Operating Manual

Frame/Signalling Analyzer PA-41

BN 4532

For instrument software version 04.00 ‘I’ / ‘S’...

Please direct all enquiries to your local Wavetek Wandel Goltermann sales organisation. The addresses are given at the end of this manual.

Order No. BN 4532/00.92 Revision 06/17.09.99

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Channel Associated Signalling Analysis

Please note that the Channel Associated Signalling Analysis test mode has been removed from the base PA-41 software and is now supplied as a separate software option (BN 4532/00.08) and forms part of the complete PA-41 package.

Full details for operating the CAS Analysis Option will be found in Operating Manual BN 4532/98.22.

Contents

1. Introduction

1.1 Overview

The PA-41 is a handheld frame/signalling analyser for use on 2Mbit/s digital primary multiplex networks. The instrument has one transmitter and two receivers conforming to ITU-T Recommendation G.703.

The user interface is via an LCD screen and membrane keyboard. The menu-driven software is structured for ease of operation and clarity of information. The user interface may be extended to a remote VDU terminal via the V.24 port. The V.24 port can also be used to drive a printer to provide hard copy of setups and results. A memory card interface provides for mass setup and results storage, and the means to install software options.

The instrument, as supplied, provides two modes of operation:

- Bit Error Ratio Testing (BERT)
- PCM and frame analysis (PCM)

Option software may be installed to provide further test modes, such as Common Channel Signalling analysis (CCS) and Channel Associated Signalling analysis (CAS).

The PA-41 has many applications for digital primary multiplex testing in the field including:

- Framed monitoring in both directions simultaneously
- Framed end-to-end analysis
- Drop and Insert testing
- Channel Associated Signalling analysis (optional)
- Common Channel Signalling analysis (optional)
- Digital cross connect testing
- Automatic protection switch testing
- Unframed end-to-end testing.

1.1.1 Key to Controls and Connectors

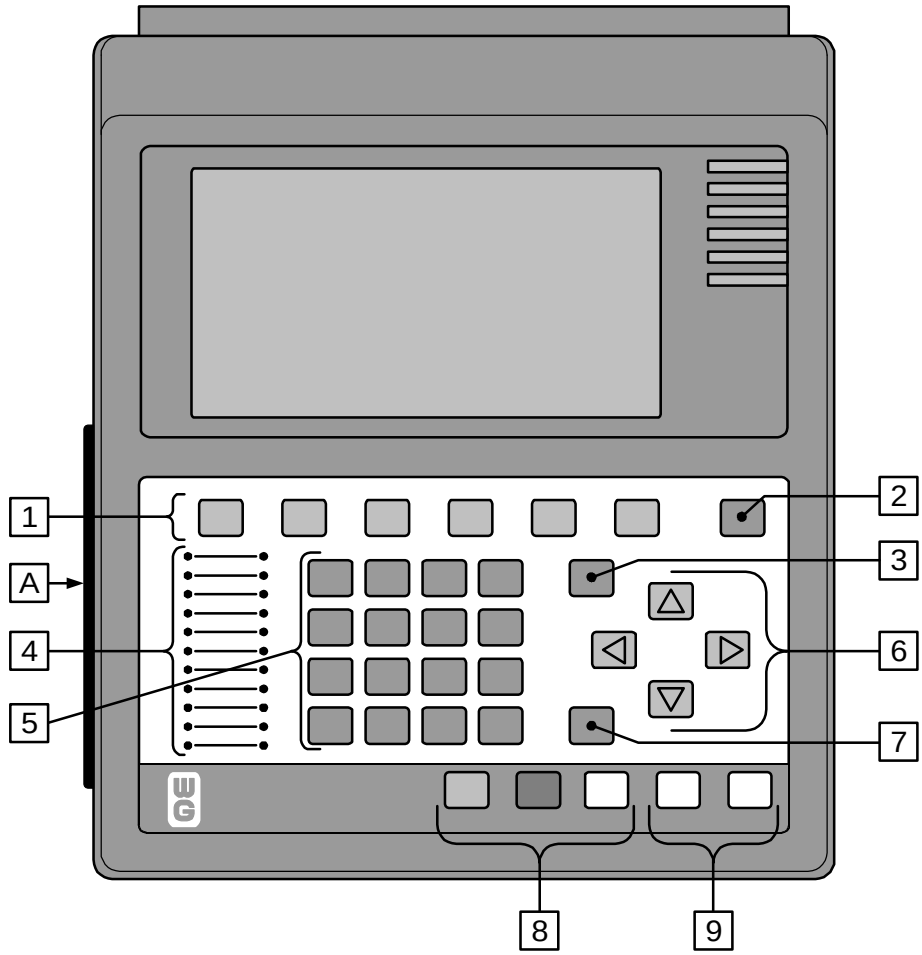


Figure 1.1-1 – Key to front panel controls

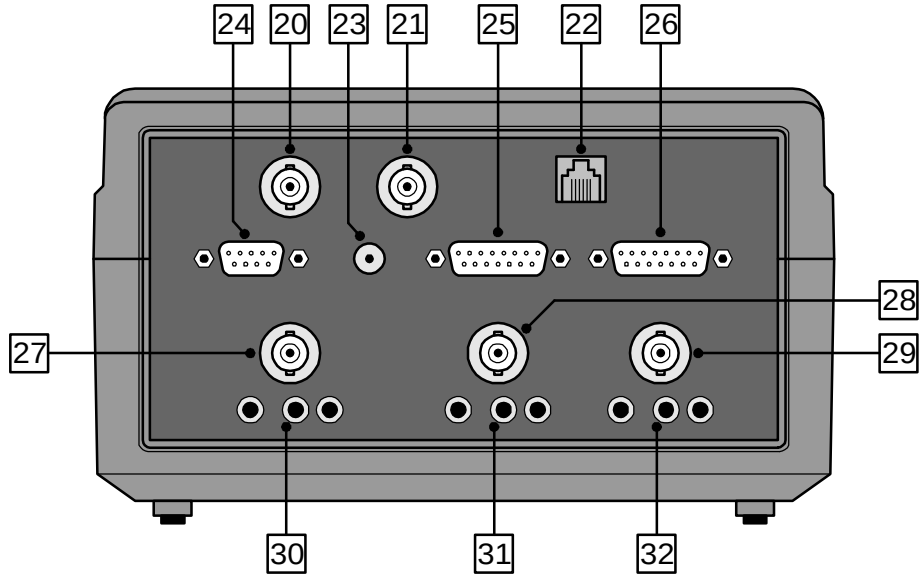


Figure 1.1-2 – Key to connectors on rear panel

Note: The numbers enclosed within square brackets used in the text, provide a quick location guide to the external controls and other items shown in Figures 1.0-1 and 1.0-2. These reference numbers are repeated, enclosed within squares, in their appropriate positions on the front and rear panels of the instrument.

Display and Keyboard

[A]	**Memory Card slot**	Suitable for JEIDA V4.0 68-pin memory cards.
[1]	**Softkeys**	These keys are labelled F1 to F6 and are associated with the bottom line of the display. Each display page defines the function of one or more of these keys.
[2]	**EXIT**	Returns user to the menu previously selected.
[3]	**MAIN MENU**	Pressing this key returns the user to the Main Menu.
[4]	**LED Alarm and Status indicators**	These LEDs provide six permanent line alarms and one user programmable alarm indicator for each receiver. In addition there are four green LEDs which indicate the channel status of the ABCD bits for Channel Associated Signalling on each receiver.
[5]	**Hexadecimal keypad**	Used for entering decimal and hexadecimal values.
[6]	**Cursor keys**	These four direction keys are used to move the cursor between fields in the menu displays, scroll through tables and results buffers.
[7]	**PRINT**	Dumps the currently displayed menu or results information to a printer via the V.24 interface.
[8]	**Contrast and Backlight keys**	The dark and light contrast keys are used to set the optimum contrast between the pixels and the background of the liquid crystal display. The third key switches the backlight on or off.
[9]	**ON/OFF**	These keys turn the instrument power on or off. The instrument will turn itself off a short time after displaying a ‘LOW BAT’ warning, or if a test is not running and no key has been pressed during the previous five minutes, and auto-power down has not been disabled.

Rear Panel Connectors

[20]	**Trigger input/output**	Enables a number of PA-41s to be connected together to provide synchronised triggering of event recording.
[21]	**External Clock input**	Provides a HCMOS level, 2048kbit/s clock input to provide synchronisation with other equipment.
[22]	**Handset Connector**	RJ11 socket providing a connection to the telephone handset.
[23]	**Power Connector**	The socket to which the LNT-6 A.C. Adaptor/Charger should be connected in order to recharge the internal NiCd batteries, or to operate the instrument from a.c. mains.
[24]	**V.24 Connector**	Interface for printing and remote control.
[25]	**V.11/X.24 Interface A**	Connector for 64 to 2048kbit/s drop and insert (DTE/DCE).
[26]	**V.11/X.24 Interface B**	Connector for 64 to 2048kbit/s drop only (DCE).
[27]	**Tx output**	G.703 interface Tx output, unbalanced, 75Ω, BNC connector.
[28]	**RxA input**	G.703 interface Rx A input, unbalanced, 75Ω, BNC connector.
[29]	**RxB input**	G.703 interface Rx B input, unbalanced, 75Ω, BNC connector.
[30]	**Tx output**	G.703 interface Tx output, balanced,120Ω, CF connector.
[31]	**RxA input**	G.703 interface Rx A input, balanced,120Ω, CF connector.
[32]	**RxB input**	G.703 interface Rx B input, balanced,120Ω, CF connector.

Note: In this and following sections, when a softkey press is required the key title is enclosed in special brackets, e.g. <**key**>. For a 'hard' keypress the key title is enclosed in square brackets, e.g. [EXIT]. Where reference is made in the text to menus or displayed pages, the title is enclosed by { } brackets, e.g. {**BERT: Patterns Menu**}, the text being the same as that shown by the display itself.

Note on the relationship between CCITT and ITU-T:
The ITU-T (the telecommunications standardisation sector of the International Telecommunications Union) recommendations referred to in this manual were formerly published by CCITT. The names and content of the recommendations are identical, only the name of the issuing authority has changed.

1.2 Test Modes

1.2.1 BER Testing

1.2.1.1 BER Testing Overview

BERT (Bit Error Ratio Testing) provides a convenient way of determining the performance of a digital PCM link.

To perform a BER test, a test pattern needs to be transmitted across the PCM link and either monitored at the far end by a second instrument (Figure 1.2-1) or looped back and monitored at the sending end by the same piece of test equipment (Figure 1.2-2).

The test pattern can occupy the entire 2Mbit/s stream or designated timeslots in a framed 2Mbit/s signal. BER analysis can also be carried out in-service on framed bitstreams, by analysing the framing information or by detecting code errors.

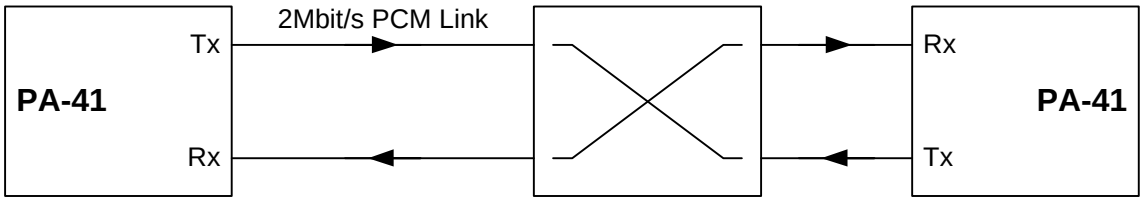


Figure 1.2-1 – End-to-end testing

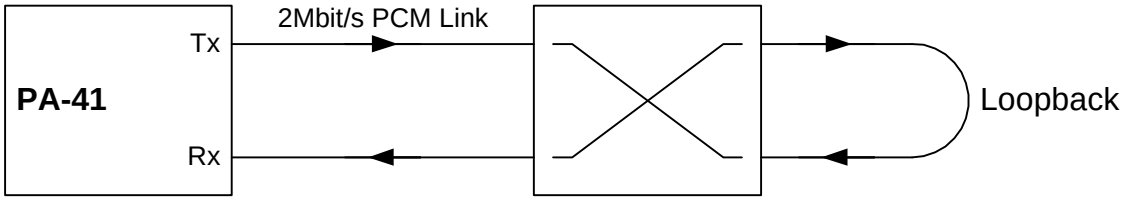


Figure 1.2-2 – Loopback testing

Since the PA-41 has two receivers, it is possible to monitor the network at two different points or in both directions simultaneously (Figure 1.2-3).

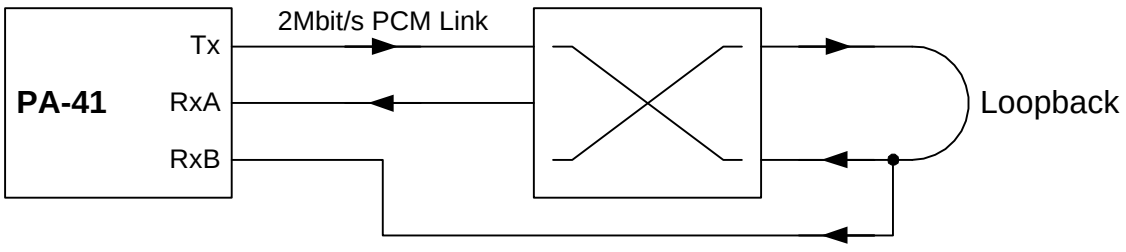


Figure 1.2-3 – Testing two network nodes simultaneously

The PA-41 can transmit a pseudo random bit sequence (PRBS) or a fixed pre-programmed or user programmable pattern.

The PRBS is used to simulate voice or data traffic with varying levels of activity. The PRBS has a defined repeating pattern length which can be chosen to suit a particular test. For example, the 2^9-1 pattern is random for 511 bits and then repeats again. For high data rates such as 2Mbit/s it is desirable to choose PRBS patterns with the lowest repetition rate possible since these are closer to real (random) voice or data signals.

Certain patterns contain particular sequences of ones and zeros which can be useful for specific tests. For example, the 2^{15}-1 pattern contains long strings of consecutive zeros which, when inserted into all 30 timeslots of a 2Mbit/s frame, can be used to check whether the network equipment under test can retain clock synchronisation (particularly with AMI line coding).

The bit errors are recorded by the two receivers along with other information such as the number of bits and pattern blocks received. A special pattern synchronisation method is employed which enables pattern sync to be maintained even in the presence of long bursts of bit errors (see Section 1.2.1.7 ***Gelbrich Synchronisation Method***).

These bit error counts are then interpreted as bit error ratios and are displayed on-line.

Performance analysis is also carried out to CCITT Recommendation G.821 (1988). This provides a rapid evaluation of link performance and shows pass or fail results against user selectable performance limits. This is carried out on both receivers simultaneously.

BERT results may be displayed numerically or graphically using the histogram displays. These results can then be stored in one of ten internal BERT stores or printed out using a suitable printer connected to the V.24 port.

BERT stores may also be archived on a memory card or remote PC file server for later correlation and analysis, see Section 3.2.8.1.

1.2.1.2 BER Testing Modes

BER tests may be carried out in FRAMED or UNFRAMED modes. The UNFRAMED mode is for use on transmission equipment where a PCM frame structure is not required. FRAMED mode is appropriate for testing most primary multiplex equipment such as multiplexers, cross-connects, digital switches and channel banks.

The MULTIPLEX and DEMULTIPLEX tester modes allow testing of multiplexers at both the V.11 or CO-DIRECTIONAL interfaces and the 2Mbit/s G.703 interface simultaneously. This mode provides a signal path through the mux/demux in either direction.

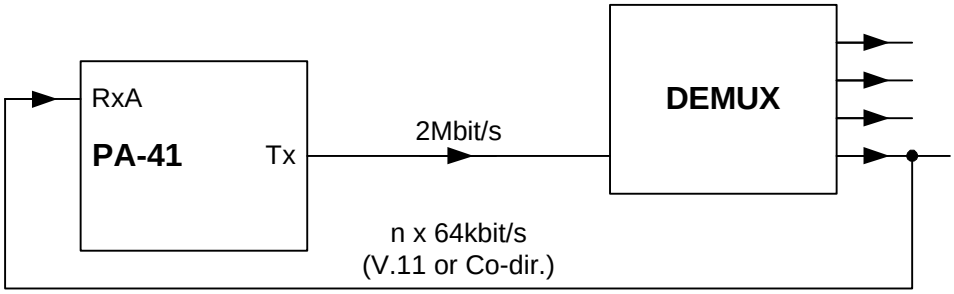


Figure 1.2-4 – Demux mode

In the DEMULTIPLEX mode, a group of nx64kbit/s channels (where n = 1...31)* carried in a 2Mbit/s primary rate frame may be routed into the mux/demux and returned from the V.11 interface at the rate of nx64kbit/s.

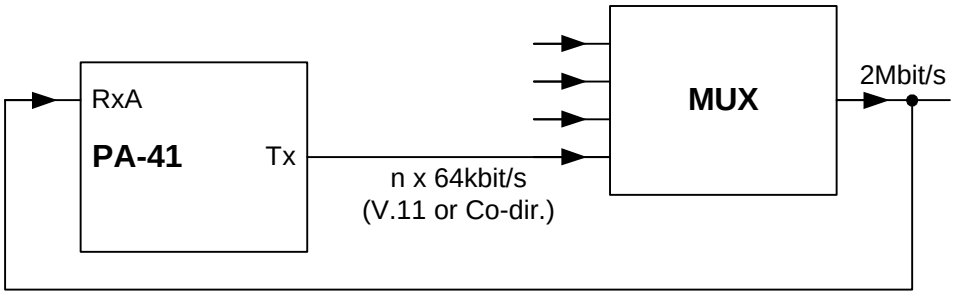


Figure 1.2-5 – Mux mode

In the MULTIPLEX mode, a group of nx64kbit/s channels (where n = 1...31)* may be routed into the mux/demux via the V.11 interface and returned in a 2Mbit/s primary rate frame from the G.703 interface.

* n = 1...8 for co-directional

1.2.1.3 Autoconfigure

Framed and Unframed tests may be initiated by a single keystroke using the AUTOCONFIGURE mode. The PA-41 will run a test on receiver RxA according to the following sequence:

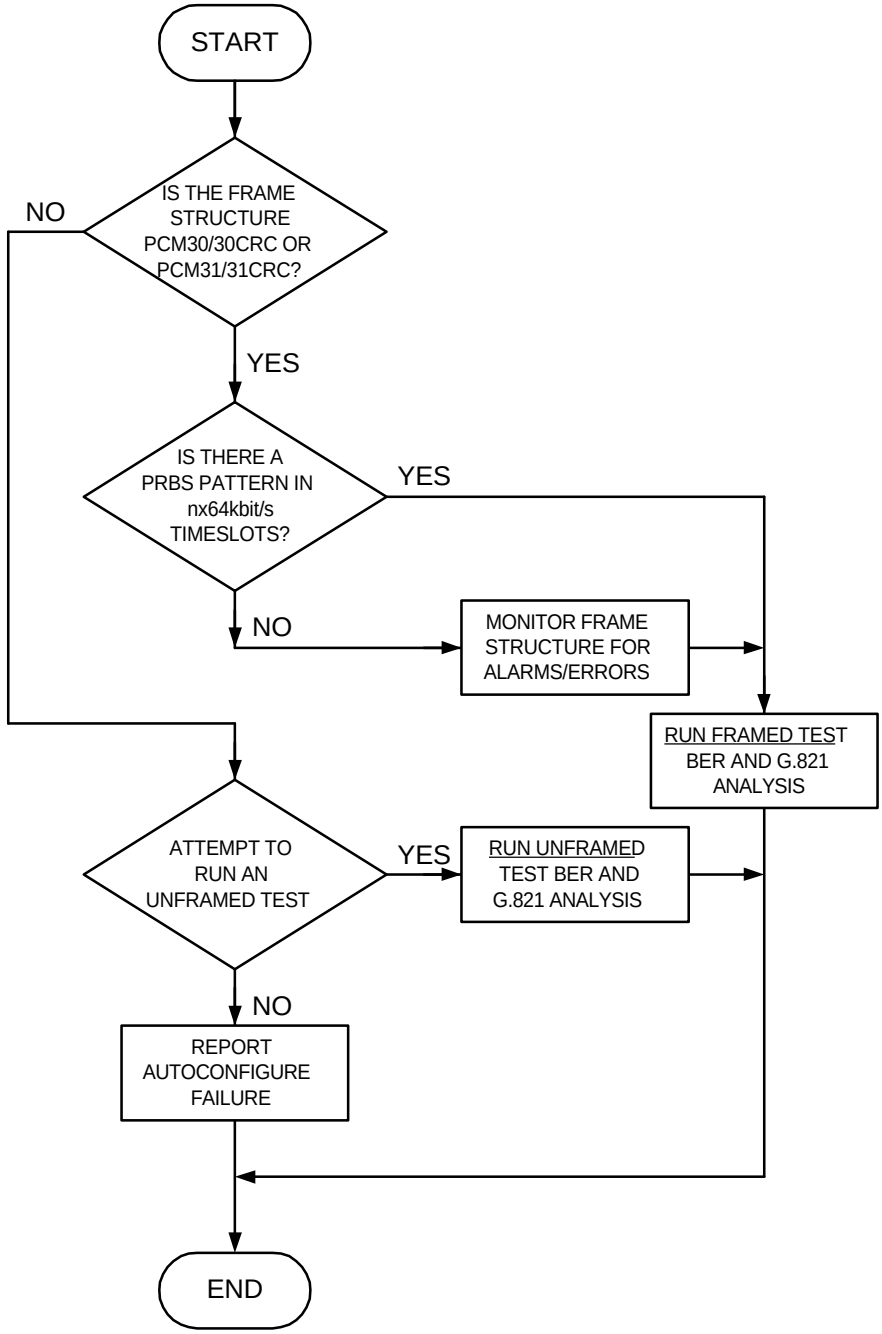


Figure 1.2-6 – Autoconfigure sequence

1.2.1.4 BER Analysis

The {**BERT: Error Results**} display is divided into three sections. The top section shows the count totals for test duration, bits, frames and multiframes received and also the line and bit rate. The centre section shows error totals and the bottom section shows error ratios as shown below:

```
BERT: Error Results RxA

Total seconds        48 Total bits 3.072E 6
Line rate       2048001 Frames        383999
Bit rate          64000 Multiframe     23999

ERROR TOTALS          Code errors            0
FAS errors          0 Bit errors             0
                      Block errors           0

ERROR RATIOS
Code error ratio                     0.000E 0
Bit error ratio                      0.000E 0
Block error ratio                    0.000E 0

  RxB  Numeric Hist          Report   Run
```

Figure 1.2-7 – Typical {BERT: Error Results RxA} page

The {**BERT: Alarm Results**} display provides counts of alarm events occurring during the test.

The top of the display shows the start time of the test and the current time. An example of the BERT alarm results page is shown below:

```
BERT: Alarm Results RxA

Start time                 17:33 15 Sep 1998
Stop time                  17:35 15 Sep 1998

ALARM SECONDS
No signal            16 AIS                 0
All zeros             0 Slip                0
All ones              0
Pattern sync loss                            0
Frame sync loss                              0
Multiframe sync loss                         0
Distant frame alarm                          0
Distant multiframe                           0

  RxB  Numeric Hist          Report   Run
```

Figure 1.2-8 – Typical {BERT: Alarm Results RxA} page

1.2.1.5 G.821 Results Analysis

The PA-41 can measure all the CCITT Rec. G.821 (1988) result parameters.

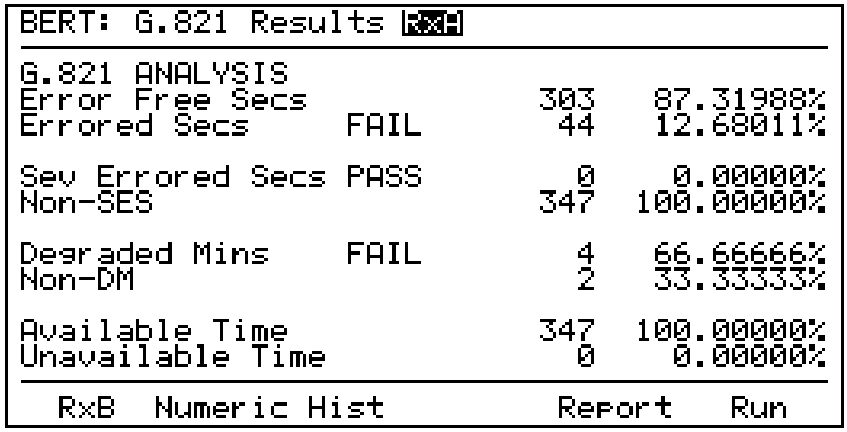


Figure 1.2-9 – Typical {BERT: G.821 Results RxA} page

The G.821 performance objectives are based on a hypothetical reference connection (HRX) of 27,500km. Since most tests are carried out over shorter sections, a weighting factor needs to be applied. The PA-41 has a parameter which enables the weighting factor to be set as a percentage entered from the keyboard. A pass/fail indication is given on the G.821 results page to show if the performance meets the weighted objective. This makes it easy to determine if the error performance objectives have been met for the network section under test.

The G.821 parameter thresholds are programmable to allow performance analysis to be carried out to the user's own objectives.

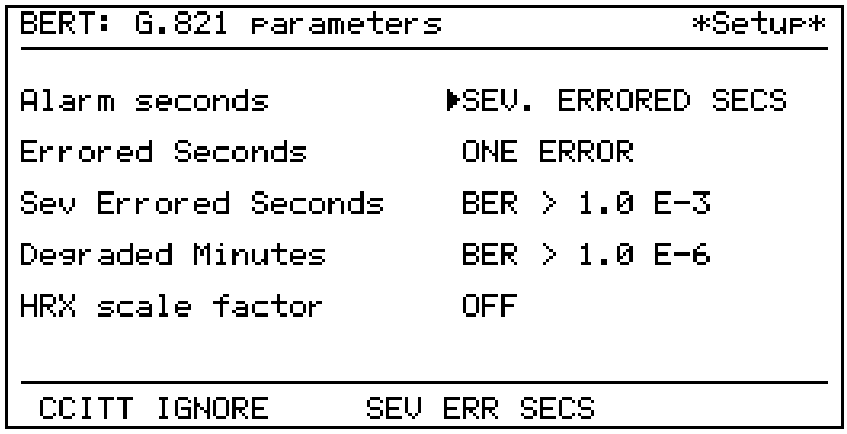


Figure 1.2-10 – {BERT: G.821 parameters} page

1.2.1.6 Histogram Analysis

Separate histograms are provided for bit errors and up to 12 alarm events. Two levels of resolution are available:

- 60 days with one day resolution, with any day expandable to one hour resolution.
- 60 hours with one hour resolution, with any hour expandable to one minute resolution.

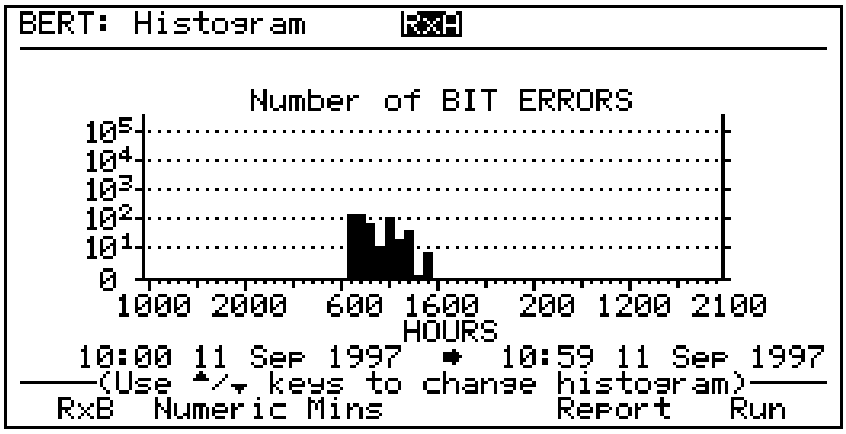


Figure 1.2-11 – Typical {BERT: Histogram} page showing number of bit errors

1.2.1.7 Gelbrich Synchronisation Method

With traditional synchronisation techniques used for bit error detection, a rapid burst of errors can result in the loss of synchronisation. During the necessary re-synchronisation the measurement cannot be continued. This means that the result at the end of the measuring period is not the true error ratio. Therefore, the quality of the line under test cannot be assessed correctly.

The Gelbrich synchronisation method avoids this problem and enables an exact error evaluation to be made. The measured results obtained are accurate and reproducible.

1.2.1.8 Error and Alarm Indication

Twelve LEDs, six for each receiver, provide an instant indication of the alarm status of the circuit under test. Additionally, two LEDs, one for each receiver, are programmable to indicate the occurrence of up to 8 error and alarm events. Four separate LEDs per receiver are also provided to indicate the CAS ABCD bits.

A warning message is displayed on the LCD display to indicate which type of alarm or error has occurred. A beeper is sounded simultaneously when the LED is illuminated (unless the beeper is turned off).

1.2.1.9 Storage of Results and Histograms

If a printer is not available, the BERT results can be held in one of ten internal battery backed memory stores. Each of these stores may be labelled with a user defined label and all of the stores may be archived on the memory card or remote PC device. The {**Stored test results**} menu is used to change the store being used. Each stores entry may be locked to prevent accidental erasure or overwriting by a new test.

Each stores location has the capability of storing numeric test results together with up to 60 days of histograms. In addition the PA-41 can store the following amount of results with high resolution:

60 days at one hour resolution spread over 10 stores, or 60 hours at one minute resolution spread over 10 stores, or a combination of both types.

A new stores location is selected automatically on running a new test if the AUTOSTORE feature is enabled and the results saved during the test. If a free stores location is not found, and the current store contains more than 1 hour of test results, the user will be prompted with **'Stored results will be lost by running'**. Otherwise, if there is less than 1 hour of results in the current store, then these results will be overwritten without warning.

The user has the option of deleting another stores entry or archiving all the stores and clearing them ready for a new set of tests.

1.2.1.10 Storage of Instrument Setups

The PA-41 can store up to 10 instrument configurations. These are accessed from the {**Stored setups**} menu. The user can label each of the stores locations with a user defined label. The time and date of the test is automatically recorded when the setup is stored.

1.2.1.11 Error Injection

While running a BER test, errors may be injected into the transmitted frame. There are three types of error injection:

- Single errors.
- Continuous errors.
- Burst errors.

Bit, Code, FAS or CRC (when framing = PCM30C or PCM31C) errors may be injected.

Single errors are injected each time the user presses <**One**>.

Continuous errors can be injected by selecting the appropriate error injection ratio and pressing <**Transmit**>. Errors are then injected continuously at that error rate until the user presses <**OFF**>.

Burst errors may be injected by selecting the error ratio and burst length. Each time the user presses <**Transmit**> an error burst will be injected.

The following constant or burst error ratios are provided:

1E-3, 1E-4, 1E-5, 1E-6, 2E-3, 2E-4, 2E-5, 2E-6, 5E-4, 5E-5, 5E-6, 5E-7.

1.2.1.12 Clock Deviation

An offset can be applied to the internal 2Mbit/s reference clock. This offset can be in increments of 1 ppm up to ±150 ppm from the nominal rate.

The offset may be pre-set in the {**Interface**} menu or adjusted while the test is running from the results display pages.

1.2.1.13 Test Timer

The BER test may be programmed to start automatically at any date and time, and to automatically stop after a selected test duration. This may be done from the {**Timer**} menu.

1.2.1.14 Test Patterns

The following test patterns are used within the PA-41:

- PRBS: 2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1
- Programmable 8-bit and 16-bit words.
- Fixed test patterns: all ones (1111), all zeros (0000), one/zero alternating (1010).

1.2.1.15 Interfaces

Three 2Mbit/s G.703 interfaces are provided with the following connectors:

- CF for balanced 120Ω operation.
- BNC for coaxial (unbalanced) 75Ω operation.

Both inputs offer high impedance (bridging) mode as well as matched impedance mode.

The input sensitivity is -30dB, (suitable for connection to a protected monitor point with attenuated output level). Gain control is automatic.

Two V.11 interfaces are provided for nx64kbit/s drop and insert. These interfaces may also be used by other loadable software options for nx64kbit/s protocol monitoring and analysis.

A V.24 interface is provided for printing, remote control or connection to a remote PC file server.

A HCMOS level external clock input is provided by a BNC connector for use at 2Mbit/s.

An external trigger input/output is provided by a BNC connector. This interface acts as a master/slave I/O and provides a method of connecting a number of PA-41s together.

This enables one instrument to ‘trigger’ the other instruments during signalling analysis applications.

An RJ11 connector provides for a telephone handset (optional accessory) to be connected to the instrument for voice monitoring and insertion into a selected 64kbit/s PCM telephone channel.

Note: To comply with EMC regulations, the use of screened cables for all interconnections is recommended.

1.2.1.16 Autoprint

The BERT Autoprint feature provides the means of printing-out a record of alarm events and error totals at pre-determined times during a test.

When Autoprint is enabled while a test is running, the printer output text is continually copied into an internal buffer store.

The contents of this store can be viewed on the screen after the test has been stopped, and the text may be printed-out at a later stage when a printer is available.

1.2.2 PCM Analysis

1.2.2.1 PCM Analysis Overview

The PCM Analysis mode provides the user with a suite of useful test facilities for carrying out analysis of 2Mbit/s PCM frames.

These facilities include:

- Frame Analysis
- Channel Status Monitor
- nx64kbit/s Drop and Insert
- Level and Frequency measurements
- Clock Difference Measurements (‘Slips’)
- Round Trip Delay Measurements

1.2.2.2 Frame Analysis

The frame analysis facility provides a display of the 2Mbit/s PCM framing information together with timeslot data for both receivers simultaneously. The test runs immediately the {**PCM: Frame**} page is entered and continues until either <**Freeze**> or EXIT is pressed.

Timeslot data is captured for a whole multiframe and so, even if the test results are ‘frozen’, each frame and timeslot may be interrogated.

During the frame monitor mode, the transmitted timeslot data and framing information may be changed by selecting <**Tx**>. A Tx setup page is then displayed where the transmit parameters, (i.e. Frame Alignment Signal, Multiframe Alignment Signal, Non-Frame Alignment Signal etc.), can be set.

The {**PCM: Frame**} page also allows the user to display the NFAS (Non-Frame Alignment Signal) words by pressing <**NFAS**>. The NFAS monitor page is then displayed.

Here, the NFAS word is displayed with the alarm status and national bits. Each national bit is shown for 8 consecutive NFAS words, i.e. over one multiframe or two CRC sub-multiframes.

1.2.2.3 Channel Status Monitor

The {**PCM: Channel Status RxA (RxB)**} page can be accessed from the {**PCM: Frame**} page by pressing <**Status**>. This feature is only available when the framing is set to PCM30 or PCM30C modes.

The {**PCM: Channel Status RxA (RxB)**} page is used to survey the status of the ABCD signalling bits on all 30 telephone channels simultaneously. A marker feature allows the user to highlight specific ABCD bit states such as blocking or idle codes.

1.2.2.4 Level and Frequency Measurements

The Level and Frequency mode provides for A-D and D-A performance analysis of multiplexers.

For A-D measurements a tone can be injected into a telephone voice channel using, for example, the PCM-23 VF Tester. It can then be monitored in the 2Mbit/s PCM frame by the PA-41 and the decoded RMS level, frequency, peak code and coder offset displayed. This can be carried out on both the 2Mbit/s receivers simultaneously if required.

For D-A measurements the PA-41 can transmit an encoded sinusoidal signal, with freely selectable level and frequency, into any one or more selected timeslots. The level and frequency of the demultiplexed channel/s from the multiplexer can then be measured by the PCM-23.

Alternatively the demultiplexed signal may be looped back through the multiplexer and the encoded tone monitored by the PA-41 providing a multiplexer/demultiplexer test simultaneously.

The audio tone may be monitored using the built-in loudspeaker or the plug-in handset supplied.

1.2.2.5 Drop and Insert

Drop and Insert mode allows the PA-41 to be used as a multiplexer/demultiplexer.

An nx64kbit/s (where n = 1...31) group of timeslots can be dropped from the incoming 2Mbit/s PCM frame on both receivers to their respective V.11 interfaces.

An nx64kbit/s data stream may be inserted from the V.11 interface (A) into a group of nx64kbit/s timeslots in the transmitted 2Mbit/s PCM frame.

In THROUGH framing mode, selected incoming timeslots in the 2Mbit/s PCM frame on RxA can be routed through the PA-41 to the transmitted 2Mbit/s PCM frame.

1.2.2.6 Clock Difference Measurements

Clock slips occur when two digital PCM signals are not synchronised with each other due to their clocks being sourced from different places. The PA-41 clock difference measurement mode compares the bit rates of two signals being applied to receivers A and B. During this measurement the line rates are measured and displayed to a resolution of 1bit/s together with their difference to 0.125bit/s.

The input signal on receiver B is regarded as the reference signal and the signal on receiver A the measured signal.

A bit slip is calculated as a count of 1 unit interval (or clock cycle, i.e. the time taken to transmit one bit) difference between the reference input signal and the measured signal. A frame slip is calculated as 256 bit slips (i.e. the number of bits in a PCM frame).

Counts of estimated bit slips and estimated frame slips are displayed together with two bar graphs showing the recorded clock difference graphically. The right bar has a range of ±8 UI with a resolution of 1 UI and increments on every unit interval counted. The right bar resets to zero after reaching ±8 UIs and the left bar which has a range of ±256 UIs is then incremented.

The elapsed time of the test is also recorded so that slip rates can be determined.

1.2.2.7 Round Trip Delay Measurements

Round Trip Delay is a test mode which allows the user to determine the time it takes for a transmitted signal to propagate through the network and return (usually by means of remote loopback applied to the distant network equipment) to the test instrument.

The delay measurement is displayed to a resolution of 1µs, with a maximum delay of 10 seconds and the measurement is carried out and displayed for both receivers.

A difference measurement is displayed which indicates the time difference between the two measured signals when two receivers are used.

The user can zero either of the receivers' delay measurements. This zeroing facility provides the user with the ability to measure the delay in a local piece of equipment and then remove the local delay from the overall round trip delay. There is also a reset facility which zeros all results and performs a new delay measurement.

1.3 The Memory Card Interface

The PA-41 has a memory card interface. Memory cards are thin, credit card size devices containing ROM (Read Only Memory) or SRAM (Static Random Access Memory) and are used for storing test data and for installing software options. The memory card slot is at the side of the instrument **[A]**.

1.3.1 Types of memory card

1.3.1.1 Static RAM Cards

Battery backed SRAM cards are used to store test results and instrument configurations. The PA-41 supports JEIDA 68-pin (version 4.0 and above) cards conforming to the PCMCIA standard.

1.3.1.2 Read Only Memory Cards

ROM cards carry software options supplied by Wandel and Goltermann.

1.3.2 Card File Formats

The memory card file format is a proprietary standard which conforms to the PCMCIA specification.

1.3.3 File Handling

Using the file utilities built into the PA-41, data files containing test results and/or instrument setups may be saved or loaded to/from memory cards, a PC or another PA-41.

1.4 Utilities

The {**Utilities Menu**} provides access to facilities not applicable to specific testing modes as follows:

- File Utilities.
- Printer configuration.
- Self Test procedures.
- Setting of Time and Date.
- Choice of displayed language.

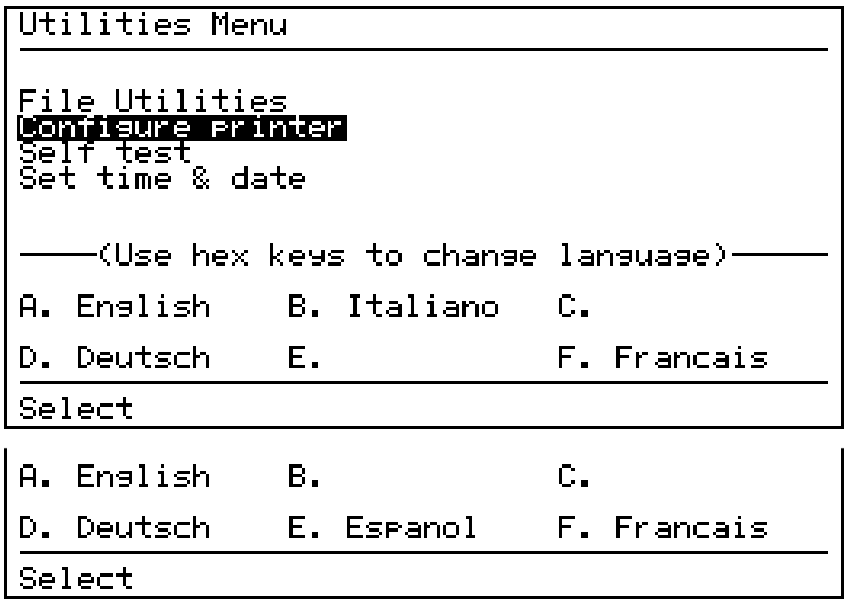


Figure 1.4-1 – {Utilities Menu} page, 04.00 'I' / 04.00 'S'

1.4.1 File Utilities

Memory cards are accessed from the stores menu in the relevant test modes or from the {**File Utilities**} menu. From these menus the SRAM cards may be formatted for use, file directories displayed and files saved, loaded, deleted renamed or copied as with personal computers.

To enter the {**File Utilities**} menu, select '**File utilities**' from the {**Utilities Menu**}.

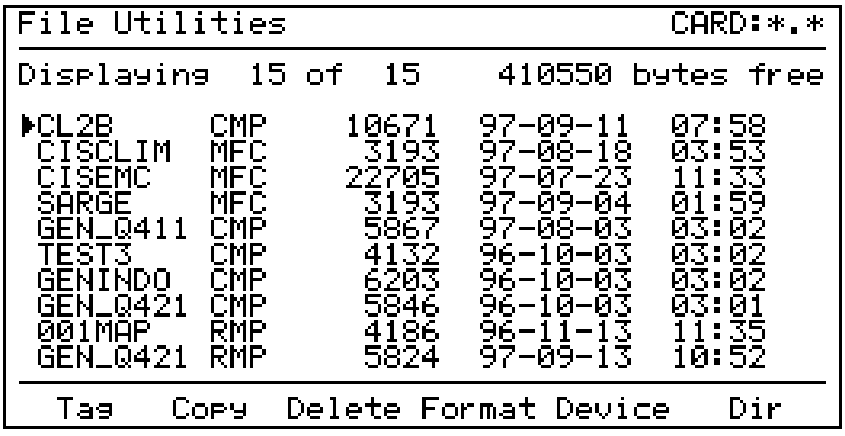


Figure 1.4-2 – {File Utilities} menu page

The file utilities softkey options are as follows:

<**Tag**> Tags the file currently pointed to by the cursor. The tagged file is then used as the source or target for the next file operation.

<**Copy**> Copies the files specified by following softkeys from the source device (i.e. the currently selected device) to the destination device:
<**One**> Copies the file pointed to by the cursor.
<**All**> Copies all the files in this directory.
<**Tagged**> Copies only the tagged files. The destination device is selected using the pop-up menu offered by the copy utility, (see <**Device**> below).

<**Delete**> Deletes the files specified by the following softkeys:
<**One**> Deletes the file pointed to by the cursor.
<**All**> Deletes all the files in this directory.
<**Tagged**> Deletes only the tagged files.

<**Format**> Formats the memory card. This option is only offered when the device is set to MEMORY_CARD.

<**Device**> Allows the user to change the file device. A pop-up menu will be displayed. Use the cursor keys and <**Select**> to select the device.

<**Dir**> Displays the current directory of the device selected on the screen.

Note: *Card File format differences with pre-02.03 versions of the instrument software.*

Files formatted on previous (pre-02.03) versions of instrument software may be read by version 02.03, or later, of the instrument software but files cannot be written to the older format cards.

Formatting with version 02.03, or later, software will generate a new card format which cannot be read by instruments with older versions of the software (pre-02.03).

Files may be copied from the old format cards to the new format cards using the file utilities to transfer files from one PA-41 to another, or to a PC using the serial link.

Alternatively, results files may be loaded from old format cards and then saved on to new format cards from within the test mode stores menu.

1.4.2 Printing

The PA-41 is fitted with a V.24 printer port enabling it to be connected to a wide variety of printers. Once the printer port has been configured for the type of printer in use, i.e. baud rate, parity etc., printing data is simply a matter of pressing <**Report**>. The PA-41 can print the following:

- Stored histograms and numeric results.
- Histograms and numeric results while the test is running.
- Combined time analysis of all alarms and errors.

- Menu setups.
- G.821 results and alarm events during a test.
- G.821 results and alarm events at selectable time intervals using the autoprint feature. The counters may be set to be either cumulative or reset after each printout. Alarm events are programmable and are printed out as they occur. The start and stop times for each alarm event are shown.

A printout of any currently displayed screen may be made by pressing PRINT (text only).

1.4.3 Self Test

1.4.3.1 Power-on Self Test

When the PA-41 is switched on, the instrument will perform a number of specific self tests before displaying the {**Main Menu**}. If any of the power-on self tests fail then the PA-41 will indicate this to the user by displaying an error message.

1.4.3.2 User Self Test

Routines are included for testing the keyboard, screen, LEDs, memory card, DTMF codes and CPU peripheral devices. See Section 3.6 for full details.

1.4.4 System Time and Date

The system time and date are displayed at the top of the {**Main Menu**} and are updated every minute. A warning **SET TIME AND DATE** will be displayed in the top right hand corner of the screen if the time and date are out of range and need setting. To set the time and date see Section 2.5.

1.4.5 Languages

The PA-41 supports 4 languages, English, French, German, and Italian (04.00 ‘I’) or Spanish (04.00 ‘S’). To change the language see Section 2.8.

1.5 Software Options

Up to four software options can be installed in the PA-41. These options are available on ROM type memory cards.

Software options are loaded into semi-permanent FLASH ROM memory in the PA-41. This provides for robust non-volatile storage of the options while the instrument is in the field.

2. Preparation for use

2.1 Introduction

This section provides information on setting-up the instrument prior to running tests.

The reference letters **A** to **D** and the numbers enclosed within square brackets used in the text, provide a quick location guide to the external controls and other items shown in Figures 1.0-1 and 1.0-2. The reference numbers are repeated, enclosed within squares, in their appropriate positions on the front and rear panels of the instrument.

2.1.1 Important Safety Instructions

While the PA-41 itself does not contain hazardous voltages, when the instrument is connected to external equipment for testing purposes then hazardous voltages may be present. Users must therefore be aware of the dangers when making connections to operating external equipment.

This apparatus has been designed and tested in accordance with IEC publication 1010, “Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use”, and has been supplied in a safe condition.

WARNING: None of the connector parts are isolated against excessive voltages. Do not connect the instrument to any circuit carrying excessive voltages (e.g. repeater feed voltage) etc.

Faults or damage

If the instrument is thought to be faulty, it should be disconnected from the LNT-6 AC Adaptor/Charger and from the circuits being measured and the batteries removed. The instrument should then be secured against unintentional operation. This applies particularly if:

- the instrument ceases to operate correctly.
- water has entered the instrument.
- the instrument shows visible signs of damage.

2.2 Power Supplies

The PA-41 may be powered from either rechargeable Ni-Cd batteries, alkaline non-rechargeable cells or via an LNT-6 AC Adaptor/Charger.

2.2.1 Battery operation

The PA-41 uses 6 x ‘C’ size cells, Ni-Cd rechargeable or alkaline.

WARNING: When using alkaline cells, the switch located inside the battery compartment beneath the instrument *must* be set to **'Alkaline'** and when using rechargeable cells the switch should be set to **'Ni-Cd'**. Switching to **'Alkaline'** disables the battery charging circuit, see Section 2.2.3.

Note that when fitting cells into the battery compartment, the middle pair should be inserted *last*.

If rechargeable cells are fitted, they can be charged within the instrument using the LNT-6 AC Adaptor/Charger.

Charging Time (Instrument OFF)	14 hours
Charging Time (Instrument ON)	28 hours
Run Time (monitor mode)	>5 hours typical
Run Time (BERT mode)	>2 hours.

2.2.2 Disposal of the Battery Pack

This instrument contains either dry cells or rechargeable battery pack which can harm the environment if disposed of in the normal rubbish handling systems or left in the instrument when it is scrapped. Therefore the pack should be returned, at the end of its useful life, to a special recycling centre or toxic waste gathering point. If these alternatives are not conveniently available, the pack should be sent to the nearest Wavetek Wandel Goltermann Service Centre.

Help protect the environment!

The section which follows indicates how to remove the dry or rechargeable cells. If you prefer not to remove the cells yourself, contact the nearest Wavetek Wandel Goltermann Service Centre.

The battery pack can be located as follows:

1. Loosen the two coin-headed captive screws securing the battery cover located near the front of the base of the instrument.

2. Remove the six cells and, if replacing with new cells, make sure the correct polarity is observed. Note that the centre pair should be fitted *last*.

First Aid

Residual deposits on the external surfaces of cells/batteries must be prevented from coming into contact with sensitive areas of the body, i.e. face and hands. If contamination occurs, irrigate with clean water immediately. If contamination of the eyes occurs, irrigate with clean water or a suitable eyewash; seek medical advice.

2.2.3 Using the LNT-6 A.C. Adaptor/Charger

The PA-41 can be powered directly from the LNT-6 A.C. Adaptor/Charger (with or without batteries fitted in the PA-41). With rechargeable batteries fitted, the LNT-6 will charge the batteries when the instrument is on or off over the charge times specified in Section 2.2.1 above.

Check that the LNT-6 is appropriate for the mains voltage to be used.

An LED on the LNT-6 will be illuminated to indicate that a charge is being accepted by the connected unit.

If, while operating the instrument via the LNT-6, there is a mains power failure, the instrument will continue to run the current test for as long as the battery charge permits.

A full recharge will take approximately 14 hours with the PA-41 switched off. Charging while a test is in progress may take longer.

Deep discharge of the Ni-Cd cells is avoided by a low battery voltage protection circuit.

Note: If the batteries are nearly discharged it may be necessary to charge the PA-41 for a few minutes before it can be switched on (due to the switch-on current required).

CAUTION: If rechargeable cells are fitted and they are subsequently replaced by a set of alkaline cells and the Alkaline – Ni-Cd switch is not set to the 'Alkaline' position there is a danger of explosion when the instrument is operated from the LNT-6.

Note: The PA-41 may be used without batteries fitted but stored data will be lost when the power supply is removed from the instrument. The internal stores memory will no longer be battery backed.

2.3 Adjusting the Stand/Carrying Handle

The stand of the PA-41 serves two functions: as a stand to set the instrument to the most convenient viewing angle for the user and also as a carrying handle.

To adjust the stand, pull the side arms gently away from the body of the instrument to disengage the retaining ratchets, then swing the stand to the required angle and release the side arms. The stand will then locate to the nearest ratchet position.

2.4 Switching-On for the first time

Switch on the PA-41 by pressing the ON key **[9]**. The instrument will then perform a number of internal self tests before displaying the {**Main Menu**}. Should any of these self tests fail, the PA-41 will display the results on the screen.

After the {**Main Menu**} has displayed the highlight bar, the instrument is ready for use. The top line of the display shows the current time and date with the format HOUR:MINUTE DAY MONTH YEAR, with 24-hour notation being employed. To alter the time and date, proceed as follows:

2.5 Setting the Time and Date

Press the <**Utils**> softkey to select the {**Utilities Menu**} then use the down cursor key to move the highlight box to '**Set time and date**' and press <**Select**>.

The display will then change to display the **Main Menu** banner with a triangular cursor on the time and date line, ready for setting the time and date using the keypad **[5]** and softkeys **[1]**.

Press <**Reset**> to reset the 'seconds' count to zero and use the cursor keys to move the cursor into the appropriate field to modify.

Use the softkeys to select the month and the keypad to enter the time, day and year.

2.6 Setting the Display Contrast

The display contrast may be adjusted at any time while the instrument is switched on using the display 'Lighter' and 'Darker' contrast keys from the group at **[8]**. Keep the appropriate key depressed until the screen contrast reaches the desired level.

2.7 Setting the Backlight

Pressing the backlight ON/OFF key **[8]** once will toggle the backlight on or off.

2.8 Setting an Alternative Language

To select an alternative language, press <**Utils**> on the {**Main Menu**} page to enter the {**Utilities Menu**}. The language options are displayed in the lower section of the display. Select the language required by pressing the appropriate alphabetic key **A** to **F** on the keypad **[5]**.

2.9 Configuring the V.24 Port

To configure the printer, press <**Utils**> in the {**Main Menu**} page to enter the {**Utilities Menu**} then move the highlight bar on to **'Configure Printer'** and press <**Select**> to select the {**Printer Menu**} page.

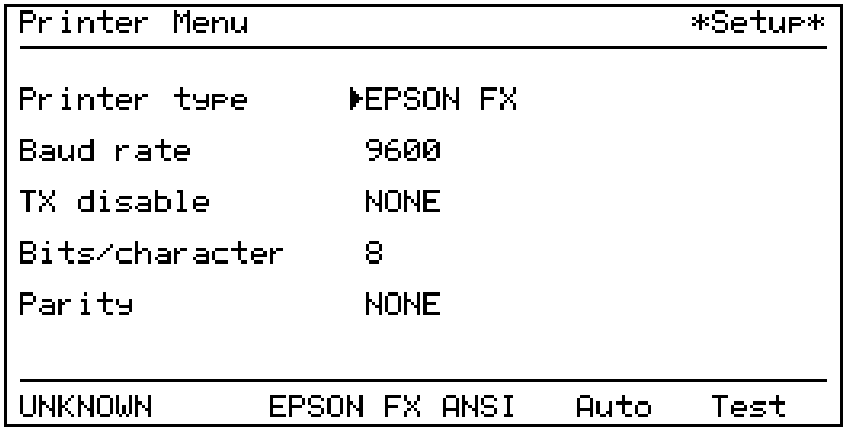


Figure 2.9-1 – {Printer Menu} page

The printer parameters may be edited using the cursor keys to move through the menu fields and the softkeys to select field parameters.

The printer configuration fields are as follows:

Printer

<**UNKNOWN**> Most printers with a V.24 serial interface.

<**EPSON FX**> Epson FX printer with V.24 serial interface or other printers supporting IBM PC extended character set.

<**ANSI**> For use with ANSI compatible terminals when the printer port is used for remote control.

<**Auto**> The ***Auto Printer*** function attempts to identify the printer configuration required for an unknown printer by sending it test lines with different settings of Baud rate, Bits/char and Parity. All possible combinations of Baud rate, Bits/char and Parity are tested with the Printer selection set to **UNKNOWN** and the Tx disable selection set to **NONE**.

The correct configuration will show as a readable line on the printer. The test lines can then be stopped using the <**Stop**> softkey, the printer configuration can then be set to the parameters shown by the readable line.

<**Test**> Sends a series of test lines to the printer.

Baud rate

<**300**> 300 baud.
<**600**> 600 baud.
<**1200**> 1200 baud.
<**2400**> 2400 baud.
<**-more-**> Displays further baud rate options.

	<**4800**>	4800 baud.
	<**9600**>	9600 baud.
	<**19200**>	19200 baud.
Tx disable	<**CTS**>	Uses CTS flow control. Stops sending if CTS (pin 8) is OFF (-5V to -12V).
	<**XON/XOFF**>	Uses XON/XOFF flow control.
	<**NONE**>	No flow control.
	<**SLOW**>	Sends characters at 8 characters per second regardless of the baud rate selected.
Bits/char	<**7**>	7 data bits per character.
	<**8**>	8 data bits per character.
Parity	<**NONE**>	No parity bit.
	<**EVEN**>	Even parity.
	<**ODD**>	Odd parity.
	(The following selections only appear when 7 bits per character is selected).	
	<**MARK**>	Set parity bit to 1.
	<**SPACE**>	Set parity bit to 0.

2.10 Formatting a memory Card

It is necessary to format SRAM memory cards before use.

To do this display the {**Main Menu**} and press <**File**> to enter the {**File Utilities**} page. Now press <**Format**> to carry out the formatting operation.

Note: This will erase any existing files.

The PA-41 will first check to see if a memory card is present and if so, the card will be formatted and the result of the formatting reported to the user.

The card may now be used to store data files.

Failure to format the SRAM may be caused by a faulty memory card or the ‘WRITE/PROTECT’ switch of the card may be incorrectly set.

3. Operation

3.1 Introduction

The PA-41 is controlled through a structured menu system. After the instrument is switched on, the PA-41 carries out a self check routine and then displays the {**Main Menu**} page with the software version number.

Figure 3.1-1 – {Main Menu} page

The user may enter commands or options via the instrument keyboard. The various types of key are described as follows:

3.1.1 The Fixed Keys

The following fixed keys are provided on the keyboard:

ON This key **[9]** turns the PA-41 on.

OFF This key **[9]** turns the PA-41 off. If used inadvertently while running a test, the current results will be lost.

MAIN MENU Pressing this key **[3]** will always return the display to the {**Main Menu**}. If a test is currently running, the test is stopped.

EXIT This key **[2]** will always cause the screen to display the previous higher level menu unless the display is currently in {**Main Menu**}. If a test is currently running, the test is stopped.

PRINT This key **[7]** can be used to dump a copy of the screen to the printer. The key may be pressed at any time while displaying menus or results. However, the screen dump facility will be disabled if a results report printout is in progress.

BACKLIGHT This key [☼] **[8]** is used to switch the backlight on and off. Press the key once to switch the backlight on or off.

CONTRAST The lighter/darker contrast keys **[8]** are used to set the LCD display contrast. Press and hold the appropriate key until the display reaches the desired contrast.

CURSOR Keys These four keys **[6]** are used to move the cursor round the menu fields and to scroll through the tables or histograms.

SECURITY This hidden key is located at the centre of the four cursor keys, its use will be explained later.

3.1.2 Using the Keypad

The hexadecimal keypad **[5]** is used for entering numeric information such as binary, decimal or hexadecimal values. The alphabetic keys **A** to **F** are also used for selecting options such as the language used to display text information. The bottom line on the LCD display, will sometimes contain a prompt such as **(key 1...30)** or **(keypad)** when input data is required to be entered via the hexadecimal keypad by the user.

3.1.3 The Softkeys

There are six softkeys **[1]** positioned in such a way that softkey labels displayed on the screen line up with the keys which are used to select menus and field parameter options.

3.1.4 Automatic Power-Down

If the PA-41 is not running a test and a key is not pressed within 4 minutes, the instrument will turn off automatically to save battery power. This feature may be overridden by pressing the **[Security]** key **[6]** followed by **'F'** and **'2'** from the numeric keypad. If the LNT-6 A.C. Adaptor/Charger is plugged into the instrument then the automatic power-down feature is disabled.

3.1.5 The Main Menu

The {**Main Menu**} allows access to the various test modes and instrument software utilities such as the software option loader and file utilities.

The top half of the screen shows the instrument banner which contains the current time and date display, instrument title and software version number.

The following softkeys are offered:

<**Select**> Selects the test mode currently highlighted by the cursor bar.

<**Fast**> An enhanced feature available on selected test modes which provides for rapid execution of a previously stored setup, (see Section 3.2.4.3).

<**Load**> Loads an option (see Section 3.4).

<**Delete**> Deletes an option (see Section 3.4).

<**Utils**> Accesses the {**Utilities Menu**} (see Section 1.4).

<**Remote**> Selects remote control operation.

3.1.6 Remote control

The PA-41 can be controlled remotely via the V.24 serial interface. The serial port parameters are set up in the {**Printer Menu**}. The printer interface should be connected to a terminal or terminal emulator using either a null modem cable (see Figure 3.1-2) or printer cable K1524, or remotely using a data communications link.

Pressing <**Remote**> in the {**Main Menu**} will switch the PA-41 to remote control. The {**Main Menu**} will now display **--(REMOTE CONTROL ON)--** in the lower graphics line of the screen. The screen and keyboard will continue to operate normally, although the keyboard may be disabled remotely to prevent unauthorised personnel from changing the instrument settings by pressing the **[Security]** key ('S' on the terminal keyboard) followed by the two digit security code **F0** using the numeric keypad. The keyboard may be re-enabled by remote control by pressing **[Security]** followed by the two digit security code **F1** or by turning the remote instrument off and then on again.

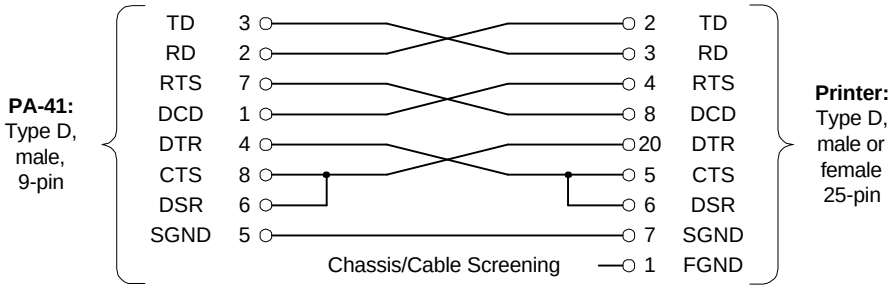


Figure 3.1-2 – 'Null Modem Cable' connections

The terminal will display PA-41 screens while the terminal keyboard may be used to provide the following functions:

0 to 9	– numerals **0** to **9**
q w e r t y	– equivalent to [F1] to [F6] softkeys respectively
Z	– equivalent to [MAIN MENU] key
I	– equivalent to [△] cursor key
J	– equivalent to [◁] cursor key
K	– equivalent to [▷] cursor key
M	– equivalent to [▽] cursor key
S	– equivalent to **[Security]** key
X	– equivalent to [EXIT] key
P	– equivalent to [PRINT] key.

Notes: The display will be enhanced by using an ANSI compatible terminal which will respond to the home cursor command as sent by the PA-41: (<ESC> [H).

Under remote control the automatic switch-off function will be disabled.

To escape from remote control mode, switch the PA-41 off and on again.

Do not change the {**Printer Menu**} parameters whilst the PA-41 is in remote control mode since this will change the V.24 interface parameters and so stop communication between the terminal and the PA-41.

The PA-41 pre-processes the serial data and substitutes certain special characters which cannot be handled by a basic terminal. A list of character conversions is given below:

superscript 7 (^{7})	will be displayed as: 7
superscript 9 (^{9})	will be displayed as: 9
superscript 11 (^{11})	will be displayed as: "
superscript 15 (^{15}), first digit	will be displayed as: 1
superscript 15, second digit	will be displayed as: 5
superscript 20 (^{20}), first digit	will be displayed as: 2
superscript 20, second digit	will be displayed as: 0
histogram cursors	will be displayed as: -
CAS line states	will be displayed as: ?
'key' symbol, first part	will be displayed as: °
'key' symbol, second part	will be displayed as: +
'f' symbol	will be displayed as: ß.

3.2 BERT Operation

This section describes how to carry out BER (Bit Error Ratio) tests using the PA-41.

3.2.1 Introduction to BER testing

BER tests can be carried out using the following interfaces and test modes :

Unframed tester: (Transmit and receive on G.703 interface):

This mode is used for testing transmission equipment at 2Mbit/s without a framing structure.

Framed tester: (Transmit and receive on G.703 interface):

This mode is used for testing 2Mbit/s circuits with a framing structure such as those used on digital cross-connects and channel banks.

Multiplex tester (V.11): (Transmit on the V.11 and receive on the G.703 interface):

This mode allows a multiplexer to be tested. The pattern is transmitted via the V.11 interface as an unframed serial bit stream at a bit rate between 64kbit/s and 1984kbit/s and received on the G.703 interface RxA in a framed 2048kbit/s signal.

Multiplex tester (co-directional):	(Transmit on the G.703 interface using a co-directional line coding and receive on the G.703 interface RxA in a framed 2048kbit/s signal):
	As above but the transmitted signal is restricted to a bit rate of between 64kbit/s and 512kbit/s.
Demultiplex tester (V.11):	(Transmit a framed 2Mbit/s signal on the G.703 interface and receive an unframed signal at a rate of between 64kbit/s and 1984kbit/s on the V.11 interface):
	This mode is used to test a demultiplexer.
Demultiplex tester (co-directional):	(Transmit a framed 2Mbit/s signal on the G.703 interface and receive an unframed signal at a rate of between 64kbit/s and 512kbit/s on the co-directional interface):
	As above.

3.2.2 Connections to the Instrument

3.2.2.1 Terminations

The PA-41 can be used in one of three different arrangements for connection to the equipment under test.

(a) Terminated mode

In this mode, the PA-41 provides a termination to the end of the line which matches the line impedance. In this way the PA-41 can replace the network equipment which would normally be connected to this point to terminate it.

The PA-41 G.703 interface must be set up for termination into 75Ω for the co-axial and 120Ω for the balanced interface (<**75/120**Ω>). (See Section 3.2.5, ***The Interface Menu***, to select this termination mode).

The circuit configuration is shown in the following diagram:

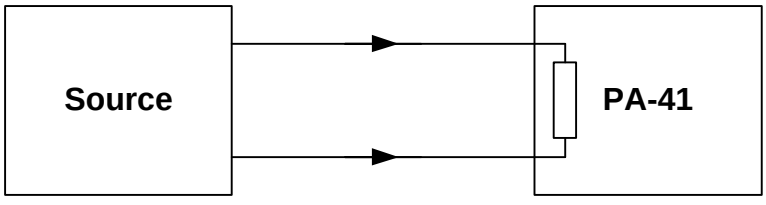


Figure 3.2-1 – Terminated mode

(b) Monitor mode

The monitor mode is used where a protected monitor point is provided on the network equipment under test. The protected monitor point isolates the test equipment from the line in such a way that the PA-41 does not 'load' the signal. The signal amplitude

at the protected monitor point is normally reduced and therefore in order to compensate for this the PA-41 receiver applies a gain to the input signal.

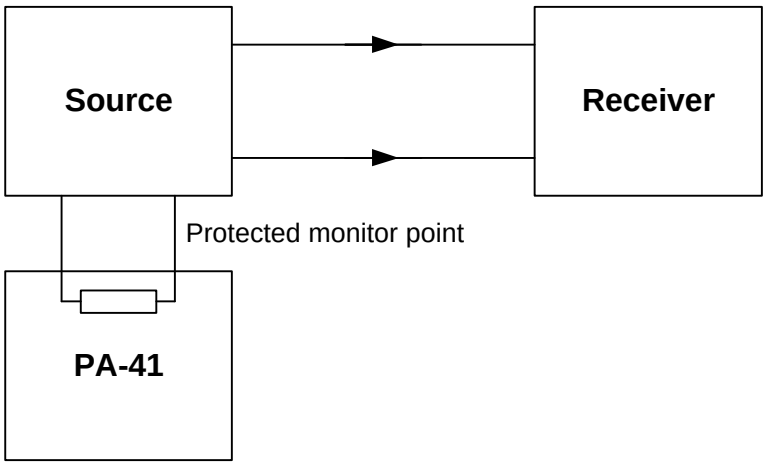


Figure 3.2-2 – Monitor mode

(c) Bridged (High impedance) mode

In this mode the PA-41 provides a load of greater than 1kΩ impedance to allow the instrument to be connected directly to the line in a bridged arrangement as shown below. The cable connecting the PA-41 to the line should be kept as short as possible.

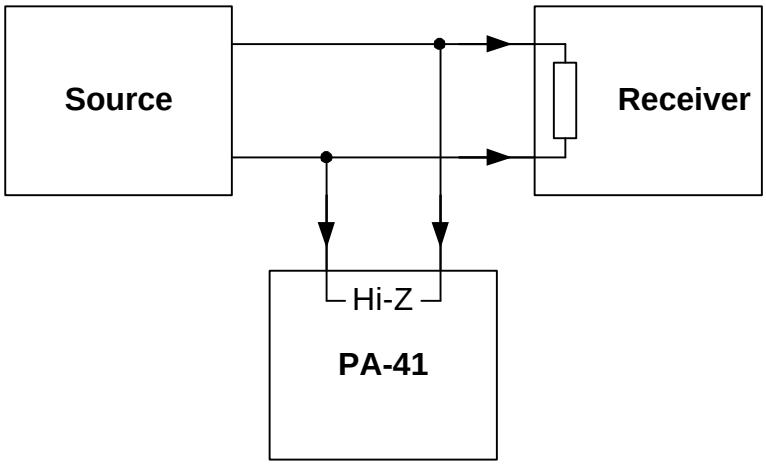


Figure 3.2-3 – Bridged mode

The PA-41 G.703 interface must be set up for high impedance (<**HI-Z**>). (See Section 3.2.5, ***The Interface Menu***, to select this termination mode).

3.2.2.2 Test Configurations

The PA-41 can be connected in a number of test configurations for various test modes.

The following connections are required for the relevant test modes:

Framed and Unframed tester:

In-service testing: One or both receivers may be used to monitor one or two points in the network.

Connect a 2Mbit/s 75Ω unbalanced circuit to the RxA input **[28]** and, if two receivers are required, the second circuit to the RxB input **[29]**. (For balanced 2Mbit/s circuits use inputs **[31]** and **[32]** respectively).

Out of service testing: The transmitter may also be connected to serve as the pattern source. Connect the transmit circuit to the Tx output **[27]** for 75Ω unbalanced circuits (or output **[30]** for 120Ω balanced circuits).

Note: See ***Appendix E – Interface and Frame Structure Details*** for electrical connections to interface cables.

Multiplexer tester: For 'out-of-service' testing only:

V.11 mode: Connect the V.11 Interface A **[25]** to the input of the multiplexer and the G.703 output from the multiplexer to the G.703 RxA input (**[28]** for unbalanced or **[31]** for balanced circuits).

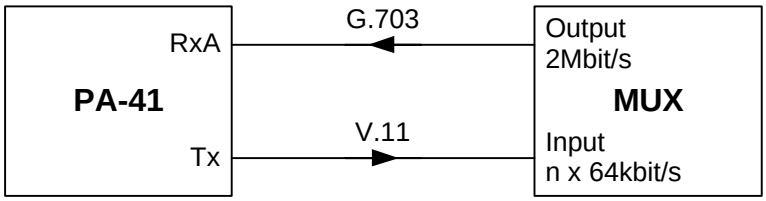


Figure 3.2-4 – V.11 MUX mode

Co-directional mode: Connect the G.703 (co-directional) interface **[30]** to the input of the multiplexer and the G.703 output from the multiplexer to the G.703 RxA input (**[28]** for unbalanced or **[31]** for balanced circuits) on the PA-41.

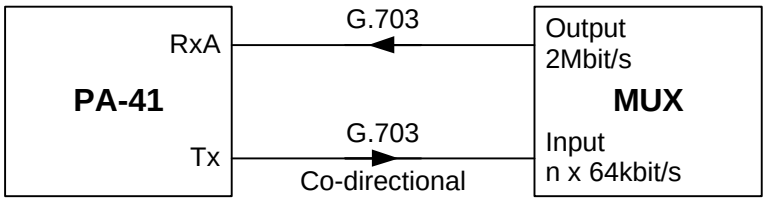


Figure 3.2-5 – CODIR MUX mode

Demultiplexer tester: For 'out-of-service' testing only:

V.11 mode: Connect the G703 Tx Interface (**[27]** for unbalanced or **[30]** for balanced circuits) to the input of the multiplexer and the V.11 output from the multiplexer to the V.11 interface 'A' **[25]** on the PA-41.

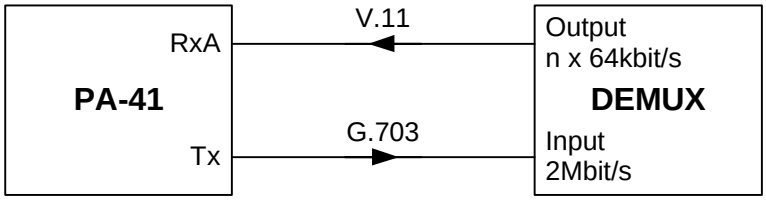


Figure 3.2-6 – V.11 DEMUX mode

Co-directional mode: Connect the G.703 Tx Interface (**[27]** for unbalanced or **[30]** for balanced circuits) to the input of the multiplexer, and the G.703 co-directional output from the multiplexer to the G.703 interface **[31]** on the PA-41.

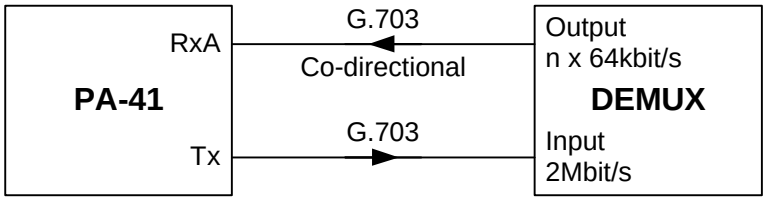


Figure 3.2-7 – CODIR DEMUX mode

3.2.3 The BERT Menu Structure

The BERT menu structure is designed to be easy to use due to its hierarchical organisation. The number of nested menu levels is restricted to four normally and each previous level may be reached by pressing EXIT.

A diagram of the BERT menu structure is provided in ***Appendix B – Menu Structures***.

3.2.3.1 The BERT Top Level Menu

The {**Bit Error Ratio Test**} lop level menu may be accessed from the {**Main Menu**} by selecting '**Bit Error Ratio Testing**' using the highlight bar and pressing <**Select**>.

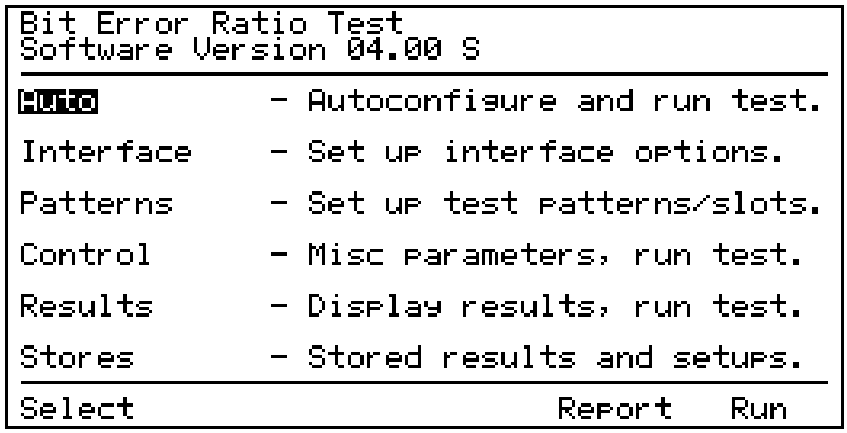


Figure 3.2-8 – {Bit Error Ratio Test} page

There are six BERT options which can be selected from this menu using the highlight bar and pressing <**Select**>. These are:

Auto	Executes the autoconfigure mode.
Interface	BERT interface parameters setup menu.
Patterns	BERT patterns setup menu.
Control	Main BER test control menu.
Results	Display BERT results pages.
Stores	Access to BERT stores.

A test can be run from this menu by pressing <**Run**>.

3.2.4 Setting the Instrument Configuration

There are six ways to set the PA-41 configuration (test parameters) prior to running a test:

- Use the previous configuration.
- Use a stored configuration in one of the internal RAM stores of the PA-41 by using the fast start softkey.
- Use a stored configuration on a memory card.
- Use a stored configuration on a remote device such as a PC or another PA-41.
- Use the Autoconfigure function.
- Enter a new configuration.

3.2.4.1 Previous Configuration

When the PA-41 is switched on it reinstates the configuration as it was immediately before the instrument was last switched off. A test may now be run using this configuration by selecting **Bit Error Ratio Testing** from the {**Main Menu**} and then press <**Run**>.

3.2.4.2 Fast Start

If the highlight bar in the {**Main Menu**} is moved on to **Bit Error Ratio Testing**, a <**Fast**> softkey will be displayed. Pressing this softkey will enter the {**BERT: Stored Setups**} page immediately. To select and run a test, just press a numeric key (0 to 9) corresponding to the store number to be loaded.

3.2.4.3 Stored Configuration

Configurations which have been previously stored for re-use in the internal BERT stores may be accessed from the {**Bit Error Ratio Test**} top level menu by selecting **Stores** to enter the {**BERT: Stores Menu**} and then select **Stored Setups** to enter the {**BERT: Stored Setups**} page, (see Section 3.2.8).

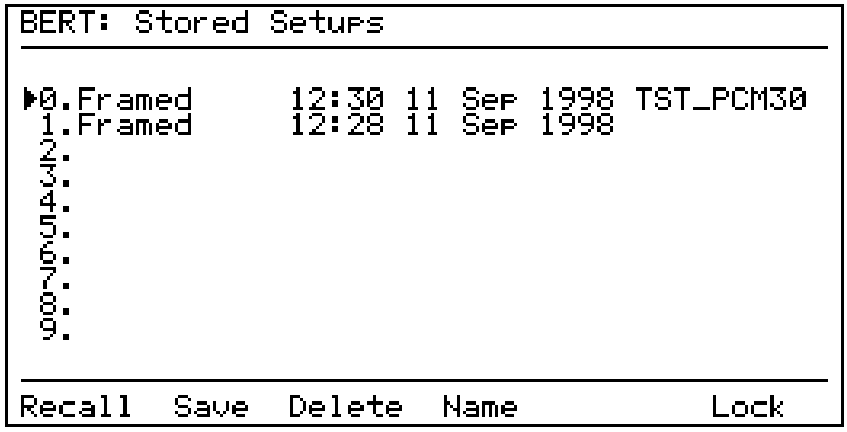


Figure 3.2-9 – Typical {BERT: Stored Setups} page

Up to 10 stores are available for storage of BERT setups. When a store contains setup information, the corresponding line consists of the following information:

- The store number (0..9).
- The test mode (FRAMED, UNFRAMED, MUX or DEMUX).
- The time and date when the test was run.
- An 8 character user defined test label.

To recall a particular setup, move the cursor to the appropriate line using the cursor keys and press <**Recall**>. The instrument configuration will overwrite the existing configuration for BER testing.

This new configuration may now be edited from the BERT setup menus {**BERT: Interface Menu**}, {**BERT: Patterns Menu**} and {**BERT: Control Menu**}.

Note: Other test modes outside BERT such as Channel Associated Signalling and PCM Analysis are not affected.

3.2.4.4 Stored Configuration on a Memory Card

BERT stores information may be archived on a memory card in the form of data files. Each file contains a snapshot of all 10 BERT stores in memory at the time of archiving.

See Section 3.2.8.1 which refers to recovering stores from a memory card.

3.2.4.5 Stored Configuration on a Remote Device

BERT stores data files may also be loaded from a remote PC or another PA-41. See Sections 1.4 and 3.5 for further information on file utilities.

3.2.4.6 Autoconfigure Function

Note: Before running autoconfigure ensure that the interface terminations for RxA and RxB are correctly set up. Autoconfigure will not alter the termination settings.

Selecting **Auto** from the BERT top level menu {**Bit Error Ratio Test**} will run the PA-41 autoconfigure function which will try to configure the instrument according to the received signal on the RxA G.703 input.

See the Autoconfigure flow diagram in Section 1.2.1.3.

Auto will first attempt a framed (in service) test and cycles through all the framing modes from PCM31CRC to PCM30. If a framing mode is recognised, auto will then attempt to run a BER test in each timeslot with each of the PRBS patterns in turn until a valid pattern is recognised. If a single slot test is not valid, Auto will then try an nx64kbit/s test with every combination of timeslots.

Should all attempts to measure successfully in a framed mode fail, then Auto will carry out unframed (out of service) tests with all the pattern permutations as above.

If the autoconfigure function succeeds, the PA-41 will automatically start running a test and display the most recent style of results. Receiver RxB will be configured to match RxA. The newly installed configuration may be viewed (but not edited) by pressing <**Menus**>.

3.2.4.7 New Configuration

A new configuration may be entered directly by editing the BERT setup menus ({**BERT: Interface Menu**}, {**BERT: Patterns Menu**} and {**BERT: Control Menu**}.

3.2.5 The Interface Menu

The {**BERT: Interface Menu**} is accessed from the BERT top level menu by selecting **Interface** and pressing <**Select**>.

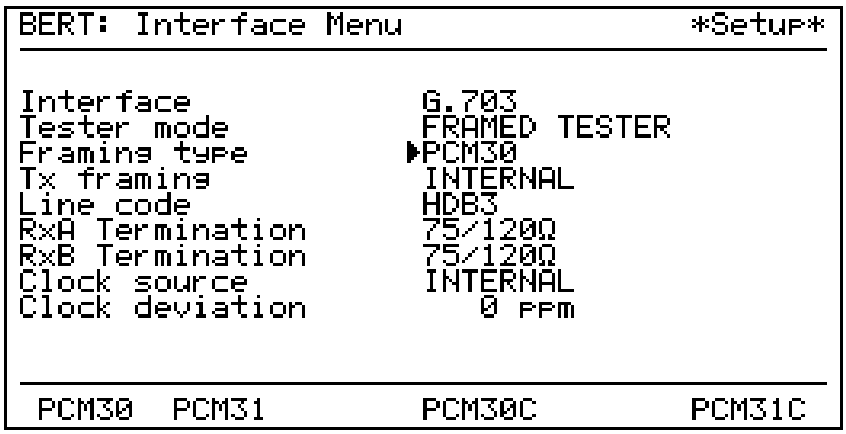


Figure 3.2-10 – {BERT: Interface Menu} page

3.2.5.1 Setting the BER Test Mode

While the cursor is pointing to the **Tester Mode** parameter field, press <**Change**> to select the {**BERT: Tester Mode**} page. Now select the tester mode using the cursor keys and press <**Select**>. Now press [EXIT] to return to the {**BERT: Interface Menu**}.

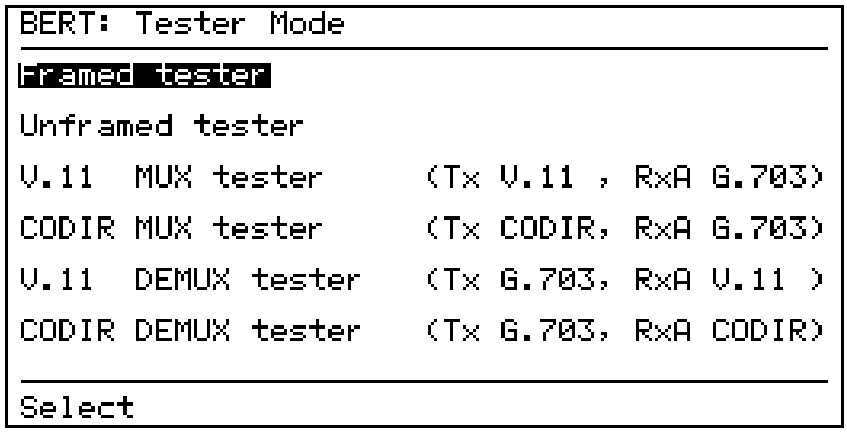


Figure 3.2-11 – {BERT: Tester Mode} page

Refer to Section 3.2.1 for more information on BER Testing Modes.

3.2.5.2 Selecting the Framing Mode

If the tester mode is not **UNFRAMED TESTER** mode then the **Framing Type** field is displayed.

Move the cursor down to the **Framing type** field using the cursor keys and select the appropriate Framing type using one of the softkeys.

The framing types are as follows:

PCM30 30 channels with Channel Associated Signalling in timeslot 16.

PCM31 31 channels without Channel Associated Signalling.

PCM30C 30 channels with Channel Associated Signalling in timeslot 16 and CRC.

PCM31C 31 channels without Channel Associated Signalling but with CRC.

For more details of these framing structures refer to ***Appendix E – Interface and Frame Structure Details***.

3.2.5.3 Transmitter Framing Modes

If the **Tester Mode** is not set to either **UNFRAMED** or **MUX** mode then the **Tx Framing** field will be displayed.

Use the cursor keys to move the cursor down to the **Tx Framing** field.

The following **Tx Framing** modes are offered:

INTERNAL This transmit framing mode causes the PA-41 to source all of its framing information from internal parameters. Some of these parameters may be set by the user as follows:

Frame Alignment signal (FAS) – Fixed.

(FAS) International Bit (Si) – Fixed.

Non FAS (NFAS)

(NFAS) International Bit (Si) – User.

(NFAS) Bit 2 – Fixed.

(NFAS) Bit 3 (Remote Alarm) – User.

(NFAS) Bit 4 through 8 (Sa) – User.

To edit these user defined Non Frame Alignment signal bits refer to Section 3.2.6.4, ***The Tx NFAS Page***.

This framing mode also restricts the BERT data slots to be sourced from internal parameters only. The user can select an Idle or PRBS pattern to transmit for each slot.

THROUGH This framing mode causes the transmitted national and international bits (Si and Sa) and Remote Alarm bit to be sourced from the receiver RxA, (i.e. they are passed through without being changed). The rest of the framing bits are generated internally by the PA-41.

In addition, **THROUGH** framing mode allows any selected transmit data slot to be sourced from receiver RxA. These slots can be selected by the user in the {**BERT: Tx Slots Menu**} (see Section 3.2.6.3).

3.2.5.4 Line Code Options

Use the cursor keys to move the cursor down to the **Line Code** field.

The following **Line Code** options are available for the G.703 ports:

HDB3 High Density Bipolar 3.

AMI Alternate Mark Inversion.

NRZ Non-Return to Zero.

The following table shows the valid line codes for each BERT tester mode:

BER Test Mode	Line Code			
	HDB3	**AMI**	**NRZ**	**Co-Dir.**
UNFRAMED	yes	yes	yes	no
FRAMED	yes	yes	yes	no
MUX (V.11)	Rx	Rx	Rx	no
MUX (Co-directional)	Rx	Rx	Rx	Tx
DEMUX (V.11)	Tx	Tx	Tx	no
DEMUX (Co-directional)	Tx	Tx	Tx	Rx

3.2.5.5 Termination

Use the cursor keys to move the cursor down to the **RxA/RxB Termination** fields.

Select the termination option for the line impedance to be used. The two impedance options are :

HI-Z Used for monitoring the signal without terminating the line into a low impedance on the G.703 interface.

75/120Ω Used to terminate the line into 75Ω for the unbalanced input or 120Ω for the balanced input on the G.703 interface.

3.2.5.6 Selecting the Clock Source

Use the cursor keys to move the cursor down to the **Clock Source** field.

The 2Mbit/s PCM transmit clock is sourced from one of the following:

EXTERNAL The clock is obtained from an external source such as a multiplexer or exchange connected to the external clock input **[21]**.

INTERNAL The clock is sourced from the internal crystal controlled oscillator.

RxA The clock is sourced from the received signal on receiver A.

RxB The clock is sourced from the received signal on receiver B.

3.2.5.7 Setting the Clock Deviation

If the **Clock source** is set to **INTERNAL** then the transmit clock frequency can be deviated from the nominal 2.048Mbit/s to a maximum of ±150 ppm with a resolution of 1 ppm.

Use the cursor keys to move the cursor down to the **Clock Deviation** field and use the softkeys to increment or decrement the clock deviation value in ±1, ±10 or ±50 ppm steps.

The transmit clock frequency may also be deviated while the BER test is running from the BERT results page. Refer to Section 3.2.9.9 for details.

3.2.6 The Patterns Menu

Enter the {**BERT: Patterns Menu**} by selecting the **Pattern** option from the {**Bit Error Ratio Test**} top level menu.

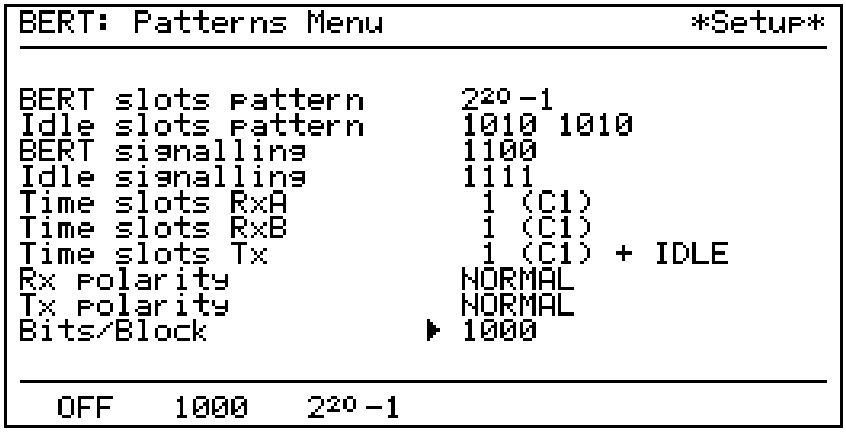


Figure 3.2-12 – {BERT: Patterns Menu} page

The following fields are available depending upon the BER tester mode selected:

BERT slots pattern (All modes) The test pattern to be inserted into the timeslots set in the **Time slots** fields can be selected from this field using the appropriate softkey. See Section 3.2.6.1.

Idle slots pattern (Framed only) The Idle slots pattern is the pattern to be inserted into all the transmitted timeslots not being used for the BER test. (See Note below).

BERT signalling (Framed only) The transmitted ABCD signalling bits associated with the BERT pattern slots can be set up in this field. (See Note below).

Idle signalling (Framed only) The transmitted ABCD signalling bits associated with the idle pattern slots can be set up in this field. (See Note below).

Time slots RxA (Framed only) The timeslots for the RxA receiver can be set from this field. See Section 3.2.6.2.

Time slots RxB (Framed only) The timeslots for the RxB receiver can be set from this field. See Section 3.2.6.2.

Time slots Tx (Framed only) The timeslots for the transmitter can be set up from this field. See Section 3.2.6.3.

Rx polarity (All modes) The polarity of the received data can be set here by using <**NORMAL**> for no inversion or <**INVERTED**> to invert the received data.

Tx polarity (All modes) The polarity of the transmitted data can be set here by using <**NORMAL**> for no inversion or <**INVERTED**> to invert the transmitted data.

Bits/Block (All modes except remote CRC) The number of bits per block can be set here. Use the following softkeys:

<**OFF**> – disables block measurements.

<**1000**> – sets block length to 1000 bits.

<**2^n-1**> – sets block length to the size of the PRBS.

CRC errors (CRC framing modes only) This field is displayed when equivalent bit error calculations are based on CRC errors (Rx slots must be ALL OFF on both receivers). The CRC errors are calculated on the received CRC frame when this field is set to **'LOCAL'**. Otherwise the CRC errors are based on the E1 and E2 bits carried in the NFAS word when <**DIST**> is selected.

Note: These bits are often used to report remote CRC errors by some network equipment.

3.2.6.1 Selecting the BERT Pattern

With the cursor in the **BERT slots pattern** field the following softkeys are available:

<**2^9-1**>	Pseudo random binary sequence 2^9-1.
<**2^{11}-1**>	Pseudo random binary sequence 2^{11}-1.
<**2^{15}-1**>	Pseudo random binary sequence 2^{15}-1.
<**2^{20}-1**>	Pseudo random binary sequence 2^{20}-1.
<**-more-**>	Selects another set of softkey options.
<**1111**>	All '1s' pattern.
<**0000**>	All '0s' pattern.
<**1010**>	Alternate '1s' and '0s' pattern.
<**BYTE**>	User programmable 8-bit pattern (see Note below).
<**WORD**>	User programmable 16-bit pattern (see Note below).

Select the required pattern using the softkeys. If the pattern is user programmable then an edit mode is entered automatically where the pattern can be edited using the softkeys or keypad (see Note below).

Note: Use the <**0**> and <**1**> softkeys to enter the binary bits zero and one respectively. Use the cursor keys to move through the pattern one bit at a time or use the <⬅> or <➡> keys to select each 4-bit nibble in the binary word.

WARNING: The use of certain invalid codes (such as 0000 for signalling bits) will cause the test to fail or indicate false alarms.

3.2.6.2 Setting the Receive Timeslots

Move the cursor into the **Time slots RxA** (or **RxB**) field. The following options now exist to select the timeslots:

a) Disabling receive timeslots

To turn off all receive timeslots without entering the {**BERT: Rx Slots Menu**} press <**OFF**>.

b) Selecting a single Receive Slot

Use the keypad to enter a single numeric value for the timeslot to be enabled for the BERT pattern. The display will show the timeslot number and the associated telephone channel number in parenthesis after the cursor has been moved out of the **Time slots** field.

c) Selecting the BERT nx64 Rx Slots

Press <**nx64**> to enter the {**BERT: Rx Slots Menu**}.

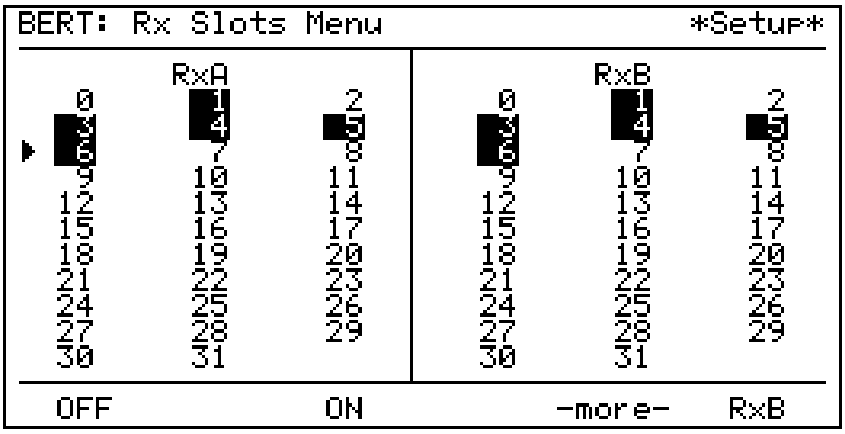


Figure 3.2-13 – {BERT: Rx Slots Menu} page

The {**BERT: Rx Slots Menu**} is divided into two halves. On the left hand side of the display is the Rx slots table for receiver RxA. On the right hand side of the display is the Rx slots table for receiver RxB. Use the cursor keys to move around the tables. Selected timeslots are indicated by a highlight box. The softkey options are described below:

<**OFF**> Turns off the selected timeslot.

<**ON**> Turns on the selected timeslot.

<**RxB**> Edit receiver B table.

<**RxA**> Edit receiver A table.

<**-more-**> Selects more softkey options.

<**ALL OFF**> Turns off all timeslots in table.

<**ALL ON**> Turns on all timeslots in table.

<**RxA➡RxB**> Copies the selected timeslots in the RxA table to the RxB table.

<**RxB➡RxA**> Copies the selected timeslots in the RxB table to the RxA table.

Notes: Timeslot 16 is reserved for signalling when the Tx framing is set to PCM30 or PCM30C and so access to it is restricted for BER testing in these framing modes. Timeslot 0 cannot be used to carry a test pattern since this slot contains the FAS (Frame Alignment Signal). FAS errors however are evaluated by the PA-41.

The BER test pattern is distributed over all the selected timeslots.

3.2.6.3 Setting the Transmit Timeslots

Move the cursor into the **Time slots Tx** field. This field allows the user to set up the timeslots to be transmitted by the PA-41 during a BER test. The following options now exist to select the timeslots:

a) Copying the RxA timeslots to the Tx timeslots:

Press <**RxA➡Tx**> to copy the RxA timeslots table to the Tx timeslots table. (This assumes that the user has already set up the RxA timeslots in the {**BERT: Rx Slots Menu**}).

b) Selecting a single transmit slot:

Use the keypad to enter a single numeric value for the timeslot to be enabled for the BERT pattern. The display will show the timeslot number and the associated telephone channel number in parenthesis after the cursor has been moved out of the **Time slots** field.

c) Setting all the transmit slots to THROUGH mode:

This option will only be available when the **Tx Framing** (set in the {**BERT: Interface Menu**}) is set to **THROUGH** mode.

Press <**THROUGH**> to force all the transmitted timeslot data to be passed through from the received timeslot data on RxA.

d) Selecting the BERT user (nx64) Tx Slots:

Press <**Edit**> to enter the {**BERT: Tx Slots Menu**}.

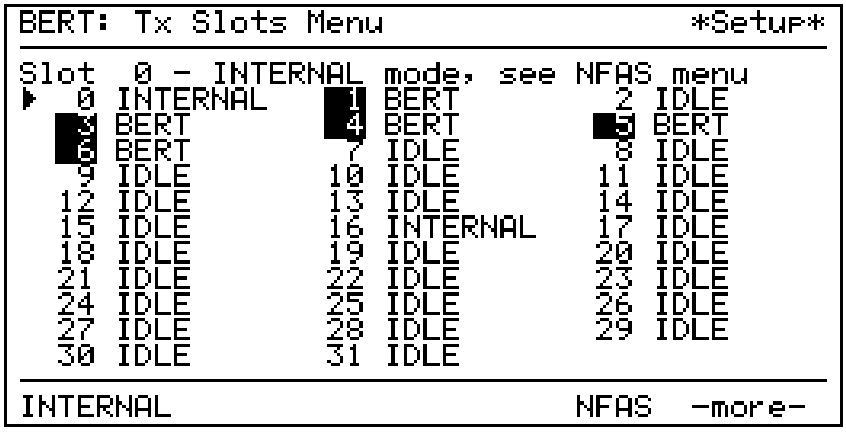


Figure 3.2-14 – {BERT: Tx Slots Menu} page

The {**BERT: Tx Slots Menu**} is used to set up the user defined transmitted timeslots. Use the cursor keys to move around the table. Each position in the table shows a timeslot number together with its status. The timeslot status can be either **THROUGH**, **IDLE** or **BERT**. The softkey options are described below:

<**IDLE**> Sets the selected Tx timeslot to contain the **IDLE** pattern.

<**THROUGH**> Sets the selected Tx timeslot to contain the data received in the corresponding timeslot from the receiver RxA. **Note:** This option will not be available if the Tx Framing mode is set to **INTERNAL** in the {**BERT: Interface Menu**}.

<**BERT**> Sets the selected Tx timeslot to contain the BERT pattern.

<**-more-**> Selects more softkey options.

<**ALL IDLE**> Sets all data timeslots to **IDLE**.

<**ALL THROUGH**> Sets all data timeslots to **THROUGH**.

<**ALL BERT**> Sets all data timeslots to contain the BERT test pattern.

<**NFAS**> Accesses the {**BERT: Tx Slots NFAS**} page, (see Section 3.2.6.4 below).
Note: This option is only offered when the cursor is in the timeslot 0 field.

<**INTERNAL**> Sets the timeslot to **INTERNAL** framing mode.
Note: This option is only offered when the cursor is in the timeslot 0 or timeslot 16 fields.

Note: Timeslot 16 is reserved for signalling when the Tx framing is set to PCM30 or PCM30C and so access to it is restricted for BER testing in these framing modes. Timeslot 0 cannot be used to carry a test pattern since this slot contains the FAS (Frame Alignment Signal). FAS errors however are evaluated by the PA-41.

Important note: When setting-up a DEMUX test with CO-DIRECTIONAL LINE coding, the receive data rate is automatically calculated from the number of Tx slots selected. The number of Tx slots must therefore always be set up for a DEMUX test to function correctly.

3.2.6.4 The Tx NFAS Page

The {**BERT: Tx Slots NFAS**} page allows the user to edit the data bits which are transmitted in the NFAS (Non-Frame Alignment Signal). The NFAS is transmitted in timeslot 0 on every alternate frame.

Enter the {**BERT: Tx Slots NFAS**} page by pressing <**NFAS**> while the cursor is in the timeslot **0** field of the {**BERT: Tx Slots Menu**}.

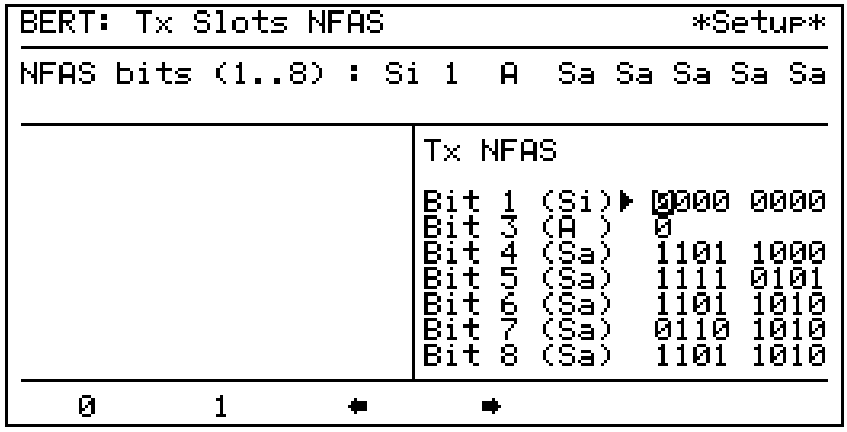


Figure 3.2-15 – {BERT: Tx Slots NFAS} page

The {**BERT: Tx Slots NFAS**} page contains a box at the top of the screen which indicates the order and preferred names of all the NFAS data bits. These bits are described as follows:

Bit1 (Si or C bit) Bit reserved for international use. It may contain formatted serial data or alarm status information when the Tx Framing mode is set to PCM30 or PCM31, (Si bit). In PCM30C or PCM31C (i.e. CRC modes) this bit (C bit) will contain the CRC multiframe alignment signal 001011 in frames 1, 3, 5, 7, 9 and 11. Frames 13 and 15 will contain the 'E' bits.

Bit2 Always set to binary '1' to avoid conflict with the Frame Alignment Signal.

Bit3 (A) This is the Remote Alarm Indication bit.

Bit4-8 (Sa bits) These are the national bits used by the national telecom authorities. These bits may contain formatted data or alarm status information.

When the Framing mode is set to PCM30C or PCM31C (i.e. CRC modes) then the ‘C’ bit (bit1) containing the CRC multiframe alignment signal (CRCMFAS) and E bits will also be displayed in the box at the top of the screen under the NFAS bits.

The table in the box at the lower right hand corner of the display contains the user programmable transmit NFAS bits. These are organised in a matrix such that the columns represent the NFAS words in the transmitted frames 1, 3, 5, 7, 9, 11, 13 and 15 over a multiframe and the rows represent the NFAS bits 1, 3 to 8, (see Note below).

In this way, the PA-41 may be programmed to transmit a repeating serial pattern of 8 bits in length for each of the NFAS Si or Sa bits. (The pattern will repeat every multiframe). This pattern may be a loopback command signal for a distant multiplexer for example.

The ‘A’ bit (Remote Alarm Indication) can also be programmed to a ‘1’ or ‘0’ in this menu. Once programmed, this bit remains constant through the whole multiframe.

Note: When the Framing mode is set to PCM30C or PCM31C (i.e. CRC modes) then the columns of this table align with the two CRC SMFs (Sub-Multiframes) SMF1 and SMF2. This is indicated over the corresponding columns so that columns 1 to 4 align with SMF1 and columns 5 to 8 align with SMF2.

To edit these fields, use the cursor keys, keypad and softkeys as follows:

<**0**>	Sets bit to binary ‘0’.
<**1**>	Sets bit to binary ‘1’.
<⬅>	Moves cursor to the next (left) 4-bit nibble.
<➡>	Moves cursor to the next (right) 4-bit nibble.
<**Enter**>	Enters the binary bit value and move to the next field.

3.2.7 The Control Menu

The {**BERT: Control Menu**} is used to set parameters which control various characteristics of the BER test such as the test duration, autoprinting and alarms.

The {**BERT: Control Menu**} is accessed from the BERT top level menu. Use the cursor keys to move the cursor down to the **Control** field and press <**Select**>.

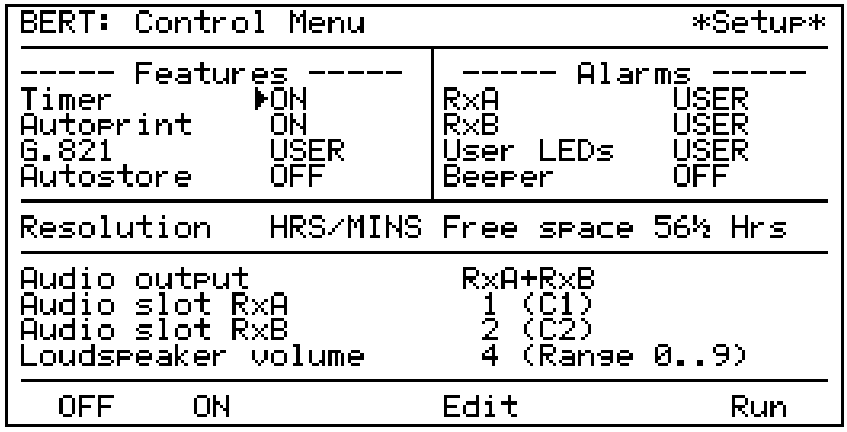


Figure 3.2-16 – {BERT: Control Menu} page

The {**BERT: Control Menu**} is divided into four sections as shown in the example above. At the top left hand side of the display is the **Features** box. This contains options for selecting the Timer, Autoprint and G.821 parameters. Each field parameter may be set to OFF (this feature is disabled) or ON (this feature is enabled).

At the top right hand side of the display is the **Alarms** box. This contains options for selecting the alarm parameters for the Screen, Autoprint and LEDs. Each of these fields may be set to **ALL OFF** (Alarms disabled), **ALL ON** (Alarms enabled) or **USER** (User programmable). The fourth option allows the user to turn the audible Beeper ON or OFF.

At the centre of the {**BERT: Control Menu**} is the **Resolution** box. This allows the resolution of the BERT histograms to be set. See Section 3.2.7.9.

The lower section of the {**BERT: Control Menu**} contains the audio output parameters. See Section 3.2.7.10.

3.2.7.1 Setting the Test Timer

In the {**BERT: Control Menu**} use the cursor keys to position the cursor on the **Timer** field and press <**Edit**>.

The display will then show the {**BERT: Timer Menu**} page.

Start Time

Use the cursor keys to position the cursor on the **Start Time** field. The **Start Time** parameter specifies when the BER test will start. If the test is required to be started manually, press <**MANUAL**>. The test can then be started immediately when <**Run**> is pressed in the {**BERT: Control Menu**} or {**BERT:Results**} pages.

If the test is required to start at some later time after <**Run**> has been pressed then press <**DELAYED**>. The start time and date will then be displayed on the screen in the **Start Time** field.

Use the cursor keys to select the field to be edited and the keypad **[5]** to enter the digits for the time, day and year. The month is selected using the softkeys.

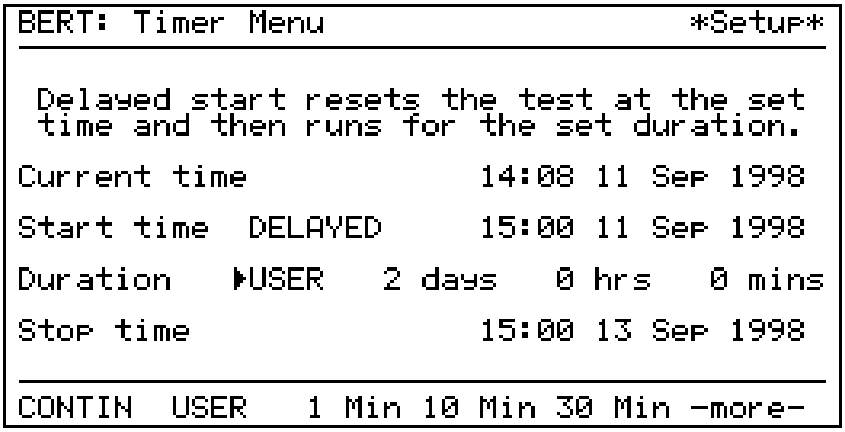


Figure 3.2-17 – {BERT: Timer Menu} page

Note: When a 'Delayed Start' is selected, the Tx and Rx sections of the PA-41 are enabled as soon as <**Run**> is pressed. At the delayed start time the results are all reset to zero. This ensures that no problems occur with system synchronisation at the start of the timed test.

Duration

Use the cursor keys to position the cursor on the **Duration** field. The duration of the test can be set in one of three ways: Continuous, User (user programmable duration) or Preset. These modes may be selected by pressing the appropriate softkey as follows:

<**CONTIN**> Use this softkey to set the test to run continuously.

<**USER**> Sets the user programmable duration time mode. The duration of the test can then be set in days, hours and minutes. Use the cursor keys and softkeys to enter the time and date in the same way as for **Start time**.

A **Stop time** field appears below the **Duration** field together with a stop time and date (see Note below).

<**1Min**>, <**10Min**>, <**30Min**>
Use these softkeys to select a fixed test duration in minutes.

A **Stop time** field appears below the **Duration** field together with a stop time and date (see Note below).

<**-more-**> Use this softkey to select the next set of softkey options.

<**1 Hr**>, <**6 Hrs**>, <**12 Hrs**>, <**24 Hrs**>, <**60 Hrs**>
Use these softkeys to select a fixed test duration in hours.

A **Stop time** field appears below the **Duration** field together with a stop time and date (see Note below).

Note: This **Stop time** field cannot be edited and the displayed stop time is calculated by the PA-41 from the start time and duration values.

3.2.7.2 Setting-up Autoprint

In the {**BERT: Control Menu**} use the cursor keys to position the cursor on the **Autoprint** field and press <**Edit**>.

The display will then show the {**BERT: Autoprint Menu**} page.

```
BERT: Autoprint Menu                          *Setup*
Autoprint on alarm events                     ON
(as set up in BERT: Alarms Menu)
Autoprint on error threshold                 ▶ON
Bit_error_threshold                           1.0 E 3
Regular autoprint of BERT totals              ON
At real time intervals of          0 Hrs 15 Mins
Reset BERT test after autoprint               ON
  OFF     ON
```

Figure 3.2-18 – {BERT: Autoprint Menu} page

The {**BERT: Autoprint Menu**} sets up the PA-41 to print out specific alarm events or BERT results totals at certain times while the BER test is running. A suitable printer must be connected to the V.24 port **[24]**, see Section 2.9 and ***Appendix C – Printers for use with the PA-41***.

Alarms and bit errors are printed out with a 1 second resolution. However, if a printer is too slow or its buffer too small, then data will be lost for high error and alarm rates. When the BER test has been completed normal histograms can be printed out to a 1 minute resolution without loss of results. A single bit error or alarm can still be seen on a histogram.

Autoprint on alarm events (Alarm results)

Move the cursor into the **'Autoprint on alarm events'** field. This autoprint feature allows selected alarms set up in the {**BERT: Alarms Menu**} to be printed as they occur during the BER test. Press <**OFF**> to disable this feature or <**ON**> to enable it.

Autoprint on error threshold (Bit errors)

The autoprint feature allows an alarm event to be printed whenever a user selectable bit error threshold has been exceeded during the last second. To turn this feature on or off, move the cursor on to the **'Autoprint on error threshold'** field and press <**ON**> or <**OFF**>.

The threshold for the alarm event may be set (as the number of bit errors received in the last second) by moving the cursor on to the **'Error Threshold'** field.

Regular autoprint of BERT totals (Error results)

Move the cursor into the **Regular autoprint of BERT totals** field. This autoprint feature allows BERT results totals to be printed at regular time intervals and may be enabled by pressing <**ON**> (or <**OFF**> to disable the feature).

To set the time interval, move the cursor into the '**At real time intervals of**' field and enter the time using the softkeys and cursor keys. The time interval softkeys offered are preset for <**1 Min**> – 1 minute, <**10 Min**> – 10 minutes, <**30 Min**> – 30 minutes, <**1 Hour**>, <**6 Hrs**> – 6 hours and <**12 Hrs**> – 12 hours.

Finally, the BER test results may be automatically reset to zero after the autoprint has taken place. To do this, move the cursor down into the **Reset BERT test after autoprint** field and press <**ON**>. Pressing <**OFF**> will disable this feature.

3.2.7.3 Viewing the Autoprint Buffer

Position the cursor against the **Autoprint** field in the features box of the {**BERT: Control Menu**}. Press <**View**> to enter the {**BERT: Autoprint View**} page.

The following softkey options are available:

<**Start**> Move to the start of the buffer.

<**End**> Move to the end of the buffer.

<**Clear**> Clear the Autoprint buffer.

<**Print**> Print the contents of the Autoprint buffer.

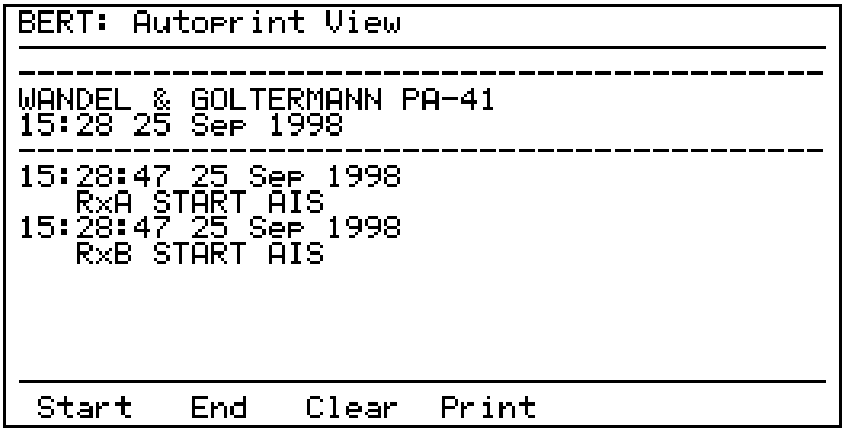


Figure 3.2-19 – The {BERT: Autoprint View} page

Use the cursor [△] and [▽] keys to move through the autoprint alarm events line by line or use the cursor [◁] and [▷] keys to move event by event.

Press [EXIT] to return to the {**BERT: Control Menu**}.

3.2.7.4 Setting the G.821 Performance Limits

In the {**BERT: Control Menu**} move the cursor into the **G.821** field in the **Features** box. The G.821 performance analysis feature may be turned on or off here using the <**ON**> or <**OFF**> softkeys. To edit the G.821 performance limits press <**Edit**>, the screen will then display the {**BERT: G.821 parameters**} page.

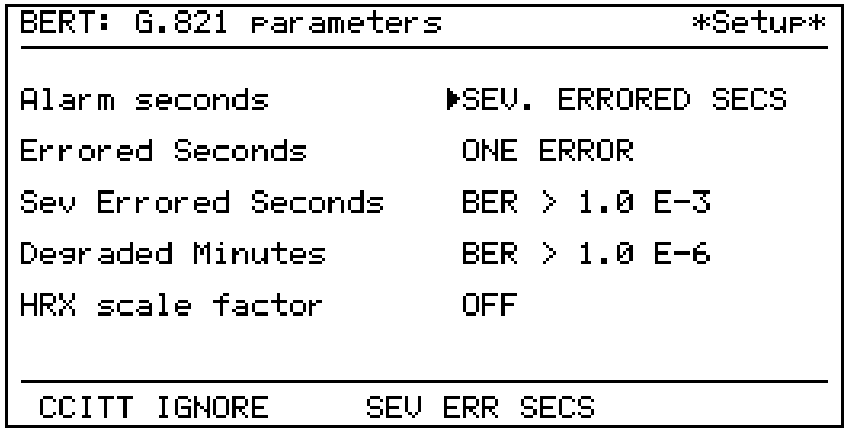


Figure 3.2-20 – {BERT: G.821 parameters} page

The following fields and parameter options are available:

Alarm seconds	**CCITT**	Same as <**IGNORE**>.
	IGNORE	Alarm seconds will be excluded from all G.821 processing.
	SEV. ERR. SECS	Alarm seconds will be processed as if they were severely errored seconds.
Errored seconds	**CCITT**	Same as <**NORM 64k**>
	NORM 64k	Normalises the received data to 64kbit/s as specified in CCITT Rec. G.821 (1988), Annex D.
	ONE ERROR	Any second containing one or more errors is classed as an errored second.
Sev errored seconds	**CCITT**	Sets the severely errored seconds threshold to 1.0E-3.
	USER	Use the cursor keys and numeric keypad to enter a threshold between 1.0E-9 and 9.9E-3.

Degraded minutes	**CCITT**	Sets degraded minutes threshold to 1.0E-6.
	USER	Use the cursor keys and numeric keypad to enter a threshold between 1.0E-9 and 9.9E-3.
HRX scale factor	**CCITT**	Sets the HRX scale to 100%.
	USER	Enter HRX scale factor between 0 and 100%.
	OFF	Turns off the G.821 PASS/FAIL messages.

3.2.7.5 Setting the Autostore

In the {**BERT: Control Menu**}, move the cursor to the **Autostore** field in the **Features** box. Autostore can be turned on or off by pressing <**ON**> or <**OFF**> respectively.

A new stores location is selected automatically on running a new test if the Autostore feature is enabled and the results saved during the test. If a free stores location is not found, and the current store contains more than 1 hour of test results, the user will be prompted with '**Stored results will be lost by running**'. Otherwise, if there is less than 1 hour of results in the current store, then these results will be overwritten without warning.

The user has the option of deleting another stores entry or archiving all the stores and clearing them ready for a new set of test results.

If **Autostore** is **OFF** then the PA-41 will attempt to run a test in the currently selected store. These results will be overwritten unless there is more than 1 hour of results. In this case the message '**Stored results will be lost by running**' will be displayed to warn the user before the test is run.

3.2.7.6 Selecting the BERT Alarms

In the {**BERT: Control Menu**} move the cursor into the **RxA** field in the **Alarms** box at the top right hand side of the menu. The **RxA** and **RxB** fields are used to set up the alarm parameters for the two receivers. Both fields function identically so a description is given for only one receiver – RxA. The following softkey options are available in these fields:

<**ALL OFF**>	Disables all the alarms for this receiver.
<**ALL ON**>	Enables all the alarms for this receiver.
<**Edit**>	Provides access to the {**BERT: Alarms Menu RxA**} for this receiver.
<**Run**>	Runs a BER test.

To edit the {**BERT: Alarms Menu RxA**} press <**Edit**>, the screen will then display the {**BERT: Alarms Menu RxA**}.

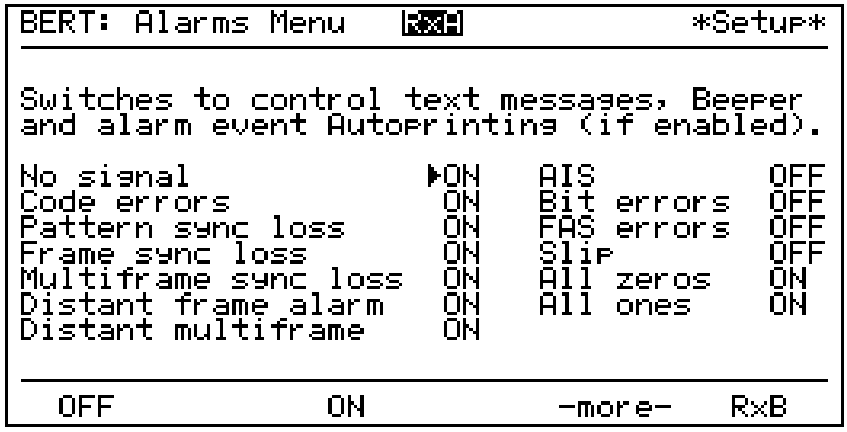


Figure 3.2-21 – {BERT: Alarms Menu RxA} page

Use the softkeys to select the following options:

<**ON**> Enables the alarm.

<**OFF**> Disables the alarm.

<**RxA**> Displays RxA receiver {**BERT: Alarms Menu RxA**}.

<**RxB**> Displays RxB receiver {**BERT: Alarms Menu RxB**}.

<**-more-**> Reveals more softkey options.

<**ALL OFF**> Disables all the alarms for this receiver.

<**ALL ON**> Enables all the alarms for this receiver.

<**RxA➡RxB**> Copies all the receiver RxA alarm settings to the RxB receiver.

<**RxB➡RxA**> Copies all the receiver RxB alarm settings to the RxA receiver.

3.2.7.7 Setting the User Programmable LEDs

In the {**BERT: Control Menu**} move the cursor into the **User LEDs** field in the **Alarms** box at the top right hand side of the menu. This field is used to set up the alarm parameters for the user programmable LEDs from the keyboard.

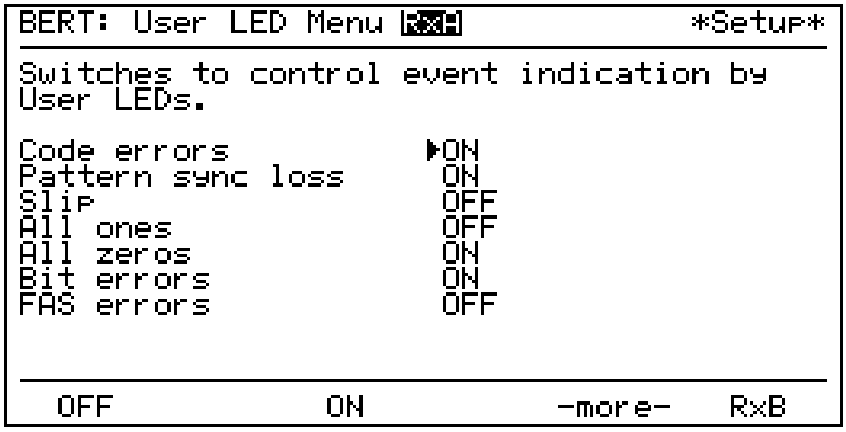


Figure 3.2-22 – {BERT: User LED Menu RxA} page

The following softkey options are available:

<**ALL OFF**> Disables all the alarms for the user LED on this receiver.

<**ALL ON**> Enables all the alarms for the user LED on this receiver.

<**Edit**> Provides access to the {**BERT: User LED Menu**}.

<**Run**> Runs a BER test.

To edit the {**BERT: User LED Menu RxA(RxB)**} press <**Edit**>, move the cursor to the required field and reset as required

Use the softkeys to select the following options:

<**ON**> Enables the alarm.

<**OFF**> Disables the alarm.

<**RxA**> Displays RxA receiver {**BERT: User LED Menu RxA**}.

<**RxB**> Displays RxB receiver {**BERT: User LED Menu RxB**}.

<**-more-**> Reveals more softkey options.

<**ALL OFF**> Disables all the alarms for this receiver programmable LED.

<**ALL ON**> Enables all the alarms for this receiver programmable LED.

<**RxA➡RxB**> Copies all the receiver RxA alarm settings to the RxB receiver.

<**RxB➡RxA**> Copies all the receiver RxB alarm settings to the RxA receiver.

3.2.7.8 Selecting the Audible Beeper

In the {**BERT: Control Menu**} move the cursor into the **Beeper** field in the **Alarms** box at the top right hand side of the menu. The **Beeper** field allows the user to turn the audible beeper on or off. Press <**ON**> to enable the beeper or <**OFF**> to disable it.

3.2.7.9 Setting the Histogram Resolution

In the {**BERT: Control Menu**} move the cursor into the **Resolution** field at the centre of the screen. The **Resolution** field is used to select the **BERT Histogram** resolution. Press <**DAYS/HRS**> for setting the histogram to resolve BERT results in days and hours or press <**HRS/MINS**> for setting the histogram to resolve BERT results in hours and minutes.

3.2.7.10 Selecting the Audio Output

If the **Tester mode** field in the {**BERT: Interface Menu**} is set to **Framed tester** or **MUX tester** then the **Audio output** field is offered in the {**BERT: Control Menu**}. The **Audio output** field is used to turn on or off the audio monitor loudspeaker or handset and to select the appropriate receivers. The following softkey options are offered when the audio output feature is enabled:

<**OFF**> Turns off the audio output.

<**RxA**> Audio output enabled for receiver A.

<**RxB**> Audio output enabled for receiver B.

<**RxA+RxB**> Audio output enabled for both receivers.

Having selected one or two receivers to provide an audio output using the above softkeys, the additional fields for **Audio slot RxA** and/or **Audio slot RxB** are provided below the **Audio output** field.

To select the timeslot to monitor the audio signal, move the cursor into the **Audio slot RxA** (or **Audio slot RxB**) field and edit the slot number using the keypad.

3.2.7.11 Setting the Loudspeaker Volume

When the audio output feature is enabled, the loudspeaker volume can be set by moving the cursor to the **Loudspeaker Volume** field at the bottom of the {**BERT: Control Menu**}. Use the keypad to enter the loudspeaker volume (**0...9**).

3.2.8 The Stores Menu

To enter the {**BERT: Stores Menu**} select the **Stores** option in the {**Bit Error Ratio Test**} BERT top level menu.

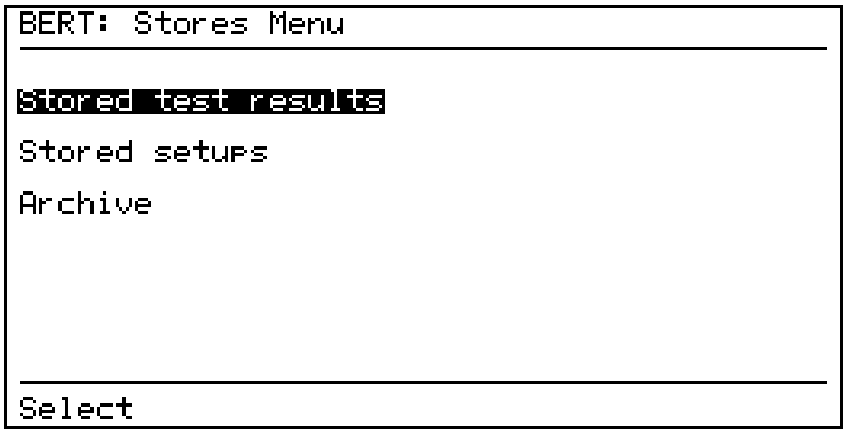


Figure 3.2-23 – {BERT: Stores Menu} page

The {**BERT: Stores Menu**} displays three options:

Stored test results Provides a means of storing the current test results or recalling previous test results in one of the 10 BERT stores. (These are separate from the configuration only stores but include the test configurations for each of the test results as well).

Stored setups Allows the user to save or recall instrument test parameters in one of the 10 configuration stores provided by the PA-41.

Archive This is a feature which allows the user to backup or recover all the internal BERT stores and configurations to/from a memory card or remote device.

3.2.8.1 Using the Test Memories

a) Saving Test Results

The PA-41 will automatically save the test results and instrument setups of the current test while the test is running. These results can be found in the store currently pointed to by the cursor in the {**BERT: Stored Results**} page. To enter the {**BERT: Stored Results**} page select **Stored test results** from the {**BERT: Stores Menu**}.

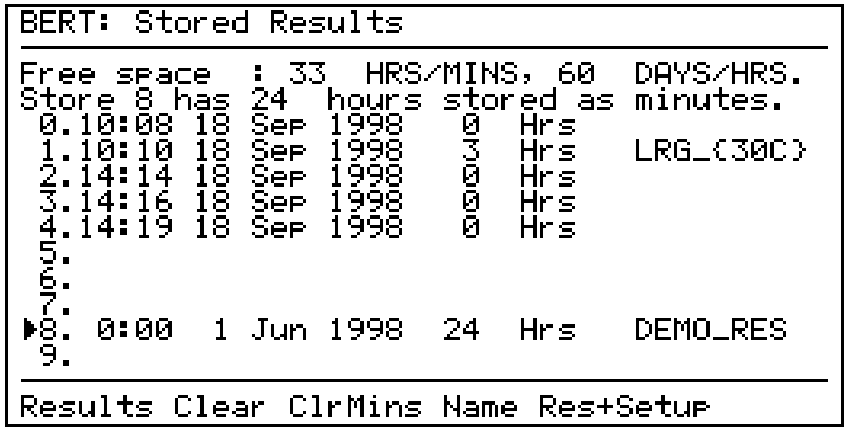


Figure 3.2-24 – {BERT: Stored Results} page

This page contains ten store locations for retaining BER test results and instrument setups. Displayed at the top of the page is the free space available for storing more test results in terms of time.

While the cursor is pointing to a store location with a set of valid test results, the following softkey functions will be available:

<**Results**> Load and view the results in the store currently pointed to by the cursor.

<**Clear**> Clear the results in the store currently pointed to by the cursor.

<**Clr Mins**> Clear only the minutes data in the store currently pointed to by the cursor. This allows space to be saved in memory for other tests to be run when most of the stores memory has been filled.

<**Name**> Allows the user to enter a store name.

<**Res+Setup**> Load and view the results and test setup in the store currently pointed to by the cursor.

<**Lock**> Locks the current store pointed to by the cursor. To unlock the store, ensure that the cursor is pointing to the required store to be unlocked and press the **[Security]** key **[6]**, followed by softkey F6.

The store containing the new set of results may be named in the same way as described below in ***c) Naming Test Setups***.

See also the Autostore feature as described in Section 3.2.7.5.

b) Saving Test Setups

To save the current BER test parameters select **Stored setups** in the {**BERT: Stores Menu**}. The screen will then display the {**BERT: Stored Setups**} page. Move the

cursor into an empty stores field (one of 0 to 9) and press <**Save**>. All the current BER test setup information will then be saved in this store.

The following softkeys will then be available:

<**Recall**> Recalls the test setups from the store number currently pointed to by the cursor.

<**Save**> Saves the current test setup.

<**Delete**> Deletes the test setup from the store number currently pointed to by the cursor.

<**Name**> Allows the user to enter a store name.

<**Lock**> Locks the current store pointed to by the cursor. To unlock the store, press the **[Security]** key **[6]** followed by softkey [F6].

c) Naming Test Setups

While the cursor is pointing to the store to be named, press <**Name**>. A pop-up edit box appears with the alphabetic characters available from which the user can build the store name. Use the cursor keys to move around the characters in the box to select a character. The cursor will wrap around on all sides of the box to save having to press the cursor keys many times to get from one side of the box to the other.

Press <**Select**> to insert the selected character into the store name which is displayed next to the edit box. Other softkeys will then be available to <**Delete**> a character from the name or <**Clear**> the whole name to start editing again. When you have finished editing the name, press <**Enter**> to enter the name into the store field.

d) Recalling Test Setups

To recall a previously stored BERT test setup, select the store to be recalled using the cursor keys and press <**Recall**>. The BER test setup is loaded and the PA-41 will return to the {**BERT: Interface Menu**} page.

e) The BERT Demo Results

A useful set of demonstration results are permanently stored within the PA-41. To access these results move the cursor to a clear store while displaying the {**BERT: Stored results**} page and press <**Demo**>. The PA-41 will then take a few seconds to recall the results and save them in the currently selected store location indicated by the cursor.

f) Archiving the BERT Stores to Memory Card

When all the BERT stores are full of useful test results, they can be archived on the memory card (or remote PC file server – see Section 3.5, ***File handling***).

To do this, move the cursor on to the Archive option in the {**BERT: Stores Menu**} and press <**Select**> to access the {**BERT: Archive**} page.

Ensure that a memory card (SRAM) of at least 256k byte capacity is plugged into the memory card slot. If the card is not formatted then the PA-41 will inform you. To format the card press <**Format**> and wait for a while. The PA-41 will inform you when the card has formatted successfully by displaying '**Directory Empty**'.

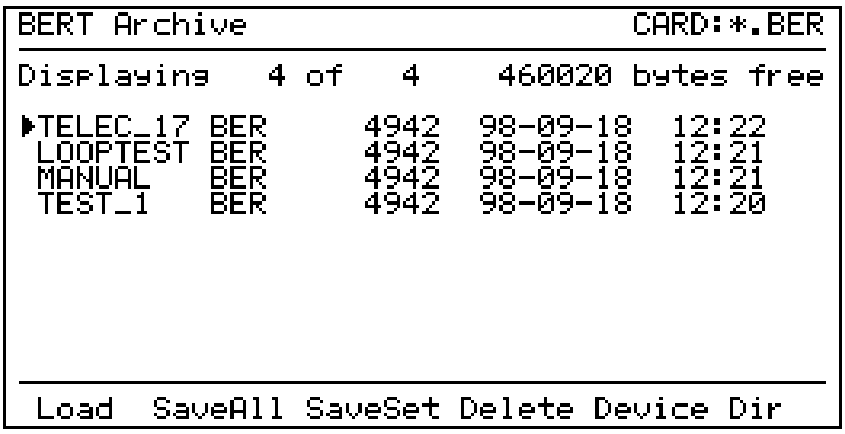


Figure 3.2-25 – {BERT: Archive} page

Figure 3.2-25 shows an example of the {**BERT: Archive**} page with the memory card device selected. The current directory of the memory card is displayed and may be scrolled using the △ and ▽ cursor keys.

Only the 3 files with the ".BER" extension will be displayed out of a possible 4 files currently held in the directory. This is due to the "*.BER" file specification selected in the file specification box, see Figure 3.2-27.

Press <**SaveAll**> if you wish to archive the BERT stores, or <**SaveSet**> to archive just the BERT setups.. The display will then pop-up the file name editor box where the file name may be entered or edited in the same way as the store name editor described in Section 3.2.8.1 ***Using the Test Memories***.

When you have entered the file name press <**SaveAll**> or <**SaveSet**> again to confirm that you wish the PA-41 to save this file.

Figure 3.2-26 shows the {**BERT: Archive**} page after <**Load**> has been pressed. The current filename (pointed to by the cursor) will be displayed in a box. This filename may be changed by pressing <**Edit**>, followed by <**Select**> and cursor keys to enter the new filename.

Figure 3.2-27 shows the {**BERT: Archive**} page with the file specification box displayed. Use <**Edit**> to enter the edit mode, and <**Select**> and cursor keys to enter the filename and extension to be displayed.

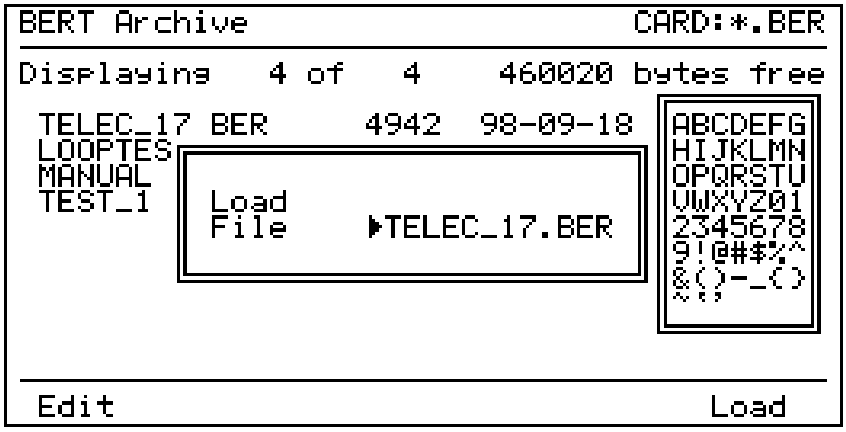


Figure 3.2-26 – {BERT: Archive} page, after <Load> has been pressed

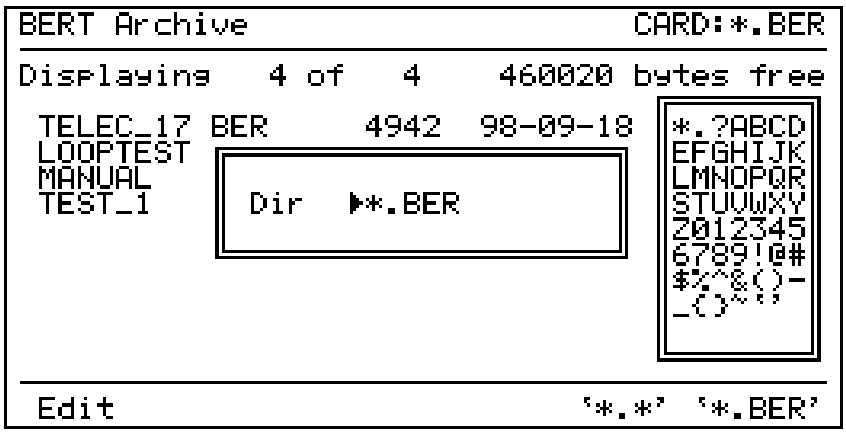


Figure 3.2-27 – {BERT: Archive} page, with file specification box displayed

(See also Section 3.5 ***File handling***, for more information about files and file utilities).

g) Recovering the Stores from Memory Card

To recover an archived set of BERT stores, ensure that the memory card (SRAM) containing the BERT data file is inserted into the PA-41 memory card slot and move the cursor on to the **Archive** option in the {**BERT: Stores Menu**}. Now press <**Select**> to access the {**BERT: Archive**} page.

The screen will display the card file directory showing all the BERT data files on the card. Use the cursor keys to move the cursor through the directory. The directory will scroll up when the cursor reaches the bottom of the screen if there are more files not shown on the display.

WARNING: The current internal BERT stores data will be overwritten by loading archived BERT stores data regardless of 'locked' stores. Ensure that you have archived the internal stores data to another file if you do not wish to lose this data.

Press <**Load**> to start the load procedure. The screen will first display the pop-up filename edit box. The file to be loaded can either be the file currently pointed to by the

cursor (the name of which will automatically appear in the pop-up edit box) or the file specified by the user by editing the file name in the edit box.

When the correct file name is displayed in the edit box, press <**Load**> again to confirm that this is the file you wish to load. The PA-41 will then load the data into the 10 internal results and configurations stores.

3.2.9 Running a BER test

A BER test may be started from three places:

- From the BERT top level menu {**Bit Error Ratio Test**} by selecting **Auto**. This will run the autoconfigure mode and is used only when the instrument configuration requirements are unknown. (See Section 1.2.1.3 ***Autoconfigure***).
- From the {**BERT: Control Menu**} by pressing <**Run**> after the instrument has been configured.
- From any of the BERT Results pages by pressing <**Run**>.

3.2.9.1 The BERT Error Results Page

The {**BERT: Error Results RxA(RxB)**} page can be accessed while running a BER test by pressing <**Numeric**> in the BERT results display.

Since the three BERT results pages {**BERT: Error Results**}, {**BERT: Alarm Results**} and {**BERT: G.821 Results**} can be selected in a circular fashion using <**Numeric**>, this softkey may have to be pressed more than once.

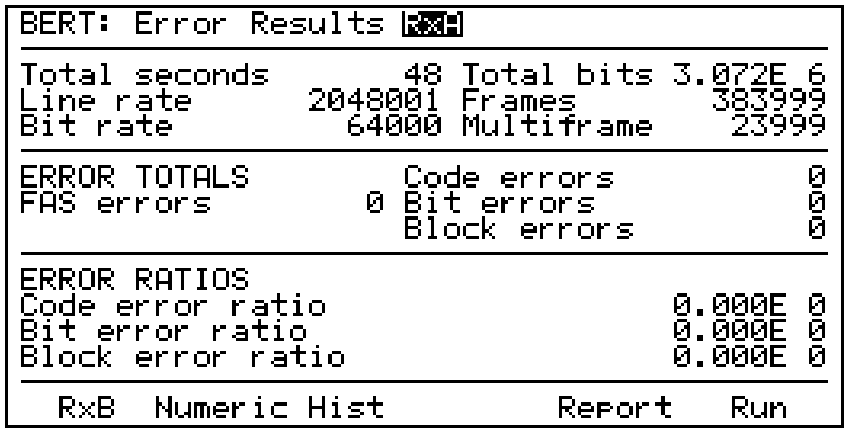


Figure 3.2-28 – {BERT: Error Results RxA} page

The {**BERT: Error Results RxA(RxB)**} page is divided into three sections:

The section at the top of the screen contains general information as follows:

Total seconds The total number of seconds elapsed since the start of the current test.

Line rate number of incoming clock pulses recorded in the last second (nominally 2048000).

Bit rate the total number of bits received during the last 60 seconds excluding seconds of No Signal, AIS, Frame sync loss, Pattern sync loss, All zeros or Slip divided by 60.

Total bits total number of bits received excluding seconds of No signal, AIS, Frame sync loss, Pattern sync loss, All ones, All zeros and Slip.

Frames total number of frames received during seconds of frame alignment.

Multiframes total number of multiframes received during seconds of multiframe alignment.

The centre section of the display contains the **ERROR TOTALS** as follows:

FAS errors total count of FAS word errors received.

Code errors total count of line code errors received.

Bit errors total count of bit errors received excluding seconds of No signal, AIS, Frame sync loss, Pattern sync loss, All ones, All zeros and Slip.

CRC errors total count of CRC errors received excluding seconds of No signal. (This field is only displayed when the framing mode is set to PCM30C or PCM31C, i.e. CRC modes).

Block errors total count of block errors excluding seconds of No signal, AIS, Frame sync loss, Pattern sync loss, All ones, All zeros and Slip. (This field is only displayed when the block measurement is enabled).

The bottom section of the display contains the **ERROR RATIOS** as follows:

Code error ratio total code errors received divided by total bits as defined above.

Bit error ratio (BER) total bit errors divided by total bits as defined above.

Block error ratio (BLER) total block errors divided by total bits multiplied by block length.

3.2.9.2 The BERT Alarm Results Page

The {**BERT: Alarm Results RxA(RxB)**} page is accessed by pressing <**Numeric**> as described above.

There are two pages for BERT alarm results, one for RxA and one for RxB. To change from one receiver results display to the other, press the <**RxA**> or <**RxB**> softkey.

The {**BERT: Alarm Results RxA(RxB)**} page is divided into two sections. The top section displays the **Start time** and **Current time** (while the test is running) or **Stop time** (when the test has been stopped) of the current test. The lower section contains the **ALARM SECONDS** totals. These fields will be dependent upon the PA-41 framing mode etc.

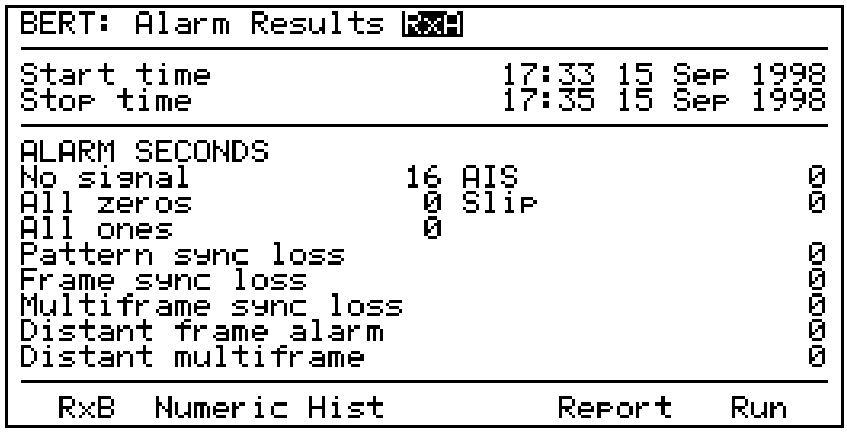


Figure 3.2-29 – {BERT: Alarm Results RxA} page

Note: In **'Delayed Start'** mode the **Start time** shows the time at which <**Run**> was pressed until the delayed Start time has expired. The **Start time** is then *reset*.

3.2.9.3 The BERT G.821 Results Page

If the G.821 analysis mode is enabled from the BERT control menu then the {**BERT: G.821 Results RxA(RxB)**} pages will be accessible.

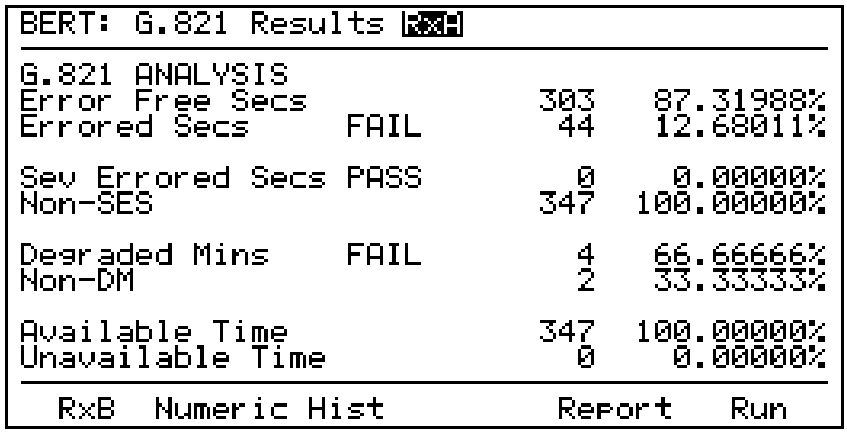


Figure 3.2-30 – {BERT: G.821 Results RxA} page

There are two pages for BERT G.821 results, one for RxA and one for RxB. To change from one receiver results display to the other, press the <**RxA**> or <**RxB**> softkey.

The {**BERT: G.821 Results RxA(RxB)**} pages contain the G.821 results as described below (refer to ***Appendix F – G.821 Parameters Defined*** for definitions of the G.821 parameters):

Error free secs The error free seconds occurring in available time expressed as a total number and as a percentage of the available time.

Errored secs The errored seconds occurring in available time expressed as a total number and as a percentage of the available time.

Sev errored secs The severely errored seconds occurring in available time expressed as a total number and as a percentage of the available time.

If the '**Alarm seconds**' option on the {**G.821 Menu**} page is set to '**SEV ERR SECS**', then seconds which contain an alarm state will be treated as severely errored seconds. If the option is set to '**IGNORE**', then these seconds will be completely excluded from the calculation of the G.821 results.

Severely errored seconds are also counted as errored seconds.

Degraded mins The degraded minutes expressed as a total and as a percentage of the total number of G.821 'minutes'.

It should be noted, however, that by definition all severely errored seconds are excluded from the degraded and non-degraded minutes, whereas only those severely errored seconds occurring in unavailable time are excluded from the available time. For this reason, the percentage for degraded and non-degraded minutes will not always add up to 100%.

Available time The available time expressed as a total number of seconds and as a percentage of the available time plus the unavailable time.

Unavailable time The unavailable time expressed as a total number of seconds and as a percentage of the available time plus the unavailable time.

If G.821 results are printed while a test is running, the most recent ten seconds of the test will be excluded from the G.821 results due to the fixed ten second delay. This can lead to misinterpretation of the results when, for example, a short autoprint interval (say 1 minute) is used in conjunction with resetting totals on autoprint.

At the end of the test the final ten seconds are included in the G.821 results.

Seconds which are counted as unavailable time are completely excluded from the calculations of other G.821 results.

Pass/Fail This is used with errored seconds, severely errored seconds and degraded minutes to indicate that the network section under test has met the Hypothetical Reference Connection (HRX) error

performance objectives set.

Performance objectives are calculated as follows:

Degraded minutes	10 x HRX/100%
Sev. errored seconds	0.1 + (0.1 x HRX/100)%
Errored seconds	8 x HRX/100%

Additional results available when using a printer:

Non-severely Errored Seconds The non-severely errored seconds occurring in available time expressed as a total number and as a percentage of the available time.

Non-degraded Minutes The non-degraded minutes expressed as a total and as a percentage of the total number of the G.821 results.

If a test is run with PCM30 or PCM31 framing and BERT slot 'OFF', the G.821 analysis will be based on FAS errors. If CRC-4 framing is used with BERT slot 'OFF', the G.821 analysis will be based on CRC errors. In these cases the {**G.821 Results**} indicator will be replaced by {**FAS G.821**} or {**CRC G.821**} respectively.

3.2.9.4 The BERT Histogram Results Pages

The {**BERT: Histogram RxA(RxB)**} pages can be accessed from the numeric results pages by pressing <**Hist**>.

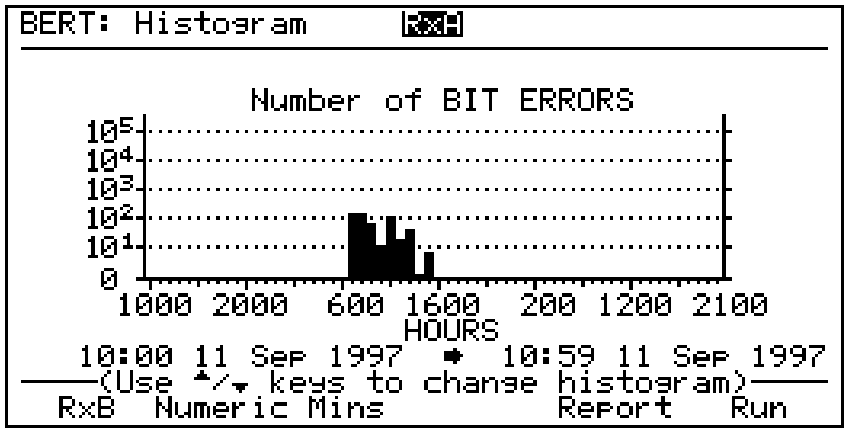


Figure 3.2-31 – {BERT: Histogram RxA} page showing bit errors

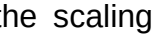
The various histograms can be selected on a rotation basis using the up and down cursor keys.

The histogram horizontal resolution may be selected using softkey F3. This will be labelled <**Days**> for days resolution, <**Hours**> for hours resolution and <**Mins**> for minutes resolution.

The following histograms are available:

BIT ERRORS, DISTANT MULTIFRAME ALARM, DISTANT FRAME ALARM, MULTIFRAME SYNC LOSS, FRAME SYNC LOSS, SLIP, PATTERN SYNC LOSS, Second of AIS, NO SIGNAL, CODE ERRORS, FAS ERRORS.

3.2.9.5 Using the Time Axis Cursor

The DAYS (HOURS) histograms incorporate a time axis cursor which shows as a break in the scaling at the base of the histogram thus:  . If a DAYS (HOURS) histogram is being displayed with its time axis cursor, then the ◁ and ▷ cursor keys can be used to move the cursor to the left or right in one hour steps. The range of movement is determined by the number of stored half day (half hour) segments of HOURS (MINUTES) histogram data in the current test memory.

If softkey F3 is pressed to change the display from the **DAYS** histogram page to the associated **HOURS** histogram page, then the HOURS histogram will begin with the day which was pointed to by the time axis cursor on the HOURS histogram page.

Similarly, if softkey F3 is pressed to change the display from the **HOURS** histogram page to the associated **DAYS** histogram page, then the HOURS histogram will correctly positioned to cover the days shown on the HOURS histogram page.

If softkey F3 is pressed to change the display from the **HOURS** histogram page to the associated **MINUTES** histogram page, then the MINUTES histogram will show the hour which was pointed to by the time axis cursor on the HOURS histogram page.

Similarly, if softkey F3 is pressed to change the display from the **MINUTES** histogram page to the associated **HOURS** histogram page, then the time axis cursor will be positioned at the hour shown at the beginning of the MINUTES histogram page.

3.2.9.6 Resetting the Numeric Totals

The numeric totals may be reset by pressing <**Reset**> while the BER test is running.

3.2.9.7 Viewing Setup Menus while Running

Press <**-more-**> until the <**Menus**> option appears in the F1 softkey position while the BER test is running. By pressing <**Menus**> the PA-41 will display each of the setup menus in sequence. These menus may be viewed but not altered. To re-display the results pages press <**-more-**> to obtain the <**Numeric**> or <**Hist**> softkey options.

3.2.9.8 Injecting Errors

The error injection mode can be set by pressing <**Inject**> while the BER test is running. The current status of the error injection mode is displayed in the graphics line above the softkey labels.

Selection of the error type is done by pressing <**Err Type**> followed by <**BIT**> for bit error injection, <**CODE**> for code error injection, <**CRC**> for CRC error injection and

<**FAS**> for frame alignment word error injection. The <**Return**> softkey can be used to return to the previous softkey level.

a) Single Error Injection

A single BIT, CODE, CRC or FAS error may be injected after selecting the appropriate error type as described above and then pressing <**One**>.

b) Continuous Error Injection

Continuous error injection can be initiated by pressing <**Length**> followed by <**CONTIN**>. The error ratio may be set by pressing <**Ratio**> followed by the appropriate ratio softkey as follows:

<**1E-3**> <**1E-4**> <**1E-5**> <**1E-6**> <**-more-**> <**Return**>
<**2E-3**> <**2E-4**> <**2E-5**> <**2E-6**> <**-more-**> <**Return**>
<**5E-4**> <**5E-5**> <**5E-6**> <**5E-7**> <**-more-**> <**Return**>

Pressing <**-more-**> selects the next set of softkey options and the <**Return**> softkey returns to the previous softkey level.

Press <**Transmit**> to start injecting the continuous errors and <**OFF**> to stop injecting the errors.

While injecting errors the PA-41 will display the inject error status in the flashing warning box at the top right-hand corner of the screen.

Notes: The error type and ratio may be altered while the error injection process is running.

Ensure that at least four consecutive ‘0s’ are present in the pattern when injecting code errors with HDB3 line coding, if not this may result in bit errors or incorrect code errors being registered.

c) Burst Error Injection

To inject a burst of errors of the error type selected above, press <**Length**> followed by the appropriate softkey to select the burst length (number of errored bits to be sent). The burst length can be set to 16, 32, 64, 128 or 256 errored bits. The error ratio can also be set as in b) above.

To send the error burst press <**Transmit**> once. The inject error status can be observed in the flashing warning box at the top right hand corner of the screen, this will indicate when the error burst is taking place and when the burst has finished.

Note: For long lengths of burst errors with a low error ratio, the time taken to transmit the complete burst may be quite considerable. To stop the error burst, press <**OFF**>.

d) FAS Error Injection

The PA-41 has two modes of FAS (Frame Alignment Signal) error injection in the BERT test mode as follows:

Default Mode (Method A)

This mode is compatible with other WWG test equipment such as the PRA-1.

The FAS error injection ratio is based upon the FAS bits and is calculated as the ratio of transmitted errored FAS bits to the total number of transmitted FAS bits. There are 7 FAS bits numbered 2-8 in each FAS word normally, with the fixed pattern of 0011011 (bit 1 – the most significant bit – is not included in the definition of the frame alignment signal since this is used for international or CRC use). The FAS word is transmitted once every two frames.

For example, a FAS error injection ratio of 1E-3 will inject a FAS bit error every 1000 FAS bits transmitted.

Note: Method A of FAS error injection is selectable from the BERT top level menu by first pressing the **[Security]** key in the centre of the cursor keys followed by the digits 'C' and '0' on the hex keypad. This mode is retained even after cycling the power on the PA-41.

Selectable FAS error injection mode (Method B)

This mode is compatible with a PA-41 incorporating a previous software version up to, and including, 02.01.

The FAS error injection ratio is based upon the frame bits and is calculated as the ratio of transmitted errored FAS bits to the total number of transmitted frame bits.

In this case for example, a FAS error injection ratio of 1E-3 will inject a FAS bit error every 1000 frame bits transmitted.

Selection of FAS error injection modes

The original method of FAS error injection (Method B) is selectable from the BERT top level menu (Bit Error Ratio Test) by first pressing the **[Security]** key in the centre of the cursor keys followed by the digits 'C' and '1' on the hex keypad. This mode is now retained even after cycling the power on the PA-41 (unless the batteries become discharged or are removed from the instrument when it will default to method A).

3.2.9.9 Setting the Clock Deviation while Running the Test

The transmit clock may be deviated from the nominal clock rate by ±150 ppm in 1ppm steps while the test is running. To do this press <**ClkDev**>. The following softkey options will then be available:

<**Recall**>	Recalls the test results from the store number currently pointed to by the cursor.
<**Zero**>	Resets the clock deviation to 0.
<**-10**>	Decrements the clock deviation value by 10 ppm.
<**-1**>	Decrements the clock deviation value by 1 ppm.

<**+1**> Increments the clock deviation value by 1 ppm.

<**+10**> Increments the clock deviation value by 10 ppm.

<**Return**> Returns to the previous softkey level.

The current clock deviation value is displayed in the graphics line above the softkeys while in this set up mode.

3.2.9.10 Printing out a Report while the Test is Running

To print out BERT results or menus while the test is running, press <**Report**> followed by the <**Menus**> softkey for the menus printout or <**Numeric**> for the BER numeric results printout.

If the current results page displayed is a Histogram page then the <**Hist**> and <**Table**> softkeys are also available. These allow the currently displayed histogram results to be printed either in histogram form (using <**Hist**>) or tabular form (using <**Table**>).

The <**Return**> softkey can be used to return to the previous softkey level.

Note: The results printed are a 'snapshot' of the current test results at the time of pressing <**Numeric**>.

3.2.9.11 Stopping the Test

The BER test may be stopped manually by pressing <**Stop**>.

3.2.10 Viewing the BERT Results Pages

The BERT results pages can be viewed after the test has been stopped in the same way as described previously when the test was running. All the softkey options are the same except for inject errors, reset, menus and clock deviation which are not available while the test is stopped.

The test may be run again from here by pressing <**Run**>.

3.2.11 Printing BERT Results

The BERT results may be printed after the test has been stopped in the same way as described in Section 3.2.9.10.

3.2.12 Storing the BERT Results

The current BER test results have already been saved in one of the 10 BERT internal stores. The {**BERT: Stored Results**} can be accessed from the BERT top level menu by selecting **Stores** and then **Stored test results** from the {**BERT: Stores Menu**}. The current test results are pointed to by the cursor and may be LOCKED to avoid accidental damage by pressing <**Lock**>. The test store may be UNLOCKED by

pressing the **[Security]** key **[6]** in the centre of the cursor keys followed by the softkey F6. For more details of the BERT stores features see Section 3.2.8.

3.2.13 Viewing and printing the autoprint buffer

To view the output results buffer see Section 3.2.7.3. The entire buffer contents may be printed-out at a later stage if a printer is available. Press <**Print**> in the {**BERT: Autoprint View**} page to do this.

3.3 PCM Analysis Operation

3.3.1 Introduction

The PCM Analysis mode has three main test functions:

- Frame Analysis
- Drop and Insert
- Level and Frequency

3.3.1.1 Frame Analysis

Used to monitor the content of PCM frames and multiframes. This mode accesses framing information and voice slot data as well as the signalling status for each telephone channel. The transmitted PCM frame can be modified by the user. Both the FAS and NFAS words are programmable together with the timeslot data and ABCD signalling bits.

3.3.1.2 Drop and Insert

One or more 64kbit/s data slots are dropped from either of the two incoming 2Mbit/s PCM frames to the two V.11 interfaces and/or inserted from the V.11 interface ‘A’ into the transmitted 2Mbit/s PCM frame.

3.3.1.3 Level and Frequency

Used for inserting a sinusoidal digital signal into a selected timeslot and monitoring a returned signal on both of the two receivers.

3.3.1.4 Clock Difference Measurements

Used to measure the clock difference (slips) between a reference clock on RxB and the signal on RxA.

3.3.1.5 Round Trip Delay Measurements

Used to determine the round trip delay incurred by a looped-back signal through the network equipment. It can determine relative and absolute delay times.

3.3.2 The PCM Analysis Menu Structure

Refer to ***Appendix B – Menu Structures***.

The PCM Analysis mode is entered from the {**Main Menu**} by highlighting and then selecting **PCM Analysis** using the cursor keys and <**Select**>.

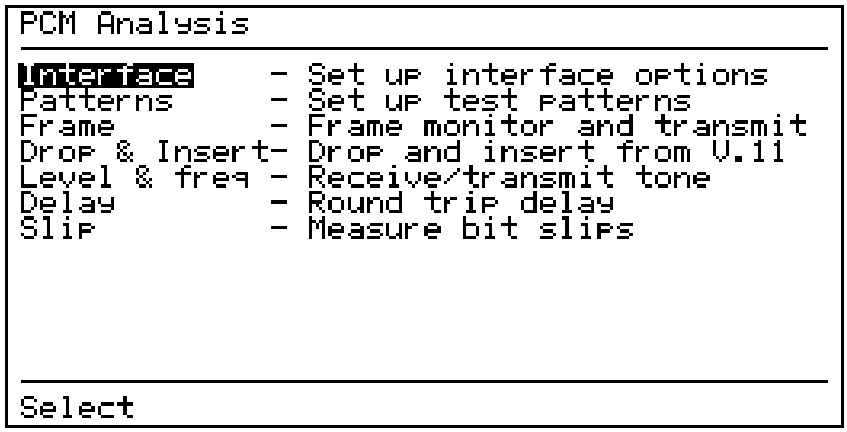


Figure 3.3-1 – {PCM Analysis} page

3.3.3 The PCM Interface Menu

Select the **Interface** option from the {**PCM Analysis**} menu by moving the highlight bar using the cursor keys and then pressing <**Select**>.

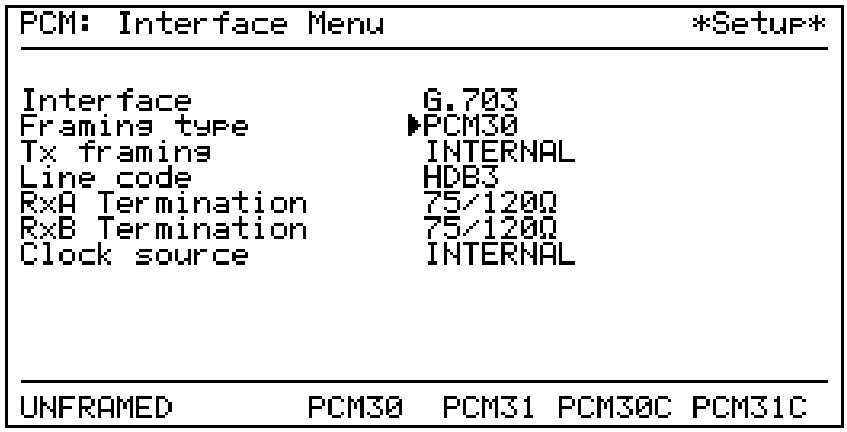


Figure 3.3-2 – {PCM: Interface Menu} page

The following fields and parameter options are available:

Interface	**G.703**	(This parameter is fixed)
Framing type	**UNFRAMED**	Unframed mode.
	PCM30	30 channels + TS16 (CAS).

	PCM30C	30 channels + TS16 (CAS) + CRC.
	PCM31	31 channels.
	PCM31C	31 channels + CRC.
Tx Framing	**THROUGH**	Transmitted national and international bits are sourced from the received frame on RxA.
	INTERNAL	Transmit frame bits and all idle CAS channels are derived by the PA-41.
Line code	**HDB3**	High Density Bipolar three.
	AMI	Alternate Mark Inversion.
	NRZ	Non-Return to Zero.
RxA/RxB Termination	**HI-Z**	High impedance.
	75/120Ω	Terminated (75 or 120 ohms).
Clock source	**EXTERNAL**	External clock.
	INTERNAL	Internal clock.
	RxA	From receiver ‘A’.
	RxB	From receiver ‘B’.

Use [EXIT] to return to the {**PCM Analysis**} top level menu.

3.3.4 The PCM Patterns Menu

Enter the {**PCM: Patterns Menu**} by selecting the **Patterns** option from the {**PCM Analysis**} top level menu. Use the cursor keys to move the highlight bar to **Patterns** and press <**Select**>.

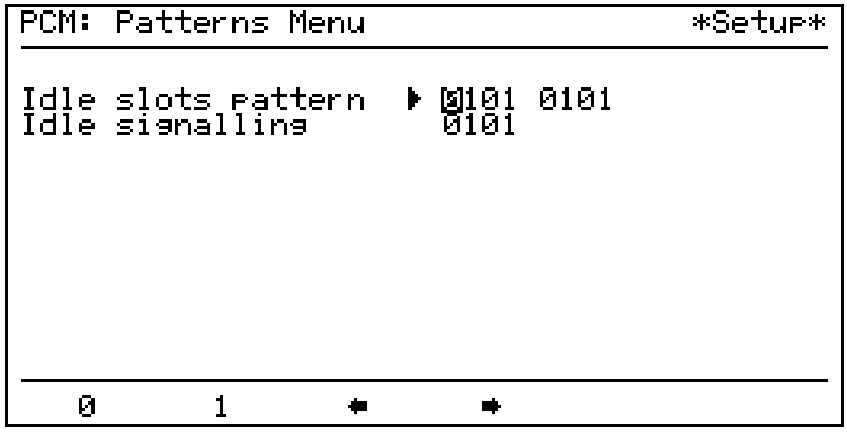


Figure 3.3-3 – {PCM: Patterns Menu} page

The following fields are available:

Idle slots pattern The pattern inserted into all non-active slots.

Idle signalling The signalling pattern is only offered in the PCM30 and PCM30C framing modes. This is the signalling pattern inserted into all the non-active signalling channels.

Use the softkeys or numeric keypad to enter the binary digits. Return to the top level menu by pressing EXIT.

3.3.5 Frame Analysis

3.3.5.1 The Frame Page

Select **Frame** from the {**PCM Analysis**} menu.

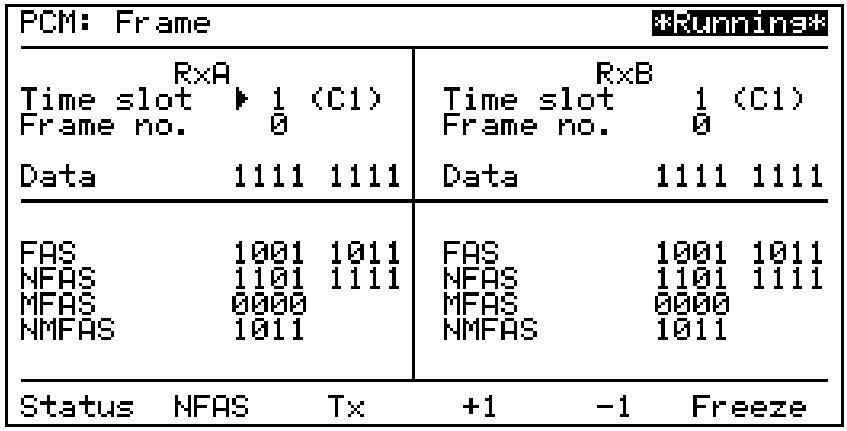


Figure 3.3-4 – {PCM: Frame} page

The PA-41 starts monitoring and transmitting PCM frames immediately the {**PCM: Frame**} page is entered.

The PA-41 displays both RxA and RxB information simultaneously in the following way:

The {**PCM: Frame**} page is divided into four sections. The two boxes at the top of the screen contain the timeslot monitor sections for the two receivers RxA on the left and RxB on the right. These boxes contain the following fields:

Field	Format	Description
Time slot	Decimal 0...31	Timeslot number (in frame)
Frame No.	Decimal 0...15	Frame number (in multiframe)
Data	Binary 8	Timeslot data

The timeslot to be monitored can be selected from any one of the 16 frames of the multiframe when the framing mode is set to PCM30 or PCM30C. To select the frame number, move the cursor into the **Frame no.** field and use the softkeys <**+1**> and <**-1**> to increment or decrement the frame number or enter the frame number using the numeric keypad. This **Frame no.** field will be suppressed in framing mode PCM31. In PCM31C the frames are aligned on the CRC MFAS since there is no multiframe.

The timeslot within the frame to be monitored is selected by moving the cursor into the **Time slot** field and using the softkeys <**+1**> and <**-1**> to increment or decrement the timeslot number or enter the number using the numeric keypad.

The ‘Data field’ will now display the selected timeslot data.

The two lower sections on the screen contain further information relating to the frame structure and are ‘read only’ fields as follows:

Field	Format	Description
FAS	Binary 8	Frame Alignment Signal
NFAS	Binary 8	Non Frame Alignment Signal
MFAS	Binary 4	Multiframe Alignment Signal
NMFAS	Binary 4	Non Multiframe Alignment Signal

Note: Some of these fields are suppressed depending to the framing mode selected.

Pressing <**Freeze**> allows the user to ‘freeze’ a whole multiframe for analysis. The data displayed in this mode will remain static. The user may change the timeslot and frame numbers to select a timeslot to display during this ‘freeze’ mode. Press <**Cont**> to continue to capture new frames.

3.3.5.2 The NFAS Words Page

To access the {**PCM: NFAS Analysis**} page press <**NFAS**> in the {**PCM: Frame**} page. The NFAS (Non-Frame Alignment Signal) page displays the activity of the non-frame alignment word.

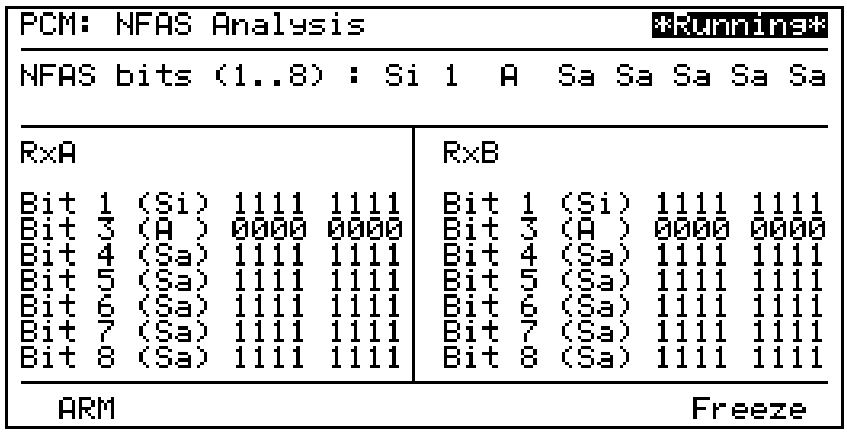


Figure 3.3-5 – {PCM: NFAS Analysis} page

The screen is divided into three parts. The top section contains a label indicating the format of the NFAS bits 1...8 and also the CRC MFAS (CRC Multiframe Alignment Signal) when the framing mode is set to one of the CRC modes. These bits are described as follows:

NFAS bits:

Bit1 (Si or C bit) Bit reserved for international use. It may contain formatted serial data or alarm status information when the Framing mode is set to PCM30 or PCM31, (Si bit).

In PCM30C or PCM31C (i.e. CRC modes) this bit (C bit) will contain the CRC multiframe alignment signal 001011 in frames 1,3,5,7,9 and 11. Frames 13 and 15 will contain the E bits.

Bit2 Always set to binary ‘1’ to avoid conflict with the Frame Alignment Signal.

Bit3 (A) This is the Remote Alarm Indication bit.

Bit4-8 (Sa bits) These are the national bits used by the national telecom authorities. These bits may contain formatted data or alarm status information.

When the Framing mode is set to PCM30C or PCM31C (i.e. CRC modes) then the C bit (bit1) containing the CRC multiframe alignment signal (CRCMFAS) and E bits will also be displayed in the box at the top of the screen under the NFAS bits.

The lower sections of the display contain the NFAS status. These are organised in a matrix such that the columns represent the NFAS words in the received frames 1, 3, 5,

7, 9, 11, 13 and 15 over a CRC multiframe and the rows represent the NFAS bits 1, 3 to 8.

Note 1: The frame numbers given above may not necessarily align with the frames 1 to 15 of a signalling multiframe.

In this way, the PA-41 may be used to monitor a repeating serial pattern of 8 bits in length for each of the NFAS Si or Sa bits, (the pattern will repeat every multiframe). This pattern may be a loopback command signal for a distant multiplexer, for example.

In a similar way, the 'C' bit may also be monitored so that the CRCMFAS word can be checked.

The 'A' bit (Remote Alarm Indication) can also be seen.

Note 2: When the Framing mode is set to PCM30C or PCM31C (i.e. CRC modes) then the columns of this table align with the two CRC SMFs (Sub-multiframes) SMF1 and SMF2. This is indicated over the corresponding columns so that columns 1 to 4 align with SMF1 and columns 5 to 8 align with SMF2.

Pressing <**Freeze**> allows the user to 'freeze' a whole multiframe for analysis. The data displayed in this mode will remain static. Press <**Cont**> to continue to capture new frames.
(CRC = Cyclic Redundancy Check)

S-bit state change detection

It is sometimes a requirement to know if certain normally fixed NFAS (Non-Frame Alignment Signal) bit patterns transmitted by network equipment suffer from momentary glitches or pattern state changes. A method for detecting these changes is described below.

While running a Frame test and monitoring the NFAS bits in the {**PCM: NFAS Analysis**} page, a softkey is available called <**ARM**>. On pressing this key the PA-41 will indicate that it has entered a **WAITING_FOR_TRIGGER** state by displaying this text in the line above the softkey labels.

The PA-41 now monitors the NFAS bits on both receivers and checks to see if any of the bits change state. If a state change is detected then the message **TRIGGERED** is displayed in the line above the softkey labels and the PA-41 enters the FREEZE display mode automatically in order to hold the NFAS bit pattern which generated the trigger event. To continue to display an active display, the <**Cont**> softkey is pressed in the usual way.

The PA-41 will re-arm for the next state transition unless the <**OFF**> softkey is pressed. This will turn off the trigger mode and return the PA-41 to normal operation.

3.3.5.3 The Transmit Data Setup Page

Press <**Tx**> in the {**PCM: Frame**} page to access the {**PCM: Transmit Setup**} menu. This menu allows the user to program the transmitted PCM frame bits.

All of the frame (FAS), non-frame (NFAS), multiframe (MFAS), non-multiframe (NMFAS) alignment signals, signalling (ABCD) and data bits can be modified *while the test is running* and without interrupting the frame transmission.

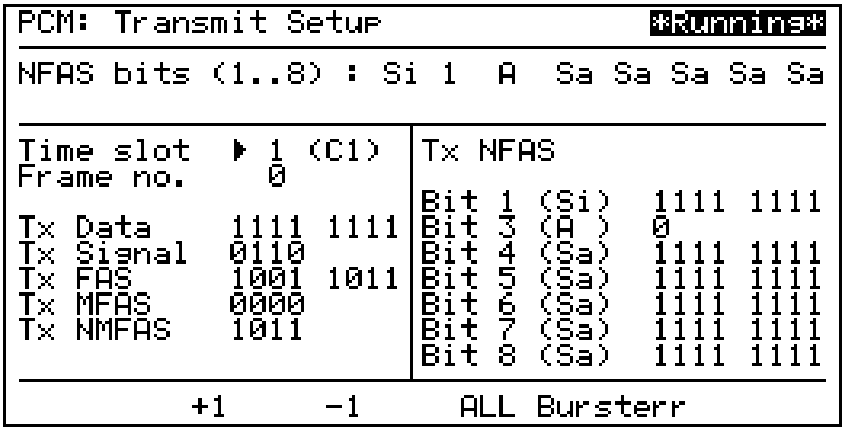


Figure 3.3-6 – {PCM: Transmit Setup} page

The screen is divided into three sections. The top section is similar to the {**PCM: NFAS Analysis**} page and contains the NFAS bits label and CRC MFAS label (if the framing mode is set to PCM30C or PCM31C) for identification purposes only.

The lower left hand box contains the transmit timeslot data and framing bit fields as follows:

Time slot Number of the timeslot to send data.

Frame no. Frame number in the multiframe in which to send the data when framing is set to PCM30, PCM30C or PCM31C.

Tx Data The data pattern to be sent in the selected timeslot as above.

Tx Signal The ABCD bit signalling pattern to be sent in the associated telephone channel with the data timeslot selected above.

Tx FAS The transmitted frame alignment signal.

Tx MFAS The transmitted multiframe alignment signal.

Tx NMFAS The transmitted non-multiframe alignment signal.

To send a particular data pattern in a selected timeslot of the PCM frame, set the timeslot number in the **Time slot** field. To do this, position the cursor in the **Time slot** field and enter the timeslot number using the numeric keypad or <**+1**> and <**-1**>

softkeys. If the framing mode is set to PCM30 or PCM30C then a particular frame may be selected in the multiframe in which the data will be sent. Position the cursor in the **Frame no.** field and enter the frame number using the numeric keypad or softkeys as above. The actual data value can then be entered in the **Tx Data** field.

Refer to ***Appendix E – Interface and Frame Structure Details***.

The following softkey options are available:

Time slot, **Frame no.** :

<**+1**>	Increments value by one.
<**-1**>	Decrements value by one.
<**ALL**>	Sets all frames or slots.
<**Bursterr**>	Enables error injection mode

Tx Data, **Tx Signal**, **Tx FAS**, **Tx MFAS**, **Tx NMFAS**:

<**0**>	Sets a binary zero at the current cursor position.
<**1**>	Sets a binary one at the current cursor position.
<**Invert**>	Inverts the binary state at the current cursor position.
<**Bursterr**>	Enables error injection mode.

Tx NFAS

The lower right hand section of the screen contains the transmit NFAS bit fields. This allows the user to program all of the transmitted NFAS (non-frame alignment signal) bits. (See Section 3.2.6.4, ***The Tx NFAS Page***, for a detailed description of this feature).

Use the cursor keys to position the cursor in the appropriate field to edit. The softkey options are similar to those described in the table above for Tx NMFAS, except for the following addition:

<**001011xx**>	Sets default CRC MFAS (Bit 1 field in CRC based framing modes only).

Burst Error Injection Mode

This error injection mode can be used for testing the loss of frame alignment alarm and recovery of frame alignment on various types of 2Mbit/s PCM equipment.

Two modes of operation are offered:

- The injection of 3 errored consecutive frame alignment signals into a continuous stream of good frame alignment signals to check equipment under test for loss of frame alignment signal alarm.

- The injection of 2 good frame alignment signals into a continuous stream of errored frame alignment signals to check equipment under test for momentary recovery of frame synchronisation.

When <**Bursterr**> is pressed, the softkey line will display the options as follows:

<**3 Bad**> Injects three consecutively errored FAS words into the transmitted background stream of continuously good FAS words *for each key press*.

<**2 Good**> Changes the continuous background FAS words to all errored *on the first key press* and then injects two good consecutive FAS words *on each subsequent key press*.

<**Return**> Restores the normal (user defined) FAS word and returns to the normal operating mode.

Note: The good FAS word is the FAS word defined by the user in the {**PCM: Transmit Setup**} page. Ensure that the Tx FAS word is set to the normal frame alignment signal used by the equipment under test for proper operation.

Transmit NFAS bit editor

On entering the {**PCM: Transmit Setup**} page while running a Frame test, the cursor can be moved into the Tx NFAS box and the NFAS bits may be modified (on-the-fly) while they are transmitted by using the softkeys <**0**> and <**1**> or the hex keypad. While this is useful, in some circumstances it may also be necessary to edit a number of NFAS bits before transmitting the new NFAS word.

Pressing the <**Edit**> key will cause the PA-41 to enter the NFAS bits edit mode and indicate this by displaying the text ‘Edit’ in the line above the softkey labels. All of the 49 NFAS bits for the whole multiframe may now be modified (the PA-41 continues to transmit the last set of NFAS bits until the edit mode is left). To leave the edit mode and transmit the new NFAS bits press the <**Enter**> softkey.

3.3.5.4 The Channel Status Monitor

The {**PCM: Channel Status RxA(RxB)**} page allows the user to monitor the status of the ABCD signalling bits in all 30 telephone channels simultaneously. The status of these signalling bits are displayed in binary form in the order ABCD (left to right) as shown below.

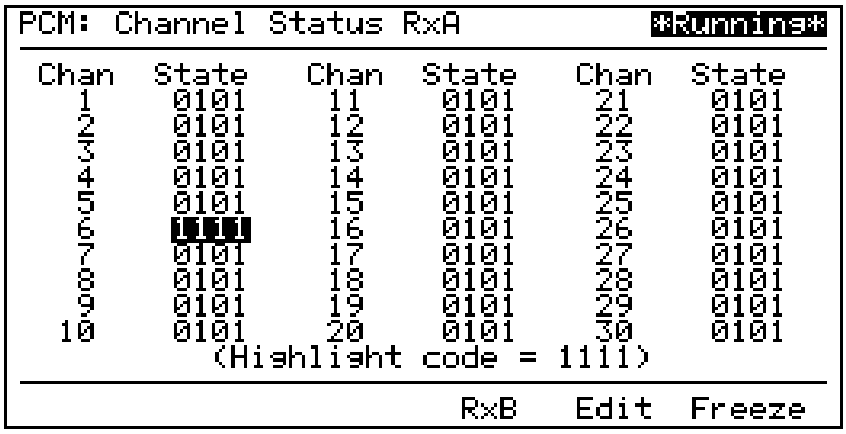


Figure 3.3-7 – {PCM: Channel Status RxA} page

To enter the {**PCM: Channel Status RxA(RxB)**} page press <**Status**> in the {**PCM: Frame**} page.

A separate page is available to display the signalling status for each of the two receivers. Use <**RxA**> or <**RxB**> to switch between these two pages.

A **Highlight code** can be set to highlight a particular pattern of ABCD bits. This may be useful for indicating idled or blocked signalling channels. Press <**Edit**> to enter the highlight code. Use the <**0**> or <**1**> softkeys or numeric keypad to enter the binary value and <**X**> for 'Don't care' bit positions. (The latter being indicated on the screen as an '**X**'). Press <**Return**> to exit the highlight editor and return to the normal softkey line.

Use <**Freeze**> to 'hold' the current set of displayed data and prevent updating to make it easier to read. Press <**Cont**> to continue to update the display.

Use [EXIT] to move back into the {**PCM: Frame**} page.

3.3.6 Drop and Insert

3.3.6.1 Overview

The channel Drop and Insert mode enables the PA-41 to be used as a multiplexer/demultiplexer by taking an incoming data stream (at a rate of 64 – 1984kbit/s) from the V.11 port 'A' and inserting it into a group of nx64kbit/s timeslots in the transmitted 2Mbit/s PCM frame at the G.703 interface.

The data in the received 2Mbit/s PCM frames in a group of nx64kbit/s timeslots on both RxA and RxB can be dropped to the respective V.11 interface ports ‘A’ and ‘B’.

3.3.6.2 The V.11 Interface ‘A’ Page

To enter the {**PCM: V.11 Interface A**} page, move the highlight bar on to the **Drop & Insert** option in the {**PCM Analysis**} menu and press <**Select**>.

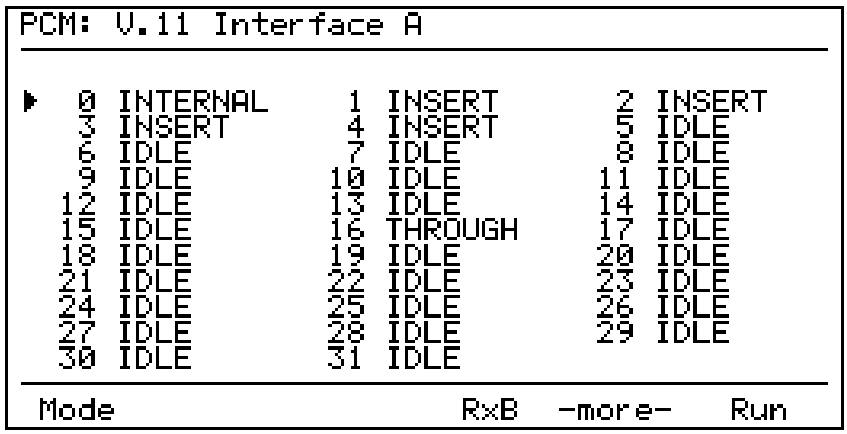


Figure 3.3-8 – {PCM: V.11 Interface A} page

The {**PCM: V.11 Interface A**} page displays the status of each of the transmit and receive (RxA) timeslots.

The transmitted (inserted) slots are closely associated with the received (dropped) slots in RxA due to the clocking requirements of the instrument. Individual timeslots may be set up for **INSERT**, **DROP** or **D&I** (Drop and Insert) modes of operation, however, these modes cannot be mixed (i.e. one slot cannot be set to DROP only and another to INSERT only).

These modes of operation can be set by pressing <**Mode**> and then selecting the mode <**INSERT**>, <**DROP**> or <**D&I**> (Drop and Insert).

The following softkey options are available:

<**INTERNAL**> Only offered in timeslot 0 and 16 fields. Sets internally sourced FAS, NFAS, MFAS and NMFAS bits for transmitted frames.

<**Mode**> Sets the drop and insert mode.

<**THROUGH**> Only offered when Tx framing mode is set to **THROUGH** mode. Sources the data for this transmitted timeslot from RxA.

<**RxB**> Enters the {**PCM: V.11 Interface B**}.

<**-more-**> Displays more softkey options.

<**Run**> Enters the **Run** mode.

<**IDLE**>	Sets the timeslot at the current cursor position to **IDLE**. The idle pattern is defined in the **PATTERNS** menu.
<**DROP**>	Only offered if drop and insert mode is set to **DROP** mode. Sets the timeslot at the current cursor position to **DROP.**
<**INSERT**>	Only offered if drop and insert mode is set to **INSERT** mode. Sets the timeslot at the current cursor position to **INSERT.**
<**D&I**>	Only offered if clock source is set to RxA, Framing is set to **THROUGH** mode and drop and insert is set to **D&I** (Drop and Insert) mode. Sets the timeslot at the current cursor position to **D&I**.
<**ALL IDLE**>	Sets all timeslots to **IDLE**.
<**ALL THRU**>	Only offered if framing mode is set to **THROUGH** mode. Sets all timeslots to **THROUGH** mode.
<**ALL DROP**>	Only offered if drop and insert mode is set to **DROP** mode. Sets all timeslots to **DROP** mode.
<**ALL INSERT**>	Only offered if drop and insert mode is set to **INSERT** mode. Sets all timeslots to **INSERT** mode.
<**ALL D&I**>	Only offered if drop and insert mode is set to **D&I** mode. Sets all timeslots to **D&I** mode.

3.3.6.3 The V.11 Interface ‘B’ Page

The {**PCM: V.11 Interface B**} page is accessed by pressing <**RxB**> in the {**PCM: V.11 Interface A**} page as described in the previous section.

The {**PCM: V.11 Interface B**} page is used only to set up the selected timeslots to be dropped to the V.11 interface ‘B’ from receiver RxB. The menu displays the timeslot status. The drop and insert test mode may be ‘run’ from here.

Timeslot 0 is not accessible from this menu and this field remains blank.

Timeslot 16 is treated the same as all the other timeslots when the framing mode is set to PCM31 or PCM31C. Timeslot 16 is not accessible when the framing mode is set to PCM30 or PCM30C.

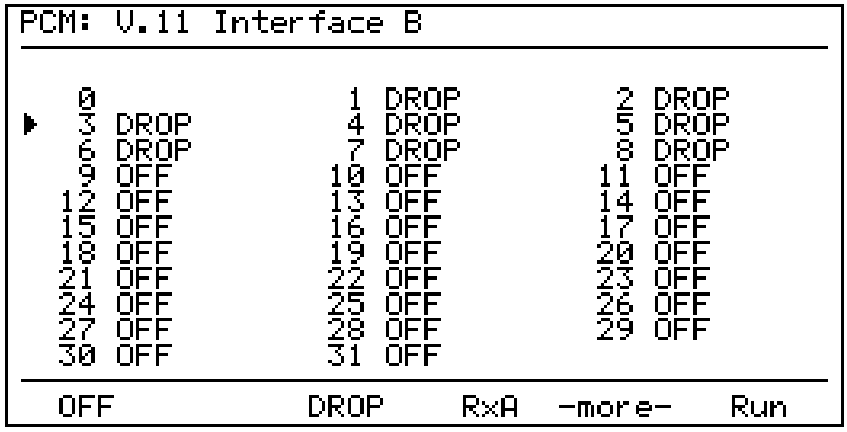


Figure 3.3-9 – {PCM: V.11 Interface B} page

The following softkey options are available:-

<**OFF**> De-selects the timeslot at the current cursor position from being dropped to the V.11 interface 'B'.

<**DROP**> Selects the timeslot at the current cursor position to be dropped to the V.11 interface 'B'.

<**RxA**> Enters the {**PCM: V.11 Interface A**} page.

<**-more-**> Displays more softkey options.

<**ALL OFF**> De-selects all timeslots.

<**ALL DROP**> Selects all timeslots to be dropped.

<**Run**> Runs the drop and insert mode.

3.3.6.4 Running the Test

The Drop and Insert test mode will be enabled after <**Run**> has been pressed and will continue until <**Stop**> is pressed.

3.3.7 Level and Frequency

3.3.7.1 Overview

The Level and Frequency test mode is used for testing digital to analogue and analogue to digital conversion equipment. A sinusoidal digital test tone is inserted into one of the timeslots in the transmitted PCM frame. The tone frequency and amplitude can be programmed by the user. An IDLE pattern is inserted into the other timeslots.

The returned signal can be received and analysed by both receivers RxA and RxB. The PA-41 can display both the received signal levels and frequencies simultaneously together with the peak signal and mean digital offset.

The PA-41 receivers can of course also display these parameters for any single tone present in a timeslot within the RxA or RxB received signal.

Access to the {**PCM: Level and Frequency**} page (which also starts the test) can be made by selecting **Level & freq** from the top level menu using the highlight bar and pressing <**Select**>.

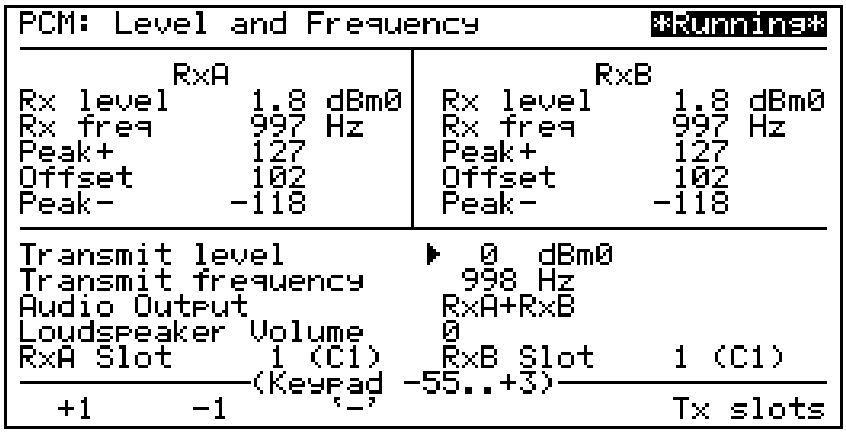


Figure 3.3-10 – {PCM: Level and Frequency} page

The {**PCM: Level and Frequency**} page is divided up into three sections. At the top of the screen are the two received data parameter boxes for RxA (top left) and RxB (top right). These boxes contain the following receive parameters:

Rx level Receive signal level (-80 to +5dBm0).

Rx freq Receive signal frequency (5 to 3998 Hz).

Peak+ Positive-going digital peak level (max. +127).

Offset Mean digital offset (±127).

Peak- Negative-going digital peak level (max. -127).

These parameters are updated continuously while displaying the {**PCM: Level and Frequency**} page.

Warning: As the tone transmit function is immediately active, you may wish to delay making the physical connections to the transmit output **[27]** or **[30]** until the tone parameters and the Tx timeslot have been selected.

3.3.7.2 Setting the Test Parameters

The lower section of the {**PCM: Level and Frequency**} page contains the user programmable parameters setup box.

These boxes contain the following test parameters:

Field	Parameters and Softkey options
Transmit level	Transmit signal level (-55 to +3dBm0) <**+1**> – increments Tx level by one <**-1**> – decrements Tx level by one <**'–'**> – minus <**Tx slots**> – selects {**PCM: Transmit Slots Menu**}
Transmit freq	Transmit signal frequency (5 to 3998 Hz) <**+5**> – increments Tx level by 5 Hz <**-5**> – decrements Tx level by 5 Hz <**Tx slots**> – select {**PCM: Transmit Slots Menu**}
Audio output	<**OFF**> – turns the audio output off. <**RxA**> – monitors audio on RxA only <**RxB**> – monitors audio on RxB only <**RxA+RxB**> – monitors audio on both receivers. <**Tx slots**> – selects {**PCM: Transmit Slots Menu**}
Loudspeaker	Volume (Range 0-9) <**+1**> – increments LS volume by one <**-1**> – decrements LS volume by one <**Tx slots**> – selects {**PCM: Transmit Slots Menu**}
RxA Slot	Timeslot to monitor for receiver A.
RxB Slot	Timeslot to monitor for receiver B. <**Tx slots**> – selects {**PCM: Transmit Slots Menu**}.

3.3.7.3 Selecting the Timeslots

Press <**Tx slots**> to select the {**PCM: Transmit Slots Menu**}. This menu is used to set the transmit timeslots

```
PCM: Transmit Slots Menu                    *Running*

▶  0 INTERNAL     1 TONE          2 IDLE
   3 IDLE         4 IDLE          5 IDLE
   6 IDLE         7 IDLE          8 IDLE
   9 IDLE        10 IDLE         11 IDLE
  12 IDLE        13 IDLE         14 IDLE
  15 IDLE        16 INTERNAL     17 IDLE
  18 IDLE        19 IDLE         20 IDLE
  21 IDLE        22 IDLE         23 IDLE
  24 IDLE        25 IDLE         26 IDLE
  27 IDLE        28 IDLE         29 IDLE
  30 IDLE        31 IDLE

INTERNAL
```

Figure 3.3-11 – {PCM: Transmit Slots Menu} page

If **INTERNAL** framing is selected then digital words in timeslot 0 (FAS) and 16 (MFAS) are sourced internally by the PA-41.

If **THROUGH** framing mode is selected then the non-framing information (such as the national and international bits) in the FAS, NFAS and NMFAS words are sourced from the receiver RxA and passed through to the transmitter. Also each transmitted timeslot data word may be passed through from the receiver RxA to the transmitter by selecting <**THROUGH**> while the cursor is positioned in the appropriate timeslot field.

The following softkey options are available in this menu:

<**INTERNAL**> Timeslot 0 or 16 only. Sets PA-41 to source all framing bits internally.

<**IDLE**> Sets the selected timeslot to **IDLE**. The **IDLE** pattern is set up in the {**PCM: Patterns menu**}.

<**THROUGH**> Sets selected timeslot data to be sourced from the receiver A.

<**TONE**> Inserts the digital tone in the selected timeslot. ***Only one Tx timeslot may contain a tone at any one time*.**

<**-more-**> Selects more softkey options.

<**ALL IDLE**> Sets all the timeslots to **IDLE**.

<**ALL THRU**> Sets all the timeslots to **THROUGH**.

Use [EXIT] to return from this menu.

3.3.8 Clock difference measurements

The {**PCM: Clock slips**} page is entered from the {**PCM Analysis**} top level menu by moving the highlight bar on to the **'Slip'** option and pressing <**Select**>**.**

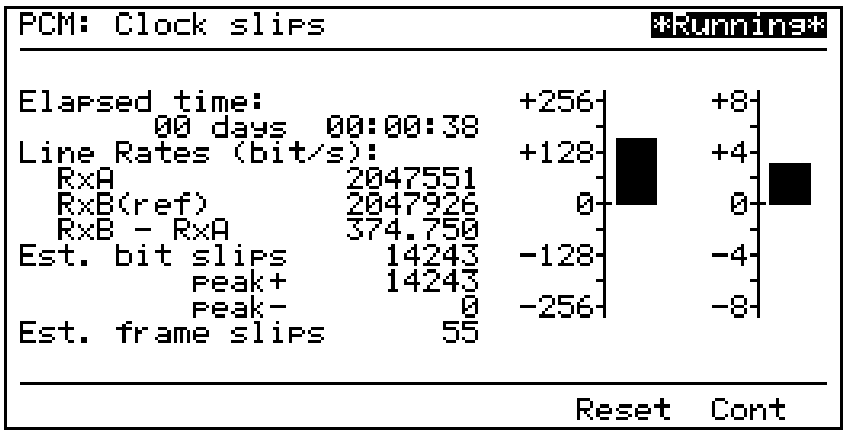


Figure 3.3-12 – {PCM: Clock slips} page

The clock difference measurement test starts running immediately after the {**PCM: Clock Slips**} page is entered. Clock differences on RxA are measured against a reference clock received on RxB.

The display shows two vertical bar graphs. One shows clock differences up to ±8 unit intervals in 1 unit interval steps. The second shows differences up to ±256 unit intervals (i.e. a full frame) in 8 unit interval steps.

The display also shows the number of estimated frame slips and estimated bit slips since the start of the test together with the peak positive and negative values.

Pressing <**Reset**> allows the result counters to be reset while running the test. Pressing <**Freeze**> stops the display from being updated so that figures can be read more easily. Pressing <**Cont**> (Continue) re-enables the display.

The elapsed time since the start of the test is displayed to a resolution of 1 second. The line rates of both receivers (to a resolution of 1UI), together with their difference (to a resolution of $^1/_8$ UI) is also displayed.

Use [EXIT] to stop the test and return to the {**PCM Analysis**} top level menu.

3.3.9 Round Trip Delay measurements

The Round Trip Delay mode is entered from the {**PCM Analysis**} top level menu by highlighting **Delay** and pressing <**Select**>.

If the framing mode is set to '**UNFRAMED**' then the measurement page is entered and the test started immediately. If the framing mode is set to **'FRAMED'** then the user is offered the n*64 slot configuration menus before entering the measurement page.

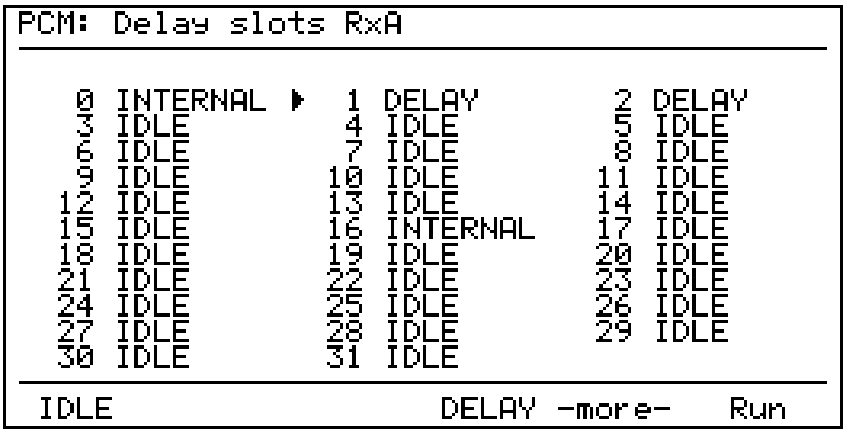


Figure 3.3-13 – N*64 slot configuration

The following softkey options are available in this menu:

<**DELAY**> Sets selected slot to measure delay.

<**IDLE**> Sets selected slot to idle.

<**-more->** Selects more softkey options.

<**ALL IDLE**> Sets all the timeslots to **IDLE**.

<**ALL DLY**> Sets all the timeslots to **DELAY**.

<**RxA➡RxB**> Copy RxA slot configuration to RxB.

<**RxB➡RxA**> Copy RxB slot configuration to RxA.

<**Run**> Run the Round Trip Delay measurement test

Use the cursor keys to move the cursor to select individual slots.

Pressing <**Run**> will cause the measurement page to be displayed and the test started.

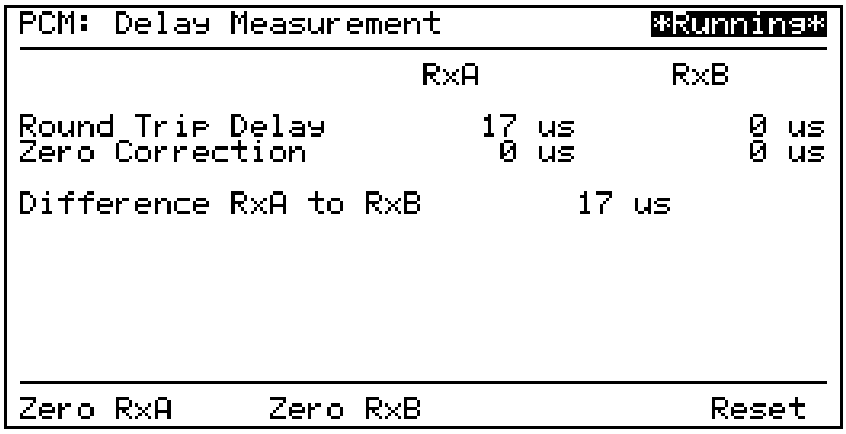


Figure 3.3-14 – Round Trip Delay measurement page

The measurement page offers the following softkey options:

<**ZeroRxA**> Sets the RxA delay measurement to zero.

<**ZeroRxB**> Sets the RxB delay measurement to zero.

<**Reset**> Resets all numerical values back to zero.

<**Stop**> Stops the test.

The display shows both RxA and RxB round trip delay measurements together with the difference value between them. A corresponding zero correction field is also shown which is set to the round trip delay value when its corresponding softkey is pressed: <**ZeroRxA**> or <**ZeroRxB**>. Pressing one of these softkeys will also zero the round trip delay value so that relative measurements can be made.

Use <**Reset**> to zero all numeric values when restarting a measurement. The test is stopped on pressing <**Stop**>, EXIT or MAIN MENU.

3.4 Option loading

Up to five options may be loaded into the PA-41 at any one time.

The title of each loaded option will appear on the {**Main Menu**} as another test mode option selectable by using the highlight bar and pressing <**Select**>.

3.4.1 Loading an option from a memory card

After the PA-41 has been switched on, an option ROM card is inserted into the PA-41 memory card slot **[A]** and the option loading menu is selected from the **Main Menu** by using <**Load**>.

The PA-41 then checks that an appropriate type of card is present in the card slot and responds as shown below:

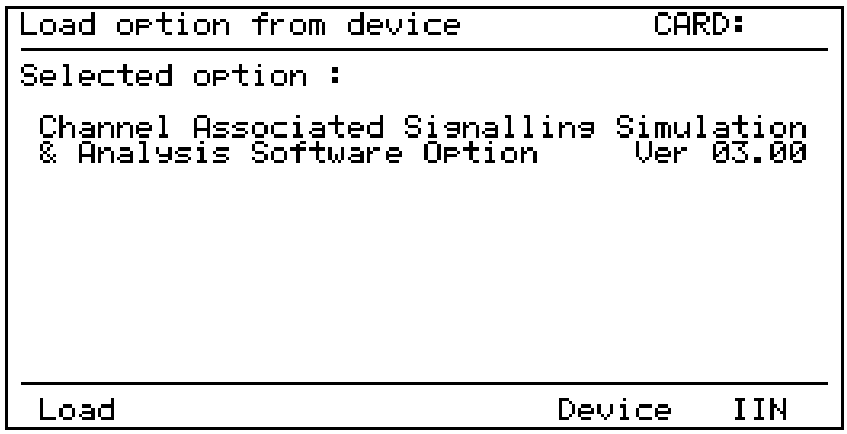


Figure 3.4-1 – {Load Option from Device} page

If there is not enough option memory space available, the following warning message will be displayed:

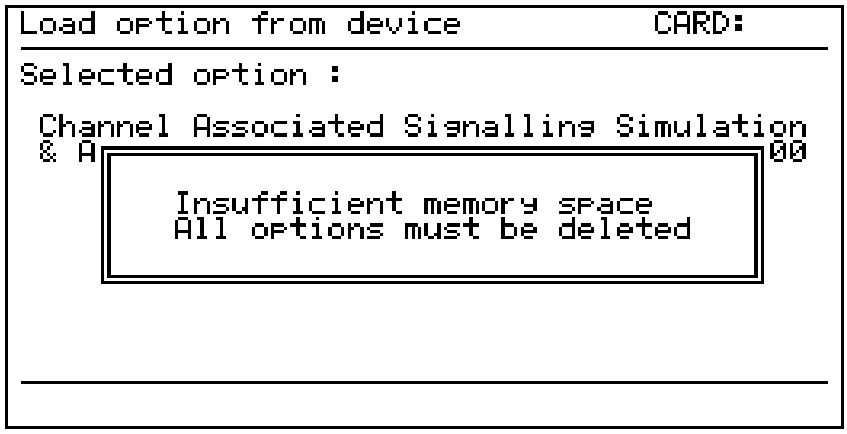


Figure 3.4-2 – {Load Option from Device} page, insufficient memory space warning

Notes: Deleting single options will not free up more memory space. Instead, *all* the options must be deleted using the highlight bar and <**Select**> in the {**Main Menu**}.

If an option is already installed, do not attempt to load the same option again.

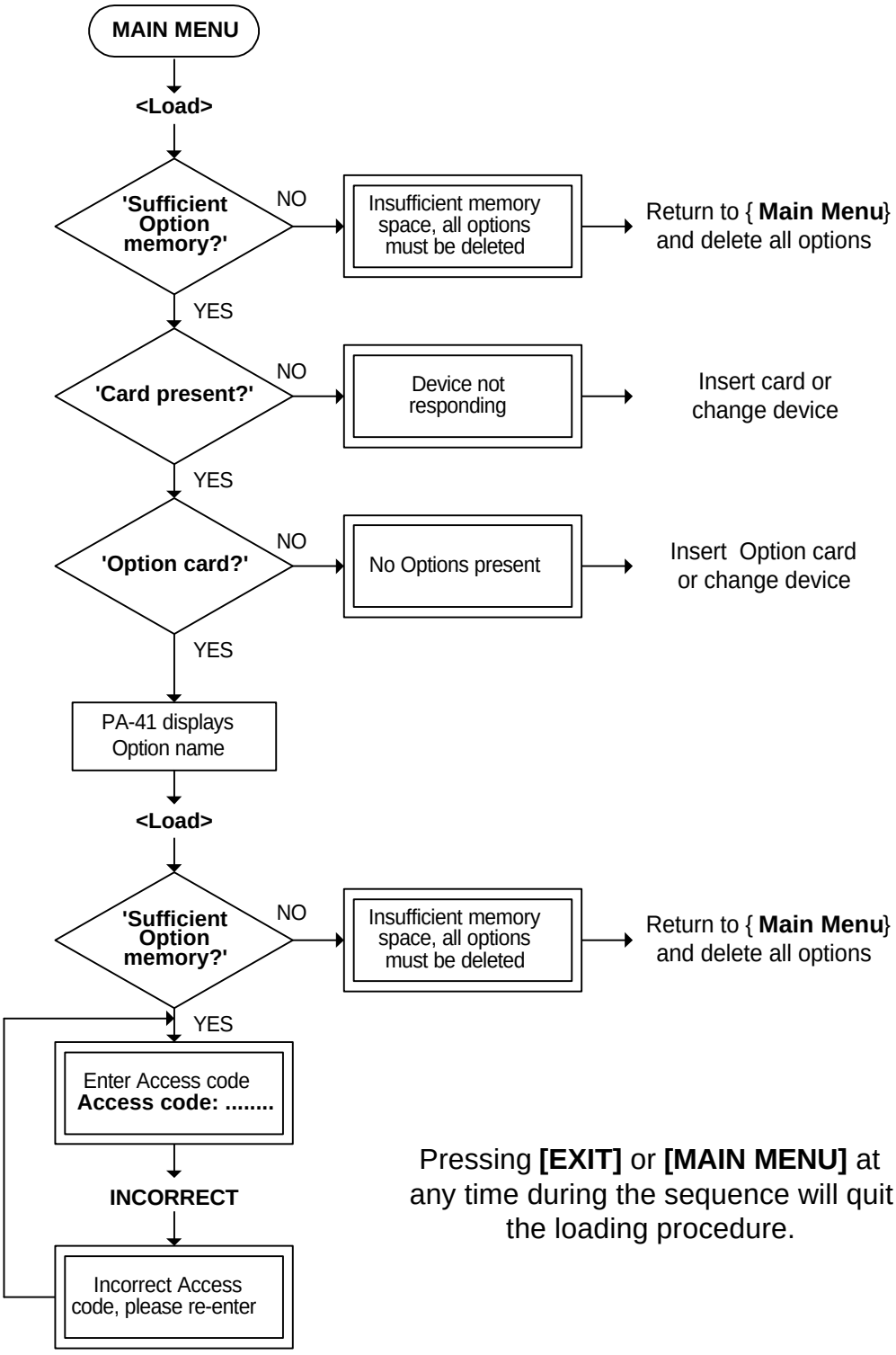


Figure 3.4-3 – Option loading sequence from memory card

In order to load a software option a security access code must first be entered before the PA-41 starts the loading sequence.

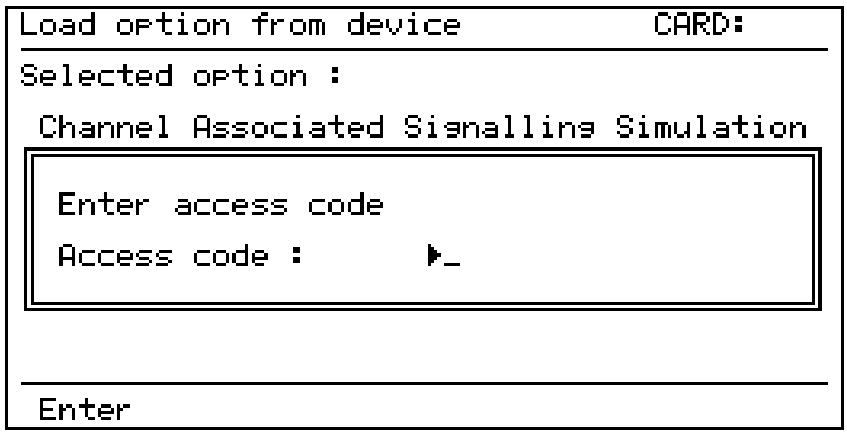


Figure 3.4-4 – {Load Option from Device} page, with access code edit box displayed

Figure 3.4-4 shows the option loading page with the Access code edit box displayed. The 6 digit (decimal) access code is entered using the numeric keypad followed by <**Enter**>.

If the access code is correct then the PA-41 will proceed to load the option.

If the access code is incorrect, then the PA-41 will inform the user and allow further attempts to enter the correct code.

3.4.2 Instrument identity

The **Identification Number (IIN)** may be displayed by pressing <**IIN**>. The PA-41 will then display the identity of the instrument hardware. (**Note:** this is quite different from the instrument serial number).

3.4.3 Option Software Operation

The operation of specific option software packages is specific to the option and is therefore outside the scope of this manual. These operating instructions can be found in the option software operating manual supplied with the software.

3.5 File handling

PA-41 Data Files may be transferred to and from external ‘devices’. Suitable devices are a Memory card, a remote PC or another PA-41.

a) Memory card device

When the CARD device is used, data files may be saved and loaded to/from the memory card (SRAM) plugged into the PA-41 memory card slot. A formatted memory card will support up to 128 files.

b) Remote PC device

Data files may be saved to and loaded from a remote PC via the V.24 serial port by selecting 'LINK' from the device menu. The remote PC must run a special communication program called **pc_link** to enable the PA-41 to access the files held in the current DOS directory on the PC. The first 128 DOS files will be displayed by the PA-41, any remaining DOS files will not be visible. Use a smaller directory if necessary.

c) Another PA-41

It is also possible to cause the PA-41 itself to act as a slave device allowing a remote host PC or another PA-41 to access the file structure on the local PA-41 memory card. In this way, files may be transferred between a host computer and the local PA-41 or between two PA-41s.

To do this, enter the {**File Utilities**} menu by pressing <**File**> in the {**Main Menu**}. Insert a memory card containing data files into the PA-41 acting as 'slave'. Connect the second PA-41 or PC to the slave unit via the serial V.24 interface. Press **[Security]** on the 'slave'. The slave unit will now indicate that it is in **slave mode** in a pop-up message box on the screen.

By using either the **pc_link** program on the PC or selecting the LINK device in the {**File Utilities**} menu, on the 'master' PA-41, the directory of the 'slave' memory card may be read and the files transferred.

3.6 Self test

The PA-41 user self tests are accessed from the {**Main Menu**} by pressing <**Utils**> to enter the {**Utilities Menu**} and then moving the highlight bar on to the Self test field and pressing <**Select**>.

The softkey line will display the following options:

<**Keybd**> Keyboard self test. Display will prompt the user to press keys. The key name will be displayed below the prompt line on the screen. To end the test, press <**Stop**> *twice*.

<**Screen**> Screen test. Displays all the screen pixels on and off followed by the full character set. The test may be temporarily halted by pressing <**pause**>.

<**LEDs**> LED self test. Turns all the keyboard LEDs on then off and then turns each one on in sequence.

<**Co-Proc**> (Only offered when the co-processor hardware option is fitted). Checks the co-processor and associated hardware by applying loopback and other tests. The results of these tests are displayed on the screen.

<**Memcard**> Memory card self test. Insert the SRAM memory card to be tested when prompted. The test will destroy all data on the memory card. The card size is determined automatically and reported to the user at the end of the test. Reports memory card test PASS or FAIL when the test has been completed.

Note: After the memory card self test has been run, the memory card must be reformatted before it can be used. Do this by pressing <**exit**> to return to the {**Utilities Menu**}. Now select the {**File Utilities**} menu and press <**Format**>.

<**DTMF**> DTMF (Dual Tone Multi-Frequency) self test. Checks both the DTMF sender and receiver by looping back internally and generating/detecting all 16 tone pairs. The result of the test is reported on the screen to the user.

<**Periph**> Tests the CTCs (Counter/timer devices), interrupt controller and DMA (Direct Memory Access) controllers. This self test is only present in instrument software before version 04.00. Results of these tests are displayed on the screen.

Note: After running a peripherals self test, switch the instrument off then on again to reset.

<**PCM**> Provides a PCM loopback test to verify both the transmitter, receivers, pattern generation and detection circuitry. This test requires the user to connect an external cable between the transmitter and the receivers.

4. Applications

This section includes some practical examples of tests which can be carried out using the PA-41.

4.1 BERT Applications

4.1.1 Unframed Testing

The following example will set up the PA-41 to carry out a typical unframed BER test for use on transmission equipment (where the PCM signal has no frame structure).

A 2Mbit/s network section has just been installed and a test must be carried out to check that the quality of the line is acceptable. The line has to meet the following criterion: “During a 48-hour test the bit error ratio shall be better than 1×10^{-8} while the line is carrying a 2^{15}-1 pseudo random pattern”.

The set-up requirements are as follows:

1. HDB3 line code.

2. 75/120Ω termination.

3. 2^{15}-1 test pattern.

4. BLER analysis is not required.

5. The test has to be programmed to start at 15:00 hours and to finish 48 hours later.

6. Slips are to be printed out as they occur. No other alarms are to be indicated. The beeper is to be off.

7. The G.821 parameters are to be to CCITT recommendations.

8. The histogram resolution is to be set to HOURS and MINUTES.

Connect the PA-41 to the line under investigation using the appropriate connections and arrange for a loopback at the remote end of the line. Use the receiver RxA only for this test (receiver RxB may also be used to make a second measurement on another line at the same time if required, but we will omit the RxB setup details for clarity). As the test continues for 48 hours, connect the LNT-6 adaptor/charger to the PA-41, switch on the PA-41 and, after the ‘self check’ procedure, select the **Bit Error Ratio Testing** mode from the {**Main Menu**} using the cursor keys and <**Select**>.

Now select the {**BERT: Interface**} menu and set up the screen parameters as shown in the menu diagram in Figure 4.1-1.

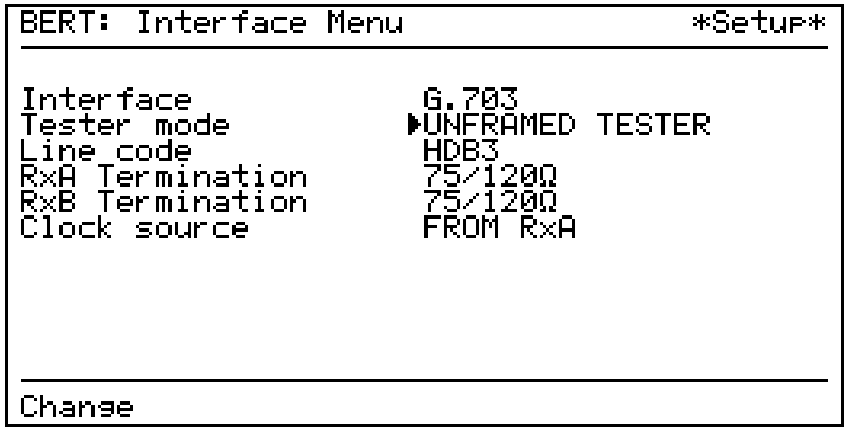


Figure 4.1-1 – {BERT: Interface Menu} page, with unframed test parameters

Now press [EXIT] to return to the {**Bit Error Ratio Test**} menu and select **Patterns** using the cursor keys and <**Select**>. Set up the parameters as shown in Figure 4.1-2.

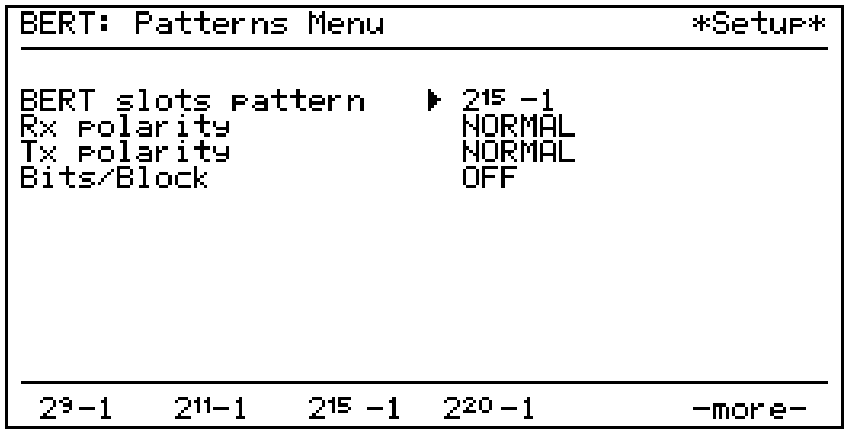


Figure 4.1-2 – {BERT: Patterns Menu} page, with unframed test parameters

Now press [EXIT] to return to the {**Bit Error Ratio Test**} menu and select **Control** using the cursor keys and <**Select**>. Set up the parameters as shown in Figure 4.1-3.

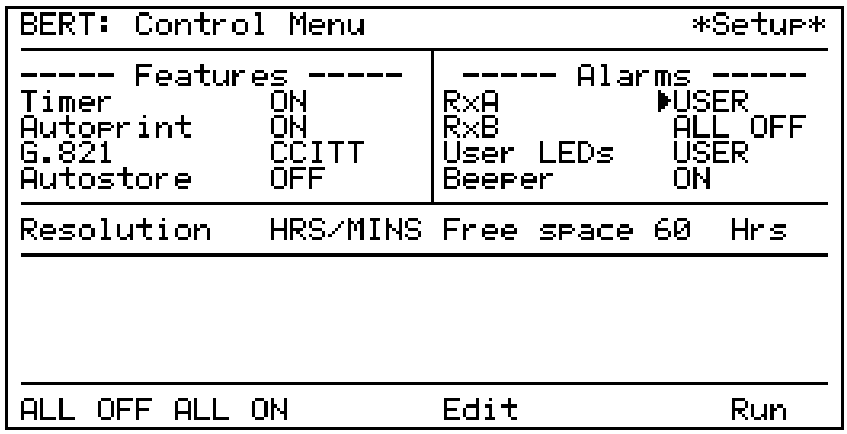


Figure 4.1-3 – {BERT: Control Menu} page, with unframed test parameters

When <**Edit**> is pressed while the cursor is in the **Timer** field, the {**BERT: Timer Menu**} appears on the screen. Set up the parameters as shown in Figure 4.1-4.

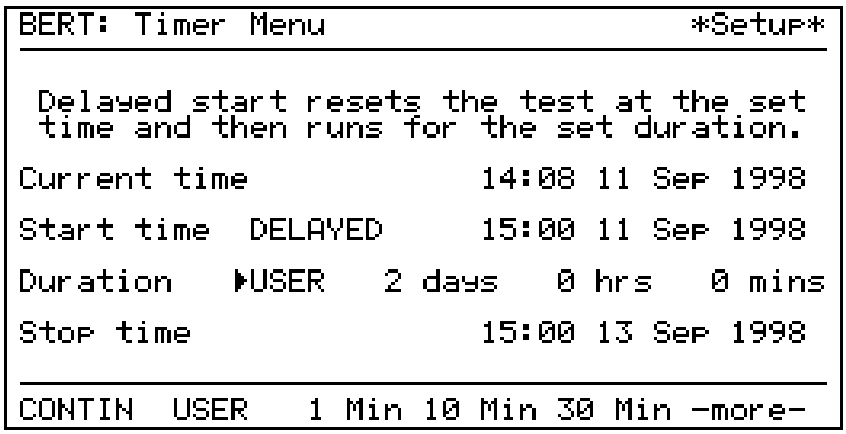


Figure 4.1-4 – {BERT: Timer Menu} page, with unframed test parameters

Now press EXIT to return to the {**BERT: Control menu**}. Move the cursor to the **Autoprint** field and press <**Edit**>. The {**BERT: Autoprint Menu**} will appear on the screen. Set up the parameters as shown in Figure 4.1-5.

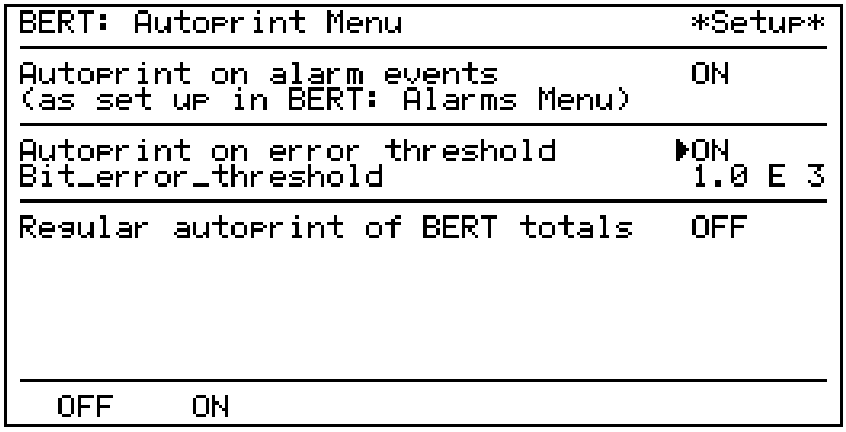


Figure 4.1-5 – {BERT: Autoprint Menu} page, with unframed test parameters

Now press EXIT to return to the {**BERT: Control menu**}. Move the cursor to the **RxA** field in the **Alarms** box at the top right hand side of the screen and press <**Edit**>. The {**BERT: Alarms Menu RxA**} will appear on the screen. Set up the parameters as shown in Figure 4.1-6.

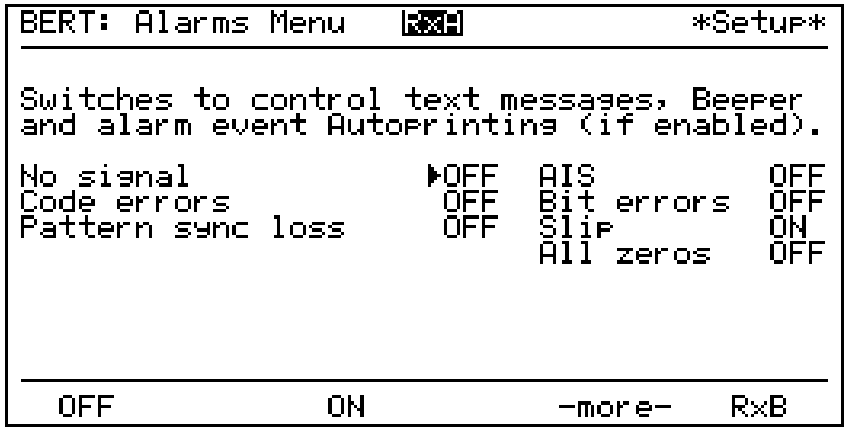


Figure 4.1-6 – {BERT: Alarms Menu RxA} page, with unframed test parameters

Now press [EXIT] to return to the {**BERT: Control menu**}. Move the cursor to the **User LEDs** field in the **Alarms** box and press <**Edit**>. The {**BERT: User LED Menu RxA**} will appear on the screen. Set up the parameters as shown in Figure 4.1-7.

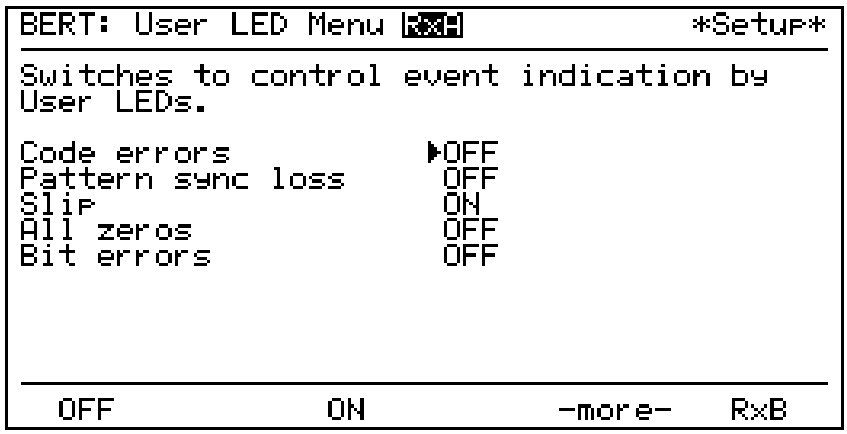


Figure 4.1-7 – {BERT: User LED Menu RxA} page, with unframed test parameters

Now press [EXIT] to return to the {**BERT: Control menu**}.

Having set up the parameters, the PA-41 is now ready to run the test. Press <**Run**>. Check that the message box in the top right hand corner of the display shows ***Delayed Start***. When the delayed time has expired, i.e. 15.00 hours, the test will begin and stop after 48 hours.

In the example above, after 48 hours the results can be analysed. Check that the BER is less than 1×10^{-6}. Figure 4.1-8 shows the results containing a typical bit error ratio.

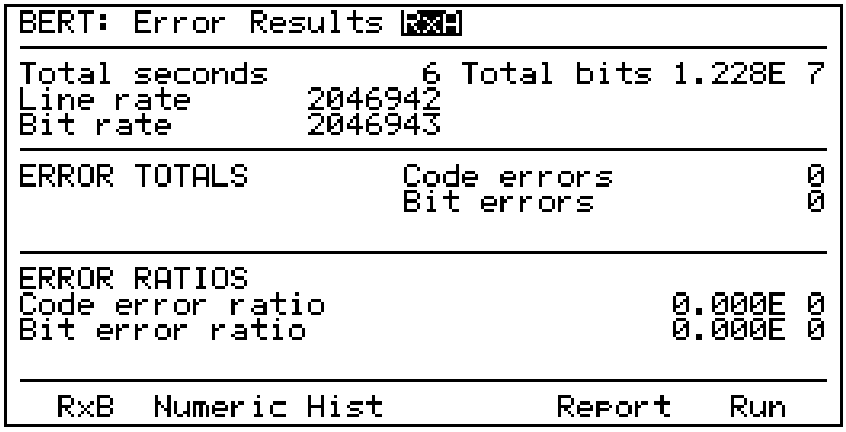


Figure 4.1-8 – {BERT: Error Results RxA} page, with unframed test parameters

4.1.2 Framed Monitor

The following example will set up the PA-41 for a typical framed monitor application.

The set up requirements are as follows:

1. PCM30 framing.
2. HDB3 line code.
3. High impedance termination.
4. 2^{11}-1 test pattern.
5. BER/BLER and G.821 analysis in n x 64kbit/s timeslots 1, 15, 17 and 31 on both receivers.
6. Audio output to the built-in loudspeaker of timeslot 10 (channel 10) on receiver RxA only.
7. The block length to be set up to the PRBS test pattern length.
8. Programmable timer off.
9. Autoprint to print out G.821 results at 5 minute time intervals.
10. The G.821 parameters are to be set to the following requirements:

    (i) Alarm seconds to be treated as severely errored seconds.

    (ii) Errored seconds to be defined as a fixed one second interval containing one or more errors.

    (iii) Severely errored seconds to be defined as a fixed one second interval with a bit error ratio greater than 1.0×10^{-4}.

(iv) Degraded minutes to be defined as a G.821 minute having a bit error ratio greater than 1.0×10^{-5}.

The Hypothetical Reference Connection error performance objectives are to be set up to a local grade network section, i.e. 15% HRX scale factor.

11. The histogram resolution is to be set to HOURS and MINUTES.

12. The occurrence of all the alarms and errors to be displayed by the LEDs.

13. The internal loudspeaker to be set to maximum volume.

14. The beeper is to be set to ON.

Connect the PA-41 to the lines to be monitored using the appropriate connections. Use both receivers RxA and RxB for this test. Switch on the PA-41 and, after the 'self check' procedure, select the **Bit Error Ratio Testing** option from the {**Main Menu**} using the cursor keys and <**Select**>.

Now select the {**BERT: Interface Menu**} and set up the screen parameters as shown in the menu diagram in Figure 4.1-9.

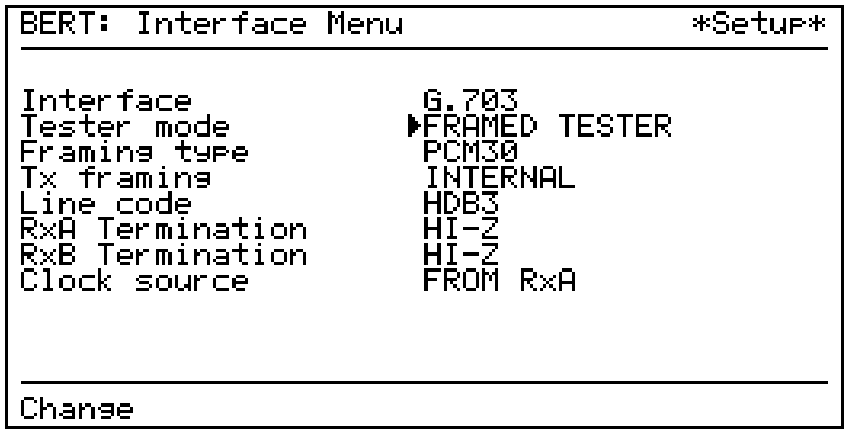


Figure 4.1-9 – {BERT: Interface Menu} page, with framed test parameters

Now press EXIT to return to the {**Bit Error Ratio Test**} menu and select **Patterns** using the cursor keys and <**Select**>. Set up the parameters as shown in Figure 4.1-10.

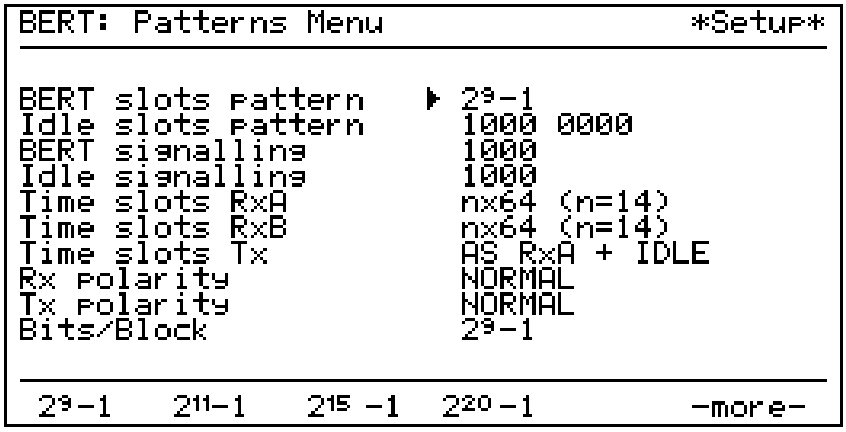


Figure 4.1-10 – {BERT: Patterns Menu} page, with framed test parameters

When the cursor is in the **Time slots RxA** field, press <**nx64**> to display the {**BERT: Rx Slots Menu**}. Set up the parameters as shown in Figure 4.1-11. You only need to set up the RxA slots on the left hand side of the screen and then use <**RxA➡RxB**> to copy the RxA slot configuration to RxB since they are both going to be the same in this test.

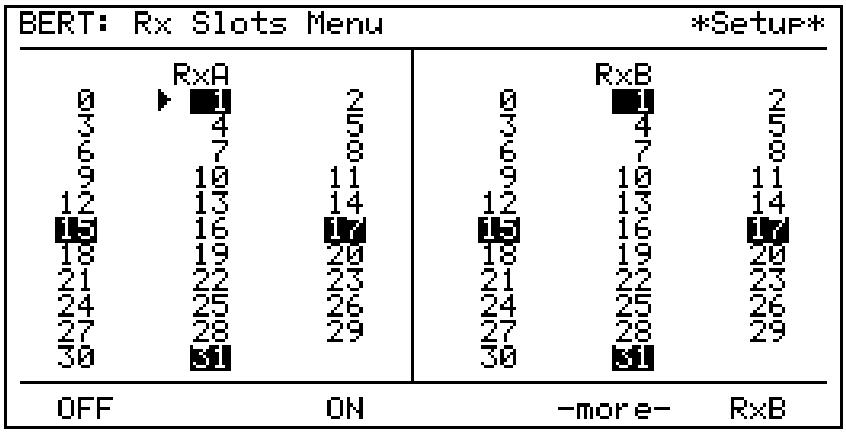


Figure 4.1-11 – {BERT: Rx Slots Menu} page, with framed test parameters

Now press EXIT to return to the {**BERT: Patterns Menu**}.

When the cursor is on the **Time slots Tx field**, press <**RxA➡Tx**> to copy the slot configuration to the transmit parameters. (There is no need to enter the {**BERT: Tx Slots Menu**}.

Now press EXIT to return to the {**Bit Error Ratio Test**} top level menu and select Control using the cursor keys and <**Select**>. Set up the parameters as shown in Figure 4.1-12.

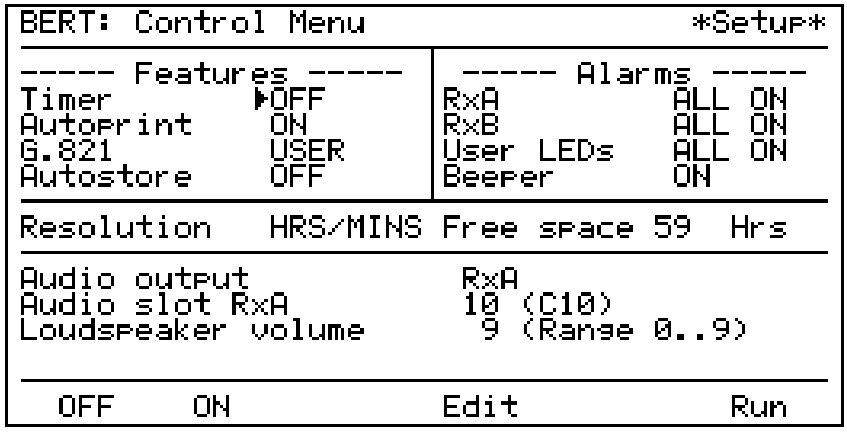


Figure 4.1-12 – {BERT: Control Menu} page, with framed test parameters

Move the cursor to the **Autoprint** field and press <**Edit**>. The {**BERT: Autoprint Menu**} will appear on the screen. Set up the parameters as shown in Figure 4.1-13.

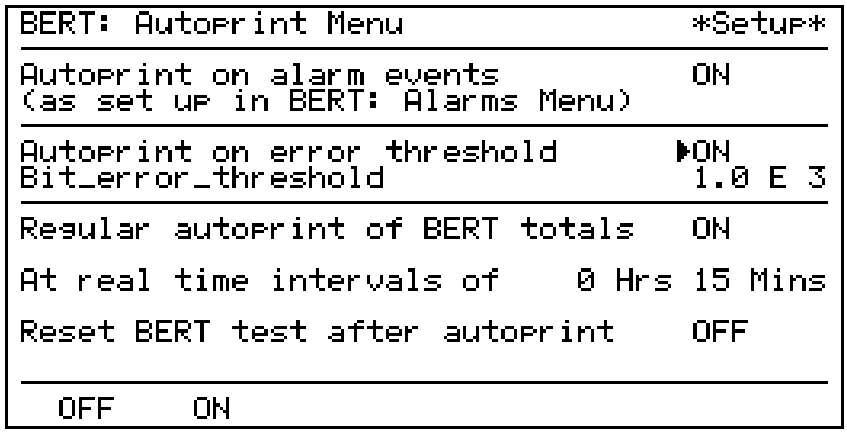


Figure 4.1-13 – {BERT: Autoprint Menu} page, with framed test parameters

Now press EXIT to return to the {**BERT: Control menu**}. Move the cursor to the **G.821** field and press <**Edit**>. The {**BERT: G.821 parameters**} page will appear on the screen. Set up the parameters as shown in Figure 4.1-14.

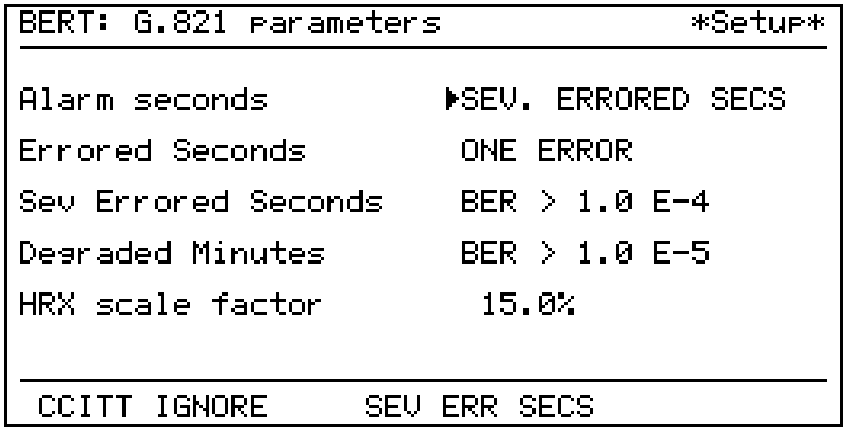


Figure 4.1-14 – {BERT: G.821 parameters} page, with framed test parameters

Now press EXIT to return to the {**BERT: Control menu**}.

Having set up the parameters, the PA-41 is now ready to run the test. Press <**Run**>. Check that the message box in the top right hand corner of the display shows ***Running***. Press <**Numeric**> repeatedly to display the results pages. Use <**Reset**> if required to reset the results whilst continuing the test. To stop the test press <**Stop**>.

4.1.3 Framed Generator

4.1.3.1 INTERNAL Framing Mode

The following example will set up the PA-41 for a typical 'Internal' frame (transmit) mode application. The requirements are as follows:

1. All framing and timeslot data to be sourced internally from the PA-41.

2. Test pattern 2^9-1 prbs inserted into timeslots 1, 15, 17, and 31.

3. Idle code inserted into all remaining timeslots.

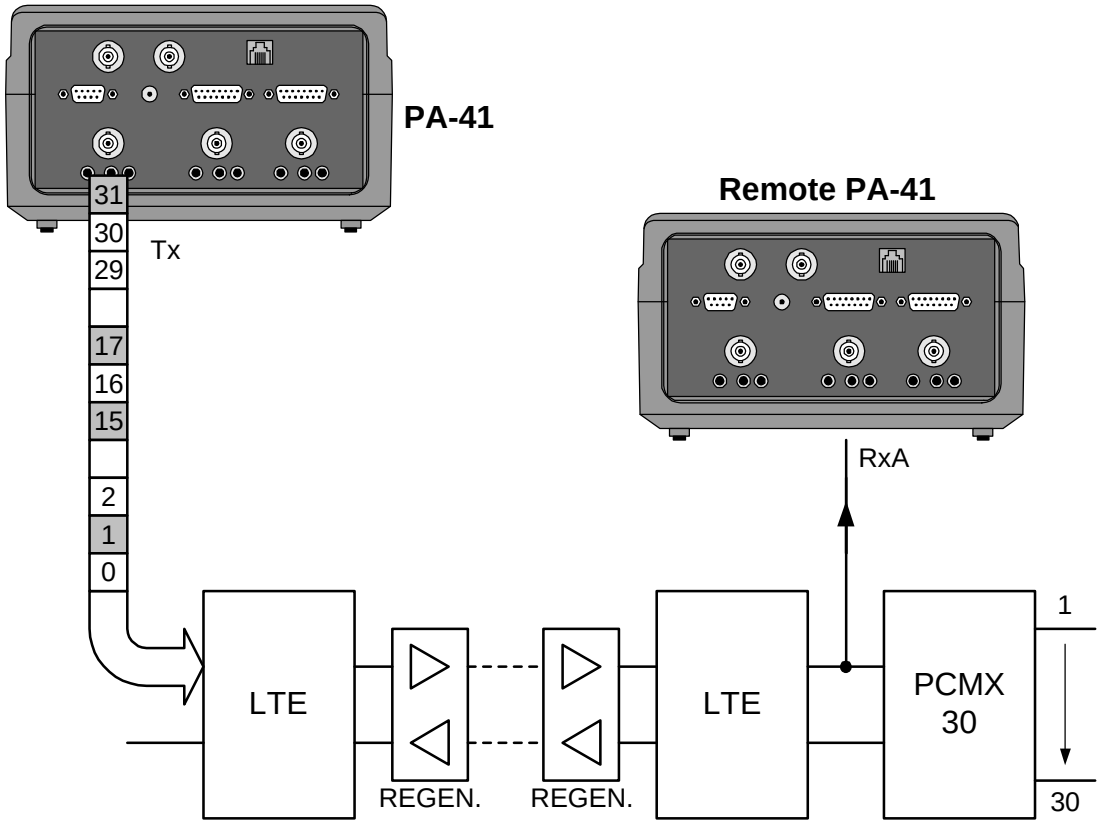


Figure 4.1-15 – Framed generator, 'INTERNAL' mode

Connect the PA-41 as shown in Figure 4.1-15 and set up the parameters of the {**BERT: Interface Menu**} as shown in Figure 4.1-16.

```
BERT: Interface Menu                    *Setup*

Interface                 G.703
Tester mode               FRAMED TESTER
Framing type              PCM31
Tx framing                INTERNAL
Line code                 HDB3
RxA Termination           HI-Z
RxB Termination           HI-Z
Clock source              INTERNAL
Clock deviation           ▶   0 ppm


  -50     -10     -1      +1      +10     +50
```

Figure 4.1-16 – {BERT: Interface Menu} page, internal framing

Use [EXIT] to return to the BERT top level menu.

Now select the {**BERT: Patterns Menu**} and set up the parameters as shown in Figure 4.1-17.

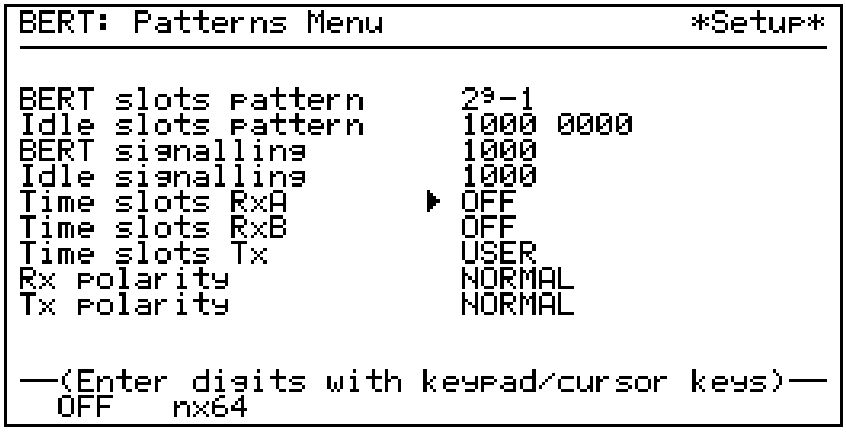


Figure 4.1-17 – {BERT: Patterns Menu} page

Now move the cursor to the **Time slots Tx** field and press <**Edit**> to set up the {**BERT: Tx slots Menu**} where the PRBS pattern is to be inserted as shown in Figure 4.1-18.

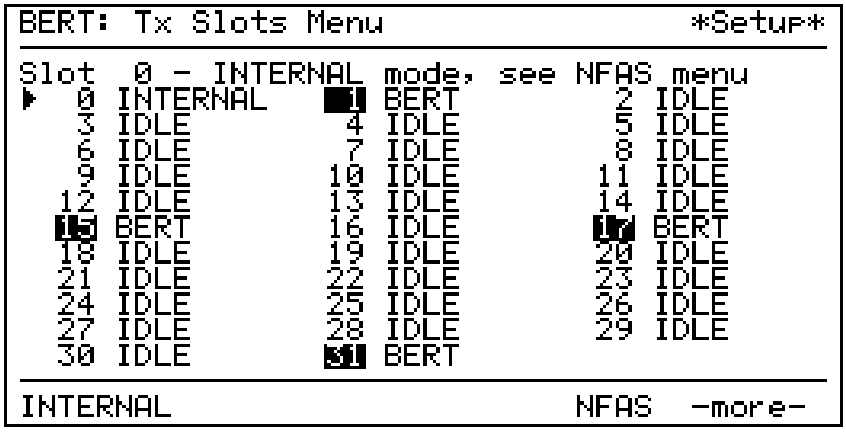


Figure 4.1-18 – {BERT: Tx Slots Menu} page

Press EXIT *twice* to return to the {**Bit Error Ratio Test**} top level menu and select '**Control**'.

The PA-41 is now set up to transmit PCM frames with internally sourced framing, BERT pattern and idle slot information.

Press <**Run**> to start the test.

4.1.3.2 THROUGH Framing Mode

The following example will set up the PA-41 for a typical 'THROUGH' framing mode application. The requirements are as follows:

1. All the framing and timeslot information apart from the timeslots to be used for the BER test to be sourced from the received signal on RxA.

2. n x 64kbit/s BER analysis in timeslots 1, 2, 3 and 4.

3. No idle timeslots.

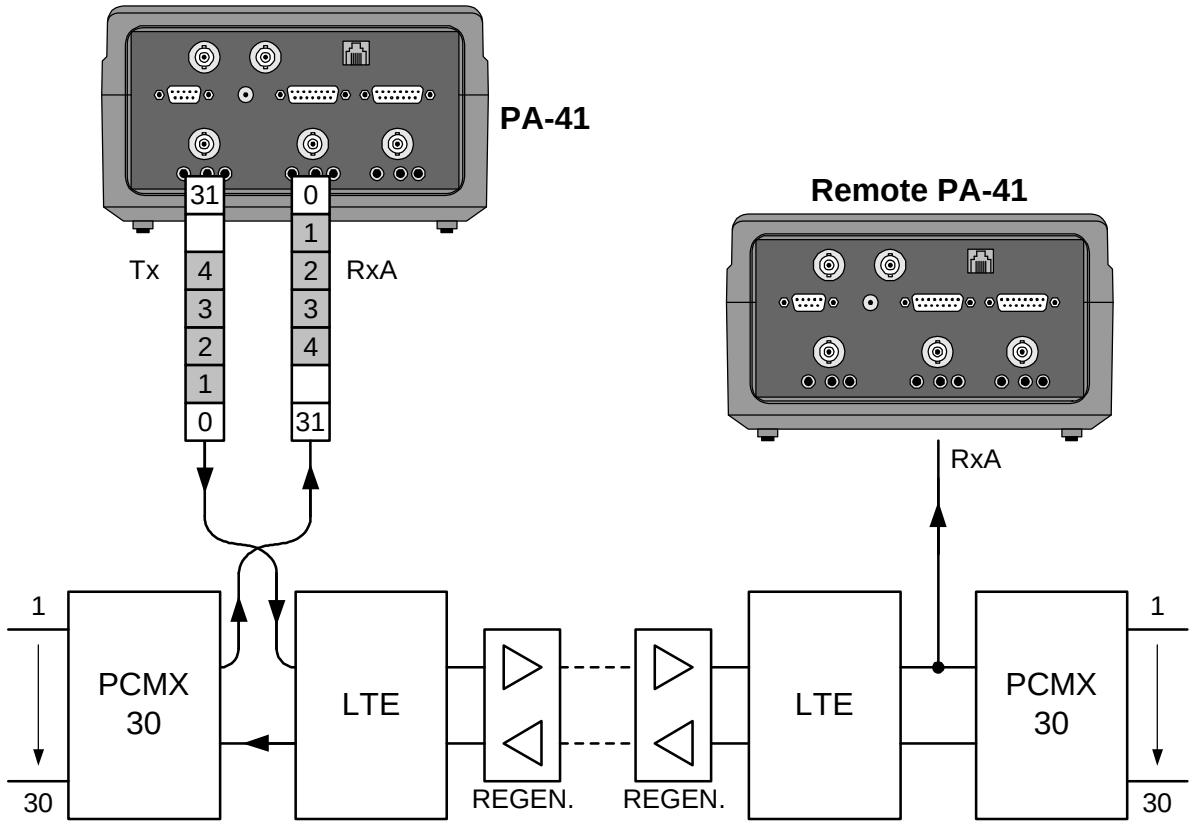


Figure 4.1-19 – Framed generator, 'THROUGH' mode

Connect the PA-41 as shown in Figure 4.1-19 and set up the parameters of the {**BERT: Interface Menu**} as shown in Figure 4.1-20.

```
BERT: Interface Menu                    *Setup*

Interface                 G.703
Tester mode               FRAMED TESTER
Framing type              PCM30
Tx framing                THROUGH
Line code                 HDB3
RxA Termination           75/120Ω
RxB Termination           75/120Ω
Clock source             ▶FROM RxA




                                          RxA
```

Figure 4.1-20 – {BERT: Interface Menu} page

Use [EXIT] to return to the BERT top level menu.

Now select the {**BERT: Patterns Menu**} and move the cursor to the **Time slots RxA** field, press the <**nx64**> softkey to display the {**BERT: Rx Slots Menu**}. Set up the parameters as shown in Figure 4.1-21. You only need to set up the RxA slots on the left hand side of the screen, since RxB is not used.

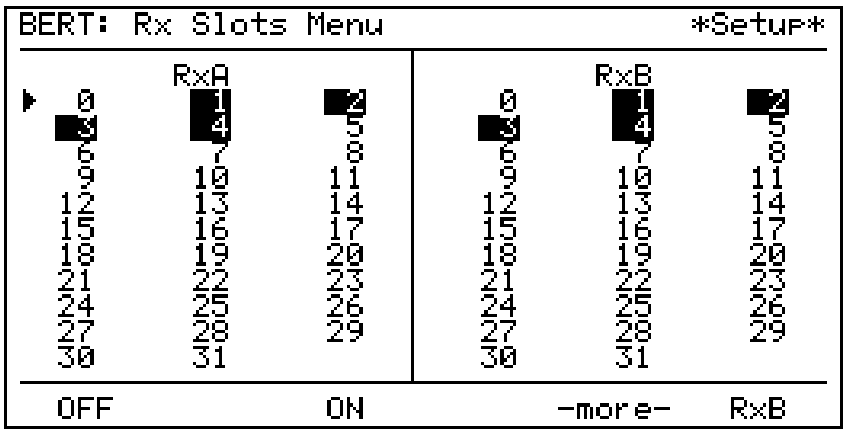


Figure 4.1-21 – {BERT: Rx Slots Menu} page

Now press EXIT to return to the {**BERT: Patterns Menu**}.

Move the cursor into the **Time slots Tx** field and press <**Edit**> to set up the {**BERT: Tx slots Menu**} where the PRBS pattern is to be inserted as shown in Figure 4.1-22.

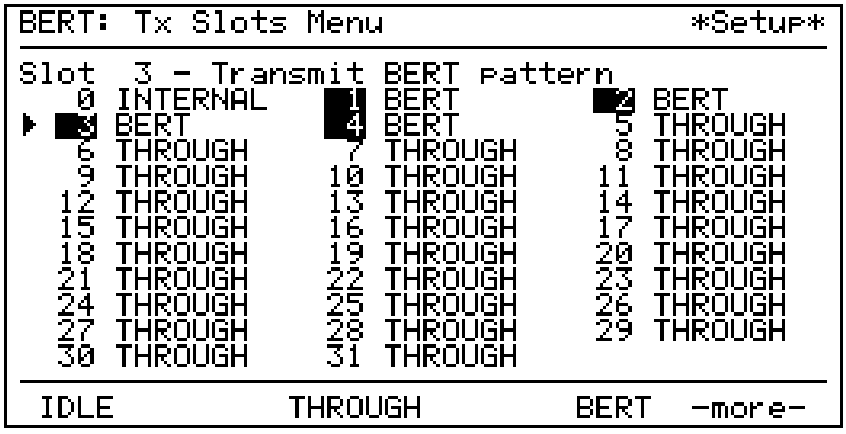


Figure 4.1-22 – {BERT: Tx Slots Menu} page

Press EXIT *twice* to return to the BERT top level menu.

The PA-41 is now ready to use in the '**THROUGH**' framing mode.

4.1.4 Multiplexer Testing

The following example will set up the PA-41 for testing a multiplexer. The requirements are as follows:

1. The transmitted signal (towards the multiplexer) will contain a 2^{15}-1 PRBS at a rate of 512kbit/s (8 x 64kbit/s) using the V.11 interface.

2. The 2Mbit/s received signal (from the multiplexer) will conform to G.703 with a PCM30 framing structure.

3. Timeslots 1 to 8 in the received PCM frame are to carry the PRBS.

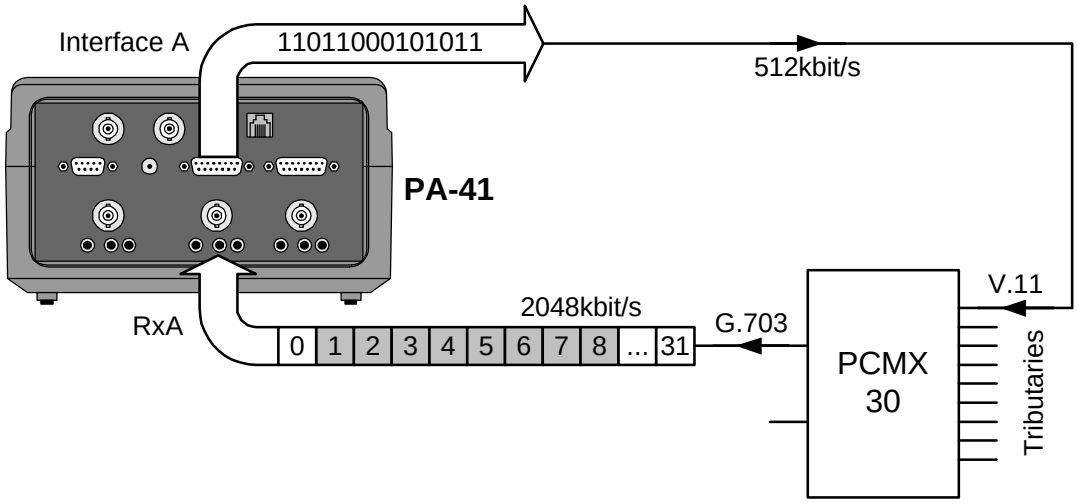


Figure 4.1-23 – Connections for multiplexer testing

Connect the PA-41 as shown in Figure 4.1-23 and set up the parameters of the {**BERT: Interface Menu**} as shown in Figure 4.1-24.

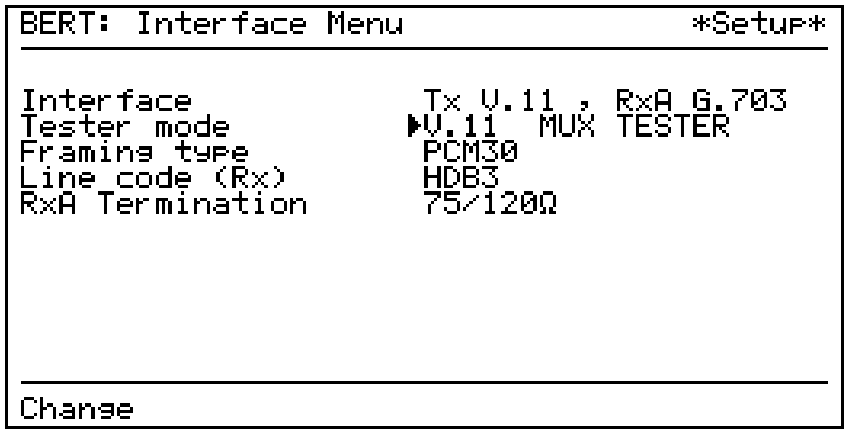


Figure 4.1-24 – {BERT: Interface Menu} page

When the cursor is in the **Tester Mode** field press <**Change**> to select the {**BERT: Tester Mode**} page.

Now select **V.11 MUX tester** using the cursor keys and highlight bar.

Use [EXIT] to return to the BERT top level menu.

Now select the {**BERT: Patterns Menu**} and move the cursor to the **Time slots RxA** field, press <**nx64**> to display the {**BERT: Rx Slots Menu**}. Set up the parameters as shown in Figure 4.1-25.

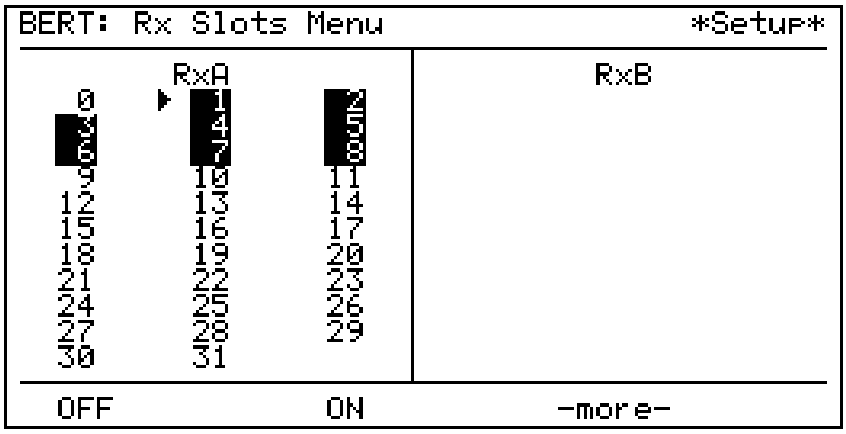


Figure 4.1-25 – {BERT: Rx Slots Menu} page

Now press [EXIT] *twice* to return to the {**Bit Error Ratio Test**} top level menu and select **Control** using the cursor keys and <**Select**>. Set up the parameters as shown in Figure 4.1-26.

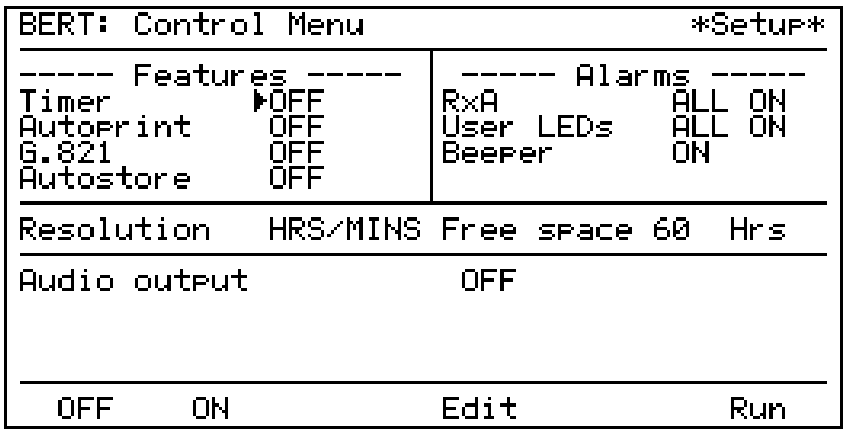


Figure 4.1-26 – {BERT: Control Menu} page

The PA-41 is now ready to use in the 'V.11 MUX' mode.

4.1.5 De-multiplexer Testing

The following example will set up the PA-41 for testing a de-multiplexer. The requirements are as follows:

1. The transmitted 2Mbit/s signal (towards the de-multiplexer) will contain a 2^{15}-1 PRBS in timeslots 1 to 8 using the G.703 interface with a PCM30 framing structure.

2. The 512kbit/s (8 x 64kbit/s) signal (from the de-multiplexer) will be received on the V.11 interface (A).

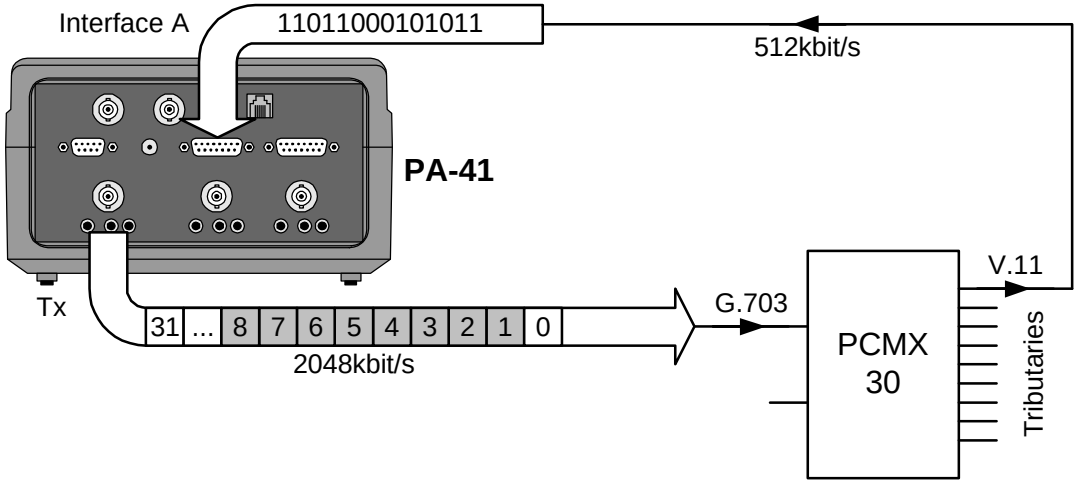


Figure 4.1-27 – Connections for de-multiplexer testing

Connect the PA-41 as shown in Figure 4.1-27 and set up the parameters of the {**BERT: Interface Menu**} as shown in Figure 4.1-28.

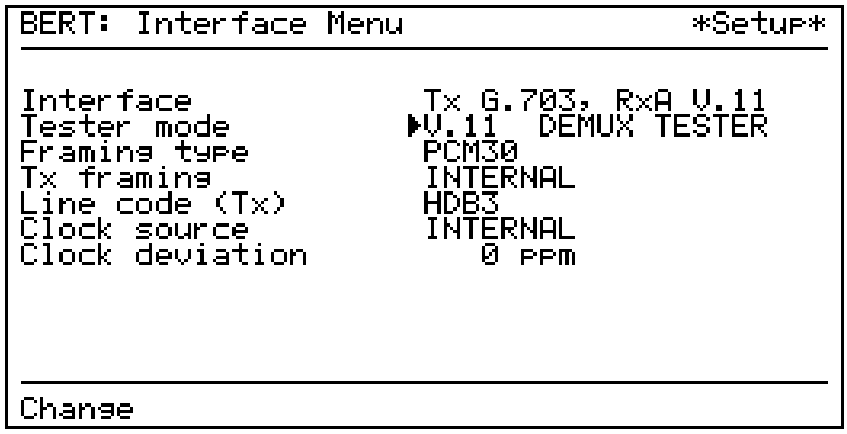


Figure 4.1-28 – {BERT: Interface Menu} page

When the cursor is in the **Tester Mode** field press <**Change**> to select the {**BERT: Tester Mode**} page.

Now select **V.11 DEMUX tester** using the cursor keys and highlight bar.

Use EXIT to return to the BERT top level menu.

Now select the {**BERT: Patterns Menu**} and move the cursor to the **Time slots Tx** field, press <**Edit**> to display the {**BERT: Tx Slots Menu**}. Set up the parameters as shown in Figure 4.1-29.

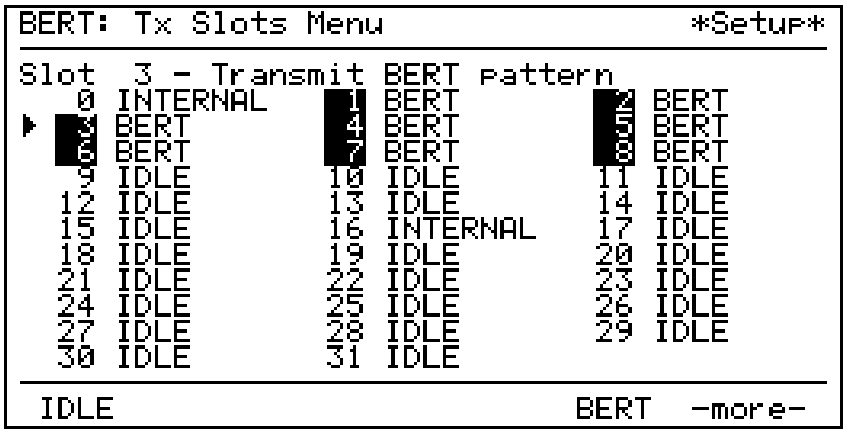


Figure 4.1-29 – {BERT: Tx Slots Menu} page

Now press EXIT to return to the {**Bit Error Ratio Test**} top level menu and select **Control** using the cursor keys and <**Select**>. Set up the parameters as shown in Figure 4.1-30.

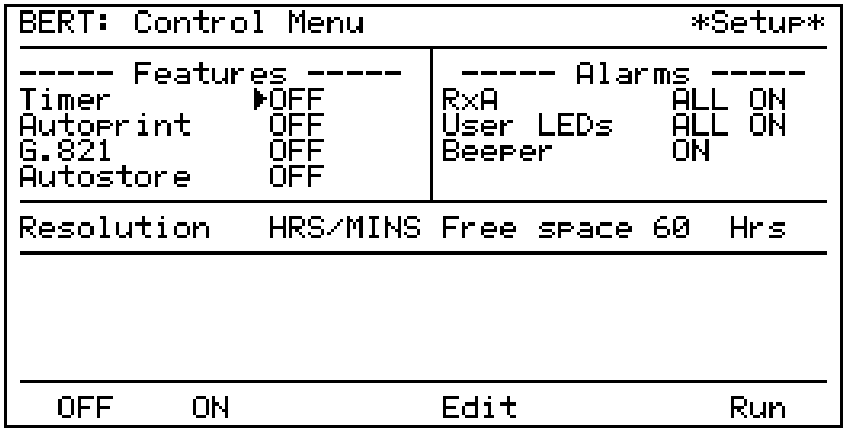


Figure 4.1-30 – {BERT: Control Menu} page

The PA-41 is now ready to use in the ‘V.11 DEMUX’ mode.

4.2 PCM Analysis Applications

4.2.1 Testing PCM Framing and Alarms

The following example describes how a piece of 2Mbit/s network equipment can be tested for various PCM frame conditions.

The requirements are as follows:

1. Equipment under test is to use a G.703 PCM30 framing structure. The equipment comprises of a digital cross-connect system with loopback applied to the test circuits as shown in Figure 4.2-1.

2. All the frame alarm conditions are to be checked.

3. The PA-41 is to derive all the framing bits and idle patterns are to be inserted into all the timeslots.

4. The Tx FAS needs to be set initially to 10011011 or the Frame alignment is lost.

Connect the PA-41 to the digital cross-connect as shown in Figure 4.2-1

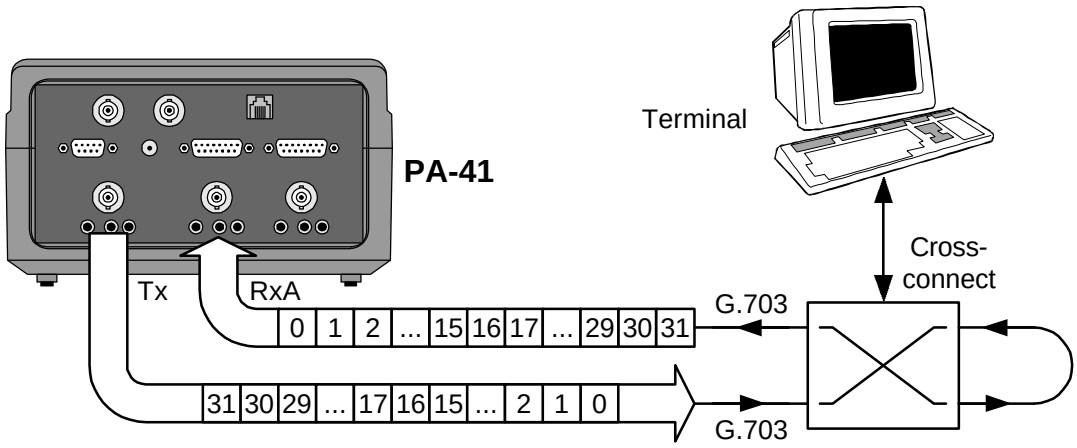


Figure 4.2-1 – Connections for a PCM frame test

From the {**Main Menu**} select the {**PCM: Analysis**} option using the cursor keys and highlight bar. Now select the **Interface** option to enter the {**PCM: Interface**} page and set it up as shown in Figure 4.2-2.

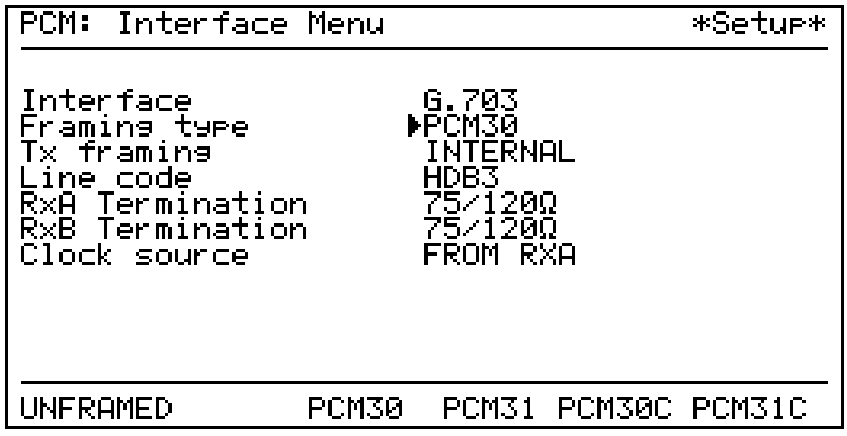


Figure 4.2-2 – {PCM: Interface Menu} page

Now use EXIT to return to the {**PCM: Analysis**} page and select the {**PCM: Patterns Menu**} using the cursor keys and highlight bar. Set the **Idle slots pattern** to 0101 0101 and the **Idle signalling** to 0101.

Now use EXIT to return to the {**PCM: Analysis**} page and select the {**PCM: Frame**} page using the cursor keys and highlight bar. The test is now running (indicated by the word ***Running*** in the top right hand corner of the screen) and the transmit parameters may be adjusted to suit the test by pressing <**Tx**> to edit them. For example, the FAS (Frame Alignment Signal) can be corrupted by moving the cursor into the **Tx FAS** field and changing, say, bit 4 using the cursor keys and softkeys. The digital cross-connect should then indicate a loss of frame alignment alarm.

4.2.2 D-A and A-D Testing of Multiplex Equipment

The following example shows how the PA-41 can be used to perform both a digital to analogue and an analogue to digital test through a multiplexer with the aid of another piece of test equipment such as a PCM-23.

The requirements are as follows:

1. To check that a digital audio tone can be dropped from a 2Mbit/s PCM frame, converted into analogue form with A-law conversion by the de-multiplexer and passed to an analogue circuit without degradation to the signal level or frequency.

2. To check the reverse of the above, i.e. that an audio tone arriving at a tributary of the multiplexer can be converted into digital form with A-law conversion and inserted into a 2Mbit/s PCM frame without degradation to the signal level or frequency.

3. The PCM frame must conform to G.704 PCM31 framing with CRC.

4. The digital audio tone frequency must be 1000Hz ±2Hz.

5. The digital audio tone level must be at 0 dBm0 with a 0 digital offset.

6. The digital audio tone is to be inserted into timeslot 1 (channel 1).

Connect the PA-41 and PCM-23 as shown in Figure 4.2-3.

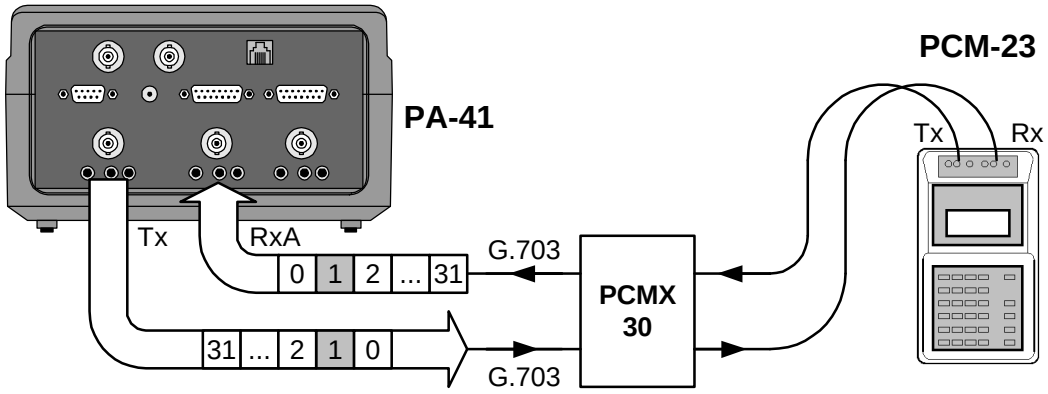


Figure 4.2-3 – Connections for a Level and Frequency test

From the {**Main Menu**}, select the {**PCM: Analysis**} page, then select '**Interface**' with the cursor keys and highlight bar and set up the interface as shown in Figure 4.2-4.

```
PCM: Interface Menu                    *Setup*

Interface                 G.703
Framing type              PCM31C
Tx framing              ▶INTERNAL
Line code                 HDB3
RxA Termination           75/120Ω
RxB Termination           75/120Ω
Clock source              FROM RXA




THROUGH        INTERNAL
```

Figure 4.2-4 – {PCM: Interface Menu} page

Now use EXIT to return to the {**PCM: Analysis**} page and select the {**PCM: Patterns Menu**} using the cursor keys and highlight bar. Set the **Idle slots pattern** to 0101 0101.

Now use EXIT to return to the {**PCM: Analysis**} page and select the {**PCM: Level and Frequency**} page using the cursor keys and highlight bar. The test is now running (indicated by the word ***Running*** flashing in the top right hand corner of the screen). The transmit parameters may now be set up as shown in Figure 4.2-5.

Note that the frequency resolution displayed is ±2Hz.

The tone level and frequency can now be measured by the PCM-23 in one direction, and having set up the PCM-23 to generate a 100Hz tone, the PA-41 can be used to measure the level and frequency in the opposite direction.

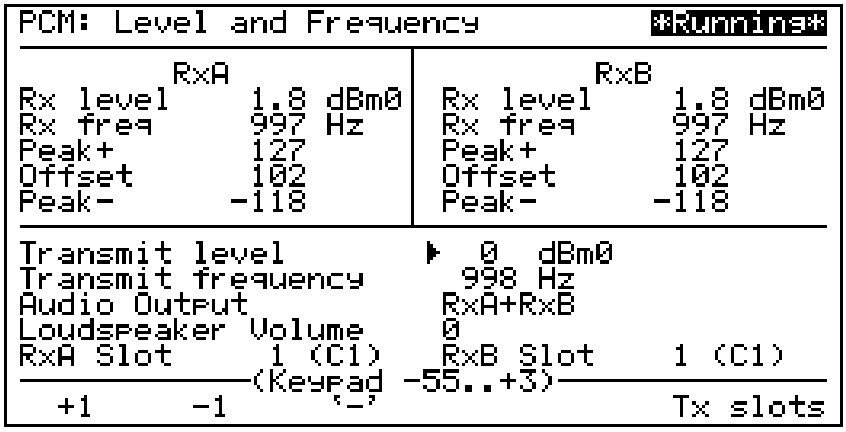


Figure 4.2-5 – {PCM: Level and Frequency} page

4.2.3 Using the PA-41 as a Drop/Insert Mux/Demux for nx64kbit/s

The following example shows how a PA-41 can be used as a digital multiplexer/demultiplexer when other equipment (such as a protocol analyser), without the necessary G.703 PCM interface, is to be connected to the network.

The requirements are as follows:

A protocol analyser to be interfaced with the network requires two V.11 circuits for protocol analysis. One to insert a digital signal at a rate of 4 x 64kbit/s into timeslots 1 to 4 of the transmitted 2Mbit/s PCM Frame. The other to monitor a digital signal at a rate of 4 x 64kbit/s from timeslots 1 to 4 of the received 2Mbit/s PCM Frame.

Connect the PA-41 to the network as shown in Figure 4.2-6.

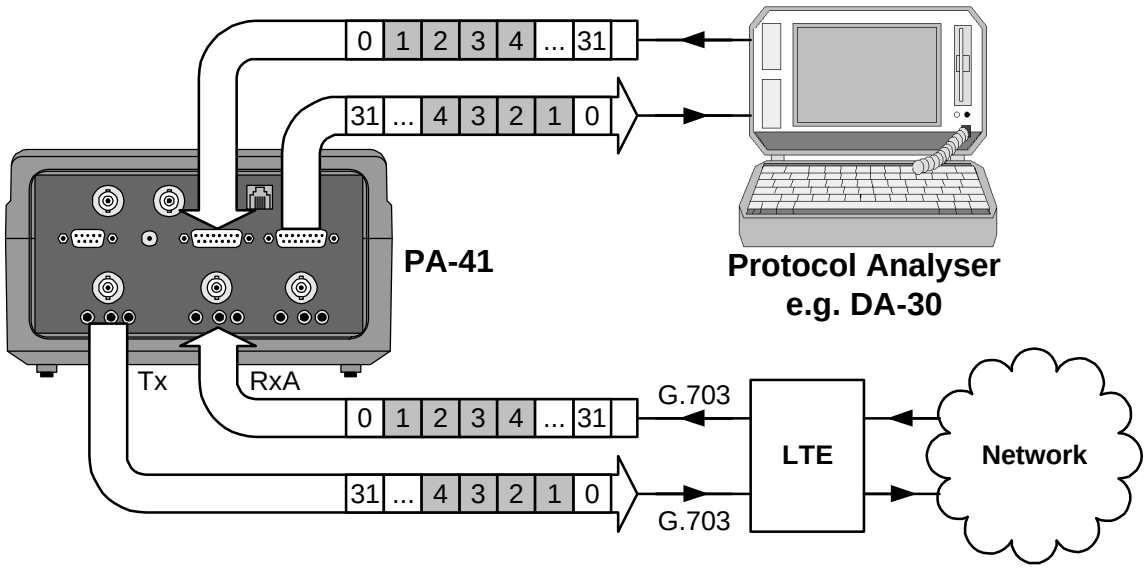


Figure 4.2-6 – Network connections

Switch on the instrument and after the initial power on self check, the PA-41 will display the {**Main Menu**}. Select the **PCM Monitoring and Analysis** option by moving the highlight bar using the cursor keys and pressing <**Select**>. Now select **'Interface'** using the highlight bar and cursor keys. Set up the {**PCM: Interface Menu**} as shown in Figure 4.2-7.

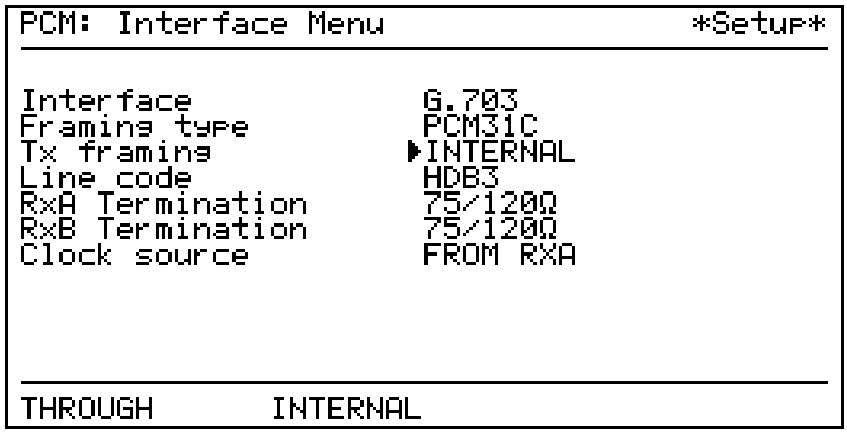


Figure 4.2-7 – {PCM: Interface Menu} page

Now use [EXIT] to return to the {**PCM: Analysis**} page and select the {**PCM: Patterns Menu**} using the cursor keys and highlight bar. Set the **Idle slots pattern** to 0101 0101.

Now use [EXIT] to return to the {**PCM: Analysis**} page and select '**Drop & Insert**' and then enter the {**PCM: V.11 Interface A**} page. Using the cursor keys and highlight bar, set up the parameters as shown in Figure 4.2-8.

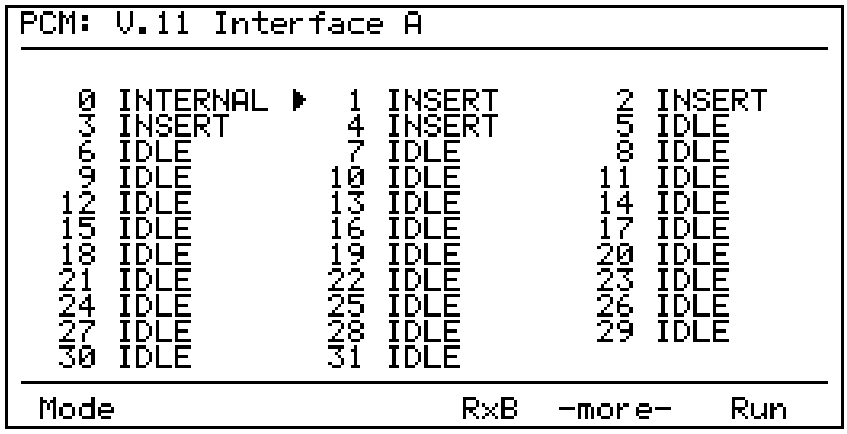


Figure 4.2-8 – {PCM: V.11 Interface A} page

Now press <**RxB**> to set up the {**PCM: V.11 Interface B**} page as shown in Figure 4.2-9.

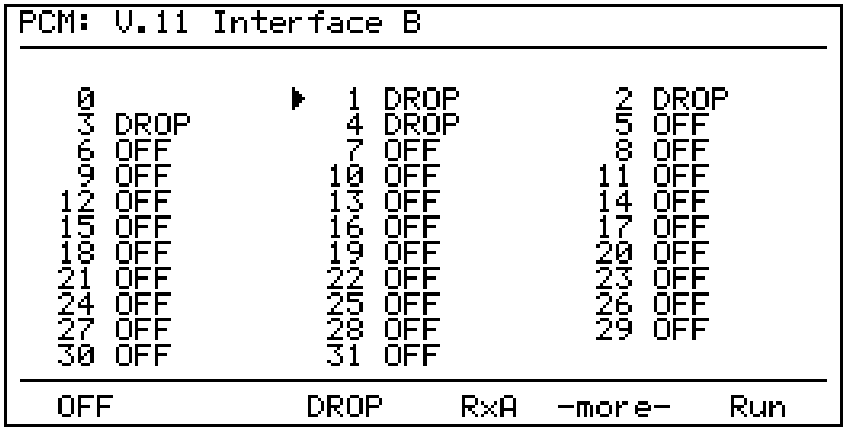


Figure 4.2-9 – {PCM: V.11 Interface B} page

Now the PA-41 is ready to perform the drop and insert function. Press <**Run**> to initiate this mode.

5. Troubleshooting

5.1 Introduction

This section provides information for the user on what to do if the instrument does not perform tests as expected, or does not function correctly when connected to other equipment.

The information following is *not* to be regarded as a *fault* searching guide, either for the instrument itself or any system to which it is connected.

5.2 General

5.2.1 Blank display

If, following switching-on, the display remains blank, and assuming that the battery has sufficient charge to operate the instrument, check the setting of the display contrast by pressing a Contrast key **[8]** for several seconds.

5.2.2 Apparent battery failure

It has been known for rechargeable Ni-Cd cells to appear to have failed when they are still serviceable. This is usually due to shallow charge/discharge cycles leading to the cells apparently losing capacity. This phenomenon is often referred to as the ‘memory effect’. If this effect is noticed, it may be cleared by first deeply discharging the battery followed by a full recharge. A similar loss of capacity can arise from frequent overcharging. This may also be remedied by a deep discharge followed by a full recharge.

It should also be noted that if Ni-Cd cells have been out of use or in storage for a considerable time, they may require between 3 and 5 full charge/deep discharge cycles to return them to full capacity.

5.2.3 Self Test Failure

If a self test failure is indicated, it is unlikely that the user will be able to either correct the fault or continue to use the instrument successfully.

If such a failure occurs the instrument should be sent to the nearest Wavetek Wandel Goltermann Service Centre, (a list of addresses may be found at the end of this manual).

5.2.4 Unable to load an Option

If the PA-41 will not load a software option, this may be due to one of the following reasons:

a) The PA-41 displays the message ‘**Device not responding**’. The option loader may be set up to load from the wrong device. Check that the device is set to

LINK for loading from a remote PC or **CARD** for loading from a ROM card. Alternatively, the device may not be connected. Ensure that when using the remote PC device, the PC is connected to the PA-41 using the correct serial port and that the PC is running the slave program **pc_link**. If the **CARD** device is selected then ensure that the software option memory card is inserted properly into the PA-41 card slot.

b) The PA-41 displays the message '**No options present**'. The PA-41 cannot find the *.INF or *.BIN files on the selected device. Both these files must be present for the PA-41 to load the option. If the device is a remote PC, the PC may be in the wrong directory or one of the required files is not present. If the device is a memory card, the card may not be an option card.

c) The option loader denies access to the user to load an option. This is most likely to be caused by the software option being incompatible with the PA-41. Each software option is protected against unauthorised duplication by having a unique access code associated with both the option software and a specific PA-41 instrument (or group of instruments). The option card must be used with the authorised PA-41 (as per its serial number) and access code supplied with the software option.

d) The PA-41 displays the message '**Option failed to load**'. In the event of the option software being damaged due to accidental erasure or mishandling, the PA-41 will report the above message. In the event of this happening, please contact Wandel and Goltermann.

5.2.5 Unable to communicate with a PC

If the PA-41 does not communicate with a slave PC file server, check the following:

a) A suitable (null modem) cable must be used to connect the PA-41 to the PC via the V.24 serial port. Check that the connections are made according to those shown in Figure 5.2-1 below.

b) The PA-41 serial port configuration must be set up to suit the PC serial port configuration parameters. This is done on the PA-41 by setting the printer configuration in the {**Printer Menu**}. Refer to the PC operating manual to set up the PC serial configuration parameters. (Some PCs have more than one serial communications port, ensure that the correct one is being used).

c) The PC is running the slave program **pc_link** and that the PA-41 device option is set to **LINK**.

d) Some versions of **pc_link**, in combination with some versions of PA-41 software, can exhibit a handshaking problem which causes the message '**Directory not found**' to appear immediately on starting the link. Reset the handshake by pressing the backlight ON/OFF key [☼] **[8]** before retrying.

5.2.6 Unable to get printer to operate

The instrument is wired as a DTE (Data Terminal Equipment) as are most printers. If the printer being used is also wired as a DTE (i.e. receives data on pin 3) it is necessary to use a 'null modem cable' to connect to the PA-41, the recommended cable is WWG Printer Cable type K 1524. See Figure 5.2-1 for details of the connections.

It is important that the baud rate, parity and bit per character options are set correctly. These must agree with the settings of the printer being used. If a high baud rate (>300 baud) is used it may be necessary to use some form of handshaking. Two standard forms of handshaking are provided – XON/XOFF and CTS. It is also possible to select the 'SLOW' option which will send out characters at a slow rate and eliminate the need for handshaking in most cases.

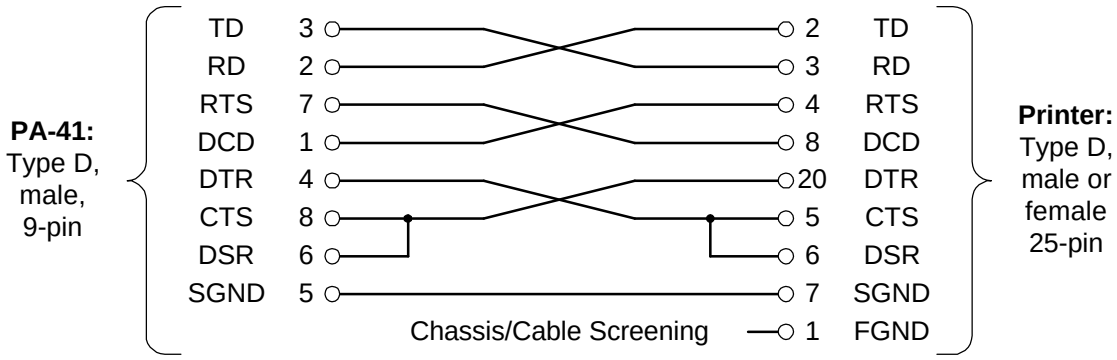


Figure 5.2-1 – 'Null Modem Cable' connections

Further printer problems and possible solutions are given below.

No printing:

Printer handshaking is inoperative – Check that the appropriate handshaking is selected for the printer in use. Ensure that the printer control lines are enabled if required. Try handshake selections 'SLOW' and 'NONE'.

Incorrect printer settings – Check baud rate, bits/char, parity or try using the Autoprint function.

Printer not switched on.

Printer incorrectly connected.

Printer out of paper.

Garbled printout, some recognisable characters:

Incorrect printer settings, e.g. parity, bits/char., baud rate.

Handshaking not working, try 'SLOW' option.

5.3 BER Testing Mode

5.3.1 Test Locked

If the current BERT store is locked, then the PA-41 will replace the <**Run**> softkey option (in the {**BERT: Control Menu**} or {**BERT: Results**} pages) with a 'key' symbol, see Figure 5.3-1.

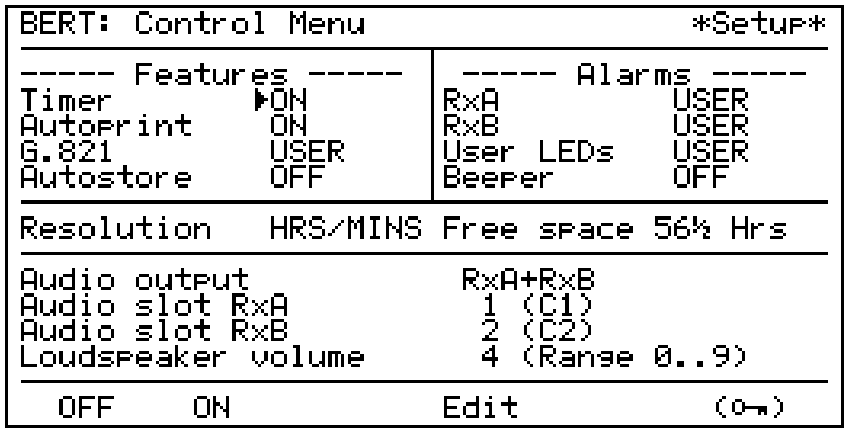


Figure 5.3-1 – Typical {BERT: Control Menu} page with current test locked

The selected BERT store should either be changed to a clear or unlocked store, or the current store can be unlocked from the {**BERT: Stored Results**} menu, see Figure 5.3-2.

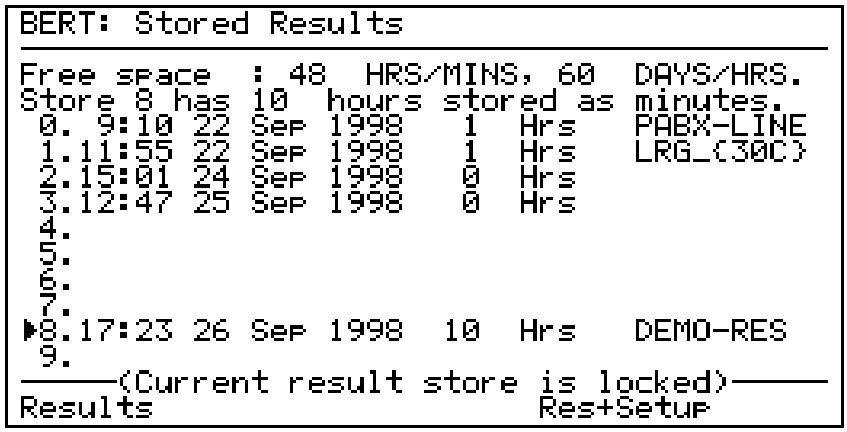


Figure 5.3-2 – Typical {BERT: Stored Results} page with current test locked

To unlock a BERT store in the {**BERT: Stored Results**} menu, move the cursor to the store to be unlocked (the message '**(Current result store is locked)**' will be displayed above the softkey line) and press the **[Security]** key **[6]** followed by F6.

Note: If **Autostore** is turned ON in the {**BERT: Control Menu**} then the PA-41 will make an automatic search through the BERT stores for the next free store after the <**Run**> key is pressed before running the test. Only if all the stores are locked will the PA-41 prompt the user.

5.3.2 Memory Space Limit

Ten test stores are available for the storage of results. Each store is capable of storing all the numeric (BER, G.821 etc.) data associated with a particular test.

In DAYS/HOURS mode a full 60 days of histogram data, with 1 day resolution (i.e. one column per day) and also up to the last 60 hours of days histogram data is available.

In HOURS/MINUTES mode a full 60 hours of histogram data, with 1 hour resolution (i.e. one column per hour) and also up to 24 hours of minutes histogram data is available.

If histogram data is required at high and low resolution, the user must ensure that there is enough space remaining in the selected store before running the test. This is done by selecting the {**BERT: Stored Results**} menu. As the cursor is moved around the display the space available may change. If more space is required then some test results may have to be deleted. This is done by using the <**Clear**> softkey. When sufficient space has been released a test can be run. The <**ClrMins**> and <**ClrHrs**> softkeys may be used to make space for histograms without clearing the numeric and G.821 results.

5.3.3 Different results obtained from different instruments

If the results obtained with the PA-41 appear to differ from those obtained with another instrument, the most likely cause is the real time second boundaries which cannot be synchronised.

This effect will be most noticeable in the Severely Errored Seconds result where a burst of errors may fall entirely within one second or be split between two seconds depending upon the exact timing of the second boundary. The other G.821 results may also show this effect to a lesser extent as will the histograms and the number of seconds containing alarms.

The effect can be minimised by running longer tests which will average out the results.

5.3.4 Unable to run a test

After pressing the <**Run**> softkey the instrument should attempt to synchronise its receiver with the incoming data. If this is successful the message box (top right-hand corner of the display) will display ***Running***. If synchronisation could not be achieved then one of the following messages will be displayed, assuming **ALARMS = ALL ON** in {**BERT: Control Menu**}:

‘No Signal’
‘No Clock’
‘AIS’
‘Sync Loss’
‘Frame Sync Loss’

No Signal, No Clock – This will normally be displayed if there is no input connected to the instrument. Check that the signal input is connected correctly and that the signal consists of valid data.

AIS – This will be displayed when an ‘all ones’ pattern is received. This is usually generated by a network component to indicate a fault or lack of data on the line. In this case clear the fault on the network and resume the test.

Sync Loss – This will be displayed when an input signal has been detected but the incoming data pattern is very different from the expected pattern. For pseudo random patterns 67% of the incoming bits must be correct; for ‘1111’, ‘0000’, ‘1010’ and programmable word patterns, 95% of the incoming bits must be correct. It may be necessary to change the Tx or Rx polarity using the <**Tx polarity**> or <**Rx polarity**> fields in the {**BERT: Patterns Menu**}.

Frame Sync Loss – The instrument cannot recognise a frame within the received signal. Ensure that framed operation is required.

In both the above cases ensure that the line code (AMI, HDB3, NRZ) is correctly set.

If a loopback is being used, check that the links are in place. If an end-to-end test is being made, check that the remote instrument is transmitting the same pattern.

5.4 PCM Analysis Mode

5.4.1 PCM Frame transmit problems

When running the Frame Analysis (and transmit) test, the equipment under test may exhibit certain alarm conditions. These may be caused by incorrect PA-41 {**PCM: Transmit Setup**} parameters as follows:

Alarm condition	**Correct PA-41 Tx parameter**
Loss of Frame Alignment	Set Tx FAS to 10011011
Distant Frame Alarm	Set Tx NFAS bit 3 (A) to 0
Loss of Multiframe Alignment	Set Tx MFAS to 0000
Loss of CRC MFAS	Set Tx NFAS bit 1 (C) to 001011.

See Section 3.3.5.3 ***The Transmit Data Setup Page*** for more information on how to change these parameters.

6. Appendix A – Specifications

Specifications are valid under nominal operating conditions, unless otherwise stated.

6.1 Generator

Interface G.703

Framed modes ..... Internal, Through, Unframed

Outputs ..... Balanced: 3-pin CF connector, impedance 120Ω
Unbalanced: BNC connector, impedance 75Ω

Digital line codes ..... HDB3, AMI, NRZ

Bit rate 2048kbit/s

Co-directional bit rate ..... 64 to 512kbit/s

Clock source ..... External
Internal
or from received signal RxA or RxB

Clock deviation ..... ±150ppm in 1ppm steps

Test Patterns

Pseudo random bit sequences ..... 2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1

Alternating ‘1s’ and ‘0s’ 1010

All ‘1s’ 1111

All ‘0s’ 0000

8 and 16 bit programmable word

Logic sense ..... normal or inverted

Digital representation of sinusoidal signals:

Frequency range ..... 5Hz to 3998Hz, in steps of 5Hz

Level range ..... -55dBm0 to +3dBm0, in steps of 1dB

Framing ..... PCM30, PCM30 CRC, PCM31, PCM31 CRC

Test pattern insertion ..... single timeslot
n x 64kbit/s timeslots

Idle code ..... 8-bit programmable word

Signalling code ..... 4-bit programmable word

Error Injection

Framed and unframed modes:

Bit, Code, FAS*, CRC* errors ..... single, continuous or burst:
* – Framed only 1E-3, 1E-4, 1E-5, 1E-6
2E-3, 2E-4, 2E-5, 2E-6
5E-4, 5E-5, 5E-6, 5E-7

Burst length ..... 16, 32, 64, 128, 256 errored bits

Signalling modes ..... DTMF or Pulse dial

6.2 Receivers

Interface G.703

Inputs ..... Balanced: 3-pin CF connector, impedance 120Ω
Unbalanced: BNC connector, impedance 75Ω

Input sensitivity ..... G.703, 0 to -30dB

Digital line codes ..... HDB3, AMI, NRZ

Framing ..... PCM30, PCM30 CRC, PCM31, PCM31 CRC

Bit rate 2048kbit/s

Co-directional bit rate ..... 64 to 512kbit/s

Test Patterns

Pseudo random bit sequences ..... 2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1

Alternating ‘1s’ and ‘0s’ 1010

All ‘1s’ 1111

All ‘0s’ 0000

8 and 16 bit programmable word

Logic sense ..... normal or inverted

Level and Frequency Measurements

Coding law ..... A-law to ITU-T Rec. G.711

Level measurements ..... -80dBm0 to +5dBm0

6.3 Display and printout of BERT results parameters

Display

	FRAMED	UNFRAMED
BER Results	Totals of: Test time, bits, bit errors, BER, BLER, block errors, bit rate, code error ratio, code errors.	Totals of: Test time, bits, bit errors, BER, BLER, block errors, bit rate, code error ratio, code errors
G.821 Results	% and number of: Error free seconds, severely errored seconds, degraded minutes, available time, unavailable time, plus: pass/fail indication of HRX error performance objectives.	% and number of: Error free seconds, errored seconds, severely errored seconds, degraded minutes, available time, unavailable time, plus: pass/fail indication of HRX error performance objectives.
Alarm Results	Seconds of: No signal, AIS, all ones, all zeros, byte sync loss, sync loss, slips.	Seconds of: No signal, AIS, all ones, all zeros, sync loss, slips.
Frame Results	Seconds of: Frame sync loss, distant multiframe, distant frame, multiframe sync loss. Totals of: CRC errors, frames, FAS errors, equivalent BER, multiframes.	

Printout

	FRAMED	UNFRAMED
Numerical Results	BER result totals, G.821 results plus: non-severely errored seconds, non-degraded minutes, current time and date, date and time of start of test, instrument configuration, alarm and error totals.	BER result totals, G.821 results plus: non-severely errored seconds, non-degraded minutes, current time and date, date and time of start of test, instrument configuration, alarm and error totals.

Display/Printout

	FRAMED	UNFRAMED
Histograms	Bit errors, no signal, AIS, multiframe sync loss, distant alarm, distant multiframe alarm, FAS errors, frame sync loss, CRC errors, slips, code errors, sync loss, byte sync	Bit errors, no signal, AIS, sync loss, slips, code errors
Menu Setups	Instrument configuration G.821 parameter thresholds, HRX weighting factor, autoprint setup parameters, alarm/error setups	Instrument configuration, G.821 parameter thresholds, HRX weighting factor, autoprint setup parameters, alarm/error setups

Autoprint

	FRAMED	UNFRAMED
Numerical Results	% of: Error free seconds, errored seconds, degraded minutes, available time, unavailable time, severely errored seconds plus: BER, time and date, HRX pass/fail, totals of bit errors, code errors, FAS errors, CRC errors	% of: Error free seconds, errored seconds, degraded minutes, available time, unavailable time, severely errored seconds plus: BER, time and date, HRX pass/fail, totals of bit errors, code errors
Alarm Events	No signal, AIS, multiframe sync loss, distant alarm, frame sync loss, slips, all ones, all zeros, sync loss, byte sync.	No signal, AIS, sync loss, slips, all zeros.

6.4 Display and printout of PCM analysis results parameters

Display	**Level and Frequency**	Level (dBm0), frequency (Hz), peak code, mean peak
Display	**Frame Analysis**	FAS, NFAS, MFAS, NMFAS, plus 8-bit digital code word in any selected timeslot.
Printout	**Menus**	All menus may be printed using the PRINT key.

6.5 Definitions of Alarms and Errors

NO SIGNAL ALARM	
HDB3/AMI	More than 31 consecutive bit periods with no pulse. *or* Signal level less than approximately 40dB.
Co-directional	Signal level less than approx 35dB. *or* Less than 50 clocks received in one second.

AIS ALARM	
HDB3/AMI	Received data is divided into 512-bit sections. AIS is declared if > 509 bits are 1.
Co-directional	More than 31 consecutive 1s received.

ALL ONES ALARM	
	More than 31 consecutive ones in the received BERT pattern.

ALL ZEROS ALARM	
	More than 31 consecutive zeros in the received BERT pattern.

PATTERN SYNC LOSS ALARM	
PRBS	More than 1 in 3 errors over a one second period.
Fixed pattern, WORD, BYTE	More than 1 in 20 errors over a one second period.

BYTE SYNC LOSS ALARM	
	If the byte pattern is correct but is out of byte alignment, Byte Sync Loss is declared.

SLIP ALARM	
	If a slip is detected in a PRBS pattern (any number of bits) a slip alarm is declared.

FRAME SYNC LOSS ALARM	
	Three consecutive incorrect FAS words *or* More than 914 CRC errors in one second.

MULTIFRAME SYNC LOSS ALARM	
The PA-41 is capable of reporting a Multiframe Sync Loss Alarm in two different ways:	
Normal operation in all menus except PCM Frame Analysis:	
	For PCM30 and PCM30C: a CAS Multiframe Sync Loss Alarm is declared if a valid MFAS signal is lost but the FAS remains valid, in accordance with ITU-T recommendations. Note that if a signal is *first applied* to the PA-41 with FAS but no MFAS, then the PA-41 reports a Frame Sync Loss.
Enhanced operation in PCM Frame Analysis:	
	Here the enhanced operation is different and may be more useful in fault diagnosis. It is only available in the **Frame** section of **PCM Analysis**. For PCM30: if a signal is received with FAS but no CAS Multiframe *at any time*, the PA-41 reports a Multiframe Sync Loss.

DISTANT FRAME ALARM	
	Declared if 3 consecutive NFAS bit 3s are 1.

DISTANT MULTIFRAME FRAME ALARM	
	Declared if 3 consecutive NMFAS bit 2s are 1.

BIT ERROR	
	Bit of received PRBS, fixed pattern, programmable byte or word received in error.

CODE ERROR	
HDB3	Violation with the same polarity as the preceding violation or a violation not preceded by two zeros.
AMI	Pulse with same polarity as the preceding pulse (bipolar violation).

FAS ERROR	
G.704	One FAS error is counted if one or more bits or a FAS word (bits 2-8) is in error.

BLOCK ERROR	
	One or more errors in a block of 1000 bits or length of PRBS.

6.6 General Specifications

Error and Alarm Indication

14 LEDs are provided; 7 for each receiver

Telephone Handset

A telephone handset (optional accessory) may be connected to the PA-41 via the RJ11 interface for voice drop and insert.

Printer and Remote Control

Interface ..... V.24 DTE

Data rates..... 300, 600, 1200, 2400, 4800, 9600, 19200 baud

Code..... CCITT 5 (ASCII)

Bits per character ..... 7 or 8

Flow control ..... none, CTS, XON/XOFF, slow (8 char./second)

Parity ..... 7 bits per character: none, odd, even, mark or space
8 bits per character: none, odd or even

Front Panel

Display ..... 128 x 256 pixels LCD with backlight

Keyboard ..... hexadecimal keypad, 4 cursor keys, 6 softkeys, backlight, Security, PRINT, MAIN MENU, EXIT, ON and OFF keys

Contrast ..... 2 dedicated keys

BERT Stores/Memory

10 test results stores each containing numeric results and histograms.

Histogram storage capacity ..... 60 days, the last 30 with 1 hour resolution or
60 hours, the last 24 with 1 minute resolution

10 configuration stores each containing instrument setup configurations.

Security

Enables ‘hidden’ features to be accessed.

Memory Card

A plug-in memory card conforming to JEIDA version 4.0 and above is supported for storage of test data and loading of software options.

Self Check

Comprehensive self check procedure at switch on.

Power Supply

Batteries, rechargeable (fitted as standard) ..... 6 x Ni-Cd, C-size cells

Operating time ..... 5 hours approx. (in Monitor mode)
(+23°C, using fully charged batteries) 2 hours approx. (in BERT mode)

Charging time (+23°C) ..... 14 hours approx. (instrument off)

Battery low ..... warning before auto switch-off

Auto switch-off ..... 4 minutes after last action, but not if test is running or LNT-6 Adaptor is plugged in; or battery very low

External supply ..... from LNT-6

Temperature range ..... operating: 0 to +50°C
storage: -20 to +60°C

Dimensions (height x depth x width) ..... 115 x 245 x 206mm

Weight ..... 3kg approx.

6.7 Ordering Information

PA-41 Frame/Signalling Analyzer ..... BN 4532/15

Complete with:

Six ‘C’ size Ni-Cd cells

A.C. Adaptor/Charger LNT-6 with mains lead

Please specify the required mains plug type when ordering:

European type power plug ..... BN 4529/00.01

UK type power plug ..... BN 4529/00.02

US type power plug ..... BN 4529/00.03

Australian type power plug ..... BN 4529/00.04

Accessories (available at extra cost):

RAM Card ..... BN 4532/00.01

Equipment case ..... BN 4527/00.01
With cut-outs for PA-41, LNT-6, Telephone Handset,
Printer and AC Mains Charger for printer

Equipment case ..... BN 4527/00.02
With cut-outs for PA-41, LNT-6 and Telephone Handset.

Telephone Handset ..... BN 4527/00.03

Printer cable ..... K 1524

THESE SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

7. Appendix B – Menu Structures

7.1 Top Level and Utilities Menus

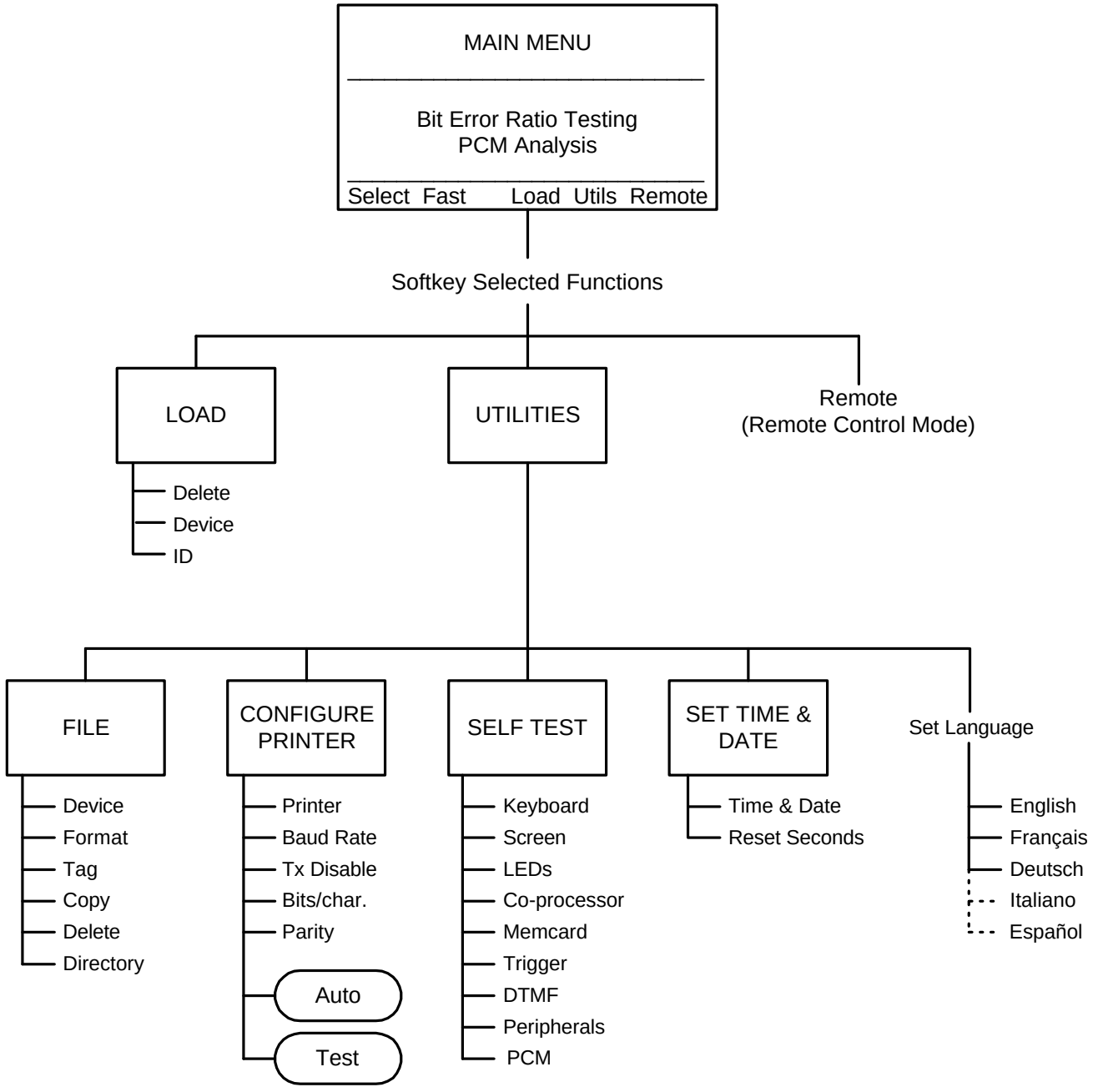


Figure 7.1-1 – Top Level and Utilities menu structure

7.2 Bert Menus

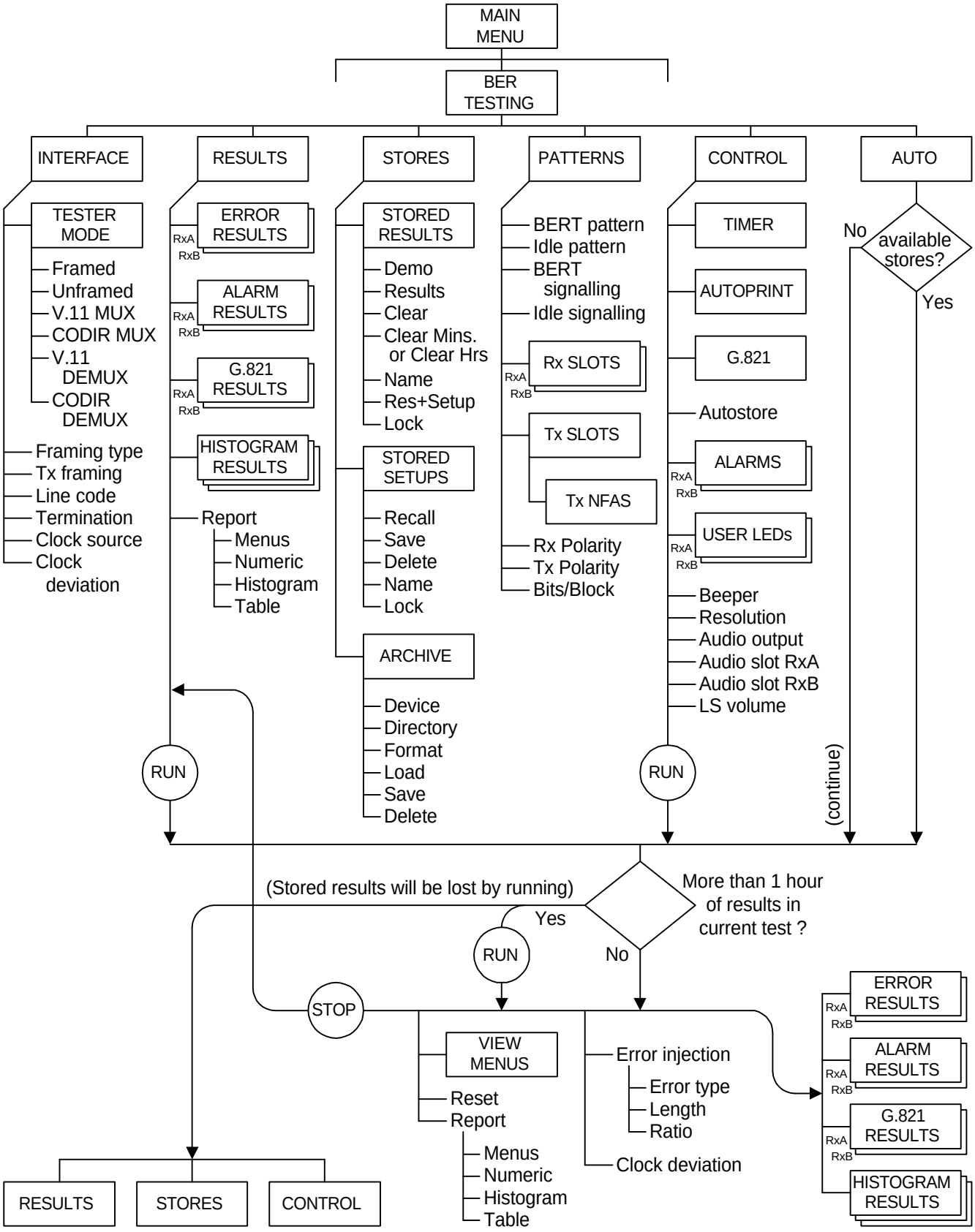


Figure 7.2-1 – Bit Error Ratio Testing menu structure

7.3 PCM Analysis Menus

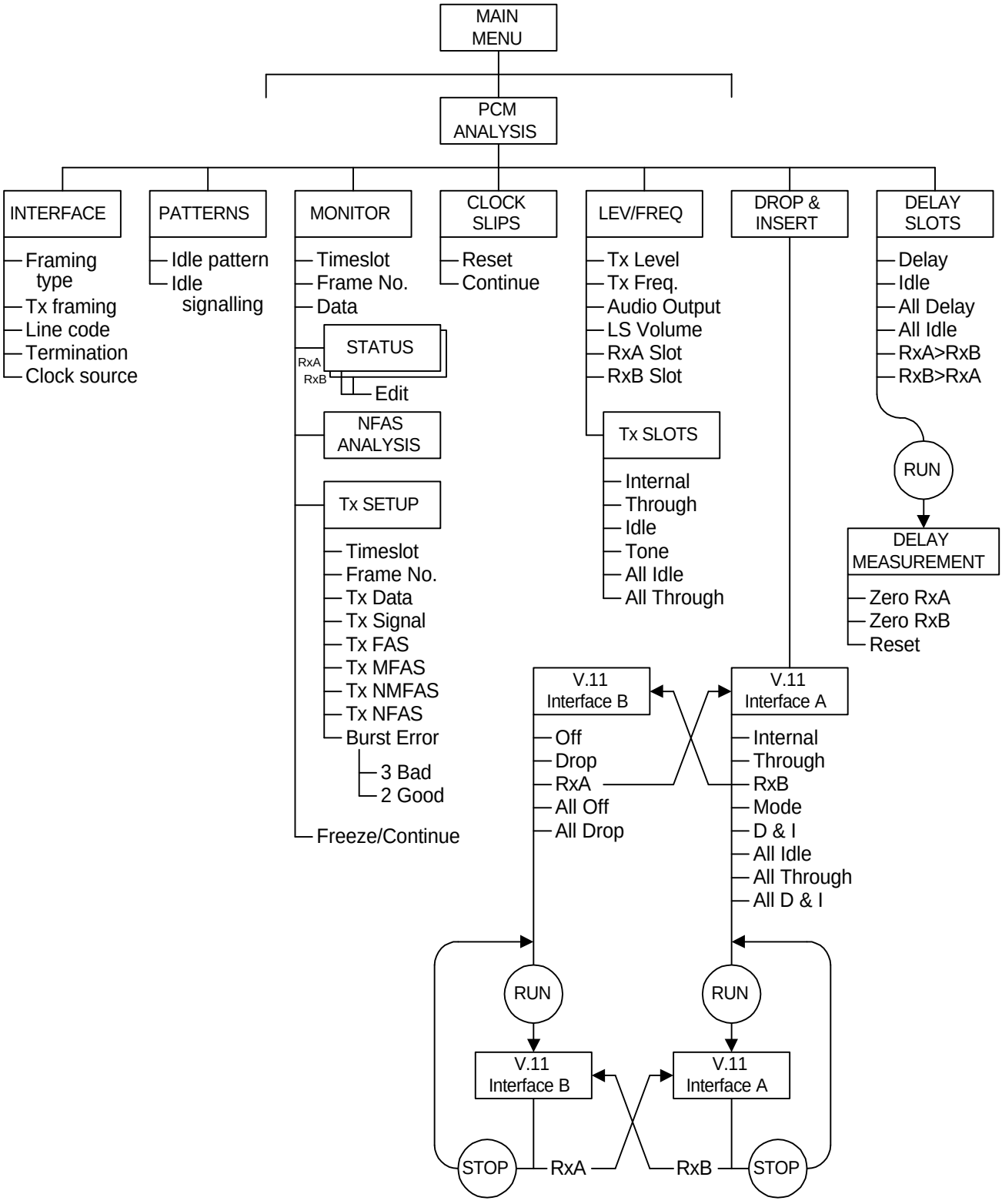


Figure 7.3-1 – PCM Monitoring and Analysis menu structure

8. Appendix C – Printers for use with the PA-41

There are several printers which are suitable for use with the PA-41. These include the Hewlett Packard Deskjet 320 and Olivetti JP 50, both of which have a range of appropriate features and CE Mark approval for use in the European Community.

For details about these and other printers please contact your local dealer.

If you have any questions about printing from the PA-41, please contact your local WWG office.

9. Appendix D – Glossary

AIS..... Alarm Indication Signal

AMI ..... Alternate Mark Inversion

ANSI ..... American National Standards Institute

BERT..... Bit Error Ratio Test(ing)

CCITT..... Comité Consultatif International Télégraphique et Téléphonique (International Telegraph and Telephone Consultative Committee), now superseded by ITU-T (see below)

CCS..... Common Channel Signalling

CEPT..... Conference of European Postal and Telecommunications administrations

CRC..... Cyclic Redundancy Check

D-A, A-D..... Digital to Analogue, Analogue to Digital

DCE..... Data Circuit Terminating Equipment

D&I ..... Drop and Insert

DTE ..... Data Terminal Equipment

DTMF..... Dual Tone Multi-Frequency

EMC..... Electro-Magnetic Compatibility

EFS..... Error Free Second

ES..... Errored Second

FAS ..... Frame Alignment Signal

HDB3..... High Density Bipolar 3

HRX..... Hypothetical Reference Connection (27,000km)

ITU-T ..... International Telecommunications Union – telecommunications standardisation section (replaces CCITT)

JEIDA..... Japan Electronic Industry Development Association

MFAS ..... Multiframe Alignment Signal

NFAS..... Non Frame Alignment Signal

NMFAS .....Non Multiframe Alignment Signal

NRZ.....Non Return to Zero

PCM .....Pulse Code Modulation

PCMCIA .....Personal Computer Memory Card International Association

PRBS .....Pseudo Random Bit Sequence

SES.....Severely Errored Second

SMF.....Sub Multiframe

SRAM.....Static Random Access Memory

UI.....Unit Interval

10. Appendix E – Interface and Frame Structure Details

10.1 V.11 Interface

Connector: ISO 4903 15-pole D-type male.

Implemented signals are as follows:

Interchange Circuit	Mnemonic	Pins	Signal Direction	
			DCE In – Out	DTE In – Out
Frame ground	FGND	1	○——	○——
Signal ground	SGND	8	○——	○——
Transmit data	TD	2 – 9	◄——	——►
Receive data	RD	4 – 11	——►	◄——
Control (always ON)		3 – 10	◄——	——►
Indication (not used)		5 – 12	——►	◄——
Signal element timing		6 – 13	——►	◄——
Byte timing		7 – 14	——►	◄——

10.2 V.24 Interface (Printer and Remote Control)

Connector: emulates a DTE using a 9-pole plug conforming to a subset of ISO 2110.

Implemented signals are as follows:

Circuit Number	Description	Pins
102	Signal ground	5
103	Transmit data	3
104	Receive data	2
105	Request to send (ON)	7
106	Ready for Sending (CTS)	8
108	Data Terminal Ready (ON)	4
109	Line signal detect (DCD)	1
125	Ringing Indicator (RI)	9
	Data set ready	6

10.3 Handset interface

Description	Pins	
Ground	1	[22]  6.....1
Microphone Ground	2	
Earpiece +	3	
Microphone	4	
Earpiece -	5	
Internal Speaker Control	6	
o/c = ON, s/c to GND = OFF		

10.4 Frame structure

2048kbit/s frame structure, from ITU-T Rec. G.704, Paragraph 3.3:

			Sync								Speech or Data	Signalling	Speech or Data
			Timeslot 0								Timeslots 1 to 15	Timeslot 16	Timeslots 17 to 31
MULTIFRAME	0	§	Z	0	0	1	1	0	1	1		* 0 0 0 0	¶ X Y_2 X X
	1	#	Z	1	Y_1	X	X	X	X	X		C1	C16
	2	§	Z	0	0	1	1	0	1	1		C2	C17
	3	#	Z	1	Y_1	X	X	X	X	X		C3	C18
	4	§	Z	0	0	1	1	0	1	1		C4	C19
	5	#	Z	1	Y_1	X	X	X	X	X		C5	C20
	6	§	Z	0	0	1	1	0	1	1		C6	C21
	7	#	Z	1	Y_1	X	X	X	X	X		C7	C22
	8	§	Z	0	0	1	1	0	1	1		C8	C23
	9	#	Z	1	Y_1	X	X	X	X	X		C9	C24
	10	§	Z	0	0	1	1	0	1	1		C10	C25
	11	#	Z	1	Y_1	X	X	X	X	X		C11	C26
	12	§	Z	0	0	1	1	0	1	1		C12	C27
	13	#	Z	1	Y_1	X	X	X	X	X		C13	C28
	14	§	Z	0	0	1	1	0	1	1		C14	C29
	15	#	Z	1	Y_1	X	X	X	X	X		C15	C30

§ = FAS # = NFAS * = MFAS ¶ = NMFAS

X = Service bit, set ‘1’ if not used.
Z = Service bit for international use, set to ‘1’ if not used for CRC-4 bits.
Y_1 = Distant frame alarm.
Y_2 = Distant multiframe alarm.
C_n = 4 signalling bits relevant to timeslot.

11. Appendix F – G.821 Parameters Defined

Error free secs The error free seconds occurring in available time expressed as a total number and as a percentage of the available time.

An error free second (EFS) is defined as a fixed one second interval not classified as an errored second.

Errored secs The errored seconds occurring in available time expressed as a total number and as a percentage of the available time.

An errored second (ES) is defined as a fixed one second interval containing one or more errors, unless the 'normalise 64k' option is used, in which case errored seconds are calculated as detailed in CCITT Rec. G.821 (1988), Annex D.

Sev errored secs The severely errored seconds occurring in available time expressed as a total number and as a percentage of the available time.

A severely errored second (SES) is defined as a fixed one second interval with a bit error ratio greater than 1.00×10^{-3}, unless the threshold is redefined in the {**G.821 Menu**}.

If the '**Alarm seconds**' option on the {**G.821 Menu**} page is set to '**SEV ERR SECS**', then seconds which contain an alarm state will be treated as severely errored seconds. If the option is set to '**IGNORE**', then these seconds will be completely excluded from the calculation of the G.821 results.

Severely errored seconds are also counted as errored seconds.

Degraded mins The degraded minutes expressed as a total and as a percentage of the total number of G.821 'minutes'.

A minute is defined in G.821 as a group of 60 one second measurement intervals assembled in chronological order after the removal of any severely errored seconds and periods of unavailable time.

A degraded minute is then defined as a minute having a bit error ratio greater than 1.00×10^{-6} (unless redefined in the {**G.821 Menu**}), except at a bit rate of 64kbit/s where:

'For practical reasons, at 64kbit/s, a minute containing 4 errors (equivalent to an error ratio 1.04×10^{-6}) is not considered degraded. However, this does not imply relaxation of the error ratio objective of 1.00×10^{-6}.'
[CCITT Recommendation G.821 (1988), Section 2, Note 4].

At all measured bit rates apart from 64kbit/s (±14bit/s), the PA-41 calculates the bit error ratio for a particular minute and classifies it as a degraded minute if the threshold is exceeded. If the measured bit rate is 64kbit/s (±14bit/s) and the degraded minutes threshold is set to 1.0E-6 or CCITT, the PA-41 classifies a minute

containing 4 errors or less as a non-degraded minute.

If there is an incomplete minute at the end of the test it is rounded up for classification purposes by assuming that the rest of the minute contained only error free seconds.

CCITT Rec. G.821 (1988), Annex B defines the percentage of degraded minutes as:

$$\frac{\text{Degraded Minutes}}{\text{Available Time (s)}/60} \times 100\%$$

where (available time/60) is rounded to the next higher integer.

The PA-41 uses the same method to calculate the percentage of non-degraded minutes.

It should be noted, however, that by definition all severely errored seconds are excluded from the degraded and non-degraded minutes, whereas only those severely errored seconds occurring in unavailable time are excluded from the available time. For this reason, the percentage for degraded and non-degraded minutes will not always add up to 100%.

Available time The available time expressed as a total number of seconds and as a percentage of the available time plus the unavailable time.

Unavailable time The unavailable time expressed as a total number of seconds and as a percentage of the available time plus the unavailable time.

A period of unavailable time begins when the bit error ratio (BER) in each second is greater than 1.00×10^{-3} (or programmable) for a period of ten consecutive seconds. These ten seconds are considered to be included in the period of unavailable time.

A new period of available time begins with the first of ten consecutive seconds each of which has a BER of less than or equal to 1.00×10^{-3} (or programmable), i.e. ten non-severely errored seconds.

In both cases the change of state occurs at the beginning of the ten second period and the ten seconds are included in the new state. Thus it is not always possible to count a particular second as available time or unavailable time until the next nine seconds have been processed. For this reason the PA-41 displays its ‘Running’ G.821 Results page with a fixed ten second delay.

If G.821 results are printed while a test is running, the most recent ten seconds of the test will be excluded from the G.821 results due to the fixed ten second delay. This can lead to misinterpretation of the results when, for example, a short autoprint interval (say 1 minute) is used in conjunction with resetting totals on autoprint.

At the end of the test the final ten seconds are included in the G.821 results.

Seconds which are counted as unavailable time are completely excluded from the calculations of other G.821 results.

Pass/Fail This is used with errored seconds, severely errored seconds and degraded minutes to indicate that the network section under test has met the Hypothetical Reference Connection (HRX) error performance objectives set.

Performance objectives are calculated as follows:

Degraded minutes	10 x HRX/100%
Sev. errored seconds	0.1 + (0.1 x HRX/100)%
Errored seconds	8 x HRX/100%

Additional results available when using a printer:

Non-severely Errored Seconds The non-severely errored seconds occurring in available time expressed as a total number and as a percentage of the available time.

Non-degraded Minutes The non-degraded minutes expressed as a total and as a percentage of the total number of the G.821 results.

If a test is run with PCM30 or PCM31 framing and BERT slot ‘OFF’, the G.821 analysis will be based on FAS errors. If CRC-4 framing is used with BERT slot ‘OFF’, the G.821 analysis will be based on CRC errors. In these cases the {**G.821 Results**} indicator will be replaced by {**FAS G.821**} or {**CRC G.821**} respectively.

12. Appendix G – Electromagnetic Compatibility and Safety

12.1 Electromagnetic Compatibility

This instrument meets the CE requirements of EMC Directive 89/336/EEC and its amendments. The standards applied are:

EN 50081-1 1992 Electromagnetic Compatibility – Generic Emission Standard

EN 55022 (CISPR 22) ..... Limit B

EN 50082-1 1992 Electromagnetic Compatibility – Generic Immunity Standard.

IEC 801-2, E.S.D. .....8kV air discharge

IEC 801-3, Susceptibility.....3V/m, 27 to 500MHz

IEC 801-4, Fast transients common mode on mains 1kV

Accessories used during the evaluation:

Cables K 12, K 80, K 1505 and K 1524; LNT-6 power supply.

12.2 Safety

The instrument complies with the safety objective of:

The Council Directive dated 19th February 1973 on the approximation of the laws of the Member States concerning electrical operating equipment for use within certain voltage limits (Low Voltage Directive – 73/23/EEC), amended by the Council Directive dated 22nd July 1993 (93/68/EEC).

To test the compliance of the instrument the following standard was used:

EN 61010-1 (IEC 1010-1) Safety Regulations for Electrical Measuring, Control and Laboratory Instruments – Part 1: General Requirements.