supply batteries are not covered by the warranty.

OUT OF WARRANTY SERVICING

We repair and service instruments of our production even once the warranty has expired if this is economically the best solution to the customer.
The mechanical and electronic spare parts are replaceable for a five year period after production when the circuits are assembled with discrete components; when integrated circuits are used, the supply of spare parts is guaranteed up to the depletion of our stock and, depending on the possibility of procuring them on the worldwide market .
The repair of instruments out of warranty is normally carried out and then the final cost is communicated to the customer; the eventual request for an estimate of this cost prior to the actual repair must be made at the moment the instrument is returned to the factory or local service centre. If the estimate is not accepted, we will debit the customer for the costs incurred for the estimate evaluation.
To avoid unnecessary loss of time, it is very important that the instrument be returned to our factory or local service centre accompanied by a proper delivery note, duly completed with all the required information, as per the current legal dispositions in force.

Please use the specific forms included in the operator's manual or attach a letter specifying the defect found on the instrument, the name of the person to contact and the relative telephone number to contact for further information.

MISCELLANEOUS

The electric block diagram and other drawings included in this manual are only indicative. We reserve ourselves the right to make any changes that may be necessary without updating the operator's manual.