# Bercut-E1

## Universal handheld analyser for telecommunication networks

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### Functional description

**Version 1.0.10**

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**Metrotek**

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# Chapter 1

# Bercut-E1: overview

Based on a handheld computer **Bercut-E1** represents the new generation of telecom measurement equipment.

**Bercut-E1** can be used to test telecommunication equipment in accordance with international and national standards, and for operative diagnostic and troubleshooting of the networks elements.

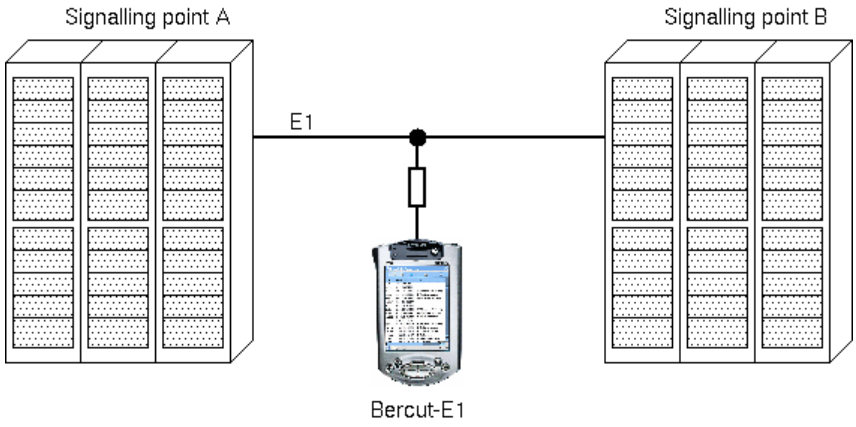
## 1.1 Basic functions

- Two basic modes - protocols analysis and pcm measurements and analysis
- Non-intrusive data stream capture
- Signalling protocols decoding and analysis
- Erroneous signalling messages indication
- Powerful Signalling data filtering system
- Context help for protocol messages (english, russian)
- Saving data for post-processing
- PCM-frame contents monitoring and voice channel control
- ITU-T G.821 and G.826 analysis with posiibility of graphical reports
- Real-time PCM status control
- Data synchronization with desktop PC
- Remote control function
- Desktop PC Software kit (Windows95/98/2000/XP or Linux) intended for the post-processing

**Bercut-E1** is very miniature and easy-to-use device. It uses universal open platform and well-known standard data transfer protocols, so user has no limits for expanding or interconnections with informational systems.

## 1.2 Operation principles

The basic principle of the **Bercut-E1** operation is the non-intrusive control mode, i.e. analyser connects to tested system in parallel with high-impedance input probe and hereby can not influence on the monitored objects while data gathering.




**Bercut-E1** allows user to display decoded signalling data, control output parameters, filter results by wide range of conditions, save data for futher post-processing etc.

## 1.3 Supply kit

The supply kit of the **Bercut-E1** analyser includes:

- Bercut-E1 analyser:
  - data processing and display module, based on iPAQ Pocket PC H5400, and
  - interface unit (E1-unit) for connection to PCM equipment based on PC Card Expansion Pack.
- Interface cable to connect to PCM equipment.
- AC/DC adapter 110/220V.
- Universal cradle for USB or serial connections.
- Desktop PC Software kit
- User Guide

# Chapter 2

# Connection and preliminary settings

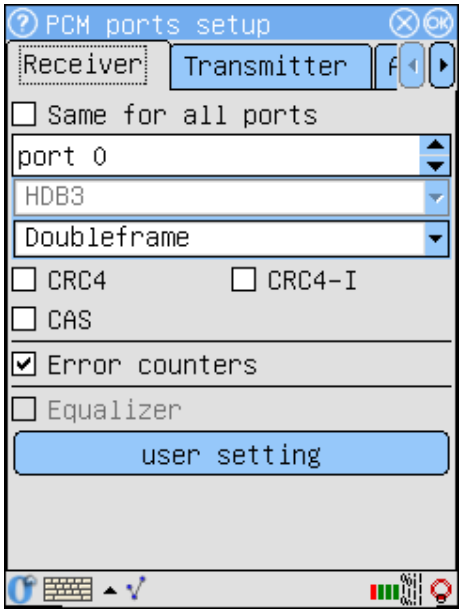
## 2.1 Connection to PCM

Connection to PCM-equipment to be tested is a very easy and short-time process. To get an access to all **Bercut-E1** applications and start an analysis user need to fulfill just 3 steps:

1. Connect the E1-module to data processing module.
2. Connect anasyser to PCM equipment using the connecting cable.
3. Turn on the power and pass authorization procedure.

## 2.2 PCM parameters setup

The first mandatory step after connecting is the PCM parameters setup by means of the “PCM settings” application.




Application “PCM settings” provides the following features:

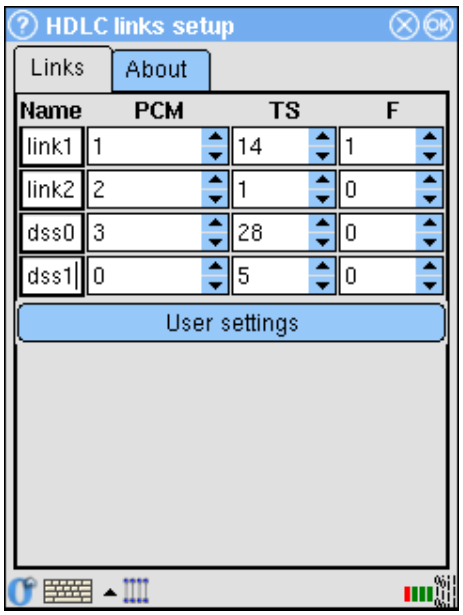
- Same for all ports
  This option allows to use same settings for all ports and therefor reduces the time for parameters settings.
- Two types of the frame structure support.
  **Bercut-E1** allows to test systems with both doubleframe or multiframe alignment.

- CRC4 control option
  For the systems with multiframe alignment there are additional options available: CRC4 and CRC4 with bits inversion performance control.
- CAS synchronization
  **Bercut-E1** supports the systems with CAS synchronization.
- Errors counters
  This option enables continious count of different errors types throughout the operating session.
- Optional long-haul support Special versions of the **Bercut-E1**'s software support the long-haul testing.

## 2.3 Signalling links parameters setup

**Bercut-E1** provides following features for setting tested signalling links parameters:

- User-defined links names.
  User can set convenient symbollic names for tested links.
- Hardware short-packets filter.
  Hardware filter of short-length signalling usits (packet length is less then 4 bytes; e.g. FISU). If this option enabled then **Bercut-E1** ignores such units and they will never be stored in RAM.
- "One-tap" restoration of the preceding configuration.
  Whenever application is loaded all parameters will be set to their default values. User can easily restore preceding parameters values using User Settings button.




## 2.4 Operational modes

**Bercut-E1** analyser can operate in two modes:

- monitoring and analysis of signalling protocols data; and
- measurements and analysis of PCM trunks

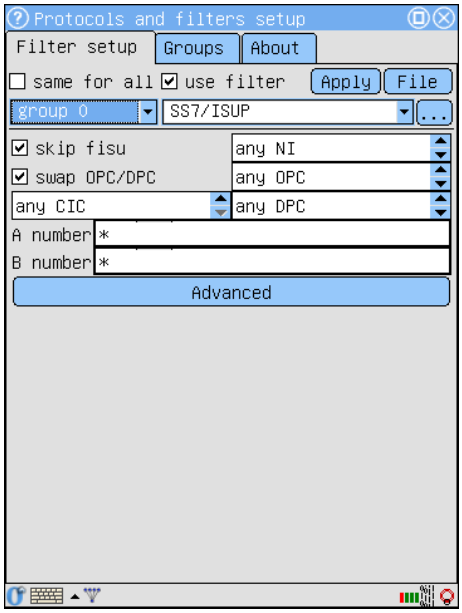
The operating modes can be easily switched without need to reset the device.

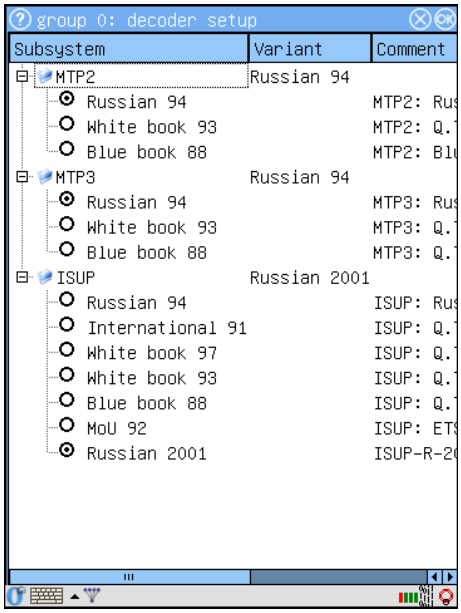
# Chapter 3

# Protocols analysis

## 3.1 Real-time monitoring

**Bercut-E1** analyser provides simultaneous monitoring for up to 4 PCM interfaces and 2 bidirectional signalling links. The device automatically captures data stream and decodes it in a real-time mode in accordance to international or national signalling system standards.




If **Bercut-E1** is connected to desktop PC then it can operate in probe mode i.e captured stream will be automatically transfered to the PC and stored on its hard disk. In this case real-time monitoring can be performed for 24 hours a day without loss any data.

Flexible link settings subsystem allows to operate in a multiprotocol monitor mode. For example, user can connect one E1-interface to SS7 signalling link and another one to DSS/PRI link to control protocols interworking. The full list of currently supported signalling systems is available in Specifications at the end of this document.

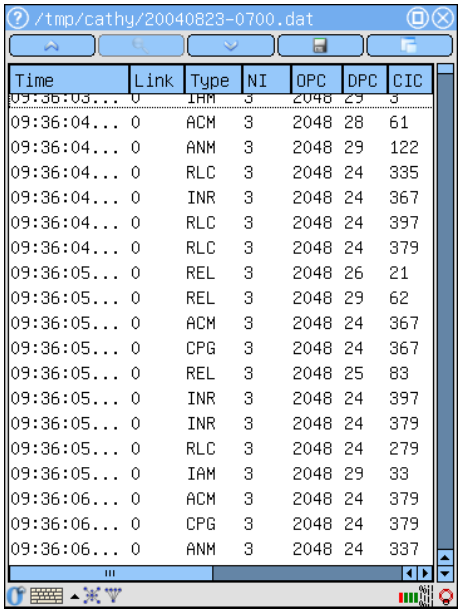
For the real-time monitoring the Filtering subsystem can be used in pre-filtration mode. This allows to reduce time spent to localize nesessary signalling information.

In the monitoring mode **Bercut-E1** also registers and counts PCM and protocol alarms and errors. Result can be viewed as counters with an apropriate built-in application.

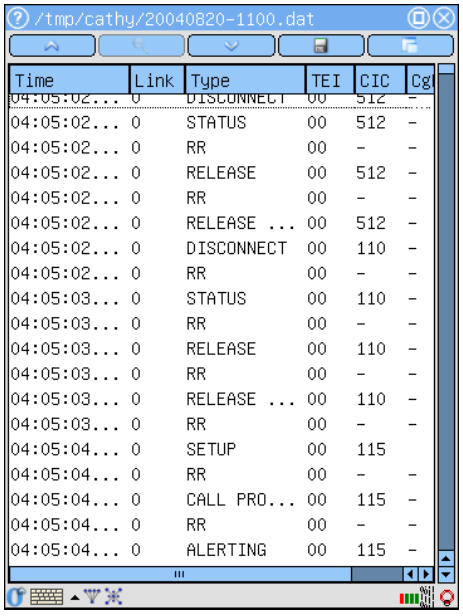
## 3.2 Data decoding

Signalling data decoding from the binary to the human-readable format is one of the main functions of the **Bercut-E1** analyser. Captured data are displayed as a tabbed list, one message per line in order of the capture time.

**Message list features**

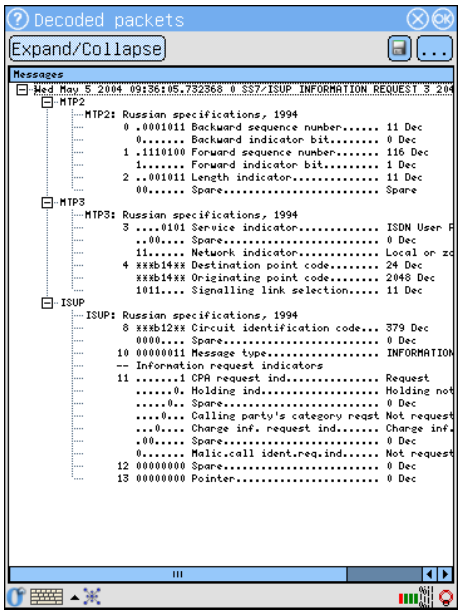



- Highlighting of erroneous or unknown messages
- The following basic parameters are displayed for all messages:
  - **Date** – message capture date
  - **Time** – message capture time
  - **Link** – signalling link and direction
  - **Proto** – signalling protocol name
  - **Info** – additional information




- Wide range of protocol-dependant fields. For example:
  - **SS7/ISUP:** Message type, Network Indicator, Originating and Destination Point Codes, CIC, Calling and Called partys numbers, Cause Value.
  - **DSS1/EDSS:** message type, TEI, CIC, Calling and Called Party Number and Cause Value
- Easy-to-customize interface.
  User can easily tune the messages list output to be convenient for current needs.
- Quick substring search of any data in the list.

Any registered message can be decoded at full length. Utterly decoded messages can be displayed with customizable detailes class, i.e. user can view only one protocol layer without expanding others (for example, view only ISUP part data without MTP2 and MTP3)




## 3.3 Data storage and post-processing

Any collected signalling data can be stored for futher processing in the **Bercut-E1** RAM or on external memory cards. Also any data can be synchronized with desktop PC.

Signalling data can be stored in two formats:

1. Captured data stream can be saved as a binary trace-file and can be lately displayed and processed with an internal protocol analysis aplication or with special desktop PC software included in **Bercut-E1** Supply kit.
2. Utterly decoded messages can be saved as a text file for further processing with any text editor.

## 3.4 Filtering and search

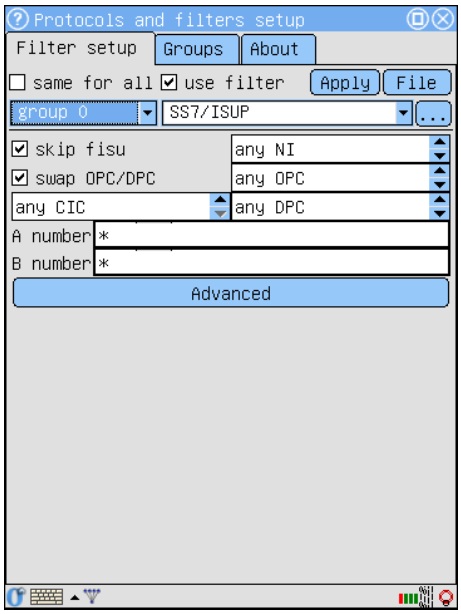
Filtering subsystem is a powerful tool allows to essentially reduce time searching for the necessary information through the signalling data stream. Filters are useful for possible malfunction localization and troubleshooting.

Filters are available in both pre- and post-filtration mode. In the first case filters applies to the captured stream and all data that do not match to defined conditions will be ignored. In case of post-filtration all filter parameters apply to an already collected and stored signalling information.

Defined filter parameters can be saved as a configuration file. This option is useful for frequently used parameters combinations. Besides, preceeding filter settings can be easily restored with only one stylus tap.

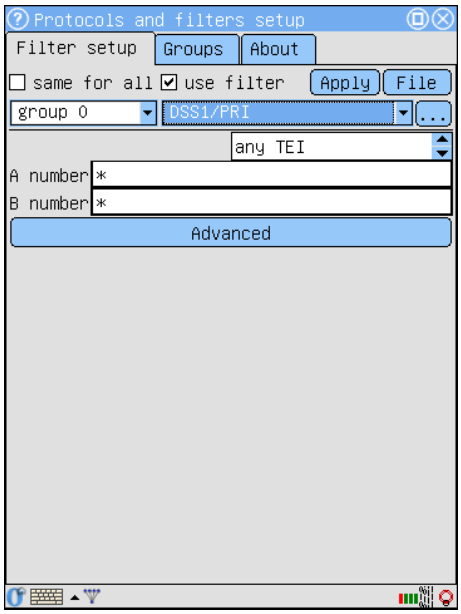
Number of filters parameters depends on currently selected signalling protocol. The list of filter settings for basic supported protocols is shown below. For several parameters (subscribers numbers and the substring) the wildcards “*” and “?” are allowed.

### SS7 Parameters



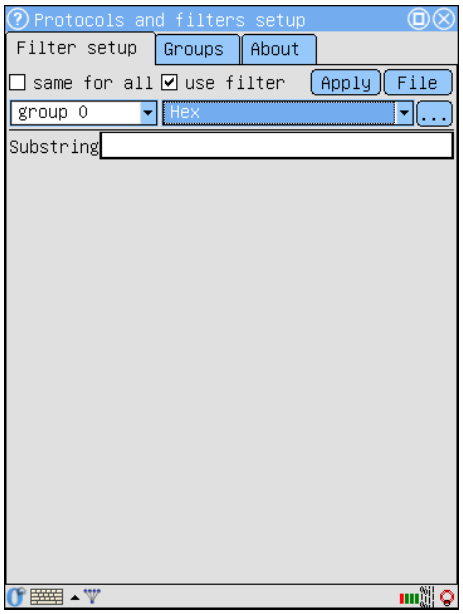

- **skip fisu** – software filter for FISUs.
- **NI** – Network Indicator
- **OPC and DPC** – Originating and Destination Point Codes
- **swap OPC/DPC** – this option enables to show messages transmitted in both directions
- **A number/B number** – Calling/Called subscriber numbers.

### DSS1/EDSS Parameters




- **TEI** – Terminal Endpoint Identifier
- **A number/B number** – Calling/Called subscriber numbers.

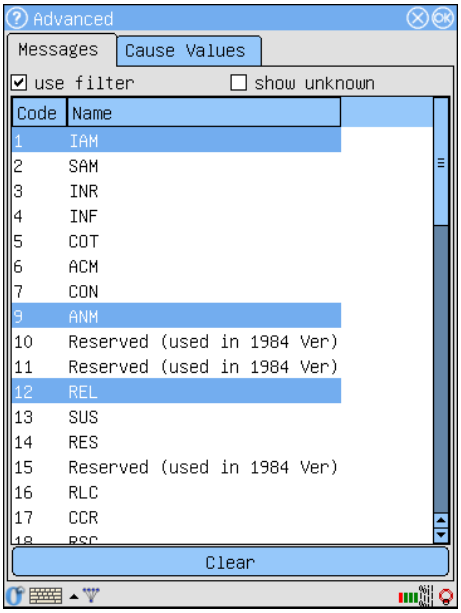
### Hexadecimal decoder settings



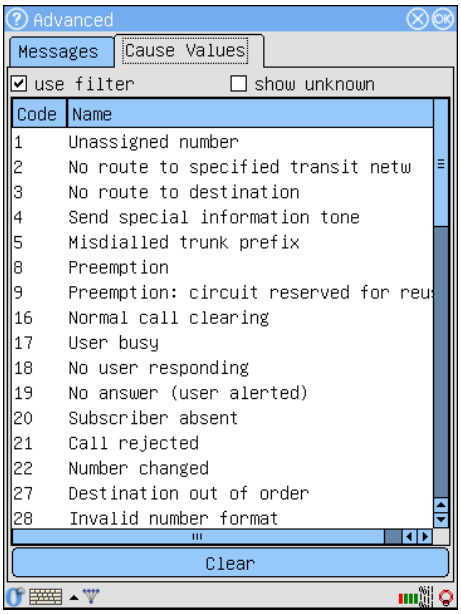

- **Substring** – set substring as filter.

For some signalling protocols such as SS7 or DSS/PRI there are advanced filter conditions available:

1. Message type filter




2. Cause value filter




3. “Show unknown” option which allows to display messages that are unknown for selected protocol

# Chapter 4

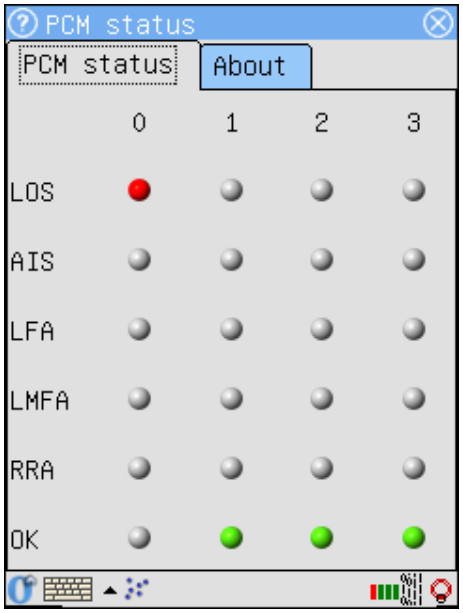
# Performance Control

## 4.1 PCM status monitor

**Bercut-E1** allows to control PCM line alarms and errors in in-service mode.

The group of four indicators (according to the device's interface ports) is allways available in a task-bar and user can immediatly react to the changing of a connected PCM-line status.

With only one tap at the indicators area user will get the detailed status information about following states:



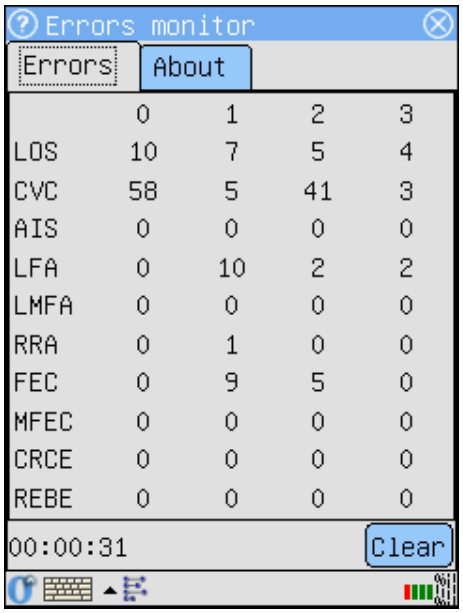

- LOS – Loss Of Signal
- AIS – Alarm Indication Signal
- LFA – Loss Frame Alignment
- LMFA – Loss MultiFrame Alignment
- RRA – Receive Remote Alarm
- OK – connected PCM line operates in a normal mode

Indicators color differs according to the status:

- Red — alarm detected
- Green — no alarms, normal ststus
- Gray — unknown state (no line connected to the port)

## 4.2 PCM errors

**Bercut-E1** collects information about registered PCM alarms and errors within operating session and allows to view these data as accumulative counters.

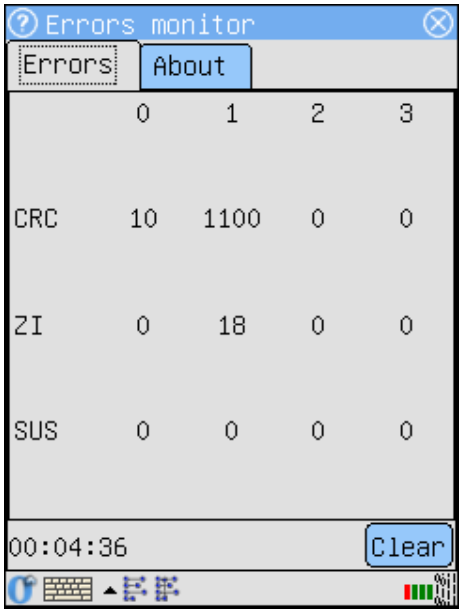



Besides counters of registered alarms listed above, **Bercut-E1** provides information for the following errors counters:

- CVC – Code Violation Counter
- FEC – Frame Error Counter
- MFEC – MultiFrame Error Counter
- CRCE – CRC Error counter
- REBE – Remote E-Bit errors counter

## 4.3 HDLC errors

**Bercut-E1** allows to control HDLC-channel performance by means of accumulated errors counters.



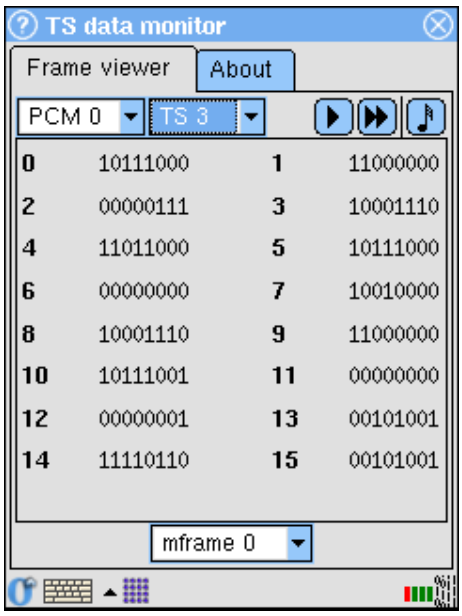

For each connected channel user can get information for the following HDLC errors:

- CRC – Cyclic Redundant Code errors
- ZI – Zero Insertion errors
- SUS – Signal Unit Size errors

## 4.4 Frame monitor

**Bercut-E1** can monitor the binary content of a PCM-frames data in 3 modes:

- reading data from a selected timeslot for 32 multiframes at once[1]
- continious reading data from a selected timeslot for 32 multiframes [2]
- real-time timeslot monitoring. This mode is also used to listen audio channels.




[1] If connected system does not use Multiframe synchronization, then **Bercut-E1** reads data from 16 frames

[2] If connected system does not use Multiframe synchronization, then **Bercut-E1** reads data from 16 frames

# Chapter 5

# PCM Measurements

## 5.1 “PCM measurements” subsystem

This **Bercut-E1** subsystem allows to measure and analyse different PCM parameters to control tested trunk performance.

The analyser carries out two types of PCM measurements:

1. In-Service monitoring (ISM) for maintance and performance monitoring.
2. Out-of-Service (OSM) for installation, provisioning and bringing-into-service tasks.

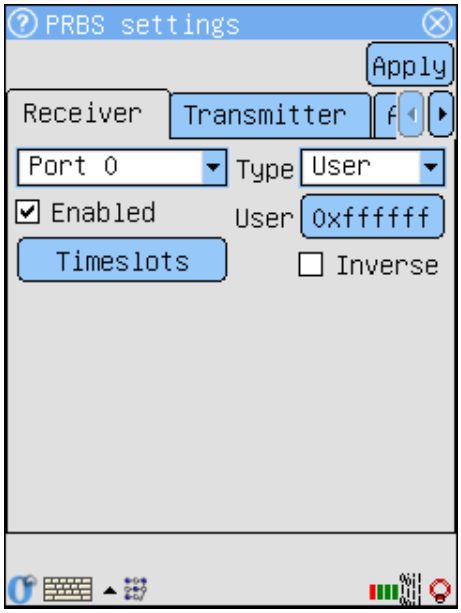
All measurement results can be saved as file for futher review at any moment during measurement session without process interraption.

### 5.1.1 Test Pattern Generator/Receiver

Test Pattern Generator/Receiver generates test pattern or PRBS in either the transmit or receive direction. The pattern can be generated in any selected timeslot(s) of connected PCM trunk.

**Pattern generator**
The following patterns can be generated:

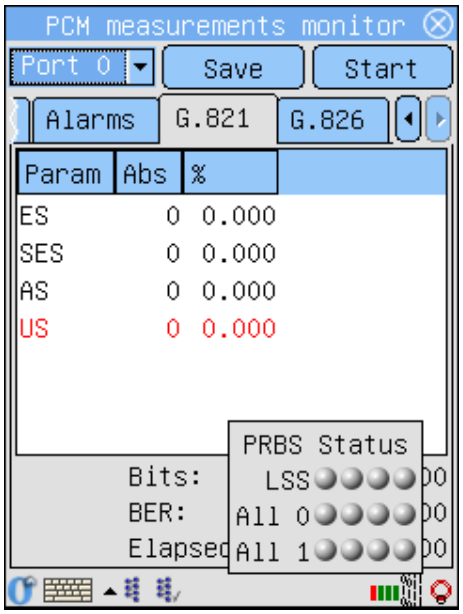
- $2^6 - 1$
- $2^9 - 1$
- $2^{11} - 1$
- $2^{15} - 1$
- $2^{23} - 1$
- Fixed patterns (all `1`, all `0`, alternative, user defined)



### 5.1.2 PRBS Status

Test pattern receiver status is displayed with an taskbar applet. This applet shows if there is synchronization of locally generated pattern with received pattern.

This data is dislayed as a table of indicators which colors differs as follows:




- Red – alarm status
- Green – normal status, no alarm
- Gray – status is not available. Such situation appears in the following cases:
  1. Pattern receiver is not enabled for current port
  2. There were LOS or AIS alarm detected for current port

Each E1 interface (numbered from 0 to 3) fits column in the table. Status parameters are displyed in table rows as followed:

- **LSS** – Loss of sequence synchronization.
  Shows status of synchronization with the received pattern.

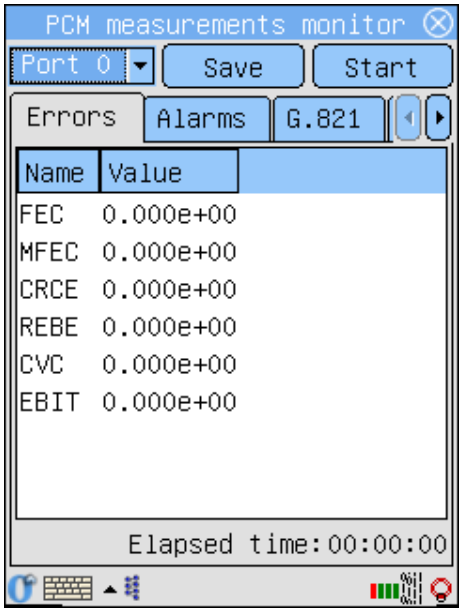
  Status can be estimated as alarm if:

  1. wrong type of pattern or it's inversion were selected
  2. timeslots for the patterm receiving have been selected incorrectly
  3. received pattern has more than 10% of bit errors
- **All 0** – additional parameter which shows that in timeslots intended for test pattern there were only `0` received (for 255 received `0` there are no `1` detected)
- **All 1** – additional parameter which shows that in timeslots intended for test pattern there were only `1` received (for 255 received `1` there are no `0` detected)

### 5.1.3 PCM Errors and Alarms

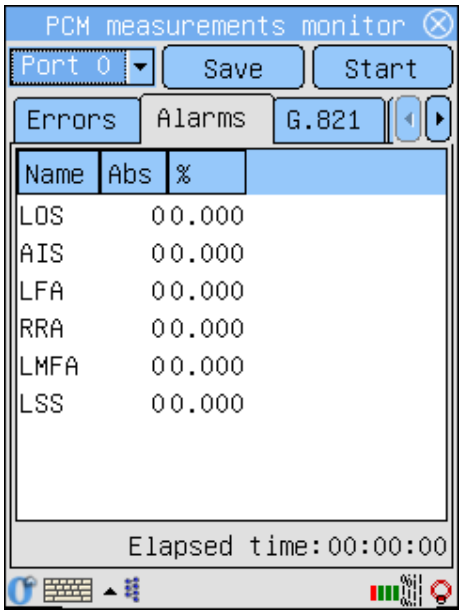
“PCM measurements” subsystem counts and displays errors and alarms detected for E1 interfaces during the measurement session.

**Errors**




- CVC – Code Violation Counter
- FEC – Frame Error Counter
- MFEC – MultiFrame Error Counter
- CRCE – CRC Error counter
- REBE – Remote E-Bit errors counter

**Alarms**




Following alarms can be detected:

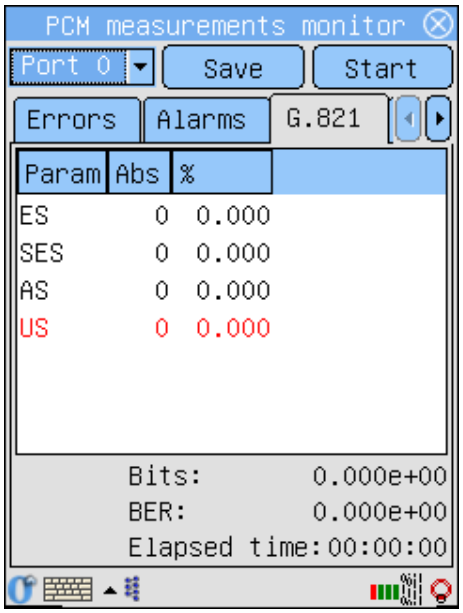
- LOS – Loss Of Signal
- AIS – Alarm Indication Signal
- LFA – Loss Frame Alignment
- LMFA – Loss MultiFrame Alignment
- RRA – Receive Remote Alarm
- LSS – Loss of Sequence Synchronization

Besides the absolute values for alarm counters error ratio is also displayed.

### 5.1.4 G.821 measurements

Measurements and analysis for following parameters are carried out:

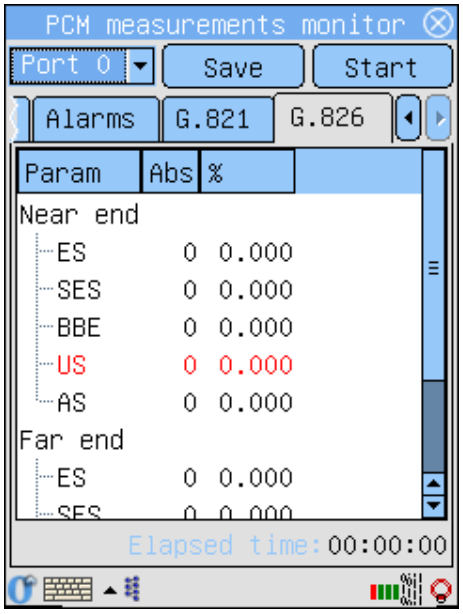
- **ES** – Errored Seconds
- **SES** – Severely Errored Seconds
- **AS** – Available Seconds
- **US** – Unavailable Seconds




### 5.1.5 G.826 measurements

PCM performance analysis according to ITU-T G.826 recomendation provides possibility to measure parameters in the In-Service mode. All measurements are carried out for near and far ends.

- **ES** – Errored Seconds
- **SES** – Severely Errored Seconds
- **AS** – Available Seconds
- **US** – Unavailable Seconds
- **BBE** – Background Block Errors

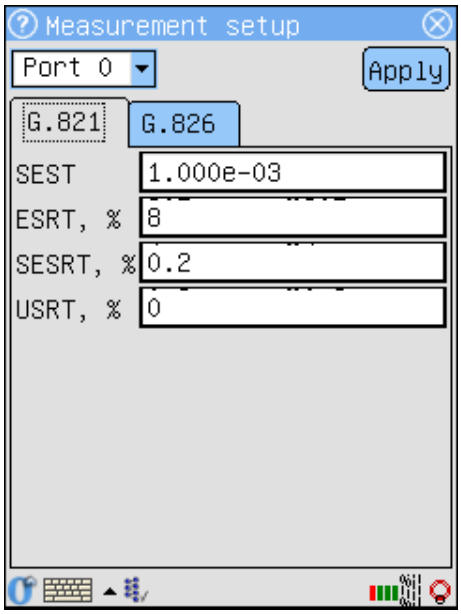


### 5.1.6 PCM measurements settings

For each measurement parameter the tresholds can be set. If these values have been achieved during the mearurement session then the measured parameter is highlighted as alarm.

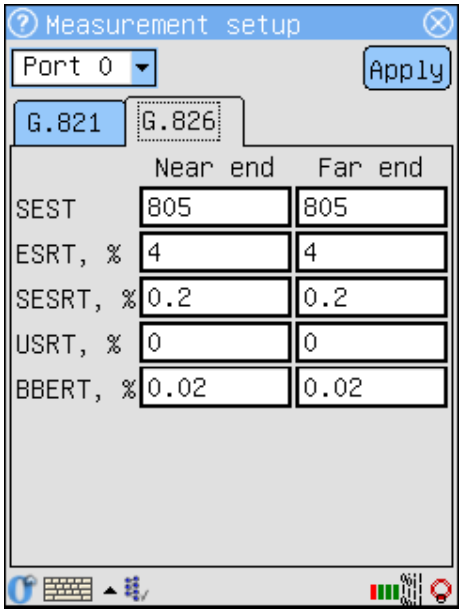
#### G.821 settings

- **SEST** – Severely Errored Seconds Treshold. The value from `0` to `1`, default value `1e10-3`.
- **ESTR** – ES ratio treshold (errored seconds), in %
- **SESRT** – SES ratio treshold (severely errored seconds), in %
- **USRT** – US ratio treshold (unavailable seconds), in %




#### G.826 settings

Following values can be set as G.826 analysis parameters:



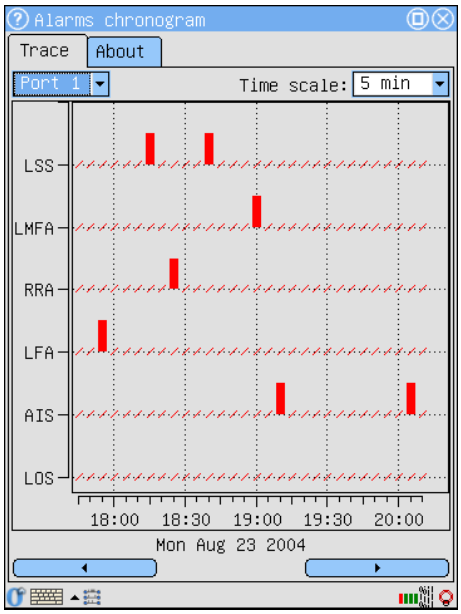

1. Quality Threshold:
   - SEST - SES counter treshold
2. Preformance Objectives:
   (a) ESRT
   (b) SESRT
   (c) USRT
   (d) BBERT

   These parameters are the tresholds for ESR, SESR, USR, BBE correspondingly.

All parameters can be set for near and far ends separately. By default their values are equal.

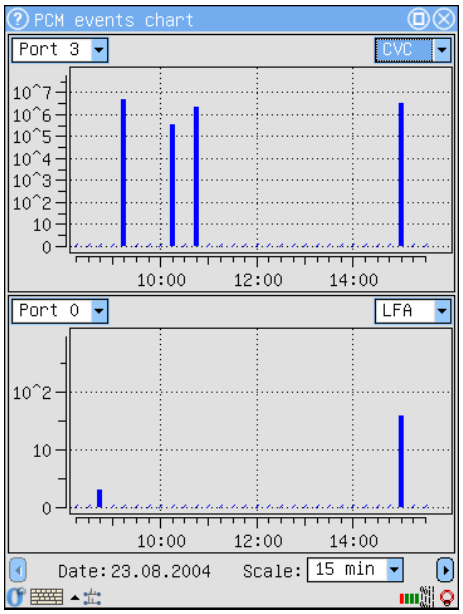
### 5.1.7 Graphic reports

"PCM measurements" subsystem allows to display analysis results in graphic format.




**Chronogram**
The chronogram traces the alarms detection during measure session for each E1 interface. Time scale can be set to 1, 5, 15, 30 minuts or an 1 hour.

**Chart**
**Bercut-E1** allows to generate charts that show values of measured parameters during the session. An application displays two charts simultaniously. Time scale is the same to the chronogram time scale.



# Appendix A

# Specifications

## A.1 Technical specifications

| | |
|---|---|
| E1 interface | duplex, symmetrical, 2x430 Ohm |
| Input resistance | not less than 4 kOhm |
| User interface | graphical |
| Display | Transflective color TFT, 240-320 pixels, 64535 colors support |
| Input methods | Touch-screen input with stylus, virtual keyboard |
| Memory | RAM 32M / ROM 32M |
| Possibility to extend memory | up to 512 Mb |
| External interfaces | Serial, USB, IrDA, Bluetooth |
| Remote access via | ssh, telnet, http, ftp, NetBIOS |
| Data sync with PC | Windows 95/98/XP/2000, Linux |
| Autonomic operational time (w/o battery recharge) | up to 10h |
| Power | 1400 mAh Li-Polymer built-in battery, AC/DC adapter |
| Size | 133 x 88 x 36 mm |
| Weight | 250 g (including battery) |

## A.2 Supported Signalling protocols

### A.2.1 SS-7

- **MTP** ITU-T Q.700-Q.709, Blue Book, 1988
  ITU-T Q.700-Q.709, White Book, 1993
  Russian (national), 1994, 2001
- **ISUP** ITU-T Q.761-Q.764, Blue Book, 1988
  ITU-T Q.767, 1991
  ISUP MoU: ETSI ETS 300 121, 1991
  ITU-T Q.761-Q.764, White Book, 1993, 1997
  Russian (national), 1994, 2001
- **SCCP** ITU-T: Q.711-Q.716, White Book, 1996
  ANSI T1.112
  Russian (national), 1994, 2001
- **TCAP** ITU-T: Q.711-Q.774, White Book, 1997
  ANSI T1.114-1996
  Russian (national), 1994, 2001
- **INAP** ITU-T: Q.1218, 1995
  ETSI: CS-1 Core INAP, ETS 300 374-1, 1994
  Russian (national), 1994

### A.2.2 DSS1/PRI

- **EURO-ISDN** ETSI:
  ETS 300 011, ETS 300 125, ETS 300 102
- **DSS1/PRI** ITU-T: I.431, Q.921, Q.931

### A.2.3 GSM, GPRS

- **MAP** GSM 09.02 Release 1996
- **MAP GPRS** GSM 09.02 Release 1997
- **Abis** GSM 08.56, 08.58, 04.08
- **BSSMAP** GSM 08.08
- **DTAP** GSM 04.08
- **SS** GSM 04.80
- **CAMEL** GSM 09.78 Release 1997
- **SMS** GSM 04.11

### A.2.4 V5

- **V5.1** ETSI: ETS 300 324
- **V5.2** ETSI: ETS 300 347

### A.2.5 QSIG

- **QSIG** ETSI: ETS 300 172, 1995