

Bercut-MMT
E1 Interface Analysis

Operation Manual
1.2.7, 2009

Metrotek

© Metrotek, 2006–2010

No part of this document may be reproduced in any form or by any means without the express written permission of Metrotek. Metrotek retains the right to make changes to the hardware, software of **Bercut-MMT**, and to this document at any time, without notice.

Contents

1	Introduction	7
1.1	General	7
1.2	Documentation Set	8
1.3	Modifications Notice	8
2	General information	9
2.1	E1 Interface Analysis Card Features	9
2.2	B4-E1-4: E1 interface analysis card	10
3	Technical Specifications	11
4	Starting Up	13
4.1	LED Status	13
4.2	Operation Mode Selection	14
4.3	Connection Diagram	15
4.3.1	Terminal	15
4.3.2	Transit	15
4.3.3	Monitor	16
4.3.4	Monitor-Transit	16
4.4	Flows synchronization scheme	17
5	PCM Parameters Configuration	19
5.1	Line Interface	19
5.1.1	Physical Configuration	20
5.1.2	G.704 Configuration	20
5.1.3	G.703 Configuration	21
5.1.4	G.711 Configuration	21
5.1.5	Elastic Buffer	21
5.2	Time Slots	21
5.2.1	Voice Functions	22
5.3	Test Pattern	24
5.3.1	Type	24
5.3.2	Invert TX	25
5.3.3	Invert RX	25

6	Signal and Event Generation	27
6.1	Jitter Generation	27
6.2	Changing of Transmitted signal Frequency	28
6.3	Alarms Generation	28
6.3.1	Alarms Type	29
6.3.2	Time	29
6.3.3	Alarm Generation Start/Stop	30
6.4	Errors Generation	30
6.4.1	Errors Type	30
6.4.2	Speed	30
6.4.3	Count	30
6.4.4	Errors Insertion Start/Stop	30
7	Measurements	31
7.1	Pulse Shape	31
7.1.1	Pulse Shape Monitoring	32
7.1.2	Oscilloscope	33
7.2	Jitter	33
7.3	MTJ - Maximum Tolerable Jitter	34
7.4	JTF - Jitter Transfer Function	35
7.5	G.821/G.826/M.2100	36
7.5.1	Base Parameters	37
7.5.2	G.821	42
7.5.3	G.826/M.2100	43
7.6	Propagation Delay	45
7.7	SLA	46
7.8	Measurement Duration	49
8	Measurement Results	51
8.1	Events Chart	52
8.2	Alarm Chronograms	52
8.3	Data Review	53
8.3.1	TS review	54
8.3.2	Sa/Si Bits Review	54
8.3.3	MFAS-CAS Bits Review	55
8.3.4	Frame review	56
9	Calibration	59
9.1	Calibration procedures and tools	59
9.2	Calibration Conditions	60
9.3	Calibration Preparation	60
9.4	Calibration Procedure	61

9.4.1	External examination	61
9.4.2	Testing	61
9.4.3	Metrological characteristics evaluation	61
9.5	Calibration Results recording	65
A	Troubleshooting	67
B	Main Technical Specifications	69
C	Measurement Cables: Pins Designation	71
D	Technical support	73
D.1	Contact Information	73

1. Introduction

1.1 General

Bercut-MMT Analyzer is a measurement device designed on the basis of a modular platform. It supports measurements in different segments of modern multi-technology telecommunication networks.

The analyzer's modular design provides its user with virtually unlimited testing and measuring capabilities for both traditional interface parameters and for working out long term diagnostics solutions for the communication network.

Figure 1.1 presents an external view of the device.



Figure 1.1. External view

The **Bercut-MMT** device consists of the system unit and two pluggable modules (cards¹), that provide an interface to such testing objects as PCM E1 streams, data transmission interfaces (Datacom) or Gigabit Ethernet.

The System Unit provides for the basic device functionality, i.e.: control of **Bercut-MMT** platform components, an interface to peripheral devices, power supply monitoring, a user interface and specialized computation, states and measurement modes indication.

¹ Terms *Pluggable Cards* and *Pluggable Modules* are convertible terms in the present manual and will be used interchangeably with equal meaning.

The **Bercut-MMT** System Unit consists of the following main components:

- Processor Module with a preinstalled operation system and nonvolatile data storage devices;
- LCD display with a sensor panel;
- number of multipurpose indication LEDs;
- keyboard;
- batteries;
- connectors for peripheral devices (serial port, USB interfaces, 10/100BaseT LAN interfaces, SD/MMC card connectors and connectors for headphones and an external power supply);
- connectors for specialized pluggable cards (modules) installation.

Cards usually contain a powerful processor that performs computations typical for a certain measurements mode. Computation results are transferred to the platform central processor that displays them to a user.

Various pluggable cards have different sets of hardware interfaces and programmable options. Each card has a unique serial number and provides information about a manufacturer, types of interfaces, allowed measurement options, etc.

1.2 Documentation Set

Depending on the ordered options, the following operations guides are delivered with the device:

- **Bercut-MMT**. Telecommunication Networks Analyzer Universal Platform.
- **Bercut-MMT**. E1 Interfaces Analysis.
- **Bercut-MMT**. Signalling Protocol Analysis.
- **Bercut-MMT**. Data transmission Interfaces Testing.
- **Bercut-MMT**. Ethernet 10/100 and Gigabit Ethernet Analysis.
- **Bercut-MMT**. OPIE Graphical Environment.

1.3 Modifications Notice

The manufacturer reserves the right to make any modifications that do not affect operability of the analyzer **Bercut-MMT** to the device hardware and software and to operation manuals without further notice and at its sole discretion.

2. General information

2.1 E1 Interface Analysis Card Features

The **E1 Interface Analysis Card** together with **Bercut-MMT** analyzer provides for capability of prompt and easy fault localization and clearing in PCM streams, and offers to a specialist a wide range of additional diagnostics functions for modern communication systems.

- Support of 4 E1 ports.
- E1 system faults diagnostics at physical, channel and network level.
- Data transmission channels measurements and parameters analysis according to ITU-T G.821 and G.826/M.2100 recommendations (with **B4-E1-4** option).
- Test sequences generation.
- Errors and alarms generation and insertion.
- Jitter measurements.
- MTJ/JTF analyzer.
- Audio frequency band signals generation and analysis.
- Capability to generate and analyze both structured and non-structured streams.
- Embedded oscilloscope.
- Events and faults presentation in the form of histograms and chronograms.

Options delivered with the **Bercut-MMT** device in the *2048 kbit/s PCM Streams Measurement and Analysis* mode:

B4-FORM: signal pulses shape analysis using G.703 pattern and automatic compatibility check.

B4-JT-1: E1 stream jitter measurement, output jitter measurement (G.823);

B4-MTJ1: jitter generator, maximum allowed jitter measurement, jitter transfer characteristics measurement in the E1 stream (including **B4-JT-1** jitter measurement option);

B4-SLA: SLA analyzer (Directive 92 of the Ministry of Communications and Informatization of the Russian Federation);

Options delivered with the **Bercut-MMT** device in the *Signalling Data Flow Monitoring and Analysis* mode:

Bercut-MMT: Operation manual

B4-SIG1: signalling protocols analyzer, including Russian national signalling protocols CCS7, ISDN, V5: MTP (Russian specifications, ITU-T Q.700-Q.709, White Book), ISUP (Russian specifications, 2001, ITU-T Q.761-Q.764, Blue Book, 1988, White Book, 1993, 1997, ITU-T Q.767, 1991, MoU: ETSI ETS 300 121, 1991), SCCP (Russian specifications 1994, 2001, ITU-T: Q.711-Q.716, White Book, 1996), TCAP (Russian specifications 1994, 2001, ITU-T: Q.711-Q.774, White Book, 1997), ISDN PRI (ETSI: ETS 300 011, ETS 300 125, ETS 300 102, ITU-T I.431, Q.921, Q.931), V.5 (ETSI: ETS 300 324, ETS 300 347);

B4-R: 2VSK (R1.5, Russian R2) signalling protocols analyzer.

2.2 B4-E1-4: E1 interface analysis card

The interface analysis card is able to operate in two modes (toggling between modes is described in *Bercut-MMT operations manual. Telecommunication Systems Universal Analyzer Platform*). Card has a number of labels:

- lower label (**Rx/Tx** and **Sync**) — corresponds to the *2048 kbit/s PCM Streams Measurement and Analysis* mode;
- upper label (**R0/T0/R1** and **R2/T1/R3**) corresponds to the *Signalling data flow monitoring and analysis* mode.

The **E1 card** layout is shown at Figure 2.1.



Figure 2.1. B4-E1-4 Card

3. Technical Specifications

Transmitter technical specifications are presented in Table 3.1:

Table 3.1: Transmitter Specifications

No	Parameter	Meaning
1	Interfaces	Tx: E1 2048 kbit/s (symmetric, 120 Ohms, RJ-45 connectors)
2	Coding	AMI, HDB-3; pulse shape according to ITU-T G.703
3	Transmitter frequency	2048 Kbit/s +/-3 ppm, adjustment +/- 6 kHz
4	Synchronization	Internal, external from Sync or Rx
5	Frame structure	<ol style="list-style-type: none"> 1. unstructured 2. PCM-31: G.704 c CRC-4, inverted CRC-4 or without CRC-4 3. PCM-31: G.704 c CAS, with CRC-4, inverted CRC-4 or without CRC-4
6	Test pattern	<ol style="list-style-type: none"> 1. All 0s, all 1s, 55, user defined 2. Pseudorandom sequence 2^{n-1}, n=6,9,11,15,23 3. Transmission, reception of inverted test sequence 4. Testing rate: N*64 Kbit/s, N=1...32
7	Errors insertion	<ol style="list-style-type: none"> 1. Faults generation: continuous, fixed duration 2. Errors insertion: once-only, continuous with configured rate 3. Errors rate: 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7} 4. Faults insertion: LOS, AIS, LOF, LOM, RDI, RMA, ARTF, LSS, ALL0, ALL1 5. Errors insertion: code, bit, E-bit, errors in FAS and MFAS, CRC errors, REBE, Slip+, Slip-
8	Jitter Generation	<ol style="list-style-type: none"> 1. Range: 0,1...10Uipp, frequency: 20...100 Hz 2. Inaccuracy: 0,1 +/- 5

Receiver technical specifications are presented in Table 3.2:

Table 3.2: Receiver Specifications

No	Parameter	Meaning
1	Interfaces	<ol style="list-style-type: none"> Rx: E1 2048 kbit/s (symmetric, 120 Ohms/High impedance / protective resistors, RJ-45 connector) Sync: E1 2048 kbit/s (symmetric, 120 Ohms/High impedance / protective resistors, RJ-45 connector)
2	Coding	<ol style="list-style-type: none"> AMI, HDB-3; pulse shape according to ITU-T G.703
3	Transmission rate	2048 kbit/s (two Rx ports, Sync)
4	Input sensitivity	Short line mode: up to 10 dB Long line mode: up to 18 dB (active attenuator), up to 36 dB (real line or line equivalent)
5	Frame structure	<ol style="list-style-type: none"> unstructured PCM-31: G.704 c CRC-4, inverted CRC-4 or without CRC-4 PCM-31: G.704 c CAS, with CRC-4, inverted CRC-4 or without CRC-4
6	Path parameters monitoring	<ol style="list-style-type: none"> Alarms: LED indication, errored seconds, errored seconds ratio, chronograms Errors: code, bit, frame, CAS, CRC-4, E-bit, Slip+, Slip-. Quantity of errors, errors coefficient, histograms G.821, G.826/M.2100 results Clock measurements of the received signal Signal propagation delay measurement
7	Oscilloscope	<ol style="list-style-type: none"> Rx port signal review. frequency range from 0,01 to 10 MHz Controlled gain of 0dB, 6dB, 12dB
8	Jitter measurements	<ol style="list-style-type: none"> Range: 0,1...10Uipp, frequency: 20...100 Hz Inaccuracy: 0,1 5
9	Pulse shape	Signal measurement at Rx port. Frequency range from 0,01 to 10 MHz G.703 mask

4. Starting Up

4.1 LED Status

The E1 interface analysis card provides indication for visual monitoring of measurement conditions and data reception. Three-colour indicators provide enough information to examine the situation and make decision.



Figure 4.1. Indicators

LOS — loss of signal:

- Green — signal is permanently present since the moment of reset;
- Red — currently signal is not present;
- Yellow — since the moment of reset signal has been lost for some time.

AIS — alarm indication signal (all 1s received):

- Green — since the moment of reset there was no AIS signal;
- Red — currently AIS signal is present;
- Yellow — since the moment of reset AIS signal has been present for some time.

LOF — loss of frame alignment:

- Green — since the moment of reset frame alignment has been detected and has not been lost;
- Red — currently there is no alignment;
- Yellow — since the moment of reset frame alignment has been lost for some time.

LOM — loss of multiframe alignment:

- Green — since the moment of reset multiframe alignment has been detected and has not been lost;

- Red — currently there is no alignment;
- Yellow — since the moment of reset multiframe alignment has been lost for some time.

RDI — remote defect indication, is transmitted with A bits in NFAS:

- Green — no;
- Red — fault is detected (A=1 in NFAS);
- Yellow — since the moment of reset A=1 in NFAS has been present for some time.

SER — symbol error rate indication. Threshold is detected when bit error rate is exceeded (BER is more than 10^{-3}) in case of bit testing, or when more than 30% CRC blocks have errors in case CRC synchronization is in effect:

- Green — no;
- Red — currently error rate threshold is exceeded;
- Yellow — currently error rate threshold is not exceeded, but since the moment of reset at least one second with exceeded error threshold has been detected.

RMA — remote multiframe alarm indication (Y-bit in MFAS is 1 for two consecutive multiframes):

- Green — no;
- Red — currently there is an alarm;
- Yellow — currently alarm is not present, but since the moment of reset it has been detected.

LSS — loss of test sequence synchronization:

- Green — since the moment of reset synchronization has been detected and has not been lost;
- Red — currently there is no synchronization;
- Yellow — since the moment of reset synchronization has been lost for some time.

AIS, LOF, LOM, RDI, RMA, SER, LSS indicators are off in case corresponding event cannot or should not be analyzed.

4.2 Operation Mode Selection

The mode of operation of data transmission interface analysis card can be configured with the help of **Firmware Update utility** application: **O-Menu** ⇒ **Settings** ⇒ **Firmware Update utility** (For details refer to operation mode setup for pluggable modules in the Operation manual *Bercut-MMT. Telecommunication Systems Universal Analyzer Platform*).

4.3 Connection Diagram

E1 Card can operate in 4 modes:

- Monitor
- Terminal
- Transit
- Monitor-Transit

These modes are schematically represented at Figure 4.2.

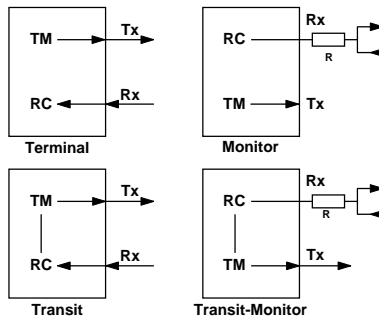


Figure 4.2. Tester Modes of Operation

For testing, one of the line interface modes has to be defined. Supported modes are described in details below.

4.3.1 Terminal

The *Terminal* mode is used for non-working line paths testing.

In this mode, the card is connected to the line path instead of a terminal and is used for E1 signal transmission and reception. Device termination load is 120 Ohms.

4.3.2 Transit

The *Transit* mode is used to receive signals and to transfer it through the device. Is used for testing of non-working line paths and loaded line paths.

Incoming signal (Rx) is received at termination load of 120 Ohms, is then regenerated and sent over Tx connector. On signal passing through the device, code errors, frame errors and other parameters are analyzed.

This mode is similar to the *Terminal* mode, but uses incoming flow to generate outgoing flow. In this mode, if error insertion is not activated, information TS are transmitted unaltered. Signalling and synchronization TS are generated by the module.

This mode can be used to analyze errors in the information TS at the far end.

4.3.3 Monitor

The *Monitor* is used when monitoring access is required. This mode allows to analyze E1 stream without affecting it. The Rx connector of a device is connected to *Monitor* connector of equipment under testing, which implies connection through high impedance resistors. Embedded in the device 470 Ohms protection resistors may be optionally inserted.

The *Monitor* mode allows a technician to monitor a path for troubleshooting purposes without interrupting communication. Note that in this mode there is not necessary to use Tx connector of the card and is also not necessary to configure test sequence for transmission. However, the transmitter of a device transmits selected test sequences, frames, coding and CRC.

4.3.4 Monitor-Transit

The *Monitor-Transit* mode is used to transfer signal through the device. Incoming signal is regenerated and sent over Tx connector. Incoming signal should come through the *Monitor* connector of equipment under testing. Note that code and frame errors are corrected in this mode. This mode can be used to add TS to the working flow or to drop them from it.

4.4 Flows synchronization scheme

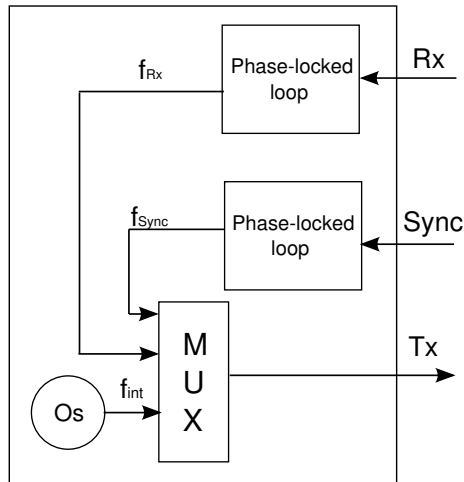


Figure 4.3. Flows synchronization Scheme

The **E1 Card** can be synchronized from three signal sources ($f_{int} \pm 1Hz$):

- Rx;
- Sync;
- Oscillator.

5. PCM Parameters Configuration

In order to access the **PCM Configuration** program, navigate to the **PCM analysis 2 Mbit/s** tab and then press the program icon.

The **PCM Configuration** menu item allows to configure:

- Line interface;
- Time slot;
- Test pattern;
- Errors and Alarms.

5.1 Line Interface

To access the **Line Interface** application use a stylus to press in the **PCM Configuration** field. Display layout is shown at Figure 5.1 (actual window layout may differ from shown at the picture as it depends on the previous parameters values that are stored automatically).

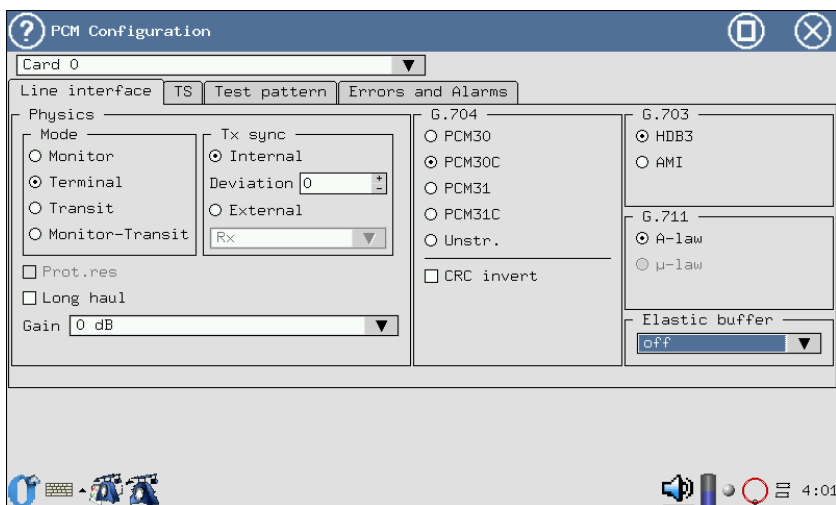


Figure 5.1. **Line Interface** Menu

This tab is used for:

- Physical configuration;
- G.704 configuration;
- G.703 configuration;
- G.711 configuration.

5.1.1 Physical Configuration

Physics field includes:

- **Mode** — this parameter is used to set the device operating mode (refer to the 4.3 chapter, p. 15); mode changing is made with a stylus.
- **Tx Synch** — **E1 Card** can work with three sources:
 - Rx: from the received signal at Rx sockets;
 - Internal: from the device internal oscillator;
 - Sync: from the signal at Sync socket.

Deviation allows to switch on or off transmitter timing frequency deviations in case **Internal** synchronization is selected. Deviation value is set by a stylus.

- **Long haul** — to compensate for attenuation and frequency response function on signal reception from the cable line with significant loss, the *Long haul* mode is used.

When the *Long haul* mode is on, the device is configured to receive signals from minus 15 dB to minus 36 dB.

When the *Long haul* mode is off, the device is configured to receive signal with minimal level of minus 18 dB.

Toggleing between Long Line mode On and Off is performed with a stylus.

- **Prot. Res** — device may optionally include protection resistors (refer to par. 4.3.3, p. 16).
- **Gain** — this parameter sets signal gain value in dB, in case when the **Long haul** flag is not set.

5.1.2 G.704 Configuration

The **G.704** menu allows to select one of the following frames:

- PCM30 — this mode is selected when the system is working with multiframe alignment in 16th TS (CAS);
- PCM31 — this mode is selected when the system is working without multiframe alignment in 16th TS;

- PCM30C is PCM30 + capability to measure CRC-4 errors in the received signal and to transmit CRC-4 bits in the outgoing signal;
- PCM31C is PCM31 + capability to measure CRC-4 errors in the received signal and to transmit CRC-4 bits in the outgoing signal;
- Unstr. — is selected when the system is working without frame synchronization and multiframe alignment;
- CRC invert — this flag is set when it is necessary to invert all CRC bits.

Use stylus to select a frame.

Specific frame structure should be chosen if:

- path under testing uses known framing type;
- this device will be used together with another device that already works in the auto determination mode;
- device will control frame structure type of the E1 stream.

5.1.3 G.703 Configuration

Coding type may be AMI or HDB3 (is selected with a stylus). If in doubt, select HDB3, because AMI code is hardly used today.

5.1.4 G.711 Configuration

These settings define companding law for audio data (A-law or μ -law).

5.1.5 Elastic Buffer

This parameter sets the size of elastic buffer, that is used to measure misalignment between Rx and Sync ports that results in clock slips: CLSLIP+ and CLSLIP—.

Writing to elastic buffer is performed with the frequency of a signal incoming to the Rx port, while reading is performed with the frequency received at the Sync port. CLSLIP— flow negative slip is detected because of the buffer overflow. CLSLIP+ — flow positive slip is detected because of the buffer underrun.

If the parameter is set to **Off** value, CLSLIP+ and CLSLIP— measurement is not performed.

Slips are just detected in the device, they do not cause loss or insertion of bits in the sequence received at Rx input.

5.2 Time Slots

To enter the program, press with a stylus at the **TS** tab. Display layout is shown at Figure 5.2. Screen layout may differ from one shown at the picture.

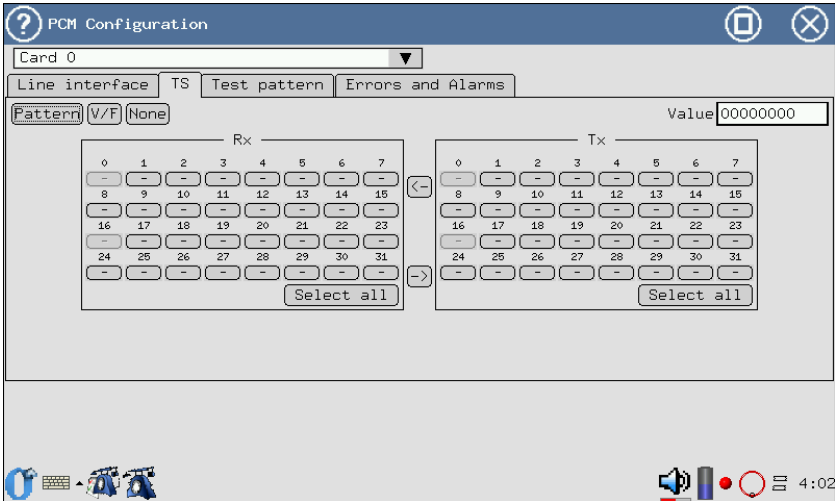


Figure 5.2. TS Menu

The **TS** tab allows to select Time Slots for transmission and reception (Tx and Rx respectively) of:

- **V/F** — voice frequency;
- **Pattern** — test pattern.

In the **Rx** field a TS is defined from which information will be received. Use stylus to select a TS. Voice frequency can set in one Ts only, test sequence can be defined for all time slots, excluding zero.

In the **Tx** field TS-s are defined into which signal will be transmitted from the selected source. **V/F** and **Pattern** can be assigned to all time slots (V/F source is defined in the **Voice Functions**).

Besides, the **Val.** can be set, that will setup all not used TS (-).

For a stream without frame synchronization (a case when in **G.704 Configuration** the **Unstr.** frame is selected), all 32 TS are chosen for test sequence transmission and reception.

To increase usability, **Select All:** (←) and (→) buttons were created.

- The **Select All** button allows to choose all available TS;
- The (←) and (→) buttons allow to copy selected TS from **Rx** to **Tx** and vice-versa.

5.2.1 Voice Functions

To enter the **Voice Functions** application press appropriate icon at the desktop. The screen layout is shown at Figure 5.3.

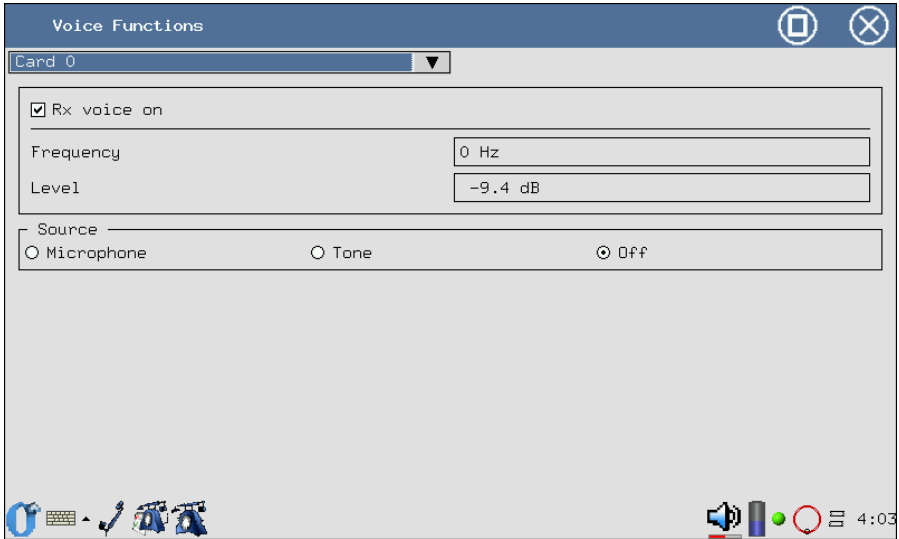


Figure 5.3. The window layout **Voice Functions**

This program provides for:

- signal transmission from external microphone to the selected TS;
- harmonic 1 KHz signal transmission to the selected TS;
- signal frequency and level measurement in the selected TS;
- listening to the voice channel with headphones.

Prior to using voice functions, it is necessary to select an interface in the upper left corner of the application.

- **Rx Voice On** is a flag for voice path audio monitoring. In order to do this, in the **PCM Configuration** \Rightarrow **TS**, the **V/F** should be set in the **Rx** field.
- **Frequency** is the signal frequency in Hz
- **Level** is the signal level in dB.
- **Source** is used to select a source of information that is transmitted to the chosen time slot:
 - **Microphone** — signal from microphone;
 - **Tone** — 1000 Hz harmonic signal;
 - **Off** — V/F functions are off.

5.3 Test Pattern

To access this section, navigate to the **Test pattern** tab of **PCM Configuration** application. Screen layout is shown at Figure 5.4 (actual screen layout may differ from one shown at the picture).

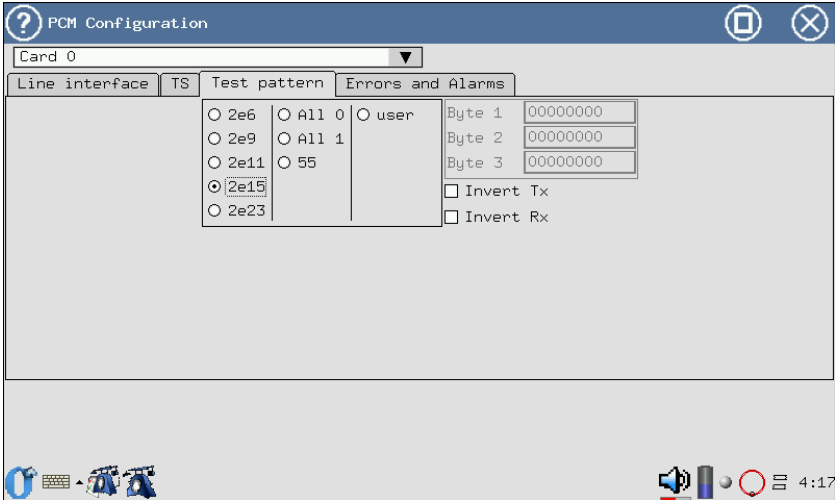


Figure 5.4. **Test Pattern** Menu

Test pattern parameters are activated at the moment of modification and are set for the object under testing that is selected in the **Line Interface** menu.

5.3.1 Type

The **Type** field allows to select the test sequence type from the following list:

- All 1 — all "ones";
- All 0 — all "zeroes";
- 55 — 55;
- 2e6 — $2^6 - 1$ pseudorandom sequence generation;
- 2e9 — $2^9 - 1$ pseudorandom sequence generation;
- 2e11 — $2^{11} - 1$ pseudorandom sequence generation;
- 2e15 — $2^{15} - 1$ pseudorandom sequence generation;
- 2e23 — $2^{23} - 1$ pseudorandom sequence generation;
- user — user defined sequence generation.

Byte 1, **Byte 2** and **Byte 3** fields allow to define 24 bits of user pattern.

In order to edit Byte 1, Byte 2 and Byte 3 fields, press with a stylus in one of the windows and insert needed quantity of zeroes and ones using keyboard.

5.3.2 Invert TX

This field allows to switch on the transmitted test test sequence

5.3.3 Invert RX

This field allows to switch on the received test sequence inversion.

6. Signal and Event Generation

6.1 Jitter Generation

To access the **Generation**, enter the **Jitter** program and then **Generation** tab. Harmonic jitter of selected frequency and level is inserted into transmitted signal. Jitter is generated in compliance with ITU -T O.171 recommendation.

For jitter generation, an internal synchronization should be used. Therefore, prior to generation ensure that in the **Line Interface** tab of **PCM Configuration** application, the **Tx Sync** parameter value is set to **Internal**.

Use stylus to configure generated jitter parameters.

The following parameters are displayed in the **Generation** window:

- Transmit — configuring generated jitter parameters;
 - Frequency — transmitted jitter frequency (20Hz...100KHz);
 - Level — jitter maximum amplitude (in UIpp);
- Receive — displaying current jitter value in the received signal;
- Steps Value — value step configuration.

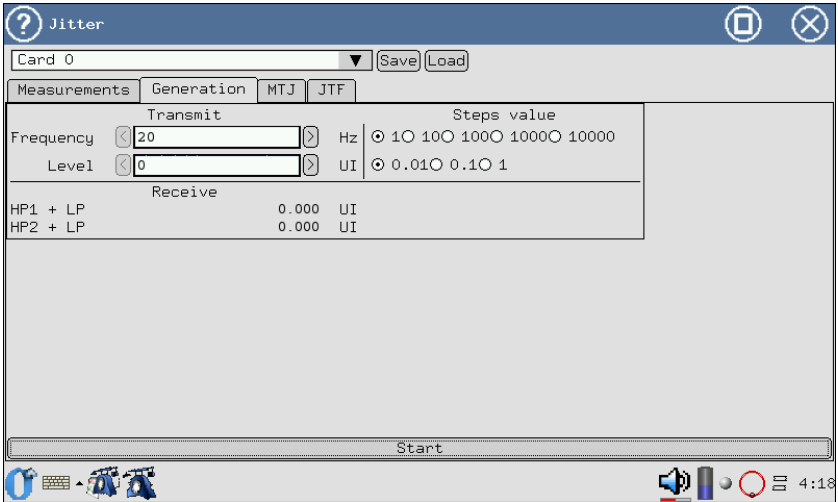


Figure 6.1. Jitter Generation Menu

6.2 Changing of Transmitted signal Frequency

It is possible to change the transmitter frequency (refer to par. 4.4, p. 17).

6.3 Alarms Generation

To enter the program, use a stylus to press **PCM Configuration** icon and then **Errors and Alarms** tab. The screen layout is shown at Figure 6.2.

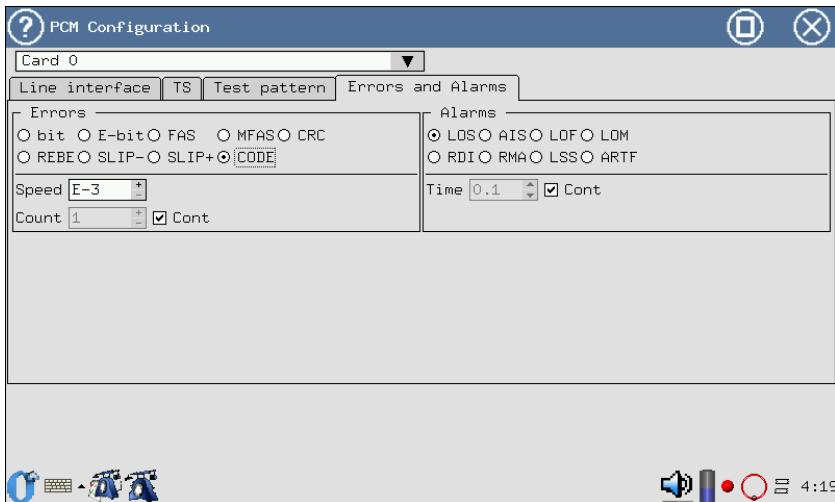


Figure 6.2. Errors and Alarms Menu

6.3.1 Alarms Type

- LOS — loss of signal;
- AIS — alarm indication signal. Transmitter sends all "ones";
- LOF — loss of frame alignment. FAS synchronization signal is lost;
- LOM — loss of multiframe alignment in TS 16 (loss of MFAS multiframe synchronization signal (G.704 ITU-T recommendation, par. 5.1.3.2), all bits in TS 16 are equal to 1 or 0);
- RDI — remote defect indication (G.706 ITU-T recommendation). Device sends 1 in every fourth bit in every zero TS of the frame that does not carry frame synchronization signal. The FAS DISTANT alarm can only be transmitted with PCM-31 and PCM-30;
- RMA — remote multiframe indication (G.732 ITU-T recommendation). For this alarm, analyzer sends 1 in every sixth bit of every 16th TS in the frame zero. The FAS DISTANT alarm can only be transmitted with PCM-30;
- LSS — loss of synchronization signal with the received test sequence;
- ARTF — a fault that makes stream unstructured (represented as zeroes and ones sequence).

6.3.2 Time

The **Time** field defines fault generation duration. With the help of a stylus, a number or **Cont.** (continuous) generation can be set.

6.3.3 Alarm Generation Start/Stop

The **Alarms** field allows for faults generation process control.

6.4 Errors Generation

The field layout is shown at Figure 6.2.

6.4.1 Errors Type

The **Error Type** parameter defines types of errors from the following list:

- bit — bit errors generation;
- E-bit — bit errors generation in the sequence;
- FAS — errors generation in the FAS word;
- MFAS — errors generation in the MFAS word;
- CRC — CRC errors generation;
- REBE — REBE errors generation;
- SLIP- — negative slips generation in the test sequence;
- SLIP+ — positive slips generation in the test sequence;
- CODE — code errors generation;

6.4.2 Speed

The parameter determines errors insertion rate. It is set with a stylus.

6.4.3 Count

This parameter determines quantity of errors to be inserted. It is possible to specify **Cont.** or continuous errors or numbers insertion (with the help of a stylus).

6.4.4 Errors Insertion Start/Stop

The **Errors** field allows for errors insertion process control.

7. Measurements

7.1 Pulse Shape

This program displays and analyses shape of 2 Mbit/s (G.703) line pulses relative to standard pulse pattern shape.

To access the program press the **Pulse information** icon with a stylus. Pulse shape displayed on a screen is a simplified version of G.703 pattern, shown at Figure 7.1.

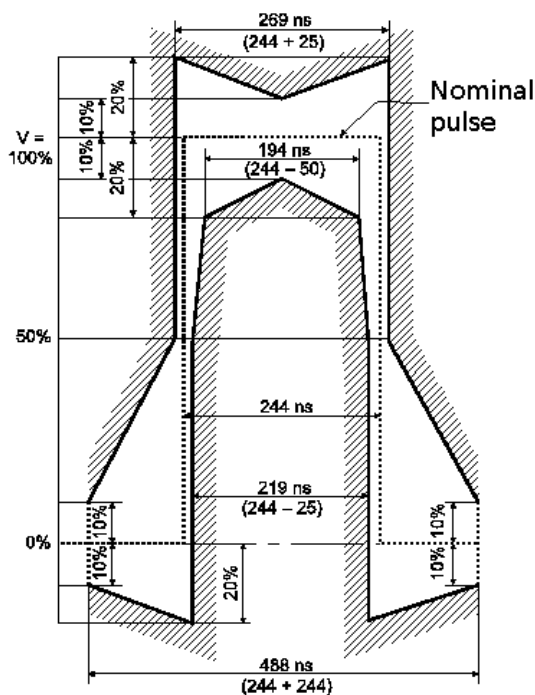


Figure 7.1. G.703 (2048 kbit/s) Pulse Pattern

7.1.1 Pulse Shape Monitoring

The display (Figure 7.2) shows single pulse that has been generated by stroboscopic method using several line signal pulses. Oscilloscope bandwidth in this mode is 0.01...110 MHz.

Prior to pulse shape monitoring, it is necessary to activate **Terminal** or **Monitor** mode in the **Line Interface** application.

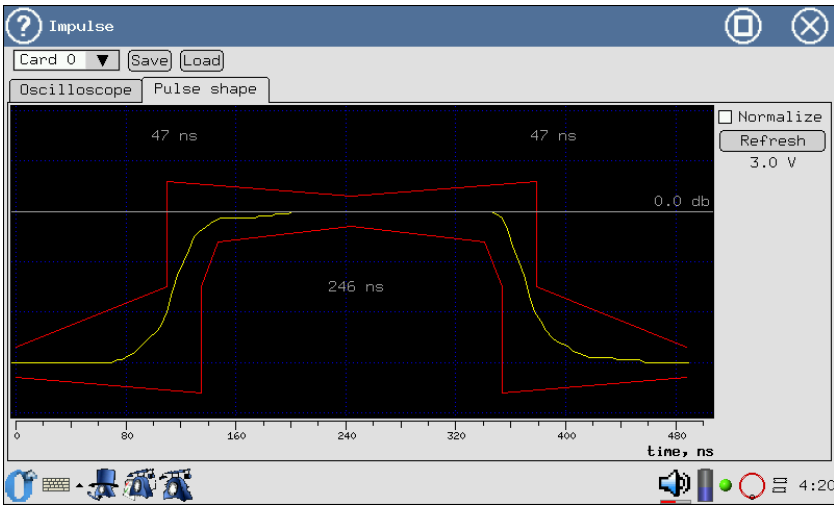


Figure 7.2. Pulse Shape Display

To refresh information on a screen, press **Refresh**.

The pulse is automatically put within G.703 pattern by pulse shifting along time axis and amplitude scaling.

Because of measurement algorithm properties, the shape of displayed pulse may differ from real one (numerous narrow bursts on oscillogram); this is caused by one of the following:

- signal amplitude above $\pm 4V$ (overflow), considering gain (refer to par. 7.1.2);
- line signal is subject to jitter;
- regular line signal (for example, most of time slots permanently transmit zeroes).

Normalize — program tries to superpose pulse and G.703 pattern (refer to Figure 7.1) regardless of level, considering maximal pulse value for 0 dB.

7.1.2 Oscilloscope

The reason of distortions may be found out by observing oscillogram of the monitored signal and examining flow contents. In case of a regular signal, change time slots contents or send AIS signal to the channel. To view oscillogram, press the **Oscilloscope** tab.

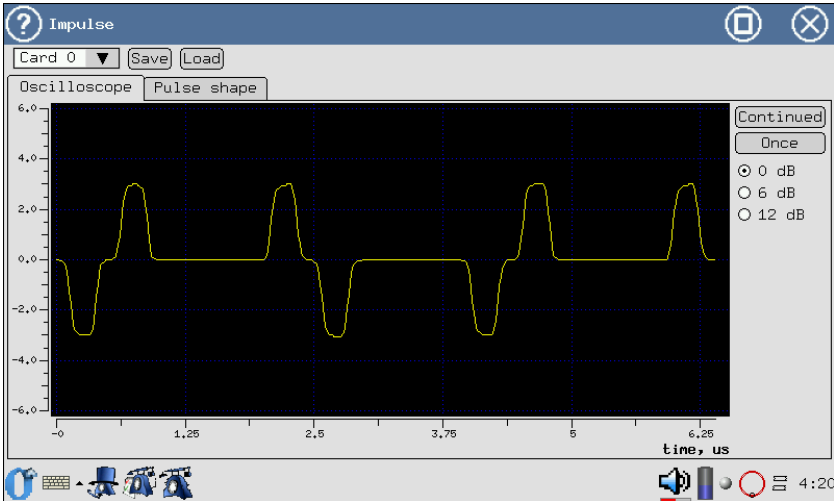


Figure 7.3. The **Oscilloscope** Display

- The X axis shows time in microseconds;
- The Y axis shows voltage in Volts.

Signal can be amplified by 0dB, 6dB, 12dB. Because of measurement algorithm properties, the shape of displayed oscillogram may differ from the real one, if signal amplitude is above $\pm 4V$.

You may take oscillogram once by pressing the **Once** button. The **Continued** button brings oscilloscope to the automatic update mode (once per second).

To save or load, press **Save/Load** with a stylus.

7.2 Jitter

This mode of operation provides for phase jitter measurement in the received signal. To access the program, press the **Jitter** icon, and then **Measurement**. Screen layout is shown at Figure 7.4.

- To start measurements, press **Start**;
- To clear screen, press **Reset**;
- To select measurement filter HP1+LP (20Hz... 100KHz) or HP2 +LP (18KHz... 100KHz) press the selected filter with a stylus.

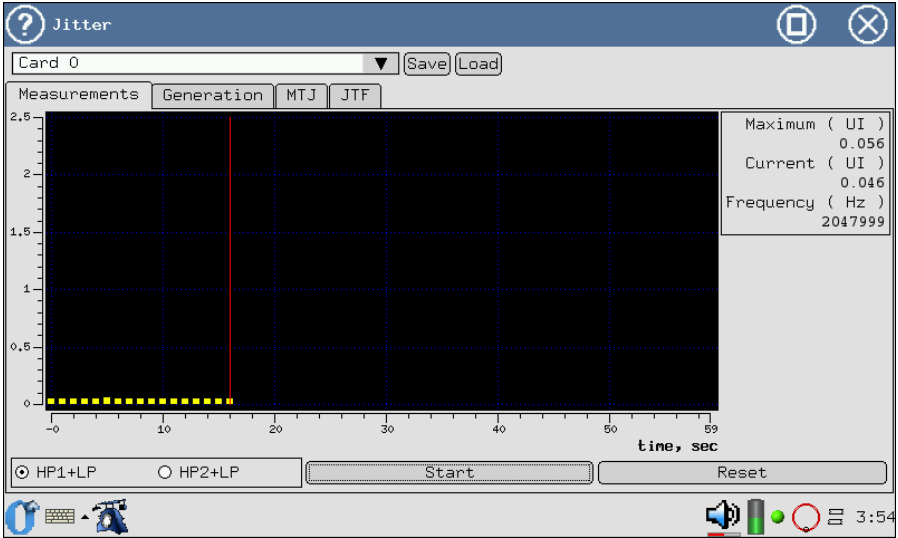


Figure 7.4. Phase Jitter Measurement

- The X axis shows time in seconds;
- The Y axis shows jitter value in Ui.

7.3 MTJ - Maximum Tolerable Jitter

The maximum tolerable jitter measurement method (MTJ, ITU-T G.823 recommendation) implies determination, for each frequency, the maximum jitter amplitude at different frequencies, at which amplitude the total errored seconds quantity in the received pseudo-random sequence does not exceed two.

To access the program, press the **Jitter** icon, and then **MTJ**.

Measurement Required Conditions:

1. Synchronization with pseudo-random sequence (no LSS alarm).
2. Because during measurements a big jitter is introduced in the sent stream, all current measurements should be postponed (LOS, AIS alarms, and also *Terminal* and *Monitor* modes should be set).

To start or to stop MTJ measurements use the **Start** key.

As a result of measurements, a diagram will be created on the device screen, showing MTJ characteristics Diagram horizontal axis corresponds to frequency range 20Hz...100KHz, vertical axis is generated jitter amplitude (refer to Figure 7.5).

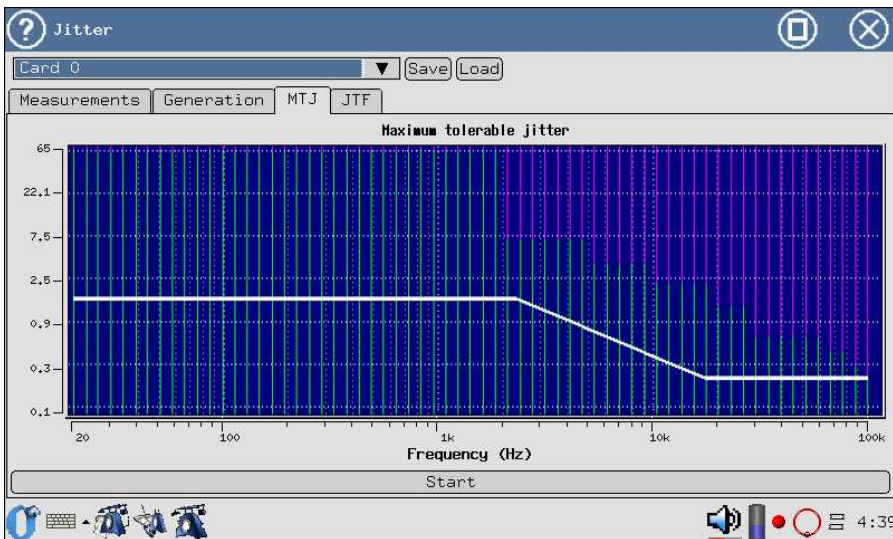


Figure 7.5. Maximum Tolerable Jitter

Colours on the generated diagram correspond to the following characteristics:

- **White** line denotes MTJ pattern according to G.823 recommendation.
- **Green** line denotes tolerable jitter for a path being tested.
- **Red** line denotes intolerable phase jitter values for a path being tested.
- **Violet** line denotes range of values that cannot be generated by the device.

7.4 JTF - Jitter Transfer Function

To enter the program, press the **Jitter** icon, and then **JTF**.

When jitter transfer function is being measured, jitter is introduced into channel according to MTJ mask (Figure G.823/13, ITU-T G.823 recommendation), and then jitter value is measured in the incoming signal. JTF is calculated according to the following formula:

$$JTF(f_i) = 20 \lg \frac{J_{out}(f_i) - J_{intr}(f_i)}{J_{in}(f_i)}$$

In order to increase accuracy, it is necessary to perform calibration prior to start of measurements (refer to par. 9).

The application screen has two allowable values masks: for transit node (violet mask) with more strict requirements to jitter suppression and for the local node (white mask) with less strict requirements.

The screen layout is shown at Figure 7.6.

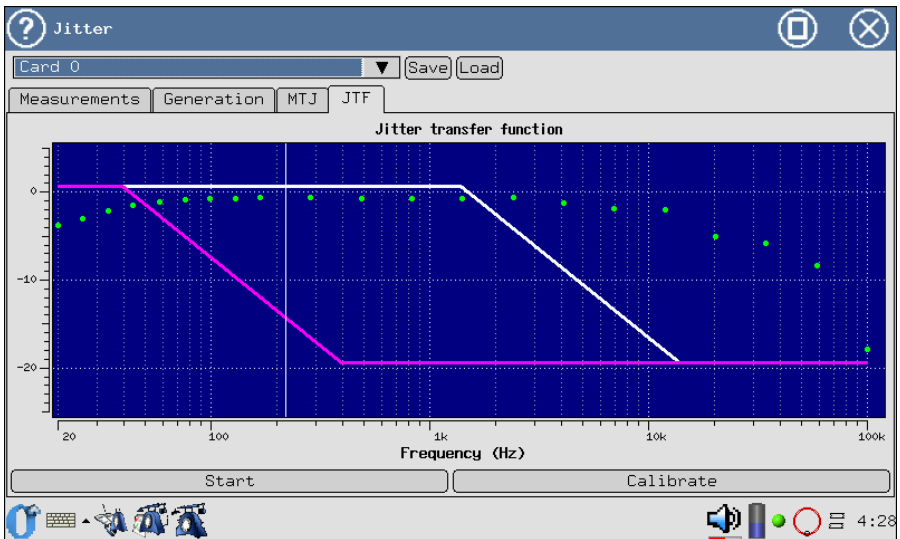


Figure 7.6. Jitter Transfer Function

7.5 G.821/G.826/M.2100

To enter the program, press the **Base Measurements** icon.

This measurement mode presents most significant results of a measurement.



To start or to stop the measurements use the **Start/Stop** key. After the **Start** button is pressed, **Errors** and **Alarms** buttons appear, that allow to control errors and faults generation process.

Measurement results can be viewed in the following tabs:

- **Base Parameters;**
 - **Base 1;**

– **Base 2**;

- **G.821**;
- **G.826/M.2100**.

Toggleing between screens is performed with a stylus or , . Parameters can be saved and loaded with **Save/Load** keys.

The **Base Parameters** tab screen contains measurement data related to specific information garbling types, such as code violation, bit errors, frame bit errors and CRC-4 block errors. It also reports all service provisioning criteria, such as errored seconds and errored seconds percentage. Measurement parameters related to E1 signal and information about alarms, frame alignment of the line under testing are displayed.

The **G.821** tab presents all parameters that are measured according to *G.821 Error Performance of an International Digital Connection Operating at a Bit Rate Below the Primary Rate of an ISDN Network*. Rates below primary are supported: Nx64, where 64 Kbit/s is the basic digital signal throughput, and N₃₁ for E1. This recommendation describes measurement methods for BER (Bit Error Rate) with taking channel out of service.

The **G.826/M.2100** tab presents all parameters that are measured according to *G.826 recommendation Error Performance and Objectives of an International Digital Connection Operating at a Bit Rate Above the Primary Rate*. This method has been designed as an extension of bit errors measurement method (BER) to the block errors region - *BLER*, that does not require channel disconnection. G.826 applies to transmission systems with data transmission rates above 64 Kbit/s.

The majority of results have a counter shown in the first column and corresponding rate or percentage value in the second column. For example, **CODE** is shown in the first column while its corresponding parameter **CODER** — in the second column of the same row. **CODE** is a counter of code violations, and **CODER** is code violations rate.

7.5.1 Base Parameters

7.5.1.1 Base 1

The **Base 1** tab layout is shown at Figure 7.7.

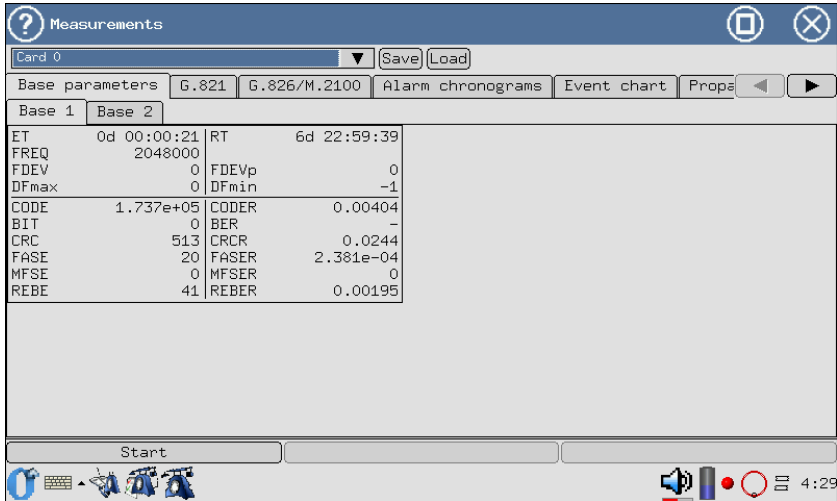


Figure 7.7. Base 1

Measured basic parameters detailed description can be found in Table 7.1.

Table 7.1: Basic Parameters Description

Param.	Description	Formula	Meas. Unit	Note
RT	Time remaining to the end of testing	Countdown	second	Countdown from the start of testing
ET	Time elapsed from the start of testing	Cumulative count	second	Continuous counting from the start of testing
FREQ	Received signal frequency	Instrument measurement with periodicity of 1 second	Hz	
FDEV	Absolute frequency deviation from nominal (2048000 Hz)	$(FREQ - 2048000)$	Hz	
FDEVp	Relative frequency deviation from nominal (2048000 Hz)	$\frac{FDEV}{2048000}$		
DFmax	Maximum frequency deviation during measurement period	$MAX(FDEV)$	Hz	
DFmin	Minimum frequency deviation during measurement period	$MIN(FDEV)$	Hz	
CODE	Code violations counter from the start of measurement period	Cumulative count		
CODER	Code violations relative rate from the start of testing	$\frac{CODE}{ET * 2048000}$		

Table 7.1: Basic Parameters Description (cont.)

Param.	Description	Formula	Meas. Unit	Note
BIT	Errored bits counter from the start of testing	Cumulative count	error	When test sequence is not synchronized, is not counted
BER	Bit error rate	$\frac{BIT}{ABIT}$		ABIT — quantity of bits received
CRC	Counter of CRC-4 blocks with errors from the start of testing	Cumulative count	error	When CRC-4 multiframe alignment is not present, it is not counted
CRCCR	Average rate of CRC-4 blocks with errors from the start of testing	$\frac{CRC}{(ET-CRCLS)*1000}$		Quantity of errored CRCs to the total quantity of CRC blocks received ratio
FASE	Frame errors counter for errors from the start of testing	Cumulative count	error	When frame alignment is not present, it is not counted
FASER	Average frame errors rate, from the start of testing	$\frac{FASE}{(ET-LOFS)*1000}$		Errored FAS words to the total quantity of FAS words received ratio
MFSE	Quantity of superframe errors detected from the start of testing	Cumulative count	error	When multiframe alignment is not present, it is not counted
MFSER	Superframe errors average rate from the start of testing	$\frac{MFSE}{(ET-LOMS)*1000}$		Errored MFAS words to the total quantity of MFAS words received ratio
REBE	Quantity of E-BIT errors, detected from the start of measurements period	Cumulative count	error	When multiframe alignment is not present, it is not counted
REBER	Average E-BIT errors rate, detected from the start of testing	$\frac{REBE}{(ET-CRCLS)*1000}$		

7.5.1.2 Base 2

The **Base 2** tab layout is shown at Figure 7.8.

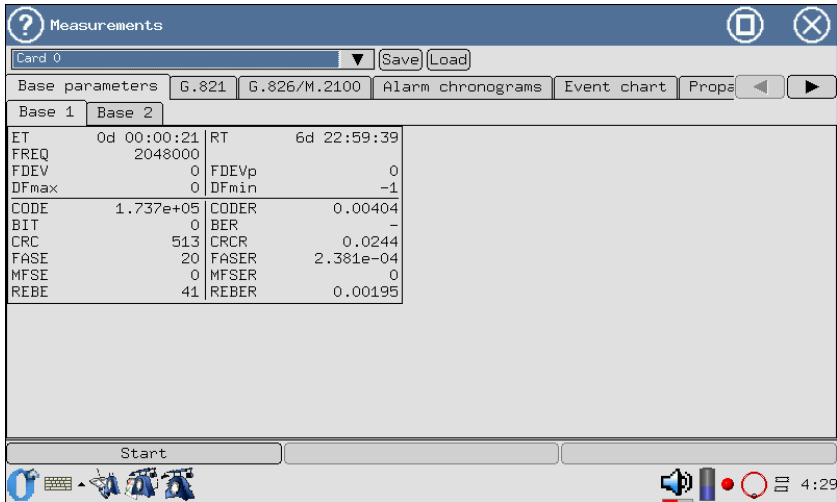


Figure 7.8. Base 2

Measured basic parameters detailed description can be found in Table 7.2.

Table 7.2: Basic Parameters Description 2

Parameter	description	Formula	Meas. unit.
LOS	Count of seconds when signal was lost	Cumulative count	second
%LOS	Percent of seconds when signal was lost	$\frac{LOS}{ET} * 100\%$	%
AIS	Count of seconds when AIS was detected (all 1s were received)	Cumulative count	second
%AIS	Percent of seconds when AIS was detected (all 1s were received)	$\frac{AIS}{ET} * 100\%$	%
LOF	Count of seconds from the start of testing when the frame alignment was lost	Cumulative count	second
%LOF	Percent of seconds from the start of testing when the frame alignment was lost	$\frac{LOF}{ET} * 100\%$	%
LOM	Count of seconds from the start of testing when multiframe alignment was lost	Cumulative count	second
%LOM	Percent of seconds from the start of testing when byte synchronization was lost	$\frac{LOM}{ET} * 100\%$	%
RDI	Count of seconds with remote frame alarm signal (FAS RAI) from the start of testing	Cumulative count	second
%RDI	Percent of seconds with remote frame alarm signal (FAS RAI) from the start of testing	$\frac{RDI}{ET} * 100\%$	%
RMA	Count of seconds with remote multiframe alarm signal (MFAS RAI), detected from the start of testing	Cumulative count	second
%RMA	Percent of seconds with remote multiframe alarm signal (MFAS RAI), detected from the start of testing	$\frac{RMA}{ET} * 100\%$	%

Table 7.2: Basic Parameters Description 2 (cont.)

Parameter	description	Formula	Meas. unit.
LSS	Count of seconds when there was no test sequence synchronization, from start of testing	Cumulative count	second
%LSS	Percent of seconds when there was no test sequence synchronization, from start of testing	$\frac{LSS}{ET} * 100\%$	%
SLP	Count of positive or negative slips in the test sequence	Cumulative count	error
%SLP	Percent of positive or negative slips in the test sequence from the start of testing	$\frac{SLP}{ET} * 100\%$	%
CLS _{SLP+}	Count of seconds from the start of testing when at least one CLS _{SLP+} (positive slip) has been detected	Cumulative count	second
%CLS _{SLP+}	Percent of seconds with at least one CLS _{SLP+} from the start of testing.	$\frac{CLS_{SLP+}}{ET} * 100\%$	%
CLS _{SLP-}	Count of seconds from the start of testing when at least one CLS _{SLP-} (negative slip) has been detected	Cumulative count	second
%CLS _{SLP-}	Percent of seconds from the start of testing when at least one CLS _{SLP-} (negative slip) has been detected	$\frac{CLS_{SLP-}}{ET} * 100\%$	

7.5.2 G.821

The G.821 tab view is shown at Figure 7.9.

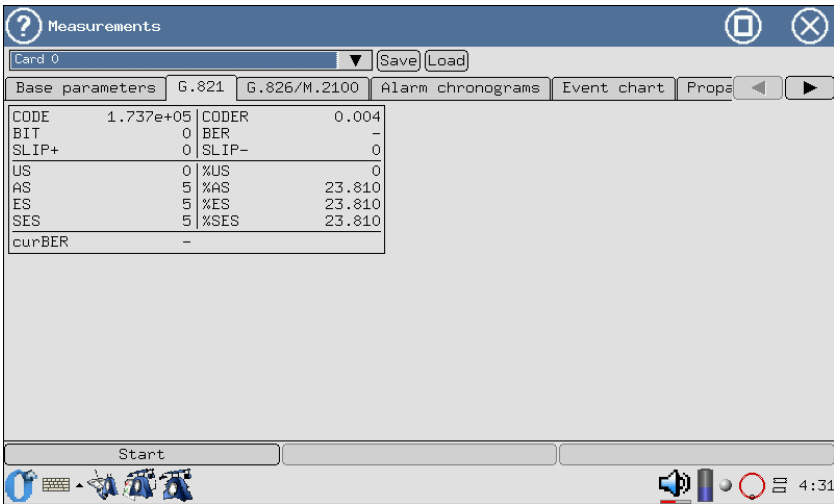


Figure 7.9. G.821

Parameters measurement description according to G.821 recommendation is presented in Table 7.3.

Table 7.3: G0.821 Recommendation Parameters Description

Parameter	Description	Formula	Meas. Unit	Meas. condition
CODE	Code violations counter from the start of testing	Cumulative count	error	
CODER	Average code violations rate from the start of testing	$\frac{CODE}{ET*2048000}$		
BIT	Errored bits counter from the start of testing	Cumulative count	error	Is not counted when test sequence is not synchronized
BER	Bit error rate	$\frac{BIT}{ABIT}$		ABIT — quantity of bits received
SLIP+	Counter of positive slips in the test sequence	Cumulative count	error	Positive slip is repetition of one bit of the test sequence.
SLIP-	Counter of negative slips in the test sequence	Cumulative count	error	Negative slip is exclusion of one bit of the test sequence.

Table 7.3: G0.821 Recommendation Parameters Description (cont.)

Parameter	Description	Formula	Meas. Unit	Meas. condition
US	Quantity of unavailable seconds ¹ from the start of testing	Cumulative count	second	
%US	Percent of unavailable seconds from the start of testing	$\frac{US}{ET} * 100\%$	%	
ES	Quantity of errored seconds from the start of testing. These are seconds with at least one error.	Cumulative count	second	Errored second is not counted as unavailable second
%ES	Percent of errored seconds from the start of testing.	$\frac{ES}{AS} * 100\%$	%	
SES	Number of severely errored seconds, from the start of testing (seconds with error rate $> 10^{-3}$).	Cumulative count	second	Severely errored seconds are not counted during unavailable second.
%SES	Percent of severely errored seconds	$\frac{SES}{AS} * 100\%$	%	
AS	Quantity not available seconds (readiness seconds)	$AS = ET - UAS$	second	
	Percent of seconds of readiness from the start of testing	$\frac{AS}{ET} * 100\%$	%	
curBER	Current bit error rate averaged for 10 seconds and less	$\frac{\sum_{i=0}^{T_{cur}} BIT_i}{T_{cur}}$		$T_{cur} = 10s$

7.5.3 G.826/M.2100

The G.826/M.2100 screen view is shown at Figures 7.10 and 7.11.

¹Unavailable seconds are counted from the beginning of 10 consecutive severely errored seconds; counting stops at the beginning of 10 seconds without errors.

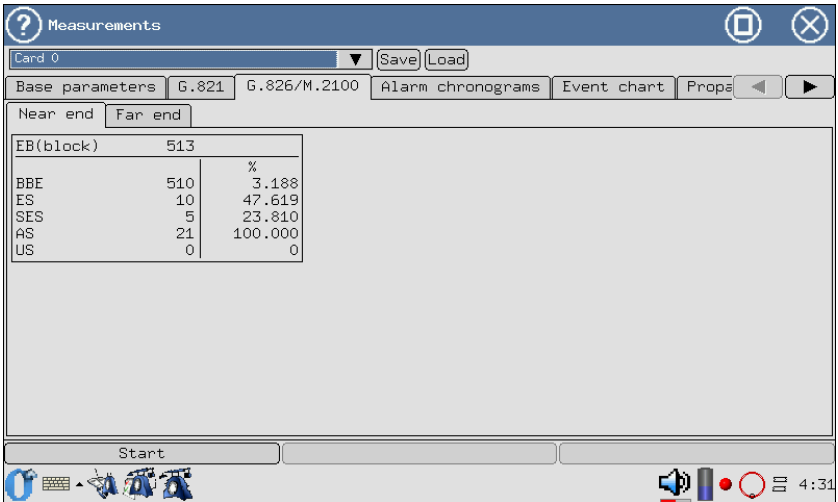


Figure 7.10. G.826/M.2100 (Near End)

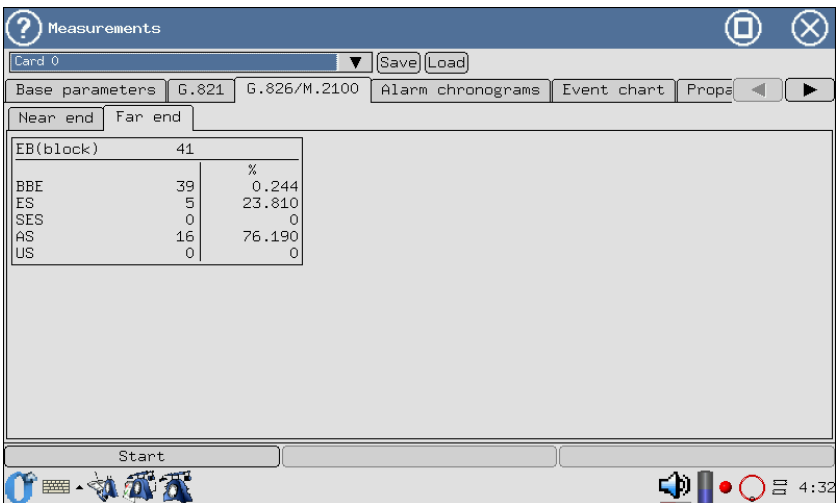


Figure 7.11. G.826/M.2100 (Far End)

G.826/M.2100 recommendation parameters description is presented in Table 7.4.

Table 7.4: G.826 Recommendation Parameters Description

Parameter	Description	Formula	Meas. Unit	Meas. condition
EB(block)	Errored blocks counter from the start of testing	$EB = CRC$	block	
BBE	Counter of blocks with background errors (blocks with errors except blocks received during SES or UAS are counted)	Cumulative count	block	
%BBE	Coefficient of blocks with background errors (excluding blocks received during SES and UAS)	$\frac{BBE}{1000 * (AS - SES)} * 100\%$	%	
US	Quantity of unavailable seconds ² from the beginning of testing	Cumulative count	second	
%US	Percent of unavailable seconds from the start of testing	$\frac{US}{ET} * 100\%$	%	
ES	Quantity of errored seconds, from the start of testing These are seconds with at least one error.	Cumulative count	second	Errored second is not counted during unavailable second
%ES	Percent of errored seconds	$\frac{ES}{AS} * 100\%$	%	
SES	1 Number of severely errored seconds, from the start of testing (seconds with error rate $> 10^{-3}$).	Cumulative count	second	Severely errored second is not counted during unavailable second
%SES	Percent of severely errored seconds, from the start of testing	$\frac{SES}{AS} * 100\%$	%	
AS	Quantity of available seconds (readiness seconds)	$AS = ET - UAS$	second	
%AS	Percent of readiness seconds from the start of testing	$\frac{AS}{ET} * 100\%$	%	

7.6 Propagation Delay

In order to measure signal propagation delay, a mark is inserted in the transmitted sequence, and then the difference between mark sending and mark detection moment is calculated. The transmitted sequence is generated by the device automatically.

Prior to start of measurements, it is necessary to do the following:

²Unavailable seconds are counted from the beginning of 10 consecutive severely errored seconds; counting stops at the beginning of 10 seconds without errors.

1. In the **PCM Configuration** \Rightarrow **TS** program, to configure same testing rate for receiving and transmitting ports (TS quantity for reception and transmission should be the same);
2. Stop the following measurements (MTJ, G.821, G.826, Base measurements);
3. Stop errors insertion or alarms generation.

To start or to stop the measurements use the **Start/Stop** key.

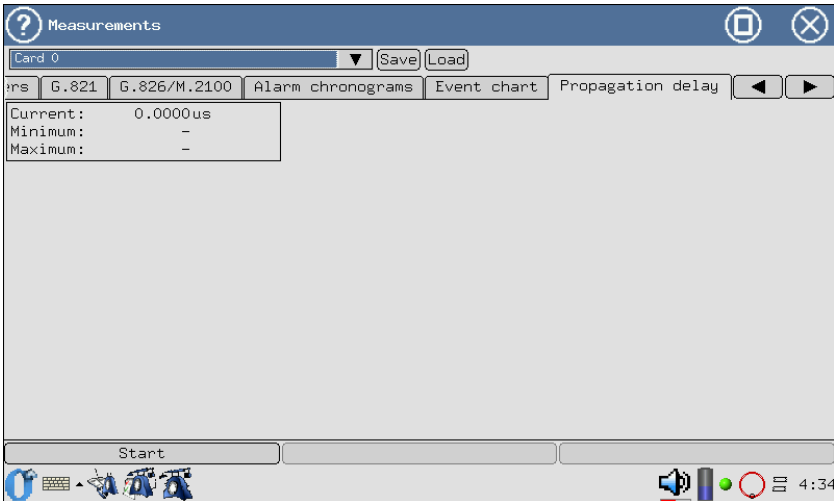


Figure 7.12. Propagation Delay Measurement

As a result of measurements, the following values are displayed:

- **Current** — current signal propagation latency value.
- **Minimal** — minimal value detected during measurement period.
- **Maximal** — maximal value detected during measurement period.

7.7 SLA

The **SLA** (Service Level Agreement) application provides for capability to perform automatic processing of quality parameters according to Directive 92 of Ministry of Telecommunications of Russian Federation. This directive is national standard for permissible norms for E1 channel parameters.

The screen layout is shown at Figure 7.13.

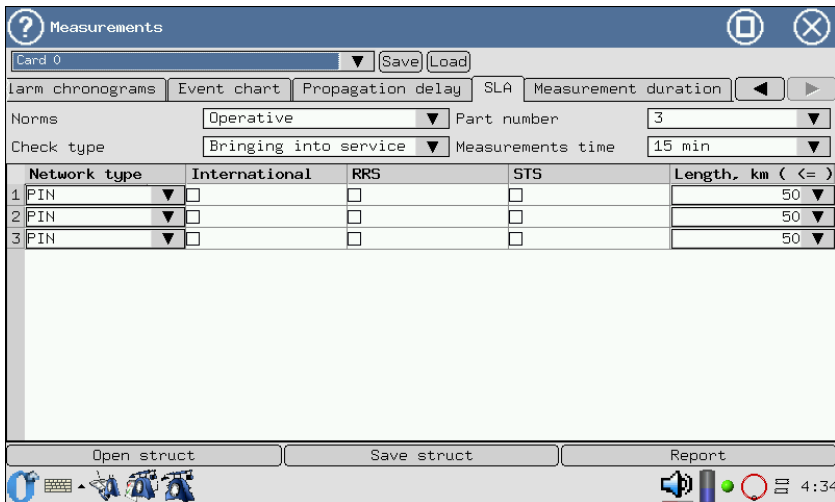


Figure 7.13. SLA Parameters Configuration View

In order to fulfill the digital channel errors parameters calculation process, it is necessary to determine applicable norms:

- **Permanent** — defined in compliance with ITU-T G.821 recommendation (for 64 Kbit/s channels) and G.826 recommendation (for paths with the rate from 2048 kbit/s and higher). Long-term norms validation requires long measurement periods — not less than one month. They are used to test qualitative characteristics of digital channels and paths of new transmission systems.
- **Operative** — are express-norms, defined on the basis of ITU-T M.2100, M.2110, M.2120 recommendations. To evaluate operative norms, relatively short measurements period is needed.

The following **Check type** relate to operative norms:

- **Bringing into service** — are used when channels, supported by analogous transmission equipment are already present at the network and were successfully tested on compliance to long-term norms.
- **After Repair** — are used on commissioning tests after equipment repair.
- **Low Quality** — when these thresholds are crossed, this path and its characteristics change analysis should be carried out more frequently.

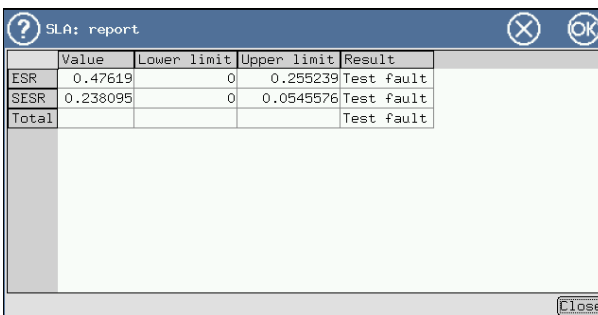
The **Part number** field allows to select path type: simple or composite.

In case of composite path, the quantity of composite link hops should be specified (from 1 to 500). Depending on the quantity of hops, channel menu displays certain quantity of rows, where each hop parameters should be specified in the form of separate fields:

- Each hop nature:
 - PIN** — Intra Area Primary Network;
 - PBN** — Core Primary Network.
- **International** — a flag to specify path type (international or national);
- Link location in the primary network:
 - RRS** — Radio Transmission System;
 - STS** — Satellite Transmission System.
- **Length** — each hop length in km;
- **Measurement Time** — time period, during which norm calculation will be performed.

Composite link structure data may be saved and loaded for future use (**Save Struct** and **Open struct** buttons). After the listed parameters are configured, measurements results may be loaded either from the current measurements report (for example, immediately after measurements are completed), or from the device memory. For quality data according to G.821/G.826/M.2100, that have been already obtained, program will only process them according to digital transmission systems certification procedure.

The system automatically generates a report (on pressing the **Report** button) according to Directive 92 requirements. The device screen displays results status on **ESR**, **SESR** and **BBER** parameters.



	Value	Lower limit	Upper limit	Result
ESR	0.47619	0	0.255239	Test fault
SESR	0.238095	0	0.0545576	Test fault
Total				Test fault

Figure 7.14. **SLA screen layout: report**

For the long-term norms, the report contains:

- **ESR** — Errored Seconds Rate (**ES** quantity (refer to par. 7.5.2, page 42) to the ratio of total quantity of seconds in readiness during fixed measurement period);
- **SESR** — Severe Errored Seconds Rate (quantity of **SES** to the ratio of total quantity of seconds in readiness period, during fixed measurement period).

The report for operative norms includes **ESR** and **SESR** parameters, and also has **BBER** , block error rate with background errors (ratio of the quantity of blocks with background errors to the total quantity of blocks during readiness period, during the fixed measurement interval, excluding all blocks during SES).

7.8 Measurement Duration

The **Measurement Duration** tab is used to configure measurements duration. Number of days, hours and minutes should be specified; on expiry testing will automatically stop.

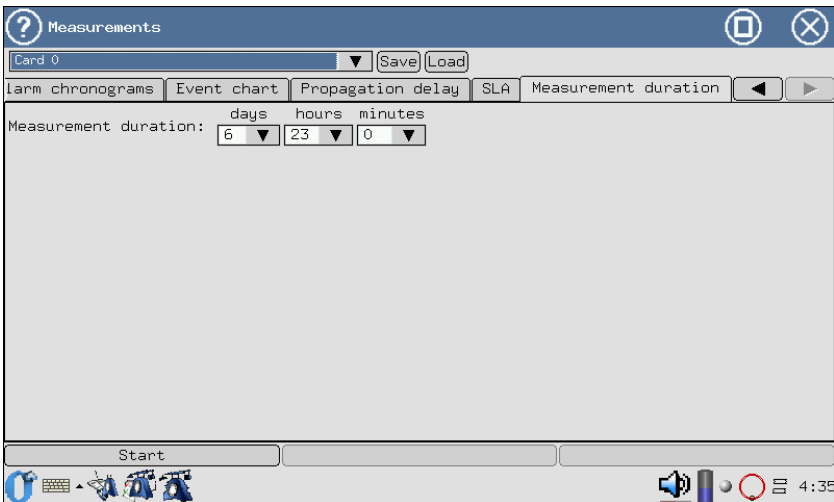


Figure 7.15. **Measurements Duration** Screen Layout

In case zero values are specified, measurement time counting starts from zero until testing is interrupted by user.

8. Measurement Results

The **Events chart** and **Alarm Chronograms** sections display obtained measurement results in the graphical form.

Horizontal axis is measurements time scale. Axis starting point corresponds to start of measurements time and then is calibrated according to the scale selected: 1, 5, 15, 30 minutes or 1 hour

Time of displayed measurement period start and end is shown in the upper left and right corners correspondingly.

To generate and view graphical reports it is necessary to:

1. Activate measurements in the **Base Measurements** ⇒ **G.821** or **G.826/M.2100** program by pressing **Start** key.
2. Navigate to the needed graphical reports section (**Base Measurements** ⇒ **Events chart** program, or **Base Measurements** ⇒ **Alarm Chronograms** program).
3. Select time measurement axis scale.

8.1 Events Chart

The screen layout is shown at Figure 8.1.

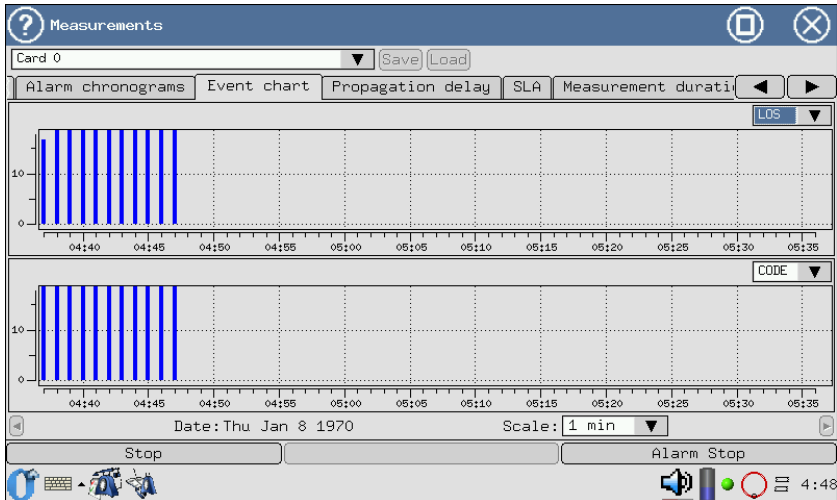


Figure 8.1. Events Chart

The graph depicts distribution information about events, observed during the measurement period. When a certain type of event is discovered, a column appears at the graph with the height that increases upon discovery of such type of event during the minute of observation.

Vertical axis has logarithmic scale and depicts values of corresponding parameters.

To view the events graph:

1. Event selection is performed with a stylus.
2. Use stylus to switch between diagram screens along horizontal axis.

8.2 Alarm Chronograms

The chronogram graphically shows errors in the stream under testing. When a fault is detected during measurements, a column appears at the axis that corresponds to this type of fault, showing presence of a fault.

The detected alarms are listed at the left side along vertical axis. Column height does not change, as it only demonstrates that an event has been detected. One column corresponds to one minute of observation.

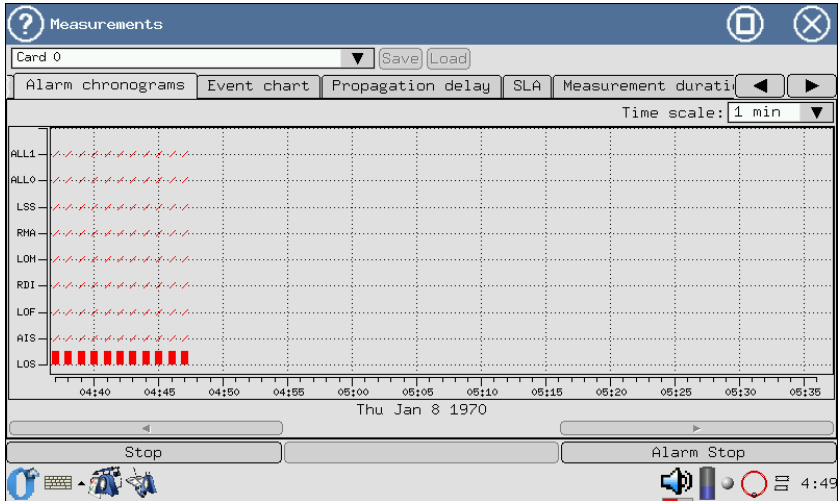


Figure 8.2. Alarm Chronograms

1. Activate the **Alarm Chronograms** application.
2. Set the time axis scale using stylus.
3. To scroll the chronogram along horizontal axis, use stylus.

8.3 Data Review

This application allows to review received and to configure sent data, such as: TS contents, CAS/MFAS/Sa/Si words and FAS/NFAS words. To access the **View Data** program, press the icon on the desktop with a stylus. Screen layout is shown at Figure 8.3.

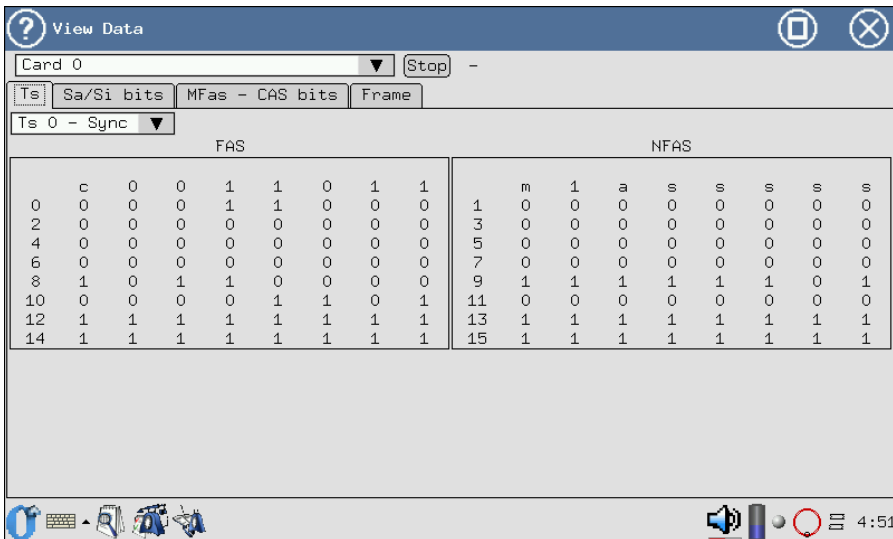


Figure 8.3. View Data Menu

8.3.1 TS review

With this device operation mode it is possible to review the contents of each time slot, including FAS/NFAS words for the last 16 frames (Figure 8.3).

Interface selection to view the data is performed in the upper left corner of the application.

To start/stop data refreshment use the **Start/Stop** button. The contents of FAS/NFAS words is displayed in the zero TS (*Ts 0 — Sync*). The first column of **FAS** field table shows even frames numbers, and first line shows each digit in binary. The *c* bit is used for CRC errors monitoring.

The **NFAS** field is also numbered according to the fields notation approved by ITU-T G.704 recommendation, including superframe field *m*, RAI (Remote Alarm Indication) field *a* and Si-bits fields, designated as *s*.

In the PCM-30 mode, the analyzer is able to monitor the E1 stream superframe structure — **MFAS**. The sixteenth TS (*Ts 16 — CAS*) contains data about 16 consecutive frames, and also includes standard data of *xyxx* type for **MFAS** and *abcdABCD* signalling for **CAS** (signalling, related to the voice channels).

8.3.2 Sa/Si Bits Review

The **Sa/Si Bits** tab (Figure 8.4) allows to configure any Sa/Si bits values in the **Transmit** field by pressing the symbol with a stylus.

		Receive								Transmit							
Frame		0	2	4	6	8	10	12	14	0	2	4	6	8	10	12	14
Si		0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0
Frame		1	3	5	7	9	11	13	15	1	3	5	7	9	11	13	15
Sa4		0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0
Sa5		0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0
Sa6		0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0
Sa7		0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Sa8		0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0

Figure 8.4. Sa/Si Bits Menu

For even transmitted and received frames, the CRC-4 bits are displayed (S_i row), for odd frames — Sa4-Sa8 bits are displayed that are reserved for national use.

8.3.3 MFAS-CAS Bits Review

The **MFAS-CAS Bits** tab allows to review the contents of MFAS/CAS words. The program allows to configure for transmission any CAS bits value. In order to do this, it is necessary to enter it in the lower TS field (upper field shows received CAS bits value). The menu screen layout is shown at Figure 8.5, page 56.

The screenshot shows a software interface titled 'View Data' with a 'Card 0' dropdown and a 'Stop' button. Below are tabs for 'Ts', 'Sa/Si bits', 'MFas - CAS bits', and 'Frame'. The 'MFas - CAS bits' tab is active, displaying a table of 30 frames. Each frame contains two rows of binary data. The bottom of the screen shows a Windows taskbar with system icons and a clock showing 4:51.

Frame	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001
1	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001
7	0000	0001	1011	0001	1111	0001	0000	0001	0000	0001	0000	0001	1111	0001	0000	0001	0000	0001	1101	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001
13	1111	0001	1111	0001	1111	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	1101	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001
19	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	0000	0001	1101	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001
25	1101	0001	0000	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001	1111	0001

Figure 8.5. MFAS-CAS Bits Menu

8.3.4 Frame review

With this device operation mode it is possible to review frames contents. Each TS data are represented in binary, hexadecimal and character format (refer to Figure 8.6, page 57). Pressing the **Stop** button stops data refreshment.

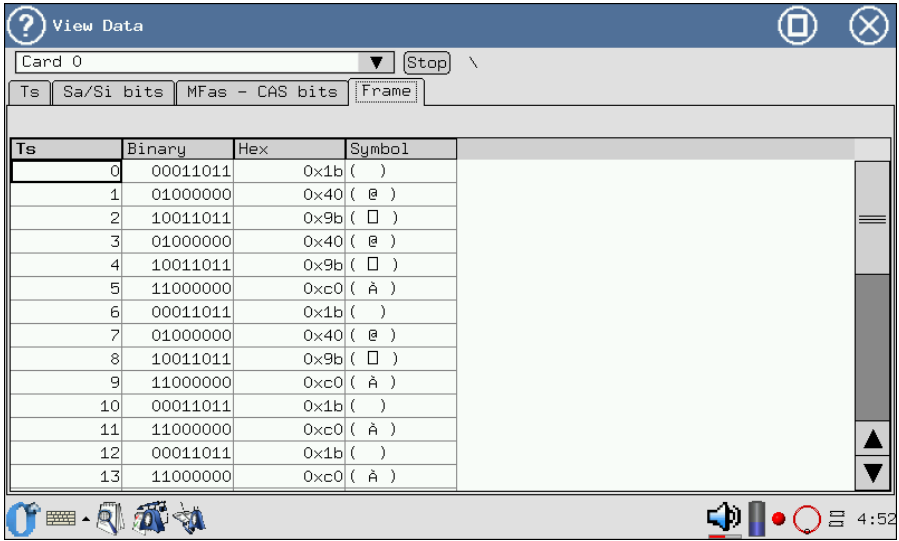


Figure 8.6. Frame Menu

9. Calibration

This section describes **E1 Card** calibration methods and tools. Recommended calibration periodicity is once a year.

9.1 Calibration procedures and tools

Calibration should be performed using procedures and measurement tools listed in Table 9.1.

Table 9.1: Measurement Tools Used

Calibration procedures	Item No	Calibrated parameters	Allowed measurement error or parameter maximum allowed value	Meas. tool
External examination	9.4.1			
Testing	9.4.2			
Metrological characteristics determination:				
Nominal transmission rate and timing frequency measurement limits determination, Hz	9.4.3.1	2048000; 2042000; 2054000	± 6	CH3-57
Determination of single pulse parameters at the 2048 kbit/s output: – pulse amplitude, V; – pulse width at half amplitude, ns; – negative and positive pulse amplitude ratio	9.4.3.2	pulse parameters at the 2048 kbit/s output	2,7 – 3,3 219 – 296 0,95 – 1,05	C1-114/1
Testing of tester error-free operation when receiving line signal at attenuation from 0 to 36 dB	9.4.3.3			IL-2048/ 1024
Transmission rate determination when synchronized from external source, bit/s	9.4.3.4	2048000	± 6	G3-112/1 CH3-57

Notes:

1. Mentioned measurement tools may be replaced with another similar measuring testers that provide respective parameters measurements with required accuracy.
2. Measurement tools should be fully operational, tested and should have testing certificates (check marks in logbooks or registration certificates).

Used technical specifications of measurement tools are listed in Table 9.2.

Table 9.2: Measurement Tools Specifications

Meas. tool name	Type	Meas. tool main specifications	
		Measurement limits	Inaccuracy
Signals generator	G3-112/1	100Hz — 10MHz	$\pm 0,5\%$
Frequency-indicating meter	CH3-57	0,1Hz - 100MHz	$\pm \left(2 \cdot 10^{-8} + \frac{1}{\frac{f_{meas} \cdot t_{count}}{T_{iakt}} \tau_{izm}} \right) \%$
Multi-purpose oscilloscope	C1-114/1	Signal amplitude: 10^{-2} —160B; Time slots: $2 \cdot 10^{-8}$ — 0,8s	$\pm 5\%$
Cable line equivalent	IL-2048/1024	0 — 36dB	

9.2 Calibration Conditions

Calibration procedure is performed at normal operating conditions:

- ambient temperature $(+20 \pm 5)^\circ \text{C}$;
- relative humidity from 40 to 80 25°C ;
- atmospheric pressure from 84 to 104,7 kPa (from 630 to 800 merc. col. mm);
- mains voltage: $(220 \pm 4,4) \text{V}$, frequency: $(50 \pm 0,5) \text{Hz}$ (when tester is powered by power supply unit).

There should be no external electrical and magnetic fields, vibration and shocks that affect tester operation.

9.3 Calibration Preparation

1. Calibration laboratory employee should be familiar with the tester operations manual and operations manuals for the measurement tools used.

- Tester should be prepared for operation according to this operation manual requirements.

9.4 Calibration Procedure

9.4.1 External examination

External examination should include following checks:

- absence of mechanical damages;
- cleanness of sockets, connectors and clips;
- condition of connecting wires and measuring cable;
- module labeling.

9.4.2 Testing

Testing of the tester under calibration is performed according to the present operations manual requirements in order to evaluate capability to support all measurement modes.

9.4.3 Metrological characteristics evaluation

9.4.3.1 Inaccuracy of setting and tuning of timing frequency

The inaccuracy of digital signal timing frequency setting is measured with the frequency meter by the following steps:

- From **PCM Analysis 2 Mbit/s** menu start **PCM Configuration** application.
- Set the following transmission parameters in **PCM Configuration** menu, **Line interface** tab:

Mode	Terminal
Tx synch	Internal
Deviation	0
G.704	PCM30C
G.703	HDB3
Prot. resist.	Off
Long haul	Off

- Using **Errors and Alarms** tab in **PCM Configuration** program configure the following modes:

Alarms	AIS
Cont	On

- From **PCM Analysis 2Mbit/s** menu start **Base Measurements** application. Press **Start** button.

5. After having executed the previous step, start the alarms generation by clicking **Alarm** button.
6. Connect module output signal from Tx connector to the frequency meter input. Measurement result is positive, if measured frequency is (1024000 ± 3) Hz.

Tuning limits of digital signal transmission timing frequency setting are measured with the frequency meter by the following steps:

1. From **PCM Analysis 2 Mbit/s** menu start **PCM Configuration** application.
2. Set the following transmission parameters in **PCM Configuration** menu, **Line interface** tab:

Mode	Terminal
Tx synch	Internal
Deviation	6000
G.704	PCM30C
G.703	HDB3
Prot. resist.	Off
Long haul	Off

3. Using **Errors and Alarms** tab in **PCM Configuration** program configure the following modes:

Alarms	AIS
Cont	On

4. From **PCM Analysis 2 Mbit/s** menu start **Base Measurements** application. Press **Start** button.
5. After having executed the previous step, start the alarms generation by clicking **Alarm** button.
6. Connect module output signal from Tx connector to the frequency meter input. Measurement result is positive, if measured frequency equals (1027000 ± 3) Hz.
7. Repeat measurements with deviation value of -6000 Hz. Measurement result is considered positive if measured frequency is (1021000 ± 3) Hz.

9.4.3.2 Output pulses parameters evaluation

Output pulses parameters evaluation at Tx output is performed using oscilloscope by the following steps:

1. From **PCM Analysis 2 Mbit/s** menu start **PCM Configuration** application.
2. Set the following transmission parameters in **PCM Configuration** menu, **Line interface** tab:

Mode	Terminal
Tx synch	Internal
Deviation	0
G.704	PCM30C
G.703	HDB3
Prot. resist.	Off
Long haul	Off

- Using **Errors and Alarms** tab in **PCM Configuration** program configure the following modes:

Alarms	AIS
Cont	On

- From **PCM Analysis 2 Mbit/s** menu start **Base Measurements** application. Press **Start** button.
- After having executed the previous step, start the alarms generation by clicking **Alarm** button.
- Connect module output signal from Tx connector to the oscilloscope input with previously connected 120 Ohm load.

Calibration results are considered satisfactory if single pulse has following parameters:

- pulse amplitude is (2,7–3,3) V;
- pulse width at half amplitude is (219–269) ns;
- negative and positive pulse amplitude ratio is 0,95–1,05.

9.4.3.3 Tester operation check on reception of line signal

Testing of tester error-free operation on receiving line signal at 0 and 36 dB attenuation is performed in two modes: with disconnected and connected cable line equivalent.

The cable line equivalent is connected between reception (Rx) and transmission (Tx) paths. In the mode without cable line equivalent, transmission and reception are interconnected. All settings and measurements for these two modes are the same.

Measurements procedure is the following:

- From **PCM Analysis 2 Mbit/s** menu start **PCM Configuration** application.
- Set the following transmission parameters in **PCM Configuration** menu, **Line interface** tab:

Mode	Terminal
Tx synch	Internal
Deviation	0

G.704	PCM30C
G.703	HDB3
Prot. resist.	Off
Long haul	Off (in the mode without equivalent) On (in the mode with equivalent)

3. Navigate to the **TS** tab. Select all TS (Time Slots) except 0 and 16 for test sequence transmission. Selected TS are marked with *;
4. Using **Test pattern** menu in **PCM Configuration** program, configure:

Type	2e15
RX invert	Yes
TX invert	Yes

5. From **PCM Analysis 2 Mbit/s** menu start **Base Measurements** application. Press **Start** button.
Prior to pressing ensure that all indicators are green.
Wait until measurement time ET counter shows 00:01:00 (1 minute).
Calibration results are considered satisfactory if:

CODE	0
BIT	0

9.4.3.4 Synchronization check on timing frequency measurement

Synchronization capability determination on measuring timing frequency at synchronization from external source is performed with the help of generator and frequency meter, completing the following steps:

1. Generator output is connected to the frequency meter input and to the **Sync** port; after that generator is tuned to 1024000Hz frequency that is monitored by the frequency meter.
2. Tx port is connected to Rx port.
3. From **PCM Analysis 2 Mbit/s** menu start **PCM Configuration** application.
4. Set the following transmission parameters in **PCM Configuration** menu, **Line interface** tab:

Mode	Terminal
Tx synch	External, Sync
Deviation	0
G.704	PCM30C
G.703	HDB3
Prot. resist.	Off
Long haul	Off

5. From **PCM Analysis 2 Mbit/s** menu start **Base Measurements** application. Press **Start** button.

The device is considered usable if measured frequency is changed by generator tuning in the range from $(2048000 - 6)$ Hz to $(2048000 + 6)$ Hz.

9.5 Calibration Results recording

Calibration results **E1 Card** that comply with the present section requirements are recorded in the device certificate in the form of calibration note, attested with the calibration lab employee signature and calibration stamp.

Modules that do not comply with the present section requirements are not admitted to operation and are subject to notification about their unsuitability with the record of tester parameters not compliant to technical specifications.

A. Troubleshooting

Possible faults and fault clearing methods are listed below in Table A.1.

Table A.1: Possible faults

Fault main indication	Possible reason	Fault clearing method
LOS when wires are connected to the path	Long line	Activate the <i>Long haul</i> mode
LSS when test sequence is configured	Time slots at reception and transmission do not coincide	Configure same time slots
Errors when device is tested <i>on its own</i>	Synchronization from received stream is configured	Configure internal synchronization mode
When card is plugged into the device, the card is not detected	It may be not connected properly	Check if it is connected properly

B. Main Technical Specifications

Table B.1: Main Technical Specifications

Parameter	Meaning
Interface type	E1
Clock frequency, MHz	2,048
— with available deviation, kHz	± 6
Clock setting relative inaccuracy allowed limits	$\pm 3 * 10^{-6}$
Pulses amplitude and shape:	
— amplitude, V	$3,0 \pm 10\%$
— pulse width at half amplitude, ns	$244 \pm 10\%$
— positive and negative pulses amplitude ratio	0,95...1,05
Output impedance, Ohm	$120 \pm 10\%$
Unmatched input attenuation relative to nominal value (120 Ohm), dB (in the frequency range, MHz)	$\begin{cases} \geq 12(0,020 - 0,102) \\ \geq 18(0,102 - 2,048) \\ \geq 14(2,048 - 3,072) \end{cases}$
Maximum input signal attenuation relative to nominal value, dB	32
Inserted jitter amplitude range, Cl.Pul., at modulation frequency, kHz	
0,02	0...10
10	0...10
18	0...0,5
50	0...0,2
Inserted jitter amplitude measurement limits, Cl.Pul.	0,035...10,4
Allowed main inaccuracy limit of phase jitter amplitude measurement (A), Cl.Pul.	$\pm(0,05A + 0,035)$

C. Measurement Cables: Pins Designation

The **E1 Card** distribution kit includes:

- B4-E1-4 card
- Measurement cables 1 and 2.

When performing PCM path and protocols analysis using **E1 interface analysis card** it is necessary to apply corresponding measuring cables 1 and 2, that differ with wire pairs designation (refer to Table C.1).

This section contains corresponding RJ-45 connectors diagrams with pinout.

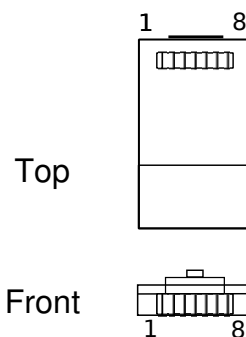


Figure C.1. The RJ-45 Connector Schematic Diagram

Table C.1: Measurement Cable Pinout

		Cable 1	Cable 2
Pin number	Wire colour	PCM/protocol analysis	PCM/protocol analysis
1	green+white	-/R0	-/R2
2	green	-/R0	-/R2
3	brown	-/-	-/-
4	orange+white	Tx/-	not used
5	orange	Tx/-	not used
6	brown+white	-/-	-/-
7	blue+white	Rx/R1	SYNC/R3
8	blue	Rx/R1	SYNC/R3

D. Technical support

Additional information on the **Bercut-MMT** device and new software can be found at the company site www.metrotek.ru. You also can send an email or call Technical Support Service (refer to **Contact Information**). Please provide problem description and device data that can be found in the device's menu item: ***Bercut-MMT Device Information*** (**O-menu** ⇒ **Configuring** ⇒ **Bercut-MMT Information**), and consist of the following information:

- device serial number (also present on the rear panel);
- version;
- pluggable modules information.

***Note:** prior to application to the technical support service it is recommended to update the firmware version of the device and to check its operability again.*

D.1 Contact Information

Metrotek
105082, Moscow,
26v/2, Bolshaya Pochtovaya street
Phone: (495) 961-0071
www.metrotek.ru