IT-100

MULTISYSTEM TV ANALYZER

OPERATING MANUAL

PLANAR

Revision 1.8 of 26.11.2019

CONTENS

1. GENERAL INFORMATION

1.1. Introduction

This Operating Manual is intended for introducing the design, functions, and basic instructions related to operation, servicing and transportation of the IT-100 Multisystem TV Analyzer (Analyzer).

The IT-100 Multisystem TV Analyzer is designed for measuring parameters of digital and analog TV signals and for controlling TV picture and audio channel.

The Analyzer can be used both in laboratory, powered by an external power source, and in field, powered by batteries.

The reliability of the IT-100 is ensured by fulfillment of regular maintenance procedures. These procedures and their intervals are described in section 5.

In this manual the following abbreviations are used:

- 8PSK – 8-ary Phase Shift Keying;
- 16APSK – 16-ary Amplitude and Phase Shift Keying;
- 32APSK – 32-ary Amplitude and Phase Shift Keying;
- ADC – Analog To Digital Converter;
- BER – Bit Error Ratio;
- CATV – Cable Television;
- CDL – Channel Data Logger;
- C/N – Carrier-to-noise ratio;
- CP – Channel Plan;
- CSO/CTB – Composite Second Order and Composite Triple Beat;
- DF – Delay Factor;
- DiSEqC – Digital Satellite Equipment Control;
- DL – Data Logger;
- DNS – Domain Name System;
- DVB-C – Digital Video Broadcasting – Cable;
- DVB-S/S2 – Digital Video Broadcasting – Satellite;
- DVB-T/T2 – Digital Video Broadcasting – Terrestrial;
- ES – Erroneous Second;
- IAT – Inter-Arrival Time;
- ICMP – Internet Control Message Protocol;
- IF – Intermediate Frequency;
- IP – Internet Protocol;
- IPTV – Internet Protocol Television;
- ISI – Input Stream Identifier;
- LCD – Liquid Crystal Display;
- LNB – Low Noise Block;
- LP – Limit Plan;
- MER - Modulation Error Ratio;
- MLT – Media Loss Total;
- MPEG – Moving Picture Expert Group;
- NTSC – National Television System Committee (Color TV broadcasting standard);
- PAL – Phase Alternating Line (Color TV broadcasting standard);
- PC – Personal Computer;
- PCR – Program Clock Reference;
- PER – Packet Error Ratio;

- PLS – Physical Layer Scrambling;
- QAM – Quadrature Amplitude Modulation;
- QPSK – Quadrature Phase Shift Keying;
- RF – Radio Frequency;
- RMS – Root Mean Square;
- RTP – Real-Time Transport Protocol;
- SECAM – Séquentiel couleur à mémoire (Color TV broadcasting standard);
- SES – Severely Errored Second;
- TF – Transponder frequency;
- TS – Transport stream;
- TV – Television;
- UDP – User Datagram Protocol;
- URL – Uniform Resource Locator;
- V/A – Video to Audio carriers ratio.

1.2. Safety Precautions

Thoroughly inspect the product and carefully read the related documentation to get acquainted with all the safety markings and instructions before you start to operate the Analyzer.

WARNING Only trained service personnel aware of the hazards involved should perform repair on the Analyzer.

CAUTION Tuning the Analyzer and replacement of the components that influence the accuracy of measurements without service personnel is strictly prohibited, since the components used in the Analyzer are purpose-made and their replacement will result in inaccurate operation of the Analyzer. To exclude the possibility of mechanical damage to IT-100, the instructions regarding the storage and transportation (see sections 7 and 8) of the Analyzer must be observed.

2. GENERAL DESCRIPTION AND PRINCIPLE OF OPERATION

2.1. Function

The IT-100 Multisystem TV Analyzer is designed for measuring parameters of digital and analog TV signals and for controlling TV video and audio. The Analyzer enables measurement of the following parameters for analog TV channels: channel level, Video to Audio (V/A) ratio, Carrier to Noise (C/N) ratio. It allows measuring the following parameters for digital TV channels: channel power and Carrier to Noise (C/N) ratio. For J.83 Annex A/B/C (cable television), DVB-T/T2 signals (terrestrial television) and DVB-S/S2 signals (satellite television), IT-100 offers measurement of reception quality parameters: modulation error ratio MER, bit error ratio BER, constellation diagram, echo diagram and impulse response. The Analyzer allows for ETSI TR 101290 real time analysis of transport stream.

The Analyzer features operation in CATV networks distributing through coaxial or fiber-optic cables, as well as in IPTV channels.

IT-100 offers automatic defining of the channel settings (channel frequency, TV system, symbol rate, modulation, etc.).

The Analyzer can be connected to a personal computer to enable remote access to its functions and updating its firmware. External memory devices can be connected to the Analyzer via USB interface to enable data storage. IT-100 also features spectrum measurement mode. It allows measuring direct and alternating current voltage of remote networks powering and television and broadcasting reception distribution systems, as well

as supplying power to antenna amplifiers or LNBs. The Analyzer supports DiSEqC and «Single Cable Routing» command system.

The appearance of the Analyzer is shown in figure 2.1.

Figure 2.1

This Operating Manual is made in accordance with the IT-100 hardware version 02.100.1 and the 2.12.X.X/1.1.X.X firmware version.

2.2. Environment Conditionals

Normal operating conditions:

1) ambient temperature (23±5) ºC;
2) relative air humidity (55±25) %;
3) atmospheric pressure 84-106 kPa (630-795 mm Hg);
4) voltage transients correspond to CAT II measurement category.

Rated operating conditions:

1) ambient temperature from -10 to 50 ºC;
2) relative air humidity not greater than 90% at temperature 25 ºC;
3) atmospheric pressure 84-106 kPa (630-795 mm Hg).

2.3. Package Contents

The Analyzer package includes:

1) IT-100 Multisystem TV Analyzer ..... 1 pc;
2) Carrying Case ..... 1 pc;
3) Carrying Sling ..... 1 pc;
4) Crosshead Screwdriver ..... 1 pc;
5) Li-Ion 7.4V 4000mAh Battery ..... 1 pc;
6) Mains Charger ..... 1 pc;

7) Mains Charger Cable ..... 1 pc;
8) Car Lighter Adapter ..... 1 pc;
9) “F”-”F” Adapter ..... 1 pc;
10) “F”-”IEC” Adapter ..... 1 pc;
11) FC optical adapter with a dust cap ..... 1 pc;
12) SC optical adapter with a dust cap ..... 1 pc;
13) USB port cable ..... 1 pc;
14) Calibration certificate ..... 1 pc;
15) Quick start guide ..... 1 pc.

2.4. Specifications

2.4.1. Spectrum Analyzer

Operating frequency range:
- terrestrial broadcasting mode: .....5 to 1200 MHz;
- satellite broadcasting mode: .....950 to 2150 MHz;
Frequency resolution: .....25 kHz;
Level measurement range: ..... 20 to 120 dBµV;
Level measurement accuracy: .....±1.2 dB;
Level measurement accuracy at operating temperature: .....±1.5 dB;
Level measurement resolution: ..... 0.1 dB;
Frequency indication: ..... 7 characters;
Channel number indication: ..... 3 characters;
Signal level indication: ..... 4 characters;
Frequency sweep range: ..... 10,20,50,100,200,400,800,1200 MHz;
Measurement detector: .....Quasi-peak, Root-mean-square;
Reference level: ..... 50 to 120 dBµV, 10 dB step;
Resolution bandwidths: .....50, 120, 250, 1000 kHz;
Number of markers: 2;
“Quick” frequency sweep time in frequency ranges, less than:
- 1200 MHz: ..... 250 ms;
- 800 MHz: ..... 170 ms;
- 10,20,50,100,200 MHz: ..... 70 ms.

2.4.2. Analog TV signal parameters measurement

Operating frequency range: .....42 to 1002 MHz;
TV broadcasting standards: ..... B/G, I, D/K, M/N;
Color TV broadcasting standards: .....PAL, SECAM, NTSC;
Level measurement range: ..... 30 to 120 dBµV;
Level measurement accuracy (C/N>20 dB): .....±1.2 dB;
Level measurement resolution: ..... 0.1 dB;
Upper C/N measurement range value (channel level > 65 dBµV): ..... 50 dB;
HUM measurement range: ..... 0.6 to 20%;
Lower CSO/CTB measurement range value (channel level > 65 dBµV): ..... -62 dBc;

2.4.3. Digital CATV signal parameters measurement

Operating frequency range: .....42 to 1002 MHz;
Power measurement range: ..... 35 to 115 dBµV;
Power measurement accuracy (C/N>20 dB): .....±1.2 dB;
Digital CATV standards: ..... ITU-T J.83 ANNEX A/B/C;
Modulation type: QAM64, QAM128, QAM256;
Symbol rate: .....5.0 to 7.2 MSps;

MER measurement range: ..... 29 to 40 dB;
MER measurement accuracy: ..... ±2.0 dB;
MER measurement resolution: ..... 0.1 dB;
BER measurement resolution: ..... $1.0x10^{-3}$ to $1.0x10^{-12}$;
Minimal channel power for quasi-error-free decoding: ..... 50 dBµV.

2.4.4. DVB-T signal parameters measurement

Operating frequency range: ..... 42 to 1002 MHz;
Power measurement range: ..... 35 to 115 dBµV;
Power measurement accuracy (C/N>20 dB): ..... ±1.2 dB;
Modulation type: ..... QPSK, QAM16, QAM64;
MER measurement range: ..... 14 to 32 dB;
MER measurement accuracy: ..... ±2.0 dB;
MER measurement resolution: ..... 0.1 dB;
BER measurement resolution: ..... $1.0x10^{-2}$ to $1.0x10^{-10}$;
Minimal channel power for quasi-error-free decoding: ..... 45 dBµV.

2.4.5. DVB-T2 signal parameters measurement

Operating frequency range: ..... 42 to 1002 MHz;
Power measurement range: ..... 35 to 115 dBµV;
Power measurement accuracy (C/N>20 dB): ..... ±1.2 dB;
DVB-T2 standard: 1.3.1;
Modulation type: ..... QPSK, QAM16, QAM64, QAM256;
MER measurement range: ..... 22 to 32 dB;
MER measurement accuracy: ..... ±2.0 dB;
MER measurement resolution: ..... 0.1 dB;
BER measurement resolution: ..... $1.0x10^{-2}$ to $1.0x10^{-10}$;
Minimal channel power for quasi-error-free decoding: ..... 45 dBµV.

2.4.6. DVB-S/S2 signal parameters measurement

Operating frequency range: ..... 950 to 2150 MHz;
Power measurement range: ..... 45 to 115 dBµV;
Power measurement accuracy (C/N>20 dB): ..... ±1.2 dB;
Modulation type: ..... QPSK, 8PSK, 16APSK, 32APSK;
Symbol rate: ..... 1 to 45 Msps;
DiSEqC standards: 1.0, 1.1, 1.2, 2.0, 2.1, 2.2;
«Single Cable Routing» standard: ..... EN 50494;
MER measurement range: ..... 14 to 25 dB;
MER measurement accuracy: ..... ±2.0 dB;
MER measurement resolution: ..... 0.1 dB;
BER measurement resolution: ..... $1.0x10^{-2}$ to $1.0x10^{-9}$;
Minimal channel power for quasi-error-free decoding: ..... 45 dBµV.

2.4.7. IPTV signal parameters measurement

Transport protocol: ..... UDP, RTP;
IP routing type: ..... unicast, multicast (IGMP v2);
TS bitrate: ..... 70 Mbps.

2.4.8. Optical input parameters

Operating wavelength range: ..... 1100 to 1650 nm;
Power measurement range: ..... -20 to +8 dBm;
Operating power level range of optical receiver: ..... -9 to +2 dBm;
0 dBm optical power measurement accuracy: ..... ±0.5 dB;
Optical power measurement resolution: ..... 0.1 dB;

Calibration wavelengths of power meter: ..... 1310, 1550 nm.

2.4.9. TV video and sound analysis parameters

Video codecs: .....H.264/AVC L4.1 HP, MPEG-2 MP@HL, VC-1 AP L3, AVS PL 6.0;
Video resolution: 1080i60, 1080p30, 720p60, 576p;
Video aspects ratio: 16:9, 4:3;
Audio codecs: ..... MPEG1 L1/2, HE-AAC;
CAM module interface: ..... CI[1].

2.4.10. Transport stream analysis parameters

TS analysis: ..... in accordance with TR101290 standard (except 3.3, 3.9, 3.10);
TS bitrate: ..... 80 Mbps.

2.4.11. Transport stream recording parameters

File format: ..... TS;
Target drive: ..... internal drive only;
TS bitrate: ..... 60 Mbps;
Recording time: ..... 10 min;

2.4.12. Inputs and interfaces

RF Input connector: ..... 75Ω F-male;
Maximum RF signal power: ..... +20 dBm;
Maximum input voltage (DC to 100Hz): ..... 90 V peak;
RF input return loss, not less than: ..... 14 dB;

Optical connector type: ..... replaceable, FC or SC, single mode 9/125;
Maximum input power: ..... +10 dBm;

USB interface: ..... USB2.0 host and USB2.0 device;
LAN interface: ..... Ethernet RJ45 10/100M;
CAM module connector: ..... PCMCIA;
Powering connector: ..... DJK-02B (5.5x2.5).

2.4.13. General specifications

Display: ..... 4.3” TFT, 480x272 pix;
Remote powering supply voltage: ..... 5,12,13,18,24 V;
Output remote powering: ..... 5 W;
Analyzer can be powered by:
- AC circuit with 100 to 242 V via 12V/3.3A charger;
- external 12±0.6 V DC source;
- internal Li-Ion 7.4 V 4000 mAh battery.

Battery life time: ..... 4 h;
Warm-up time: ..... 2 min;
Dimensions:
- analyzer: ..... 245x150x65 mm;
- package: ..... 425x325x135 mm;

Weight:
- analyzer: ..... 1.5 kg;
- in package: ..... 3.4 kg.

[1] Not compatible with CAM modules with CI+ interface

2.5. IT-100 Range of Application

The IT-100 Analyzer is designed to ensure high-performance control and adjustment of television and broadcasting distribution networks, as well as of separate components of such networks, or other electronic devices. The Analyzer allows for measurement of TV signal level, DVB-C/T/T2/S/S2 and ITU-T J.83 annex A,B,C digital and analog signal parameters. It also enables measurements of optical signal power and fiber-optic cable network parameters.

The Analyzer can be used both in laboratory, powered by an external power source, and in field, powered by batteries.

2.6. Design and Operation Overview

2.6.1. Principle of Operation

The IT-100 Multisystem TV Analyzer is basically a TV signal receiver demodulating signal to MPEG transport stream. If the transport stream is encrypted, it is restored by a CAM-module and decoded into TV picture and sound. The input tuner is a double-conversion superheterodyne receiver with manual and automatic frequency adjustment. Modulation error ratio MER and constellation diagram are measured during demodulation of quadrature signal based on vector analysis. Bit error ratio BER in digital transport stream is measured by means of analysis of operation of noise immune convolutional codecs. Radio signal measurement is performed by means of conversion of analog RF signal into digital sequence using ADC and its further processing using signal processor based on discrete Fourier transformation. The principle of operation of spectrum analyzer is based on serial or parallel method of analysis with spectrum indication on display.

The resulting image is displayed on LCD in the measurement mode of digital and analog TV signals reception quality parameters and is basically numerical values and graphical representation of measured digital parameters (modulation error ratio and bit error ratio). The constellation diagram mode features vector structure of quadrature components of demodulated signal with digital modulation in the phase plane. The spectrum analyzer mode displays the tested signal amplitude to frequency dependence chart. The TV channel radio signal level measurement mode displays numeric value of signal level, video carrier to audio carrier level ratio and carrier to noise ratio in the distribution channel for analog channels or signal power in the channel band for digital modulation signals.

2.6.2. Component Arrangement

The IT-100 Analyzer is implemented in plastic shockproof sectional housing with rubber-coated protective elements and includes printed and three-dimensional wiring.

The front panel of the Analyzer consists of a keypad, a graphical display and battery charge and external power source status indicators (figure 2.2). A loudspeaker (1) and a fold-out support (2) are located on the rear panel (figure 2.3) of the Analyzer.

Figure 2.2

Figure 2.3

1) functional keys enable the commands shown on the screen of the Analyzer.
2) alphanumeric keys.
3) **«Shift»** key enables selection of an alternative set of functional keys and additional functions of alphanumeric keys indicated by yellow icons.
4) remote feeding power source status indicator.

Indicator	**External power source status**
(No light)	Power source is off.
(Green light)	Power source is on. The input connector voltage is normal.
(Red light)	Power source failure. The input connector voltage is outside the predefined limits.

5) battery charge indicator.

Indicator	**Battery charge status**
(No light)	No power from the charger.
(Yellow light)	The battery is charging.
(Green light)	The battery is charged.
(Red light)	Battery failure.

6) navigation keys.
   - **«▲»**, **«▼»**, **«◄»** and **«►»** keys are used to move the cursor on the LCD screen;
   - **«ENTER»** is used to confirm the current command entry;
   - **«EXIT»** is used to cancel the current command or return to a previous menu level.
7) **«⏻»** key switches the Analyzer on/off.

The lower panel (figure 2.4) has a cover under which the communication ports for connecting the Analyzer with the external devices and the external power source connector are located. Below are air gates.

Do not close the air gates during the Analyzer operation. This may cause the Analyzer overheating!

The upper panel (figure 2.5) includes the input RF connector and optical connector.

Figure 2.4

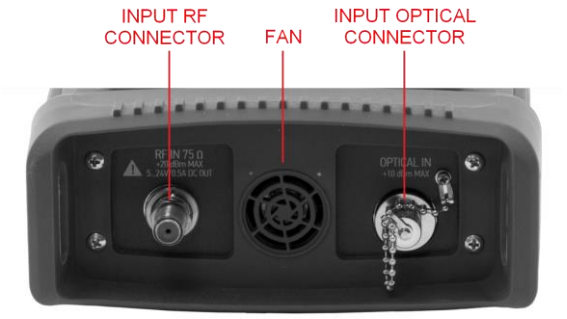


Figure 2.5

The right panel (figure 2.6) has the CAM module compartment cover fixed by two captive screws.

Figure 2.6

The CAM module port and eject button are inside the compartment (figure 2.7). In order to install or remove the CAM module, unscrew the captive screws using the screwdriver included in the package. The right screw should be unscrewed completely to allow the compartment cover rotate freely on the left screw, which should be unscrewed by half the first. **The CAM module should be installed face (surface A) down to the bottom of the Analyzer.**

To remove the module, press the eject button.

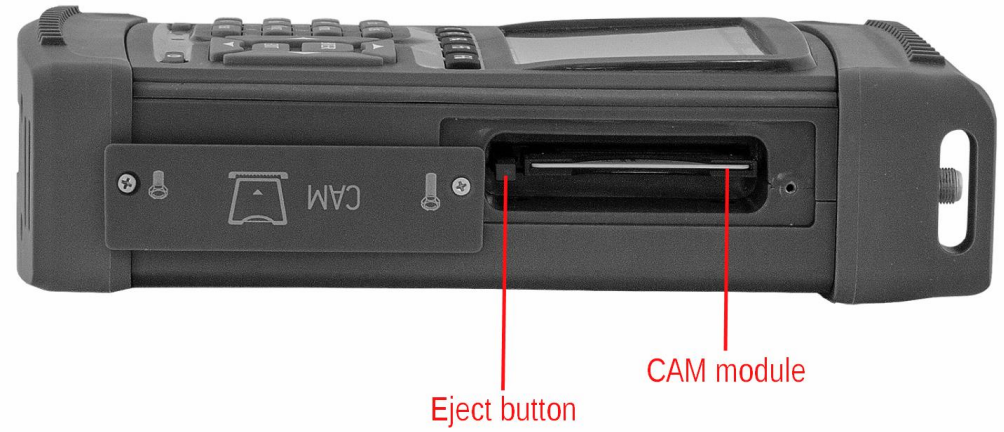


Figure 2.7

3. PREPARATION FOR OPERATION

Perform external examination to make sure your IT-100 is free from any visible mechanical damage.

Upon receipt of the package, check the availability of the items contained in it against the list provided (see section 2.3).

If your IT-100 has been kept in the environment other than the rated operating conditions, leave the Analyzer in facilities with normal operating conditions at least for 2 hours prior to operation.

4. OPERATION PROCEDURE

4.1. Operation starting

Before you start to operate your IT-100 make sure to carefully read this Operating Manual as well as to inspect the location of the controls and indicators of the Analyzer (section 2.6.2).

To prepare your Analyzer for operation from an external power source, connect the Charger to the connector located on the bottom of the Analyzer and then to the power source. Push and hold the **«⏻»** key until the LCD backlight turns on.

To prepare your IT-100 for operation in stand-alone mode, powered by batteries, push and hold the **«⏻»** key until the LCD backlight turns on.

The following message (figure 4.1) will appear on the screen, when firmware is started up.

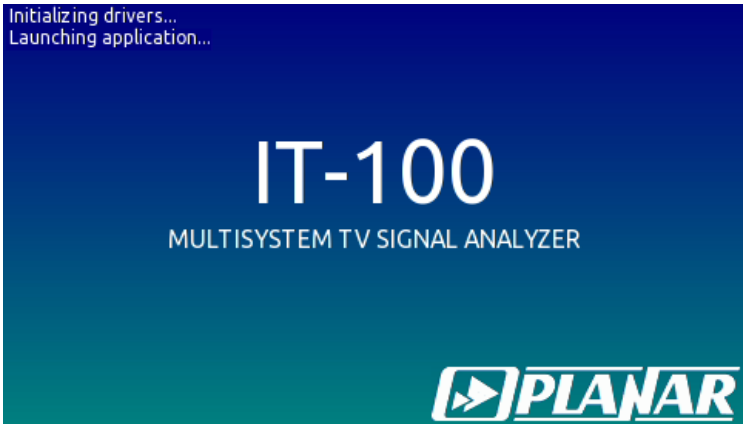


Figure 4.1

The screen displays name and type of the Analyzer. In approximately one second, the Analyzer will open the main mode selection menu – Main Menu (figure 4.2) or the last previously operated mode before the power was switched off (section 4.10.3).

4.2. Controls and Indicators

The location of controls, indicators and connectors is described in section 2.6.2.

To select an alternative function of a key, press the **«Shift»** key once. An alternative function for switching between the measurements modes will appear in the field of functional keys. The Analyzer will return to the basic functional keys layout after you press any key.

To select a “hot key”, press the **«Shift»** key and one of the alphanumeric keys with additional functions simultaneously:

Key	Icon	Function
7		Battery service mode (section 4.13)
8		Screenshot saving to file (section 4.11)
9		Selecting system panel indicated data: current operating mode name, current time, current date
.space		Remote feeding power supply control (section 4.3.1.5)
0		Volume adjustment (sections 4.7.2, 4.7.3)

The Analyzer features interactive operating mode selection menu, which is basically a set of graphical pictures (icons) on the LCD screen, each of which corresponds to a certain mode. The selection menu is shown in figure 4.2.

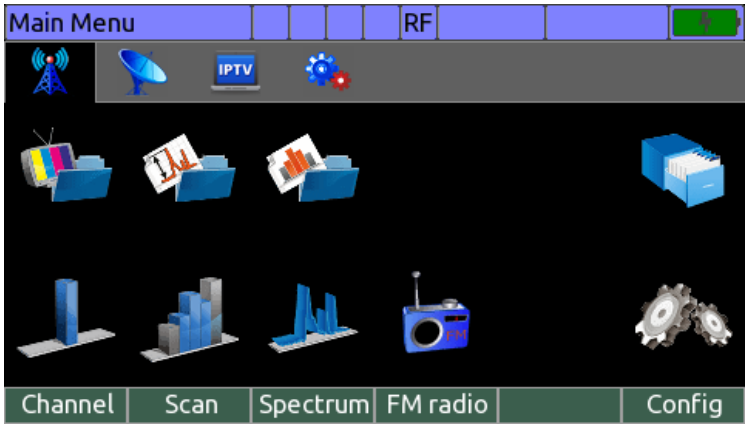


Figure 4.2

The menu introduces four tabs (pages) of icons: the page of terrestrial TV measurement icons , the page of satellite TV measurement icons , the page of IPTV measurement icons and the page of setting icons which are switched using the **«◄»** and **«►»** keys. To select a mode, set its icon in the bottom screen line. The mode names will appear on functional keys. Use the corresponding functional key to select the mode. Press **«EXIT»** to go back to the selection menu.

4.3. Terrestrial TV Channels Measurement Procedure

4.3.1. General Data

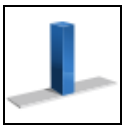
4.3.1.1. Measurement modes and switches among them

The Analyzer features four basic and several additional measurement modes:

1) Channel parameters measurement in the **Channel** mode.
   Additional modes for analog channels:
   - video and sound control (**Video**);
   - second-order and third-order distortion measurement in the cable network (**CSO/CTB**);
   - measurement of unwanted modulation (**HUM**);
   - reception quality parameters monitoring (**Statistics**).

   Additional modes for digital channels:
   - video and sound control (**Video**);
   - transport stream analysis (**MPEG Analyzer**);
   - transport stream recording (**MPEG Recorder**);
   - reception quality parameters monitoring (**Statistics**);
   - DVB-T/T2 echo diagram (**Echo Diagram**);
   - DVB-C and J.83-B/C demodulator equalizer parameters measuring (**Equalizer**).
2) All channels level measurement in the **Full Scan** mode.
   Additional modes:
   - channel flatness measurement in absolute and relative terms;
   - channel tilt measurement in absolute and relative terms.
3) Signal spectrum measurement in the **Spectrum** mode;
4) FM radio station parameters measurement in the **FM radio** mode.

In the Main Menu (figure 4.2), use the **«▲»** and **«▼»** buttons to set the desired measurement mode icon in the bottom line of the screen. The following icons correspond to measurement modes:

			
Channel	**Scan**	**Spectrum**	**FM radio**

Click on one of the functional keys with the desired icon to select the measurement mode. Press **«EXIT»** to return to the selection menu.

On the functional keys panel, **«F1»** is used to open the setting menu, and **«F2»** to **«F6»** are used to set up the current mode. Press the **«Shift»** key to display the functional keys which enable quick switching between measurement modes.

4.3.1.2. Screen view in measurement modes

The screen view in all measurement modes has common elements and settings, as shown in figure 4.3.

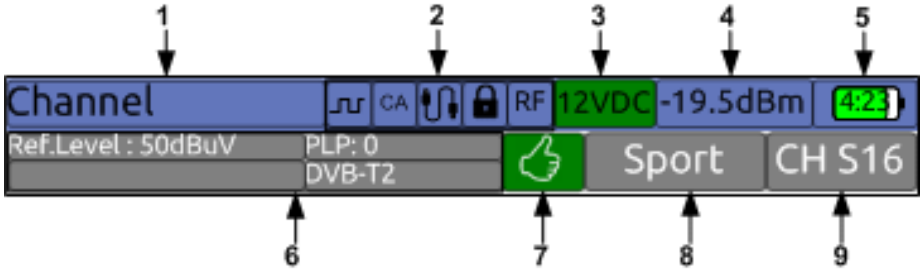


Figure 4.3

The spaces are aimed to display the following information:

1) Depending on the selected indication type: current operating mode name, current time, current date (section 4.10.3);
2) Modes and settings icons;
3) RF input or output voltage value;
4) Optical power value in case optical input is selected;
5) Battery charge status and remaining time;
6) Current mode parameters and measuring channel parameters;
7) Automatic limit plan test results;
8) Selected channel name;
9) Selected channel number.

Modes and settings icons are the following:

	LNB power 22 kHz modulation mode
	Conditional access module (CAM) found
	Device connected to PC via USB port
	Selected channel synchronization indicator
	Selected input indicator: RF (radio frequency) or OP (optical).

4.3.1.3. Navigation

Channel or frequency navigation (depending on the **Setting** parameter value and the selected mode) is carried out by the **«◄»** and **«►»** keys or alphanumeric keys. To select a special channel, start its entry with the **«.space»** key. Press **«ENTER»** after you complete the number entry. If the channel number entered is incorrect, the previous channel number will be displayed.

If you use the **«◄»** and **«►»** keys in the selected channel plan operating mode (section 4.3.13.1), tuning will be performed by channels from the plan. Direct entry of the channel number allows tuning to any channel. If such channel is not listed in the channel plan, only its number will be displayed on the screen. Channel tuning and numbering is carried out in accordance with the selected channel allocation standard (channel template) (section 4.10.2).

4.3.1.4. Checking According to Limit Plan

In the **Channel** measurement mode the measured parameters are checked for compliance with the selected limit plan. The green indicator is displayed on the screen if the parameter values are within the set limits. Otherwise the red indicator is displayed. Values of measured parameters which are outside the set limits are highlighted in red.

Note. The checking in switched off by default.

4.3.1.5. Remote feeding power supply

To power external devices, such as, for example, antenna amplifiers, the IT-100 analyzer is equipped with a controlled remote power source. Power from the source feeds the RF input connector. To set the voltage value, as well as to turn the source on or off, it is necessary to call the source control mode. To call the mode, press the **«Shift»** button and then, without releasing it, press the **«** / **.space»** button. The control mode window will appear on the screen as shown in figure 4.4:

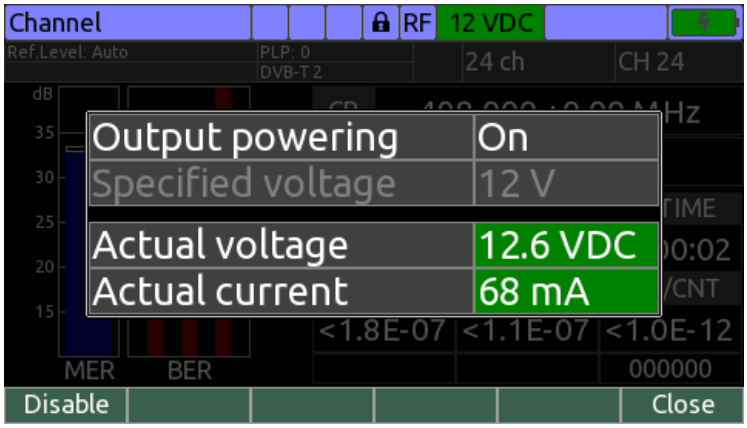


Figure 4.4

The source control mode is only called from one of the measurement modes. To set the voltage value from the 5V, 12V or 24V series, use the **«◄», «►»** or **«F3 / ◄», «F4 / ►»** buttons. Voltage change is only possible when the source is turned off. To turn the source on/off, press the **«F1 / Enable/Disable»** button. If the source is switched on, the current power and current values are displayed in the mode window. If the values are within acceptable limits, then the background color is green. The green color of the LED on the front panel of the analyzer duplicates the indication of the power supply to the input connector. In case of a source failure error detection (there is power on the input of the

analyzer, the power is out of tolerance or the current exceeds the allowable value), the panel color of the power or current value becomes red, which is also duplicated by the red light of the LED.

If the source is switched off, the value of the voltage that is fed to the input of the device is displayed in the window. The nature of the voltage is also displayed. The direct voltage is accompanied by the abbreviation VDC, alternating voltage by the abbreviation VAC.

To exit the mode, press the **«F6 / Close»** or **«EXIT»** button.

4.3.2. Operating Modes Settings

Parameters setting program is intended for setting the device operation parameters in the terrestrial TV broadcasting mode. The  icon in the terrestrial TV folder corresponds to this mode. The parameters setting screen view is shown in figure 4.5:

VHF/UHF setup					RF				
Parameter								Value	
Input signal source								RF	
Test point compensation								Off	
Test point attenuation								20.0 dB	
Optical signal wavelength								1310 nm	
Channel template								OIRT	
Level units								dBuV	
HUM power grid								50 Hz	
Output measurement results via USB								Off	
Save									Cancel

Figure 4.5

The table includes the following editable parameters:

1) **Input signal source**. Selection of radio frequency (RF) or optical input (OP).
2) **Test point compensation**. Enabling signal level correction during measurement at test point.
3) **Test point attenuation**. Test point signal attenuation value.
4) **Optical signal wavelength**. Selection of optical signal wavelength.
5) **Channel template**. Selection of TV system.
6) **Level units**. Selection of signal level measurement units.
7) **HUM power grid**. Setting the power grid frequency value for HUM modulation measurement.
8) **Output measurement results via USB**. Enabling measurement results output via USB interface (section 4.14).

4.3.3. TV Channel Parameters Measurement in Channel Mode

The Channel mode allows displaying level and other reception quality parameters of TV channel. View of the mode and functionality set depends on the measured channel type (analog or digital).

4.3.3.1. Analog channel measurement

The screen view and information displayed for analog channel parameters measurement option are shown in figure 4.6.

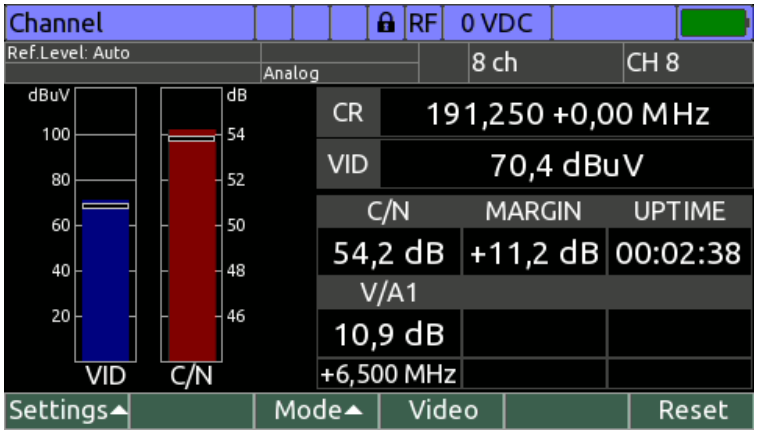


Figure 4.6

The following parameters are displayed on the screen: video carrier frequency and frequency offset (**CR**), measured level (**VID**), as well as reception quality parameters, such as video to audio ratio (**V/A1**, **V/A2**), audio carrier frequency offset, carrier to noise ratio (**C/N**) and carrier to noise margin (**MARGIN**). **UPTIME** parameter shows elapsed time since TV channel was locked. In case a parameter value is outside the limits of selected limit plan (section 4.3.14), it is indicated with red background.

Level and carrier to noise ratio values are indicated in graphical form in left part of the screen. The bar height indicate current parameter value, and markers indicate minimal and maximal parameter value achieved.

Channel selecting is performed with the **«◄»** and **«►»** key pressing. When pressed with **«Shift»** holding, channel is changed with bigger step. Channel can also be selected by typing its number with alphanumeric keyboard.

When a channel is selected, the Meter will automatically detect the standard and modulation parameters. It is recommended to use channel plan (section 4.3.13) in order to make synchronization faster.

To set up the mode, press **«F1 / Settings»**. The following parameters are available for editing in the dropdown menu:

1) **Ref. level**. Selection of reference level value. Possible values are **50** to **120 dBuV** and **Auto**. The setting resolution is 10 dB. The parameter sets up the maximum possible measured signal level;
2) **Level scale**. Setting level histogram division value: **2**, **5, 10** or **20 dB**;
3) **Averaging**. Selection of measured parameters averaging factor: **Off**, **Low**, **Medium**, **High**. It is recommended to operate with averaging switched off when perform antenna positioning;
4) **Sound indication**. Selecting the parameter value sound indication type: **off** – switched off, **Tone** – sound frequency is proportional to parameter value, **Pulse** – pulse repetition rate is proportional to parameter value;
5) **Indicate parameter**. Selecting the parameter to indicate its value with sound: **level** – channel power, **MER or C/N** – MER or C/N value.

Press **«F3 / Mode»** to get access to additional measurement modes. The following modes are available in the dropdown menu:

1) **HUM**. Undesirable modulation measurement mode (section 4.3.9);
2) **CSO&CTB**. Composite Second Order and Composite Triple Beat measurement in cable network (section 4.3.10);
3) **Statistics**. Channel reception quality monitoring (section 4.3.11).

Press **F4 / Video** to enter TV Video and Sound analysis operating mode. Press **F5 / Info** to see channel modulation parameters. Press **F6 / Reset** to clear all the measurement results and restart measuring.

To switch the external devices power supply on and off, use the source control mode. To call the mode, press the **«Shift»** key and then, without releasing it, press **/ .space** key (section 4.3.1.5).

To open the **Scan** or **Spectrum** measurement modes, use the **«F2»** and **«F3»** keys in the additional set of functions, which is started by pressing the **«Shift»** key.

4.3.3.2. Digital channel measurement

Digital modulation channels feature measurements of actual channel power level in the channel allocation bandwidth and TV channel reception quality parameters in numeric form and in the form of vertical bars (figure 4.7).

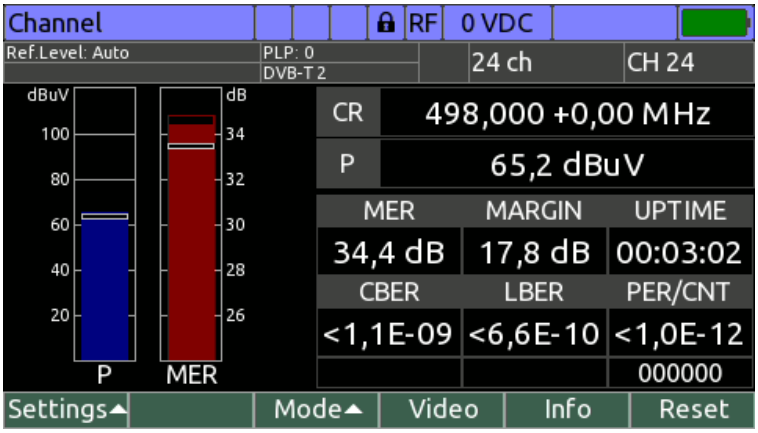


Figure 4.7

The following data is displayed on the screen: tuning frequency and frequency offset (**CR**), actual channel power level in the channel allocation bandwidth (**P**) and measured reception quality parameters, such as modulation error ratio (**MER**), MER margin to quasi error-free reception threshold (**MARGIN**), uncorrected MPEG packets rate and quantity on demodulator output (**PER/CNT**). The following parameters of decoders are measured for different standards:

1) DVB-C and J.83-B/C. Bit error rate before Reed Solomon decoder (**CBER**);
2) DVB-T. Bit error rate before Viterbi decoder (**CBER**) and after Viterbi decoder (**VBER**);
3) DVB-T2. Bit error rate before LDPC decoder (**CBER**) and after LDPC decoder (**LBER**).

UPTIME parameter shows elapsed time since TV channel was locked. In case a parameter value is outside the limits of selected limit plan (section 4.3.14), it is indicated with red background.

Level value and MER values are indicated in graphical form in left part of the screen. The bar height indicate current parameter value, and markers indicate minimal and maximal parameter value achieved.

Channel selecting is performed with the **«◄»** and **«►»** key pressing. When pressed with **«Shift»** holding, channel is changed with bigger step. Channel can also be selected by typing its number with alphanumeric keyboard.

When a channel is selected, the Meter will automatically detect the standard and modulation parameters. It is recommended to use channel plan (section 4.3.13) in order to make synchronization faster.

To set up the mode, press **«F1 / Settings»**. The following parameters are available for editing in the dropdown menu:

1) **Ref. level**. Selection of reference level value. Possible values are **50** to **120 dBuV** and **Auto**. The setting resolution is 10 dB. The parameter sets up the maximum possible measured signal level;
2) **Level scale**. Setting level histogram division value: **2**, **5, 10** or **20 dB**;
3) **Averaging**. Selection of measured parameters averaging factor: **Off**, **Low**, **Medium**, **High**. It is recommended to operate with averaging switched off when perform antenna positioning;
4) **Sound indication**. Selecting the parameter value sound indication type: **off** – switched off, **Tone** – sound frequency is proportional to parameter value, **Pulse** – pulse repetition rate is proportional to parameter value;
5) **Indicate parameter**. Selecting the parameter to indicate its value with sound: **level** – channel power, **MER or C/N** – MER or C/N value;
6) **View**. Graphical data representation type: **Histogram** – Level and MER values in form of a graph, **Constellation** – constellation diagram;
7) **Zoom**. Constellation diagram zoom mode: **x1** or **x4**;
8) **PLP**. Selecting PLP stream for DVB-T2 channel;
9) **Profile**. Selecting stream for DVB-T channel: **HP** – high priority stream, **LP** – low priority stream.

To get access to additional measurement modes, press the **«F3 / Mode»** key. The following functions are available in the dropdown menu:

1) **MPEG Analyzer**. MPEG transport stream analyzing (section 4.6);
2) **MPEG Recorder**. MPEG transport stream recording to file (section 4.8);
3) **Statistics**. Channel reception quality monitoring (section 4.3.11);
4) **Echo Diagram**. DVB-T/T2 channels echo diagram measurement (section 4.3.6);
5) **Equalizer**. Equalizer parameters measuring for DVB-C and J.83-B/C channel (section 4.3.8).

Press **F4 / Video** to enter TV Video and Sound analysis operating mode. Press **F5 / Info** to see channel modulation parameters. Press **F6 / Reset** to clear all the measurement results and restart measuring.

To switch the external devices power supply on and off, use the source control mode. To call the mode, press the **«Shift»** key and then, without releasing it, press  **/ .space** key (section 4.3.1.5).

To open the **Scan** or **Spectrum** measurement modes, use the **«F2»** and **«F3»** keys in the additional set of functions, which is started by pressing the **«Shift»** key.

4.3.4. Signal Spectrum Measurement in Spectrum Mode

The radio signal spectrum is displayed on the screen in this mode. The screen view and the information displayed are shown in figure 4.8:

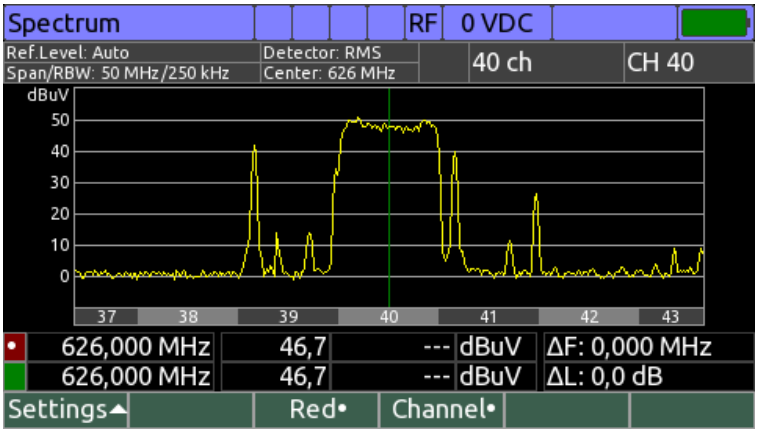


Figure 4.8

Information panel is indicated at the top of the screen and represents the following information:

1) **Ref.Level**. Selected reference level;
2) **Span/RBW**. Spectrum window span and measurement filter bandwidth;
3) **Detector**. Selected level detector type;
4) **Center**. Spectrum window central frequency;
5) Channel number and name in the selected marker position.

There is a spectrum window with a couple of markers in the central part of the screen. At the bottom of the spectrum window the ruler is displayed. It can be represented as channel boarders indicator, or frequency ruler (see **«Frequency ruler»** setting below).

There is a information of the measurement results in the markers position at the bottom of the screen: marker frequency, current level in the marker position, level of the additional trace in the marker position (▲ - minimum trace, ▼ - maximum trace), level units, **ΔF** – markers frequency difference absolute value, **ΔL** – markers level difference absolute value.

The following navigation modes can be selected with **«F4»** key pressing:

1) Channels navigation (**«Channel•»** is indicated on **F4** key, **«Tuning»** parameter is set to **«Channel»** value). **«◄»** and **«►»** keys are used for selecting channel to be measured. When pressed together with **«Shift»**, channels are listed with a bigger gap. The channel number can be entered with the alphanumeric keyboard. When the channel is selected, the markers will be allocated according to the channel type: analog channel – on the video and audio carriers, digital channel – on the channel central frequency;
2) Spectrum window moving (**«Window•»** is indicated on **F4** key, **«Tuning»** parameter is set to **«Frequency»** value). **«◄»** and **«►»** keys are used for moving the spectrum window. When pressed together with **«Shift»**, window frequency is changing with bigger step. The frequency can also be entered with the alphanumeric keyboard;
3) Marker moving (**«Marker•»** is indicated on **F4** key). **«◄»** и **«►»** are used for moving the selected marker in the spectrum window. When pressed together with **«Shift»**, marker frequency is changing with bigger step. The frequency can also be entered with the alphanumeric keyboard. Marker selecting can be performed with **«F3»** key. Selected marker color is indicated below the key.

To access the mode settings, press the **F1 / Settings** key. The following settings are available:

1) **Ref. level**. Selecting reference level value. Available values 50 to 120 dBuV and Auto. The setting resolution is 10 dBuV. The parameter sets up the maximum possible measured signal level;

2) **Level offset**. Possible values: **Manual** and **Auto**. In the **Auto** mode, the amplitude scale position is set automatically, in accordance with the maximal measured level value. In the **Manual** mode, the scale position can be set manually using the ▲ and ▼ keys;
3) **Level scale**. Setting the amplitude scale value: **5**, **10 dB**;
4) **Averaging**. Selecting measured level averaging degree. Availablevalues: **off**, **Low**, **Medium**, **High**;
5) **Hold level**. Enabling an additional signal level trace. Possible values: **off**, **MIN**, **MAX**. If an additional trace is enabled, the second signal line is displayed on the screen showing minimum and maximum values obtained during measuring. To reset the trace, press the **«F5** / **Reset»** key;
6) **Measure**. Measuring mode. Possible values: **Single**, **Quick**, **Precise**. In the single sweep mode a single scanning is carried out by pressing the **ENTER** or **F6 / Start** key. The **Quick** continuous scanning mode enables the quickest scanning by decreasing the level measurement accuracy. The **Precise** scanning mode allows for maximum accuracy of signal level measurements;
7) **Span**. Frequency scanning span. Possible span values and corresponding measuring filter passband values are given in the table below.

Scanning range, MHz	10	20	50	100	200	400	800	1200
Filter passband, kHz	50	250	250	1000	1000	1000	1000	1000

8) **Tuning**. Tuning mode: **Channel** – channels navigation, **Frequency** – moving spectrum window;
9) **Frequency ruler**. Selecting the horizontal scale presentation variant: **Channel** – channel boarders, **Frequency** – frequency marks;

To switch the external devices power supply on and off, use the source control mode. To call the mode, press the **«Shift»** key and then, without releasing it, press  **/ .space** key (section 4.3.1.5).

To open the **Channel**, **Scan** or **FM radio** measurement modes, use the **«F1»**, **«F2»** and **«F4» keys** in the additional set of functions, which is started by pressing the **«Shift»** key.

4.3.5. TV Channel Parameters Measurement in Full Scan Mode

The **Full Scan** mode is used for measurements of channel levels in full frequency span. There are five screen views in this mode:

1) **Full Scan.** Full Scan Channel level measurement.
2) **Limit.** Measurement of channel level flatness.
3) **Limit rel.** Measurement of channel flatness in relative terms.
4) **Tilt**. Tilt measurement at channel level tuning.
5) **Tilt rel.** Tilt measurement at channel level tuning in relative terms.

The screen view can be selected by pressing **«F2 / View»**.

In the **Full Scan** mode TV radio signal levels are displayed in the form of vertical bars. The screen view is shown in figure 4.9:

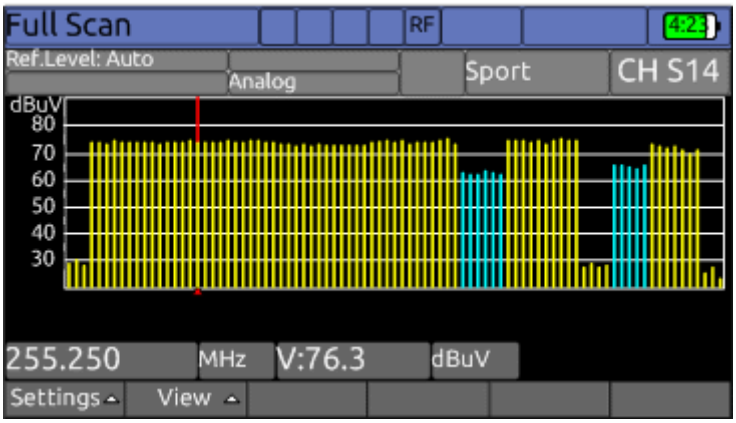


Figure 4.9

Analog channels are indicated by the yellow color, and digital – by blue. The tuning frequency and channel level values, which are marked by the marker, are displayed under the channel level chart. The marker position can be changed by the **«◄»** and **«►»** keys. To designate the marker position directly type in the channel number using the alphanumeric keys and press **«ENTER»**.

To set up the spectrum analyzer mode, press the **«F1 / Settings»** key. The following parameters will be available for editing in the dropdown menu.

1) **Ref.level**. Selection of reference level value. Possible values are **50** to **120dBuV** and **Auto**. The setting resolution is 10 dB. The parameter sets up the maximum possible measured signal level.
2) **Level offset**. Possible values: Possible values are **Manual** and **Auto**. In the **Auto** mode the amplitude scale position is set automatically. In **Manual** mode the scale position can be set manually by pressing the **«▲»** and **«▼»** keys.
3) **Scale**. Setting amplitude scale range values: **2dB**, **5dB** or **10dB**.
4) **Averaging**. Selecting averaging degree for measured values. Possible values: **Off**, **Medium**, **High**.

The screen view in the **Limit** mode is shown in figure 4.10.

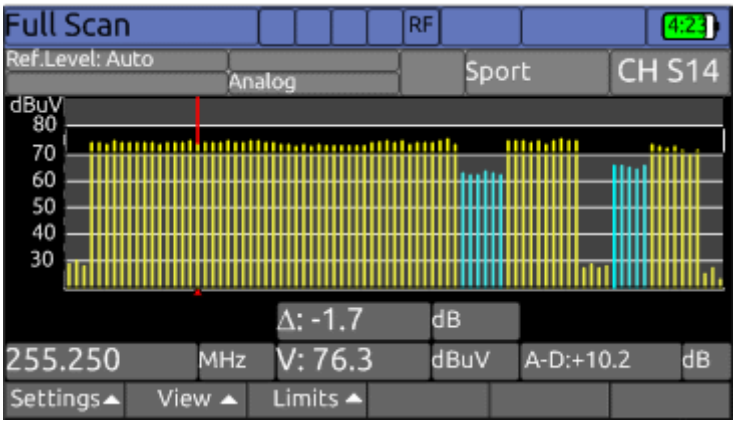


Figure 4.10

In the **Limit** mode the scope of permissible values of channel level is displayed additionally. The reference level and flatness are set up in the dropdown menu which is activated by the **«F3 / Limits»** key. The deviation from the reference level is indicated on the screen along with the channel level at which the marker is set up. The difference between analog and digital channels indicated in the corresponding limit plan is displayed as **A-D**.

The screen view in the **Limit rel.** mode is shown in figure 4.11.

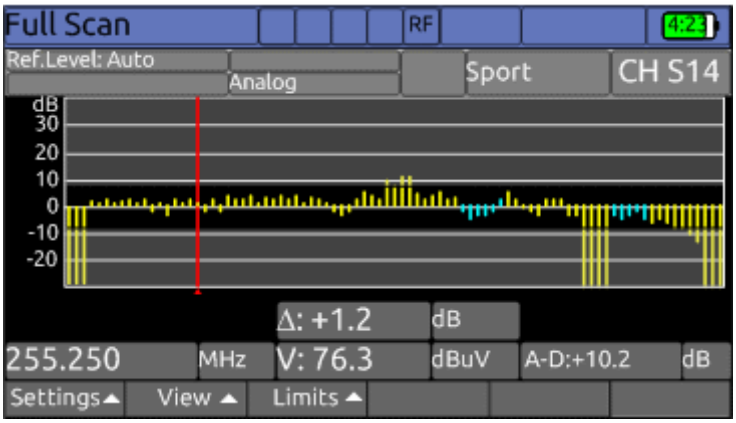


Figure 4.11

The level difference between measured and reference level is indicated on the screen. The digital channel levels are additionally compensated using the **A-D** value.

The screen view in the **Tilt** mode is shown in figure 4.12.

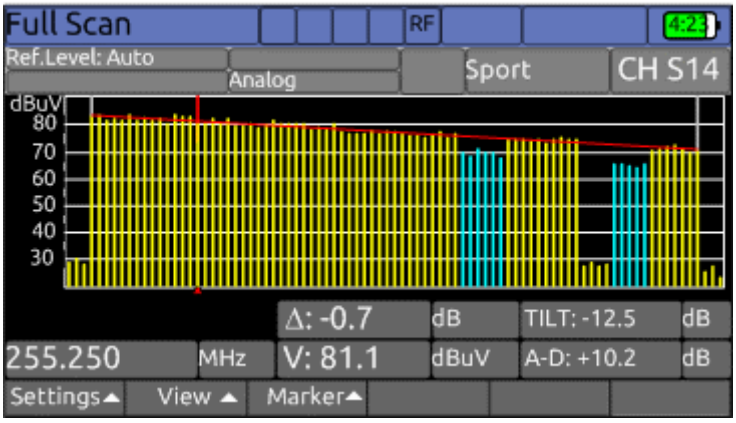


Figure 4.12

In the **Tilt** mode the tilt line between two selected reference channels is indicated on the screen. The reference channels location is set up in the dropdown menu, which is activated by pressing the **«F3 / Marker»** key. If a channel marked by the cursor is located between the markers, then the difference between the marked channel level and the tilt line will be indicated. The positive value means that the channel level is higher than the tilt line, and the negative value means that the channel level is lower than the tilt line. General tilt value between reference channels is indicated as **TILT**.

The screen view in the **Tilt rel.** mode is shown in figure 4.13.

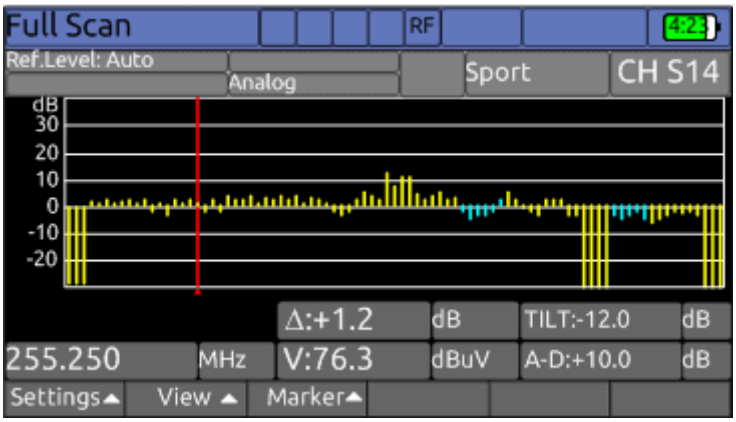


Figure 4.13

The difference levels between the measured values and the tilt line are displayed on the screen. The digital channel levels are additionally compensated using the **A-D** value.

4.3.6. FM radio station parameters measurement in FM radio mode

The FM radio mode allows displaying level and listening to the audio. The screen view and information displayed are shown in figure 4.14.

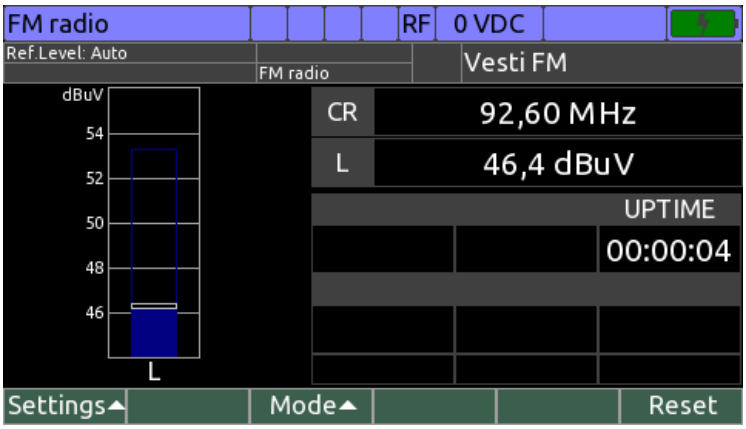


Figure 4.14

The following parameters are displayed on the screen: FM radio station carrier frequency (**CR**), measured level (**L**) and elapsed time since the measurement has started (**UPTIME**). In case a parameter value is outside the limits of selected limit plan (section 4.3.14), it is indicated with red background.

Level value is indicated in graphical form in left part of the screen. The bar height indicate current parameter value, and markers indicate minimal and maximal parameter value achieved.

FM radio station frequency selecting with 100 kHz spacing is performed with the **«◄»** and **«►»** key pressing. When pressed with **«Shift»** holding, frequency is changed with 1 MHz step. Frequency can also be selected with 10 kHz spacing by typing it with alphanumeric keyboard.

When operating with channel plan selected (section 4.3.13) the station is selected from the list of saved FM stations with the **«◄»** and **«►»** key pressing.

To set up the mode, press **«F1 / Settings»**. The following parameters are available for editing in the dropdown menu:

1) **Ref. level**. Selection of reference level value. Possible values are **50** to **120 dBuV** and **Auto**. The setting resolution is 10 dB. The parameter sets up the maximum possible measured signal level;
2) **Level scale**. Setting level histogram division value: **2**, **5, 10** or **20 dB**;

3) **Averaging**. Selection of measured parameters averaging factor: **Off**, **Low**, **Medium**, **High**. It is recommended to operate with averaging switched off when perform antenna positioning.

Press **«F3 / Mode»** to get access to additional measurement modes. The following modes are available in the dropdown menu:

1) **Statistics**. Channel reception quality monitoring (section 4.3.11).

Press **F6 / Reset** to clear all the measurement results and restart measuring.

To switch the external devices power supply on and off, use the source control mode. To call the mode, press the **«Shift»** key and then, without releasing it, press  **/ .space** key (section 4.3.1.5).

To open the **Spectrum** measurement modes, use the **«F3»** key in the additional set of functions, which is started by pressing the **«Shift»** key.

4.3.7. TV channels parameters measurement in Echo Diagram mode

The echo diagram deal with displaying DVB-T or DVB-T2 channel impulse response diagram, as well as basic reception quality parameters. The screen view and the data displayed are presented in Fig. 4.15:

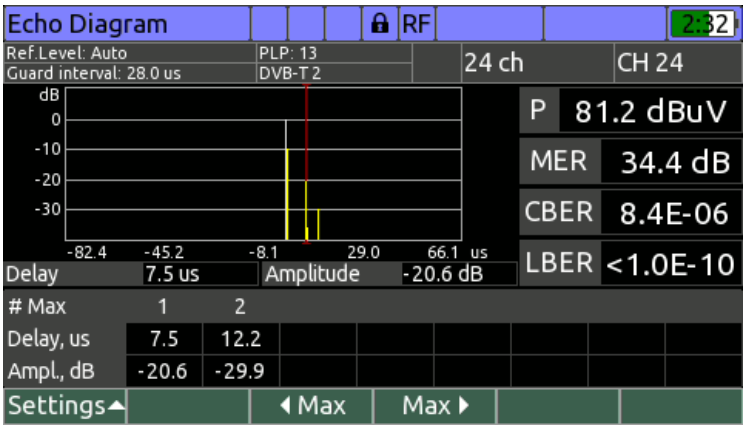


Figure 4.15

Echo diagram features the bar graph of signal amplitudes which arrive with delay after the main signal (of peak amplitude). Signal amplitude is measured in reference to the main signal amplitude in dB, while the main signal amplitude is assumed to be equal to 0 dB. The delay value can then be negative, i.e. the echo signal arrives to the signal reception point before the main signal. This is true if there reflected signal amplitude is higher than that of the main signal (for example, when the signal arrives from the transmission antenna and retransmitter).

The echo diagram is intended for high precision positioning of the reception antenna. The main quality criteria for the selection of signal arrival direction is minimum echo signal level, especially outside the guard interval limits. The positioning procedure requires controlling basic reception quality parameters, such as level, MER and BER.

To change the cursor position, use the ◄ and ► keys. Press one of these keys along with the **Shift** key to move the cursor by several positions. By pressing the **F3 / ◄Max** and **F4 / Max►** key, the cursor will shift through echo signals with maximum amplitude values. The echo signal delay and amplitude in the marker position are indicated under the diagram.

The echo diagram updating is indicated by the • marker in the upper right corner of the diagram. To make the echo signal analysis easier, the table of maximum amplitude

signals (up to 8 signals) is shown on the screen. The echo signals are arranged in the descending order of amplitude.

To change the measurement parameters, press the **F1 / Settings** key. The following settings will be listed in the dropdown menu:

1) **Zone**. Selecting the echo signal delay range indicated on the diagram: **Full-echo** – the full delay range supported by the Analyzer, **Pre-echo** – the negative delay range, **Post-echo** – the positive delay range, **Near-echo** – the range close to the main signal;
2) **Resolution**. The delay resolution of echo diagram measurement: **Normal** – fast echo diagram measurement with rough delay estimation, **High** – slow echo diagram measurement with precise delay estimation;
3) **Units**. The delay measurement unit: **Distance** – additional distance traveled by echo signal in reference to main signal in km or miles (depending on regional settings), **Delay** – echo signal arrival time in reference to main signal.

4.3.8. Equalizer parameters measurement of DVB-C and J.38-B/C channels

This mode allows displaying the parameters of signal demodulator equalizer, as well as the common quality parameters of DVB-C and J.83-B/C channels reception. The screen view and the data displayed are presented in Fig. 4.16:

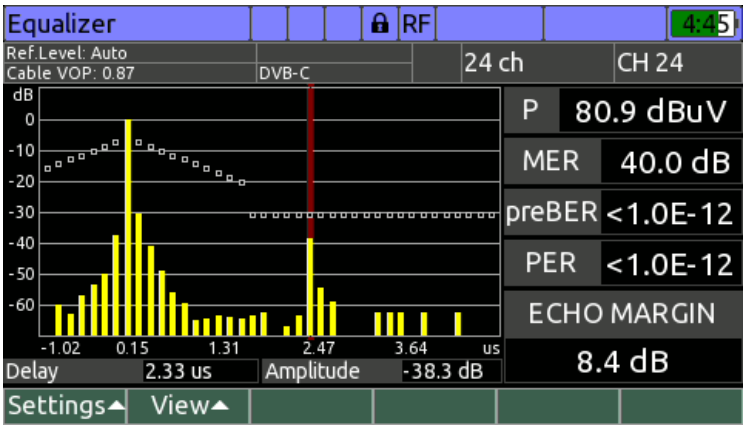


Figure 4.16

The equalizer is intended for correcting the amplitude and phase response of the received signal, thus enabling higher quality of reception in presence of distortion. That is why the equalizer parameters analysis allows estimating the signal correction level in terms of quality and quantity, and thus determining its distortion.

The equalizer parameters are presented graphically. The following display modes are available for selection from the drop down menu by pressing the **F2 / View** key:

1) **Equalizer taps**. This mode allows viewing the gain values diagram for each of the equalizer taps. The values are shown in dB in reference to the central tap having the gain value of 0 dB. Each equalizer tap enables the signal delay equal to time, which is a multiple of symbol duration. When receiving the ideal signal, all of the equalizer taps energy is concentrated in three to five taps to the left and to the right of the central tap. In case of distortion, the energy is distributed to the larger number of taps. A peak value at one or several taps is the evidence of the reflected signal arrival. Gain value and tap signal delays in the cursor position are indicated in the bottom part of the screen. If you select the **Distance** measurement unit from the **F1 / Settings** dropdown menu, the screen view will display the distance[2] from the signal source to obstacle at the boundary of which the signal was reflected instead of delay. Each of the tap bars has a marker of

[2] For distance calculation, relative signal propagation rate in cable is assumed to be equal to 0.87

maximum permissible tap gain value according to ETSI TR 101290. The **ECHO MARGIN** column displays the worst-case difference between the permissible value and the value measured at all taps, i.e. this value indicates the noise margin of reflected signals level;

2) **Freq. Response**. This mode displays the amplitude to frequency response of the channel calculated from the equalizer impulse response characteristic. Frequency offset in reference to the channel center and the response level in dB in the cursor position are indicated in the bottom of the screen. Response flatness in dB is indicated in the **FLATNESS** column;
3) **Group delay**. This mode allows viewing channel group delay, calculated from the equalizer impulse response. Frequency offset in reference to the channel center and delay value in ns in the cursor position are indicated in the bottom of the screen. Response flatness in ns is indicated in the **FLATNESS** column.

4.3.9. Measurement of analog channel undesirable modulation (HUM)

This mode allows viewing relative level bar graph of harmonic component of analog channels undesirable modulation, as well as total relative level of undesirable modulation in the channel frequency band. The screen view and the data displayed are presented in Fig. 4.17.

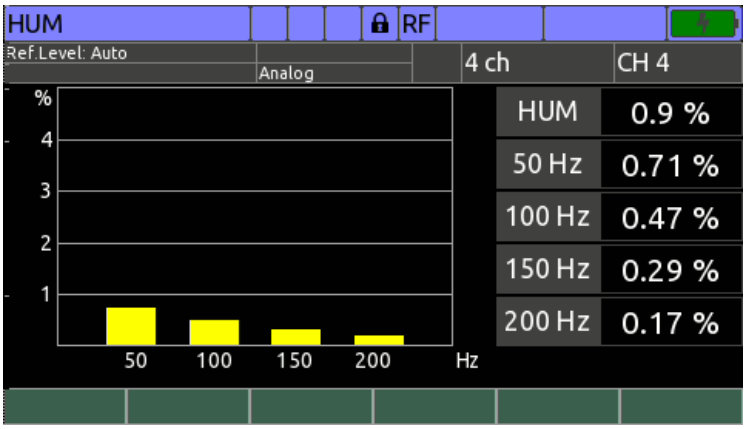


Figure 4.17

The relative level value of undesirable modulation is measured using the following formula:

HUM[%] = (Lmax – Lmin) * 100 / Lch, where
Lmax – maximum level of parasitic component in the measurement interval,
Lmin – minimum level of parasitic component in the measurement interval,
Lch – average carrier level value in the measurement interval.

Measurement results analysis of undesirable modulation level of separate harmonic component enables qualitative evaluation of the nature of distribution network problem. High value of fundamental harmonic (50 or 60 Hz) usually indicates the problem with power sources of signal generation and distribution equipment. High value of second harmonic (100 or 120 Hz) indicates the problem with the equipment grounding circuit, which is the reason of parasitic signal rectification.

Total relative level of undesirable modulation in the channel frequency band enables numerical determination of the video and sound quality. It is indicated in the **HUM** parameter line to the right from the bar graph.

The power grid frequency is selected in the terrestrial TV channels setting mode (section 4.3.2).

4.3.10. Measurement of Second-order and Triple-beat intermodulation (CSO/CTB)

This mode enables graphical and textual presentation of measurement results of second and third order distortion for analog TV channel. The screen view and the data displayed are presented in fig. 4.18.

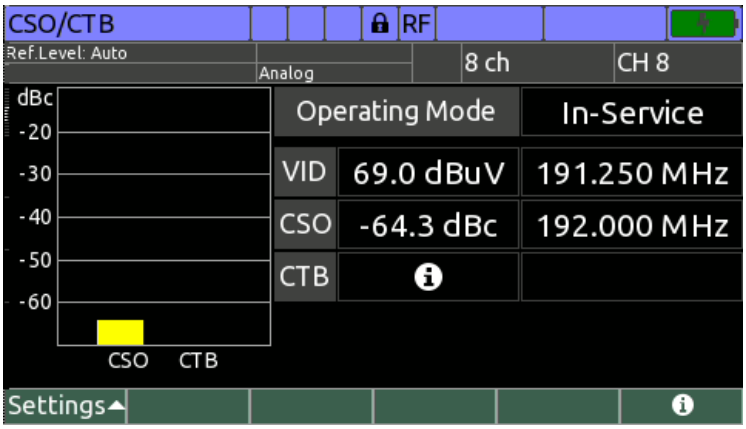


Figure 4.18

Relative levels of second-order distortion (CSO) and third-order distortion (CTB) are indicated on the left-side bar graph. The measurement is carried out in reference to the channel carrier level. The table to the right from the bar graph indicates the following data:

1) **VID**. Level and frequency of channel carrier;
2) **CSO**. Relative level of second-order distortion and the frequency at which distortion was measured. The Analyzer automatically calculates frequencies of second-order harmonic components occupying the channel and indicates the measurement results for the highest level harmonic component. Frequency of harmonic components occupying the channel is calculated using the cross products of channel frequencies from channel plan or TV system, if channel plan is not used;
3) **CTB**. Relative level of third-order distortion and frequency at which distortion was measured. The measurement is carried out at the channel carrier frequency.

The dropdown menu of the **F1 / Settings** key enables selection of the following measurement modes:

1) **In-Service**. The measurement is carried out during channel broadcasting. In this mode the Analyzer synchronizes with the analog channel and measures CSO harmonic components in the course of “black” lines, i.e. the measurement can be carried out only in case of synchronization with the channel. CTB cannot be measured in this mode, because this measurement is carried out at the channel carrier frequency;
2) **Out-Service**. The measurement is carried out when the channel is switched off (carrier must not be available). This mode enables CSO and CTB measurement in the disabled channel frequency band. As the channel is not available, the measurement in carried out in reference to the nearest analog channel. If the channel plan is not used, the Analyzer determines channel type according to the selected TV system.

4.3.11. Channel reception quality monitoring

This mode allows displaying timing diagram of analog or digital channel reception quality parameters in the given time interval. The screen view and the data displayed are presented in fig. 4.19.

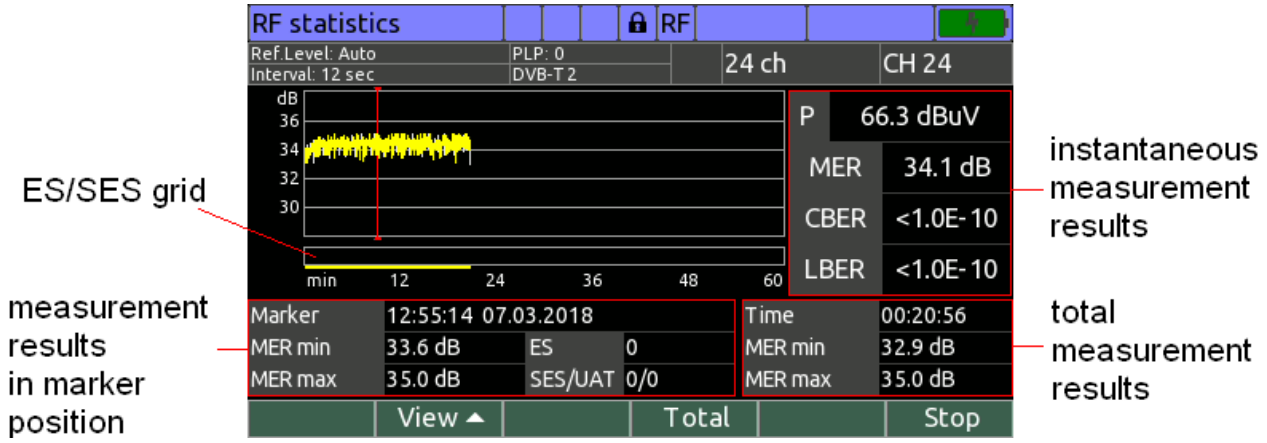


Figure 4.19

Depending on the type of the measured channel, the Analyzer enables monitoring of the following quality parameters:

Channel type	Measured parameter			
	Level	C/N	MER	BER
Analog	+	+		
Digital (DVB or J.83-B/C)	+		+	+
Digital (unknown modulation)	+	+		
FM-radio	+			
Pilot signal	+	+		

Each parameter diagram includes 300 time intervals. Depending on the user-defined measurement duration, each time interval equals to:

Measurement duration	5 min	10 min	30 min	1 h	2 h	6 h	12 h	24 h	48 h	72 h
Time interval, sec	1	2	6	12	24	72	144	288	576	864

Each time interval accumulates minimum and maximum values of quality parameter, as well as errored seconds count:

1) **ES**. Indicates the number of seconds during which errors were detected:
   - **DVB or J.83-B/C Channel**. At least one errored MPEG packet or synchronization loss is detected during the second;
   - **Analog Channel**. Minimum signal-to-noise ratio below 43 dB or synchronization loss is detected during the second;
2) **SES**. Indicates the number of seconds during which severe errors were detected:
   - **DVB or J.83-B/C Channel**. Over 5% of errored MPEG packets or synchronization loss is detected during the second;
   - **Analog Channel**. Synchronization loss is detected during the second;
3) **UAT**. Indicates the number of seconds during which channel synchronization was lost.

The measurement mode can be set up in the dropdown menu accessed by pressing the **F1 / Settings** key:

1) **Duration**. Signal measurement duration: **5 min**, **10 min**, **30 min**, **1 h**, **2 h**, **6 h**, **12 h**, **24 h**, **48 h**, **72 h**;
2) **Beeping on SES**. Switching sound indication of severe error (SES) detection: **Off**, **On**;
3) **Autosave**. Switching automatic measurement results saving to a file upon measurement completion: **Off**, **On**.

Measurement can be started by pressing the **F6 / Start** key. In case the **Autosave** function is on, it is necessary to specify the page name for further automatic saving to a file.

In order to stop the measurement, press the **F6 / Stop** key during measurement. A beep will sound when the measurement is stopped.

The following data is indicated on the screen during measurement (section 4.48):

1) Instantaneous measurement results of level, MER or C/N and BER measured within seconds;
2) Total measurement results. Include all time intervals passed from the beginning of measurement, minimum and maximum parameter values for the whole measurement time, total ES and SES number during the whole measurement time;
3) Timing diagram of the selected parameter. For level, C/N and MER parameters, the diagram consists of vertical lines, the lowest point of which corresponds to minimum parameter value in the time interval, and the upper point – to maximum. For BER the diagram consists of bars, the height of which corresponds to the number of corrected (green) and uncorrected (red) bits in the respective time interval;
4) Measurement results at the marker position. Include absolute time of time interval beginning at the market position, parameter values and the number of ES, SES and UAT errored seconds in the time interval at the marker position;
5) ES/SES grid. Features the grid with vertical marks matched with the time diagram. In case at least one severe error (SES) is detected in the time interval, a red mark is indicated, and if an ES error is detected, a green mark is indicated. This grid allows determining whether errors were detected during measurement, and how they are grouped in time. The indicator of the time passed is shown under the grid in the form of a line.

The parameter to be viewed on the diagram can be selected using the dropdown menu of **F2 / View**. To move the cursor, use the ◄ and ► keys. By pressing these keys along with the **Shift** key, the cursor can be moved with a larger pitch.

To view the detailed measurement results obtained during all measurement time, press the **F4 / Total** key. The table includes the following information:

1) **Bits total**. Total number of bits received before the first decoder;
2) **Bits corrected**. Total number of bits corrected by decoders;
3) **Bits uncorrected**. Total number of uncorrected bits at the output of the last decoder;
4) **ES total**. Total number of errored seconds;
5) **SES/UAT total**. Total number of severely errored seconds, as well as the number of seconds during which synchronization loss was detected;
6) **MER min/max**. Minimum and maximum MER values obtained during all measurement time;
7) **MER avr**. Average MER value obtained during all measurement time;
8) **SNR min/max**. Minimum and maximum C/N value obtained during all measurement time;
9) **SNR avr**. Average C/N value obtained during all measurement time;
10) **LEV/POW min/max**. Minimum and maximum channel level value obtained during all measurement time;
11) **LEV/POW avr**. Average channel level value obtained during all measurement time.

Measurement results can be saved to a file upon completion or forced stop of measurement using the **F5 / Save** key. You need to specify the page name in the popup field and press **ENTER**. In case a USB flash drive is connected to the Analyzer, the page will be saved to it, otherwise the page will be saved to the internal drive. You can view the

measurement results saved to a file in the file manager (section 4.9) by selecting the **RF Statistics** file type.

4.3.12. Data Logger Function

Data Logger (DL) is intended for automation of the procedure of recording the measurement results. There are three data logger directories: Channel Plan List, Limit Plan List, and Channel Data Logger. The DL memory is common for all directories and is allocated dynamically. The memory capacity allows saving up to 99 channel plans, 99 limit plans, and 999 channel data logger pages each containing maximum channel quantity. The DL memory can be controlled in the Memory Manager (section 4.9), which allows operating with files in internal memory or external USB flash drive.

The data logger directories can be scrolled through by arrows and functional keys. In the main selection mode select the desired page of icons using the **«◄»** and **«►»** keys, set the desired mode icon in the bottom screen line using the **«▲»** and **«▼»** keys and then select the desired mode using functional keys. The following icons correspond to the Data Logger directories:

		
Channel Plans	Limit Plans	Channel DL

4.3.13. Channel Plans

4.3.13.1. Channel Plans List

This mode allows performing all the operations with channel plans: viewing, editing, deleting, and creation of new plans. The screen view of the mode is shown in figure 4.20.

The table on the screen displays the channel plan name and the date of creating or editing. The channel plan set up in the Analyzer is marked in the table by the ✓ symbol. Channel plans in the table are arranged by names. The channel plan **«All channels»** is always located in the upper line of the table and corresponds to channel template. If this plan is selected, the Analyzer operates without a channel plan.

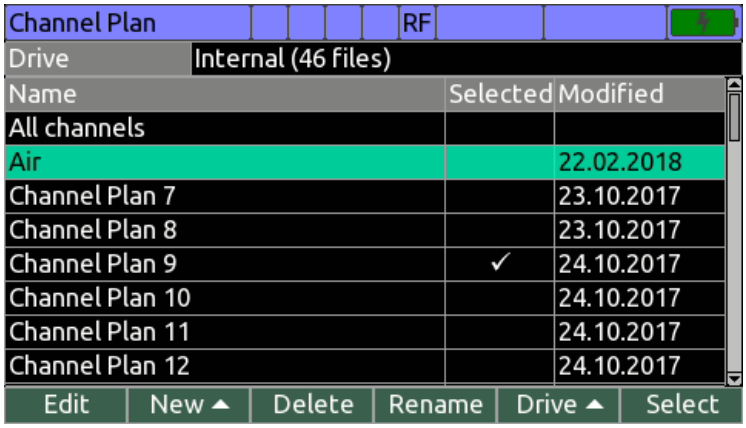


Figure 4.20

Use the functional keys to perform the following operations with channel plans:

– **«F1 / Edit».** Reading and editing the channel plan in cursor position.

– **«F2 / New».** Creating a new channel plan: empty or automatically detecting.
– **«F3 / Delete».** Deleting the channel plan in cursor position.
– **«F4 / Rename».** Renaming the channel plan in cursor position.
– **«F5 / Drive».** Channel plans source drive selecting: internal drive or USB flash drive.
– **«F6 / Select».** Selecting the channel plan in cursor position.

4.3.13.2. Channel Plan Editing

The screen view of the channel plan table is shown in figure 4.21:

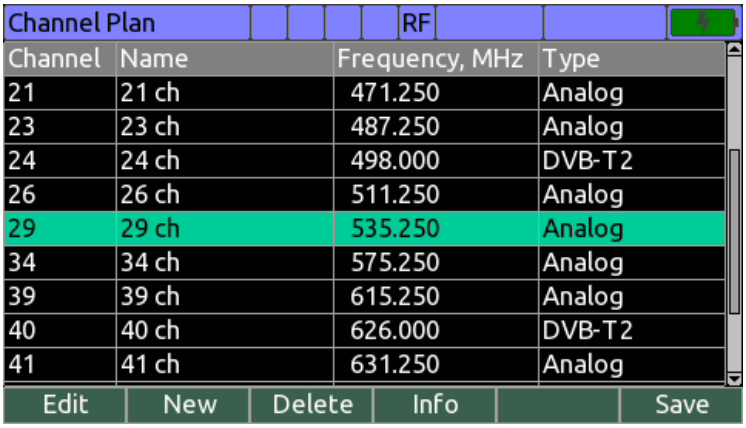


Figure 4.21

The table indicates channel number, channel name, its frequency and signal type. Functional keys enable the following operations:

– **«F1 / Edit»**. Editing the channel in cursor position.
– **«F2 / New»**. Adding a new channel.
– **«F3 / Delete»**. Deleting the channel in cursor position.
– **«F4 / Info»**. Viewing information about channel plan name and channels quantity.
– **«F6 / Save»**. Save changes and quit.

Channel selecting is performed with **«▲»** and **«▼»** keys or entering channel number with alphanumeric keyboard. To edit selected channel press **«F1 / Edit»** or **«ENTER»** key.

The screen view in the channel parameters editing mode is shown in figure 4.22.

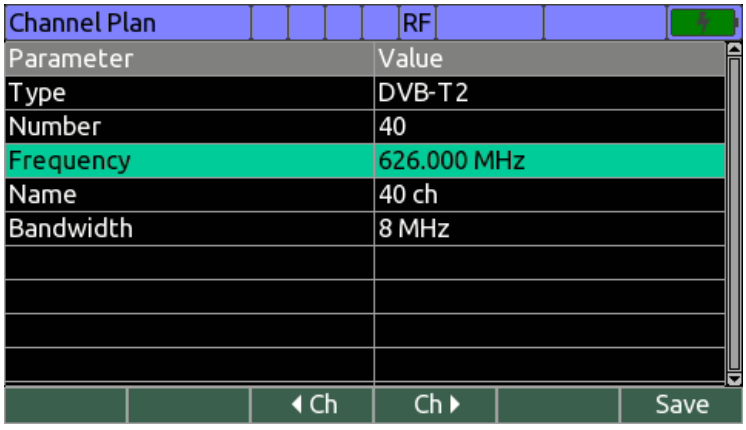


Figure 4.22

Possible signal types and their parameters are as follows:

1) Common parameters:

- **Number**. Channel number in accordance with selected TV system
- **Frequency**. Channel frequency.
- **Name**. Channel name.

2) **Analog**. TV signal with analog modulation.
   - **Standard**. Broadcast television standard: **B, G, H, D, K, I, M, N**.
   - **System**. Color television standard: **Auto**, **PAL**, **SECAM**, **NTSC**. When **Auto** selected, the Analyzer detects color standard automatically. However it can be detected wrong in case of receiving signal with particular impairments.
   - **Audio**. Audio standard: **Mono**, **NICAM**, **Dual**. Dual corresponds to stereo broadcasting standards similar to A2.
   - **Audio-2 frequency offset**. Audio second subcarrier frequency offset relative to channel frequency.
   - **SNR method**. C/N measurement method: **off**, **inband**, **outband**. When **inband** selected, noise level is measured inside the channel bandwidth during black lines transmitting. When **outband** selected, noise level is measured outside the channel bandwidth at the frequency with minimal signal level.
3) **Pilot signal**. Unmodulated carrier.
   - **SNR method**. C/N measurement method: **off**, **outband**. When **outband** selected, noise level is measured at frequency specified with **«Noise frequency offset»** parameter.
   - **Noise bandwidth**. Signal bandwidth for which noise level is calculating.
   - **Noise frequency offset**. Frequency offset relative to channel frequency at which noise level is measured.
4) **FM**. FM radio.
5) **Digital**. Channel with digital modulation which is not supported by the Analyzer.
   - **Bandwidth**. Channel bandwidth.
   - **SNR method**. C/N ratio measurement method: **off**, **outband**. When **outband** is selected, noise level measurement is performed outside the channel bandwidth at frequency with minimal signal level.
6) **DVB-C.** J.83 Annex A (DVB-C) cable TV channel.
7) **J.83-B.** J.83 Annex B cable TV channel.
8) **J.83-C.** J.83 Annex C cable TV channel.
   - **Modulation**. Modulation type: **QAM64**, **QAM128**, **QAM256**.
   - **Symbol rate**. Symbol rate.
9) **DVB-T.** DVB-T channel.
10) **DVB-T2.** DVB-T2 channel.
   - **Bandwidth**. Channel bandwidth: **6**, **7**, **8 MHz**.

The initial parameter values are set during automatic channel plan definition and can be corrected. To adjust the parameter value, select the desired parameter using the **«▲»** and **«▼»** keys. The parameter is adjusted using the **«◄»**, **«►»** keys or typed in directly using the alphanumeric keys. You can scroll through the channels using the **«F3»** and **«F4»** keys without returning back to the channel plan table.

4.3.13.3. New Channel Plan Creation

To create a new channel plan in the automatic mode, send a signal to the Analyzer input press the **«F3 / New»** key and select **«Scan»** option. Enter the channel name in the popup window and press **«ENTER»**. After that the Analyzer will scan all TV channels and enter the channel plan editing mode. Adjust the channel parameters and open the channel

plans table saving the new channel plan in the DL memory. You can change the channel plan name if necessary.

4.3.14. Limit plans

4.3.14.1. Limit Plans List

Limit plans contain channel parameters check criteria and are used for measurements in the channel data logger mode.

This mode allows performing all operations with the limit plan (LP): reading, editing, deleting, creating a new LP, selecting an LP for checking in the measurement modes. The screen view of the limit plan list is shown in figure 4.23.

The table indicates the limit plan name, the current limit plan, date of creating or editing. Limit plans in the table are arranged by their names. The **«Switched off»** limit plan is always located in the upper line of the table and cannot be edited.

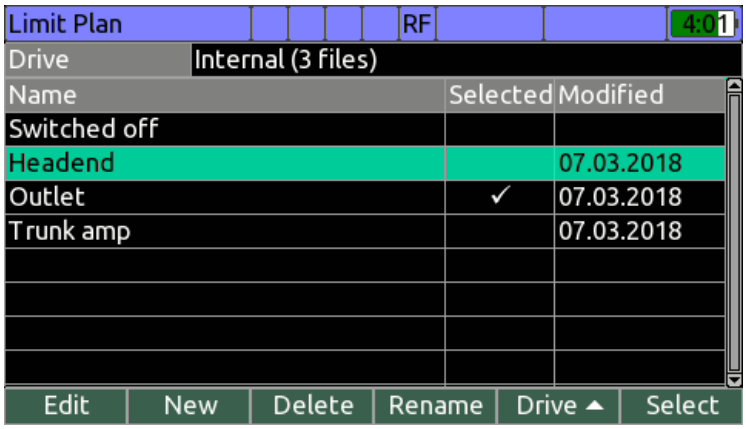


Figure 4.23

The functional keys enable the following operations with limit plans:

- **«F1 / Edit».** Reading and editing the limit plan in cursor position.
- **«F2 / New».** Creating a new limit plan.
- **«F3 / Delete».** Deleting the limit plan in cursor position.
- **«F4 / Rename».** Renaming the limit plan in cursor position.
- **«F5 / Drive».** Limit plans source drive selecting: internal drive or USB flash drive.
- **«F6 / Select».** Selecting the limit plan in cursor position.

4.3.14.2. Limit Plan Editing

The screen view is shown in figure 4.24:

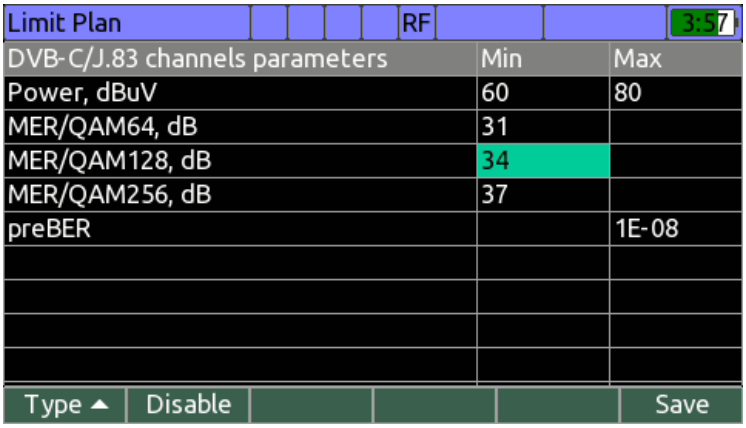


Figure 4.24

The table indicates the TV channel parameter names and their minimum and maximum limit values against which the measured parameters are checked in the terrestrial TV channels measurement modes. A separate parameters setting page is provided for each channel type, which can be opened by pressing the **«F1 / Type»** key. To save the changes press **"F6 / Save"**.

The following channel types and their parameter sets are available.

1) **General**. General limit plan settings[3].
   - **Level delta**: Maximal available channels level difference. Performed separately for analog channels and digital channels.
   - **Analog/Digital Delta**: Minimal and maximal available level difference between analog and digital channels.
   - **Adj. Channels Delta**: maximal available level difference between adjacent channels. Analog and digital channels are never supposed to be adjacent.
2) **Analog channels**. Channel with analog modulation.
   - **Video Level**: Minimal and maximal available channel level.
   - **Video/Audio-1**: Minimal and maximal available values of video-to-audio ratio for first audio subcarrier.
   - **Video/Audio-2 (Dual)**: Minimal and maximal available values of video-to-audio ratio for second audio subcarrier (for channels with A2 stereo broadcasting).
   - **Video/Audio-2 (NICAM)**: Minimal and maximal available values of video-to-audio ratio for second audio subcarrier (for channels with NICAM stereo broadcasting).
   - **C/N**: Minimal available C/N ratio value.
3) **Pilot signal.** Unmodulated carrier.
   - **Level**: Minimal and maximal available level.
   - **C/N**: Minimal available C/N ratio value.
4) **FM radio.** FM radio.
   - **Level**: Minimal and maximal available channel level.
5) **Digital channels**. Channel with digital modulation of unknown type.
   - **Power**: Minimal and maximal available channel power.
   - **C/N**: Minimal available C/N ratio value.
6) **DVB-C/J.83 channels**. Digital cable TV channels.
   - **Power**: Minimal and maximal available channel power.
   - **MER/QAM64**: Minimal available MER value for channels with QAM64 modulation.
   - **MER/QAM128**: Minimal available MER value for channels with QAM128 modulation.

[3] Pilot signals and FM radio are not checked against general parameters

- **MER/QAM256**: Minimal available MER value for channels with QAM256 modulation.
- **preBER**: Maximal available value of BER before Reed-Solomon decoder.

7) **DVB-T channels.** DVB-T digital on-air broadcasting standard channels.
   - **Power**: Minimal and maximal available channel power.
   - **MER/QPSK**: Minimal available MER value for channels with QPSK modulation.
   - **MER/QAM16**: Minimal available MER value for channels with QAM16 modulation.
   - **MER/QAM64**: Minimal available MER value for channels with QAM64 modulation.
   - **CBER**: Maximal available value of BER before Viterbi decoder.
   - **VBER**: Maximal available value of BER after Viterbi decoder.
8) **DVB-T2 channels.** DVB-T2 digital on-air broadcasting standard channels.
   - **Power**: Minimal and maximal available channel power.
   - **MER/QPSK**: Minimal available MER value for channels with QPSK modulation.
   - **MER/QAM16**: Minimal available MER value for channels with QAM16 modulation.
   - **MER/QAM64**: Minimal available MER value for channels with QAM64 modulation.
   - **MER/QAM256**: Minimal available MER value for channels with QAM256 modulation.
   - **CBER**: Maximal available value of BER before LDPC decoder.
   - **LBER**: Maximal available value of BER after LDPC decoder.

To adjust the parameter value, select the desired parameter using the **«▲»** and **«▼»** keys. The parameter is adjusted using the **«◄»** and **«►»** keys. Any limit plan parameter can be disabled for checking in the channel data logger with pressing **«F2/ Disable»** key. Press **«F2 / Enable»** again to enable checking.

4.3.15. Channel Data Logger

4.3.15.1. General Information

The Channel Data Logger (CDL) is used for measurement of TV channel and other signal parameters using one of the channel plans and their checking against the selected limit plan. The Analyzer allows saving the measurement and check results in the data logger memory as well as measurement timestamp. The CDL allows viewing measurement results, viewing different parameter errors, saving to CSV file for further processing and presentation of test results.

4.3.15.2. List of Channel Data Logger Pages

This mode allows performing all possible operations with the CDL pages: reading, deleting, creating a new page and measuring page. The screen view of this mode is shown in figure 4.25:

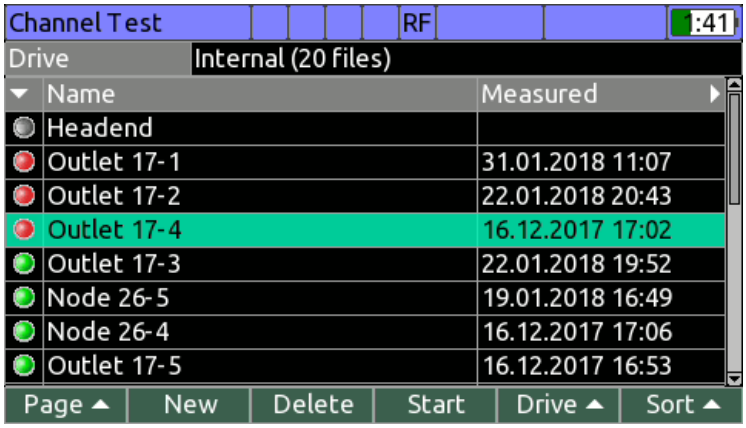


Figure 4.25

The screen shows the list of channel data logger pages. Each CDL page contains the following data: status, page name, date and time of last measurement, name of related channel plan and name of related limit plan.

Press the **«►»** key to view the related channel plan. Press **«►»** key again to view related limit plan on the screen. Press **«◄»** key twice to return to view of last measurement time and date.

To select one of the CDL pages viewing mode, open the popup menu by pressing the **«F1 / Page»** key:

1) **Open**. Opening the selected CDL page.
2) **Info**. Viewing page parameters.
3) **Graph**. Viewing the selected CDL page in the **Scan** mode (in development).
4) **Delta**. Reading the selected CDL page in the **Scan** mode, and indicating the difference between the CDL page channel levels and current channel levels (in development).

You can delete the unnecessary CDL page by pressing the **«F3 / Delete»** key. A new CDL page can be created using the **«F2 / New»** key. The **«F6 / Sort»** key allows selecting the method of pages sorting in the table (by the last measurement time and date, status, page name, channel plan or limit plan name). To select the CDL files source drive, press the **«F5 / Drive»** key. Page can be measured with pressing **«F4 / Start»** key.

The status indicator specifies the CDL page state:

Grey indicator	Page created but not measured
Red indicator	Page measured, errors found
Green indicator	Page measured, errors not found

When you create a channel data logger page (by pressing the **«F2 / New»** key), page setup window will be displayed on the screen as shown in figure 4.26.

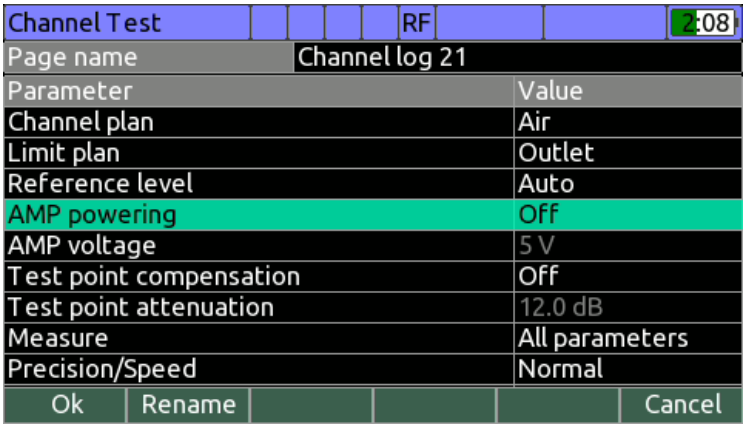


Figure 4.26

To set up the page, specify the following parameters:

1) **Page name**. Can be edited with pressing **«F2 / Rename»** key;
2) **Channel plan**. Channel plan with channels set for measurement. Can be selected one of the channel plans of internal disk or external USB flash drive. Selected channel plan data is copied to CDL page, so, editing or deleting selected channel plan will not affect the page;
3) **Limit plan**. Limit plan with measurement results checking limits defined. Can be selected one of the limit plans of internal disk or external USB flash drive. Selected limit plan data is copied to CDL page, so, editing or deleting selected limit plan will not affect the page;
4) **AMP powering**. Switching off/on supplying external devices via RF input (for example antenna amplifier);
5) **AMP voltage**. External devices supplying voltage: **5**, **12**, **24 V**;
6) **Test point compensation**. Turning off/on compensation of signal attenuation at test point;
7) **Test point attenuation**. Test point attenuation value in dB: **0...40 dB**;
8) **Measure**. Selecting parameters for measuring (affects measurement duration): **All parameters** – measure all the parameters, **Level only** – measure only channels level, **Level + CN/MER** – measure Level and channel C/N or MER;
9) **Precision/Speed**. Select the balance between measurement results precision and measurement duration: **Fast** – fast measurement without averaging[4], **Normal** – acceptable measurement duration with some averaging, **Precise** – high measurement duration with strong averaging.

All the parameters except for **Channel plan** and **Limit plan** can be modified before measurement.

4.3.15.3. Channel Data Logger Reading and Measurement

When enters data logger page common page information view appears on the screen (figure 4.27).

[4] Analog channels C/N is always measured with **outband** method regardless of the channel plan configuration

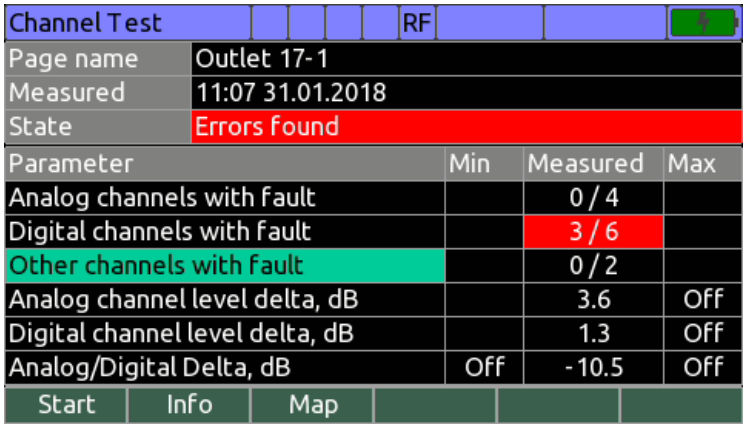


Figure 4.27

The following information on page measurement results is indicated on the screen:

1) **Page name**. Data logger page name;
2) **Measured**. Time and date of page measuring. In case the page is not measured, this field is not shown;
3) **State**. The page state: **Errors found** – the page is measured, but the results do not conform to the limit plan check criteria, **No errors** – the page is measured, and the results conform to the limit plan check criteria, **Not measured** – the page is not measured;
4) **Analog channels with fault**. The number of analog channels, measurement results of which do not conform to the limit plan check criteria. Total number of analog channels is also indicated;
5) **Digital channels with fault**. The number of digital channels, measurement results of which do not conform to the limit plan check criteria. Total number of digital channels is also indicated;
6) **Other channels with fault**. The number of other channels (pilot signals, FM radio), measurement results of which do not conform to the limit plan check criteria. Total number of channels of such type is also indicated;
7) **Analog channel level delta, dB**. The maximum level flatness value for analog channels. In case this value exceeds the permissible value, it is highlighted in red;
8) **Digital channel level delta, dB**. The maximum level flatness value for digital channels. In case this value exceeds the permissible value, it is highlighted in red;
9) **Analog/Digital delta, dB**. The value of maximum level difference between analog and digital channels. In case this value is beyond the permissible limits, it is highlighted in red.

To view the information on page settings, press the **F2 / Info** key. The page parameters table will then appear on the screen (figure 4.26). To start the measurement, press the **F1 / Start** key. To cancel the measurement, press the **F1 / Cancel** key. To save the measurement results, use the **F6 / Save** key.

To view the channel measurement results in a form of a map, press the **F3 / Map** key. In this mode the channel map is indicated on the screen (figure 4.28). Each cell of the map corresponds to a channel of the page. The cell color indicates the channel status:

1) Green – the channel is measured, the measurement results conform to the limit plan check criteria;
2) Red – the channel is measured, the measurement results do not conform to the limit plan check criteria;
3) Grey – the channel is not measured.

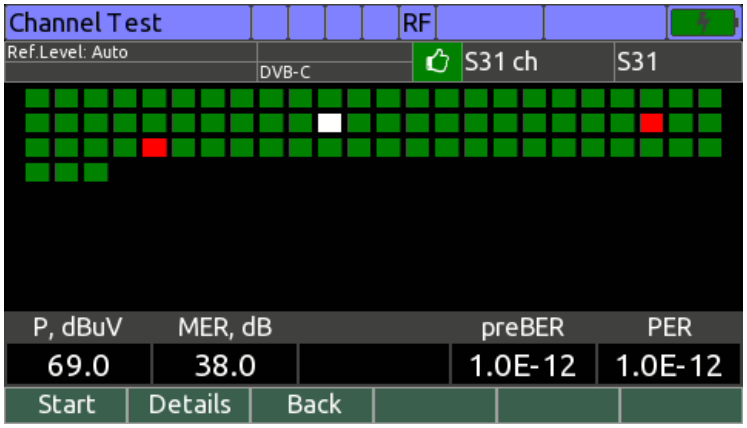


Figure 4.28

The channel can be selected on the map using the ►, ◄, ▲ and ▼ keys. The table under the map indicates the channel measurement results in the cursor position. Press the **F2 / Details** or **ENTER** key to view the detailed measurement results for the selected channel as shown in fig. 4.29.

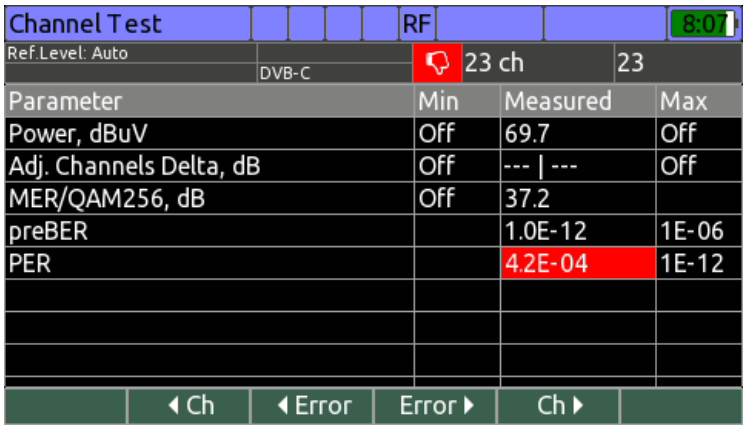


Figure 4.29

The table indicates the parameters of measurement results checking against the limit plan, as well as measured parameters for current channel. The parameter value is highlighted in red if it does not satisfy the test criterion. The parameter value is not indicated if this parameter measurement is disabled in the channel plan or CDL page parameters.

Use the **«F2 / ◄Ch »** and **«F5 / Ch► »** keys to scroll through the channels without leaving to the common table. To scroll through the channels with errors use the **«F3 / ◄Error »** and **«F4 / Error► »** keys.

To return to the common page parameters view press **«F3 / Back»** or **«EXIT»** key.

4.3.15.4. **Delta Mode**

This mode presents data in the form of a bar graph as in the **Graph** mode, but the length of a bar indicates the difference between the level value in CDL and currently measured channel level value. The positive value indicates that the CDL level value is higher than the measured level value, and vice versa. The measured level values are at the same time checked against the limit plan. The channel plan and the limit plan are obtained from the CDL. The sample view of the **Delta** mode is shown in figure 4.30.

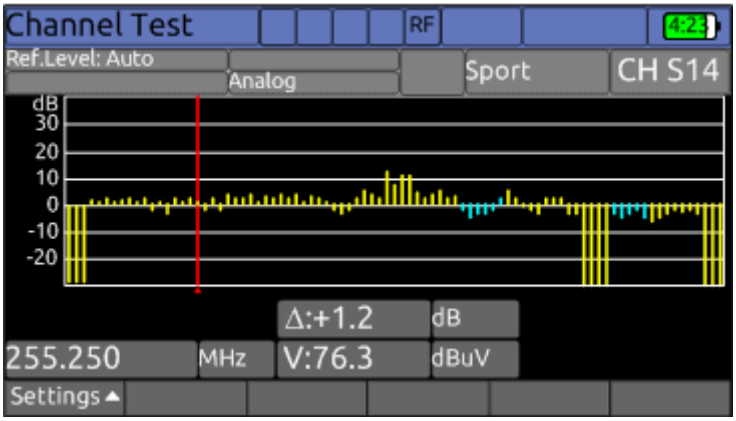


Figure 4.30

4.4. Satellite TV Channels Measurement Procedure

4.4.1. General Information

You need to specify the LNB configuration settings manually before you start operating your Analyzer and in process of measurements. The LNB configuration setting mode is used for this purpose (section 4.4.10). The LNB icon in the main menu corresponds to this mode. This mode enables the LNB configuration setting.

The Analyzer features three measurement modes:

1) Measurement of DVB-S/S2 signal parameters in the **Channel** mode (single LNB dish alignment mode).

Additional measurement modes:

- video and sound control (**Video**);
- MPEG transport stream analysis (**MPEG Analyzer**);
- MPEG transport stream recording (**MPEG Recording**);
- Transponder reception quality monitoring (**Statistic**).

2) Measurement of reception quality parameters of DVB-S/S2 signal in the **MER/BER** mode.

Additional measurement modes:

- video and sound control (**Video**);
- MPEG transport stream analysis (**MPEG Analyzer**);
- MPEG transport stream recording (**MPEG Recording**);
- Transponder reception quality monitoring (**Statistic**).

3) Signal spectrum measurement in the **Spectrum** mode.

Use the **«▲»** and **«▼»** keys in the main menu (figure 4.2) to set the desired operating mode icon in the bottom screen line. The following icons correspond to the measurement modes:

		
Channel	**MER/BER**	**Spectrum**

To select the measurement mode press the corresponding key from the set of functional keys with the respective icon. To return to the main menu, press the **«EXIT»** key.

The screen view includes common elements and settings in all measurement modes as shown in figure 4.31.

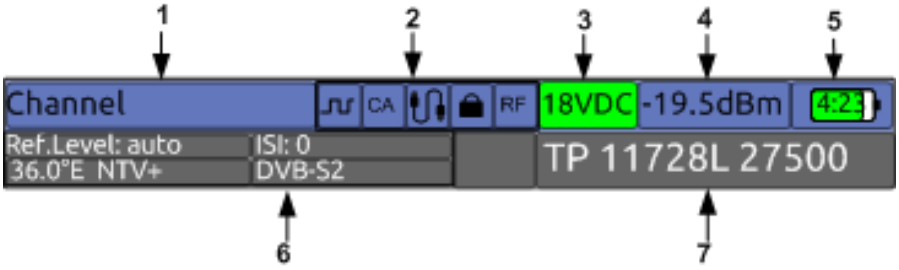


Figure 4.31

The fields on the screen indicate the following information:

1) Depending on the selected indication type: current operating mode name, current time, current date (section 4.10.3)
2) Voltage value at the RF input (section 4.3.1.5)
3) Optical power value, in case optical input is selected
4) Battery charge status and remaining time
5) Current measurement mode parameters and channel parameters
6) Transponder parameters: frequency, polarization and symbol rate.

The **«F1»** key on the functional keys panel is used to open the settings menu. The **«F3»** to **«F6»** keys enable the current mode setting. Press the **«Shift»** key to display the functional keys for quick switching between the measurement modes.

The LNB settings menu (**«F2»** key) contains a list of parameters which can be selected using the **«▲»** and **«▼»** keys, and set up using the **«◄»** and **«►»** keys.

In case measuring is performed with LNB profile selected, the following list of LNB parameters is available:

1) **Satellite.** The selected LNB satellite name. The information parameter cannot be edited.
2) **LNB**. Selection of LNB: **LNB1** to **LNB4**. 2…4 converters (available if LNB profile contains more than one converter). For the SCR converter the parameter enables the slot selection.
3) **LO**. Selection of converter heterodyne: **Low**, **High**.
4) **Polarization**. Selection of LNB polarization: V – vertical, H – horizontal, L – left-handed circular, R – right-handed circular.

In case operating is performed without LNB profile the following list of LNB parameters is available:

1) **Tone 22 kHz**. Switching **on**/**off** 22 kHz tone;
2) **Voltage**. Target LNB voltage: **13**, **18 V**.

4.4.2. Operating Modes Setting

The parameters setting program is used for setting the device operation parameters in the satellite TV broadcasting mode. The  icon in the satellite TV folder corresponds to this mode. The parameters setting screen view is shown in figure 4.32:

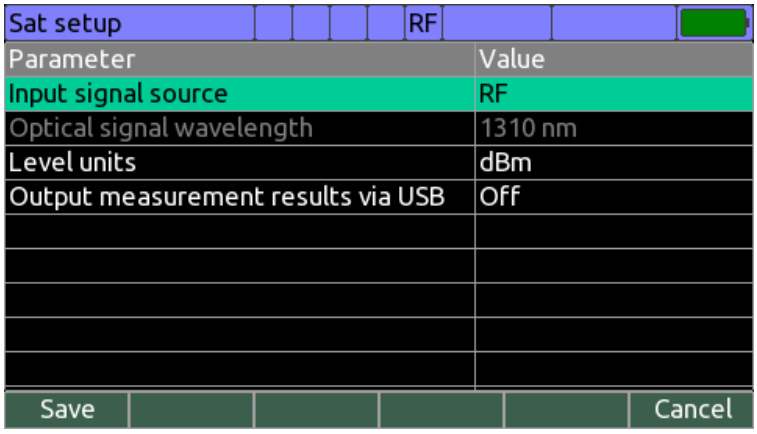


Figure 4.32

The table contains the following editable parameters:

1) **Input signal source**. Selection of radio frequency or optical input.
2) **Optical signal wavelength**. Selection of optical signal wavelength.
3) **Levels units**. Selection of signal level measurement units. Possible variants: **dBuV**, **dBmV** or **dBm**.
4) **Output measurement results via USB**. Enabling measurement results output via USB interface (section 4.14).

4.4.3. Satellite Transponder Parameters Measurement in the Channel Mode

The screen view of the Channel mode and the information displayed are shown in figure 4.33.

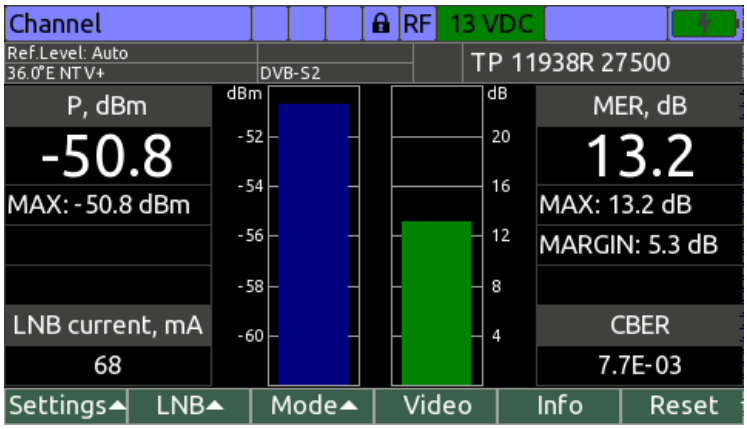


Figure 4.33

The following is displayed on the left of the screen:

1) **P**. Transponder power;
2) **MAX**. Maximal transponder power detected during all the measurement time;
3) **LNB current**. LNB supply current in mA;

The following is displayed on the right of the screen:

1) **MER**. MER value;
2) **MAX**. Maximal MER value detected during all the measurement time;
4) **MARGIN**. MER margin to quasi error-free reception threshold;
5) **UPTIME**. Transponder measurement duration;
6) **CBER**. BER before Viterbi decoder (for DVB-S), or before LDPC decoder (for DVB-S2);

In the central part of the screen you can see power and MER values in a form of a histogram with markers of minimal and maximal values detected during all the measurement time.

At the top you can see informational panel (figure 4.31) operating mode settings and locked transponder parameters.

To set up transponders, use the ◄ and ► keys. When holding pressed **Shift** key transponders will be scrolling with a higher pitch value. To enter transponder frequency or symbol rate, use the alphanumeric keys. Confirm entering with one of the following keys:

1) **F1 / IF**. Intermediate frequency is specified. Current polarization will not changed;
2) **F2 / TF, H/L**. Satellite band frequency is specified and horizontal/left-handed circular polarization selected;
3) **F3 / TF, V/R**. Satellite band frequency is specified and vertical/right-handed circular polarization selected;
4) **F4 / SR**. Transponder symbol rate is specified;
5) **ENTER**. Satellite band or intermediate frequency is specified (detected automatically). Current polarization will not be changed.

To access the mode settings, press the **F1 / Settings** key. The following settings are available:

1) **Ref. level**. Selecting reference level value. Available values **50** to **120 dBuV** and **Auto**. The setting resolution 10 dB. The parameter sets up the maximum possible measured signal level.
2) **Level scale**. Histogram level scale value: **2**, **5**, **10 dB**
3) **Averaging**. Selection of measured level averaging degree. Available values: **off**, **Low**, **Medium**, **High**. When satellite dish positioning is performed it is recommended to specify **off** value.
4) **Sound indication**. Selecting the parameter value sound indication type: **off** – switched off, **Tone** – sound frequency is proportional to parameter value, **Pulse** – pulse repetition rate is proportional to parameter value;
5) **Indicate parameter**. Selecting the parameter to indicate its value with sound: **level** – transponder power, **MER** – MER value.
6) **Motor control**. Enabling or disabling DiSEqC positioner operating mode (section 4.4.7);
7) **ISI**. Selecting DVB-S2 transponder logical stream;
8) **PLS**. Specifying DVB-S2 transponder descrambling key.

To enter additional transponder measurement modes, press the **F3 / Mode** key. The following modes are available:

1) **MPEG Analyzer**: MPEG transport stream analysis (section 4.6).
2) **MPEG Recorder**: MPEG transport stream recording (section 4.8).
3) **Statistics**: Transponder reception quality monitoring (section 4.4.8).

To enter the TV video viewing mode, press the **F4 / Video** key. Press **F5 / Info** key to see transponder modulation parameters.

To restart transponder measurement press the **F6 / Reset** key.

To switch the LNB power supply on and off, use the source control mode. To call the mode, press the **«Shift»** key and then, without releasing it, press  **/ .space** key (section 4.3.1.5).

LNB converter configuring is performed in the **F2 / LNB** popup menu (section 4.4.14.4.2).

To open the **MER/BER**, **Spectrum** or **DiSEqC** measurement modes, use the **F3**, **F4** and **F5** keys in the additional set of functions which is started by the **Shift** key.

4.4.4. Satellite Transponder Parameters Measurement in the MER/BER Mode

In this mode the measured DVB-S/S2 signal quality parameters are displayed on the screen in figure form and in the form of vertical bars. It also features a constellation diagram measurement mode. The screen view of this mode is shown in figure 4.34

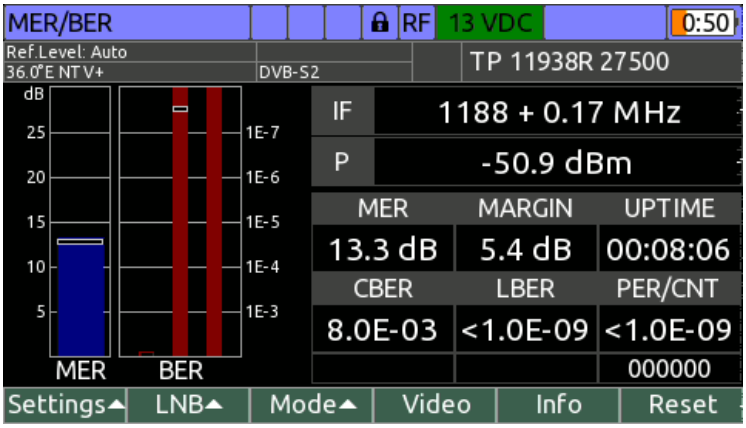


Figure 4.34

The following is displayed on the screen:

7) **IF**. Transponder tuning frequency (IF) and locked transponder frequency offset relative to tuning frequency;
8) **P**. Transponder power;
9) **MER**. MER value;
10) **MARGIN**. MER margin to quasi error-free reception threshold;
11) **UPTIME**. Transponder measurement duration;
12) **CBER**. BER before Viterbi decoder (for DVB-S), or before LDPC decoder (for DVB-S2);
13) **VBER/LBER**. BER after Viterbi decoder (for DVB-S), or after LDPC decoder (for DVB-S2);
14) **PER/CNT**. Erroneous packets error rate and total erroneous packets number.

On the left of the screen MER and BER values are displayed in a form of a histogram with markers of minimal and maximal values detected during all the measurement time.

At the top you can see informational panel (figure 4.31) operating mode settings and locked transponder parameters.

To set up transponders, use the ◄ and ► keys. When holding pressed **Shift** key transponders will be scrolling with a higher pitch value. To enter transponder frequency or symbol rate, use the alphanumeric keys. Confirm entering with one of the following keys:

6) **F1 / IF**. Intermediate frequency is specified. Current polarization will not changed;
7) **F2 / TF, H/L**. Satellite band frequency is specified and horizontal/left-handed circular polarization selected;
8) **F3 / TF, V/R**. Satellite band frequency is specified and vertical/right-handed circular polarization selected;
9) **F4 / SR**. Transponder symbol rate is specified;
10) **ENTER**. Satellite band or intermediate frequency is specified (detected automatically). Current polarization will not be changed.

To access the mode settings, press the **F1 / Settings** key. The following settings are available:

9) **Ref. level**. Selecting reference level value. Available values **50** to **120** **dBuV** and **Auto**. The setting resolution 10 dB. The parameter sets up the maximum possible measured signal level.

10) **Averaging**. Selection of measured level averaging degree. Available values: **off**, **Low**, **Medium**, **High**. When satellite dish positioning is performed it is recommended to specify **off** value.
11) **View**. Graphical representation type: **Histogram** – MER and BER values in a form of a graph, **Constellation** – constellation diagram measuring.
12) **Zoom**: Constellation diagram zoom: **x1** or **x4**;
13) **Motor control**. Enabling or disabling DiSEqC positioner operating mode (section 4.4.7);
14) **ISI**. Selecting DVB-S2 transponder logical stream;
15) **PLS**. Specifying DVB-S2 transponder descrambling key.

To enter additional transponder measurement modes, press the **F3 / Mode** key. The following modes are available:

4) **MPEG Analyzer**: MPEG transport stream analysis (section 4.6).
5) **MPEG Recorder**: MPEG transport stream recording (section 4.8).
6) **Statistics**: Transponder reception quality monitoring (section 4.4.8).

To enter the TV video viewing mode, press the **F4 / Video** key. Press **F5 / Info** key to see transponder modulation parameters.

To restart transponder measurement press the **F6 / Reset** key.

To switch the LNB power supply on and off, use the source control mode. To call the mode, press the **«Shift»** key and then, without releasing it, press **/ .space** key (section 4.3.1.5).

LNB converter configuring is performed in the **F2 / LNB** popup menu (section 4.4.14.4.2).

To open the **Channel**, **Spectrum** or **DiSEqC** measurement modes, use the **F3**, **F4** and **F5** keys in the additional set of functions which is started by the **Shift** key.

4.4.5. Signal Spectrum Measurement in the Spectrum Mode

The signal spectrum is displayed on the screen in this mode. The screen view and the information displayed are shown in figure 4.35:

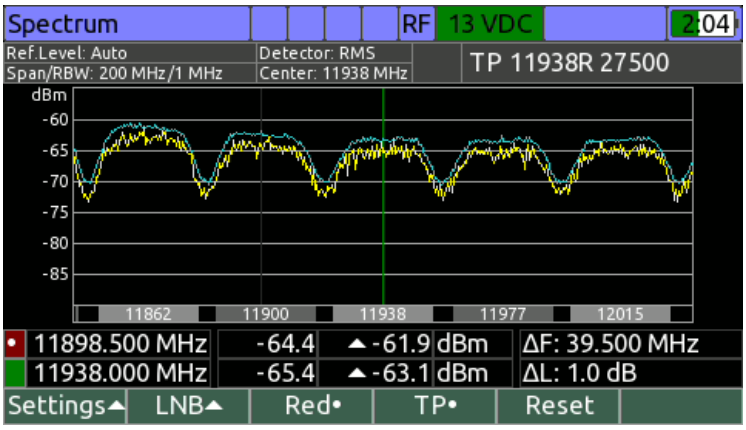


Figure 4.35

Frequency navigation is performed as follows:

1) Navigation of transponders (**F4** key is indicated as **TP•**). The transponder selection is set up using the ◄ and ► keys for current polarization. To enter the frequency value directly, use the alphanumeric keys. To confirm the frequency value entry, press the **«ENTER»** key. The Analyzer automatically detect which kind of frequency is entered – intermediate frequency or satellite band frequency and set specified frequency in the center of the screen. If confirmation is

performed with **F1 / IF** key, it is assumed intermediate frequency is entered. If confirmation is performed with **F2 / TF, H/L** or **F3 / TF, V/R** key, it is assumed satellite band frequency is entered and horizontal/left-handed circular polarization or vertical/right-handed circular polarization is selected;

2) Navigation of markers (**F4** key is indicated as **Marker•**). The marker position moving within the spectrum window is performed using the ◄ and ► keys. To enter the frequency value directly, use the alphanumeric keys. To confirm the frequency value entry, press the **«ENTER»** key. The Analyzer automatically detects which kind of frequency is entered – intermediate frequency or satellite band frequency and move selected marker to the specified frequency. If confirmation is performed with **F1 / IF** key, it is assumed intermediate frequency is entered. If confirmation is performed with **F2 / TF** key, it is assumed satellite band frequency is entered. Marker selecting is performed with **F3** key. Selected marker color is indicated in the **F3** key position.

To access the mode settings, press the **F1 / Settings** key. The following settings are available:

10) **Ref. level**. Selecting reference level value. Available values 50 to 120 dBuV and Auto. The setting resolution is 10 dBuV. The parameter sets up the maximum possible measured signal level;
11) **Level offset**. Possible values: **Manual** and **Auto**. In the **Auto** mode, the amplitude scale position is set automatically, in accordance with the maximal measured level value. In the **Manual** mode, the scale position can be set manually using the ▲ and ▼ keys;
12) **Averaging**. Selecting measured level averaging degree. Availablevalues: **off**, **Low**, **Medium**, **High**;
13) **Hold level**. Enabling an additional signal level trace. Possible values: **off**, **MIN**, **MAX**. If an additional trace is enabled, the second signal line is displayed on the screen showing minimum and maximum values obtained during measuring. To reset the trace, press the **«F5** / **Reset»** key;
14) **Measure**. Measuring mode. Possible values: **Single**, **Quick**, **Precise**. In the single sweep mode a single scanning is carried out by pressing the **ENTER** or **F6 / Start** key. The **Quick** continuous scanning mode enables the quickest scanning by decreasing the level measurement accuracy. The **Precise** scanning mode allows for maximum accuracy of signal level measurements;
15) **Span**. Frequency scanning span. Possible span values and corresponding measuring filter passband values are given in the table below.

Scanning range, MHz	10	20	50	100	200	400	800	1200
Filter passband, kHz	50	250	250	1000	1000	1000	1000	1000

16) **Frequency ruler**. Selecting the horizontal scale presentation variant:
   - **IF**: IF frequencies displayed on the horizontal scale.
   - **TF**: Satellite frequencies displayed on the horizontal scale. The setting is available only if the converter profile is selected.
   - **TP**: Transponders bandwidth displayed on the horizontal scale. The setting is available only if the converter profile is selected.
   - **LNB band**: LO operating ranges displayed on the horizontal scale.
17) **Level scale**. Setting the amplitude scale value: **5**, **10 dB**.
18) **Motor control**. Enabling or disabling DiSEqC positioner operating mode (section 4.4.7).

To switch the LNB power supply on and off, use the source control mode. To call the mode, press the **«Shift»** key and then, without releasing it, press **/ .space** key (section 4.3.1.5).

LNB converter configuring is performed in the **F2 / LNB** popup menu (section 4.4.14.4.2).

To open the **Channel**, **MER/BER** or **DiSEqC** measurement modes, use the **F3**, **F4** and **F5** keys in the additional set of functions which is started by the **Shift** key.

4.4.6. DiSEqC control mode

The DiSEqC TX/RX icon in the main selection menu corresponds to this mode. The mode is intended for sending arbitrary DiSEqC commands. The Analyzer serves as a master DiSEqC device in this mode. The mode screen view is presented in fig. 4.36.

Figure 4.36

The mode features a table of sent commands and responses to them as a sequence of bite in hexadecimal format. The last sent commands are indicated in the beginning of the list.

To send a typical command, press the **F1 / List** key and select one of the commands from the dropdown menu:

1) **1.0 Switch**. DiSEqC 1.0 switch control command. You need to specify the input number (1…4);
2) **1.1 Switch**. DiSEqC 1.1 switch control command. You need to specify the input number (1…16);
3) **SCR LNB UB signal on**. The command switches the tone on in all SCR LNB slots;
4) **SCR LNB UB power off**. The command switches the tone off in the given SCR LNB slot. You need to specify the slot number;
5) **Stop**. The command enables positioner movement stopping;
6) **Go home**. The command enables positioner moving to the starting position;
7) **Go to position**. The command enables positioner moving to the given position. You need to specify the position number (1…99);
8) **Save position**. The command enables position saving under the given number. You need to specify the position number (1…99).

To enter an arbitrary command, press the **F3 / New** key. You have to enter three to six bites in hexadecimal format (0 to 9 digits, A to F letters) in the popup field.

To repeat a recently sent command, select the needed command by the ▲ and ▼ keys and press **F2 / Repeat**.

In case the command sent implies a response, the **Received** column will indicate a bite set received from a slave device and the command progress status:

1) **Ок**. The command is received;
2) **not supported**. The command is not supported by the device;
3) **not recognized**. The command is received with an error;
4) **parity error**. The command is received with an error.

To clear the command history, use the **F4 / Clear** key.

To enable or disable the LNB power supply source, use the power source control mode. To select the mode, press **Shift** and **.space /** simultaneously (section 4.3.1.5).

To go to **Channel**, **MER/BER** and **Spectrum** measurement modes, use the **F2**, **F3** and **F4** keys in the additional panel of functional keys accessed by the **Shift** key.

4.4.7. DiSEqC positioner operating

To operate the DiSEqC positioner in the **Channel**, **MER/BER** and **Spectrum** measurement modes, the control mode of basic DiSEqC positioner functions is available. The mode can be enabled in the dropdown menu of **F1 / Settings** using the **Motor Control** option:

1) **Off.** The control is disabled;
2) **Stepwise**. The control is enabled, movement is incremental;
3) **Continuously**. The control is enabled, movement is continuous.

Enabling the DiSEqC control mode results in **F3** to **F6** functional keys reassignment:

1) **F3 / ◄ W** – westward movement;
2) **F4 / E ►** – eastward movement;
3) **F5 / Stop** – positioner stop;
4) **F6 / Motor** – positioner commands menu:
   - **Go home**. The command enables positioner moving to the starting position;
   - **Goto position**. The command enables positioner moving to the earlier saved position. You need to specify the position number (1…99);
   - **Save position**. The command enables the current position saving under the given number. You need to specify the position number (1…99);
   - **Set East limit**. The command enables setting the current position as maximum when moving to the east;
   - **Set West limit**. The command enables setting the current position as maximum when moving to the west;
   - **Delete limits**. The command enables deleting the earlier defined east and west limits.

4.4.8. Transponder reception quality monitoring

This mode displays timing diagrams of transponder reception quality parameters in the given time interval.

The mode operation principle is similar to the quality parameters monitoring mode for terrestrial TV channel reception (section 4.3.11).

4.4.9. Data Logger Handling

The Data logger (DL) is used to save the setting profiles. The Analyzer features two types of structures referring to DL: LNB configurations table and satellite parameters table.

The data logger memory is common for all types of structures and is allocated dynamically. The memory capacity allows storing up to 99 LNB profiles (section 4.4.10.2), and up to 999 satellite parameters pages each of which may contain up to 300 transponders (section 4.4.11). The Analyzer allows viewing, creating and editing the saved data off-line. The following icons correspond to the DL modes:

	
LNB Configurations Table	Satellite Parameters Table

4.4.10. LNB Configuration Setting Mode

The LNB configuration tables are available for making the Analyzer application convenient in a specific system containing a reception satellite antenna, one or several LNB converters and signal routing network with DiSEqC switches. The table sets up the converter parameters, polarization control and LO selection methods, converter access method, and satellite parameters.

LNB configuration consists of the following parameters:

1) Configuration name;
2) LNB converters number;
3) Parameters of each of LNB converters;
4) Satellite, attached to each of LNB converters;

There is a non-editable LNB configuration **«Without converter»**. When selected, it gives possibility to manually control LNB voltage and 22 kHz tone, as well as to send DiSEqC commands.

4.4.10.1. LNB configuration list

This mode allows creating, deleting, editing and selecting LNB configuration, as well as setting up the parameters of converters and attached satellites. The screen view of this mode is shown in figure 4.37.

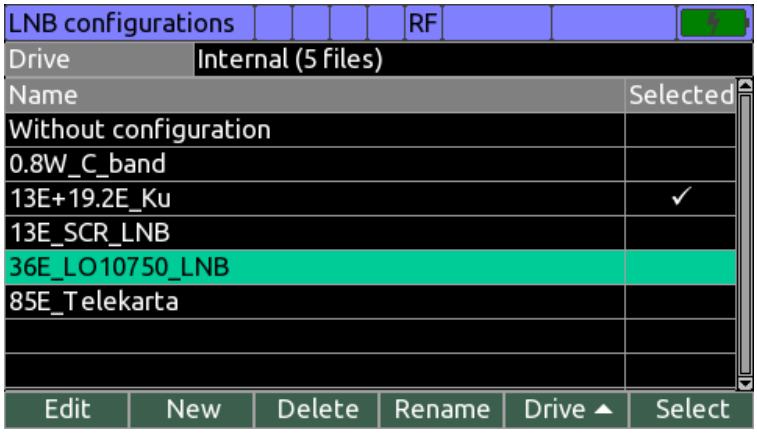


Figure 4.37

Use the functional keys to perform the following operations with satellites:

- **«F1 / Edit».** Reading and editing the configuration in cursor position (section 4.4.10.2).
- **«F2 / New».** Creating a new configuration.
- **«F3 / Delete».** Deleting the configuration in cursor position.
- **«F4 / Rename».** Renaming the configuration in cursor position.
- **«F5 / Drive».** Configurations source drive selecting: internal drive or USB flash drive.
- **«F6 / Select».** Selecting the configuration for operating in measurement modes.

4.4.10.2. LNB Configuration common parameters handling

The LNB configuration common parameters screen view is shown in figure 4.38.

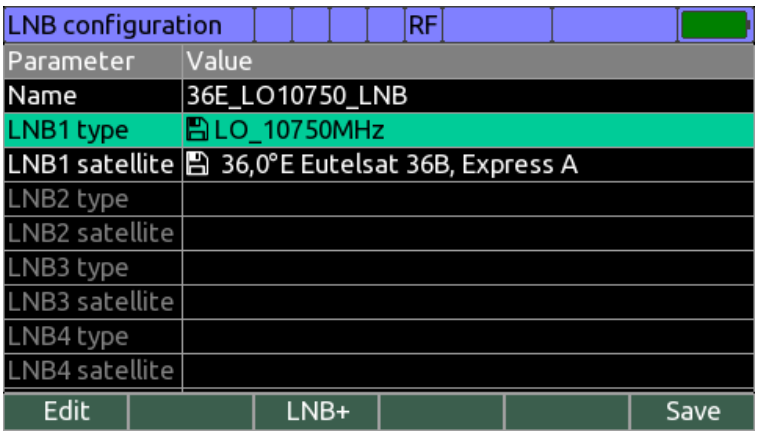


Figure 4.38

The following parameters are available for configuring:

1) **Name**. LNB configuration name;
2) **LNB type**. LNB converter type. Use the **«◄»** and **«►»** keys to select one of the typical converter types. Press **«ENTER»** or **«F1 / Edit»** key to edit selected converter parameters (section 4.4.10.3). icon indicates converter that is stored in the LNB configuration;
3) **LNB satellite**. Satellite, which signal is received by the converter. Use the **«◄»** and **«►»** keys to select one of the satellites of the Analyzer (section 4.4.11). Use alphanumeric keyboard to find a satellite with its orbital position. Press **«ENTER»** or **«F1 / Edit»** key to edit selected satellite parameters (section 4.4.11.2). icon indicates satellite that is stored in the LNB configuration;

Press **«F3 / LNB+»** or **«F4 / LNB-»** to specify converters number. To exit the mode and save the changes, use the **«F6 / Save»** key. To exit the mode and discard changes, use the **«EXIT»** key.

4.4.10.3. LNB Configuration converter parameters handling

The common converter parameters table view is shown in figure 4.39.

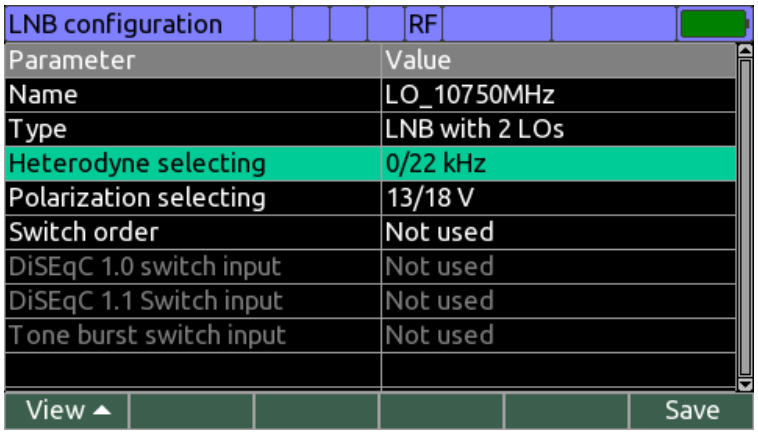


Figure 4.39

The following parameters are available for configuring:

1) **Name**. Converter name. This name is indicated in the **«LNB»** context menu of the measurement modes, when selecting converter to operate with;

2) **Type**. Converter type: **«LNB with 1/2/3/4 LOs»** - usual converter with 1…4 LOs, «SCR LNB» - Single Cable Routing converter, **«DLNB»** - converter which moving each receiving transponder on a fixed intermediate frequency (specifying in the satellite transponder parameters);
3) **Heterodyne selecting**. LO selecting algorithm for **«LNB with 2 LOs»** converter: **«Manual»** - LO is selected according to **«LO selecting»** LO parameter, **«0/22 kHz»** - low LO is selecting when 22 kHz tone is disabled, and high – when 22 kHz tone is enabled, **«DiSEqC»** - LO is selecting with standard DiSEqC command sequence;
4) **Polarization selecting**. Signal polarization selecting algorithm for **«LNB with 1/2 LOs»** converter: **«Without control»** - each band operates with signal of fixed polarization (see **«Polarization»** parameter in LO settings), **«13/18 V»** - for each band polarization is selectable with LNB voltage (13 V – vertical or right-handed circular polarization, 18 V - horizontal or left-handed circular polarization), **«DiSEqC»** - polarization selecting is performed with standard DiSEqC command sequence;
5) **Switch order**. Signal routing network configuration: **«Not used»** - receiver is connected directly to converter, **«LNB -> TB -> 1.1 -> 1.0»** - converter is connected to receiver via Tone Burst switch, DiSEqC 1.1 switch and DiSEqC 1.0 switch in order, **«LNB -> TB -> 1.0 -> 1.1»** - converter is connected to receiver via Tone Burst switch, DiSEqC 1.0 switch and DiSEqC 1.1 switch in order;
6) **DiSEqC 1.0 switch input**. DiSEqC 1.0 switch input, converter connected to: **«Not used»** - switch is not used, **«LNB 1…4»** – 1, 2, 3 or 4 input;
7) **DiSEqC 1.1 switch input**. DiSEqC 1.1 switch input, converter connected to: **«Not used»** - switch is not used, **«LNB 1…16»** – 1…16 input;
8) **Tone burst switch input**. Tone Burst switch input, converter connected to: **«Not used»** - switch is not used, **«LNB A»** - input A, **«LNB B»** - input B;
9) **Slots number**. **«SCR LNB»** converter slots number: **4** or **8**;
10) **Slot 1…8**. **«SCR LNB»** converter slot 1…8 intermediate frequency.

Use **«F1/ View»** context menu to switch between common converter parameters and LO parameters. When LO parameters configuring is selected, the following table will appear on the screen (figure 4.40).

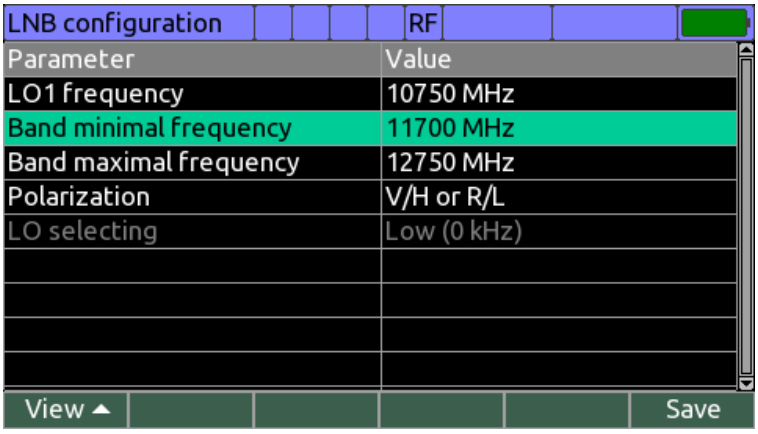


Figure 4.40

The following parameters are available for configuring:
1) **LO frequency**. LO frequency which is used to move satellite band to receiver's intermediate frequency;
2) **Band minimal frequency**. Satellite band minimal frequency value;
3) **Band maximal frequency**. Satellite band maximal frequency value;
4) **Polarization**. Selecting signal polarization, which is available for the satellite band: **«V/H или R/L»** - any polarization can be selected, according to

«Polarization selecting» converter parameter, **«V»** - vertical polarization is only available for satellite band, **«H»** - horizontal polarization is only available for satellite band, **«L»** - left-handed circular polarization is only available for satellite band, **«R»** - right-handed circular polarization is only available for satellite band;

5) **LO selecting**. LO selecting scheme: **«Low (0 kHz)»** - LO is selected when 22 kHz tone is disabled, **«High (22 kHz)»** - LO is selected when 22 kHz tone is enabled, **«Low/High (DiSEqC)»** - LO is selecting with standard DiSEqC command sequence.

Converter performs moving signal of satellite frequency to the receiver intermediate frequency according to the following formulas:

$$IF_{TP} = | F_{TP} - F_{LO} | \quad (1)$$

$$IF_{TP} = | F_{LO} - F_{TP} | \quad (2)$$, where

F_{TP} – transponder frequency,

F_{LO} – LO frequency,

IF_{TP} – transponder intermediate frequency.

The formula (1) or (2) which is used for moving transponder frequency is selecting according to converter internal structure.

To exit to the LNB configuration common parameters setting mode and save the changes, use the **«F6 / Save»** key. To exit the mode and discard changes, use the **«EXIT»** key.

4.4.11. Satellite Parameter Tables Handling

4.4.11.1. General Information

Satellite parameter tables are used for quick Analyzer setting to transponder frequency. The table allows saving parameters of the satellite (name, orbital position), as well as parameters of transponders (frequency, polarization, symbol rate, relative coding rate). Parameters tables are used as templates for satellite assignment in the converter configuration profile (i.e. copied in the configuration profile).

The  icon in the main menu corresponds to this mode. This mode allows performing all operations with the satellite parameters. The screen view is shown in figure 4.41.

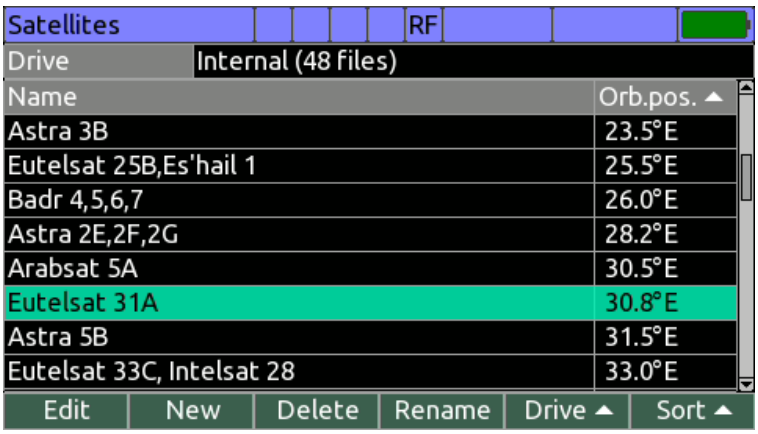


Figure 4.41

The table indicates satellite name and its orbital position. Use the functional keys to perform the following operations with satellites:

– **«F1 / Edit».** Reading and editing the satellite in cursor position.
– **«F2 / New».** Creating a new satellite.
– **«F3 / Delete».** Deleting the satellite in cursor position.
– **«F4 / Rename».** Renaming the satellite in cursor position.
– **«F5 / Drive».** Satellites source drive selecting: internal drive or USB flash drive.
– **«F6 / Sort».** Selecting the satellites sorting order: by name or by orbital position.

Enter orbital position with alphanumeric keyboard to find a corresponding satellite in the list.

4.4.11.2. Satellite Entry Creating and Editing

The screen view of this mode is shown in figure 4.42.

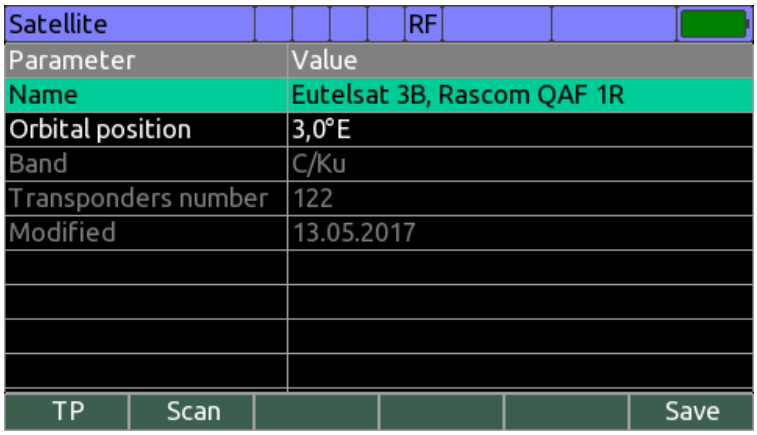


Figure 4.42

The satellite entry includes five parameters:

1) **Name**. Satellite name.
2) **Orbital position**. Satellite orbital position, in degrees from 0 to 180 of eastern (**E**) or western (**W**) longitude.
3) **Band**. Satellite transponders broadcast band: **Ku** – Ku band, **Ka** – Ka band, **C** – C band. The parameter cannon be edited, it is defined automatically using the list of transponders.
4) **Transponders number**. Number of transponders in satellite entry (cannot be edited).
5) **Modified**. Date of creating/updating satellite entry (cannot be edited, set up automatically).

Press **«F2 / Scan»** key to enter transponders searching mode (section 4.4.11.4).

To exit the mode and save the changes, use the **«F6 / Save»** key. To exit the mode and discard changes, use the **«EXIT»** key.

To edit the transponder entries, press the **«F1 / TP »** key (figure 4.43).

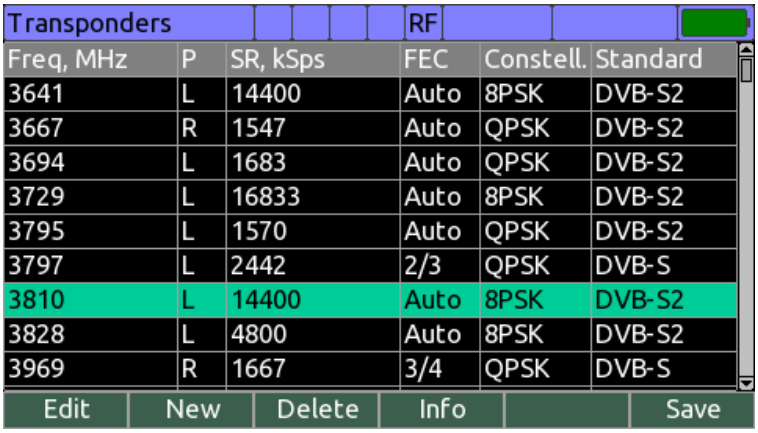


Figure 4.43

The table indicates the transponder number in the list, frequency, polarization, symbol rate, relative code rate, modulation type and broadcast standard.

Use the functional keys to perform the following operations with transponders:

- **«F1 / Edit».** Reading and editing the transponder in cursor position.
- **«F2 / New».** Creating a new transponder.
- **«F3 / Delete».** Deleting the transponder in cursor position.
- **«F4 / Info».** Show satellite name and number of transponders.
- **«F6 / Save».** Save changes and exit.

Enter frequency with alphanumeric keyboard to find corresponding transponder in the list. To exit the mode and discard changes, use the **«EXIT»** key.

4.4.11.3. Transponder Entry Creating and Editing

The screen view of the transponder editing mode is shown in figure 4.44.

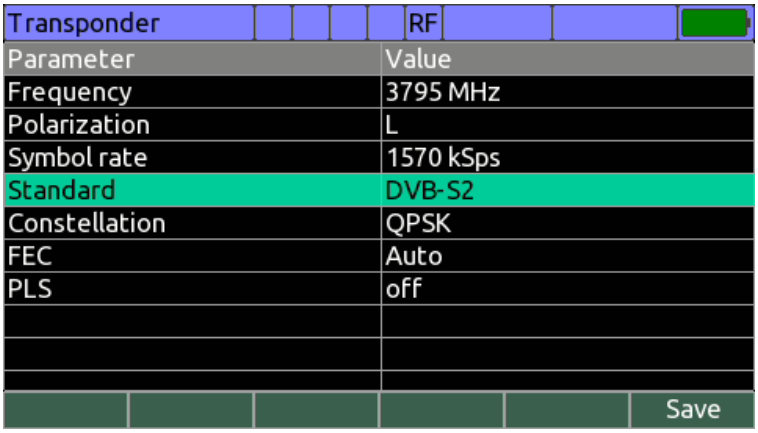


Figure 4.44

The following transponder parameters are available for configuring:

1) **Frequency**. Transponder central frequency in MHz.
2) **Polarization**. Transponder signal polarization: **V** – vertical, **H** – horizontal, **L** – left-handed circular, **R** – right-handed circular.
3) **Symbol rate**. Transponder symbol rate in kSps.
4) **Standard**. Transponder broadcast standard: **DVB-S** or **DVB-S2**.
5) **Constellation**. Transponder modulation type: **QPSK**, **8PSK**, **16APSK**, **32APSK**. The parameter is available for DVB-S2 standard only.
6) **FEC**. Transponder relative code rate. If **«Auto»** specified, relative code rate will be defined by the Analyzer automatically.
7) **PLS**. Scrambling key for decoding DVB-S2 data stream.

4.4.11.4. Searching for transponders

Transponders searching mode allows to perform input signal scanning in order to get the transponders list. The view of the mode is represented on the figure 4.45.

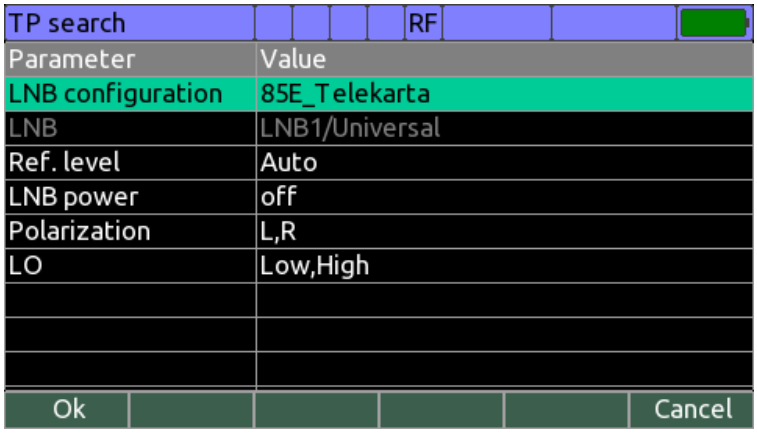


Figure 4.45

The following parameters setting up should be performed in the settings table:

1) **LNB configuration**. Selecting one of the LNB configurations to perform scanning with (section 4.4.10.1). Transponders searching is available only for LNB configurations with converters other than SCR or DLNB;
2) **LNB**. Selecting one of the converters of the selected LNB configuration;
3) **Ref. level**. Selecting reference level value. Available values **50** to **120 dBuV** and **Auto**. The setting resolution is 10 dBuV. The parameter sets up the maximum possible input signal level;
4) **LNB power**. LNB converter powering control: **on**, **off**;
5) **Polarization**. Selecting converter polarization(s) to scan: **L** – left-handed circular, **R** – right-handed circular, **V** – vertical, **H** – horizontal;
6) **LO**. Selecting converter LO(s) to scan.

Press **«F1 / Ok»** key to start transponders searching. The progress and found transponders number is indicated during the searching.

Press **«F6 / Cancel»** or **«EXIT»** to discard changes and leave the mode.

4.5. IPTV Measurements Procedure

4.5.1. General Information

Before you start operating your Analyzer, you need to set up the network interface parameters (section 4.10.5) and select IPTV playlist (section 4.5.5) if needed.

The Analyzer features the following operating modes:

1) IPTV stream reception quality parameters measurement. It enables the access to the following additional modes:
   - TV video and sound analysis (section 4.7);
   - MPEG transport stream analysis (section 4.6);
   - MPEG transport stream recording (section 4.8);
   - IPTV stream reception quality monitoring (section 4.5.3);
2) TCP/IP connection testing in Ping mode.

To enable the required operating mode in the main menu (figure 4.2), use the ▲ and ▼ keys to set the required icon in the bottom line of the screen and press the corresponding functional key. Operating modes and their icons are matched as follow:

	
IPTV	**Ping**

To return to the main menu, press the **EXIT** key.

The screen view of the measurement modes features common elements and settings as shown in figure 4.46.

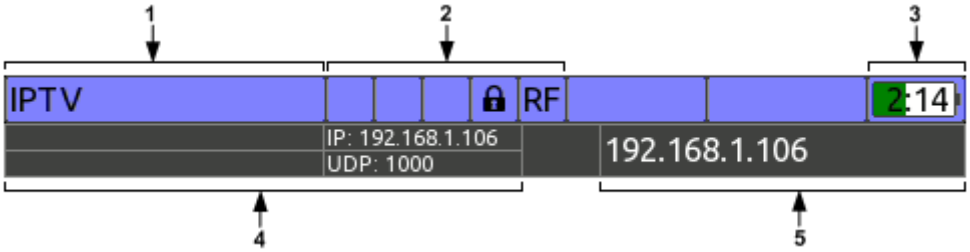


Figure 4.46

The following data is displayed on the screen:

1) Depending on the selected indication type: current operating mode name, current time, current date (section 4.10.3);
2) Modes and settings icons (section 4.2);
3) Battery charge status;
4) IPTV stream parameters: IP address, type of protocol and port;
5) IPTV stream name specified in playlist (section 4.5.5), or IP address, in case no name is specified.

The panel of functional keys includes the following keys: **F1** is used to open the settings menu, **F2** through **F6** are used to set up the current mode. Press the **Shift** key to display the functional keys for quick switching between modes.

4.5.2. IPTV Stream Reception Quality Parameters Measurement

In this mode the IPTV stream reception quality parameters are displayed according to RFC 4445. The screen view and displayed information are shown in figure 4.47.

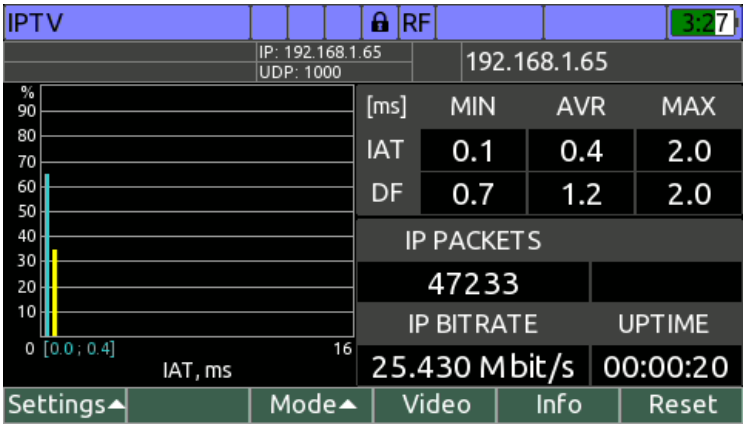


Figure 4.47

The following parameters are displayed on the screen:

1) **IAT (MIN/AVR/MAX)**. Minimum/average/maximum value of variability of the arrival interval of adjacent IP packets throughout the stream measurement. IAT is measured in ms and can be used to evaluate the stream flatness (jitter);
2) **DF (MIN/AVR/MAX)**. Minimum/average/maximum value of data delay factor throughout the stream measurement. DF is measured within the second interval and displayed in ms. In fact, DF indicates the amount of time of data delay in the receive buffer or the amount of time required to drain the buffer. So, DF indicates minimal necessary depth of stream reception buffer enabling constant stream rate at the buffer output and eliminating the data loss. The buffer volume can be estimated as follows:

   V = DF * BR * 1000, where
   V is buffer depth in bytes,
   DF is data delay factor in ms,
   BR is MPEG stream rate in Mbit/s.
3) **IP PACKETS**. Total number of received IP packets throughout the measurement;
4) **MLT**. Number of lost MPEG packets throughout the measurement. For RTP protocol the measurement is based on the analysis of RTP packets sequence number. The RTP packet is considered to be lost if it is missing in the buffer for RTP packet sequencing. The buffer allows for up to 10 packets sequencing. For UDP protocol number of lost packets measurement is performed based on the analysis of the continuity_counter field in the MPEG packet header;
5) **IP BITRATE**. The rate of IPTV ETHERNET frames in Mbit/s;
6) **UPTIME**. The IPTV stream measurement time after synchronization. The synchronization progress bar is indicated until the synchronization is achieved.

The bar graph shown on the screen indicates the distribution of received IP packets in IAT intervals. Each bar corresponds to a certain IAT interval of 0.4 ms. The bar height indicates the number of packets corresponding to this IAT interval expressed as percent of the total number of received packets. The maximum value bar is highlighted and its interval limit values are indicated at the X axis. The bar graph view allows analyzing the near-field stream distortion. The near-field stream distortion may be due to high degree of network or its separate nodes usage, low signal-to-noise ratio of the distribution network, etc.

To set up the IPTV stream source, press the **F1 / Settings** key. The following parameters are available for editing from the dropdown menu:

1) **IP Address**. The IP address of the IPTV stream source. The Analyzer will automatically determine the routing type (unicast/multicast) using the IP address.
2) **Port**. The IPTV stream source port.

To confirm the changes, press the **F1 / Settings** or **EXIT** key.

In case the operating is performed with IPTV playlist specified (section 4.5.5), **«◄»** and **«►»** keys can be used for selecting the streams of the playlist. When pressed together with **«Shift»** the streams are listed with bigger gap.

Additional functions will become available after synchronization. The **F3 / Mode** key opens the dropdown menu, enabling the following additional operation modes:

1) **Statistics**. Monitoring of IPTV stream reception quality (section 4.5.3);
2) **MPEG Analyzer**. The MPEG transport stream analysis (section 4.6);
3) **MPEG Recorder**. The MPEG transport stream recording (section 4.8);

Press the **F4 / Video** key to go to the TV video and sound analysis mode (section 4.7).

Press the **F5 / Info** key to display the table of additional information on IPTV stream:

1) **Protocol**. The IPTV stream protocol: UDP or RTP;
2) **Routing**. The IPTV stream routing type: unicast or multicast;
3) **Packets/frame**. The number of MPEG packets in the IP packet;
4) **MPEG bitrate**. The MPEG transport stream rate in Mbit/s;
5) **Order errors**. Number of the RTP packets sequence errors.

Press the **F6 / Reset** key to reset the IPTV stream measurement results. The measurement is restarted.

Press the **Shift** key to enable additional functions on the functional panel: use the **F1 / Network** key to go to the Analyzer network settings mode (section 4.10.5), **F3 / Ping** to go to the TCP/IP connection testing mode (section 4.5.4).

4.5.3. IPTV stream reception quality monitoring

This mode displays timing diagrams of IPTV stream reception quality parameters according to RFC 4445 in the given time interval. The screen view and the data displayed are presented in fig. 4.48.

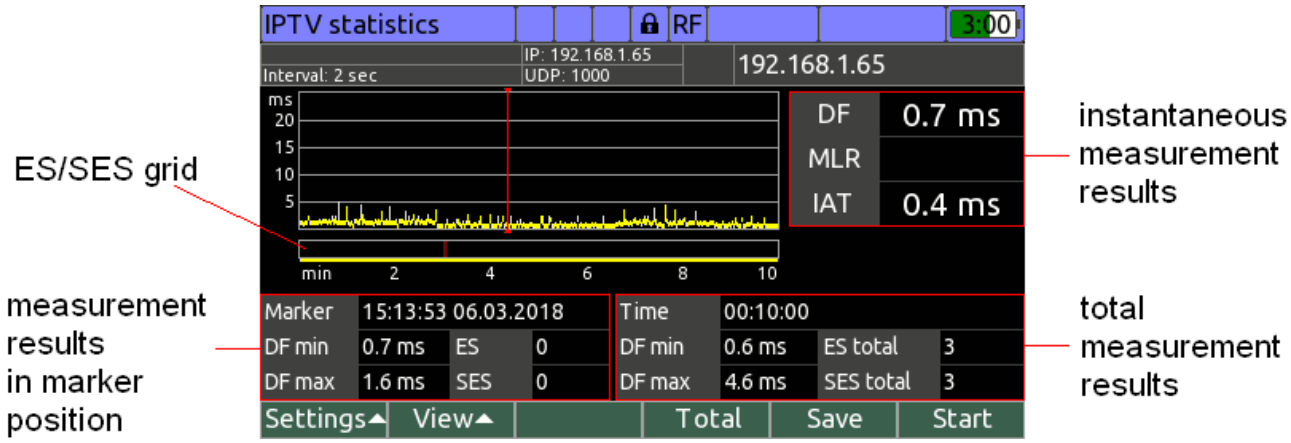


Figure 4.48

The Analyzer allows monitoring the DF, MLR and IAT (section 4.5.2). Each parameter diagram includes 300 time intervals. Depending on the user-defined measurement duration, each time interval equals to:

Measurement duration	5 min	10 min	30 min	1 h	2 h	6 h	12 h	24 h	48 h	72 h
Time interval, sec	1	2	6	12	24	72	144	288	576	864

Each time interval accumulates minimum and maximum values of quality parameter, as well as errored second counts:

1) **ES**. Indicates the number of seconds during which errors were detected;
2) **SES**. Indicates the number of seconds during which severe errors were detected (including stream synchronization loss).

The second is errored if the measured parameter (DF or MLR) value has exceeded the respective user-defined limit value during a second.

The measurement mode setting is carried out in the dropdown menu by pressing the **F1 / Settings** key:

1) **Duration**. IPTV stream measurement duration: **5 min**, **10 min**, **30 min**, **1 h**, **2 h**, **6 h**, **12 h**, **24 h**, **48 h**, **72**;
2) **DF limit (ES)**. DF limit value, by exceeding of which the second is considered to be errored: **5...500 ms**;
3) **DF limit (SES)**. DF limit value, by exceeding of which the second is considered to be severely errored: **5...500 ms**;
4) **MLR limit (ES)**. MLR limit value, by exceeding of which the second is considered to contain errors: **1...50**;
5) **MLR limit (SES)**. MLR limit value, by exceeding of which the second is considered to contain severe errors: **1...50**;
6) **Beeping on SES**. Switching sound indication of severe error (SES) detection: **Off**, **On**;
7) **Autosave**. Switching automatic measurement results saving to a file upon measurement completion: **Off**, **On**.

Measurement can be started by pressing the **F6 / Start** key. In case the **Autosave** function is switched on, it is necessary to specify the page name for further automatic saving to a file.

In order to stop the measurement, press the **F6 / Stop** key during measurement. A beep will sound after the measurement is stopped.

The following data is indicated on the screen during measurement (figure 4.48):

1) Instantaneous measurement results of DF, MLR, and IAT measured in a second interval;
2) Total measurement results. Include all time intervals passed from the beginning of measurement, minimum and maximum parameter values for the whole measurement time, total ES and SES number during all measurement time;
3) Timing diagram of the parameter to be displayed. For the DF and IAT parameters, the diagram includes vertical lines, the lower point of which corresponds to the minimum parameter value in the time interval, and the upper point – to the maximum value. For the MLR parameter, the diagram includes bars, the height of which corresponds to the number of lost MPEG packets in the respective time interval;
4) Measurement results at the marker position. Include absolute time value of time interval beginning at the market position, minimum and maximum parameter values, and the number of ES and SES errored seconds in the time interval at the marker position;
5) ES/SES grid. Features the grid with vertical marks matched with the timing diagram. In case at least one severe error (SES) is detected in the time interval, a red mark is indicated, and if an ES error is detected, a green mark is indicated. This grid allows determining whether errors were detected during measurement, and how they are grouped in time. The indicator of the time passed is shown under the grid in the form of a line.

The parameter to be viewed on the diagram can be selected using the dropdown menu of **F2 / View**. To move the cursor, use the ◄ and ► keys. By pressing these keys along with the **Shift** key, the cursor can be moved with a larger pitch.

To view the detailed measurement results obtained during all measurement time, press the **F4 / Total** key. The table includes the following information:

1) **ES total**. Total number of errored seconds during all measurement time;
2) **SES total**. Total number of severely errored seconds during all measurement time;
3) **DF min/max**. Minimum and maximum DF values during all measurement time;
4) **DF avr**. Average DF value during all measurement time;
5) **MLT**. The number of lost MPEG packets during all measurement time;
6) **IAT min/max**. Minimum and maximum IAT values during all measurement time;
7) **IAT avr**. Average IAT value during all measurement time;
8) **IP bitrate**. Average IP stream bitrate during all measurement time;
9) **MPEG bitrate**. Average MPEG stream bitrate during all measurement time.

Measurement results can be saved to a file upon completion or forced stop of measurement by pressing the **F5 / Save** key. Specify the page name in the popup field and press **ENTER**. In case a USB flash drive is connected to the Analyzer, the page will be saved to it, otherwise the page will be saved to the internal drive. You can view the measurement results saved to a file in the file manager (section 4.9) by selecting the **IPTV Statistics** file type.

4.5.4. TCP/IP network connection quality testing (TCP/IP ping)

This mode displays the results of connection quality testing in TCP/IP networks. The screen view and the data displayed are presented in fig. 4.49.

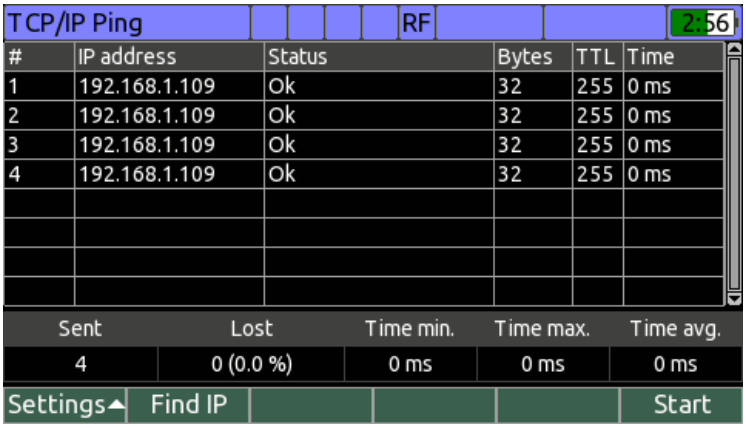


Figure 4.49

Connection quality testing in TCP/IP networks is carried out by sending an ICMP echo request and receiving an echo response from the remote network node. Quality evaluation is performed using the data on echo response packet integrity, as well as the time between sending the request and receiving the response.

To set up the mode, press the **F1 / Settings** key. The following parameters from the dropdown menu are available for editing:

1) **IP address**. IP address of the network node, at which ICMP echo requests are to be sent;
2) **Continuously**. Enabling/disabling of the continuous request sending mode until manual stop: **On**, **Off**;
3) **Packets quantity**. Number of echo requests to be sent: **1...10000**. The parameter is available for editing if the continuous request sending mode is disabled;
4) **Packet length**. Data field size of ICMP echo request in bytes: **0...65500**;

5) **Interval**. Request sending interval in seconds: **1...60 sec**.

In case the IP address of the remote node is not known, it can be determined using the domain node name by pressing the **F2 / Find IP** key. Specify the full domain node name in the popup field. If the IP address is detected, it will be indicated on the screen, as well as set in the mode settings. To find the IP address, the Analyzer needs access to the DNS network server (section 4.10.5).

The testing is started by pressing the **F6 / Start** key. The testing is stopped automatically after sending of the number of requests specified in the settings, or manually by pressing the **F6 / Stop** key.

The testing results are indicated in the table, in which the following data is shown for each echo response:

1) #. Request number;
2) **IP address**. The node IP address, at which echo requests are sent;
3) **Status**. Echo request sending results: **Ok** – proper echo response received within the specified time, **Response timeout** – the response is not received within the specified time (5 sec), **No connection** – the Analyzer is not connected to the TCP/IP network;
4) **Bytes**. The number of data field bytes of the received ICMP echo response;
5) **TTL**. IP header TTL field value of echo response;
6) **Time**. The time between echo request sending and echo response receiving in ms.

Total testing session statistics containing the following data is indicated in the lower part of the screen:

1) **Sent**. The number of echo requests sent;
2) **Lost**. The number of missing responses to echo requests;
3) **Time min**. Minimum time of response to echo request during all testing time;
4) **Time max**. Maximum time of response to echo request during all testing time;
5) **Time avg**. Average time of response to echo request during all testing time;

Press the **Shift** key, and additional functions will become available for the functional panel keys: **F1 / Network** – switching to the Analyzer network settings mode (section 4.10.5), **F2 / IPTV** – switching to the quality parameters measurement mode for the IPTV stream reception (section 4.5.2).

4.5.5. IPTV Playlists

Except for direct entering IP address and port of IPTV stream the Analyzer also gives the possibility to select the IPTV stream from the list, which is called playlist.

Playlist is a textual M3U formatted file (section 4.5.5.1), supported with almost all popular video and audio players.

Playlists should be allocated in the IT100MEM/PLAYLIST folder of the internal drive or external USB drive. All the operations with playlist files can be performed with the File Manager (section 4.8), when **«M3U Playlist»** files type is selected. Playlist selecting for the measurement can be performed with the IPTV playlist manager (section 4.5.5.2).

4.5.5.1. Playlist format

Playlist file should meet the following requirements:

1) File should have M3U extension;
2) File should be UTF-8 encoded for correct representing playlist and stream names;
3) Windows, Unix or Mac OS 9 line ending are supporting;
4) Empty lines are ignored;
5) Comments should go after # symbol;

6) Playlist name can be declared with **#PLAYLIST:name** tag, where name – playlist name. In case name is not specified, file name will be used instead. Tag can be declared in any line of the file, but should go before declaring the IPTV streams;
7) **#EXTM3U** tag is ignored, but in case, it is declared, it should go before declaring IPTV streams;
8) IPTV stream name can be declared with **#EXTINF:duration,name** tag, where duration – stream duration (ignored), name – stream name. IPTV stream URL should go right after the tag. It is allowed not to specify IPTV stream name. In this case IP address will be used instead;
9) IPTV stream address is declared with URL, which can contain protocol type, user name, password, domain name or IPT address, port, path, query and fragment. User name, password, path, query and fragment fields are ignored. URL examples:

   udp://192.168.1.42:2000
   udp://@226.100.10.42:1000
   udp://user1:qwerty@226.100.10.44:1000
   rtp://stream1.myplayer.com:500

   UDP or RTP protocol field must always be declared. Otherwise the stream will be ignored.

4.5.5.2. IPTV playlist manager

IPTV playlist manager is intended for reading, deleting and selecting IPTV playlist. The manager is accessed from the Main Menu by pressing **«F2 / M3U»** key under the  icon.

IPTV playlist manager screen is represented on figure 4.50.

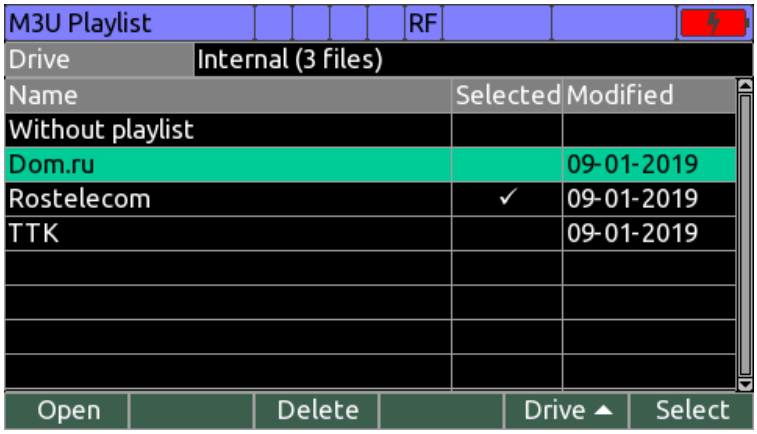


Figure 4.50

The table consists of the palylist name and modification date. Selected for the measurement playlist is indicated with ✓ icon. Playlists are sorted by their names. **«Without playlist»** item is always at the top of the table. In case, it is selected, the Analyzer is operating without playlist, supporting only direct entering IP address and port of an IPTV stream.

Function keys give the possibility to perform the following actions:

- **«F1 / Open»**. Reading the playlist in cursor position;
- **«F3 / Delete»**. Deleting the playlist in cursor position;
- **«F5 / Диск»**. Playlists source drive selecting: internal drive or USB flash drive;
- **«F6 / Select»**. Selecting the playlist in cursor position.

Opened playlist contents are represented on figure 4.51.

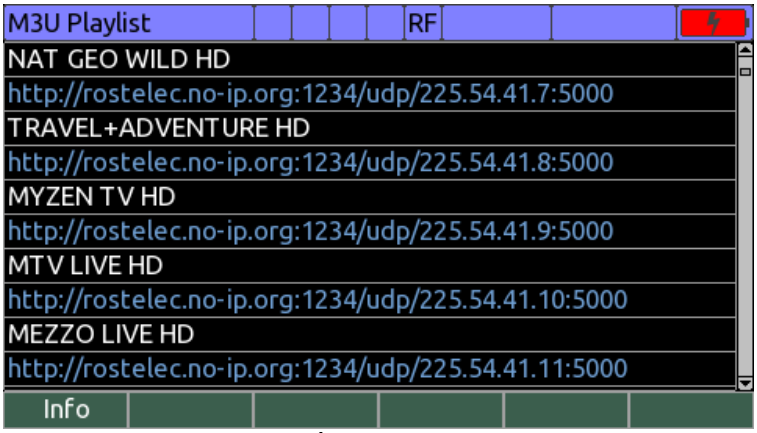


Figure 4.51

Each of stream occupies 2 lines of the table – first line is the name of the stream (can be empty), and the second is its URL.

Streams can be listed with **«▲»** and **«▼»** keys. When pressed together with **«Shift»** key, listing is performed with bigger gap.

When pressing **«F1 / Info»** key, the window with the information about the playlist name and number of UDP, RTP and other streams is appeared on the screen.

4.6. Transport Stream Analysis Procedure

4.6.1. General information

Transport steam analyzer is designed to learn the structure of MPEG transport steam (TS), and to check TS compliance to the requirements of ETSI TR 101 290 in the real time. In addition, this mode allows you to measure a number of indicators of TS and its components: the TS bitrate, the bitrate of elementary streams, the repetition rate of PSI/SI tables, the repetition rate of PTS timestamps, PCR accuracy (jitter of the PCR timestamps source), the PCR timestamps frequency offset, the frequency drift rate of PCR timestamps, etc.

Access to the mode is performed by pressing the **«F3 / Mode**» button and selecting **«MPEG Analyzer»** in the drop-down menu from the following modes:

1) Channel mode, for the terrestrial and cable TV channels (section 4.3.3);
2) Channel mode, for the satellite TV transponders (section 4.4.3);
3) MER/BER mode, for the satellite TV transponders (section 4.4.4);
4) IPTV mode, for the IPTV stream (section 4.5.2);
5) File Manager for the TS files (section 4.9).

Before performing TS analysis it is necessary to learn the general features, and also the recommendations on the analysis procedure (section 4.6.4).

4.6.2. Transport stream general information window

The TS general information window allows you to get a general idea about the structure of the stream, found errors, and to manage the analysis process (figure 4.52).

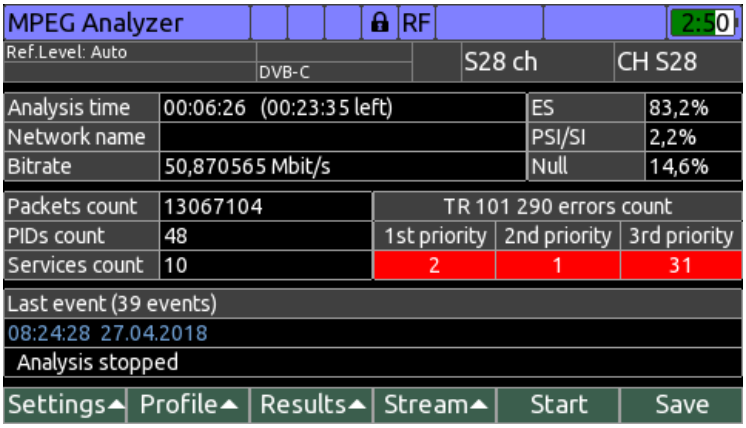


Figure 4.52

The window contains the following information:

1) **Analysis time**. The duration of the TS analysis and time remaining until the analysis is finished;
2) **Network name**. The name of the broadcast network that is transmitted in the NIT table;
3) **Bitrate**. Average TS bitrate in Mbit/s;
4) **ES**. Summary bitrate of elementary streams (video, audio and data) as a percentage of the TS bitrate;
5) **PSI/SI**. Summary bitrate of service information tables (PAT, PMT, NIT, etc.) as a percentage of the TS bitrate;
6) **Null**. Staffing bitrate (PID=0x1FFF) as a percentage of the TS bitrate;
7) **Packets count**. The number of TS packets received during the analysis;
8) **PIDs count**. The PIDs number in the TS;
9) **Services count**. The number of programs in the TS;
10) **TR 101 290 errors count**. The number of analysis errors of ETSI TR 101 290 priority 1, 2 and 3 that were found during the analysis;
11) **Last event**. Information about the latest event in the events logger (section 4.6.5) and the total number of events in the events logger.

The analysis is set up by using the **"F1 / Settings"** button context menu. There are the following settings:

1) **Duration**. The necessary analysis duration: **5 min**, **10 min**, **30 min**, **1 h**, **2 h**, **6 h**, **12 h**, **24 h**, **48 h**, **72 h**;
2) **Profile**. Select profile analysis settings: **Cable, Terrestrial, Satellite, IPTV (SPTS), Custom.** The analysis settings profile is a set of settings (the ETSI TR 101 290 parameters checklist, PSI/SI tables and elementary streams intervals limits, etc.) which are used for TS analysis. The profile is selected automatically by the Analyzer in accordance with the TS source;
3) **Beep on event**. Switching on/off sound signal playing in case an event occurs during the TS analysis;
4) **Autosave**. Switching automatic analysis results saving to a file upon analysis completion: **Off**, **On**.

Configuring of the analysis profile settings is performed in the **"F2 / Profile"** button context menu. The menu contains the following options (section 4.6.3):

1) **TR101290**. Selecting ETSI TR 101290 parameters to be checked during the analysis;
2) **Limits.** Setting the limit values for the TS parameters (repetition rate of PSI/SI tables, PTS timestamps, PCR timestamps, etc.);

3) **Exceptions.** Excepting some TS objects from the analysis. This can be useful when the analyzed TS have a complex structure, in case the Analyzer doesn't have enough resources to handle such TS.

The analysis is started by pressing the **«F5 / Start»** button. In case the **Autosave** function is switched on, it is necessary to specify the page name for further automatic saving to a file. Pressing the **«F6 / Stop»** button again leads to the analysis stopping.

Access to the analysis measurement results is available from the **«F3 / Results»** button context menu. One of the following items can be selected:

1) **Events**. Enter to the analysis events logger (section 4.6.5);
2) **Errors**. Enter to the analysis errors detailed information window for each of the ETSI TR 101 290 priorities (section 4.6.6).

Press **«F4 / Stream»** button to learn the TS structure. Select one of the following items in the appeared context menu:

1) **Services**. Enter to the TS programs list (section 4.6.7);
2) **PIDs**. Enter to the TS PIDs list (section 4.6.9);
3) **PSI/SI**. Enter to the TS service information tables tree view (section 4.6.10).

Analysis results can be saved to a file upon completion or forced stop of measurement by pressing the **«F6 / Save»** key. Specify the page name in the popup field and press **«ENTER»**. In case a USB flash drive is connected to the Analyzer, the page will be saved to it, otherwise the page will be saved to the internal drive. You can view the analysis results saved to a file in the file manager (section 4.9) by selecting the **«MPEG analysis results»** file type.

Press the **«EXIT»** button to leave the TS analysis mode. In order to prevent accidental data loss, the Analyzer cannot be switched off during the analysis.

4.6.3. Transport stream analysis profile settings

Access to the TS analysis profile settings is performed from the TS general information window (section 4.6.2) from **«F2 / Profile»** button context menu. The active profile can be selected in the TS analysis settings context menu.

4.6.3.1. ETSI TR 101 290 parameters checking list

Selecting ETSI TR 101 290 parameters to be checked during the analysis is performed from the list, as shown in the figure 4.53.

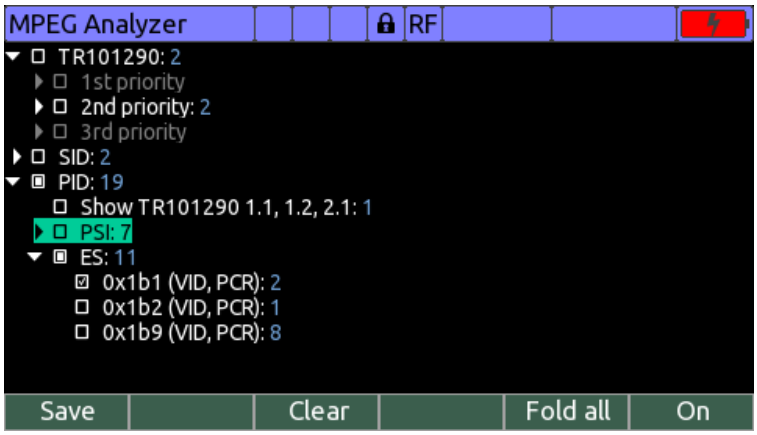


Figure 4.53

The list of available parameters is presented in a form of a table divided into 3 columns. Each column corresponds to its priority (1st, 2nd or 3rd), according to ETSI TR

101 290. If the parameter is selected to be checked during the analysis it is marked with a ✓ icon.

The following parameters of the first priority are available:

1) **1.1 TS sync loss**. Loss of synchronization with the transport stream: two or more packets in a row have the synchronization byte value different from 0x47. Restore of synchronization registers when 5 MPEG packets in a row have a proper synchronization byte;
2) **1.2 sync byte error**. MPEG packet synchronization byte value is different from 0x47;
3) **1.3a PAT error 2**. The repetition period of all sections with table_id=0x00 (PAT) in PID=0x0000 exceeds the defined value (500 ms by default). Sections with table_id different from 0x00 found in PID=0x0000. Scrambling_control_field is different from 0x0 for PID=0x0000;
4) **1.4 Continuity count**. Incorrect packets sequence order: the continuity_count field value of two consecutive packets with the same PID differs by more than 1; a packet with the same continuity_count field value for the PID appears more than twice in a row[5];
5) **1.5a PMT error 2**. The repetition period of all sections with table_id=0x02 (PMT) in PID specified in the program_map_pid of the PAT table exceeds the defined value (500 ms by default). Scrambling_control_field is different from 0x0 for PID specified in the program_map_PID of the PAT table;
6) **1.6 PID error**. The repetition period of the MPEG packets of elementary streams (video, audio, data) exceeds the defined limit (5 sec by default). Elementary streams of audio and data with a language descriptor of ISO 639 type, that is different from 0, are excluded from checking.

The following parameters of the second priority are available:

1) **2.1 Transport error**. Transport_error_indicator field of the MPEG packet equal to 1. This indicates that the packet is damaged and cannot be further analyzed;
2) **2.2 CRC error**. The CRC error was detected in the CAT, PAT, PMT, NIT, EIT, BAT, SDT or TOT table sections. This indicates that the table section is damaged and should not be used by the receiver;
3) **2.3a PCR repetition**. The repetition period of the PCR timestamps exceeds the defined limit (40 ms by default);
4) **2.3b PCR discontinuity**. The difference between the two consecutive PCR timestamps counter values (PCR_i – PCR_{i-1}) is less than 0 or exceeds the defined limit (100 ms by default), and, meanwhile, the discontinuity_indicator flag is not set;
5) **2.4 PCR accuracy**. The value of the PCR accuracy metric (the jitter of the PCR timestamps source) is outside of the defined range (-500...+500 ns by default). The measurement is made in accordance with the profile MGF2 (100 mHz), according to ETSI TR 101 290;
6) **PCR FO/DR**. The frequency offset of PCR timestamps is outside of the defined range (-810...+810 Hz, by default). The frequency drift rate of PCR timestamps is outside of the defined range (-27...+ 27 mHz/s by default). The measurement is made in accordance with the MGF2 (100 mHz) profile, according to ETSI TR 101 290;
7) **2.5 PTS error**. The repetition period of PTS timestamps exceeds the defined limit (700 ms by default);
8) **2.6 CAT error**. The MPEG packets with the scrambling_control_field different from 0, were detected in the transport stream, and table with table_id=0x01 (CAT) were not detected; table sections with table_id, that are different from 0x01, were detected in PID=0x0001.

[5] According to ISO/IEC 13818-1, the appearance of a MPEG packet duplicate is not an error

The following parameters of the third priority are available:

1) **3.1a NIT actual error**. The sections with table_id other than 0x40 (NIT of the current broadcast network), 0x41 (NIT of the broadcast networks different from the current one), or 0x72 (ST) are detected in PID=0x0010. The repetition period of all sections with table_id=0x40 (NIT of the current broadcast network) in PID=0x0010 exceeds the defined value (10 sec by default). The interval between the arrival time of any two sections with table_id=0x40 (NIT of the current broadcast network) in PID=0x0010 is less than the defined value (25 ms by default);
2) **3.1b NIT other error**. The repetition period of all sections with table_id=0x41 (NIT of the broadcast networks different from the current one) of each table in PID=0x0010 exceeds the defined value (10 sec by default);
3) **3.2 SI repetition error**. The repetition period of all sections in the PAT, CAT, PMT, NIT, SDT, BAT, EIT, TDT, and TOT tables separately exceeds the defined value. The interval between the arrival time of any two PAT, PMT, NIT, SDT, BAT, EIT, RST, TDT, and TOT sections for each table separately less than the defined value (25 ms by default). The parameter is a duplicate for most types of tables, and in case an error is detected, 3.2 indicator will be set in addition to indicator specific for the checking table;
4) **3.4a Unreferenced PID**. The packets with a PID that is not referenced by any service information table (PSI/SI) within the defined time interval (500 ms by default) is detected in the transport stream;
5) **3.5a SDT actual error**. The repetition period of all sections with table_id=0x42 (SDT of the current transport stream) in PID=0x0011 exceeds the defined value (2 sec by default). The sections with table_id different from 0x42 (NIT of the current broadcast network), 0x46 (SDT of the transport streams that are different from the current one), 0x4A (BAT), or 0x72 (ST) are detected in PID=0x0011. The interval between the arrival time of any two sections with table_id=0x42 (SDT of the current transport stream) in PID=0x0011 is less than the defined value (25 ms by default);
6) **3.5b SDT other error**. The repetition period of all sections with table_id=0x46 (SDT of the transport streams different from the current one) of each table in PID=0x0011 exceeds the defined value (10 sec by default);
7) **3.6a EIT actual error**. The repetition period of all sections with table_id=0x4E (EIT of the current/following program event of the current transport stream) of each of the tables in PID=0x0012 exceeds the defined value (2 sec by default). The sections with table_id different from 0x4E...0x6F (EIT) or 0x72 (ST) are detected in PID=0x0012. The interval between the arrival time of any two sections with table_id=0x4E (EIT of the current/following event of the current transport stream) of each of the tables in PID=0x0012 is less than the defined value (25 ms by default);
8) **3.6b EIT other error**. The repetition period of all sections with table_id=0x4F (EIT of the current/following event of transport streams different from the current) of each of the tables in PID=0x0012 exceeds the defined value (10 sec by default for cable and satellite TV and 20 sec for terrestrial TV);
9) **3.6c EIT P/F error**. If one of the sections (0 or 1) of the EIT table (current/ following event) for the program of any of the transport stream presents, the other must present too. In case the transport stream doesn't match the condition, an error is registered;
10) **3.7 RST error**. The sections with table_id different from 0x71 (RST) or 0x72 (ST) are detected in PID=0x0013. The interval between the arrival time of any two sections with table_id=0x71 (RST) in PID=0x0013 is less than the defined value (25 ms by default);

11) **3.8 TDT error**. The repetition period of all sections with table_id=0x70 (TDT) in PID=0x0014 exceeds the defined value (30 sec by default). The sections with table_id different from 0x70 (TDT), 0x72 (ST), or 0x73 (TOT) are detected in PID=0x0014. The interval between the arrival time of any two sections with table_id=0x70 (TDT) in PID=0x0014 is less than the defined value (25 ms by default).

The cursor is moved by using the **«◄»**, **«►»**, **«▲»** and **«▼»** buttons. To select and deselect the parameter for checking, press **«ENTER»** or **«F6»** button. To select or deselect all the parameters of a priority at the cursor position, press the **«F5 / All»** button. To set the default parameters selection for the current profile, press the **«F2 / Default»** button.

To exit from the mode with saving of changes it is necessary to press the **«F1 / Save»** button. To exit and discard changes, press the **«EXIT»** button.

4.6.3.2. Transport stream parameters limit values setting

Setting the limit values of the transport stream parameters is performed in the table shown in the figure 4.54.

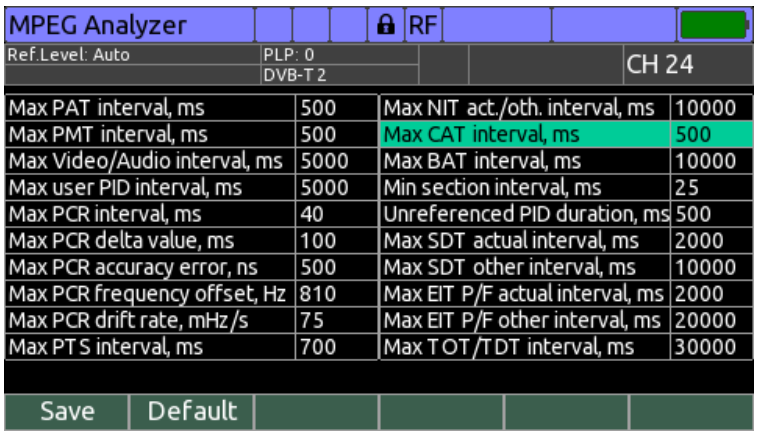


Figure 4.54

The following transport stream parameters and their limit values are shown in the table:

1) **Max PAT interval, ms**. The maximum repetition period of all sections of the PAT table: **1…60000 ms**;
2) **Max PMT interval, ms**. The maximum repetition period of all sections of the PMT table: **1…60000 ms**;
3) **Max Video/Audio interval, ms**. The maximum repetition period of video and audio elementary streams packets: **1…60000 ms**;
4) **Max user PID interval, ms**. The maximum repetition period of the data elementary streams: **1…60000 ms**;
5) **Max PCR interval, ms**. The maximum repetition period of PCR timestamps for each of the program: **1…60000 ms**;
6) **Max PCR delta value, ms**. The maximum difference between the two consecutive PCR timestamps counter values (PCR_i – PCR_{i-1}) for each of the program: **1…60000 ms**;
7) **Max PCR accuracy error, ns**. The maximum allowed value of the PCR accuracy metric (absolute value) for each of the program: **1…60000 ns**;
8) **Max PCR frequency offset, Hz**. The maximum allowed value of the PCR timestamps frequency offset (absolute value) for each of the program: **1…60000 Hz**;

9) **Max PCR drift rate, mHz/s**. Maximum allowed value of the of PCR timestamps frequency drift rate (absolute value) for each of the program: **1…60000 mHz/s**;
10) **Max PTS interval, ms**. The maximum allowed repetition period of the PTS timestamps for each of the elementary stream: **1…4000 ms**;
11) **Max NIT act./oth. interval, ms**. The maximum repetition period of all sections of the NIT table for each broadcast networks: **1…60000 ms**;
12) **Max CAT interval, ms**. The maximum repetition period of all sections of the CAT table: **1…60000 ms**;
13) **Max BAT interval, ms**. The maximum repetition period of all sections of the BAT table for each of the bouquet: **1…60000 ms**;
14) **Min section interval, ms**. The minimum allowed time between arrival of any two sections of the same table: **1…16000 ms**;
15) **Unreferenced PID duration, ms**. Maximum allowed time during which a PID doesn't referenced by PSI/SI tables: **1…60000 ms**;
16) **Max SDT actual interval, ms**. The maximum repetition period of all sections of the SDT table of the current transport stream: **1…60000 ms**;
17) **Max SDT other interval, ms**. The maximum repetition period of all sections of the SDT table for each of the transport streams different from the current one: **1…60000 ms**;
18) **Max EIT P/F actual interval, ms**. The maximum repetition period of all sections of the EIT table (current/following event) for each program of the current transport stream: **1…3000 ms**;
19) **Max EIT P/F other interval, ms**. The maximum repetition period of all sections of the EIT table (current/following event) for each program of transport streams different from the current one: **1…60000 ms**;
20) **Max TDT/TOT interval, ms**. The maximum repetition period of all sections of the TOT and TDT tables: **1…32500 ms**;

The cursor is moved by using the **«◄»**, **«►»**, **«▲»** and **«▼»** buttons. The value for the parameter at the cursor position can be edited by using the alpha-numeric keyboard. To set the default limit values for the current profile, press the **«F2 / Default»** button.

To exit from the mode with saving of changes it is necessary to press the **«F1 / Save»** button. To exit and discard changes, press the **«EXIT»** button.

4.6.3.3. Transport stream objects exception from analysis setting

Setting the exception of the transport stream objects from the analysis is performed by using the table, as shown in the figure 4.55.

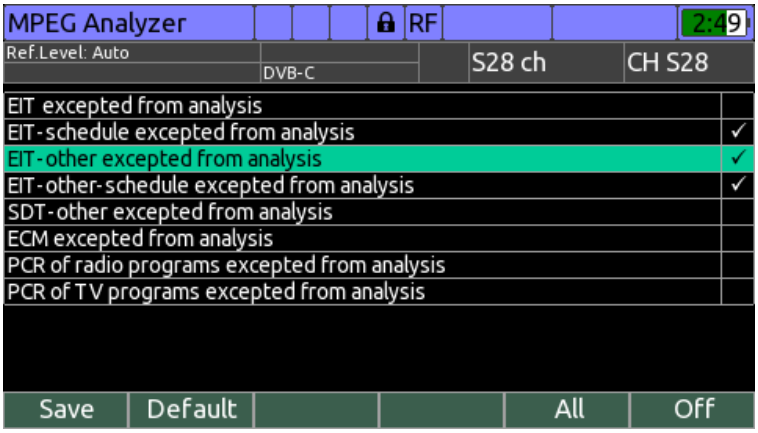


Figure 4.55

The table contains the following items for their exception from the analysis:

1) **EIT excepted from analysis**. Exception the EIT tables (current/following event) of the current transport stream programs;
2) **EIT-schedule excepted from analysis**. Exception the EIT tables (several days schedule) of the current transport stream programs;
3) **EIT-other excepted from analysis**. Exception the EIT tables (current/following event) of the programs of the transport streams different from the current one;
4) **EIT-other-schedule excepted from analysis**. Exception the EIT tables (several days schedule) of the current transport stream programs different from current one;
5) **SDT-other excepted from analysis**. Exception the SDT tables of the transport streams different from the current one;
6) **ECM excepted from analysis**. Exception the ECM elementary streams;
7) **PCR of radio programs excepted from analysis**. Exception the PCR timestamps of all radio programs;
8) **PCR of TV programs excepted from analysis**. Exception the PCR timestamps of all TV programs;

The selected exceptions are marked the ✓ icon. Recommendations on exceptions configuring are given in the section 4.6.4.

The cursor moves by using the **«▲»** and **«▼»** buttons. For selecting or deselecting exception press **«ENTER»** or **«F6»** button. For selecting or deselecting of all the exceptions press «**F5 / All»** button. To set the default exceptions selecting for the current profile, press the **«F2 / Default»** button.

To exit from the mode with saving of changes it is necessary to press the **«F1 / Save»** button. To exit and discard changes, press the **«EXIT»** button.

4.6.4. Transport stream analysis recommendations

Before starting to perform the transport stream analysis (especially long-term), it is necessary to prepare the Analyzer as follows:

1) Set the required duration of the analysis in the settings (section 4.6.2);
2) Make sure the Meter is connected to the external power source when you are planning a long-term analysis;
3) Make sure the required analysis profile is selected in the settings (section 4.6.2);
4) Make sure that the analysis settings correspond to the task (section 4.6.3);
5) Start the analysis of transport stream (section 4.6.2);
6) When you plan a long-term analysis, observe the analysis progress for the first 2-3 minutes, and make sure that the analysis does not stop and there is no a large number of events in the events logger (section 4.6.5);
7) Leave the Meter until the end of the analysis.

It is not recommended that a large number of similar events are registered in the logger during the analysis. As a result, the Analyzer's efficiency reduces, and also it becomes difficult to find a particular event in the logger among a batch of similar events. It is important to remember that no more than 10,000 events can be registered in the log. Usually, a large number of similar events indicate that the limit values of transport steam parameters are set incorrectly (section 4.6.3.2).

Another problem is the fact that the analysis might be emergency stopped because of the lack of the Analyzer's resources due to the complex structure of the transport stream. Normally this problem appears in the first 2-3 minutes. The critical features of the transport stream complexity are in following:

1) A large number of programs (several dozens). Usually transport streams with plenty of the radio programs are the risk factor;

2) Broadcasting TV programs schedule (EIT) in the transport stream with a total duration of more than 1 week. The risk factor in this case is the transport streams broadcasting schedule for all the programs in the network, not only for the programs of the current transport stream;
3) Presence of a large number of ECM elementary streams in the transport stream. The risk factor is transport streams with a large number of programs and groups of programs and several encryption systems.

To analyze such transport streams, you should exclude some types of the objects from the analysis (section 4.6.3.3).

It is also necessary to remember about some features of the Meter concerning the analysis of the structure of the service information tables of the transport stream (section 4.6.10). Because the Meter has a limited performance, the accumulation of the sections of the tables is performed when such the opportunity is appeared. Considering that the total amount of information of the average transport stream carried in the tables of service information is more than 1 MB, so the accumulation of all sections can take 5...10 min. Hence, the period of time from the beginning of the analysis to the appearance of the table in the service information tables tree should not be associated with the frequency of occurrence of this table in the transport stream. You should remember this when analyzing the transport stream from the short-duration file: after the analysis is completed, sections of some tables could absent in transport streams service information tables tree, although they are actually present in the stream.

4.6.5. Transport stream analysis events logger

The events logger is a table of event with a timestamp and description that occurred during the TS analysis (figure 4.56).

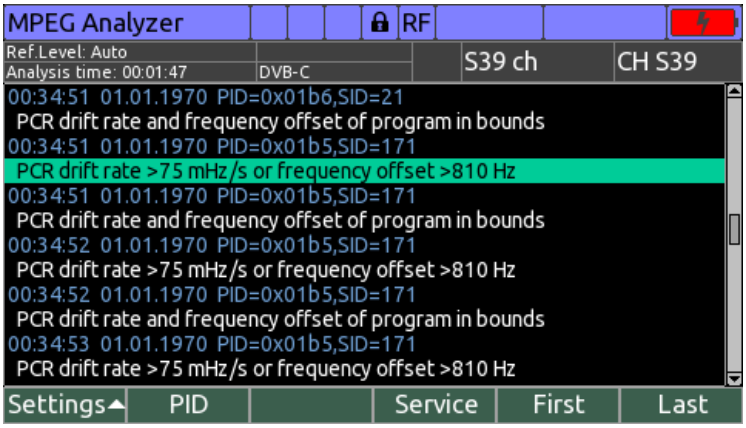


Figure 4.56

Each event consists of two lines and contains the following information:

1) The occurred events time and date or time elapsed since the analysis has started (in **+HH:MM:SS** format). The indicated time stamp type is selected in the events logger settings menu (see below);
2) The PID identifier, which the event is associated with. Available for the most of events;
3) The program identifier (SID) which the event is associated with;
4) The originating broadcast network identifier (ONID), which the event is associated with;
5) The transport streams identifier (TS), which the event is associated with;
6) The programs bouquet identifier (bouquet), which the event is associated with;

7) Event indicator identifier according to ETSI TR 101 290. Available for the most of events;
8) Textual description of the event.

The logger can contain the following events:
1) The event of registration an error according to ETSI TR 101 290 indicators. The description of the event consists of indicator identifier and a detailed description of the event (for example **«3.1a: NIT repetition period >500 ms»**);
2) **PCR drift rate >X mHz/s or frequency offset >Y Hz**, where X and Y – the limit values of parameters. The event occurs when the frequency offset and(or) the drift rate of PCR timestamps goes outside the defined range;
3) **PCR drift rate and frequency offset of program in bounds**. The event occurs when the frequency offset and the drift rate of PCR timestamps return to the defined range;
4) **Analysis started**. Analysis of the transport stream is started;
5) **Analysis stopped**. The transport streams analysis is completed thanks to the user's initiative, due to the completion of the defined analysis duration, or due to a critical fault;
6) **Synchronization with signal source lost**. Lost of synchronization with the signal source by which the transport stream is transmitting: DVB channel demodulator (no synchronization), IPTV network interface (no IP packets for 1 sec) or file system (end of file);
7) **Synchronization with signal source established**. Synchronization with the transport stream source is established: DVB channel demodulator (synchronization appeared), IPTV network interface (IP packets appeared) or file system (start playing of the file);
8) **MPEG packet size other than 188 bytes**. The MPEG packet with size other than 188 bytes is detected;
9) **MPEG stream bitrate is too high**. The transport streams bitrate is higher than the processing rate of the Analyzer. The analysis cannot be continued;
10) **Not enough memory to continue analysis**. There is not enough RAM for the transport streams analysis. Analysis cannot be continued. It is necessary to exclude some objects of the transport stream from the analysis (section 4.6.3.3);
11) **Events register too often**. The Meter does not have enough time to register events in the logger, because they arrive too quickly. Analysis cannot be continued. It is necessary to change the parameters of analysis settings profile (section 4.6.3);
12) **MPEG stream structure has changed**. The transport stream structure has changed (the number of programs, the program elementary stream set, etc.). Analysis cannot be continued. To continue the analysis it is necessary to run it again;
13) **Too much events registered**. The maximum number of logger events is reached. The transport streams analysis continues, but events do not register anymore. To avoid registration a large number of similar events, it is necessary to set up the analysis settings profile parameters (section 4.6.3);
14) **Unknown fault happened**. An unknown error occurred during the analysis. Analysis cannot be continued. It is necessary to contact the manufacturer to fix a fault;
15) The events about excluding the transport streams objects from the analysis. Events appear when the analysis is started if one or several exceptions are selected (section 4.6.3.3).

The cursor is moved by using the **«▲»** and **«▼»** buttons. If pressed together with the **«Shift»** button, the cursor is moved on the several events. To move to the beginning of the logger, press the **«F5 / Start»** button, and to move to the end – **«F6 / End»**.

For the event at the cursor position, it is possible to move to the other modes to view the measurement results associated with that event:

1) **«F2 / PID»**. Go to PIDs list view with setting the cursor to the PID associated with the event;
2) **«F3 / PSI/SI»**. Go to the transport stream service tables structure tree with setting the cursor to the table associated with the event;
3) **«F4 / Service»**. Go to the program list view with setting the cursor to the program associated with the event.

Pressing **«F1 / Settings»** leads to logger configuring context menu appearing. The following options are available:

1) **Setup Filter…** Enter events filter settings menu (see below);
2) **Filter enabled**. Events filer enabling/disabling. ☑ icon is indicated in case the filter is enabled, and ☐ - in case it is disabled;
3) **Relative time**. Switching on/off indicating relative time for events. ☑ icon is indicated in case the time elapsed since the analysis has started is indicated for events, and ☐ - in case absolute time and date is indicated.

Events filter settings menu is represented on figure 4.57.

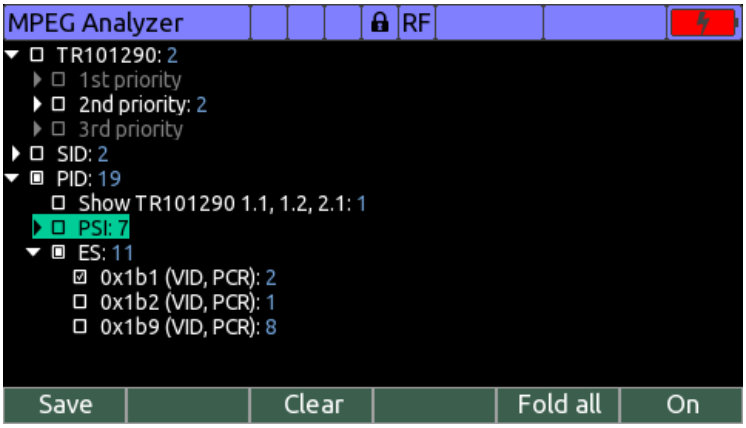


Figure 4.57

It consists of list of event types, represented in a form of the tree. Events are classified in accordance with the following event groups:

1) **TR101290**. Selecting ETSI TR 101 290 checking criterion;
2) **SID**. Selecting transport stream services;
3) **PID**. Selecting transport stream PIDs.

There is number of events which meet the event type (with respect to the rest of the filter settings) on the right of the node. The state of the node is indicated on the left with one of the following icons:

1) ☐. Criterion is disabled;
2) ☑. Criterion is enabled;
3) ▣. Some criterions of the group are enabled and some are disabled.

In case no one of criterion of the group is enabled, it is considering, that all the events, which meet the criterions of the group are selected.

Node name is indicated in gray color in case the criterion is not compatible with the other filter settings.

Root nodes that contain a structured set of data are indicated with the **«▼»** (node expanded) or **«►»** icon (node collapsed). The cursor moves by using the **«▲»** and **«▼»** buttons. When pressed together with the **«Shift»** button, the cursor moves on several nodes. When pressing the **«►»** button on the root node, it expands. When pressing it again, the cursor moves to the first child node of the root node. Press the **«◄»** button to move the cursor to the nearest root node. When pressing the **«◄»** button again the selected root node is collapsed. When pressing the **«◄»** button together with the **«Shift»** button, all root nodes of the branch in the cursor position are collapsed, up to the main root node. When pressing the **«►»** button together with the **«Shift»** button, all root nodes of the branch in the cursor position are expanded, up to the most hidden node. Press the **«F5 / Fold all»** button to collapse all the tree nodes.

Press the **«ENTER»** or **«F6 / On»** and **«F6 / Off»** buttons to enable or disable node. Press **«F3 / Clear»** to disable all the nodes.

Press **«F1 / Save»** to save the settings and leave the menu. In this case, filter will be enabled automatically. Press **«EXIT»** to leave without saving the settings.

4.6.6. ETSI TR 101 290 errors information window

The errors information window consists of ETSI TR 101 290 parameters list with information about the status of each parameter, as shown on the figure 4.58.

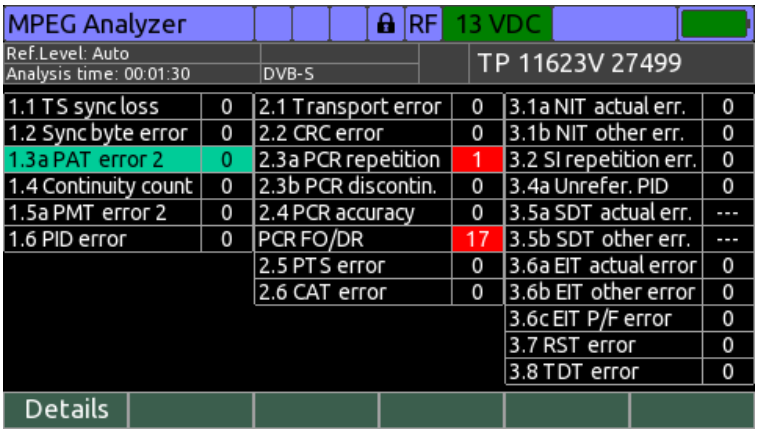


Figure 4.58

The list contains parameters similar to those presented in the ETSI TR 101 290 parameters checking list (section 4.6.3.1). There is a registered errors counter on the right of the checking parameter. In case at least one error is registered, the counter is displayed with the red background. If checking of the parameter is switched off, the «---» is indicated instead of errors counter.

The cursor is moved by using the **«◄»**, **«►»**, **«▲»** and **«▼»** buttons. Press the **«ENTER»** or **«F1 / Details»** button to see detailed information about the parameter in the cursor position. The detailed information of registered errors will appear on the screen in a form of a tree (figure 4.59).

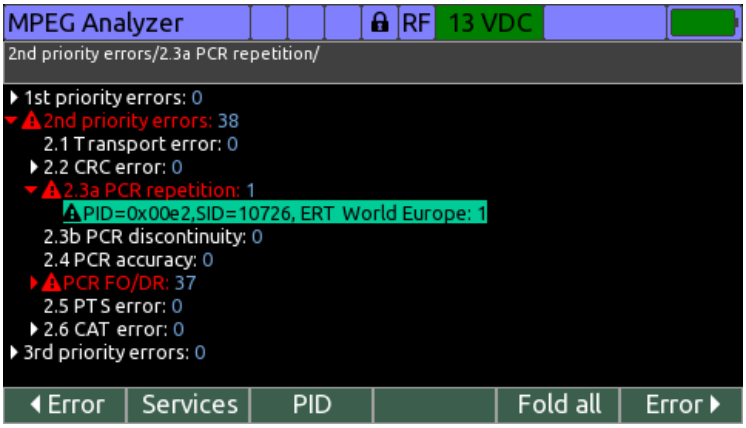


Figure 4.59

The tree consists of errors counters for all the checking parameters grouped according to their priorities. Some checking parameters (for example **«1.3a PAT error 2»**) are divided into sub-parameters according to TR 101 290. Errors are counted for each transport stream object (PID, PSI/SI table) separately, and indicated on the screen with the object identification information (PID, SID, service name).

Root nodes that contain a structured set of data are indicated with the **«▼»** (node expanded) or **«►»** icon (node collapsed). If checking parameter or group of parameters contains one or more errors, the corresponding node is indicated with the icon, and the node name is displayed in red color.

The cursor moves by using the **«▲»** and **«▼»** buttons. When pressed together with the **«Shift»** button, the cursor moves on several nodes. When pressing the **«►»** button on the root node, it expands. When pressing it again, the cursor moves to the first child node of the root node. Press the **«◄»** button to move the cursor to the nearest root node. When pressing the **«◄»** button again the selected root node is collapsed. When pressing the **«◄»** button together with the **«Shift»** button, all root nodes of the branch in the cursor position are collapsed, up to the main root node. Press the **«F5 / Fold all»** button to collapse all the tree nodes. Press the **«F1 / ◄Error»** or **«F6 / Error►»** button to navigate cursor among the nodes, which contain errors.

There is a tree route map at the top of the window, which shows the names of the nodes, separated by the **«/»** symbol. These nodes are the successive root nodes for the node in the cursor position.

When setting the cursor on one of objects containing errors, the following actions are available:

1) Pressing **«F2 / Service»** button to switch to the programs list with cursor on the corresponding service (section 4.6.7);
2) Pressing «F3 / PID» button to switch to the PIDs list with cursor on the corresponding PID (section 4.6.9).

4.6.7. Transport stream programs list

The transport stream programs list is represented as a table with the information about the programs, as shown in the figure 4.60.

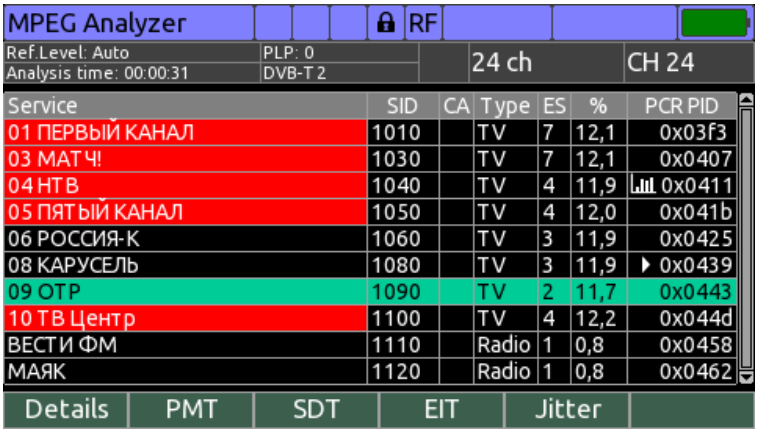


Figure 4.60

The table columns contain the following information about the programs of the transport stream:

1) **Service**. The name of the program according to the SDT table. If one or more elementary streams of the program contain errors, the name of the program is displayed on the red background;
2) **SID**. The programs identifier according to PMT and SDT tables;
3) **CA**. The indicator of encrypted program;
4) **Type**. Program type: **TV** – TV program, **Radio** – radio program, **Data** – another types of program;
5) **ES**. Number of elementary streams (video, audio and data) of the program;
6) **%**. The summary bitrate of all elementary streams of the program as a percentage of the transport stream bitrate;
7) **PCR PID**. The PID identifier in which the program PCR timestamps are transmitted and PCR monitoring status icon (section 4.6.8): ▶ - monitoring is in progress, 📶 - monitoring is finished, measurement results are available. If the program does not have PCR timestamps, the value is specified as **«---»**.

The cursor is moved by using the **«▲»** and **«▼»** buttons.

For viewing the structure of the PMT table (section 4.6.10) press **«F2 / PMT»** button, SDT table - **«F3 / SDT»**, EIT (current/following event) table - **«F4 / EIT»**.

For switching to the PCR time domain monitoring mode, press the **«F5 / Jitter»** button (section 4.6.8).

Press the **«ENTER»** or **«F1 / Details»** button to view the detailed information about the components of the program in the cursor position. The table with information about the program structure appears on the screen, as shown on the figure 4.61.

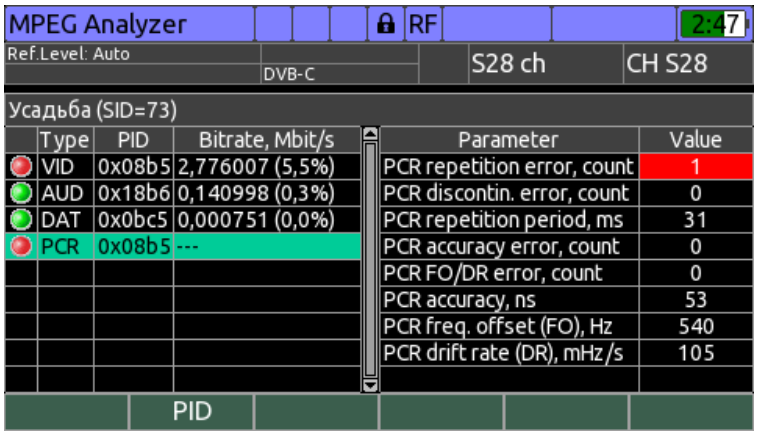


Figure 4.61

There is the table with the list of elementary streams of the program on the left side of the screen. The table consists of columns with the following information:

1) Status of elementary stream:
   a. **(green)**. The elementary stream is free of errors;
   b. **(red)**. The elementary stream contains errors;
   c. **(grey)**. The elementary stream does not contain data for checking (applies to ECM);
2) **Type**. Elementary stream type: **VID** -video, **AUD** – audio, **PCR** – PCR timestamps, **ECM**;
3) **PID**. PID identifier of the elementary stream. It is displayed on the red background if PID contain errors (section 4.6.9);
4) **Bitrate, MBit/s**. Absolute and relative bitrate of the elementary stream as a percentage of the transport stream bitrate.

Technically, ECM is not a part of the program, but the program refers to ECM, so it is displayed in the table. The several programs can refer to the same ECM.

The cursor is moved by using the **«▲»** and **«▼»** buttons. Additional information about the elementary stream in the cursor position is displayed on the right side of the screen:

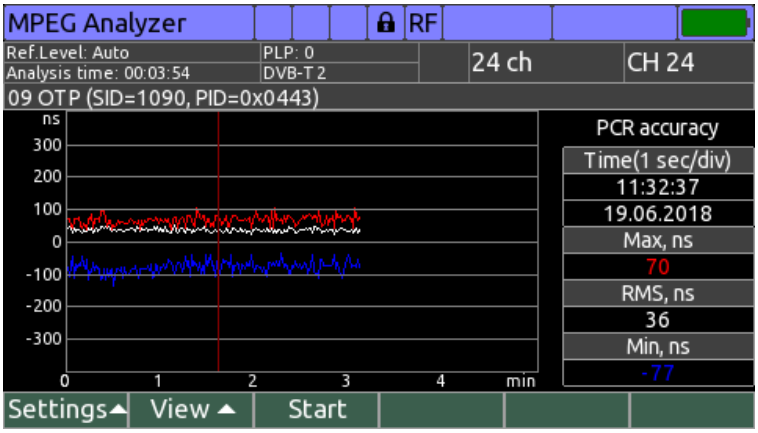
1) **PID interval error, count**. The number of times elementary stream packets repetition period exceeds the defined limit during the analysis;
2) **PTS interval error, count**. The number of times PTS timestamps repetition period exceeds the defined limit during the analysis. If the elementary stream doesn't have PTS timestamps or the elementary stream is encrypted, the **«---»** value is displayed;
3) **PTS repetition period, ms**. The average repetition period of PTS timestamps in ms. If the elementary stream doesn't have PTS timestamps or the elementary stream is encrypted, the **«---»** value is displayed;
4) **PCR repetition error, count**. The number of times PCR timestamps repetition period exceeds the defined limit during the analysis;
5) **PCR discontin. error, count**. The number of times the difference of the consecutive PCR timestamps counter values (PCR_i – PCR_{i-1}) is outside the defined range during the analysis;
6) **PCR repetition period, ms**. The average PCR repetition period in ms;
7) **PCR accuracy error, count**. The number of times PCR accuracy metric (jitter of PCR timestamps source) is outside of the defined range during the analysis;
8) **PCR FO/DR error, count**. The number of times PCR timestamps frequency offset or drift rate is outside the defined range during the analysis;
9) **PCR accuracy, ns**. The current RMS value of the PCR accuracy metric (jitter of PCR timestamps source) in ns;
10) **PCR freq. offset (FO), Hz.** The current average PCR timestamps frequency offset value in Hz. The value is displayed in gray color until the measurement accuracy will achieve the optimal value (about 1 min since the beginning of the analysis);
11) **PCR drift rate (DR), mHz/s**. The current RMS value of the PCR timestamps drift rate mHz/s. The value is displayed in gray color until the measurement accuracy will achieve the optimal value (about 1 min since the beginning of the analysis).

If the parameter value exceeds the defined range, it is displayed on the red background.

Press **«ENTER»** or **«F2 / PID»** to switch to the PIDs list view with the cursor on the PID of the selected elementary stream.

4.6.8. PCR time domain monitoring

Time domain monitoring of program PCR timestamps allows to measure PCR repetition period, PCR frequency offset etc., in real time with representing measuring results in a form of a graph (figure 4.62).



Picture 4.62

Each of the graphs consists of three traces. Depending on the measured parameter, the traces have the following meaning:

parameter	trace value		
	trace 1	trace 2	trace 3
PCR accuracy (PCR source jitter)	maximum	RMS	minimum
PCR repetition period	maximum	average	minimum
PCR drift rate	maximum	RMS	minimum
PCR frequency offset	maximum	average	minimum

Each trace includes 300 time intervals. Depending on the user-defined measurement duration, each time interval equals to:

Measurement duration	5 min	10 min	30 min	1 h	2 h	6 h	12 h	24 h	48 h	72 h
Time interval, sec	1	2	6	12	24	72	144	288	576	864

Each time interval accumulates parameter value according to trace type.

There is program name, its identifier (SID) and PCR PID identifier (PID) at the top of the screen. The following information is indicated on the right of the screen: measured parameter name, starting time and date of the interval and the measurement results in the cursor position. Measurement results value color corresponds to the trace color. In case of transport stream synchronization loss, corresponding time intervals is not shown on the trace.

Monitoring setting up is performed in the **«F1 / Settings»** context menu:

1) **Duration**. Monitoring duration: **5 min**, **10 min**, **30 min**, **1 h**, **2 h**, **6 h**, **12 h**, **24 h**, **48 h**, **72 h**.

Selecting of the parameter to show on the graph is performed in **«F2 / View»** context menu:

1) **PCR accuracy**. PCR timestamps source jitter;
2) **PCR interval**. PCR repetition period;
3) **PCR drift rate**;
4) **PCR freq. offset**. PCR frequency offset.

Press **«F3 / Start»** to launch monitoring. Monitoring can be started only in case transport stream analysis is in progress (section 4.6.2). The monitoring is continued when leaving the mode. PCR monitoring only for one of the programs can be performed at a time.

Press **«F3 / Stop»** to stop monitoring. Monitoring is automatically stopped in case the set up time is over or transport stream analysis has finished (section 4.6.2). The measurement results are saved for each program separately when leaving the mode, and available on the screen on the following enter the mode.

To move the cursor, use the ◄ and ► keys. By pressing these keys along with the **Shift** key, the cursor can be moved with a larger pitch.

4.6.9. Transport stream PIDs list

The transport stream PIDs list is a table of the PID identifiers which the transport stream consists of, and their additional information (figure 4.63).

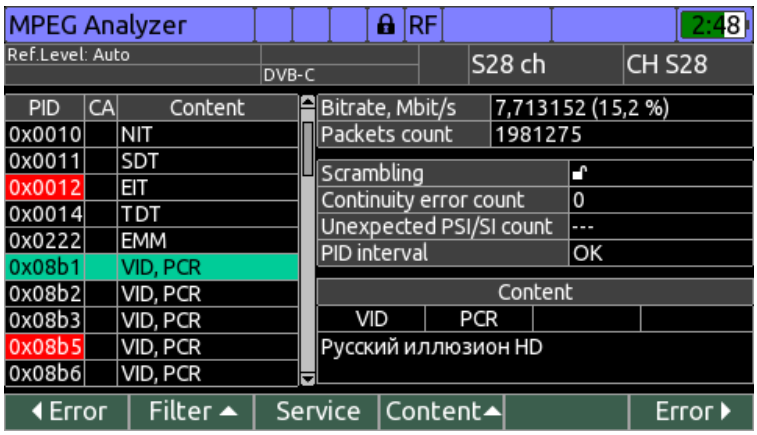


Figure 4.63

There is a PIDs list on the left side of the screen with the following information:

1) **PID**. The PID identifier value. If the PID contains errors, the identifier is displayed on a red background;
2) **CA**. The indicator of the encrypted information transferred in this PID;
3) **Content.** The list of objects transferred in the PID (see below).

The cursor moves by using the **«▲»** and **«▼»** buttons. When pressed together with the **«Shift»** button, the cursor moves on the several PIDs. Additional information is displayed for the PID in the cursor position on the right side of the screen:

1) **Bitrate, Mbit/s**. The absolute and relative PID bitrate as a percentage of the transport stream bitrate;
2) **Packets count.** The total number of the MPEG packets of the PID received during the analysis. In case no packets received for PID, which is referenced by the transport stream service information, the value is displayed on the red background;
3) **Scrambling**. PID data encrypting status: 🔓 – PID is transmitted without encryption, 🔒 (no background) - PID data is encrypted, 🔒 (red background) – PID data is encrypted, but according to the standard should not be (all PSI/SI tables except EIT), **CAT is not detected** – PID data is encrypted, but CAT table is not found in the transport stream;
4) **Continuity error count**. Number of continuity_count errors detected during the analysis. If the value is more than 0, it is displayed on a red background;

5) **Unexpected PSI/SI count**. The number of detected service information tables (PSI/SI) that should not appear in this PID. If the value is more than 0, it is displayed on a red background;
6) **PID interval**. The indicator of elementary stream repetition period exceeding the defined limit: **OK** – no errors detected, **ERROR** – one or more errors are detected (displayed on the red background);
7) **Reference to PID**. The indicator of the lack of reference to PID in the service information tables (PSI/SI) of the transport stream. The parameter is displayed only for PID without the reference and **«not found»** value is displayed on the red background.

A list of the objects transmitted in the selected PID is displayed at the bottom of the table («Contents» group):

1) the service information table (PSI/SI), as part of: **PAT, CAT, PMT, NIT** (the NIT for the current network broadcast), **NIT-oth** (NIT for the broadcast networks different from the current one), **SDT** (SDT for the current transport stream) **SDT-oth** (SDT for transport streams different from the current one), **EIT** (current/following event for the programs of the current transport stream) **EIT-oth** (present/following event for the programs of the transport streams different from the current one), **EIT-sch** (schedule for a few days for the programs of the current transport streams), **EIT-oth-sch** (schedule for a few days for programs transport streams different from the current one), **BAT, TOT, TDT, ST, RST, TSDT**;
2) **VID**. Video elementary stream;
3) **AUD**. Audio elementary stream;
4) **DAT**. Data elementary stream;
5) **ECM**. The messages stream of access control: information about the rules of access to the channels and bouquets of the channels;
6) **EMM**. The messages stream of access management: information about the authorization of subscribers and groups of subscribers, the cryptographic keys;
7) **NULL**. Staffing, transmitted in PID=0x1FFF.

Below the content description group, there is a field with the name of the program that contains the selected PID, or the name of the program that references to the selected PID. In case the several programs reference to the selected PID, the number of programs is displayed instead of the program name.

If the object transmitting in the PID contains errors, its name is displayed on a red background.

The cursor move through the PIDs which contain errors is performed by pressing the **«F1 / ◄Error»** and **«F6 / Error►»** button. For the convenience of data analysis, it is possible to display a PIDs list that is matched to the filter specified by the **«F2 / Filter»** button context menu:

1) **All**. Display all the PIDs;
2) **Erroneous**. Display only the PIDs that contains the errors;
3) **EMM/ECM**. Display only EMM and ECM PIDs;
4) **ES**. Display only the elementary stream PIDs;
5) **PSI/SI**. Display only PIDs with the service information tables.

For elementary stream PIDs pressing the **«F3 / Service»** button leads to switching to the programs list view with setting the cursor on the program the selected PID refer to.

By pressing the **«F4 / Content»** button, the context menu will appear that allows switching to one of the following modes:

1) For elementary streams **(VID, AUD, DAT)**. Go to the program detailed information view (section 4.6.7) with setting the cursor on the selected elementary stream;

2) For service information tables (PSI/SI). Go to the service information tables tree view (section 4.6.10) with setting the cursor on the selected table.

4.6.10. Transport stream service information tables tree

The Transport stream service information tables (PSI/SI) structure is represented as a tree of nodes in the **«key: value»** format with the table data (figure 4.64).

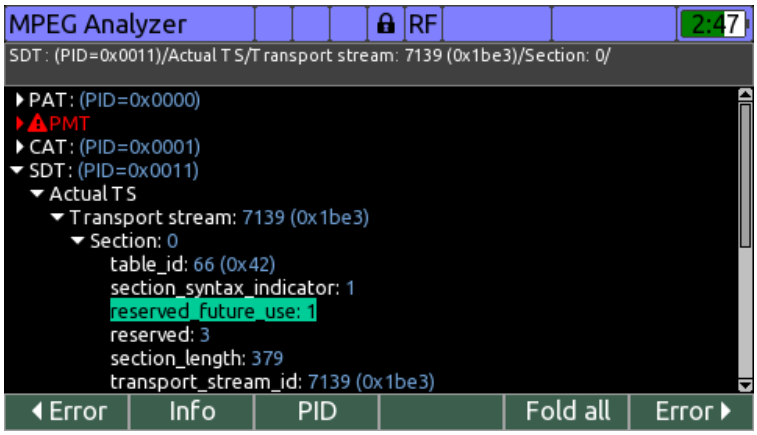


Figure 4.64

The tree displays information about the service tables which are described in the ISO/IEC 13818-1 and ETSI EN 300 468 standards.

Root nodes that contain a structured set of data are indicated with the **«▼»** (node expanded) or **«►»** icon (node collapsed). If service information table or group of tables contains one or more errors, the corresponding node is indicated with the ⚠ icon, and the node name is displayed in red color.

The cursor moves by using the **«▲»** and **«▼»** buttons. When pressed together with the **«Shift»** button, the cursor moves on several nodes. When pressing the **«►»** button on the root node, it expands. When pressing it again, the cursor moves to the first child node of the root node. Press the **«◄»** button to move the cursor to the nearest root node. When pressing the **«◄»** button again the selected root node is collapsed. When pressing the **«◄»** button together with the **«Shift»** button, all root nodes of the branch in the cursor position are collapsed, up to the main root node. Press the **«F5 / Fold all»** button to collapse all the tree nodes. Press the **«F1 / ◄Error»** or **«F6 / Error►»** button to navigate cursor among the nodes which contain errors.

There is a tree route map at the top of the window, which shows the names of the nodes, separated by the **«/»** symbol. These nodes are the successive root nodes for the node in the cursor position.

Press the **«F3 / PID»** button to switch to the PIDs list view (section 4.6.9) with setting the cursor on the PID, which the selected table is transferred in.

Press the **«ENTER»** or **«F2 / Info»** button to view the detailed information about the table in the cursor position. The table with additional information of the table appears on the screen, as shown on the figure 4.61.

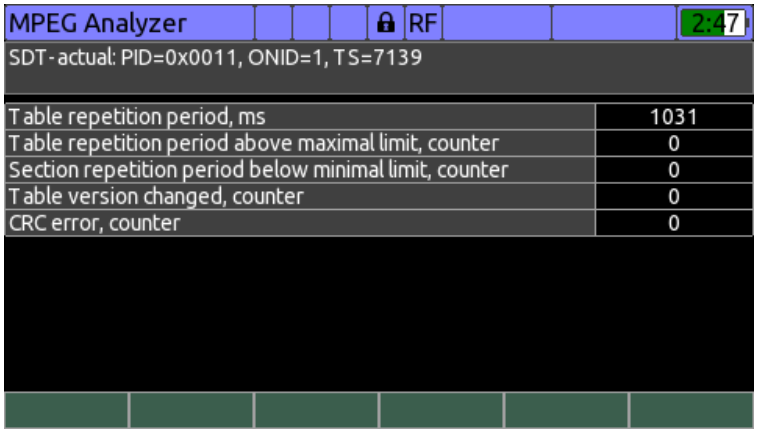


Figure 4.65

There is the name and identification information of the selected table at the top of the window. The table of detailed information contains the following parameters:

1) **Table repetition period, ms**. The average repetition period of all sections of the table in ms. If the repetition period exceeds the defined limit, the value is displayed on the red background;
2) **Table repetition period above maximal limit, counter**. The number of times repetition period of all sections of the table exceeds defined limit during the analysis. If the value is more than 0, it is displayed on the red background;
3) **Section repetition period below minimal limit, counter**. The number of times any two sections of the table arrival interval is less than the defined limit during the analysis. If the value is more than 0, it is displayed on the red background;
4) **Table version changed, counter**. The number of times the table version is changed during the analysis;
5) **CRC error, counter**. The number of times CRC error in the table sections occurs during the analysis. If the value is more than 0, it is displayed on the red background;
6) **Section 0 repetition period above maximal limit, counter**. The number of times the repetition period of section 0 of the EIT table (current/following event) exceeds defined limit during the analysis. If the value is more than 0, it is displayed on the red background;
7) **Section 1 repetition period above maximal limit, counter**. The number of times the repetition period of section 1 of the EIT table (current/following event) exceeds defined limit during the analysis. If the value is more than 0, it is displayed on the red background;
8) **Section 0 or 1 is not present, counter**. The number of times the section 0 or 1 of the EIT table (current/ following event) is missing. If the value is more than 0, it is displayed on the red background;
9) **Time left since last table arrival, min**. Time in minutes passed from the last time the RST table appeared in the transport stream.

4.7. TV Video and Sound Analysis Procedure

4.7.1. General Information

The TV video and sound analyzer is used for real-time control of TV decoded signal. The mode allows decoding signal, displaying video at the built-in display and controlling audio at the built-in loudspeaker.

4.7.2. TV Picture and Sound Analysis for Digital Channels

To start the TV picture and sound analysis mode for digital TV channels, set up the frequency to the required TV channel in the **Channel** measurement mode (section 4.3.3). After channel synchronization press the **«F5 / Video»** key. The table will appear on the screen as shown in figure 4.66.

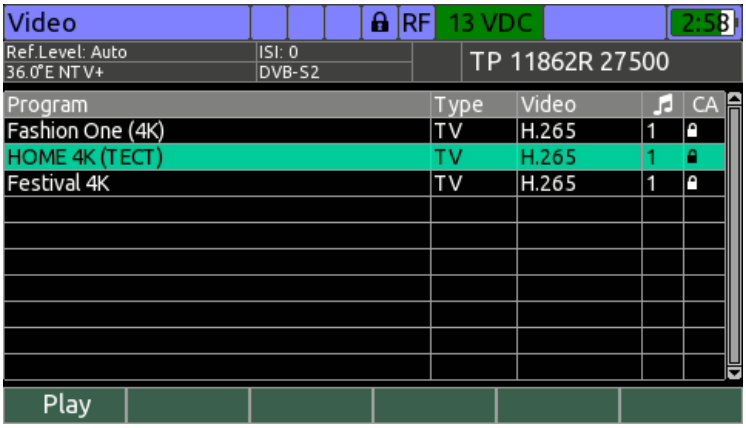


Figure 4.66

The table includes the list of all programs and their parameters in the current transport stream: program name, its type, video codec, number of sound tracks and encrypted program icon. Use **«▲»** and **«▼»** keys to select program. Press the keys together with **«Shift»** to navigate through programs with bigger step.

To view the selected program, press the **«F1 / Play»** key. A video from the selected service will appear on the screen (figure 4.67). Video and audio stream parameters are indicated in the right part of the table. If two or more audio tracks available, select the needed track using the **«F3 / ◄Audio»** and **«F4 / Audio►»** keys or **«◄»** or **«►»** keys together with **«Shift»**. To view the video in the full screen mode, press the **«F1 / Zoom»** key. To go back to the current mode, press **«EXIT»** key.

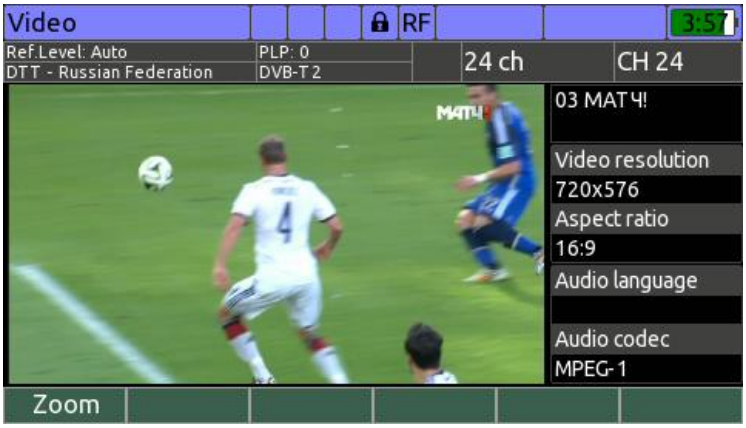


Figure 4.67

To adjust the volume of the sound, press the **«◄»** or **«►»** key.

4.7.3. TV Video and Sound Analysis for Analog Channels

To start the TV video and sound analysis mode for analog TV channels, set up the frequency to the required TV channel in the **Channel** measurement mode (section 4.3.3). After channel synchronization press the **«F4 / Video»** key. A video will appear on the screen (figure 4.68).

Video and audio parameters are indicated in the right part of the table. To view the picture in full screen mode, press the **«F1 / Zoom»** key. To go back to the current mode, press **«EXIT»** key.

Figure 4.68

To adjust the volume of the sound, press the **«◄»** or **«►»** key.

4.8. MPEG Transport Stream Recording Procedure

This mode enables the real-time MPEG transport stream data recording in the Analyzer internal memory. The mode becomes available upon pressing the **F3 / Mode** key and selecting **MPEG Recorder** in the dropdown menu from the following modes:

1) Channel mode, for terrestrial TV channels (section 4.3.3);
2) Channel mode, for satellite TV channels (section 4.4.3);
3) MER/BER mode, for satellite TV channels (section 4.4.4);
4) IPTV mode, for the IPTV stream (section 4.5.2).

The mode is available only in case the synchronization with the MPEG transport stream source is achieved.

The mode screen view is shown in figure 4.69.

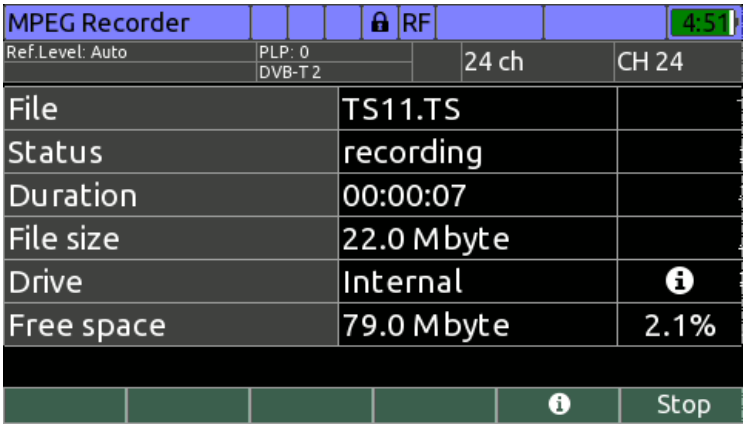


Figure 4.69

The table includes the following information:

1) **File**. The name of file for stream recording.
2) **Status**. The current mode status: **recording** – the recording is in progress, stopped – the recording is stopped.
3) **Duration**. The time of recording.
4) **File Size**. The current size of the recorded file.

5) **Drive**. The drive for stream recording. The transport stream can be recorded only to the Analyzer internal memory.
6) **Free Space**. Free space on the drive for recording. In case the drive is not available[6], **Not available** is displayed.

To set up the recording time, press the **F1 / Settings** key and select one of the **Duration** values in the dropdown menu: **15 sec**, **30 sec**, **45 sec**, **45 sec**, **1 min**, **3 min**, **5 min**. To be able to control the recording time manually, select the **indef** value.

To start the recording, press the **F6 / Start** key. The information on the transport stream being recorded is updated in the real-time mode during recording.

To stop the recording, press the **F6 / Stop** key. The recoding can also be automatically stopped by the Analyzer in the following cases:

1) The time of recording has achieved the preset duration;
2) The synchronization with the MPEG transport stream is lost;
3) No enough of free drive space;
4) The transport stream rate exceeds the file recording speed.

In case the recording is automatically stopped by the Analyzer, you will hear the beep sound and see the message stating the reason of recording stop on the screen.

By pressing the **F5 / i** key the message will be displayed stating that the transport stream can only be recorded in the Analyzer internal memory.

You can play or perform MPEG analysis of recorded transport stream files with File Manager (section 4.9).

4.9. File Manager

4.9.1. General information

File manager is intended for controlling files on the Analyzer internal drive, as well as on the USB flash drive, connected to the Analyzer. The file manager allows viewing, deleting, copying and moving files, and well as drive formatting.

The file manager is accessed from any selected tab in the main selection menu. Use the ▲ and ▼ keys to set the  icon in the bottom line of screen and select the corresponding functional key. To return to the selection menu, use the **EXIT** key.

4.9.2. Operating File Manager

The file manager screen view is presented in fig. 4.70.

[6] The internal drive is not available if the Analyzer is connected to the PC via USB.

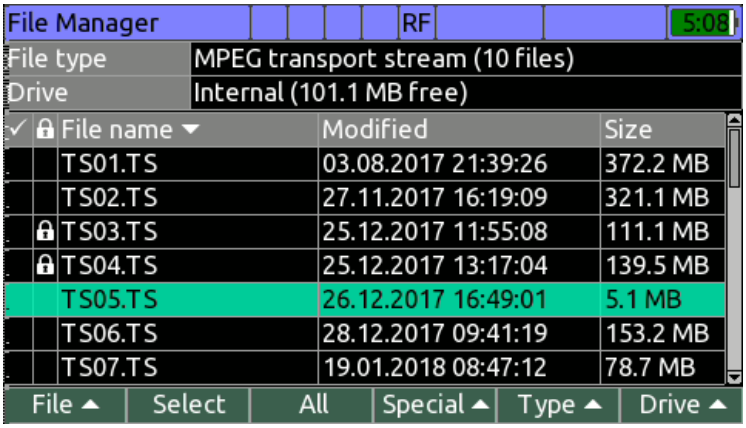


Figure 4.70

The name of the selected file type is indicated in the upper line of the screen. The next line indicates the selected drive and free memory capacity. In case the drive is not available or not formatted[7], then the respective message is displayed.

The table of files includes the following information:

1) File selection identifier for operating a group of files;
2) 🔒. The identifier of file delete protection during file moving. Available only for files containing measurement results;
3) **Description**. File description (channel data logger page name, LNB profile, etc.). Can be unavailable for certain file types;
4) **File name**. File name in the file system;
5) **Modified**. Date and time of file editing;
6) **Size**. File size.

Only certain number of the table columns is indicated on the screen. To switch between the visible table columns use the ◄ and ► keys.

To move the cursor through the file list, use the ▲ and ▼ keys. Press one of these keys along with the **Shift** key to move the cursor by several positions.

The file table indicates the list of files for the selected file type and drive. The drive is selected in the dropdown menu by pressing the **F6 / Drive** key, and the file type is selected from the dropdown menu by pressing the **F5 / Type** key.

To arrange the files in the list using one of the parameters, press the **F6 / Sort** key on the additional panel of functional keys (accessed by pressing the **Shift** key). Select the parameter of sorting in the dropdown menu. Sorting is carried out in the reverse order by the repeated selection of the parameter.

The file operation in the cursor position is selected from the dropdown menu accessed by pressing the **F1 / File** key:

1) **Open**. Open a file. There are several opening options depending on the file type;
2) **Move**. Move a file from the current drive to another drive. If the file protection identifier is set, the file cannot be deleted, but can only be copied from the current drive to another drive;
3) **Copy**. Copy a file from the current disk to another disk;
4) **Delete**. Delete a file.

To select a group of files, set the cursor to the needed files successively and then press the **F2 / Select** key or **Shift** + **ENTER**. The selection is cancelled by a repeated action on the selected file. To select all files from the list, press the **F3 / All** key. All files selection will be cancelled by the repeated pressing of this key.

The file group operation is selected from the dropdown menu accessed by the **F1 / Group** key:

1) **Move**. Move a file group from the current drive to another drive. Files with the set protection identifier can be copied but not deleted;

[7] The Analyzer can operate only the FAT32 file system drives

2) **Copy**. Copy a file group from the current drive to another drive;
3) **Delete**. Delete a file group;
4) **Deselect**. Cancel a file group selection.

Press the **F4 / Special** key to access the dropdown menu of special functions selection:

1) **Move data**. Move all files of measurement results from the internal drive to the connected USB flash drive. Files with the set protection identifier cannot be copied or deleted. This function can be used in field in case there is not enough free memory space on the internal drive to save new measurement results, and a high-capacity external USB flash drive available;
2) **Format drive**. Format the selected drive. All files will be deleted after the drive is formatted!

The following rules are used for copying and moving files:

1) If a file type has a **Description** identifier, then in case the description of the file being copied or moved matches the description of one of the files on the target drive, one of the following actions will be offered: copy/move file with replacement, save both files, cancel file copying/moving;
2) The file name is generated by the Analyzer automatically. Thus if the copied/moved file name is the same as the name of one of the files on the target drive, this is not treated as a conflict. In this case, the file being copied or moved will be assigned with a unique name.

4.10. Setup and Test Modes

4.10.1. Self-Test Mode

The self-test mode is used for checking the performance of the IT-100 components and their functional condition. The  icon in the main menu corresponds to this mode. The screen view of this mode is shown in figure 4.71:

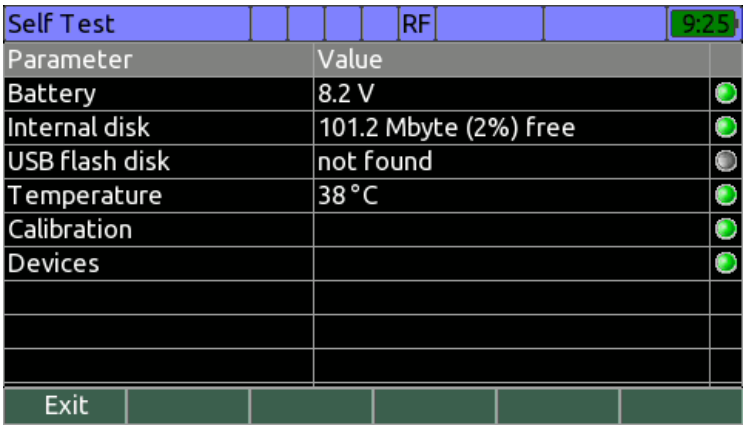


Figure 4.71

The table includes the following parameters to be checked:

1) **Battery**. Battery voltage and charge status.
2) **Internal disk**. Status and volume of free internal memory of the Analyzer.
3) **External disk**. Status and volume of free external memory of the Analyzer.
4) **Temperature**. Temperature inside the Analyzer.
5) **Calibration**. Status of the Analyzer calibration tables.

6) **Devices**. Condition of the Analyzer components.

4.10.2. Regional Parameters Setting

Regional parameters setting program is used for the Analyzer adaptation to local conditions for the ease of use. The  icon in the main mode corresponds to this mode. The screen view is shown in figure 4.72.

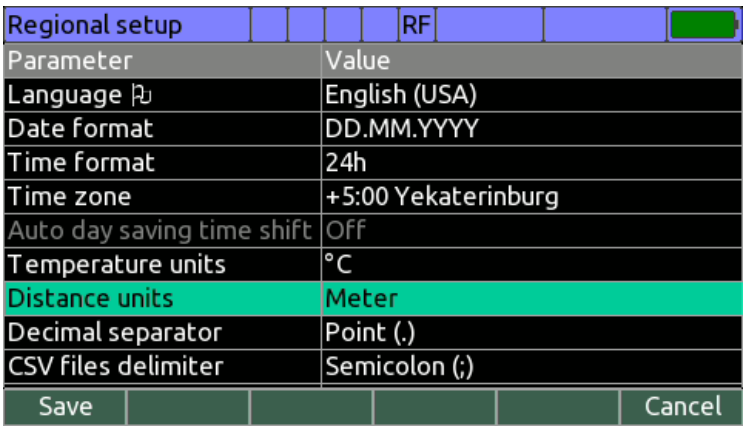


Figure 4.72

The table includes the following parameters to be edited:

1) **Language**. Selection of graphical interface language.
2) **Date format**. Selection of date indication format.
3) **Time format**. Selection of time indication format.
4) **Time zone**. Selection of time zone.
5) **Auto day saving time shift.** Selection of auto day saving time shift.
6) **Temperature units**. Selection of temperature measurement units.
7) **Distance units**. Selection of distance measurement units.
8) **Decimal separator**. Selection of decimal separator symbol.
9) **CSV files delimiter**. Selection of CSV files delimiter.

The parameters are selected using the **«▲»** and **«▼»** keys and modified using the **«◄»** and **«►»** keys.

4.10.3. Analyzer Operation Parameters Setting

The Analyzer parameters setting program is used for setting general modes of Analyzer operation. The  icon in the main menu corresponds to this mode. The screen mode is shown in figure 4.73:

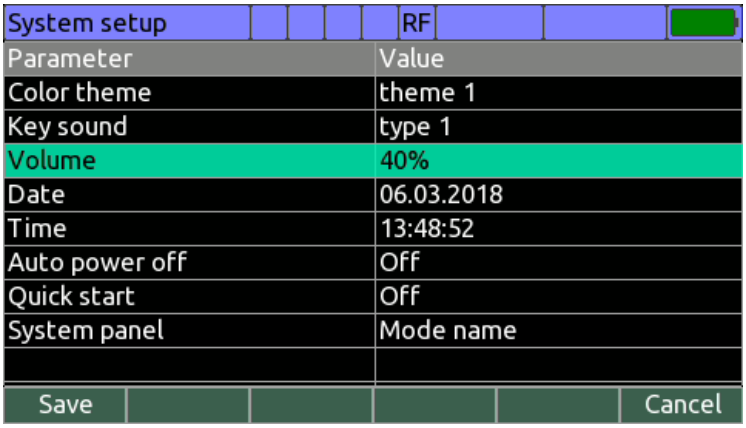


Figure 4.73

The table includes the following parameters to be edited:

1) **Color theme**. Selection of a color set of graphical interface elements.
2) **Key sound**. Selection of key pressing sound or disabling key pressing sound.
3) **Volume**. Adjustment of audio volume.
4) **Date**. Setting the date.
5) **Time**. Setting the time.
6) **Auto power off**. Setting auto analyzer power off mode.
7) **Quick start**. Setting the Analyzer starting mode.
8) **System panel**. Selecting system panel indicated data: current operating mode name, current time or current date.

To select a parameter, use the **«▲»** and **«▼»** keys. To modify a parameter, use the **«◄»** and **«►»** keys.

The **Auto power off** parameter allows to automatically switch the Analyzer off when no keys are pressed during a selected time interval.

The **Quick start** parameter allows selecting the Analyzer switching on method. If the parameter is set to **off**, the Analyzer switches on in the **Main menu** mode. If the parameter is set to **on**, the last used before switching the Analyzer off measurement mode is opened after switching the Analyzer on.

4.10.4. Identification Data Readout

The identification data readout program is used for indication of the Analyzer serial number and modification, firmware version, network addresses and names. It also displays the checksum of metrologically significant part of the firmware. The mode allows updating the Analyzer firmware. The  icon in the main menu corresponds to this mode. The screen view is shown in figure 4.74:

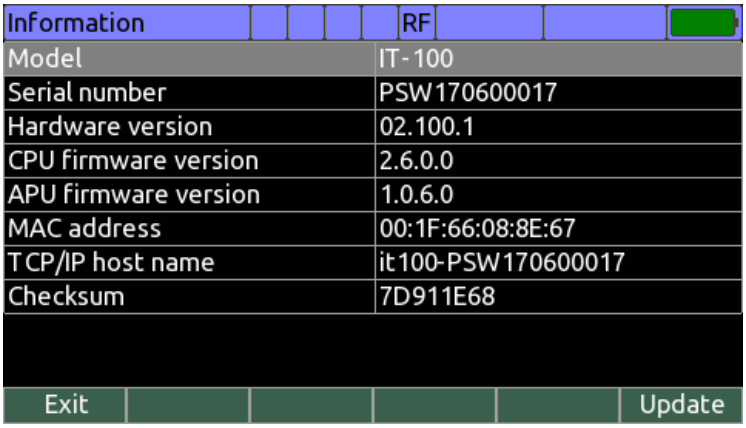


Figure 4.74

4.10.5. Network Parameters Setting

The network parameters setting mode is used to determine and modify the current network parameters. The mode also allows updating the Analyzer firmware. The  icon in the main menu corresponds to this mode. The screen view is shown in figure 4.75:

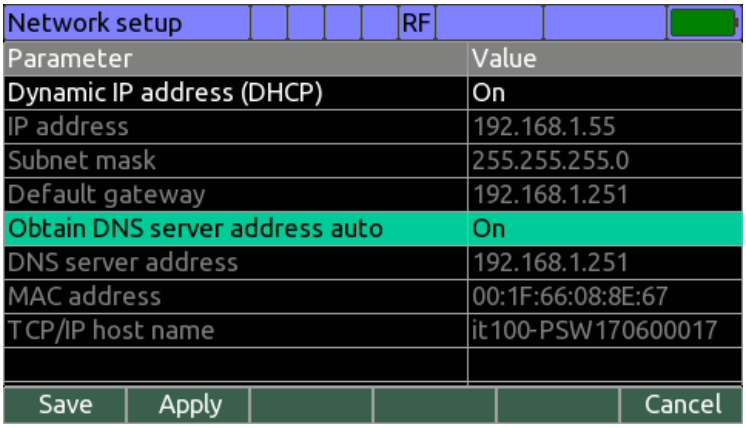


Figure 4.75

The network interface of the device is the ETHERNET port. The device is capable of working with a static IP address, as well as with a dynamic IP address, with a DHCP protocol assignment. The device can make registration on a remote DNS server, which address can be specified statically, or dynamically, with the DHCP protocol assignment. In this case, the device can be accessed from other devices in the network not only by its IP address, but also by the device name "it100-XXXXXXXXXXXX", where XXXXXXXXXXXX is the serial number of the device.

In the mode, the following items are provided for setup and viewing:

1) **Dynamic IP address (DHCP).** Enable / disable the automatic assignment of the IP address of the device via the DHCP protocol.
2) **IP address.** Setting the IP address of the device. The setting is not available in the automatic IP address assignment mode.
3) **Subnet mask.** Setting the subnet mask. The setting is not available in the automatic IP address assignment mode.
4) **Default gateway.** Setting the IP address of the subnet default gateway. The setting is not available in the automatic IP address assignment mode.

5) **Obtain DNS server address auto.** Enabling / disabling automatic detecting IP address of DNS server via DHCP protocol. The setting is present only in the mode of automatic IP address assignment.
6) **DNS server use.** Enabling / disabling the use of the DNS server. The setting is present only in the manual IP address assignment mode.
7) **DNS server address.** Setting the IP address of the DNS server. The setting is available only if the use of the DNS server is turned on and the automatic detection of the IP address of the DNS server is turned off.
8) **MAC address.** Indication of the unique MAC address of the device's network interface.
9) **TCP/IP host name.** Indication of the unit's name, using which it is possible to access the device from the network.

When operating in the automatic IP address assignment mode, in the items **"IP address"**, **"Subnet mask"** and **"Default gateway"** the values are displayed assigned by the DHCP server, or one of the following messages:

1) **No link detected.** The network cable is not connected to the ETHERNET port of the device;
2) **Not assigned yet.** The corresponding parameter is not yet defined;

The similar behavior is used for the item **"DNS server address".**

To apply the settings without exiting the operation mode, press the **«F2 / Note»** button. To apply the settings with exit into the main menu, press the **«F1 / Save»** button. To exit to the main menu and cancel the changes, press the **«F6 / Cancel»** button.

4.11. Taking screenshot

To save the current screenshot to file, press the Shift and 8 /  keys simultaneously. A message indicating the file name and the drive to which the file was saved will be shown on the screen. If an external flash drive is connected to the USB port, the file will be saved to it. Otherwise, the file will be saved in the internal Analyzer memory. The screenshot is saved in the PNG format with assignment of an ordinal number in the file name and located in the IT100MEM\SNAPSHOT section of the drive root directory.

Previously saved screenshot can be viewed it the File Manager (section 4.9) when **«Screen snapshot»** file type is selected.

4.12. Analyzer Firmware Updating

The IT-100 Analyzer allows updating its firmware without the use of any additional equipment. We continue development of the Analyzer and keep on working out new firmware and software versions that provide new features. These new versions come available for free download on our website www.planarchel.ru in the section that describes IT-100.

The firmware version includes updating the central processing unit (CPU) program and the auxiliary processing unit (APU) program. Each version has its unique identification number in the X.X.X.X format (for example, 2.0.1.0). File with the firmware build for downloading has the it100_build_YYYYYY.bs2 format, which includes the device type and the build identification number (YYYYYY). The CPU and APU versions can be viewed in the identification data readout mode (section 4.10.4).

4.12.1. Regular Firmware Updating Procedure

To enter the firmware updating mode from the identification data readout mode (section 4.10.4), press the **«F6 / Update»** key.

The mode displays the table of firmware files search sources:

1) **Manufacturer server**. Firmware updating files are searched on the Analyzer manufacturer's server, in case the Analyzer has access to the Internet.
2) **USB flash drive**. Firmware updating files are searched in the root partition of the USB flash drive, connected to the Analyzer.
3) **Internal memory**. Firmware updating files are searched in the root partition of the Analyzer internal memory. The firmware updating files can be copied to the internal memory when the Analyzer is connected to a PC via USB. In this case the operating system recognizes the device as a removable medium named **IT-100**.

The firmware updating files search result for different sources is indicated by the following messages:

1) **connecting…** the Analyzer is connecting with the remote server;
2) **no Internet connection** the Analyzer is not connected to any network;
3) **failed to connect** the Analyzer did not connect with the remote server;
4) **not found** USB flash drive was not found;
5) **not available** internal memory is not available because the Analyzer is connected to a PC via USB;
6) **not formatted** the USB flash drive or internal memory is not formatted or format differs from FAT32;
7) **fault** hardware error during USB flash drive or internal memory operation;
8) **files found** firmware updating files found;
9) **no files found** firmware updating files not found.

To start the firmware updating procedure, proceed as follows:

1) Select the source with the updating firmware found and press the **«F6 / Select»** or **«ENTER»** key;
2) Confirm the selection by pressing the **«F6 / Yes»** key in the dialog box;
3) If the updating source is the manufacturer's server or the internal memory, and the Analyzer is connected to a PC via USB, disconnect the Analyzer from the PC to start updating;
4) If the updating source is the manufacturer's server, the firmware updating file will be uploaded to the Analyzer internal memory. Loading progress is indicated on the screen;
5) When the file is uploaded, the Analyzer will automatically restart, open the loader mode and start the firmware updating process;
6) If the firmware updating file has the same version as the Analyzer firmware, then the loader panel will display the following message "**File firmware version is identical to device firmware version**". Updating can be started by force using the **F1** key;
7) If the firmware updating file version is lower than the Analyzer firmware version, then the loader panel will display the following message "**File is not compatible with the device firmware version**". Updating can be started by force using the **F1** key.

The firmware updating process is indicated at the progress bar. If the firmware updating is completed successfully, the Analyzer will start with the new program.

4.12.2. Emergency Firmware Updating Procedure

If the Analyzer firmware updating mode cannot be started as in case of program hang-up, the firmware can be updated as follows:

1) Power the Analyzer off, press and hold the **«clear»** key down. Switch the Analyzer on;
2) When the screen displays information, release the key;
3) Wait until you see the following message in the bottom of the panel "**>> Plug source with a valid file…**".

To update firmware using the file stored in the internal memory of the Analyzer, proceed as follows:

1) Connect the Analyzer to a PC using a USB cable;
2) Wait until you see the **IT-100** removable disk in the operating system ;
3) Copy the bs2 firmware updating file to the **IT-100** disk root partition;
4) Disconnect the Analyzer from the PC;
5) Wait until the firmware updating process is completed.

To update firmware using the file stored at the USB flash drive:

1) Copy the bs2 firmware updating file to the flash drive root partition;
2) Connect the USB flash drive to the Analyzer;
3) Wait until the firmware updating process is completed.

The firmware updating process is indicated at the progress bar. If the firmware updating is completed successfully, the Analyzer will start with the new program.

4.13. Analyzer Remote Control

Remote control of the device allows to send commands to the Analyzer from the distant PC, get access to the Analyzer's desktop, and also work with the files of the internal drive of the Analyzer.

Remote control is provided through ETHERNET interface. Before starting please make sure, the Analyzer network interface is set up (section 4.10.5). Antivirus software and firewall on the distant PC should not block applications for remote control.

4.13.1. Remote Desktop

Access to the Analyzer remote desktop is performed via VNC protocol. To control the Analyzer on the distant PC, you need to install any of the available VNC clients (for example, UltraVNC, TightVNC or RealVNC). Testing was executed by using the VNC client UltraVNC Viewer version 1.2.1.7. The program settings for working with the Analyzer (picture 4.76) are shown below:

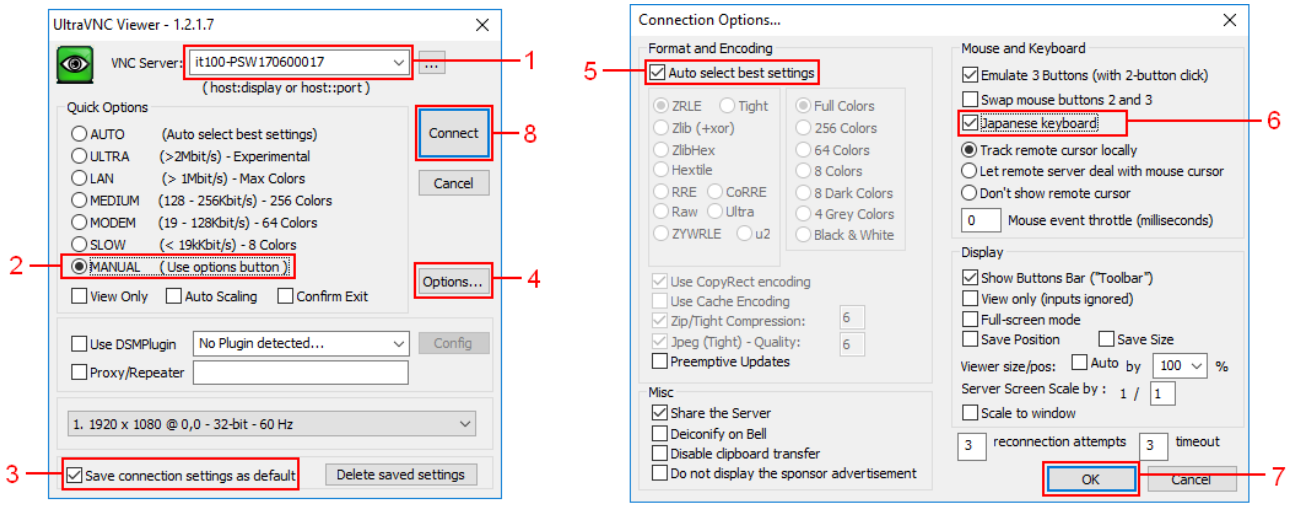


Figure 4.76

To configure you should complete the following actions:

1) In the **«VNC Server»** window you should select IP address or the Analyzer's domain name which the connection is made to;
2) Choose the **«MANUAL»** option in the **«Quick Options»** menu;
3) Set the **«Save connection settings as default»** mark to use the specified settings as the default settings for subsequent program launches;
4) Press the **«Options…»** button to activate manual setting;
5) In the appeared window set the **«Auto select best settings»** mark in the **«Format and Encoding»** menu;
6) Set the **«Japanese keyboard»** mark in **«Mouse and keyboard»** menu;
7) Press the **«OK»** button to accept modifications;
8) Press the **«Connect»** button in the Main Menu to set the connection with the Analyzer.

When configuring other VNC clients please note that the Analyzer supports Raw, ZRLE and Hextile encoding only.

After connection with the Analyzer is established the image of the Analyzer with the keyboard and the display appears on the PC screen (Figure 4.77).

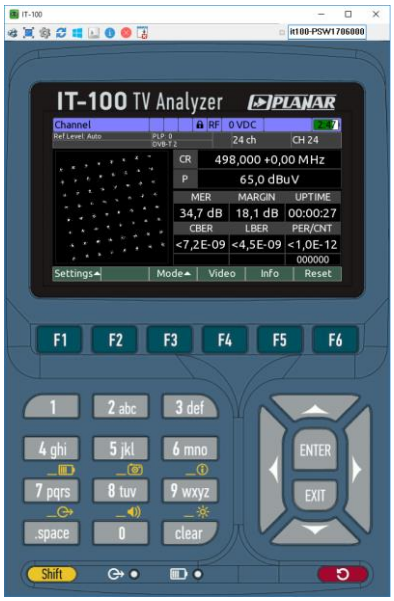


Figure 4.77

When you remotely operate the Analyzer, you should remember about the following features:

1) The Analyzer can be operated by pressing the left mouse button above the image one of the Analyzer's buttons on the PC screen;
2) The Analyzer can be operated by pressing the following buttons on the PC keyboard: **F1**…**F6** – the buttons of the functional group, **0**…**9** – the buttons of the alphabetic-numeric group, **Enter** – the **«ENTER»** button**, Esc** – the **«EXIT»** button, **space** – the **«.space»** button, **backspace** – the **«clear»** button, **Shift** – the **«Shift»** button, **Up/Down/Left/Right** – the navigation buttons;
3) The Analyzer restart button is available instead of the power off button;
4) When you press the **«Shift»** button with the mouse button a red circle marker will appear on the buttons image. This red circle marker shows the button is pressed. This operations logic allows you to press the «Shift» button together with the other keys;
5) When you press **Ctrl**+**Alt**+**Shift** combination on the keyboard of the distant PC the **«Shift»** button passes into the pressed state (see chapter 4).

4.13.2. Operating Internal Drive

Access to the internal disk files is performed via the FTP protocol. To operate the files, you need to install any of the available FTP clients on the distant PC (for example, FileZilla, FireFTP or SmartFTP).

As a rule most of clients don't need to set additional setting except specifying the Analyzer's IP address or domain name which the connection is made to.

There are 2 drives in the FTP root directory of the Analyzer's server:

1) **/INTERNAL.** The internal drive. Unavailable if the Analyzer is connected to the PC via USB;
2) **/USB0**. USB - flash disk connected to the Analyzer.

4.14. Measurement results output via USB interface

4.14.1. General information

The function of measurement results output via the USB interface can be used for receiving and processing the measurement results in the real time with third party Software.

For activation the function, it is necessary to perform the following actions:

1) activate the option **«output measurement results via USB»** in the operating mode settings of the terrestrial or the satellite TV (section 4.3.2 and 4.4.2);
2) connect the device to the PC with USB cable;
3) set the virtual COM-port driver (available on request).

For transferring the data by the Analyzer, it is necessary to enter to the one of the measurement modes that support this function (see below) and setup the measurement parameters (set an averaging factor, select the channel, etc.).

4.14.2. Message format

The messages sent by the device are the set of the ASCII encoded text lines. Each line begins with the 10-digits timestamp in ms, since the Analyzer is started up. The line is ended with the sequence of symbols with 0x0D code (carriage return) and 0x0A code (line feed).

When numerical values are displayed, the separator of the integer and fractional parts specified in the regional settings of the device is used (section 4.10.2). After the numerical values, the measurement unit is specified that is separated from the number by the space symbol.

The appearance of messages not regulated by the Operating Manual is acceptable.
The example of the text messages sequence is shown below:
0006755820 LEVEL = 64.7 dBuV
0006756310 LEVEL = 64.6 dBuV
0006756820 LEVEL = 64.6 dBuV
0006757060 LOCKED (DVB-T2/32k/QAM64/PLP=0)
0006757330 LEVEL = 64.3 dBuV
0006758860 LEVEL = 64.3 dBuV
0006759130 MER = 33.9 dB
0006759240 BER0 < 1.8E-07
0006759390 LEVEL = 64.4 dBuV
0006759910 LEVEL = 64.3 dBuV

4.14.3. Messages of channel measurement results

The messages with channel measurement results are available from the following operating modes:

1) Terrestrial or Cable TV channel measurement mode (section 4.3.3);
2) Satellite transponder parameters measurement in the Channel mode (section 4.4.3);
3) Satellite transponder parameters measurement in the MER/BER mode (section 4.4.4).

The following message types are available[8]:

1) **LEVEL_=_X_dBuV|dBmV|dBm**. The current channel or transponder level is the **X** (one decimal place);
2) **SNR_=_X_dB**. The current value of signal-to-noise ratio is the **X** value (one decimal place);
3) **V/A1_=_X_dB**. The current value of level-to-audio ratio (mono audio subcarrier) of the analog channel is the **X** (one decimal point);
4) **V/A2_=_X_dB**. The current value of level-to-audio ratio (additional audio subcarrier for stereo broadcasting) of the analog channel is the **X** (one decimal point);
5) **LOCKED_(X)**. Synchronization with the channel is set, **X** - channel parameters in one of the following formats:
   a. **Analog/X-Y**. Analog channel, **X** - the color system (**PAL**, **SECAM** or **NTSC**), and **Y** – the analog broadcasting standard (**B**, **D**, **G**, **H**, **I**, **K**, **L**, **L'**, **M** or **N**);
   b. **DVB-C/X/Y**. DVB-C channel, **X** – the constellation type (**QAM64**, **QAM128** or **QAM256**), and **Y** – the symbol rate in MSymb/s (3 decimal places);
   c. **J.83-B/X/Y**. J.83-B channel, **X** – the constellation type (**QAM64** or **QAM256**), and **Y** – the symbol rate in MSymb/s (3 decimal places);
   d. **J.83-C/X/Y**. J.83-C channel, **X** – the constellation type (**QAM64**, **QAM128** or **QAM256**), and **Y** – the symbol rate in MSymb/s (3 decimal places);
   e. **DVB-T/X/Y**. DVB-T channel, **X** – FFT type (**2k** or **8k**), and Y – the constellation type of subcarriers (**QPSK**, **QAM16** or **QAM64**);
   f. **DVB-T2/X/Y/PLP=Z**. DVB-T2 channel, X – FFT type (**1k**, **2k**, **4k**, **8k**, **16k** or **32k**), Y – the constellation type of subcarriers (**QPSK**, **QAM16**, **QAM64** or **QAM256**), and Z – the identifier of the receiving PLP logical steam;
   g. **DVB-S/X/Y**. DVB-S transponder, X – the constellation type (**QPSK**), and Y – the symbol rate in kSymb/s;

[8] Here and elsewhere, the symbol «_» corresponds to the space symbol, and the symbol «|» separates the possible variants of the substrings.

h. **DVB-S2/X/Y/ISI=Z**. DVB-S2 transponder, X – the constellation type (**QPSK, 8PSK**, **16APSK** or **32APSK**), Y – the symbol rate in kSymb/s, and Z – the identifier of the receiving ISI logical steam;
i. **FM**. FM radio;
j. **?**. Unknown type channel;

6) **UNLOCKED**. Synchronization with the channel is lost;
7) **MER_=|<|>_X_dB**. The current channel MER value is equal/less/more than X (one decimal point);
8) **MARGIN_=|<|>_X_dB**. The current value of the noise margin to the quasi-error-free decoding point is equal/less/more than the X (one decimal point);
9) **BER1_=|<|>_X**. The current BER value before the decoders is equal/less/more than X (scientific notation with one decimal point, for example, 1.0E-09). For DVB-C and J.83-C – BER before the Reed-Solomon decoder, DVB-T and DVB-S – BER before the Viterbi decoder, DVB-T2 and DVB-S2 – BER before the LDPC decoder;
10) **BER2_=|<|>_X**. The current BER value after the first decoder is equal/less/more than X (scientific notation with one decimal point, for example, 1.0E-09). For J.83-B, DVB-S and DVB-T – BER before the Reed-Solomon decoder, DVB-T2 and DVB-S2 – BER before the BCH decoder;
11) **BER3_=|<|>_X_(Y_bad_packets)**. The current PER value at the output of the last decoder is equal/less/more than X (scientific notation with one decimal point, for example, 1.0 E-09). Y – the number of uncorrected MPEG packets at the output of the decoder (that is the accumulative counter in case the averaging is switched on in the measurement mode settings). For DVB-C, J.83-B, J.83-C, DVB-T and DVB–S – PER after the Reed-Solomon decoder, for DVB-T2 and DVB-S2 – PER after the BCH decoder;
12) **FATAL_ERROR_(X)**. The fatal error occurred, X - the error description. Please contact the Analyzer's manufacturer to fix the error.

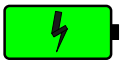
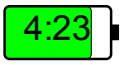
4.15. Battery Operation

As an integrated power source in the analyzer is used a Lithium-ion battery with a voltage of 7.4 V and a capacity of not less than 4000 mAh.

The battery status and operating mode are signaled in several ways. The «  » LED on the front panel of the IT-100 signals the charging mode of the battery:

Indication	Battery charge status
	No voltage from external charger.
	Battery is charging.
	Battery is charged.
	Battery failure.

The icon in the upper right corner of the display shows the battery charge mode:

Indication	Battery operation mode and status
	Battery is charging.
	Battery is discharging. Remaining capacity and the remaining operating time.

When detecting a battery failure during charging, the icon's background becomes red. The length of the color bar displays the value of remaining charge. When the charge is more than 30%, the color of the bar is green. The color changes to yellow when the capacity decreases and turns red at less than 15%.

For more information about the operating mode and battery status, run the diagnostic mode by pressing the **«Shift»** button and then without releasing it press the **«**  **/ 7»** button. The battery diagnostic mode will appear on the display as shown in figure 4.78:

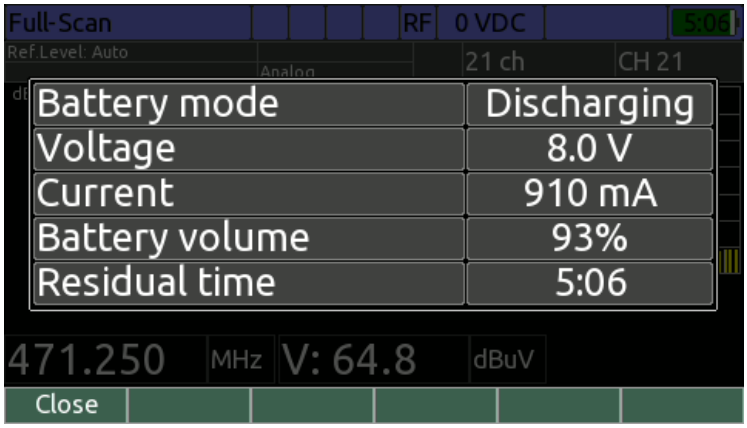


Figure 4.78

The current battery mode is displayed in the mode window: **Discharging** / **Charging** / **Charged**. There are also displayed the current values of power, current, remaining level of charge and operating time. To exit the mode, press the **«EXIT»** key.

When operating from the battery and capacity reducing to a critical level, the analyzer displays the charge level indicator red. In a while the analyzer will automatically turn off.

To charge the battery, connect the external power source which is included in the delivery set and provide the power supply. The batteries will charge even if IT-100 power is not turned on. The **«**  **»** indicator signals the power supply from the charger and indicates the battery charge mode. The yellow color of the indicator means the process of battery charge. Appearance of a green indicator means that the battery is charged approximately 80%. To charge the battery fully it is recommended to charge within one more hour. If the battery is charged during operation of the analyzer, the charge time will increase. The battery charge should be performed at an ambient temperature from 0 to +40 ^{0}C.

5. MAINTENANCE

Required maintenance is limited to observation of instructions related to proper operation, storage, and shipment, which are supplied in this Manual and also minor defects correction.

Perform preventive inspections covering check of controls, reliability of the assembly, and the keypad condition after the warranty period has expired and annually since then.

6. TROUBLESHOOTING

Defect detection: After the Analyzer is switched on, nothing is displayed on the screen and there is no backlight.

Possible reason: Extremely low charge, malfunction or one or several batteries missing.

Methods of correction: To check the Analyzer condition, connect it to the Mains Charger. If the Analyzer switches on, check the battery voltage in Self-Test mode (section 4.10.1). Low voltage (under 7 V) indicates that the battery is discharged or malfunctioning. Charge the battery in case it is low or

contact the repair service to replace the malfunctioning battery.

Possible reason: Firmware failure.

Methods of correction: Install the firmware from external PC (section 4.12).

Defect detection: High error at radio signal level measurements.

Possible reason: Incorrect setting of the input attenuation value.

Methods of correction: Check the reference level setting in the measurement mode (**«F1 / Settings»**) (sections 4.3.3, 4.3.4, 4.3.5, 4.4.3, 4.4.5). If the reference level selection is complicated, set the **Auto** selection mode.

Possible reason: Damage of the RF input adapter.

Methods of correction: Replace the input adapter.

Possible reason: Incorrect setting of channel plan or channel template as a result of which the Analyzer tunes to frequency offset channel. This can be checked in the spectrum analysis mode.

Methods of correction: Adjust the channel plan (section 4.3.13). Check the selected channel template: **Channel template** (section 4.3.2).

Defect detection: the Analyzer fails to switch off by pressing the **«⏻»** key briefly.

Possible reason: Firmware failure.

Methods of correction: Unplug the Mains Charger power connector. Press and hold the **«⏻»** key until the power switches off.

Defect detection: the Analyzer drive is not available when connected to PC, or OS requesting for USB driver.

Possible reason: Measurement results output via USB interface is enabled in terrestrial or satellite settings menu.

Methods of correction: Disable measurement results output via USB interface (section 4.3.2, 4.4.2).

7. STORAGE

Store your IT-100 Analyzer under the following conditions: environment temperature from -20 to +40 ^{0}C, relative humidity up to 90 % (at 30 ^{0}C).

8. TRANSPORTATION

The IT-100 Analyzer must be shipped in any closed vehicle at temperature from -20 to +40 ^{0}C, relative humidity 90% (at 30 ^{0}C) and atmospheric pressure of 84 to 106.7 kPa (630 to 800 mm Hg).

Cargo holds, railway cars, containers, and truck beds, utilized for shipment of the Analyzer should be free from any traces of cement, coal, chemicals, etc. When shipped by air the products should be kept in aircraft sealed compartments.

9. LABELING

The serial numbers of Analyzer, which contain index number and date-of-manufacture code, can be found on the bottom panel of the respective item and also can be viewed on the display in identification data readout program (section 4.10.4).

10. WARRANTY INFORMATION

The manufacturer warrants the IT-100 Multisystem TV Analyzer to conform to the specifications of this Manual when used in accordance with the regulations detailed in this Manual.

The manufacturer will repair or replace without charge, at its option, any IT-100 Multisystem TV Analyzer found defective in manufacture within the warranty period, which is twelve (12) months from the date of purchase. Should the user fail to submit the warranty card appropriately certified by the seller with its stamp and date of purchase the warranty period will be determined by the date of manufacture.

The warranty is considered void if:

1) the defect or damage is caused by improper storage, misuse, neglect, inadequate maintenance, or accident;
2) the product is tampered with, modified or repaired by an unauthorized party;
3) the product's seals are tampered with;
4) the product has mechanical damage.

The battery is not included or covered by this warranty.

Transport risks and costs to and from the manufacturer or the authorized service centers are sustained by the buyer.

The manufacturer is not liable for direct or indirect damage of any kind to people or goods caused by the use of the product and/or suspension of use due to eventual repairs.

When returning the faulty product please include the accurate details of this product and clear description of the fault. The manufacturer reserves the right to check the product in its laboratories to verify the foundation of the claim.