IT-15T2

DVB-T/T2 SIGNAL ANALYZER

OPERATING MANUAL

PLANAR

Revision 1.7 of April 15, 2015

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1 GENERAL INFORMATION

1.1 Introduction

This operating manual is intended for introducing the design, functions, and basic instructions related to operation and servicing of the IT-15T2 DVB-T/T2 Signal Analyzer (Analyzer).

The IT-15T2 is designed for testing and adjustment of television and broadcasting distribution networks as well as of separate components of such networks, or other electronic devices. The Analyzer allows you to measure the channel level, parameters of TV signal with analog and digital modulation of DVB-T and DVB-T2 standards.

The Analyzer can be used both in laboratory, powered by an external power source, and in field, powered by battery or car cigarette lighter.

The reliability of the IT-15T2 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:

ADC	- Analog-to-Digital Converter
CD	- Compact Disk
PC	- Personal Computer
LCD	- Liquid Crystal Display
BER	- Bit Error Ratio
MER	- Modulation Error Ratio
COFDM	- Coded Orthogonal Frequency Division Multiplexing
DVB-T	- Digital Video Broadcasting – Terrestrial
DVB-T2	- Digital Video Broadcasting – Terrestrial, generation 2
CDL	- Channel Data Logger
IF	- Intermediate Frequency
LDPC	- Low-Density Parity-Check
BCH	- Bose-Chaudhuri-Hocquengham
FFT	- Fast Fourier Transform
PLP	- Physical Layer Pipe
MPEG	- Motion Pictures Expert Group
QAM	- Quadrature Amplitude Modulation
QPSK	- Quadrature Phase Shift Keying

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 the IT-15T2, the instructions regarding the storage and transportation (Sections 7 and 8) of the Analyzer must be observed.

2 GENERAL DESCRIPTION AND PRINCIPLE OF OPERATION

2.1 Function

The IT-15T2 offers measurement of the following parameters of analog channels: video carrier level, video carrier to audio carrier (V/A) ratio, and carrier to noise (C/N) ratio. For digital channels the following measurements are performed: channel power and C/N ratio. For DVB-T signals the Analyzer offers the measurement of the following reception quality parameters: modulation error ratio MER, bit error ratio BER before and after Viterbi decoder, erroneous packets after Reed-Solomon decoder counter, constellation diagram and channel impulse response (echo graph). For DVB-T2 signals the Analyzer allows measuring the following parameters: MER, BER before and after LDPC decoder, erroneous packets after BCH decoder

counter, constellation diagram and echo graph as well. The Analyzer features automatic defining of the settings (channel frequency, number of subcarriers, subcarriers' modulation type, guard interval, code rate, spectrum inversion).

The IT-15T2 can be connected to a personal computer to access additional modes. It can also provide power to external devices via its input connector. The Analyzer allows you to measure direct and alternating voltage of the remote power supply of the TV and broadcasting distribution networks.

The appearance of the Analyzer is shown in Figure 2.1 and Figure 2.2.

Figure 2.1

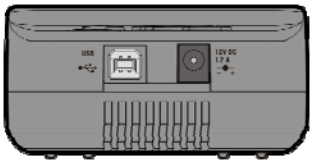

Figure 2.2

This Operating Manual is made in accordance with the firmware versions 15.0.0.10 and 15.2.0.0 for the IT-15T2.

2.2 Environmental Conditions

Normal operating conditions:
a) ambient temperature (23±5) °C;
b) relative air humidity (55±25)%;
c) atmospheric pressure 84-106 kPa (630-795 mm Hg);
d) voltage transients correspond to installation category CAT. II.

Rated operating conditions:
a) ambient temperature from -10 to 50 °C;
b) relative air humidity not greater than 90% at 25 ºC temperature;
c) atmospheric pressure 84-106 kPa (630-795 mm Hg).

2.3 Package Contents

The Analyzer package includes:
a) IT-15T2 ..... 1 pc;
b) Rubber Boot..... 1 pc;
c) Li-Ion Battery……..1 pc;
d) “F”-”F” Adapter..... 1 pc;
e) 12V/1.5A Mains Adapter..... 1 pc;
f) Operating Manual……..1 pc.

2.4 Specifications

Operating frequency range……45 to 900 MHz
Resolution.....125 kHz
Channel template.....OIRT, CCIR and customized

Input parameters:
input impedance within operating frequency range:.....75 Ohm
input impedance for frequencies up to 50 Hz, min:.....200 kOhm
Allowed resulting value of AC input voltage for frequencies over 5 MHz:……..3 V
Allowed resulting of AC and DC input voltage for frequencies under 100 Hz:...30 V

Level measurement range ..... 30 to 120 dBµV
Measurement level resolution ..... 0.1 dB
Accuracy within 30 – 120 dBµV level range ..... ±1.5 dB
Accuracy at operating temperature ..... ±2.2 dB
Measurement channel passband for -3 dB level ..... 230 ± 60 kHz
Frequency indication ..... 6 characters on LCD
Channel number indication ..... 3 characters on LCD
Signal level indication ..... 4 characters on LCD
MER indication ..... 3 characters on LCD
DVB-T channel parameters:
- Channel bandwidth ..... 7, 8 MHz
- Channel modulation type ..... COFDM
- Subcarriers modulation type ..... QPSK, QAM16, QAM64
- Number of subcarriers 2k, 8k
- Guard interval 1/32, 1/16, 1/8, 1/4
- Hierarchical modulation type ..... α=1, α=2, α=4
- Code rate 1/2, 2/3, 3/4, 5/6, 7/8

DVB-T2 channel parameters:
- Channel bandwidth ..... 7, 8 MHz
- Standard specification:
  - for IT-15T2 hardware modifications 16.02.01 and 16.02.02 ..... v1.2.1
  - for IT-15T2 hardware modifications 16.02.20 and 16.02.21 ..... v1.3.1
- Channel modulation type ..... COFDM
- Subcarriers modulation type ..... QPSK, QAM16, QAM64
- Subcarriers number 1k, 2k, 4k, 8k, 16k, 32k
- Extended bandwidth mode ..... yes
- Guard interval 1/128, 1/32, 1/16, 1/8, 1/4, 19/128, 19/256
- Pilot pattern PP1-PP7
- PLP subcarriers modulation type ..... QPSK, QAM16, QAM64, QAM256
- PLP constellation rotation ..... yes
- BB-frame length of PLP 16k, 24k
- PLP code rate 1/2, 2/3, 3/4, 3/5, 4/5, 5/6

BER measurement range
- for DVB-T signals before Viterbi decoder ..... 5.0×10^{-2} to 1.0×10^{-6}
- for DVB-T signals after Viterbi decoder ..... 1.0×10^{-3} to 1.0×10^{-8}
- for DVB-T2 signals before LDPC decoder ..... 5.0×10^{-2} to 1.0×10^{-6}
- for DVB-T2 signals after LDPC decoder ..... 1.0×10^{-4} to 1.0×10^{-8}

DVB-T MER measurement range ..... 2 to 35 dB
DVB-T2 MER measurement range (for QAM64 modulated PLP) ..... 16 to 35 dB
MER measurement resolution ..... 0.1 dB
Allowable frequency deviation
- for DVB-T signal ..... ±0.5 MHz
- for DVB-T2 signal ..... ±0.1 MHz

Warm-up time, less than ..... 5 min
IT-15T2 powering:
- from external DC source with 10 to 14 V voltage and ripple level no greater than 0.5 V;
- from Li-ion battery with 1500 mAh capacity.

Current consumed from external power source or batteries, max ..... 0.7 A
Voltage of external devices powering:
- for IT-15T2 hardware modifications 16.02.01 and 16.02.20 ..... 12 V, 24 V
- for IT-15T2 hardware modifications 16.02.02 and 16.02.21 ..... 5 V, 12 V, 24 V

Power fed to external devices:
- for 5V voltage ..... 1.5 W
- for 12 V, 24 V voltage ..... 3 W

Continuous stable operation under normal conditions (when powered by external source), min ..... 24 hrs

Battery life under normal conditions (1500 mAh battery capacity), min ..... 3 hrs
Mean time between failures, min ..... 10000 hrs
Average lifetime, min ..... 5 years
Dimensions ..... 193x94x53 mm
Package dimensions ..... 255x180x70 mm
Weight ..... 0.5 kg
Weight in package ..... 0.95 kg.

2.5 Design and Operation Overview

2.5.1 Principle of Operation

The IT-15T2 Signal Analyzer is a receiver of DVB-T and DVB-T2 signals with demodulation of the traffic stream to MPEG-2 or MPEG-4. The input tuner is a super heterodyne receiver with triple frequency conversion (auto or manual frequency tuning). Modulation error ratio MER and constellation diagram are measured in the process of COFDM signal demodulation based on vector analysis. Bit error ratio BER in digital stream is determined by means of analysis of Viterbi decoder operation (BER before Viterbi decoder) and Reed-Solomon decoder operation (BER after Viterbi decoder and erroneous packets after Reed-Solomon decoder counter) for DVB-T channels, and analysis of LDPC decoder (BER before LDPC decoder) and BCH decoder operation (BER after LDPC decoder and erroneous packets after BCH decoder counter) for DVB-T2 channels. Impulse response of DVB-T and DVB-T2 channels is measured by demodulator. Channel power is measured by means of analog-to-digital converter after signal peak detection at output of logarithmic detector of the amplifier of the third IF. The principle of spectrum analyzer is based on sequential analysis method with spectrum indication on the LCD display.

The view displayed on the screen in the measurement mode for DVB-T signal reception quality parameters is the numeric values of the following measured digital parameters: MER, BER before and after Viterbi decoder, and erroneous packets after Reed-Solomon decoder counter. The measurement mode of DVB-T2 signal reception quality parameters shows the numeric values of the following measured digital parameters: MER, BER before and after LDPC decoder, and erroneous packets after BCH decoder counter. The constellation diagram mode shows the vector structure of the quadrature components of the demodulated signal in the amplitude-phase plane. In the mode of DVB-T and DVB-T2 channels impulse response measurement you can see the graph of delayed signal level dependence from the delay value (signal delayed from the main signal). The signal level measurement mode in a frequency point displays the following information: the numeric value of the signal level, V/A and C/N ratios for the analog signals; and the actual channel power for digital signals.

2.5.2 Block Diagram

The block diagram of IT-15T2 is shown in Figure 2.5.1.

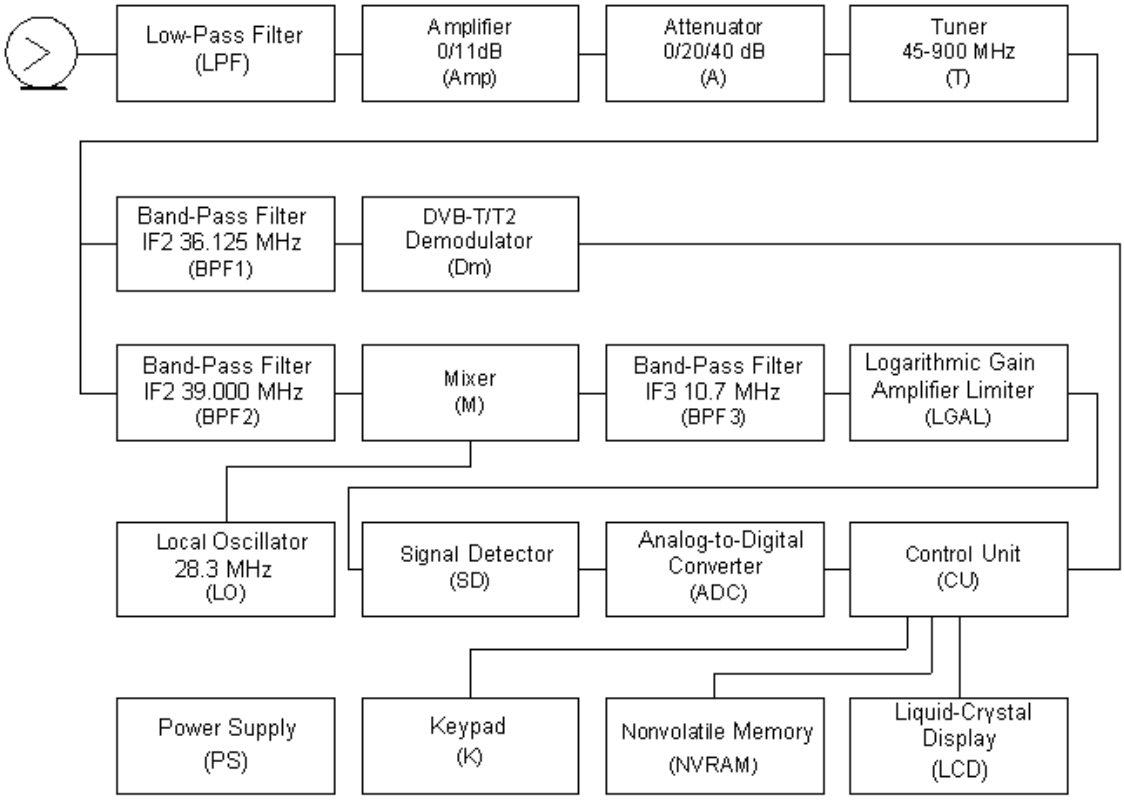

Figure 2.5.1

After the low-pass filter (LPF), the input signal if necessary is strengthened by the wide-band amplifier (Amp) or reduced by the attenuator (A). Then the signal is converted into the second IF 39 MHz in level measurement mode or 36.125 MHz in DVB-T and DVB-T2 signal demodulation mode by the tuner (T) with double-frequency conversion.

The signal of the second IF is converted into the third IF by means of mixer (M) controlled by the local oscillator (LO), and further is filtered at 10.7 MHz frequency by the band-pass filter (BPF3), which defines the receiver measurement filter bandwidth.

Logarithmic gain amplifier limiter (LGAL) performs logarithmation and signal detection.

Signal detector (SD) allows measuring signal level by means of analog-to-digital converter (ADC). SD uses peak detection for measuring analog channel level and average detection for measuring noise level and digital channel power. The digital code of the input signal level logarithm is defined as real value and is corrected in accordance with the calibration matrix of the control unit (CU) microcontroller.

In DVB-T and DVB-T2 signal demodulation mode, after band-pass filter (BPF2) the second IF signal comes to DVB-T/T2 demodulator (Dm), which performs demodulation and measurement of signal parameters. The control unit (CU) processes the measured results.

The control unit receives the commands from the user entered via keypad (K), processes the data, displays them on the LCD, and also controls the operation with external PC.

The nonvolatile memory (NVRAM) stores the calibration coefficients set by the manufacturer, data log pages, channel template, channel plans and service information.

The power supply unit (PS) generates the required voltages either from battery or from an external power source.

2.5.3 Component Arrangement

The IT-15T2 DVB-T/T2 Signal Analyzer is implemented in plastic shockproof sectional housing that includes printed and three-dimensional wiring. The IT-15T2 dimensions are 193x94x53 mm.

The upper panel of the Analyzer has a rubber keypad and a graphical display (see Figure 2.1). The front panel has a USB connector for connection with PC and external power source connector (see Figure 2.2). The 75-Ohm input “F”-male connector is located on the rear panel.

3 PREPARATION FOR OPERATION

Perform external examination to make sure your IT-15T2 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 the IT-15T2 has been kept in the environment other than the rated operating conditions, leave your Analyzer in facilities with normal operating conditions for at least 2 hours prior to operation.

4 OPERATION PROCEDURE

4.1 Controls and Indicators

The location of controls, indicators and connectors is shown in Figures 2.1 and 2.2. These elements have the following functions:

a) **F1, F2, F3** functional keys enable the commands corresponding to icons shown on the screen of IT-15T2;
b) key allows you to return to the previous menu level;
c) ✱ key enables the menu with auxiliary functions;
d) ▲, ▼, ◄ , and ► arrows allow you to edit the current operating mode;
e) key confirms the selected option and allows you to reset the measurement results in different measurement modes;
f) ⏻ key switches the power of IT-15T2 on/off;
g) **12V DC 1.2A** connector is for connection to an external power source;
h) **USB** connector is for connection to a computer;
i) **INPUT** connector is for signal input, “F”-male connector.

4.2 Operation Start

Before you start operating your IT-15T2, make sure to carefully read this Operating Manual as well as to inspect the location of the controls and indicators of the Analyzer (see Section 4.1).

To prepare your Analyzer for operation from an external power source, connect the Mains Adapter to the connector located on the front panel of the IT-15T2 and then to the power source.

To prepare your IT-15T2 for operation in stand-alone mode, powered by the battery, press and hold the ⏻ key until the LCD backlight turns on.

The following message (see Figure 4.2.1) will appear on the screen:

Figure 4.2.1

The screen displays the name and type of the Analyzer. After approximately 1 second, the Analyzer will open the main mode-selection menu (see Figure 4.3.1), further referred to as Main menu.

4.3 Main Menu

The Main menu is intended for selecting one of the operating modes of the Analyzer. This menu represents a number of icons, each icon referring to a certain mode. After you switch the Analyzer on, you the Main menu will be displayed on its screen (see Figure 4.3.1).

The Main menu contains two pages of icons. You can switch between them using the ▲ and ▼ keys. See the screen view of the second page of icons in Figure 4.3.2.

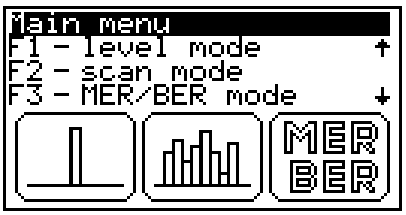

Figure 4.3.1

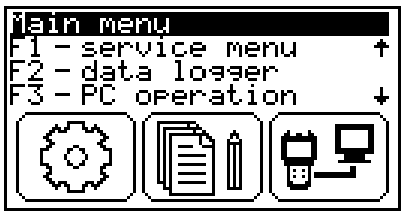

Figure 4.3.2

Use the **F1**, **F2** and **F3** functional keys to select one of the operating modes. To return to the Main menu from any measurement mode, press the ⏏ key.

You can access the following operating modes from the Main menu:

a)  - **LEVEL** measurement mode;

b)  - **SCAN** measurement mode;

c)  - **MER/BER** measurement mode;

d)  - the Analyzer Service menu;

e)  - the Analyzer Data Logger menu;

f)  - operation with PC.

If you select the  icon, the Analyzer Service Menu will appear on the screen (see Figure 4.3.3); and if you select the  icon, you will see the Analyzer Data Logger menu (see Figure 4.3.4)

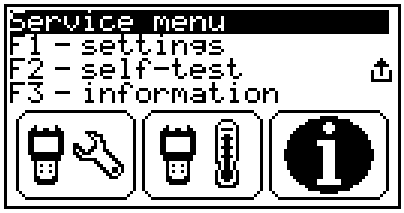

Figure 4.3.3

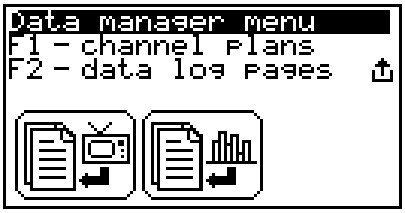

Figure 4.3.4

Use the **F1**, **F2** and **F3** functional keys to select one of the operating modes from the Service menu as well as from the Data Logger menu. To return to the additional menu from any operating mode, press the ⏏ key. Press the ⏏ key once again to return to the Main menu.

You can access the following operating modes from the Analyzer Service and Data Logger menus:

a)  - the Analyzer Configuration mode;

b)  - Self-Test mode;

c)  - information about the Analyzer;

e)  - channel plan list;

f)  - channel data logger.

4.4 Preparation for Measurements

To make sure your Analyzer is operating properly, perform the procedure described below.

First you should get acquainted with the Analyzer Main menu structure (see Section 4.3).

Enter the Analyzer Service menu and select the  icon to enter the Analyzer Configuration mode. Use the ▲ and ▼ keys to select a line with the required parameter for editing, and set the following parameter values by the ◄ and ► keys:

- **Ch template:** OIRT;
- **Channel plan:** ch template;
- **Language:** English (other option is **Язык:** Русский);
- **Unit:** dBµV;
- **Contrast:** 50%;
- **Display:** normal;
- **Sound:** type1;

- **Power off:** off;
- **Beeping:** off.

Press the ⏏ key to return to the Main menu. Select the **LEVEL** measurement mode from the Main menu. The screen view of the signal level measurement mode in a frequency point shall be as shown in Figure 4.5.1. Set the measurement frequency to the frequency of the video carrier of the 25th TV channel by pressing the ◄ and ► keys. The first line on the screen will show the channel number **25**, and the third line on the screen will show the channel frequency **503.250 MHz**.

To return to the Main menu, press the ⏏ key.

4.5 Measurement Procedure

4.5.1 General Information

The IT-15T2 DVB-T/T2 Signal Analyzer offers the following seven measurement modes which you can access both from the Main menu and from any of the measurement modes:

a) measurement of signal level in a frequency point, V/A and C/N ratios, as well as alternating and direct voltage at the input of the Analyzer in **LEVEL** mode;
b) TV signal level measurement in **SCAN** mode;
c) TV signal level ripple measurement in **RIPPLE** mode;
d) signal spectrum measurement in **SPECTRUM** mode;
e) measurement of DVB-T and DVB-T2 channels reception quality in **MER/BER** mode;
f) DVB-T and DVB-T2 channels constellation diagram in **CONSTELLATION** mode;
g) DVB-T and DVB-T2 channels echo graphs in **ECHO GRAPH** mode.

You can access **LEVEL**, **SCAN** and **MER/BER** measurement modes from the Analyzer Main menu. To enter **RIPPLE** and **SPECTRUM** modes, press the **F2** and **F3** functional keys accordingly within **SCAN** mode. **CONSTELLATION** and **ECHO GRAPH** modes can be selected from **MER/BER** measurement mode by pressing the **F2** key.

If you have selected a channel plan, its name and the **Channel plan:** message will appear on the screen for a short period of time when you enter **LEVEL**, **SCAN** and **MER/BER** measurement modes.

4.5.2 LEVEL Measurement Mode

The icon in the Main menu refers to **LEVEL** measurement mode. In this mode you can measure the signal level in a frequency point, parameters of TV channel with analog or digital modulation, as well as voltage of the remote power supply of the cable network. You can see the screen view of this mode in Figure 4.5.1 (for analog channels) and Figure 4.5.2 (for digital channels).

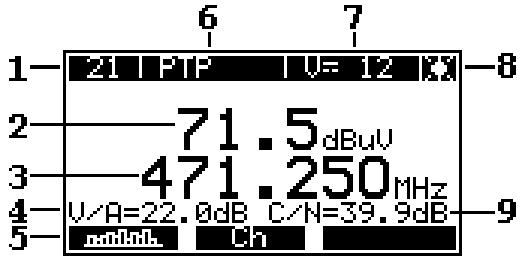

Figure 4.5.1

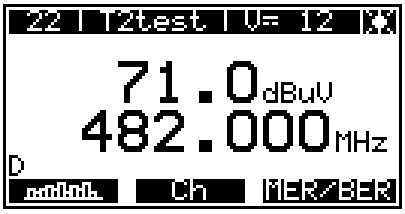

Figure 4.5.2

The screen displays the following information:
1 – channel number according to the selected channel template;
2 – signal level measured in dBμV, dBmV or dBm;
3 – channel tuning frequency in MHz;
4 – V/A ratio in dB for analog channel;
5 – line with the **F1**, **F2** or **F3** keys for accessing additional modes and settings;
6 – channel name according to the selected channel plan;
7 – voltage at the Analyzer input;
8 – status of external devices powering mode (see Section 4.5.9);
9 – C/N ratio for analog channel.

Measurement of analog channel parameters

The following three parameters are measured for the channels with analog modulation:

- video carrier level which is measured in a frequency point defined by the channel plan (when a channel plan is selected) or by the channel template (if no plan is selected) (see Section 4.7).
- video carrier to audio carrier ratio. It is determined as level difference between audio and video carriers. For this purpose the Analyzer performs an additional measurement in the frequency point of audio carrier which is defined in accordance with the channel template (see Section 4.7).
- channel to noise ratio. To measure C/N ratio, the Analyzer performs an additional measurement in the frequency point with the lowest content of useful RF signal components within the channel bandwidth. The C/N ratio will be calculated by the following formula:

C/N = Uch – Unoise – 10 * Lg(Bch / Bm) – K, where

C/N – carrier to noise ratio;
Uch – signal level;
Unoise – noise level;
Bch – video channel bandwidth;
Bm – filter passband;
K – correction factor.

Value of **Uch** frequency is defined by the channel plan when a channel plan is selected or by the channel template if no channel plan is selected (for OIRT template this frequency point is minus 1.125 MHz from video carrier frequency). The **Bch** value is determined in accordance with the selected channel template (see Section 4.7). The correction factor **K** is determined empirically.

To increase the measurements accuracy when a channel plan is selected, set the frequency for noise measurements of analog channels to its optimal value (see Section 4.6.2.2).

You can turn off the C/N ratio measurement by editing the corresponding channel settings in the channel plan or channel template (see Section 4.7). In this case the C/N value will not be shown.

Measurement of digital channel parameters

For digital channels the Analyzer performs the measurement of channel power within the channel bandwidth. To perform this measurement, the Analyzer applies the integration method. The IT-15T2 calculates the total channel power value by consecutive measurement of channel power within the whole bandwidth with 125 kHz step. Then it recalculates the total value into actual power value using the following formulas:

$$\mathbf{Usum} = \sum_{i=0}^{\frac{Bch}{0.125}} \left[10^{Ui/20}\right]$$

Uch = 20* log(Usum) + K, where

Ui – channel power value in the ***i*** frequency point of the channel;
Bch – digital channel bandwidth in MHz;
Usum – total channel power value within the channel bandwidth, μV;
Uch – actual channel power in dBμV;
K – correction factor.

The **Bch** bandwidth is determined by the channel plan when a channel plan is selected or by the channel template if no channel plan is selected (see Section 4.7). The **K** correction factor is determined empirically.

To increase the measurements accuracy when a channel plan is selected, set the optimal value of the digital channel bandwidth (see Section 4.7).

When digital channels are measured, the **D** symbol is shown on the Analyzer screen instead of V/A and C/N ratio values.

Measurement of the remote power supply voltage of the cable network

The range of voltage measurement at the Analyzer input is from 10 to 100 V. The absolute error of the measurement is lower than ±1.5 V. The measured value is indicated in position 7 (see Figure 4.5.1). If the voltage is direct, you will see the icon on the screen; if it is alternating, you will see the icon. If the Analyzer is operating in external devices powering mode (see Section 4.5.9) and an error occurs, it will be shown on the screen by **---** message in position 7 (see Figure 4.5.1).

General settings of LEVEL mode

To perform tuning by channels, use the ◄ and ► keys. When a channel plan is selected, scrolling is possible only through the channels from the plan. If no channel plan is selected, the arrow keys will navigate through all the channels in the channel template (see Section 4.7).

The selected channel type is determined in accordance with the channel plan when a channel plan is selected (see Section 4.7) or automatically if no channel plan is selected.

If audio indication of signal level is turned on in the Analyzer Configuration mode (see Section 4.7), the Analyzer will produce continuous beeps and the frequency of beeps will be increasing as the signal level becomes higher.

You can access other measurement modes by using functional keys. Press **F1** to switch to **SCAN** measurement mode (see Section 4.5.3). If you are measuring digital channel parameters, you can switch to **MER/BER** measurement mode by pressing **F3**.

If you press the **F2** key in **MER/BER** measurement mode, the Analyzer will return to signal level measurement in a frequency point. You can see the screen view of this mode in Figure 4.5.3.

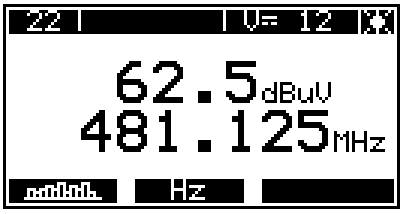

Figure 4.5.3

In this mode the signal level is measured in the selected frequency point. In this case V/A and C/N ratios are not displayed. Use the ◄ and ► keys to perform tuning by frequency with 125 MHz step. To return to channel parameters measurement, press the **F2** key again.

Press the ⏏ key to return to the Main menu. Press the ✱ key to see the settings menu of external devices powering mode (see Section 4.5.9).

4.5.3 SCAN Measurement Mode

The  icon in the Main menu refers to **SCAN** measurement mode. This mode displays the channels signal level as a bar-graph. See Figure 4.5.4 for the mode screen view:

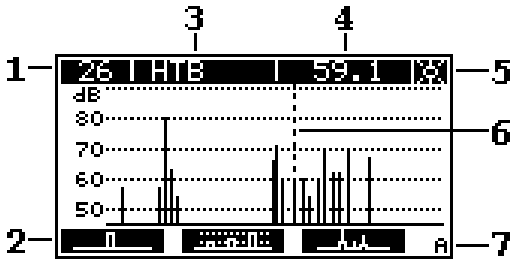

Figure 4.5.4

The screen displays the following information:

1 – number of the channel at the marker position according to the selected channel template;
2 – line with **F1**, **F2** or **F3** keys for accessing additional modes and settings;
3 – name of the channel at the marker position according to the selected channel plan;
4 – signal level of the channel at the marker position in dBµV, dBmV or dBm;
5 – status of external devices powering mode (see Section 4.5.9);
6 – marker;
7 – type of the channel at the marker position: **A** – analog, **D** – digital.

The bar-graph on the screen shows the signal level of channels as bars with different height. The method of measurement of analog and digital channels signal level is described in Section 4.5.2.

You can navigate the marker by the ◄ and ► keys.

The channel type is determined in accordance with the channel plan when a channel plan is selected (see Section 4.7) or automatically if no channel plan is selected. Channel modulation type is determined automatically when you enter the measurement mode or after the signal is received at the Analyzer input. When the Analyzer determines the channel type, you will see the **Scanning channels** message and process indicator on the screen.

From this measurement mode you can switch to **LEVEL** mode (see Section 4.5.2) by pressing the **F1** key, to **RIPPLE** mode (see Section 4.5.4) by pressing the **F2** key, and to **SPECTRUM** mode (see Section 4.5.5) by pressing the **F3** key. Press the ⏏ key to return to the Main menu.

You can select the division value of the level scale using ▲ and ▼ keys. The allowable division values are: **5 dB**, **10 dB**, or **20 dB** per division. The selected value will be shown on the Analyzer screen. The reference level in the bar-graph is set automatically to the channel with the highest level.

Press the ✱ key to see the settings menu of external devices powering mode (see Section 4.5.9).

4.5.4 RIPPLE Measurement Mode

RIPPLE measurement mode can be accessed from **SCAN** mode (see Section 4.5.3) by pressing the **F2** key. In this mode you will see the channels signal level as vertical bars and two dashed lines of ripple between two selected channels. The screen view is shown in Figure 4.5.5:

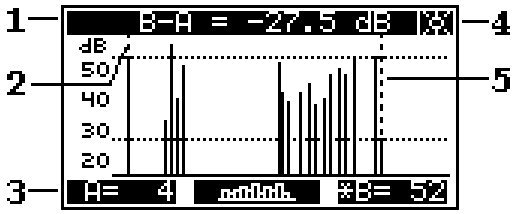

Figure 4.5.5

The screen displays the following information:
1 – ripple value between channels indicated by markers A and B;
2 – marker A;
3 – line with **F1**, **F2** or **F3** keys for accessing additional modes and settings;
4 – status of external devices powering mode (see Section 4.5.9);
5 – marker B.

To change the marker position, first you should select the required marker by the **F1** (for marker A) or the **F3** keys (for marker B). The selected marker will be shown on the screen by the ✳ symbol and the number of selected channel. Then you can navigate the selected marker by the ◄ and ► keys. Note that marker A is always on the left from marker B.

Press the **F2** to return to **SCAN** mode, and press the ⏏ key to return to the Main menu.

You can select the division value of the level scale using the ▲ and ▼ keys. The allowable division values are: **5 dB**, **10 dB**, or **20 dB** per division. The selected value will be shown on the Analyzer screen. The reference level in the bar-graph is set automatically to the channel with the highest level.

Press the ✳ key to see the settings menu of external devices powering mode (see Section 4.5.9).

4.5.5 SPECTRUM Measurement Mode

SPECTRUM measurement mode can be accessed from **SCAN** mode by pressing the **F3** key. In this mode you will see the spectrum of the input signal in tunable scanning range. The screen view is shown in Figure 4.5.6:

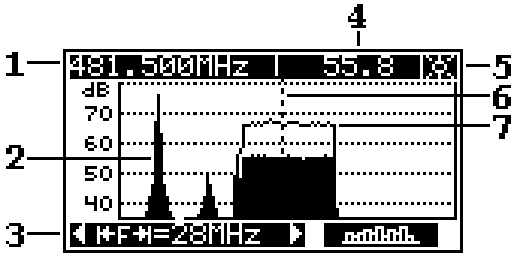

Figure 4.5.6

The screen displays the following information:
1 – frequency value at the marker position in MHz;
2 – trace with the current level;
3 – line with **F1**, **F2** or **F3** keys for accessing additional modes and settings;
4 – level value at the marker position for the trace with the current level (in dBμV, dBmV or dBm);
5 – status of external devices powering mode (see Section 4.5.9);
6 – marker;
7 – trace with the maximum level.

The Analyzer performs spectrum scanning by making consecutive measurements in frequency points with 125 kHz step. If several frequency points appear at one point of the spectrum diagram, only one point with maximum level will be displayed. The spectrum diagram contains two traces: trace with the current level and trace with the maximum level. Press the ⏏ key to reset the trace with maximum level.

You can change the frequency scanning range by pressing the **F1** or **F2** keys. The available values are: **14 MHz**, **28 MHz**, **55 MHz** and **110 MHz**. The current scanning range value is shown on the screen in position 3 (see Figure 4.5.6).

Adjust the marker position by the ◄ and ► keys. Press the **F3** key to return to **SCAN** measurement mode, and press the ⏏ key to return to the Main menu.

You can select the division value of the level scale using ▲ and ▼ keys. The available division values are: **5 dB**, **10 dB**, or **20 dB** per division. The selected value will be shown on the Analyzer screen. The reference level in the diagram is set automatically to the frequency point with the highest level.

Press the ✱ key to see the settings menu of external devices powering mode (see Section 4.5.9).

4.5.6 MER/BER Measurement Mode

The MER BER icon in the Main menu refers to **MER/BER** measurement mode. In this mode the screen displays the measured reception quality parameters of DVB-T and DVB-T2 channels in the form of a table. The screen view is shown in Figure 4.5.7 (for DVB-T channels) and Figure 4.5.8 (for DVB-T2 channels):

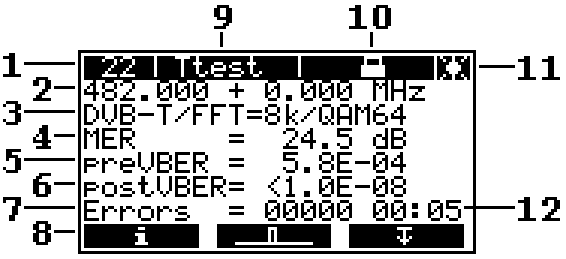

Figure 4.5.7

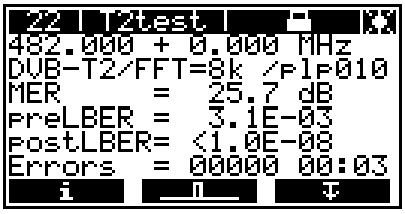

Figure 4.5.8

The screen displays the following information:

1 – channel number according to the selected channel template;

2 – tuning frequency and frequency shift in MHz;

3 – basic channel modulation parameters: channel type (DVB-T or DVB-T2), FFT mode, subcarrier modulation type for DVB-T channels or number of the current PLP for DVB-T2 channels;

4 – MER value;

5 – BER value before Viterbi decoder for DVB-T channels (perVBER) or BER value before LDPC decoder for DVB-T2 channels (preLBER);

6 – BER value after Viterbi decoder for DVB-T channels (postVBER) or BER value after LDPC decoder for DVB-T2 channels (postLBER);

7 – counter of erroneous packets after Reed-Solomon decoder for DVB-T channels or after BCH decoder for DVB-T2 channels;

8 – line with **F1**, **F2** or **F3** keys for accessing additional modes and settings;

9 – channel name according to the selected channel plan;

10 – icon of Analyzer synchronization with the channel;

11 – status of external devices powering mode (see Section 4.5.9);

12 – channel measurement time.

After you have selected a channel to be measured, the Analyzer will perform channel synchronization. The synchronization status is shown on the screen in position 10 (see Figure 4.5.7). The process of synchronization can take up to 10 seconds and is indicated on the screen as a progress bar ... in position 10. After synchronization is achieved, you will see the icon on the screen in position 10, the channel frequency shift value will be shown in position 2, and the channel modulation parameters will be shown in position 3 (see Figure 4.5.7). In case the signal level at the Analyzer input is low, the icon will appear on the screen in position 10 (see Figure 4.5.7).

If no channel plan is selected, all the signal parameters except for the channel bandwidth (determined by the channel template) are determined automatically. When a channel plan is selected, the signal parameters are taken from the channel plan (see Section 4.7) and the channel synchronization takes less time.

NOTE! For DVB-T channels with hierarchical modulation BER after Viterbi decoder and counter of erroneous packets after Reed-Solomon decoder are measured for low priority stream.

General settings of MER/BER mode

To perform tuning by channels, use the ◄ and ► keys. When a channel plan is selected (see Section 4.7), scrolling is possible only through the digital channels from the plan. If there are no digital channels in the selected channel plan, you will see the following message on the screen: **There's no any dg. ch in channel plan**.

If a DVB-T2 channel contains several independent data streams (PLP streams), you can measure the reception quality parameters for each stream. Use the ▲ and ▼ keys to select the required PLP. The

selected PLP number will be shown on the screen in position 3 (see Figure 4.5.7). Once tuning to the channel is finished, the Analyzer will perform synchronization with the PLP defined in the channel plan (when a channel plan is selected) or with the first PLP from the PLP list (if no channel plan is selected).

To reset the channel measurement results, press the key. In this case the Analyzer will repeat the channel synchronization.

A line of functional keys (position 8 on the screen in Figure 4.5.7) contains two sets of additional functions which can be switched by **F3** key. Using the first set of functions, you can access the following modes:

F1 key: table of channel modulation parameters;
F2 key: **LEVEL** measurement mode (see Section 4.5.2).

Using the second set of functions, you can switch to the following modes:
F1 key: **CONSTELLATION** measurement mode (see Section 4.5.7);
F2 key: **ECHO GRAPH** measurement mode (see Section 4.5.8).

Press the key to return to the Main menu. Press the ✱ key to see the settings menu of external devices powering mode (see Section 4.5.9).

Table of channel modulation parameters

You can see the screen view of DVB-T channel parameters table in Figure 4.5.9:

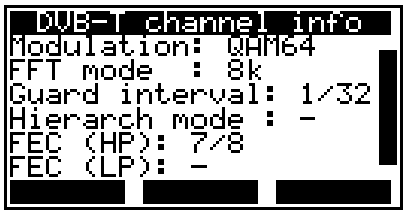

Figure 4.5.9

The screen displays the following information:
- **Modulation** – type of subcarriers modulation;
- **FFT mode** – number of subcarriers;
- **Guard interval** – relative duration of guard interval;
- **Hierarch mode** – mode of hierarchical modulation;
- **FEC (HP)** – relative code rate for high priority stream;
- **FEC (LP)** – relative code rate for low priority stream.

Press the key to return to **MER/BER** measurement mode.

You can see the screen view of DVB-T2 channel parameters table in Figure 4.5.10:

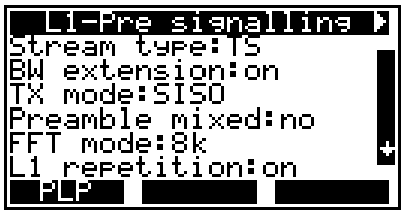

Figure 4.5.10

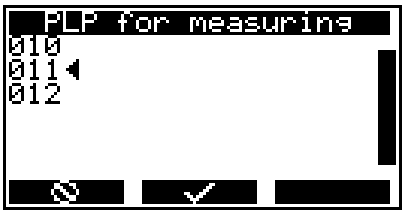

Figure 4.5.11

This table displays the modulation parameters given in table for L1 pre-signaling and post-signaling of DVB-T2 channel. The channel parameters table consists of four columns, which can be switched by the ◄ and ► keys. The names of the table columns are shown in the upper line of the screen:
- **L1-Pre signaling –** table with channel parameters from L1 pre-signaling field;
- **L1-Post signaling –** table with common channel parameters from L1 post-signaling field;
- **L1-Post data PLP –** table with parameters of the current data PLP from L1 post-signaling field;
- **L1-Post common PLP–** table with parameters of the PLP which is adjacent to the current data PLP from L1 post-signaling field. The table is shown in case if the current data PLP has an adjacent PLP.

Use the ▲ and ▼ keys to scroll through the parameters table. The parameters in the table correspond to version 1.1.1 of DVB-T2 specification.

Press the key to return to **MER/BER** measurement mode.

Press the **F1** key to see the list of PLPs in a channel (see Figure 4.5.11). In this list you can select a PLP for measurement using the ◄, ►, ▲ and ▼ keys. To confirm your selection, press **F2**. The Analyzer will

return to **MER/BER** measurement mode and will start synchronization with the selected PLP. Press the **F1** or ⮉ key to exit the list of PLPs without selecting a new stream.

4.5.7 CONSTELLATION Measurement Mode

CONSTELLATION measurement mode can be accessed from **MER/BER** mode by pressing the **F1** key. In this mode you will see the constellation diagram of DVB-T or DVB-T2 channels and also the basic reception quality parameters. The screen view is shown in Figure 4.5.12 (for DVB-T channels) and Figure 4.5.13 (for DVB-T2 channels):

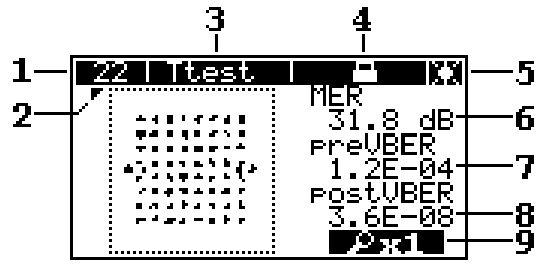

Figure 4.5.12

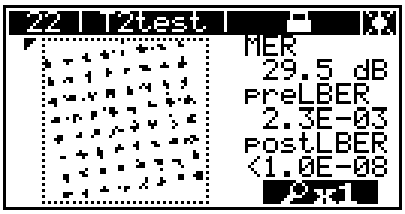

Figure 4.5.13

The screen displays the following information:
1 – channel number according to the selected channel template;
2 – marker for diagram quadrant selection;
3 – channel name according to the selected channel plan;
4 – icon of Analyzer synchronization with the channel;
5 – status of external devices powering mode (see Section 4.5.9);
6 – MER value in dB;
7 – BER value before Viterbi decoder for DVB-T channels (perVBER) or BER value before LDPC decoder for DVB-T2 channels (preLBER);
8 – BER value after Viterbi decoder for DVB-T channels (postVBER) or BER value before LDPC decoder for DVB-T2 channels (postLBER);
9 – constellation diagram scale.

When synchronization with the channel is achieved, the diagram will display the stored samples of the demodulated input signal as points. The coordinates of these points correspond to the values of signal quadrature component.

To enlarge the displayed diagram, press the **F3** key. The screen will zoom in the selected diagram quadrant. Press **F3** once more to return to previous diagram scale. Use the ▲, ▼, ◄ and ► keys to select the diagram quadrant for zooming. The selected quadrant will be indicated by the marker in its corner (position 2 in Figure 4.5.12).

To reset the channel measurement results, press the ⮋ key. In this case the Analyzer will repeat the channel synchronization.

Press the ⮉ key to return to **MER/BER** measurement mode. Press the ✱ key to see the settings menu of external devices powering mode (see Section 4.5.9).

4.5.8 ECHO GRAPH Measurement Mode

ECHO GRAPH measurement mode can be accessed from **MER/BER** mode by pressing the **F2** key. In this mode you will see the impulse response curve of DVB-T or DVB-T2 channels and also the basic reception quality parameters. The screen view is shown in Figure 4.5.14:

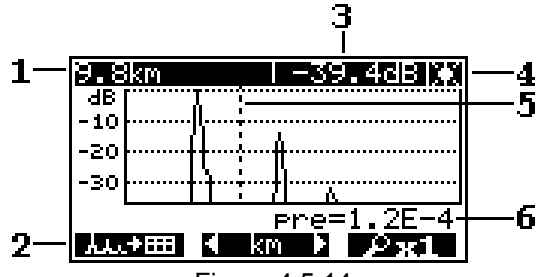

Figure 4.5.14

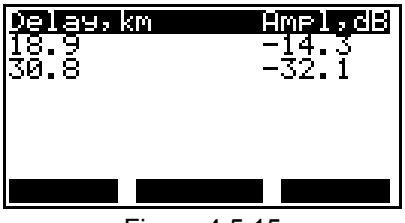

Figure 4.5.15

The screen displays the following information:
1 – echo delay value at the marker position in μs, km or miles;

2 – line with F1, F2 or F3 keys for accessing additional modes and settings;

3 – relative echo amplitude at the marker position in dB (if synchronization with the channel is achieved) or icon of Analyzer synchronization with the channel (if synchronization is not achieved);

4 – status of external devices powering mode (see Section 4.5.9);

5 – marker;

6 – BER value before Viterbi decoder for DVB-T channels or before LDPC decoder for DVB-T2 channels.

Once synchronization is achieved, you will see the channel impulse response graph, which shows the dependence of echo amplitude from the main signal delay value. Echo amplitude value is measured in respect to the main signal amplitude equal to 0 dB.

Adjust the marker position using the ◄ and ► keys. The echo delay value at the marker position is displayed in position 1, and the echo relative amplitude value is shown in position 4 (see Figure 4.5.14). Use the ▲ and ▼ keys to shift the graph along the amplitude scale.

The impulse response graph can have three display options along the signal delay axis: normal, 2x and 4x zoom. Normal option shows the maximum range of delay values available. To select another display option, press **F3**. The current graph display option is shown at the **F3** key icon.

Use the **F2** key to change the measurement units of echo delay value (the available options are microseconds, kilometers, and miles). The current measurement unit is shown at the **F2** key icon.

You can also see the echo graph as a table. To enter this mode, press the **F1** key. In this mode the screen shows a table of echos with maximum amplitude values (see Figure 4.5.15 for the screen view). The first table column shows the echo delay value, and the second column shows the echo amplitude. The table can list up to 5 echos in descending order of their relative amplitude.

To reset the channel measurement results, press the ⮋ key. In this case the Analyzer will repeat the channel synchronization.

Press the ⮉ key to return to **MER/BER** measurement mode. Press the ✻ key to see the settings menu of external devices powering mode (see Section 4.5.9).

4.5.9 External Devices Powering Mode

This mode is used for powering the receiving antenna equipment via the Analyzer input connector. Press the ✻ key in any of the measurement modes to enter the settings menu of external devices powering mode. This settings menu also opens during automatic defining of the channel plan and opening of the channel data logger page. The screen view is shown in Figure 4.5.16.

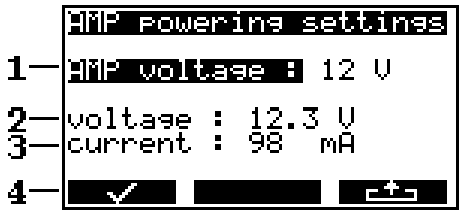

Figure 4.5.16

The screen displays the following information:

1 – power source operating mode;

2 – measured voltage at the Analyzer input;

3 – measured load current value;

4 – line with **F1**, **F2** or **F3** keys for accessing additional modes and settings.

External devices powering is possible only in the measurement modes, during automatic defining of the channel plan and opening of the channel data logger page. In other modes external devices powering is turned off.

Use the ◄ and ► buttons to select the powering voltage value. The values available are: **off, 5 V, 12 V,** and **24 V**[1]. The currently selected value is shown on the screen in position 1 (see Figure 4.5.16). Once you selected the voltage value, press **F1** to turn on the powering.

The measured voltage at the Analyzer input is shown on the screen in position 2, and the load current value is shown in position 3. If powering of external devices is turned off, you will see the **--.- V** message in position 2, and **--- mA** message in position 3 (see Figure 4.5.16).

Before turning the powering of external devices on, the Analyzer measures voltage at its input. If the voltage is detected, external devices powering is not activated and switches to emergency mode. In this case you will see the **external!** message on the screen in position 2 (see Figure 4.5.16). After de-energizing the Analyzer input, external devices powering switches to its normal operating mode. If the power consumed

[1] 5 V voltage option is available for IT-15T2 of 16.02.02 and 16.02.21 hardware modifications only

by external devices exceeds the maximum allowable value, their powering will be turned off and you will see the **overload** message on the screen in position 3 (see Figure 4.5.16). In this case the Analyzer will be repeating attempts to turn on the powering of external devices.

Press the **F3** key to exit the settings menu of external devices powering mode.

The status of external devices powering mode is shown in the right corner of the screen by the following icons:

– powering of external devices is off;

– powering of external devices is on and in normal mode;

(icon blinks) – powering of external devices is in emergency mode, you will hear audible alarm.

NOTE! Be careful when turning on powering of external devices. The connected devices can be damaged by the voltage at the Analyzer input, if they are not intended for receiving such voltage. Also the Analyzer can be damaged by external voltage that is applied at its input.

4.6 Data Logger Function

4.6.1 General Information

The Data Logger function is intended for automation of the measurement results recording. There are two Data Logger directories: Channel Plan List and Channel Data Logger. The memory capacity allows saving up to 16 channel plans (up to 112 frequency points per plan), up to 130 channel data logger pages (up to 112 channels per page, and up to 8 PLPs in each DVB-T2 channel). The Analyzer allows viewing the saved data off-line or by means of a computer (see Section 4.11).

4.6.2 Channel Plan List

4.6.2.1 General Information

The  icon in the Analyzer Data Logger Menu corresponds to this mode. The mode allows you to perform all the operations with channel plans: viewing, editing, deleting, and creation of new plans. See the view of the screen in Figure 4.6.1.

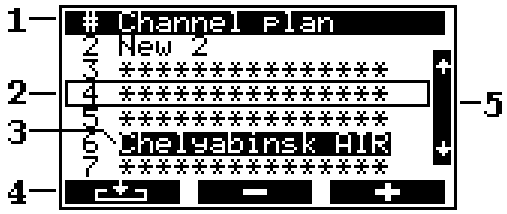

Figure 4.6.1

The screen displays the following information:
1 – table header;
2 – selected table row;
3 – channel plan selected for measurement;
4 – line with **F1**, **F2** or **F3** keys for accessing additional modes and settings;
5 – scroll bar.

The table contains two columns: plan sequential number and its name (up to 15 characters). The channel name is assigned by the Analyzer automatically during creation of a new plan, and later you can edit it by means of computer (see Section 4.11). If a channel plan is empty, the ********** message will be shown on the screen instead of its name. If a channel plan is selected in the Analyzer Configuration mode (see Section 4.7), its name will be highlighted in inverse color (position 3 in Figure 4.6.1).

You can scroll through the table rows using the ▲ and ▼ keys. The selected row will be framed (position 2 in Figure 4.6.1). You can use the scroll bar (position 5 in Figure 4.6.1) to change the visible part of the table.

List of available commands:

F1 or ↵ key – view and edit the selected channel plan (see Section 4.6.2.2);

F2 – delete the selected channel plan (see Section 4.6.2.4);

F3 – create a new plan in automatic mode (see Section 4.6.2.3).

To return to the Analyzer Data Logger Menu, press the ⮉ key.

4.6.2.2 Channel Plan Editing

To view and edit a channel plan, select the required one in the channel plans table and press **F1** or ⮋ key. The screen view is shown in Figure 4.6.2:

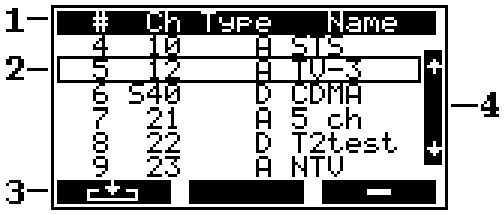

Figure 4.6.2

The screen displays the following information:
1 – table header;
2 – selected table row;
3 – line with **F1**, **F2** or **F3** keys for accessing additional modes and settings;
4 – scroll bar.

The table shows a list of channels comprising the channel plan. The table contains four columns: channel number, channel number according to the channel template (see Section 4.7), channel modulation type (**A** for analog, and **D** for digital), and channel name (up to 6 characters). The channel name is assigned by the Analyzer automatically during creation of a new plan, and later you can edit it using an external PC (see Section 4.11).

You can scroll through the table rows using the ▲ and ▼ keys. The selected row will be framed (position 2 in Figure 4.6.2). You can use the scroll bar (position 4 in Figure 4.6.2) to change the visible part of the table.

Press the **F3** key to delete the selected channel plan (this command is available only for channel plans comprising more than one channel).

To return to the channel plans table, press the ⮉ key. If you have created a new channel plan or made changes to the existing one, the Analyzer will offer saving such plan or changes. Once you confirm the saving, all respective pages in the Channel Data Logger will be deleted, and a new channel plan with new pages will be saved. If a new plan was created automatically and then saved, it will be selected in the Analyzer Configuration mode for measurements.

Press the **F1** or ⮋ key to view and edit the parameters of the selected channel plan. See the screen views of the channel plan parameters table in Figure 4.6.3 (for analog channels), Figure 4.6.4 (for DVB-T channels), 4.6.5 (for DVB-T2 channels), and 4.6.6 (for digital channels with unknown modulation).

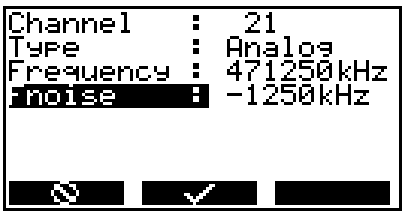

Figure 4.6.3

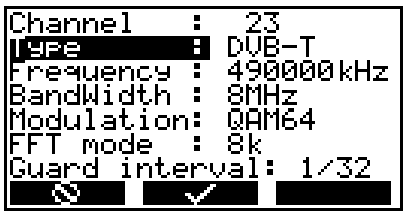

Figure 4.6.4

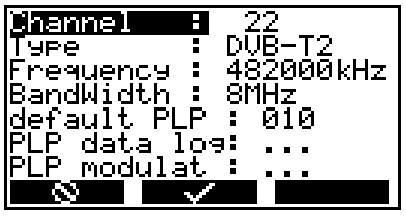

Figure 4.6.5

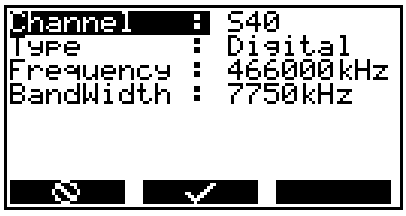

Figure 4.6.6

Use the ▲ and ▼ keys to select a parameter for editing. The selected parameter will be highlighted in inverse color. To change the parameter value, use the ◄ and ► keys. Press **F2** to save the changes and return to the channel plans table or **F1** to exit the parameters table without saving the changes.

The channel plan parameters table contains the following parameters:

a) **Channel** – channel number according to the channel template (see Section 4.7). The parameter is available for all channel modulation types. You can select the channel number only from the numbers of the most adjacent channels in the channel plans table;
b) **Type** – channel modulation type. The values available: **analog**, **DVB-T**, **DVB-T2**, **digital** (digital channel with unknown modulation);
c) **Frequency** – tuning frequency in kHz. The parameter is available for all channel modulation types. The parameter value is changed within the channel bandwidth with 125 kHz step;
d) **Fnoise** – frequency shift for C/N ratio measurement. This parameter is available only for analog channels. The values available are from -8000 to +8000 kHz with 125 kHz step. You can set the zero value for this parameter, in this case the Analyzer will not measure the C/N ratio for this channel, and the **off** message will be shown on the screen instead of this parameter value;
e) **Bandwidth** – frequency bandwidth of a digital channel. This parameter is available only for digital channels. The values available for DVB-T and DVB-T2 channels are: **7 MHz** and **8 MHz**. For channels with unknown modulation you can select the values from -1000 to +8000 kHz with 250 kHz step. The default bandwidth value is set in accordance with the channel template (see Section 4.7);
f) **Modulation** – type of subcarriers modulation of a DVB-T channel. The following values are available: **QPSK**, **QAM16**, **QAM64**;
g) **FFT mode** – number of subcarriers of a DVB-T channel. The values available are: **2k**, **4k**;
h) **Guard interval** – value of guard interval of a DVB-T channel. The values available are: **1/32**, **1/16**, **1/8**, **1/4**;
i) **Default PLP** – number of a PLP (of a DVB-T2 channel) which is selected by default for synchronization in the MER/BER measurement mode and for measurements with the PC (see Section 4.11). The parameter value is selected from the PLP list of a DVB-T2 channel;
j) **PLP data log** – numbers of PLPs (of a DVB-T2 channel) whose MER and BER are measured in the Channel Data Logger mode. If a channel contains only one PLP, its number will be shown in the value field for this parameter, and the parameter will not be available for editing. If a channel contains several PLPs, the **…** message will be shown instead of the parameter value. When you select this parameter for editing, the PLP selection menu will open (see the description of this menu below);
k) **PLP modulat** – modulation type of a PLP (of a DVB-T2 channel) whose MER and BER are measured in the Channel Data Logger mode. If a channel contains only one PLP, its modulation type will be shown in the value field for this parameter. The following values are available: **QPSK**, **QAM16**, **QAM64**, **QAM256**. If a channel contains several PLPs, the **…** message will be shown instead of the parameter value. When you select this parameter for editing, the PLP modulation type selection menu will open (see the description of this menu below).

When you edit the **PLP data log** parameter value of a DVB-T2 channel containing several PLPs, the Analyzer will open the PLP selection menu (see Figure 4.6.7), where you can select a PLP for measurement in the Channel Data Logger mode. When you edit the **PLP modulat** parameter value of a DVB-T2 channel containing several PLPs, the Analyzer will open the PLP modulation type selection menu (see Figure 4.6.8), where you can set the modulation type of the PLP employed for measurement in the Channel Data Logger mode.

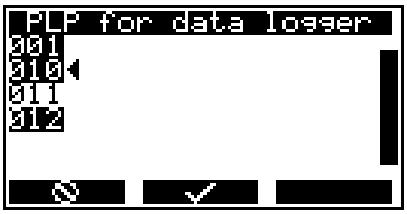

Figure 4.6.7

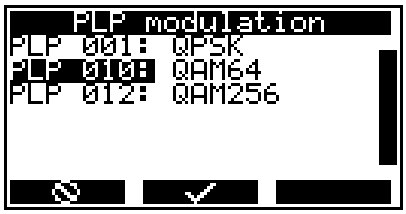

Figure 4.6.8

The PLP selection menu is a table containing the numbers of PLPs of a DVB-T2 channel. You can scroll through this table using the▲, ▼, ◄ and ► keys. The currently selected PLP is marked by the cursor on the right. Use the ⮋ key to make the selection as well as to cancel it (to cancel the selection, press this key twice). The numbers of the selected PLPs are highlighted in inverse color (for example, in Figure 4.6.7 the PLPs with numbers 1, 10 and 12 are selected). You can select up to 8 PLPs. If you create a new channel plan with DVB-T2 channels manually, the PLP list will contain all the possible numbers of PLPs from 0 up to 255. To exit the PLP selection menu and save the changes, press the **F2** key; to exit without saving the changes, press the **F1** key.

The selection menu of PLP modulation type is a table containing the numbers of PLPs and corresponding modulation types. The table contains only the PLPs selected in the previously described menu. You can scroll through this table using the ▲ and▼ keys. The number of the selected PLP is

highlighted in inverse color. You can select the modulation type of this PLP using the ◄ and ► keys. The values available are: **QPSK**, **QAM16**, **QAM64**, **QAM256**. To exit the menu and save the changes, press the **F2** key; to exit without saving the changes, press the **F1** key.

The default channel parameters are set by the Analyzer automatically during creation of a new plan (see Section 4.6.2.3), and later you can edit them manually.

4.6.2.3 Channel Plan Creating

To create a new channel plan automatically, select an empty row in the channel plans table and press the **F3** key. You will see the settings menu of external powering mode on the screen (see Section 4.5.9). Select the required voltage value in this menu. After that the Analyzer will search for channels according to the selected channel template (see Section 4.7), determine the channel modulation type (analog or digital), and also determine the parameters of DVB-T and DVB-T2 channels. This process will be indicated by the **Searching channels** message and progress bar on the screen. When the Analyzer searches for DVB-T and DVB-T2 channels, you will see the **Searching DVB ch.** message on the screen.

Once the Analyzer completes scanning the channels, it will switch to channel plan editing mode (see Section 4.6.2.2). Edit the channel plan parameters if required and save the plan.

When a new channel plan is created, the channel parameters have the following values:

- for analog channels the frequency is set in accordance with the channel template (see Section 4.7). The noise measurement frequency is set to minus 1.125 MHz;
- for digital channels the frequency and channel bandwidth are set in accordance with the channel template (see Section 4.7).

4.6.2.4 Channel Plan Deleting

To delete a channel plan, select the plan in the channel plans table and press the **F2** key. Once you confirm the deleting, the Analyzer will delete the channel plan and all respective pages from Channel Data Logger.

4.6.3 Channel Data Logger

4.6.3.1 General Information

The Channel Data Logger (CDL) is intended for measurement of TV channel parameters in accordance with one of the channel plans, for checking the cable network parameters against the limit plan, and saving the limit test results. The CDL allows you to view the measurement results and errors in different parameters, correct each parameter of the limit plan separately, and upload the data onto your PC for further processing and report preparation.

4.6.3.2 List of Channel Data Logger Pages

The  icon in the Analyzer Data Logger menu corresponds to this mode. This mode allows performing all the operations with CDL pages: viewing, deleting, and creating of a new page. See the screen view in Figure 4.6.9:

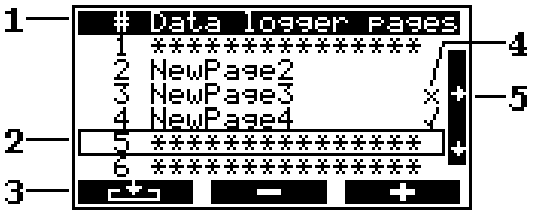

Figure 4.6.9

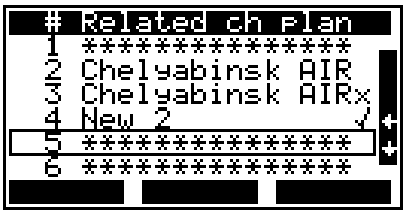

Figure 4.6.10

The screen displays the following information:
1 – table header;
2 – selected table row;
3 – line with **F1**, **F2** or **F3** keys for accessing additional modes and settings;
4 – page status icon;
5 – scroll bar.

The screen shows the list of CDL pages as a table. This table contains 3 columns: CDL page number, page name (up to 15 characters), and its status. The CDL page name is assigned by the Analyzer automatically during creation of a new page, and later you can edit it using an external PC (see Section 4.11). If a CDL page is empty, the ********** message will be shown in the screen instead of its name. The status icon in position 4 (see Figure 4.6.9) shows the CDL page status:

- **no icon** – page not scanned;
- ✓ - page scanned, no errors found;
- ✕ - page scanned, errors found.

You can scroll through the table rows using the ▲ and ▼ keys. The selected row will be framed (position 2 in Figure 4.6.9). Pressing the ► key you can change the view of the screen (see Figure 4.6.10). The screen will show the name of related channel plan. To return to the previous view, press the ◄ key. You can use the scroll bar (position 5 in Figure 4.6.9) to change the visible part of the table.

List of available commands:

F1 or ⮋ key - view and check the selected CDL page (see Section 4.6.3.3)
F2 – delete the selected CDL page (see Section 4.6.3.6);
F3 – create a new CDL page (see Section 4.6.3.5).

To return to the Analyzer Data Logger Menu, press the ⮉ key.

4.6.3.3 Channel Data Logger Page Viewing

To view and measure the channel data logger (CDL) page, press the **F1** or ⮋ key. The screen view is shown in Figure 4.6.11:

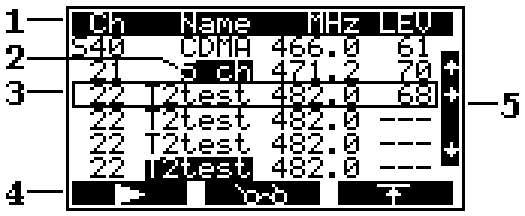

Figure 4.6.11

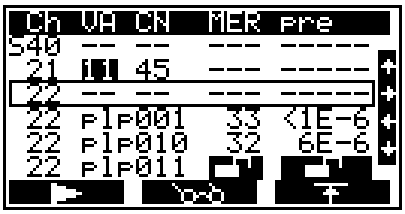

Figure 4.6.12

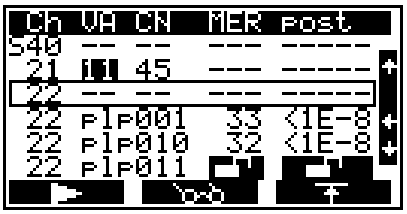

Figure 4.6.13

The screen displays the following information:
1 – table header;
2 – channel name;
3 – selected table row;
4 – line with **F1**, **F2** or **F3** keys for accessing additional modes and settings;
5 – scroll bar.

The screen will show a table with CDL page measurement results. Each row of this table represents one of the measured channels with analog, unknown digital or DVB-T modulation, or one of the measured PLPs of a DVB-T2 channel. Three screen views of the table are available; you can switch between them using the ◄ and ► keys.

The following parameters of measured channels are shown in the table header (position 1 in Figure 4.6.11):

a) **Ch** – channel number according to the channel template (see Section 4.7);
b) **Name** – channel name according to the channel plan;
c) **MHz** – tuning frequency in MHz according to the selected channel plan (frequency value is rounded up to 0.1 MHz);
d) **LEV** – channel level value in dBµV, dBmV or dBm. If a CDL page was not scanned, this parameter value is 0. When PLPs of the DVB-T2 channel are measured, you will see dashes **---** in the value field;
e) **VA** – video to audio ratio in dB. If a channel is digital, the dashes **---** are shown in the value field. For PLPs of the DVB-T2 channel you will see the measured PLP number (e.g. **plp010**);
f) **CN** – channel to noise ratio in dB. If a channel is digital or this parameter is not measured for analog channels, the dashes **---** are shown in the value field. For PLPs of the DVB-T2 channel you will see the measured PLP number (e.g. **plp010**);

g) **MER** – MER value of DVB-T and DVB-T2 channels. If this parameter is not measured for digital or analog channels, you will see dashes **---** in the value field. If synchronization with a digital channel failed, the icon will be shown.

h) **pre** – BER value before Viterbi decoder for DVB-T channels, or BER value before LDPC decoder for PLPs of DVB-T2 channels. If a channel is digital or this parameter is not measured for analog channels, the dashes **---** are shown in the value field. If synchronization with a digital channel failed, the icon will be shown. This parameter measurement can be turned off in the page limit plan settings (see Section 4.6.3.4);

i) **post** – BER value after Viterbi decoder for DVB-T channels, or BER value after LDPC decoder for PLPs of DVB-T2 channels. If a channel is digital or this parameter is not measured for analog channels, the dashes **---** are shown in the value field. If synchronization with a digital channel failed, the icon will be shown. This parameter measurement can be turned off in the page limit plan settings (see Section 4.6.3.4).

For DVB-T2 channels with only one PLP all measurement results are shown in one table row. The PLP number is not shown in this case.

In case a channel contains one or several errors after the limit test (see Section 4.6.3.4), its name in the table is highlighted in inverse color. The parameter which failed the limit test is also highlighted in inverse color.

You can scroll through the table rows using the ▲ and ▼ keys. The selected row will be framed (position 3 in Figure 4.6.11). You can use the scroll bar (position 5 in Figure 4.6.11) to change the visible part of the table.

To start a CDL page measurement, press the **F1** key. You will see the settings menu of external powering mode on the screen (see Section 4.5.9). Select the required mode of external powering in this menu. After that the Analyzer will perform measurements according to the selected channel plan. This process will be indicated by the **Scanning channels** message and a progress bar on the screen. When the Analyzer measures DVB-T and DVB-T2 channels, you will see the **Scanning DVB ch.** message on the screen and a progress bar. Once the Analyzer finishes the measurement, it will check the results against the limit plan (see Section 4.6.3.4) and will show the table with CDL page measurement results.

If you press **F2**, you will see the level values of the page channels as a bar-graph in **SCAN** mode (see Section 4.5.3).

Press **F3** to view and edit the limit plan parameters (see Section 4.6.3.4). To return to the CDL pages list, press the key. If you have created a new CDL page, performed measurement of a page or made changes in the limit plan of a previously saved CDL page, the Analyzer will offer saving such page. Once you confirm the saving, the previously saved page under this number will be deleted, and a new CDL page will be saved.

4.6.3.4 Limit Plan Viewing and Editing

You can view and edit the limit plan parameters of any CDL page. To do this, press the **F3** key in the table with CDL page measurement results. See the Figure 4.6.14 for the screen view of the limit plan parameters:

Figure 4.6.14

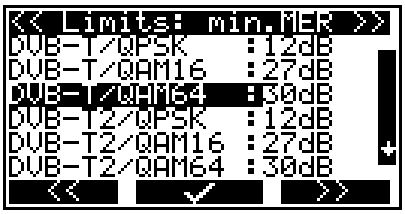

Figure 4.6.15

Figure 4.6.16

The screen displays the following information:

1 – limit plan table header;

2 – selected table row;

3 – line with **F1**, **F2** or **F3** keys for accessing additional modes and settings;

4 – scroll bar.

The screen will show a table with limit plan parameters. Three screen views of the table are available: basic parameters, MER test parameters and BER test parameters. You can switch between these views using the **F1** and **F3** keys.

The table contains the following parameters:

a) **Lev Vid min** – the minimum possible value of video carrier level for analog channels in dBµV, dBmV or dBm. Available values: 45 to 95 dBµV;
b) **Level Vid max** – the maximum possible value of video carrier level analog channels in dBµV, dBmV or dBm. Available values: 45 to 95 dBµV;
c) **Level Dig max** – the maximum possible value of channel power for digital channels in dBµV, dBmV or dBm. Available values: 45 to 95 dBµV;
d) **Level Dig min** – the minimum possible value of channel power for digital channels in dBµV, dBmV or dBm. Available values: 45 to 95 dBµV;
e) **Video/Audio min** – the minimum possible value of V/A ratio for analog channels in dB. Available values: 5 to 20 dB;
f) **Video/Audio max** – the maximum possible value of V/A ratio for analog channels in dB. Available values: 5 to 20 dB;
g) **Video/Noise min** – the minimum possible value of C/N ratio for analog channels in dB. Available values: 15 to 55 dB;
h) **dL adjacent max** – the maximum possible difference between adjacent channel levels of the channel template (see Section 4.7) in dB. Available values: 2 to 10 dB;
i) **Video/Dig max** – the maximum possible difference between analog and digital channel levels within the channel template (see Section 4.7) in dB;
j) **DVB-T/QPSK** – the minimum possible value of MER for DVB-T channels with QPSK subcarriers modulation in dB. Available values: 2 to 35 dB;
k) **DVB-T/QAM16** – the minimum possible value of MER for DVB-T channels with QAM16 subcarriers modulation in dB. Available values: 2 to 35 dB;
l) **DVB-T/QAM64** – the minimum possible value of MER for DVB-T channels with QAM64 subcarriers modulation in dB. Available values: 2 to 35 dB;
m) **DVB-T2/QPSK** – the minimum possible value of MER for DVB-T2 channels with QPSK modulation of PLP stream, in dB. Available values: 4 to 35 dB;
n) **DVB-T2/QAM16** – the minimum possible value of MER for DVB-T2 channels with QAM16 modulation of PLP stream, in dB. Available values: 10 to 35 dB;
o) **DVB-T2/QAM64** – the minimum possible value of MER for DVB-T2 channels with QAM64 modulation of PLP stream, in dB. Available values: 16 to 35 dB;
p) **DVB-T2/QAM256** – the minimum possible value of MER for DVB-T2 channels with QAM256 modulation of PLP, in dB. Available values: 22 to 35 dB;
q) **DVB-T/preVBER** – the maximum possible value of BER before Viterbi decoder for DVB-T channels. Values available: 1E-4, 1E-5, 1E-6;
r) **DVB-T/postVBER** – the maximum possible value of BER after Viterbi decoder for DVB-T channels. Values available: 1E-4, 1E-5, 1E-6, 1E-7, 1E-8;
s) **DVB-T2/preLBER** – the maximum possible value of BER before LDPC decoder for DVB-T2 channels. Values available: 1E-3, 1E-4, 1E-5, 1E-6;
t) **DVB-T2/postLBER** – the maximum possible value of BER after LDPC decoder for DVB-T2 channels. Values available: 1E-4, 1E-5, 1E-6, 1E-7, 1E-8.

You can scroll through the limit plan parameters table using the ▲ and ▼ keys. The selected table row will be highlighted in inverse color (position 2 in Figure 4.6.14). You can use the scroll bar (position 4 in Figure 4.6.14) to change the visible part of the table. To change the value of a selected limit plan parameter, use the ◄ and ► keys. If you set a parameter value below the minimum allowable limit, the CDL page will not be tested against this parameter, and its value in the table will be shown as **off**.

NOTE! If you turn off the limit test of a CDL page against the **preBER** or **postBER** parameters, the corresponding BER will not be measured during CDL page scanning.

Press the **F2** or 🡻 keys to save changes to a limit plan and return to the table with CDL page measurement results. After that the Analyzer will perform the limit test only against the parameter which was selected in the limit plan table. To exit the limit plan parameters table without saving the changes, press the 🡹 key.

4.6.3.5 Channel Data Logger Page Creating

To create a new CDL page, select the required page number in the list of CDL pages and press the **F3** key. Channel plan selection screen will open, and the **Choose a channel plan, chann.plan=** message will appear, as well as number and name of a channel plan for selection. Use the ▲ and ▼ keys to select the channel plan, which will be used for CDL page measurement. Confirm your selection by pressing the 🡻

key. The screen will show a table of CDL page measurement results with zero values (see Figure 4.6.11). Then you can edit and measure this new page as described in Section 4.6.3.3.

4.6.3.6 Channel Data Logger Page Deleting

To delete a CDL page, select the required one in the list of CDL pages and press the **F2** key. The confirmation request screen will appear. To abort deleting, press **F2**. To confirm deleting of the selected page, press **F1**. To delete all CDL pages, press the **F3** key.

4.7 Analyzer Configuration Mode

The  icon in the Analyzer Service menu corresponds to the Analyzer configuration mode. This mode allows you to see the Analyzer settings and edit them. See the screen view in Figure 4.7.1:

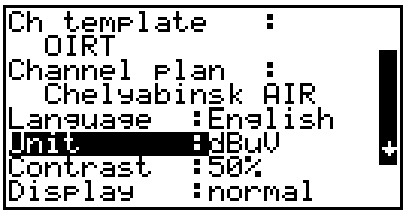

Figure 4.7.1

The table contains the following parameters which are available for editing:

a) **Ch template –** the selected channel template. Available values: **OIRT**, **CCIR**, and **user** template (with the icon). You can configure the user channel template via PC (see Section 4.11);
b) **Channel plan** – the selected channel plan. Available values: **ch template**, names of preset channel plans (see Section 4.6.2). If you select the **ch template** value, the measurements will be performed without a channel plan;
c) **Language** – user interface language. Available values: **English**, **Русский**;
d) **Level** – level measurement units. Available values: **dBµV**, **dBmV** or **dBm**;
e) **Contrast** – screen contrast. Available values: **0** to **100%** with 10% step;
f) **Display** – display view. Available values: **normal** - white characters against blue background, **reverse** – blue characters against white background;
g) **Sound** – key sound. Available values: **off**, **type 1**, **type 2**, **type 3**;
h) **Power off** – mode of the Analyzer automatic switching off (when Analyzer is powered by the battery). Available values: **off** – the Analyzer does not switch off, **5 min**, **15 min** – the Analyzer automatically switches off if its buttons are not pressed for 5/15 minutes;
i) **Beeping** – audio indication of signal level. Available values: **on**, **off**. Beeping is used in LEVEL mode to control the channel level by means of internal speaker.

You can select a parameter to be edited using the ▲ and ▼ keys. You can change the parameter value using the◄ and ► keys.

Press the key to return to the Analyzer Service menu.

4.8 Self-Test Mode

The  icon in the Analyzer Service menu corresponds to self-test mode. This mode is intended for checking the performance of the IT-15T2 components and its functional condition. You can see the screen view in Figure 4.8.1:

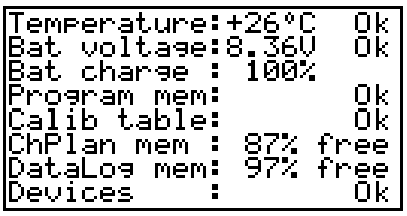

Figure 4.8.1

The table displays the following parameters to be checked:

a) **Temperature.** Temperature inside the Analyzer. Temperature is the main environmental factor, which influences the accuracy of measurements. If the temperature value is within the allowed

range (– 10 to 50 ºC), then **Ok** status will be displayed in the value filed. If the temperature is out of this allowed range, then status will not be displayed. If the **---** value is displayed, it means that the temperature measuring device is defective, and the Analyzer has to be sent to repair service;

b) **Bat voltage.** Voltage of the battery;

c) **Bat charge.** The remaining capacity of the battery. This parameter and the **Bat voltage** are intended for checking the battery condition. Check the battery condition when operating in off-line mode (power supply switched off). If the measured battery voltage is greater than 6.8 V, then **Ok** status is indicated. If the voltage is lower than 6.8 V, then **low** status is indicated. The voltage will then be recalculated into the remaining battery capacity value in percents, which will help you to estimate the remaining Analyzer operating time. Not that the battery capacity decreases as the ambient temperature lowers. This should be taken into account when estimating the remaining Analyzer operating time;

d) **Program mem.** Condition of the Analyzer firmware. If the test does not detect any error, the **Ok** status is displayed. If an error has been detected, the **error** status is displayed, in this case the firmware shall be reinstalled (see Section 4.12);

e) **Calib table.** Status of the Analyzer calibration tables. If the test does not detect any error, the **Ok** status is displayed. If an error has been detected, the **error** status is displayed, in this case the Analyzer has to be sent to repair service;

f) **ChPlan mem.** Determining the channel plan memory resources (memory available for storing the channel plans), in percents;

g) **DataLog mem.** Determining the CDL memory resources (memory available for storing the CDL pages), in percents;

h) **Devices.** Condition of the internal devices. The program checks the condition of the Analyzer components. If the test does not detect any error, the **ok** status is displayed. If an error has been detected, the **error** status is displayed, in this case the Analyzer shall be sent to repair service.

Press the ↑ key to return to the Analyzer Service menu.

4.9 Identification Data Readout

The  icon in the Analyzer Service menu corresponds to this mode. This mode is intended for determining the Analyzer identification data: its type, serial number, modification, firmware version, and the set channel template. The screen view is shown in Figure 4.9.1:

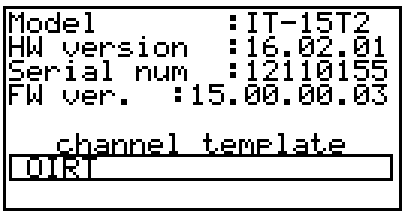

Figure 4.9.1

The upper part of the screen displays the identification information about the Analyzer:
Model: the Analyzer model (IT-15T2);
HW version: number of the hardware version;
Serial num: the Analyzer serial number;
FW ver.: installed firmware version number.

The lower part of the screen displays the name of the channel template which was selected in the Analyzer Configuration mode (see Section 4.7).

Press the ↑ key to return to the Analyzer Service menu.

4.10 Battery Operation

The IT-15T2 is powered by built-in power source with original Li-Ion battery with 7.4 V nominal voltage and 1500 mAh capacity.

To determine the residual capacity of the battery, use the Self-Test mode (see Section 4.8). When the battery voltage drops below 7.0 V, you will hear a warning beep. This means that the time of operation until total battery discharge is a few minutes and you should charge the battery.

You can charge the battery inside the Analyzer by connecting it to an external power source or car cigarette lighter socket via an appropriate adapter. We recommend charging the battery in the Main menu

mode (see Section 4.3) in which the Analyzer will charge the battery most quickly. See the screen view of this charging mode in Figure 4.10.1:

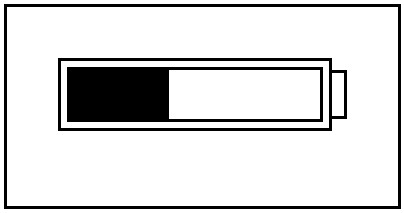

Figure 4.10.1

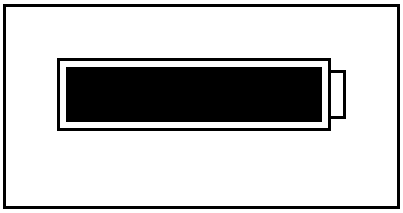

Figure 4.10.2

The charging process is shown on the screen and takes about 4 hours in case the battery was fully run-down. Once the charging is over, the indicator will stop at the maximum level (see Figure 4.10.2), and the Analyzer can then be used in stand-alone mode.

If you charge the Analyzer in one of the measurement modes, the charging is performed with low charging current and can take about 8 hours.

We recommend storing the Analyzer with fully charged battery and for this purpose you should charge the battery using an external power source once every 3 months in order to increase its service life.

NOTE! The battery replacement is associated with partial disassembly of the Analyzer and shall be performed only by service personenl in case of failures or its lifetime expiry.

4.11 Operation with PC

4.11.1 General Information

You can control the operation of your IT-15T2 via PC. For connection to PC, use the **USB** connector on the front panel of your Analyzer. The **ItToolsT2** software is available at our website http://www.planar.chel.ru. The software allows you to:

a) measure the parameters of analog and digital (DVB-T and DVB-T2) channels in the similar way they are measured by the Analyzer;
b) measure the spectrum within an arbitrary frequency range (from 45 to 900 MHz);
c) create and view the channel data logger pages;
d) create and edit the channel plans;
e) edit the channel template of the Analyzer;
f) save and printout the measurement reports;
g) update the firmware of the Analyzer.

4.11.2 Software Installation

You can get all the information about software installation procedure as well as the minimum PC configuration requirements for operating with **ItToolsT2** from the **readme_eng.txt** text file which is distributed together with the installation file.

4.11.3 USB Port Driver Installation

In 32-bit versions of operating systems the USB port driver is installed automatically by installation wizard after the **ItToolsT2** software installation (see Section 4.11.2).

To install the USB port driver in 64-bit versions of operating systems, follow the procedure below:

a) install the **ItToolsT2** software (see Section 4.11.2);
b) switch the Analyzer on and connect it to your PC via USB port;
c) once the system detects a new equipment, you will see the driver installation dialog. Select the manual driver installation and set the **Drivers** folder as a path to the driver. This folder is located in the destination folder you have selected for the **ItToolsT2** software;
d) wait until the installation process is finished.

4.11.4 Starting the Software

Connect your Analyzer to a PC using the USB cable. Switch the power of the Analyzer on and select the Operation with PC mode in the Main menu. The icon corresponds to this mode. You will see the **Waiting for command** message on the Analyzer screen. Start the **ItToolsT2** software and select the

Analyzer with the corresponding serial number in the program window. You can get all the required information on how to work with the **ItToolsT2** software from the program Help, which you can access by pressing the **F1** key.

4.12 Firmware Updating

The IT-15T2 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 http://www.planar.chel.ru in the section that describes the IT-15T2. Each version of the firmware has its unique identification number, e.g. 15.00.00.03. You can see the firmware version in identification data readout mode (see section 4.9).

To update your firmware, proceed as follows:

- connect your IT-15T2 to a free USB port by means of a regular cable;
- install the USB port driver, if required (see Section 4.11.3);
- turn the Analyzer on;
- if you see the **Bootloader** and **Waiting for command** messages on the screen, your Analyzer firmware is damaged and you should skip the next step;
- select the Operation with PC mode in the Analyzer Main menu (see Section 4.11.4);
- start the **ItToolsT2** software and select the firmware updating mode on the program toolbar (see Figure 4.12.1).

Figure 4.12.1

- select the Analyzer with the corresponding serial number from the list (position 1 in Figure 4.12.2) and in the next field (position 2 in Figure 4.12.2) select a file with new version of IT-15T2 firmware;
- click the **Start** button (position 3 in Figure 4.12.2) to start the firmware updating. Confirm the updating in the confirmation dialog.

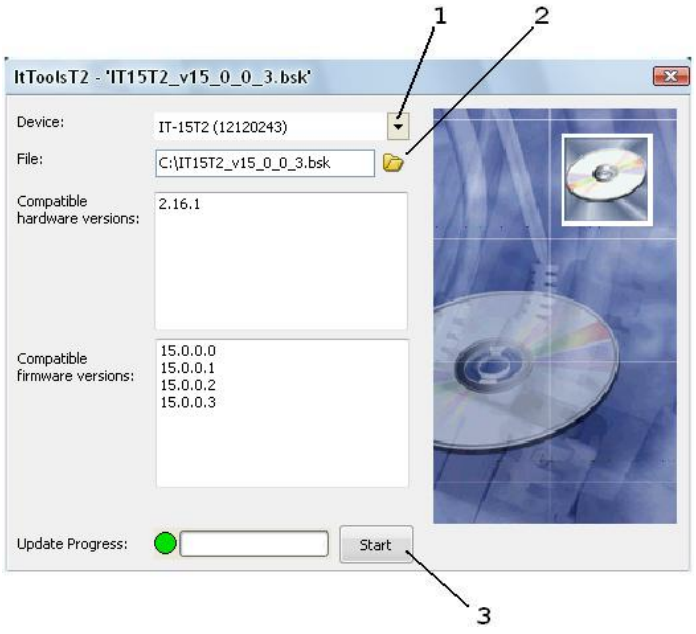

Figure 4.12.2

If your Analyzer functions properly, USB port cable is connected correctly, and the firmware to be downloaded is compatible with the IT-15T2, the process of program download onto your Analyzer will start automatically. Once the download is over, the pop-up window on PC will announce that the operation has been successfully completed. The Analyzer will reboot and start operating.

NOTE! During firmware updating the Analyzer must be powered from an external power source.

Do not interrupt the firmware uploading process. But if this does occur, repeat the firmware updating process.

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: The IT-15T2 fails to turn on in stand-alone mode.

Possible reason: Extremely low charge or malfunction of the battery.
Methods of correction: To check the Analyzer condition, connect it to the Mains Adapter. If the Analyzer switches on, check the battery voltage in Self-Test mode (see Section 4.8). Low voltage (under 6.8 V) is an evidence that the battery is discharged or malfunctioning. High voltage level (over 8.5 V) may also indicate the battery malfunction. Charge the battery in case it is low (see Section 4.10) or contact the repair service to replace the malfunctioning battery.

Defect detection: The IT-15T2 is switched on in stand-alone mode but instead of displaying the Main menu it displays the **Bootloader** and **Waiting for command** messages.

Possible reason: Firmware failure.
Methods of correction: Reinstall the firmware from your computer (see Section 4.12).

Defect detection: The Analyzer does not respond to key pressing.

Possible reason: “Freezing” of the Analyzer firmware.
Methods of correction: Push and hold the ⏻ key for several seconds. The Analyzer will turn off. Then turn the IT-15T2 on again.

Defect detection: High error at signal level measurements for some or all channels.

Possible reason: Incorrect selection of the channel template.
Method of correction: Check the selected channel template (see Section 4.7).

Possible reason: Incorrect selection of the channel plan.
Method of correction: Check the selected channel plan (see Section 4.7).

Possible reason: Incorrect channel plan settings.
Method of correction: Check the selected settings of the channel plan (see Section 4.6.2).

Possible reason: Increased wear of the input RF adapter.
Method of correction: Replace the input RF adapter by a proper one.

7 STORAGE

Store your IT-15T2 Signal 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-15T2 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 (see Section 4.9).

10 WARRANTY INFORMATION

The manufacturer warrants the IT-15T2 DVB-T/T2 Signal 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-15T2 DVB-T/T2 Signal 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:

a) the defect or damage is caused by improper storage, misuse, neglect, inadequate maintenance, or accident;
b) the product is tampered with, modified or repaired by an unauthorized party;
c) the product's seals are tampered with;
d) 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.