WISE Indústria de Telecomunicações

Operation Manual
TSW200E1

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Summary

1 - Introduction

The TSW200E1 Test Set is a portable equipment designed to allow performance analysis and digital network maintenance. It also eases and speeds the performance analysis of digital modems interface, both in assembly lines and during maintenance and homologation tasks. Every ITU-T test condition can be easily generated.

The equipment has liquid crystal graphic display. The TSW200E1 can monitor the operating interface signals, making it easy to identify any possible source of disturbance.

The TSW200E1 is used to carry out both framed and unframed tests on a wide range of equipments like modems, multiplexers and general telecommunications circuits, operating from 50 bps to 2048 kbps. It can also test Frame Relay Protocol links.

1.1 - General Characteristics

- High resolution graphic display
- Rechargeable batteries with external power supply
- Displays available battery charge
- Real-time clock
- Configurations and test results are kept in local memory
- Allows printout of test results
- Software upgrades downloadable into flash memory, through personal computer serial port (cable provided). New versions can come by e-mail.
- ITU-T standards G.821, G.826, M.2100 analysis: the TSW200E1 measures every ITU-T G.821 parameters. In structured circuits, this analysis is performed for bit errors and for FAS and CRC errors. For the TX/RX FRAMED and THROUGH FRAMED modes (E1/G.704 module), the TSW200E1 does ITU-T M.2100 analysis. These analyses are based on block patterns.
- Histograms: the TSW200E1 has histograms displaying data and events, like bit errors and alarms, recording their time of occurrence. They allow the user to know exactly which error (or alarm) occurred – time-stamped.
- Test duration set-up: The TSW200E1 can be programmed to operate in a determined time frame, up to 2000 hours. It is also possible to program the test starting time.

1.2 - Package contents

- 01 (one) TSW200E1 – V.24/RS 232 cable
- 01 (one) TSW200E1 – V.35/V.11 cable (optional)
- 01 (one) TSW200E1 – V.36/V.11 cable (optional)
- 01 (one) TSW200E1 – X.21/V.11 cable (optional)
- 01 (one) TSW200E1 – 64 Kbps G.703 interface cable
- 02 (two) BNC/BNC coaxial cables to connect 2 Mbps G.703 interface
- 02 (two) BNC/Siemens 169-13 coaxial cables to connect 2 Mbps G.703 interface (optional)
- 01 (one) serial printer cable (optional)
- 01 (one) parallel printer cable (optional)
- 01 (one) serial cable
- DCE simulations adaptors, for every interface (optional)

- 01 (one) RS232/G.703 converter
- 01 (one) user manual
- 01 (one) transport valise
- 01 (one) switching power supply

1.3 -   *TSW200E1 Specifications*

The TSW200E1 has many working modules, which are split in many modes. The equipment specifications are:

- 192x128 pixels graphic display
- 23 key alphanumeric keypad with function keys
- Full-duplex communications mode
- Synchronous and asynchronous* transmission
  *After 2019, the equipments will no longer have the ASYNCHRONOUS module.
- Operating speeds:
  - Asynchronous mode: 50, 75, 110, 150, 300, 600, 1200, 1800, 2400, 3600, 4800, 7200, 9600, 14400, 19200, 28800, 38400, 57600, 115200 bps
  - Synchronous mode: 1200, 2400, 4800, 7200, 9600, 14400, 19200, 24000, 28800, 38400, 48000, 57600, 64000 bps up to 10Mbps.
  - External clock: up to 2048 Kbps
  - Recovered / regenerated clock: for co-directional G.703 and 2 Mbps G.703.
- Interfaces: V.24/RS 232, V.35/V.11, V.36/V.11, X.21/V.11, co-directional G.703, 2048 Kbps G.703.
- Bits per character: up to 8
- Parity: odd, even, none, mark, space
- Stop bits: 1, 1.5 or 2
- Operating modes:
  - BERT/BLERT module – SYNCHRONOUS and ASYNCHRONOUS
  - E1/G704 module – TX/RX FRAMED, THROUGH FRAMED, MUX, DEMUX, MONITOR, FREQUENCY/LEVEL, ROUNDTRIP DELAY
  - Dual E1 module
  - Pulse Mask module
  - FR.RELAY module – TURN UP, PING, FOX
  - X.25/xDLC module – SDLC/HDLC/X.25/ASYNC/SYNC/DDCMP
  - PPP module
  - HDLC CISCO module
  - X.50 module frame
  - CAS MFC-R2 module
  - DTMF module
  - ISDN module
  - VT100 module
- Frequency measuring: from 0 to 2048000 Hz
- PCM frame structure: PCM30, PCM30C, PCM31, PCM31C
- Line codes: HDB3 and AMI
- Data printing: serial and parallel
  - interface: cable supplied
  - speeds: 1200 to 115200 bps

- ◆ line parameters: 8 bits per character, 1 stop bit, no parity
- Electrical specifications:
  - ◆ DC supply using NiMH rechargeable battery with 6 hours average operation and 5 and a half hours complete recharge with external AC adaptor and charger
  - ◆ AC adaptor and charger - Input: 90Vac to 290Vac, 50Hz to 60Hz $^{238}_{93}$ 5% with automatic selection. Output: 10Vdc/1A
- Operating Temperature: 0 to 45 degrees Celsius (32 to 113 degrees Fahrenheit)
- Storage Temperature: -20 to +70 degrees Celsius (- 4 to + 158 degrees Fahrenheit)
- Relative Humidity: 95% MAX (not condensed)
- Mechanical dimensions: 24,09 x 12,59 x 5,64 cm (9,4842 x 4,9566 x 2,2204 inches)
- Weight: 1.1kg (2.4lb)

Here the general characteristics and the technical specifications of each module are presented. Each one will be extensively covered on later sections or on other operating manuals separately provided.

1.3.1 - BERT/BLERT Module

- **SYNCHRONOUS MODE**: allows analysis of bit and block error counting, bit and block rate errors, degraded minutes, severely errored seconds, errored seconds, error-free seconds, available and unavailable seconds. Follows ITU-T Recommendation G.821, with speeds from 8 Kbps up to 2048 Kbps. Allows real-time clock slips counting, following ITU-T Recommendation G.822. If the interface is G.703-2M, the available speed is 2048 Kbps. The bit and block errors, sync loss (PAT LOSS) and SLIP are displayed by histograms.
  - ◆ Available interfaces: V.24/RS232, V.35/V.11, V.36/V.11, X.21/V.11, RS530, Co-directional G.703 (64 kbps) and G.703 2 Mbps.
  - ◆ Generated test patterns: 7 (2E3-1), 15 (2E4-1), 31 (2E5-1), 63 (2E6-1), 127(2E7-1), 127 LA, 127 LD, 511 (2E9-1), 1023 (2E10-1), 2047 (2E11-1), 2E15-1, 2E17-1, 2E18-1, 2E20-1 O153, 2E20-1 O151, QRSS, 2E21-1, 2E22-1, 2E23-1, 2E25-1, 2E28-1, 2E29-1, 2E31-1, 2E32-1, all marks ('1111'), all spaces ('0000'), ALT M/S (alternating '1s' and '0s'), Double Alt ('1100'), 3 in 24, 1 in 16, 1 in 8, 1 in 4, D4 LA, D4 LD, USER and 7:1, in the NORMAL and INVERTED modes;
  - ◆ Generated patterns for co-directional G.703 interface: 63, 511, 2047, 4095, 2E15-1, 2E20-1, 2E23-1, all marks ('1111'), all spaces ('0000'), ALT M/S (alternating '1s' and '0s') and USER, in the NORMAL and INVERTED modes;
  - ◆ Internal, external and recovered reception clock to G.703-2M interface;
  - ◆ Internal clock and recovered clock to co-directional G.703 interface;
  - ◆ G.703-2M interface impedance: 75 □ unbalanced, 120 □ balanced or high impedance (balanced and unbalanced);
  - ◆ Test duration: continuous or timer-controlled.

- **ASYNCHRONOUS MODE:** allows test execution for bit error counting (*Bit Error Rate Test*) and for block error counting (*Block Error Rate Test*) in asynchronous communications. The rates of bit and block errors are also displayed. Keys on the operating panel allow error insertion and test aborting. It is also possible to obtain a distribution of errors as a function of time using the following measurements: DEGRADED MIN (Degraded Minutes), SEV. ERR. SEC (Severely errored seconds), ERRORED SEC (Errored seconds), ERR. FREE SEC (error-free seconds), AVAILAB.TIME (available time) and UNAVAIL.TIME (unavailable

time) following Rec. G.821. Real-time clock SLIPS counting is done according to ITU-T Rec. G.822. There are histograms for errored bits, errored blocks, sync lost (FAULTS) and SLIP.

- ❖ Available Interfaces: V.24/RS232, V.35/V.11, V.36/V.11, X.21/V.11, RS530;
- ❖ Transmission rate from 50 to 115200 bps;
- ❖ Generated patterns: 63, 511, 2047, 4095, 2E15-1, 2E20-1, Mark, Space, ALT M/S, FOX, USER, 7:1 and 1:7 in the NORMAL and INVERTED modes;
- ❖ Selection of parity bit, bits/char and stop bits;
- ❖ Full duplex;

1.3.2 - E1/G.704 Module

- · **TXRX FRAMED MODE**: The TSW200E1 can replace a network terminal equipment or even simulate a network. The TSW200E1 generates a signal internally structured at 2048 kbps following ITU-T Rec. G.704, where the transmitter is independent of the receiver, allowing signal analysis with PCM frame structures. Some of the characteristics are:
  - ❖ Signal generation with PCM30, PCM30C, PCM31 or PCM31C data structures;
  - ❖ Generated patterns: 7 (2E3-1), 15 (2E4-1), 31 (2E5-1), 63 (2E6-1), 127(2E7-1), 127 LA, 127 LD, 511 (2E9-1), 1023 (2E10-1), 2047 (2E11-1), 2E15-1, 2E17-1, 2E18-1, 2E20-1 O153, 2E20-1 O151, QRSS, 2E21-1, 2E22-1, 2E23-1, 2E25-1, 2E28-1, 2E29-1, 2E31-1, 2E32-1, all marks ('1111'), all spaces ('0000'), ALT M/S (alternating '1s' and '0s'), Double Alt ('1100'), 3 in 24, 1 in 16, 1 in 8, 1 in 4, D4 LA, D4 LD, USER, and 7:1 in the NORMAL and INVERTED modes;
  - ❖ Error analysis in one or more timeslots like error bits and blocks, FAS error, CRC error, E-BIT and code error;
  - ❖ Rate of bits / blocks in error;
  - ❖ Clock SLIP analysis, AIS (Alarm Indicator Signal), frame and multiframe sync losses analysis. Alarm analysis;
  - ❖ Error analysis like degraded minute count, severe errored seconds, errored seconds, error-free seconds, available and unavailable seconds following ITU-T Rec. G.821;
  - ❖ Real-time clock SLIPS counting according to ITU-T Rec. G.822;
  - ❖ Analysis of errors, like block counting error, errored blocks, block background error, errored seconds, severe errored seconds, available and unavailable seconds, according to ITU-T Rec. G.826;
  - ❖ Analysis of errors, like errored blocks, errored seconds, severe errored seconds, seconds available and unavailable following ITU-T Rec. M.2100. According to that Recommendation, an evaluation is performed to define if a period is accepted, rejected or inconclusive;
  - ❖ Selection of timeslots to be tested;
  - ❖ Selection of idle code to be transmitted in non-selected channels;
  - ❖ Internal, external or reception-regenerated clock;
  - ❖ G.703 interface impedance: 75 Ω unbalanced, 120 Ω balanced or High impedance (bal and unbal);
  - ❖ NFAS (Non-Frame Alignment Signal) word Sa bit programming and timeslot #16 signalling word (ABCD bits);
  - ❖ Allows timeslot audio output through loudspeaker;

◆ Insertion of errors (BIT, FAS and CRC);
◆ Test duration: continuous or timer-limited.

- **MODE THROUGH FRAMED:** In this mode, the TSW200E1 is inserted in the circuit under test and the same frame structured received signal is sent to the transmitter. The equipment remains transparent to the circuit.
    ◆ Signal generation with PCM30, PCM30C, PCM31 or PCM31C frame structure
    ◆ Generated patterns: 7 (2E3-1), 15 (2E4-1), 31 (2E5-1), 63 (2E6-1), 127(2E7-1), 127 LA, 127 LD, 511 (2E9-1), 1023 (2E10-1), 2047 (2E11-1), 2E15-1, 2E17-1, 2E18-1, 2E20-1 O153, 2E20-1 O151, QRSS, 2E21-1, 2E22-1, 2E23-1, 2E25-1, 2E28-1, 2E29-1, 2E31-1, 2E32-1, all marks ('1111'), all spaces ('0000'), ALT M/S (alternating '1s' and '0s'), Double Alt ('1100'), 3 in 24, 1 in 16, 1 in 8, 1 in 4, D4 LA, D4 LD, and USER, in the NORMAL and INVERTED modes;
    ◆ Selection of timeslot to be tested;
    ◆ Analysis of errors in one or more timeslots like errored bits and blocks, FAS error, CRC error, E-BIT and code error;
    ◆ Rate of errored bits / blocks;
    ◆ Analysis of clock SLIP, AIS, Frame and Multi-Frame sync losses and alarms;
    ◆ Analysis of degraded minute counting, severely errored seconds, errored seconds, error-free seconds, available and unavailable seconds, following ITU-T Rec. G.821;
    ◆ Real-time clock SLIPS counting following ITU-T Rec. G.822;
    ◆ G.703 interface impedance: 75 Ω unbal, 120 Ω bal or High impedance (bal and unbal);
    ◆ NFAS (Non-Frame Alignment Signal), Sa bits programming and timeslot 16 (ABCD bits) signalling word programming;
    ◆ Allows substitution of frame-structured data for a test pattern in one or more timeslots;
    ◆ Allows timeslot audio output through loudspeaker;
    ◆ Insertion of errors (BIT, FAS and CRC);
    ◆ Test duration: continuous or timer-limited.

- **MUX MODE:** In this mode, the TSW200E1 is used to test multiplexers via the interfaces V.24/RS232, V.35/V11, V.36/V.11, X.21/V.11 or RS530.

- **DEMUX MODE**: Allows performing demultiplexer tests. These tests can be monitored through one of the V.24/RS232, V.35/V11, V.36/V.11, X.21/V.11 or RS530 interfaces.

- **MONITOR MODE:** Allows monitoring and displaying: FAS, NFAS, MFAS, NMFAS words and the bits Si, Sa, A and E of the NFAS word, for timeslot 0. Allows monitoring and displaying the eight-bit code word for any timeslot and of the CAS (Channel Associated Signalling – ABCD bits) status for all thirty telephone channels.

- **FREQUENCY/LEVEL MODE:** In this mode, the TSW200E1 allows a coded sinusoidal signal to be inserted in any timeslot. The signal has programmable level and frequency. Simultaneously, TSW200E1 shows the level (in dBm0) and the frequency of a sinusoidal signal in a timeslot. It can monitor (in dBm) a tone in any timeslot, decoding the structured

2048 Kbps signal, thus allowing the audio output of a timeslot for internal loudspeaker monitoring.

· **ROUND-TRIP DELAY Mode:** In this mode, the TSW200E1 allows measuring the delay of a certain path. To do that, a remote loopback is done and a marker is inserted. The delay is evaluated by measuring the time that that marker took to show up at reception.

· **SLIP MONITOR Mode:** The Slip mode is used to monitor the synchronization in an E1 link. During the test, two E1 signals are compared. The synchronism between them is checked by detecting slips.

· **RATES MONITOR Mode:** In this mode, the two signals rate is measured, in bps, and is presented on screen. It is acquired together with Slip Monitor Mode. Available on hardwares I or newer.

1.3.3 - Frame Relay Module (optional)

The TSW200E1 performs the correct link management between CPE and the network, checking if the frames are correctly transmitted and received in the structure of the Frame Relay protocol. The Frame Relay module operating manual is provided separately.

1.3.4 - X.25/xDLC Module (optional)

The equipment performs tests of link integrity, verifying if the frames are being transmitted and received correctly in structures that employ one of these protocols: SDLC, HDLC, X.25, ASYNC, SYNC or DDCMP. The ASYNC and SYNC tests allow data transmission and reception using buffers. The X.25/xDLC module operating manual is provided separately.

1.3.5 - X.50 Module (optional)

X.50 is a frame structure used at 64 Kbps to allow the transport of many data channels with lower rates within the synchronous 64 Kbps data band. The X.50 FRAME mode allows tests for divisions 2 and 3. The X.50 module operating manual is provided separately.

1.3.6 - PPP Module (optional)

The PPP test mode allows connectivity analysis and response times evaluation in IP networks that use PPP protocol, using synchronous communication. The PPP module operating manual is provided separately.

1.3.7 - CAS MFC-R2 (optional)

In the MFC-R2 module, the TSW200E1 operates as simulator or analyser in a communication using MFC-R2 signalling. As an analyser, the equipment observes the communication without interfering on it, gets Forward and Backward signals, identifies the line signalling (digital R2) and the signalling between registers (MFC) for each channel. As a simulator, it acts as one of the communication ends, answering the incoming calls or starting a call. The CAS MFC-R2 module operating manual is provided separately.

1.3.8 - HDLC CISCO Module (optional)

The HDLC CISCO test mode allows connectivity analysis and response times evaluation in IP networks that use HDLC CISCO protocol, using synchronous communication. The HDLC

CISCO module operating manual is provided separately.

1.3.9 - DTMF Module (optional)

The DTMF Module allows a user to emulate a call setup process using DTMF. The user can choose the CAS patterns and enter the dial digs manually or supplied from a preset speed dial string. The DTMF module operating manual is provided separately.

1.3.10 - VT100 Module (optional)

To avoid the need of the TSW200E1 user to have around a computer running a VT100 software emulator, Wise Indústria de Telecomunicações has created a VT100 emulation module inside the equipment itself. The VT100 module operating manual is provided separately.

1.3.11 - Pulse Mask (optional)

The Pulse Mask test mode allows the user to monitor the pulse quality of an incoming E1 signal. The Pulse Mask module operating manual is provided separately.

1.3.12 - ISDN (optional)

The ISDN module allows the equipment to be connected to an ISDN network to receive, interpret and reply to the received frames. The TSW200E1 operates as simulator or analyser in a communication using ISDN protocol and identifies the Q.931 and HDLC protocol frames. The ISDN module operating manual is provided separately.

1.3.13 - Dual E1 (optional)

The TSW200E1 internally generates and analyses two PCM frame structured signals at 2048 kbps following ITU-T Rec. G.704. The two transmitters are independent of the two receivers. The DUAL E1 module operating manual is provided separately.
- Signal generation with PCM30, PCM30C, PCM31 or PCM31C data structures;
- Generated patterns:127 LA, 511 (2E9-1), 2047 (2E11-1), 2E15-1, QRSS,all marks ('1111'), all spaces ('0000'), ALT M/S (alternating '1s' and '0s'), Double Alt ('1100') ('1100'), 3 in 24, 1 in 16, 1 in 8, 1 in 4, USER (24 bits) and 7:1, in the NORMAL and INVERTED modes;
- Error analysis in one or more timeslots like error bits and blocks, FAS error, CRC error, E-BIT and code error;
- Error analysis in one or more timeslots like error bits and blocks, FAS error, CRC error, E-BIT and code error;
- Rate of bits / blocks in error;
- Clock SLIP analysis, AIS (Alarm Indicator Signal), frame and multiframe sync losses analysis. Alarm analysis;
- Error analysis like degraded minute count, severe errored seconds, errored seconds, error-free seconds, available and unavailable seconds following ITU-T Rec. G.821;
- Real-time clock SLIPS counting according to ITU-T Rec. G.822;
- Analysis of errors, like block counting error, errored blocks, block background error, errored seconds, severe errored seconds, available and unavailable seconds, according to ITU-T Rec. G.826;
- Analysis of errors, like errored blocks, errored seconds, severe errored seconds, seconds available and unavailable following ITU-T Rec. M.2100. According to that Recommendation, an evaluation is performed to define if a period is accepted, rejected or

inconclusive;
- Selection of timeslots to be tested;
- Selection of idle code to be transmitted in non-selected channels;
- Internal, external or reception-regenerated clock;
- G.703 interface impedance: 75 ☐ unbalanced, 120 ☐ balanced or High impedance (bal and unbal);
- NFAS (Non-Frame Alignment Signal) word Sa bit programming and timeslot #16 signalling word (ABCD bits);
- Allows timeslot audio output through loudspeaker;
- Insertion of errors (BIT, FAS and CRC) and alarms (AIS, RAI, RMF Alarm, TS16 AIS);
- Test duration: continuous or timer-limited.

2 -   Physical Characteristics

The TSW200E1 is a portable equipment with keyboard and liquid crystal display. The display has 16 lines with 32 small characters each. The characters have many sizes to ease operation and displaying of results. It has also many LEDs to help check test results, interfaces in use and the signals at the interfaces.

It has a buzzer, a loudspeaker and a microphone.

The equipment is fed by internal batteries, charged by the provided power supply. On the following sections, each part of the equipment will be covered.

2.1 -   External Connections

- Switching power supply SPS: on the right side of the equipment there is a connector to plug the provided battery charger.
- Remote/Printer: Serial communications connector for printer or computer. It is located on the back panel.
- TX – G.703 2M: Coaxial cable connector used for G.703 2MHz interface transmission.
- RX1 – G.703 2M: Coaxial cable connector used for G.703 2MHz interface reception.
- RX2 – G.703 2M: Coaxial cable connector used for G.703 2MHz interface reception, used only in the CAS-MFC module with the ANALYSER option.
- 120Ω TX1/RX1/RX2: RJ-45 female connector on the back panel. Used by the G.703 2M interface when the 120Ω balanced interface is chosen.
- ETHERNET: RJ-45 female connector on the back panel.
- V.35/ V.36 / V.11: HD26 female connector for these interfaces, located on the back panel.
- RS232 / G.703 64k: DB25 female connector for these interfaces, located on the back panel. For G.703 64k interface, it is necessary to use the provided adaptor.
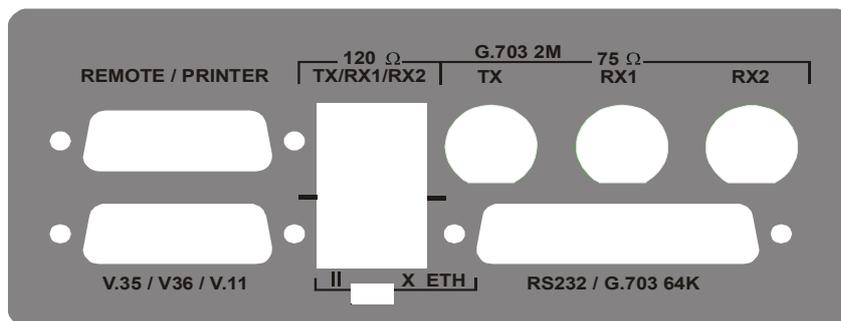
2.2 -   LEDs

The TSW200E1 has an array of LEDs to ease test monitoring and equipment state monitoring. See the figure below:
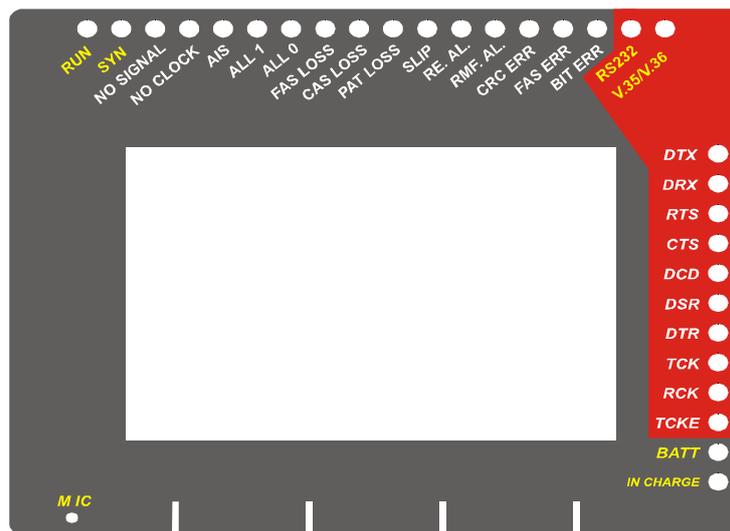
On the left side, there are two control indicator LEDs:
- RUN: this LED is on when a test is in progress.
- SYN: sync LED. Turned on when the Test Set is in sync with the received data. This LED should be on when any test is running. Otherwise, the number of errored bits and blocks displayed is not trustworthy.

The 11 status LEDs follows. When they are turned on during tests, they indicate the occurrence of alarms.

NO SIGNAL: on to indicate that the 2M stream signal is missing.
- NO CLOCK: on to indicate that the clock is missing.
- AIS: on when there is any alarm (AIS - Alarm Indication Signal).
- ALL1: getting all 1s
- ALL0: getting all 0s
- FAS LOSS: Indicates frame sync loss.
- CAS LOSS: Indicates multiframe sync loss
- PAT LOSS: Indicates pattern sync loss. The expected pattern is not being received.
- SLIP: clock SLIP counting
- RE.AL.: Indicates remote alarm
- RMF. AL: Indicates multiframe remote alarm

These LEDs are followed by three error LEDs:
- CRC ERR: When on, indicates CRC error or a CRC Loss
- FAS ERR: When on, indicates FAS error
- BIT ERR: When on, indicates bit error

Two interface indicator LEDs remain turned on to show that the interface is being used:
- RS232
- V.35 / V.36

On the right side of the front panel, there are the signal LEDs. When the equipment is under test, some of these LEDs must be turned on, indicating that there are active signals from the RS232, V.35, V.36, G703 - 64k interfaces.

- DTX: Transmit data
- DRX: Receive data
- RTS: Request to send
- CTS: Indicates modem clear to send
- DCD: Indicates detected carrier
- DSR: Indicates data set ready
- DTR: Indicates data terminal ready
- TCK: Transmit clock
- RCK: Receive clock
- TCKE: Internal transmission clock

Finally, there are two LEDs that monitor the battery condition:
- BATT: Blinks when the battery has insufficient charge for equipment operation.
- IN CHARGE: On when the battery charger is connected. It turns red when the battery is being charged and green if the charge is already complete.

2.3 - *Keyboard*

The TSW200E1 keyboard description follows:
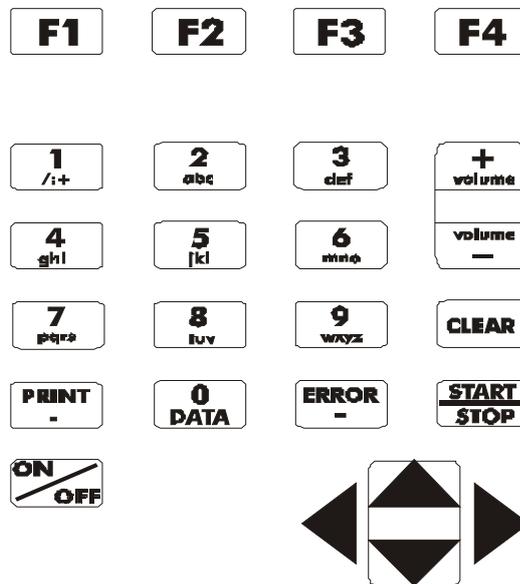
- **ON/OFF**: turns the equipment on and off
- **<F1>, <F2>, <F3>, <F4>**: The function of these keys depends on the displayed screen. The bottom display line defines their use.

> **Note: Throughout this manual, the notation**
> <F1>, <F2>, <F3> and<F4>
> **will be used to represent these keys.**

By simultaneously pressing ← and → at any screen, the display backlight is toggled on or off.
- ←, ↑, → and ↓: Used for cursor navigation throughout the screen and to change the

selected option.
- **Volume+, volume-**: used to raise or lower the loudspeaker volume (not the buzzer volume).
- **START/STOP**: Starts or stops the test.
- **PRINT**: Sends to printer the selected test memory data.
- **DATA (0)**: According to the screen, starts editing mode or inserts 0 (zero).
- **CLEAR**: clears editing or the current test results.
- **ERROR (-)**: Operates the "-" key or inserts an error when a test is running.
- **Alphanumeric Keys**: Used for editing. When editing numbers, the key corresponds to the pressed number. When editing text, the alphanumeric keys provide the first letter shown after the first press. If pressed again, they issue the second letter. If pressed for a third time, they issue the third letter. The fourth or fifth time (according to the key) gives the corresponding number.

2.4 - Battery

The TSW200E1 is fed by NiMH batteries that last for an average of 6 hours, depending on the intended use. The complete battery recharge takes 5 hours and a half. The NiMH batteries perform better if they are totally discharged before a new charging period. This procedure allows maximum battery life. It is also important to remember that even with the device off the battery suffers discharge and it is recommended to recharge it at least once a month. Keeping the battery totally discharged lowers the life-time specified.

When the TSW200E1 internal batteries need recharging, the equipment must be connected to the switching power supply SPS – 12A (input: 90 to 240 VAC / 60 Hz). There is a plug on the right side of the equipment. When the switching power supply is plugged on the power outlet, a LED will turn on, showing that the charging is in progress.

During battery charge, the "IN CHARGE" LED will be illuminated and red. When this LED turns green, the battery is fully charged. The TSW200E1, during charging, is being fed by the power supply until it is unplugged.

To avoid power line variations to modify the test results, it is advisable to stop any tests before plugging/unplugging the battery charger.

The TSW200E1 has a battery manager that displays the charge percent remaining (please see Section 3). When the battery reaches the minimum level the BATT LED will flash for twenty seconds and the buzzer will beep. After this time the equipment turns off. Otherwise the BATT LED is off.

Note: The TSW200E1 must be charged using the provided SPS-12A Power Supply. Otherwise, Wise cannot be held responsible for any damage to the equipment, performance loss or diminishing battery life.

2.5 - Interfaces

The TSW200E1 can use RS232/V.24, V.35/V.11, V.36/V.11, X.21/V.11, G.703 64k co-directional and G.703 2M interfaces.

RS232/V.24 and G.703-64 kbps co-directional interfaces use the same connector. The conversion between RS232 - G.703 co-directional interfaces is done by an external adaptor (in the electrical circuit), which has, at one end, a DB25 male connector and, at the other, a 4-bolt ruler to connect the twisted pairs to.

The G.703-64 kbps interface is synchronous, co-directional, and 64 kbps only. It has a

symmetric pair for transmission and another for receiving data. The signals follow the ITU-T G.703 recommendation for 64 kbps co-directional interfaces.

The G.703 - 2 Mbps interface uses BNC connectors and it is used on the BERT/BLERT, E1/G.704, MFC-R2, X.50 and FRAME RELAY modules.

The G.703 interfaces allow balanced and unbalanced impedances to be used, employing the adequate cable.

2.6 - Audio

The TSW200E1 has a microphone in its front panel. In section 2.2 there is a picture of the front panel where it is possible to see the identification MIC, showing the microphone location. The microphone can be used for the MFC-R2 module and Frequency/level mode tests. It remains off for the remaining modules.

There is also a loudspeaker located inside the equipment. For some modes, it is possible to activate this loudspeaker to listen to the received data. For the MFC-R2 mode, this loudspeaker remains on. It is possible to adjust the volume using the front panel keys, marked Volume+, Volume-. For the Frequency/level, TX/RX and THROUGH modes, it is possible to turn the audio on or off.

3 -   TSW200E1 Operation

To operate correctly, the appropriate configuration and connections must be set up for the intended test. The sections below describe the necessary steps for each module. The results display is shown.

The TSW200E1 has three operation modes: Configuration, Test and Data.

For the Configuration mode, it is possible to select the intended function and its parameters. During the test, every error and alarm that occur are recorded. These are displayed in general counters or histograms as a function of time. Resulting data can be stored in memory. The last test is automatically stored and can be later displayed.

The TSW200E1 can be used for the execution of loopback tests and end-to-end tests in modems, when they are in full-duplex mode. It is also possible to carry out tests for multiplexers and for general digital circuits. The equipment can emulate a DTE as well as a DCE. The figures below show some of the TSW200E1 applications.

DTE Emulation

Local Test

End to end test
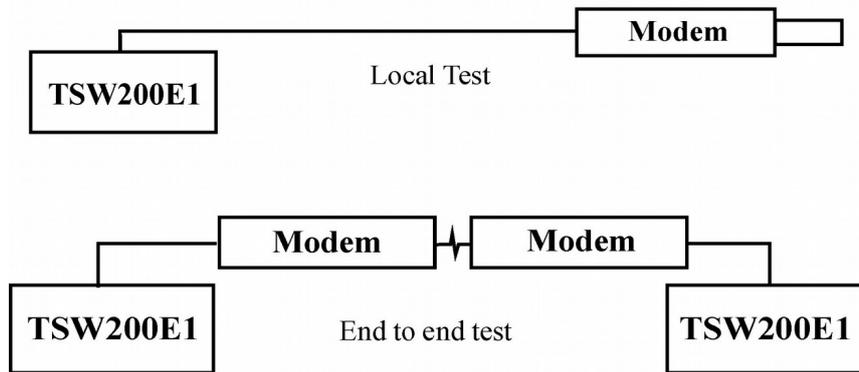
DCE Emulation
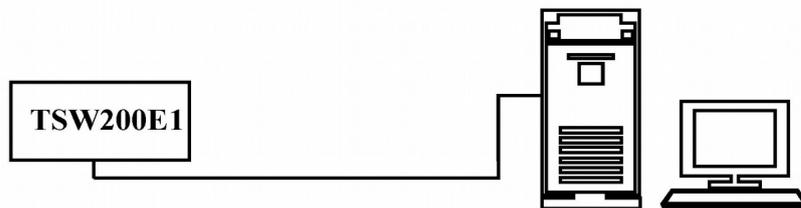
After the equipment is turned on for the first time, the Logo screen is displayed (shown below):

```
|||||||||||||||||||||||||||||||||||||||  ▪
        ∕∕∕
       ∕ ∕ ∕ WISE
    Indústria de Telecomunicações
        T S W 2 0 0 E 1

    25/06/2001        12:45:37

  REGIST            MODULE    SETUP
```

| **F1** | **F2** | **F3** | **F4** |

It is then possible to check the equipment register pressing <F1> (REGIST). This screen displays the hardware and software versions and the equipment serial number.

```
        Serial Number :98.04.238

         This product is registered to:

                  DEMO


  HARDWARE VERSION: 05-03-07/0001

  SOFTWARE VERSION: EE1V017

                  LOGO
```

| **F1** | **F2** | **F3** | **F4** |

In many TSW200E1 screens, there is an arrow-shaped cursor appearing on the right side of the screen. This cursor will be used for configuring the equipment. Its position defines the parameter to be changed or selected. To move it to another line, use the ↑ and ↓ keys.

Every configuration parameter and memory contents are kept even after power off. So, when the equipment is turned on again, the last screen shown will be displayed, unless it is not a test or editing screen.

3.1 - *General Configurations and Equipment Utilities*

To perform general configurations and to use the utilities it is necessary to go to the Setup screen. To reach this screen, look for the <F4> SETUP function key. In this screen the battery level is displayed.

```
                      SETUP
BATTERY CHARGE:      60%

BUZZ ENABLE:         ON

POWER-OFF TIME:      30 min

DATE/TIME

SELF-TEST

CONTRAST:            07

              LOGO
```

F1	**F2**	**F3**	**F4**
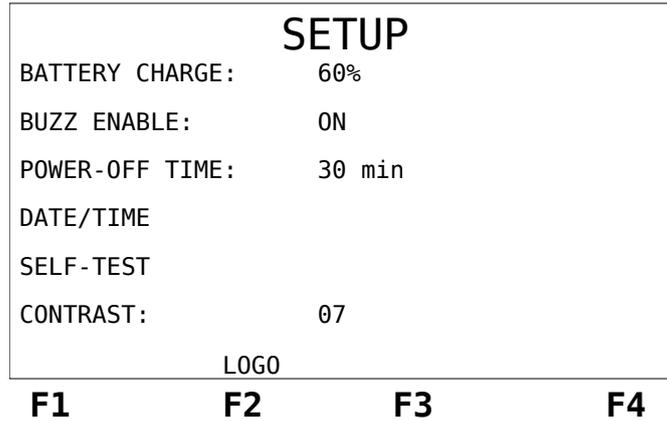
It is possible to turn the keyboard, alarms and error buzzer on or off. To do that, move the cursor to the Buzz Enable line and use the ← and → keys to toggle between ON or OFF. When the buzzer is on, a beep sounds when any key is pressed.

The Setup screen allows the setting of the automatic turn-off time, when the equipment is not under test. After this time, the equipment turns itself off if left at any configuration screen, e.g. the setup screen. If any key is pressed, the countdown is restarted. To select the turn-off time of 5 min, 10 min, 20 min or 30 min, use the← and → keys.

The Logo screen displays date and time. To edit, press DATA with the cursor pointing to the Date/Time line. Use the alphanumeric keys for editing and the← and → keys to move the cursor. Press <F4> (ENTER) to end editing.

The self-test allows checking the TSW200E1 memory, LEDs, display and keyboard. To start the self-test, press <F3> (ENTER). Initially, a memory test is run. If successful, MEMORY OK will be displayed. After that, the LEDs test is started. If this test is successful, LEDS OK will be displayed on screen. Next, the display is completely written on so the user may check if there is any display failure.

The following step is the keyboard test. After any key is pressed, the TSW200E1 will start the keyboard test. The user must press each key to check if the corresponding character is written on the equipment screen, or if there is any failure. Once started, the SELF TEST can only be stopped during the keyboard test. When the self-test is over, the equipment will clear memory and any previously chosen set-ups. So, before the test starts, the user must be sure that he or she can discard that information.

3.2 -   *Operating Module Selection*

The choice of the operating module is easily done. It is necessary to be in the Module screen (shown below) to do it.

```
           Modules

BERT/BLERT                    ◄
E1/G.704
DUAL E1
X.50 FRAME
PULSE MASK

MEMORY      LOGO       ENTER    MORE
```
| F1 | F2 | F3 | F4 |

```
           Modules

FRAME RELAY                   ◄
PPP
HDLC CISCO
X.25/xDLC
VT100

BACK        LOGO       ENTER    MORE
```
| F1 | F2 | F3 | F4 |

```
           Modules

CAS MFC-R2                    ◄
ISDN
DTMF



BACK        LOGO       ENTER
```
| F1 | F2 | F3 | F4 |

To get to that screen, look for the MODULE (F2 or F3) function key. If none appears, the equipment is already operating in one of the modules. If it is not the desired module, go back to the menu, using the function key labelled MENU and from the MODULE screen the MODULE function key will be found.

To alternate between these module screens press <F1> (BACK) or <F4> (MORE).

On the Module screen, move the cursor to the line corresponding to the desired module.

Then press <F3> (ENTER). The first chosen module screen will then be displayed.

To access the equipment memory, press <F1> (MEMORY). Section 6 of this manual details the operation of the equipment memory.

3.3 - DTE and DCE Simulation

3.3.1 - DTE Simulation

For the TSW200E1 to simulate a data terminal equipment, it is necessary to connect it to a DCE (for example a modem). If the DCE under test does not have the CTS and DCD signals in an active state, it is possible to force their corresponding levels using a cable that connects the CTS, DCD and RTS signals. If the DCE needs other signals, the user should perform the necessary connections.

3.3.2 - DCE Simulation

The TSW200E1 can simulate a data communication equipment as described below:
- V.24/RS232 Interface: the user can use a CROSS cable. The user has only to connect a terminal to the TSW200E1 and run the desired tests.
  - V.35/V.11, V.36/V.11 and X.21/V.11 Interface: the TSW200E1 can do DCE simulation with the V.35/V.11, V.36/V.11 and X.21/V.11 interfaces. It can be done using the CROSS cable (See Appendix C for a description of these interfaces). The cable must have the pin settings shown on the table below.

The connector pinout assignment for DCE simulation is listed on Appendix F.

RS232 Interface		V.35/V.11 Interface		V.36/V.11 e X.21 Interface	
DTX	DRX	DTXA	DRXA	DTXA	DRXA
DRX	DTX	DRXA	DTXA	DRXA	DTXA
RTS CTS	DCD	DTXB	DRXB	DTXB	DRXB
DCD	RTS CTS	DRXB	DTXB	DRXB	DTXB
DSR	DTR	RTS	CTS (A) DCD(A)	RTSA	DCD(A) CTS(A)
DTR	DSR	CTS (A) DCD(A)	RTS	DCD(A) CTS(A)	RTSA
RCK	TCKE	DSR(A)	DTR	RTSB	CTSB DCDB
RCK	TCKE	DTR	DSR(A)	CTSB DCDB	RTSB
		RCKA	TCKEA	DSR(A)	DTRA
		TCKEA	RCKA	DTRA	DSR(A)
		RCKB	TCKEB	DSRB	DTRB
		TCKEB	RCKB	DTRB	DSRB
				TCKEA	RCKA
				RCKB	TCKEB
				TCKEB	RCKB

3.4 - *Hierarchy of Errors and Alarms*

Among the TSW200E1 test results, there are errors and alarms counters. To master the equipment operation and to know what each counter really means, it is necessary to understand each counter function and its hierarchy.

When there are higher priority alarms, the lower priority alarms are not displayed. This is done to avoid counting the lower priority alarms that are caused by higher priority alarms. The alarms are counted once each second whenever they are active, even if they do not happen for the entire second. The errors are counted in absolute values of occurrence: each error is counted. The exception is when a higher priority alarm becomes active, inhibiting the lower priority errors. For example, the occurrence of FAS Error is inhibited by FAS Loss, AIS or No Signal, etc. The highest priority alarm is the No Signal alarm.

The definition for each counter follows:

- BIT ERROR: The counter is incremented whenever a bit error is detected on the received pattern.
- FAS ERROR:

- E1/G.704– the counter is incremented whenever there is one (or more) errors in the FAS word.
  - X.50 - the counter is incremented whenever any bit in the FAS word is wrong. The maintenance bits are not included.
- CRC ERROR: The counter is incremented whenever one or more errors are detected on the CRC word.
- CODE ERR.: The detection of this error depends of the used line code:
  - HDB3 – there is a code error when the violation comes with the same polarity of the preceding violation or when a violation does not come preceded by two zeros;
  - AMI – a code error occurs when the pulse comes with the same polarity of the preceding pulse (bipolar violation).
- E-BIT: This counter is incremented each time that bit 7 of frames 13 or 15 of G.704 multiframe are set to zero by the remote device, indicating that the remote device detected CRC error.
- SLIP: The SLIP alarm is set if SLIP is detected in the pseudo-random sequences.
- SIGNAL LOSS: This counter is incremented whenever 255 consecutive bits are 0.
- NO CLOCK: This counter is incremented if a there occurs a period of more than 125 .00s with no clock.
- AIS:
  - E1/G.704– it is generated whenever 512 bits or 2 consecutive frames have all bits equal to 1 in the 2 Mbps frames.
  - X.50 – it is generated whenever 504 consecutive bits are 1 in the 2 Mbps frames.
- FAS LOSS
  - E1/G.704- Counter that indicates FAS sync loss. The counter is incremented whenever there are three consecutive FAS words with error or if bit 2 of the odd frames is received with error for three consecutive times.
  - X.50 - This counter is incremented whenever the FAS error remains active for more than 10 ms.
- CAS LOSS: Counter that indicates multiframe sync loss. In the 2Mbps G.704 analysis, when two consecutive MFAS words are in error or when many ABCD words are equal to 0000, the equipment is not capable of identifying the MFAS (0000) and it flags a CAS sync loss. So, it is necessary to set at least a bit of each ABCD word for channels 1 to 15.
- CRC LOSS: Counter that indicates CRC sync loss. This counter is incremented every time that, for a thousand CRC words, there are 915 or more in error.
- PAT LOSS:
  - In the Asynchronous Mode this counter is incremented once a second whenever there are more than 10% of errors in a 1024-bit block.
  - For the other modes this counter is incremented once a second if there are more than 6.25% of errors in a 1024-bit block.
- REMOTE ALARM:
  - E1/G.704- the counter is incremented whenever bit 3 (A) of the NFAS word is set for three consecutive times.
  - X.50 - the counter is incremented whenever bit A of the FAS sequence indicates an alarm.
- RMF ALARM: In the 2Mbps G.704 analysis, the counter is incremented whenever bit 6 of timeslot 16 is set for two consecutive times.

4 -   The BERT/BLERT Module

This module has two modes: Synchronous and Asynchronous. See the screen below.

```
┌─────────────────────────────────────────┐
│              BERT/BLERT                  │
│                                          │
│   S Y N C H R O N O U S          ←       │
│                                          │
│   A S Y N C H R O N O U S                │
│                                          │
│                                          │
│              MODULE      ENTER           │
└─────────────────────────────────────────┘
       F1        F2        F3        F4
```
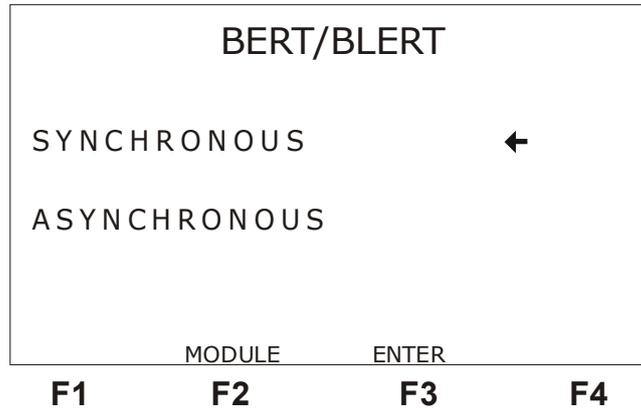
To choose between one of the two modes move the cursor, with the ↑ and ↓ keys, to the corresponding desired mode and press <F3> (ENTER). The first screen for the chosen module setup will be displayed.

For the two modes, the test counts the bit error rate (BER) and the rate of errored blocks (BLER). This test allows checking:

- degraded minutes
- severely errored seconds
- errored seconds
- error-free seconds
- available time
- unavailable time
- real-time clock SLIPS following ITU-T Rec. G.822.

The test is based on a data pattern that is transmitted to the modem under test. The received data pattern is then compared to the transmitted pattern, and the occurrence of any error is accounted for. Before the test is started, the user must be sure that every parameter has been adequately selected according to the modem strapping.

4.1 -   Synchronous Mode Configuration

Before running the test, it is necessary to set many configuration parameters. The figures below present the two screens used to configure this mode.

```
              SYNCHRONOUS

Interface:           RS232      ←
Pattern:             2E3-1/ 07
Polarity TX & RX:    NORM NORM
Tx Clock Source:     INTERNAL
Tx Rate:             0064000 bps



              MENU                  NEXT
```

F1   F2   F3   F4

```
              SYNCHRONOUS

Test Period:       CONTINUOUS ←
Error Insert:      SINGLE
Histo Resolution:  MINUTES
Alarm & Error Buzz:ON ON
Loopback:          NONE
DTR/RTS:           ON ON
BACK          MENU
```

F1   F2   F3   F4

From any of the two screens it is possible to go back to the Mode menu using <F2> (MENU). To alternate between these screens use <F1> (BACK) and <F4> (NEXT).

The description of the synchronous mode parameters follows. To change these parameters, place the cursor on the corresponding line and follow the instructions concerning each description.

- **Interface**: Chooses the test interface as RS232, V.35, V.36, X.21, RS530, G.703–64K or G.703-2M. Use the ← or → keys.
- **Pattern**: Determines which pattern will be transmitted and received by the Test Set. The choice can be done by using the ← or → keys. It is possible to choose among the following pseudo-aleatory patterns: 2E3-1/ 7, 2E4-1/ 15, 2E5-1/ 31, 2E6-1/ 63, 2E7-1/ 127, 127 LA, 127 LD, 2E9-1/ 511, 2E10-1/ 1023, 2E11-1/ 2047, 2E15-1, 2E17-1, 2E18-1, 2E20-1 O153, 2E20-1 O151, QRSS, 2E21-1, 2E22-1, 2E23-1, 2E25-1, 2E28-1, 2E29-1, 2E31-1, Mark ('1111'), Space ('0000'), ALT M/S (alternating '1' e '0'), Double Alt ('1100'), 3 in 24, 1 in 16, 1 in 8(1:7), 1 in 4, D4 LA, D4 LD, USER e 7:1 (mark:space). Other than these standards, there is the AUTO option. If the test is started with this option the TSW200E1 tries to synchronize automatically to the pseudo-aleatory patterns that it gets. When the TSW200E1 gets the correct pattern, it starts to transmit this pattern. There is a limitation concerning the detection of QRSS and 2E20-1 O151 patterns. Since they are very similar, the TSW200E1 units can synchronize in one of then and begins to count eventual bit errors, it means that the correct pattern is the other one. The USER pattern can be user edited, bit-by-bit. To do this, select the USER pattern

and press the DATA key. The editing mode screen will be displayed. Using the 0 and 1 keys, edit the desired word. To end editing, press <F4> (ENTER). To cancel the editing, press <F1> (EXIT).

- **Polarity**: Determines signal polarity. It can be normal or inverted. For inverted polarity, every pattern bit value is inverted. To choose, use the ← or → keys. This parameter allows the user to select separately the polarity of the transmit and receive signals as normal (NORM) or inverted (INV).

- **Tx Clock Source**: This parameter defines the clock source. To choose, use the ← or → keys. The clock source can be:
    - INTERNAL: when the Test Set itself provides the transmission clock.
    - EXTERNAL: when the transmission data are synchronized with an external circuit clock, which must be set up for internal or regenerated clock. For G.703-2M, the external clock must be provided by the V.35 interface (the user must connect the TSW200E1 ground to the clock-providing equipment ground).
    - FROM RX: when the transmit data are in sync with the modem-provided clock, this must be set up for internal or regenerated clock. This option can be used for the G.703-2M interface only.
    - RECOVERED: when the clock is regenerated from reception. This last option is available only for the G.703-64k interface.

- **Tx Rate**: Chooses the transmission rate, which varies from 1200 bps to 2048 Kbps, using the ← or → keys. If the USER option is chosen, edit the rate up to 10 Mbps. To edit, choose the USER option and press the <DATA> key. Using the alphanumeric keys, enter the desired value for the transmission rate. To end editing, press <F4> (ENTER). To cancel editing press <F1> (EXIT).

- **Test Period**: Chooses the test period. The test can be continuous, lasting for a given time or for a certain number of blocks. To select, use the ← or → keys. If the timer option is chosen, it is necessary to edit the test time (duration) and the starting time (time to begin). To do that, press the DATA key when the cursor points to the proper line. If the test is to be started immediately, set the time to begin to zero.

- **Error insert**: This option allows selection of the bit error insertion mode. It can be SINGLE (inserts one error at each time the ERROR key is pressed) or it can select a rate of errored bits from 10E-1 to 10E-7. To choose, use the ← or → keys.

- **Histo Resolution**: Selects the resolution for the result histograms. The histograms can have resolution in minutes or hours. To choose, use the ← or → keys.

- **Alarm & Error Buzz**: Allows the user to activate or deactivate the alarm and error buzzers. The options are OFF OFF, ON OFF, OFF ON or ON ON. When set to ON, the buzzer is active and when set to OFF, the buzzer is inactive. To choose, use the ← or → keys.

- **Loopback**: Allows the equipment to be configured to perform a local loopback test (LOCAL), remote (REMOTE) or no loop at all (NONE). For the local loopback, the same data transmitted by the equipment are internally sent to its reception. So, the equipment can be in sync when the test is started, without receiving external data. For the remote loopback, the equipment sends the data it is receiving. Available on hardwares E or newer.

- **DTR/RTS**: Allows the user to activate (ON) or deactivate (OFF) both control signals DTR and RTS. Available on hardwares I or newer.

- **Clock Deviation:** When the used interface is G.703-2M, allows the user to choose the transmission clock deviation which varies from -50 to+50 ppm.

4.2 -   *Asynchronous Mode Configuration*

For asynchronous communication, the Asynchronous mode setup parameters differ from the parameters described in the previous section (sec. 4.1). The figures below display the two set-up screens for this mode.

From any of the two screens press <F2> (MENU) to go back to the Modes menu screen. To alternate between these screens use <F1> (BACK) and <F4> (NEXT).

Each parameter is described after the figures. To edit these parameters, place the cursor at the adequate line and follow the specified instructions.

```
                    ASYNCHRONOUS

   Interface:          RS232      ⬅
   Pattern:            2E6-1/ 63
   Polarity:           NORM NORM
   Test Period:        CONTINUOUS
   Histo Resolution:   MINUTES
   DTR/RTS:            ON ON
                  MENU                NEXT
```

F1   F2   F3   F4

```
                 ASYNCHRONOUS

   Data Rate:         50 bps       ⬅
   Number of Bits:    8
   Parity:            NONE
   Stop Bits:         1
   Alarm & Error Buzz: OFF OFF
   Loopback:          NONE

    BACK       MENU
```

F1   F2   F3   F4

- **Interface**: Determines the interface to be used in the test as RS232, V.35, V.36 or X.21, using the ← or → keys.
- **Pattern**: Determines which pattern will be transmitted and received by the Test Set. The choice can be done by using the ← or → keys. It is possible to choose among the following pseudo-aleatory patterns: 2E6-1/ 63, 2E9-1/ 511, 2E11-1/ 2047, 2E12-1/ 4095, 2E15-1, 2E20-1 0153, Mark ('1111'), Space ('0000'), ALT M/S (alternating '1' e '0'), FOX, USER , 7:1 e 1:7 (mark:space). The USER pattern can be user edited, bit-by-bit. To do this, select the USER pattern and press the DATA key. The editing mode screen will be displayed. Using the 0 and 1 keys, edit the desired word. To end editing press <F4> (ENTER). To cancel the editing, press <F1> (EXIT).
- **Polarity**: Determines signal polarity. It can be NORMAL or INVERTED. For inverted polarity every pattern bit value is inverted for transmission and the analysis is adjusted

for that. To choose, use the ← or → keys.

- **Test Period**: See section 4.1.
- **Histo Resolution**: See section 4.1.
- **DTR/RTS**: See section 4.1.
- **Data rate**: Chooses the transmission rate, in the range of 50 to 115200 bps, using the ← or → keys.
- **Bits Number**: Selects the word size (5, 6, 7 or 8) for the asynchronous transmission, using the ← or → keys.
- **Parity**: Selects the parity (NONE, EVEN, ODD, MARK or SPACE) for the asynchronous transmission. To choose, use the ← or → keys.
- **Stop Bits**: Selects the number of Stop bits (1, 1.5 or 2) for asynchronous transmission. To choose, use the ← or → keys.
- **Alarm & Error Buzz**: See section 4.1.
- **Loopback**: See section 4.1.

4.3 - Executing the Bert/Blert Test

The figure below is an example of the connection modes to execute the BERT/BLERT (Bit Error Rate Test/ Block Error Rate Test).
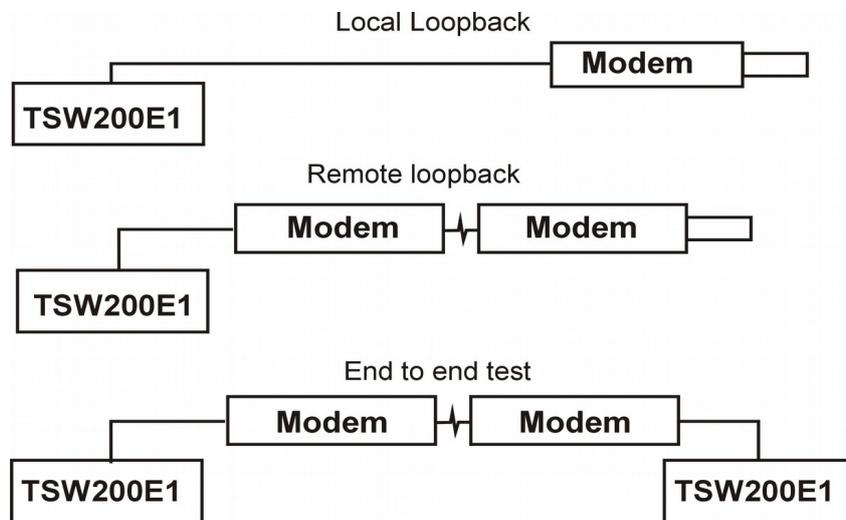
After making connections and after setting up the configuration parameters, press the START/STOP key to start the test. If the CTS circuit is active, the Test Set will continuously transmit the selected pattern. The RUN indicator LED will remain on while the test is running. If the test is continuous, press START/STOP to stop the test.

To enable the data transmission, the CTS circuit must be activated by the modem under test. The reception starts when the modem under test activates DCD. The test result is displayed.

For the asynchronous mode, "WAIT..." can appear on the screen. It is displayed while the TSW200E1 tries to locate the start bit. The duration of this message depends on the selected transmission rate: greater rates, less time. After some time, if the start bit is not found, the NO SIGNAL message is displayed. Even then the TSW200E1 keeps trying, until the user presses STOP.

While the test runs without any occurrence of errors or alarms, the equipment displays the OK screen (shown below). This screen shows that the test is running, the elapsed time and the RX RATE. Next section comments about errors and alarm counters.

```
            RUNNING

         OK
          0000:00:00
           64000 bps
                   MENU
```

  F1   **F2**   **F3**   **F4**
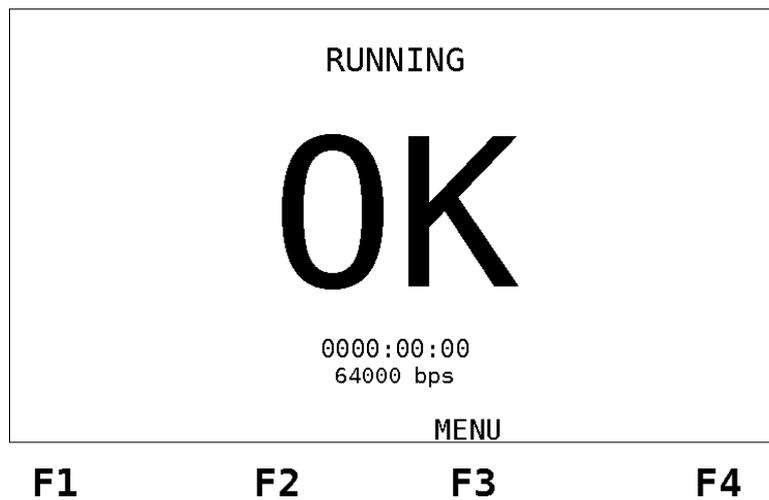
Obs.: The RX RATE shown at the OK screen is only available on hardwares K or newer.

From the OK screen, press <F3> MENU to go to the menu screen shown below:

```
            RUNNING

      BASIC ERRORS        ←
      RATES & ALARMS
      HISTOGRAMS
      G.821
      EVENT LOG

                  ENTER
```

   F1   **F2**   **F3**   **F4**
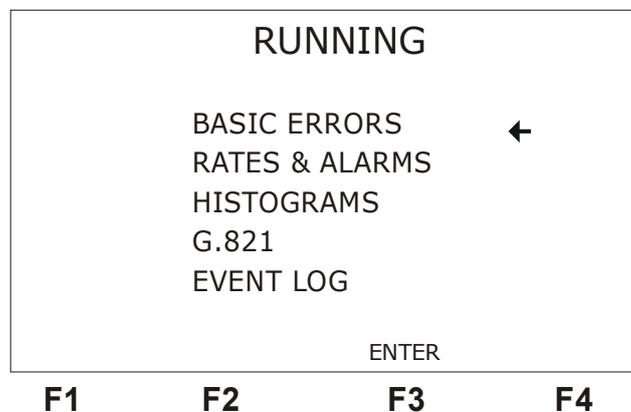
This screen presents the Rates & Alarms options for the Synchronous mode, but only the Alarms option for the Asynchronous mode.

If any error or alarm occurs, the OK screen is replaced automatically by the corresponding error or alarm screen. The OK screen becomes unavailable. From the MENU screen, the error counters screen, alarm counters screen, histograms screen, event log screen or the ITU-T standard G.821 screen can be reached by placing the cursor adequately and by pressing <F3> (ENTER). Pressing <F2> (MENU) in any of these screens takes the user back to the menu.

When the CLEAR key is pressed, the test time, all counters and histograms are cleared and the test is restarted. If the TSW200E1 was in sync, it remains in sync.

4.4 - Results Display

The results displayed during the test are:

- many error and alarm counters

- histograms of errors or alarms versus time
- event log of alarms

4.4.1 - Basic Errors

In the BERT/BLERT module, four screens display the basic errors. Two screens report to Recommendation G.821. In one of them the counters are displayed and in the other the percentage of the counters is displayed.

The first basic errors screen is seen next.

```
            B A S I C   E R R O R S

   BIT ERR = 0000000
   BER  =   0.00E-00
   RX RATE =   2048000 bps
   TIME =       0000:10:26




              MENU              NEXT
```
F1   F2   F3   F4

```
            B A S I C   E R R O R S

   BIT ERR =         0000000
   BER  =            0.00E-00
   INJEC. ERR. =    0000000
   TIME =           0000:10:26




              MENU              NEXT
```
F1   F2   F3   F4

This screen displays the following test results:

- BIT ERROR: Counter that indicates the number of errored bits that occurred during the running test.
- BER: Exponential notation rate between the number of errored bits and the total number of received bits.
- RX RATE: For the asynchronous mode, it indicates the preset programmed rate.
- INJEC. ERR.: Displays the number of transmission errors inserted by means of the ERROR key.
- TIME: Shows the total elapsed test time. Format: hours:minutes:seconds.

From this first basic error screen it is possible to go three ways:
a. Press <F4> (NEXT) to access the second screen

b. Press <F2> (MENU) to go back to menu screen

The basic errors second screen is the following:

```
┌─────────────────────────────────────────┐
│         B A S I C   E R R O R S          │
│                                          │
│   BLK ERROR  =   00000                   │
│   BLER       =   0.00E-00                │
│   BLOCKS     =   6.80E+04                │
│                                          │
│                                          │
│                                          │
│   BACK        MENU              NEXT      │
└─────────────────────────────────────────┘
    F1          F2         F3       F4
```

The counters displayed above are now described:

- BLK ERROR: indicates the total number of errored blocks that occurred until that moment during the test in progress. Any number of errored bits that occurred in a 1024-bit block is marked as a single errored block.
- BLER: indicates the exponential notation proportion between the number of errored blocks and the total number of received blocks.
- BLOCKS: exponential counter of the total number of 1024-bit blocks received during the test in progress.

From that screen, it is possible to:
   a. Press <F1> (BACK) to go back to the first error screen
   b. Press <F2> (MENU) to go to the menu screen
   c. Press <F4> (NEXT) to access the third screen

The basic errors second screen is the following:

```
┌─────────────────────────────────────────┐
│         B A S I C   E R R O R S          │
│                                          │
│    SLIP        =   00000                 │
│    SLIP/HOUR   =   00000                 │
│    SLIP/DAY    =   00000                 │
│                                          │
│                                          │
│                                          │
│    BACK        MENU            NEXT       │
└─────────────────────────────────────────┘
     F1          F2         F3       F4
```

- SLIP: indicates a clock slippage, or a misalignment between receive and transmit clocks.

It is valid only for pseudo-aleatory sequences.

- SLIP/HOUR: indicates the proportion of SLIPS per hour (following Recommendation G.822).
- SLIP/DAY: indicates the proportion of SLIPS per day (following Recommendation G.822).

From that screen, it is possible to:
- a. Press <F1> (BACK) to go back to the first error screen
- b. Press <F2> (MENU) to go to the menu screen
- c. Press <F4>(NEXT) to go to the fourth error screen

The basic errors fourth screen is only showed if the selected inteface is G703-2M. It is the following:
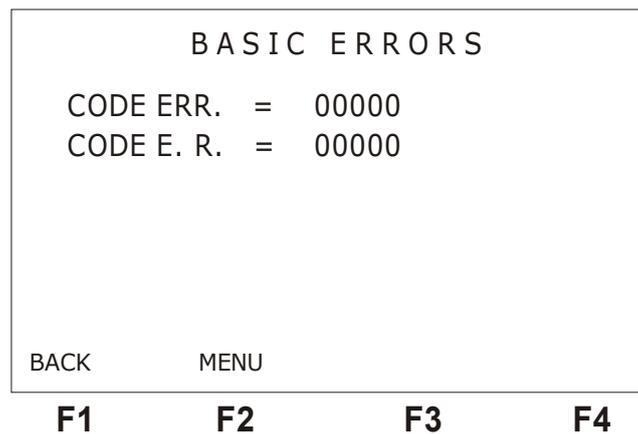
```
┌─────────────────────────────────────┐
│         B A S I C   E R R O R S      │
│                                      │
│    CODE ERR.   =    00000            │
│    CODE E. R.  =    00000            │
│                                      │
│                                      │
│                                      │
│                                      │
│    BACK        MENU                  │
└─────────────────────────────────────┘
     F1          F2         F3         F4
```

- CODE ERROR: indicates the total number of code errors (HDB3 or AMI line codes) that occur while the test is running.
- CODE E. R.: exponential notation rate between the number of code errors and the total number of received bits.

From that screen, it is possible to:
- a. Press <F1> (BACK) to go back to the first error screen
- b. Press <F2> (MENU) to go to the menu screen

4.4.2 - The Recommendation G.821 Error Analysis

The Recommendation G.821 counters screen is displayed in the figure below:

```
              G . 8 2 1 / B I T

   ERRORED   SEC  =  0000000
   SEV.ERR    SEC  =  0000000
   DEGRADED  MIN  =  0000000
   AVAILAB.    SEC  =  0000000
   UNAVAIL.    SEC  =  0000000
   ERR. FREE  SEC  =   0000000

                MENU              %
```

F1   F2   F3   F4

The G.821 counters are the following:

- ERRORED SEC: shows how many one-second time intervals have at least one error.
- SEV. ERR. SEC: shows how many one-second time intervals have a bit error rate equal or greater than 1.10^{-3}.
- DEGRADED MIN: shows how many one-minute time intervals have an error rate greater than 1.10^{-6}.
- AVAILAB.SEC: quantity of available seconds during the test.
- UNAVAIL.SEC: quantity of unavailable seconds during the test.
- ERR.FREE SEC: shows how many one-second time intervals have no error.

To go back to the menu screen, press <F2> (MENU). To display these counters in percent values, press <F3> (%). Below is presented the description of each displayed value. These parameters follow ITU-T Recommendation G.821.

- ERRORED SEC: indicates the rate between the number of one-second time intervals that have at least one error and the available measuring time.
- SEV. ERR. SEC: indicates the rate between the number of one-second time intervals where the bit error rate is equal or greater than 1.10^{-3} and the available measuring time.
- DEGRADED MIN: indicates the rate between the number of one-minute time intervals where the error rate is greater than 1.10^{-6} and the available measuring time.
- AVAILAB. SEC: indicates the rate between the available measuring seconds and the total elapsed time. The available measuring seconds are given by the difference between the total measuring time and the unavailable time.
- UNAVAIL. SEC: indicates the rate between the unavailable measurement seconds and the total elapsed time. The unavailable time is evaluated when a bit error rate, for one-second intervals, is greater than 1.10^{-3}, for 10 consecutive seconds.
- ERR. FREE SEC: indicates the rate between the number of one-second time intervals that have no error and the available measuring time.

4.4.3 -   Rates & Alarms

When the Rates & Alarms option is chosen on the menu screen, the following screen is displayed.

```
                    RATES

     RX RATE=           2048 kbps
     RX CLK DEV=        00000 ppm




              MENU              NEXT
       F1       F2        F3        F4
```

This screen presents an on-line frequencimeter (RX RATE) that displays the estimated receive rate in kbps and the deviation (RX CLK DEV) from the nominal chosen transmission rate. The receive clock deviation (RX CLK DEV) is calculated following this rule:

(RX RATE - Nominal Rate) / Nominal Rate

where Rx Rate is the measured value of the reception clock and the Nominal Rate is the defined value for transmission clock (Tx Rate).

Even if the Tx Clock Source is defined as EXTERNAL, it is possible to choose a nominal rate using the Tx Rate value. Follow these steps:

1. Stop the test (START/STOP key)
2. Change the Tx Clock Source to INTERNAL
3. Choose the desired value to the nominal rate in the Tx Rate option
4. Change the Tx Clock Source to EXTERNAL
5. Restart the test (START/STOP key)

By pressing the <F4> (NEXT) key the alarm screen is shown. For both the ALARMS screen and for the RATES screen the <F2> (MENU) key takes the user back to the Menu screen.

The alarms displayed depend on the selected mode and interface. The screen shown below refers to the G.703 - 2M interface using synchronous mode only, but a description of all alarms follows.

```
                 A L A R M S

     SIGNAL LOSS =   00000
     NO SYNC =       00000
     SYNC LOSS =     00000
     PAT LOSS =       00000
     ALL ONES =      00000
     ALL ZEROS =      00000
                         MENU
       F1       F2        F3        F4
```

- FAULTS: indicates the total number of sync losses between transmitter and receiver

during the test in progress. This alarm is effective only for the asynchronous mode and for the G703-64k interface synchronous mode.

- DROPOUT: indicates the total number of carrier losses during the test in progress. This alarm is effective only for the asynchronous mode and for the synchronous mode only when the interface is G703-64k.
- SIGNAL LOSS (for G.703-2M interface only): indicates the total number of occurrences of missing signal for the 2Mbps stream during test execution.
- NO CLOCK: Indicates the number of seconds during which the equipment has detected the absence of the clock signal at its reception.
- NO SYNC: Indicates the number of seconds during which the equipment has lost sync.
- SYNC LOSS: Indicates the number of times that the equipment lost sync respectively to the receive signal.
- PAT LOSS: indicates the pattern sync losses. This means the expected sequence is not being received.
- ALL ONES: Keeps track of the seconds during which the receive signal is always 1.
- ALL ZEROS: Keeps track of the seconds during which the receive signal is always 0.

4.4.4 - Histograms

Histograms are graphical representations of the quantity of errors or alarms versus time. For each error or alarm that can occur in a test situation, a histogram is displayed. Each histogram column displays the quantity of errors or alarms that occurred during that minute, or during that hour, according to the chosen resolution.

The histogram screens are accessible during the test, or by memory visualisation. The histograms are accessible from the Menu screen, by positioning the cursor at the appropriate line and then pressing <F3> (ENTER). The first histogram displayed is always the errored bits histogram (shown below).
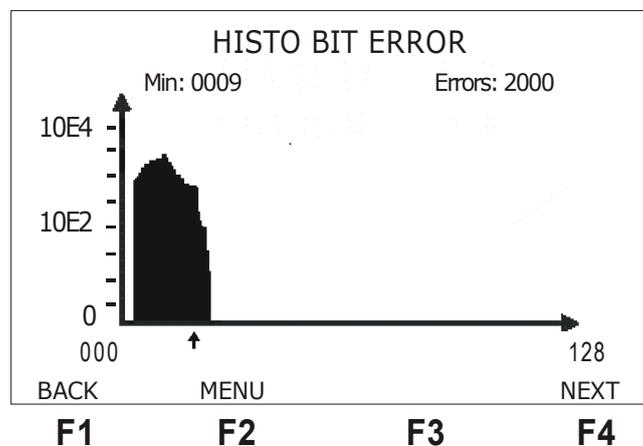
There is a small cursor just below the graph that points to a column. In the upper part of the display, just below the title, there is the minute or hour that corresponds to the column where the cursor is. There is also the number of errors or alarms (according to the plotted graph) that occurred on that particular minute. To move the cursor through the graph, a column at a time, use the → and

← keys .Use the ↑ and ↓ keys to move the cursor 16 positions at once.

Press <F4> (NEXT) to go to the next screen or <F1> (BACK) to go to the previous one. Press <F2> (MENU) to go back to the Menu screen.

Depending on the type of error or alarm and of the chosen resolution, the histogram scale is linear or logarithmic. The maximum number of errors or alarms that can be shown in a histogram is 65534, but most counters can count more than that.

The histogram has two limitations: the total monitoring time and the quantity of errors that it can store. The histogram memory is limited to up to 3663 positions. This means that if the chosen resolution is minutes, the equipment can monitor a test during up to 61 hours. But also, the maximum number of errored minutes that can be shown is 70. So, for example, if more than 70 minutes are monitored and they all have error(s), no more errored minutes can be stored.

4.4.5 -   The Event Log

The event log screen displays the time of occurrence and of clearance of alarms and errors. It is depicted on the next figure.

```
┌─────────────────────────────────────────────┐
│                EVENT LOG                    │
│                                             │
│  20/09/2004  09:46:14     SIG LOSS          │
│  20/09/2004  09:46:20     END SIG LOSS      │
│                                             │
│                                             │
│                                             │
│                                             │
│                                             │
│                                             │
│  FREEZE        MENU                         │
└─────────────────────────────────────────────┘
      F1          F2          F3          F4
```
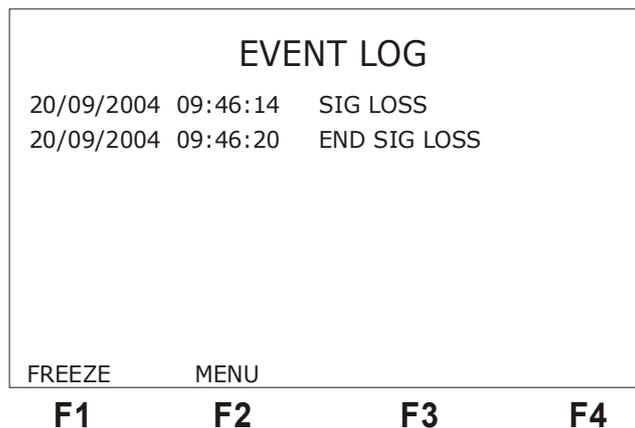
To go back to the menu screen, press <F2> (MENU). By pressing <F1>(FREEZE) the screen is not updated anymore. Over the <F3> key the number of the last line shown on screen is displayed. Over the <F4> key the total log lines is displayed. With the ← and → keys it is possible to go to the start or to the end, respectively, of the log. The ↑ and ↓ keys display the previous or the next line. To update the screen again, press <F1> UPDATE.

5 -   The E1/G.704 Module

When the E1/G.704 is selected, the screen shown below is displayed. This screen allows the user to select the operating mode.

```
┌─────────────────────────────────────────┐
│              E1/G.704                    │
│                                          │
│                                          │
│   TX/RX FRAMED                    ←       │
│   THROUGH FRAMED                         │
│   MUX                                    │
│   DEMUX                                  │
│   MONITOR                                │
│                                          │
│                                          │
│            MODULE      ENTER      MORE    │
└─────────────────────────────────────────┘
     F1         F2         F3         F4
```
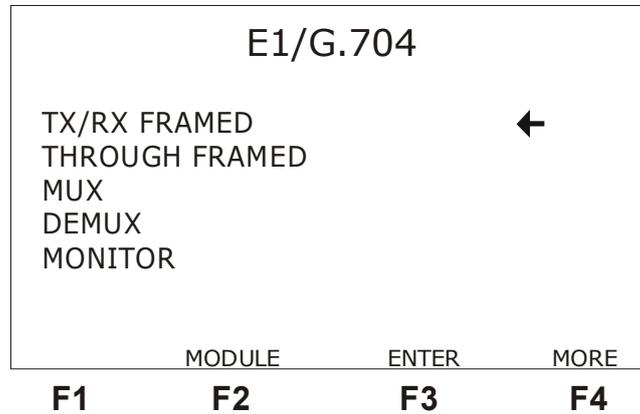
The next screen is reached with <F4> (MORE). It allows selection of more operating modes, as follows.

```
┌─────────────────────────────────────────┐
│              E1/G.704                    │
│                                          │
│                                          │
│   FREQUENCY/ LEVEL                ←       │
│   ROUND TRIP DELAY                       │
│                                          │
│                                          │
│                                          │
│                                          │
│                                          │
│  BACK       MODULE      ENTER             │
└─────────────────────────────────────────┘
     F1         F2         F3         F4
```
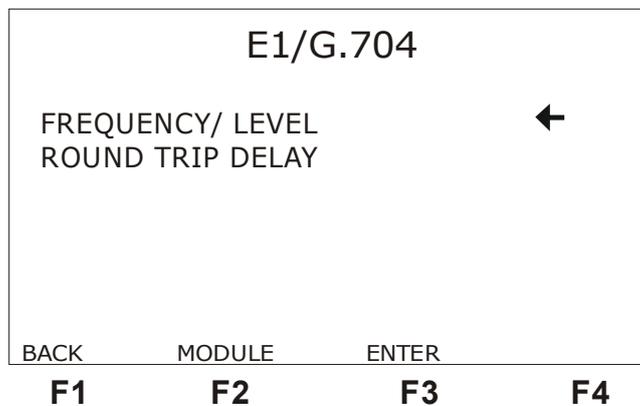
To alternate between these two menu screens, use <F4> (MORE) or <F1> (BACK). Press <F2> (MODULE) to go back to the Module screen.

To select one of the available modes on any of these two screens, place the cursor at the desired line, using the ↑ or ↓ keys. Then, press <F3> (ENTER). The first setup screen for the selected mode will be displayed. The following subsections describe the operation of each mode.

In this module, the signal generation and analysis are done in a framed (structured) way. The signal is generated at 2048 Kbps. The user can choose to use CRC or not (as in ITU-T Rec. G.704) and to use 30 or 31 channels.

The E1/G.704 module performs the error analysis for one or more timeslots, counting:

- errored bits (BIT ERROR)
- errored blocks (BLK ERROR)
- FAS ERROR
- CRC ERROR
- E-BIT and

- code error (CODE ERR).

It also displays the test time (TIME).

It does the clock SLIP analysis (according to ITU-T Rec. G.822) and the following analyses:
- AIS
- Signal sync losses (SIGNAL LOSS)
- Frame losses (FAS LOSS)
- Multiframe losses (CAS LOSS)
- CRC LOSS
- Pattern loss (PAT. LOSS)
- REMOTE ALARM
- Remote multiframe alarm (RMF ALARM)

The error analysis is done following ITU-T Rec.G.821 for the BIT ERROR, FAS ERROR, CRC ERROR and E-BIT counters, counting errored seconds (ERRORED SEC.), severely errored seconds (SEV.ERR.SEC.), degraded minutes (DEGRADED MIN.), available seconds (AVAILAB.SEC.), unavailable seconds (UNAVAIL.SEC.), error free seconds (ERR. FREE SEC), bit error rate (BER) and block error rate (BLER). For the TX/RX FRAMED mode, the ITU-T G.826 and M.2100 analyses are performed.

There is the possibility of insertion of:
- bit errors, changing any bit in the sequence,
- FAS errors, altering one or more bits of the even frames FAS word,
- CRC errors.

The bit errors can be manually inserted in the SINGLE mode (one single error inserted at a time by pressing the ERROR key) or automatically according to a user-chosen bit rate, varying from 10^{-1} to 10^{-7}.

For the FAS and CRC errors, the user can:
- use the ERROR key to input SINGLE errors, in the SINGLE mode,
- choose automatic error insertion, with bit error rate of 10^{-3}
- ditto, 10^{-5}

When the automatic error insertion is chosen, if the ERROR key is pressed during the test, the insertion of errors is automatically toggled to SINGLE mode.

When the 2Mbps G.703 interface is used, its impedance can assume the following values:
- 75 ohms (unbalanced - UNBAL)
- 120 ohms (balanced - BAL)
- HIGH-Z - high impedance (balanced - BAL or unbalanced - UNBAL).

5.1 - E1/G.704 Module test procedure

After correctly making the connections and after setting the equipment configurations, press START to run the test. The RUN LED will remain on while the test is running. To stop the test, press the start/stop key.

In the following sections, the configurations and tests for each module will be described in detail. Note that the OK screen below will be displayed when the START key is pressed to run the test, with the exception of the Monitor, Frequency/Level and Round-Trip Delay modes. This screen shows that the test is running, the time elapsed and the status of each slot. If the test does not display any error or alarm, the equipment will remain in this screen, waiting for user intervention

(see next section for a description of error and alarm counters).

```
┌─────────────────────────────────────┐
│            RUNNING                   │
│                                      │
│             OK                       │
│                                      │
│           0000:00:00                 │
│ ○●○○○○○●○○○●●○○○●○●○●○○○○○○○●●○○○●   │
│ ERRTYPE              MENU       AUDIO │
└─────────────────────────────────────┘
    F1        F2        F3        F4
```
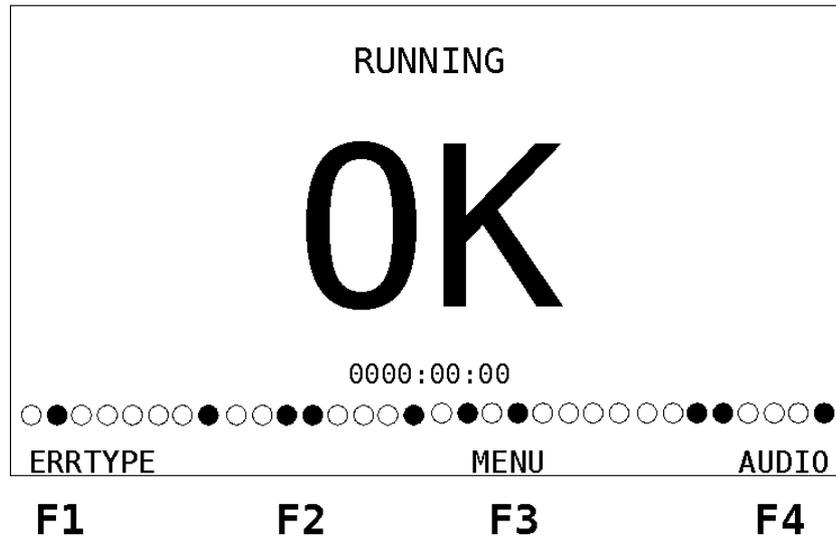
From the first OK screen it is possible to go to one the following screens pressing:

- <F1> (ERRTYPE) takes to the error insert type selection screen shown below
- <F3> (MENU) takes to the menu screen
- <F4> (AUDIO) turns on or off the audio coming from the received data

```
┌─────────────────────────────────────┐
│                                      │
│            RUNNING                   │
│                                      │
│                                      │
│        Error Typer:BIT      ←        │
│              BIT                     │
│              FAS                     │
│              CRC                     │
│                                      │
│                     ENTER            │
└─────────────────────────────────────┘
     F1        F2        F3        F4
```
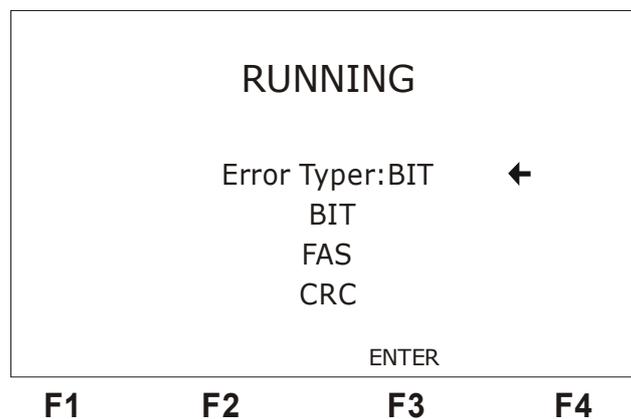
In this screen it is possible to select the type of error inserted when the <ERROR> key is pressed. To select the kind of error, move the cursor to the appropriate line and then press <F3> (ENTER).

If any error or alarm occurs, the equipment automatically changes from the OK screen to the corresponding error or alarm screen. The OK screen becomes unavailable.

From the menu screen, the other result screens can be reached by using the cursor and the

<F3> (ENTER) key.
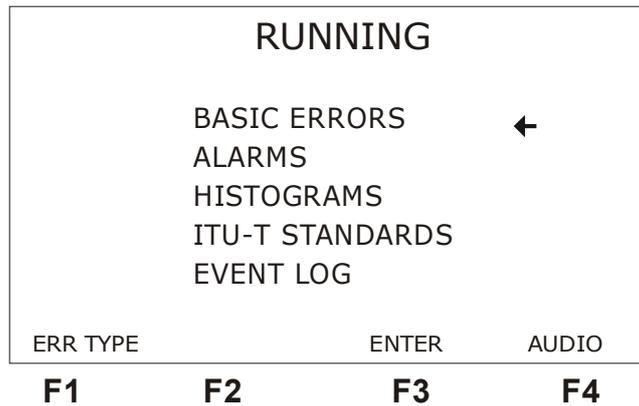
```
                  RUNNING

            BASIC ERRORS        ←
            ALARMS
            HISTOGRAMS
            ITU-T STANDARDS
            EVENT LOG


    ERR TYPE              ENTER     AUDIO
```

F1	**F2**	**F3**	**F4**

When the CLEAR key is pressed, the test time, all counters and histograms are cleared and the test is restarted. If the TSW200E1 was in sync, it remains in sync.

5.2 - Results display

During the TX/RX FRAMED, THROUGH FRAMED, MUX and DEMUX test modes, the results are displayed in the following way:

- an array of error and alarm counters
- histograms of errors or alarms versus time
- event log

For the FREQUENCY/LEVEL, MONITOR and ROUND-TRIP DELAY modes, the results are displayed differently and will be described appropriately in the corresponding sections.

5.2.1 - Basic errors

For the E1/G.704 module, many screens display the basic errors.
The first basic errors screen is shown below.

```
            B A S I C   E R R O R S

      BIT ERR =      0000000
      BER  =         0.00E-00
      INJEC.ERR. =   0000000
      RX RATE =      1920000 bps
      TIME =          0000:10:26


              MENU               NEXT
```

F1	**F2**	**F3**	**F4**
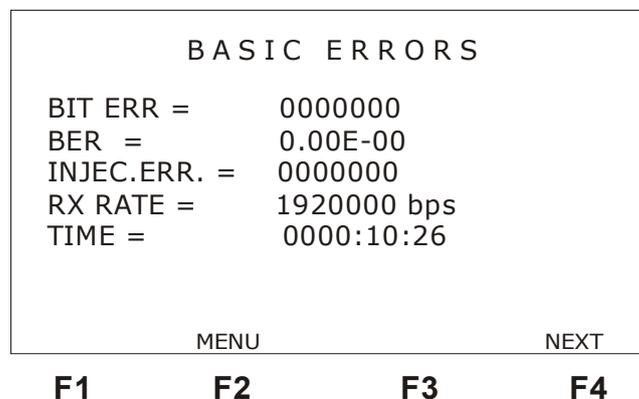
In this screen the following test results are displayed:
- BIT ERROR: this counter indicates the number of errored bits that were flagged while the test is running.

- BER: rate, in exponential notation, between the number of errored bits and the total number of bits received.
- INJEC. ERR.: Displays the number of transmission errors inserted by means of the ERROR key.
- RX RATE: on-line frequencimeter, which estimates the received data rate.
- TIME: shows the total test elapsed time. Format: hours:minutes:seconds.

From this first basic errors screen press the key:
- <F2> (MENU) to go back to MENU screen
- <F4> (NEXT) to access the second basic errors screen

The second basic errors screen is shown below:

```
                B A S I C   E R R O R S

        BLK ERROR   =    00000
        BLER        =    0.00E-00
        BLOCKS      =    6.80E+04




        BACK         MENU                      NEXT
         F1           F2           F3           F4
```

From the second basic errors screen, it is possible to press the key:
- <F1> (BACK) to go back to the previous screen
- <F2> (MENU) to go back to MENU screen
- <F4> (NEXT) to go the third basic errors screen

The counters displayed in the second basic errors screen are the following:
- BLK ERROR: indicates the total number of block errors that happen when the test is running. Any number of errors bits that are flagged in a 1024-bit block is marked as a single error block.
- BLER: indicates the rate, in exponential notation, between the number of error blocks and the total number of received blocks.
- BLOCKS: exponential counter displaying the total number of 1024-bit blocks received when the test is running.

From the third basic errors screen displayed below, it is possible to press:
- <F1> (BACK) to go back to the previous screen
- <F2> (MENU) to go back to MENU screen
- <F4> (NEXT) to go the fourth basic errors screen

```
              B A S I C   E R R O R S

     SLIP        =    00000
     SLIP/HOUR   =    00000
     SLIP/DAY    =    00000




     BACK        MENU              NEXT
```

F1   F2   F3   F4

- SLIP: indicates a clock slippage, i.e., a misalignment between the receive and transmit clocks. It is valid only for pseudo-random sequences.
- SLIP/HOUR: indicates the proportion of SLIPS per hour (according to Rec. G.822).
- SLIP/DAY: indicates the proportion of SLIPS per day (G.822).

From the fourth basic errors screen, it is possible to press the key:
- <F1> (BACK) to go back to the previous screen
- <F2> (MENU) to go back to MENU screen
- <F4> (NEXT) to go the fifth basic errors screen

```
              B A S I C   E R R O R S

     CODE ERR.  =    00000
     CODE E. R. =    00000
     FAS ERROR  =     00000
     FAS E. R.  =    0.00E-00



     BACK       MENU              NEXT
```

F1   F2   F3   F4

The counters displayed in the fourth basic errors screen are the following:
- CODE ERROR: indicates the total number of code errors (HDB3 or AMI line codes) that occur while the test is running.
- CODE E. R.: exponential notation rate between the number code errors and the total number of received bits.
- FAS ERROR: indicates the total number of FAS errors that occurred during the test.
- FAS E. R.: indicates the rate between the total number of FAS errors and the total FASs transmitted.

From the fifth basic errors screen, it is possible to press the key:

- <F1> (BACK) to go back to the previous screen
- <F2> (MENU) to go back to MENU screen

```
┌─────────────────────────────────────────┐
│           B A S I C   E R R O R S        │
│                                          │
│    CRC ERROR  =    00000                 │
│    CRC E. R.  =    0.00E-00              │
│    E-BIT      =     00000                │
│                                          │
│                                          │
│                                          │
│    BACK           MENU                   │
└─────────────────────────────────────────┘
       F1         F2         F3        F4
```
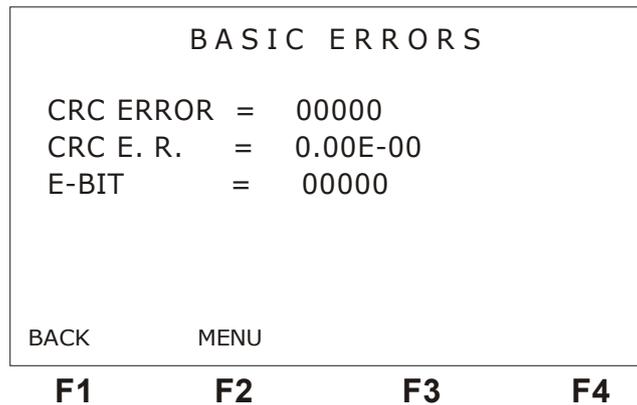
The counters displayed in the fourth basic errors screen are the following:
- CRC ERROR: indicates the total number of CRC errors that occurred during the test.
- CRC E. R.: indicates the rate between the number of CRC errors and the total CRCs transmitted.
- E-BIT: indicates the total number of CRC errors detected by the remote device during the test.

5.2.2 - ITU-T Standards

The TSW200E1 furthermore evaluates the ITU-T Rec. G.821, G.826, and M.2100.

```
┌─────────────────────────────────────────┐
│          ITU-T STANDARDS                 │
│                                          │
│              G.821              ←        │
│              G.826                       │
│              M.2100                      │
│                                          │
│                                          │
│              MENU         ENTER          │
└─────────────────────────────────────────┘
       F1         F2         F3        F4
```
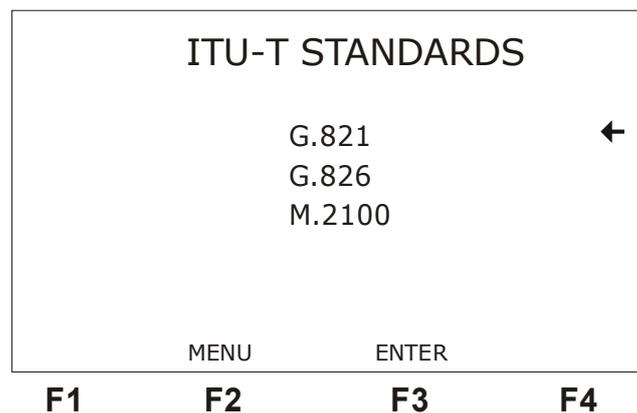
The user can choose the analysis to be displayed, placing the cursor appropriately and pressing <F3> (ENTER).

The G.821 analysis has corresponding parameters for each of the counters: BIT ERROR, FAS ERROR, CRC ERROR and E-BIT. These counters are displayed in absolute or relative (%) modes. The screens that are displayed depend on the chosen configuration. Choosing certain configurations cause the screens that show the FAS and bit errors to be the only ones displayed.

The screen with the Rec. G.821 counters is shown below. There are screens like these for FAS, CRC and E-BIT errors. They are accessible by using <F4> (NEXT) function key.

```
          G . 8 2 1 / B I T

  ERRORED   SEC  =  0000000
  SEV.ERR   SEC  =  0000000
  DEGRADED  MIN  =  0000000
  AVAILAB.  SEC  =  0000000
  UNAVAIL.  SEC  =  0000000
  ERR. FREE SEC  =   0000000


  EXIT         FAS         CRC         %
```

F1	**F2**	**F3**	**F4**

```
          G . 8 2 1 / B I T

  ERRORED   SEC  =  0000000
  SEV.ERR   SEC  =  0000000
  DEGRADED  MIN  =  0000000
  AVAILAB.  SEC  =  0000000
  UNAVAIL.  SEC  =  0000000
  ERR. FREE SEC  =   0000000

               ITU-T         %        NEXT
```

F1	**F2**	**F3**	**F4**

The G.821 counters are now described:

- ERRORED SEC: shows how many one-second time intervals have at least an error.
- SEV. ERR. SEC: shows how many one-second time intervals have the bit error rate equal or higher than 1.10^{-3}.
- DEGRADED MIN: shows how many one-minute time intervals have a bit error rate higher than 1.10^{-6}.
- AVAILAB.SEC: number of available seconds during the test.
- UNAVAIL.SEC: shows the number of unavailable seconds during the test.
- ERR.FREE SEC: shows how many one-second time intervals have no error.

To go back to the ITU-T Standards screen, press <F2> (ITU-T). To display these counters in percent values, press <F3> (%). A description of each parameter displayed in the percent values screen follows. They all follow ITU-T Recommendation G.821. To display the FAS, CRC and E-BIT results, press <F4> (NEXT).

- ERRORED SEC: indicates the rate between the number of one-second time intervals that have at least one error and the available measuring time.
- SEV. ERR. SEC: indicates the rate between the number of one-second time intervals where the bit error rate is equal or higher than 1.10^{-3} and the available measuring time.
- DEGRADED MIN: indicates the rate between the number of one-minute time intervals whose error rate is over 1.10^{-6} and the available measuring time.
- AVAILAB. SEC: indicates the rate between the available seconds actually used for

measurement (AVAILAB. SEC.) and the total elapsed time. The available seconds are given by the difference between the total measurement time and the available time.

- UNAVAIL. SEC: indicates the rate between the unavailable seconds and the total elapsed time. The unavailable time is defined when the bit error rate, measured in one-second intervals, is over 1.10^{-3} for 10 consecutive seconds.
- ERR. FREE SEC: indicates the rate between the number of one-second time intervals that have no error and the available measuring time.

The TSW200E1 calculates parameters according to ITU-T Rec. G.826. These parameters are shown in the two screens displayed below.

```
                    G . 8 2 6

    BLOCKS         =  4.15E+02
    ERRORED BLK    =  0000000
    BKGD BLK ERR   =  0000000
    ERRORED SEC    =  0000000
    SEV. ERR. SEC  =  0000000


         ITU-T                    NEXT
    F1         F2          F3          F4
```

The parameters are now described.
- BLOCKS: Counter that indicates, in exponential notation, the total number of 2048-bit blocks received when the test is running.
- ERRORED BLK (EB): indicates the total number of errored blocks flagged when the test is running. The block error is associated with the occurrence of CRC error. Any number of wrong CRCs flagged in a 2048-bit block is marked as a single errored block.
- BKGD BLK ERR (background block error): indicates the total number of errored blocks in which there were no SES (severely errored second).
- ERRORED SEC (ES): shows how many one-second time intervals have at least one of the following errors:
    - FAS, EB, LOS (loss of signal), AIS or LOF (FAS loss).
- SEV.ERR. SEC: displays how many one-second time intervals had more than 30% FAS or EB errors. Or if there occurred any of the alarms LOS, AIS or LOF.

```
                G . 8 2 6

   ES RATE    =       000.0%
   SES RATE   =       000.0%
   BBE RATE   =       0.00E-00
   AVAILAB. SEC   =  0000948
   UNAVAIL. SEC   =  0000000



   BACK          EXIT
```

| F1 | F2 | F3 | F4 |

- ES RATE: indicates the rate between the value of the errored seconds (ES) given by the ERRORED SEC counter and the available measuring time.
- SES RATE: indicates the rate between the number of severely errored seconds (SES), given by the SEV.ERR.SEC. counter and the available measuring time.
- BBE RATE: indicates the rate between the number of background block error (BBE) received and the total number of received blocks during the available time, without SES.
- AVAILAB.SEC: indicates the number of available seconds during the test.
- UNAVAIL.SEC: indicates the number of unavailable seconds during the test.

To go back to the ITU-T Standards screen press <F2> (ITU-T). To go to the first G.826 screen press <F1> (BACK). These counters are updated each second. However, these data are recalculated if unavailable seconds occur (going back 10 seconds).

The TSW200E1 calculates parameters according to ITU-T Rec. M.2100. These parameters are shown in the following two screens.

```
                M . 2 1 0 0

   ERRORED SEC   = 0000000
   SEV. ERR. SEC   = 0000000
   AVAILAB. SEC   = 0000534
   UNAVAIL. SEC   = 0000000



          ITU-T              NEXT
```

| F1 | F2 | F3 | F4 |

- ERRORED SEC (ES): shows how many one-second time intervals have at least one of the following errors: FAS or EB or LOS (signal loss) or AIS or LOF (FAS loss).
- SEV.ERR. SEC.: for PCM30 and PCM31, displays the number of one-second time intervals where more than 805 Errored Blocks (Ebs) occurred or more than 28 FAS errors (PCM30 and PCM31) occurred. Or if any of the alarms LOS, AIS or LOF occurred.

- AVAILAB.SEC.: indicates the quantity of available seconds during the test.
- UNAVAIL.SEC.: indicates the quantity of unavailable seconds during the test.

```
┌─────────────────────────────────────────┐
│              M . 2 1 0 0                  │
│                                           │
│     TEST PERIOD = 7 DAYS                  │
│                                           │
│     COMPLETED PERIODS = 0000              │
│                                           │
│          PERIOD:          RESULT:         │
│          01/08            -----------     │
│                                           │
│                                           │
│   BACK        ITU-T                SCROLL │
└─────────────────────────────────────────┘
     F1          F2        F3        F4
```
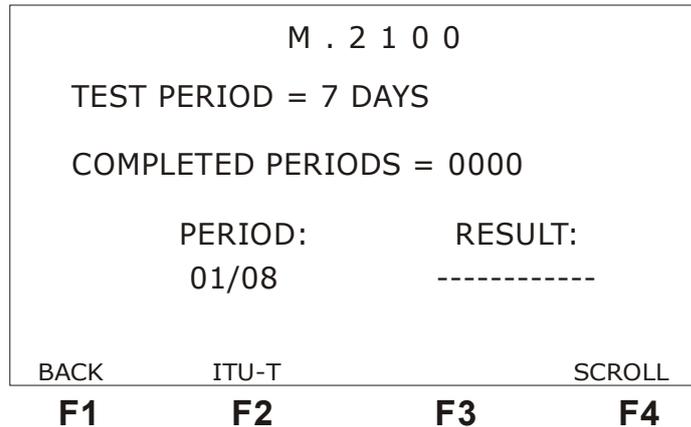
- TEST PERIOD: repeats the test duration chosen in the setup.
- COMPLETED PRD: total test periods already completed by the Test Set.
- RESULT: indicates if the test duration that was running was accepted, rejected or if it is uncertain to decide. When the test is uncertain, that means that it is impossible to come to conclusions about that particular period of test and thus the test must be rerun.
- PERIOD: indicates the period to which the result refers. To visualise other periods use <F4> (SCROLL).

5.2.3 - Alarms

The TSW200E1 displays screens with an array of alarm counters. To navigate through them press <F1> (BACK) and <F4> (NEXT). To go back to the Menu screen press <F2> (MENU).

```
┌─────────────────────────────────────────┐
│              A L A R M S                  │
│   SIGNAL LOSS  =    00000                 │
│   AIS =             00000                 │
│                     00000                 │
│   NO SYNC =         00000                 │
│   SYNC LOSS =       00000                 │
│   FAS LOSS =        00000                 │
│   CAS LOSS =        00000                 │
│                                           │
│            MENU              NEXT         │
└─────────────────────────────────────────┘
     F1         F2        F3        F4
```
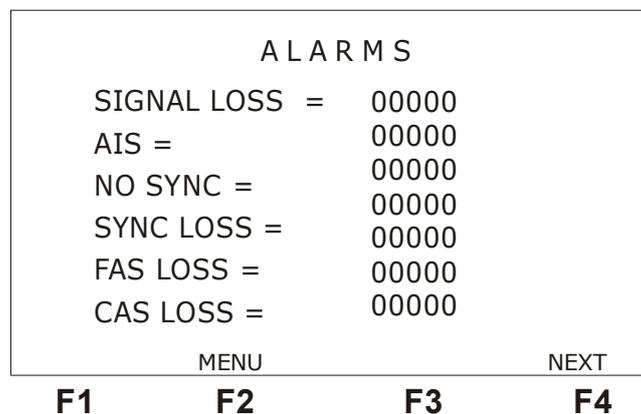
- SIGNAL LOSS: indicates the total number of absences of the 2M stream when the test is running.
- AIS: indicates the total number of occurrences of alarm signalling when the test is running.

- NO SYNC: Indicates the number of seconds during which the equipment has lost sync.

- SYNC LOSS: Indicates the number of times that the equipment lost sync respectively to the receive signal.
- FAS LOSS: indicates the total number of frame sync losses flagged when the test is running.
- CAS LOSS: indicates the total number of multiframe sync losses flagged when the test is running. For PCM30 and PCM30C only.

```
                 A L A R M S

        CRC LOSS=            00000
        PAT LOSS =           00000
        ALL ONES =           00000
        ALL ZEROS =          00000
        REMOTE ALARM =       00000
        RMF ALARM =          00000
     BACK                MENU

       F1          F2          F3          F4
```

- CRC LOSS: indicates the total number of CRC sync losses flagged when the test is running.
- PAT LOSS: Indicates the number of pattern sync losses. This means the desired pattern is not being received.
- ALL ONES: Keeps track of the seconds during which the receive signal is always 1.
- ALL ZEROS: Keeps track of the seconds during which the receive signal is always 0.
- REMOTE ALARM: Indicates the number of times that the remote alarm was sent. When there is frame sync loss, timeslot 0 bit A is set on the even frames, which indicates the occurrence of remote alarm.
- RMF ALARM: Indicates the number of times that the multiframe remote alarm was sent. When there is multiframe sync loss, timeslot 16 bit 6 (for frame 0) is set, indicating multiframe remote alarm.

5.2.4 - Histograms

The histograms are graphic representations of the number of errors or alarms versus time. For each kind of error or alarm that can occur within a given configuration, one histogram is displayed. Each histogram column displays the number of errors or alarms that occurred per minute, or per hour, according to the chosen resolution.

The histogram screens are accessible during the test, or by visualising the memory. To see the histogram from the OK screen, press <F4> (HISTO). From the Menu screen, place adequately the cursor and press <F4> (ENTER). The first histogram displayed is always the errored bits histogram, as in the figure below.

```
                    HISTO BIT ERROR
            Min: 0009                Errors: 2000

      10E4 ─

      10E2 ─

         0 ─
         000        ↑                         128
       BACK        MENU                       NEXT
        F1          F2          F3             F4
```
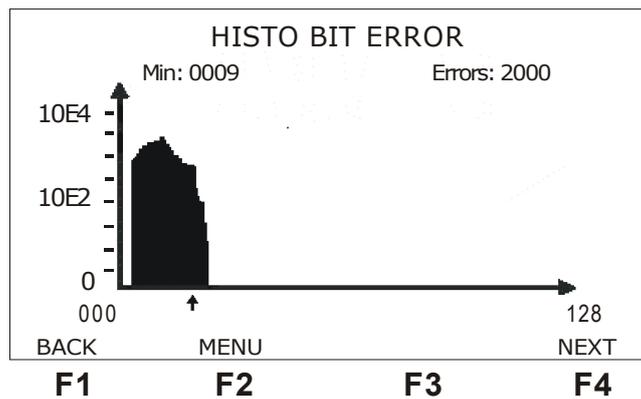
There is a small cursor immediately below the graphic which points to a column. In the upper part of the display, just below the title, there is the minute or hour that corresponds to the column pointed to by the cursor and the number of errors or alarms that happened per minute. To move the cursor through the graph, use the → or ← keys to move the cursor a column at a time, or the ↑ or ↓ keys to move the cursor 16 positions at a time.

From a histogram screen it is possible to press:
- <F1> (BACK) to go back to the previous screen
- <F2> (MENU) to go back to the Menu screen
- <F4> (NEXT) to access the next histogram

The histogram scale can be linear or logarithmic, depending on the kind of error or alarm chosen and also of the chosen resolution. The maximum number of errors or alarms that can be displayed in one histogram is 65534, but most of the counters can count more than that.

The histogram is limited to 3663 positions. So, if the selected resolution is in minutes, a test of up to 61 hours can be monitored. But the maximum number of errored minutes that can be displayed in the histogram is 70.

5.2.5 - Event log

The event log screen displays the time of occurrence and of clearance of alarms and errors. It is depicted on the next figure.

```
                    EVENT LOG

      20/09/2004 09:46:14    SIG LOSS
      20/09/2004 09:46:20    END SIG LOSS




      FREEZE        MENU
        F1          F2          F3             F4
```
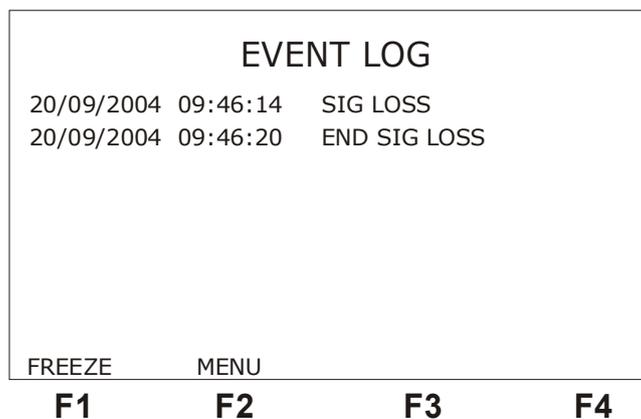
To go back to the menu screen, press the <F2> (MENU) key. By pressing the <F1>

(FREEZE> key, the screen is not updated anymore and the number of the last line displayed on screen is shown above the <F3> key; also, the total number of log lines is displayed above the <F4> key. Using the ← and → keys it is possible to go, respectively, to the start or to the end of the log. The ↓ and ↑ keys respectively display the next or previous line. For the screen to be updated again, press <F1> UPDATE.

5.3 - *TX/RX FRAMED mode*

In this mode, the TSW200E1 can substitute a network terminal equipment or it can even simulate a network. The TSW200E1 generates an internally framed signal at 2048 Kbps according to ITU-T Rec. G.704, where the transmitter is independent of the receiver. This signal can have a frame structure, which varies for PCM30, PCM30C, PCM31 and PCM31C.

When the test is started, a structured signal is generated, according to the selected pattern. In the empty timeslots, one programmable code (idle code) is inserted. The source of the transmit clock can be internal, external or regenerated from reception.

The the NFAS and NMFAS words and the ABCD bits of timeslot 16 can be programmed.

If it is desired to listen to the timeslot audio output by the loudspeaker during the test, press <F4>(AUDIO) on the OK/MENU screen. To turn the loudspeaker off, press the AUDIO key again. Use the volume buttons to adequate sound level, for it can vary a lot according to the chosen sequence.

5.3.1 - TX/RX FRAMED Mode Configuration

The TX/RX FRAMED mode has many configuration parameters, which must be carefully selected for the test to run correctly. Now the TX/RX FRAMED Mode setup screens are presented with a description of the parameters of each screen. To scroll between the setup screens use the <F4> (NEXT) OR <F1> (BACK) keys. To change a parameter, place the cursor at the desired line using the ↑ or ↓ keys and proceed as specified at each description.

```
┌─────────────────────────────────────────┐
│           TX/RX  FRAMED                  │
│                                          │
│  PCM:                 PCM30C      ◄       │
│  Pattern:             2E3-1/ 07          │
│  Polarity Tx & Rx:    NORM NORM          │
│  Idle Code:           11111111           │
│  NFAS/NMFAS:       DEFAULT               │
│  ABCD:                DEFAULT            │
│            MENU              NEXT         │
└─────────────────────────────────────────┘
     F1        F2         F3        F4
```
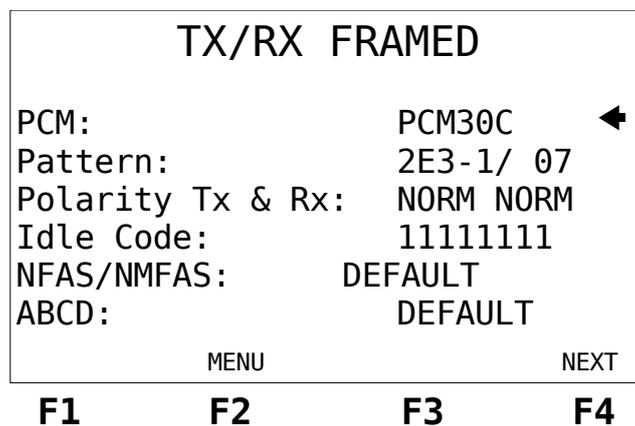
- **PCM**: Selects a frame structure. The possible structures are PCM30, PCM30C, PCM31, PCM31C or AUTO. For the AUTO option, the equipment identifies the frame structure it is receiving and automatically adjusts itself to it. To change this option, use the ← or → keys.
- **Pattern**: Selects the pattern to be transmitted in the selected timeslot (or timeslots). The patterns are pseudo-random, with bit length 7 (2E3-1), 15 (2E4-1), 31 (2E5-1), 63 (2E6-1), 127(2E7-1), 127 LA, 127 LD, 511 (2E9-1), 1023 (2E10-1), 2047 (2E11-1), 2E15-1,

2E17-1, 2E18-1, 2E20-1 O153, 2E20-1 O151, QRSS, 2E21-1, 2E22-1, 2E23-1, 2E25-1, 2E28-1, 2E29-1, 2E31-1, 2E32-1, or all Marks, all Spaces, alternating Mark(M)/Space(S), Double Alt ('1100'), 3 in 24, 1 in 16, 1 in 8, 1 in 4, D4 LA, D4 LD. Other than these standards, there is the AUTO option. If the test is started with this option, the TSW200E1 tries to synchronize automatically to the pseudo-aleatory patterns that it gets. When the TSW200E1 gets the correct pattern, it starts to transmit this pattern. There is a limitation concerning the detection of QRSS and 2E20-1 O151 patterns. Since they are very similar, the TSW200E1 units can synchronize in one of then and begins to count eventual bit errors, it means that the correct pattern is the other one. It is possible to opt for the USER and IDLE patterns. The USER pattern is any chosen test sequence with up to 16 bits. Editing the USER pattern is done in the same way as for the BERT/BLERT mode. For the IDLE pattern, the Test Set analyses the frame structure only, and not the data. This option can be changed with the ← or → keys.

- **Polarity**: Selects signal polarity between NORMAL, where the selected pattern sequence bits are normally transmitted or INVERTED, where the bits are inverted. To change polarity, use the ← or → keys. This parameter allows the user to select separately the polarity of the transmit and receive signals as normal (NORM) or inverted (INV).

- **Idle Code**: Selects the Idle Code to be transmitted in the non-selected channels. To edit, press DATA. The ← or → keys move the cursor to the bit that will be changed. To toggle the bit, use the alphanumeric keys. To exit the editing mode, press <F4> (ENTER) to update the edited value or <F1> (EXIT) to cancel editing mode.

- **NFAS/NMFAS**: The DEFAULT option keeps all bits at 1. The USER option allows the programming of the NFAS/NMFAS word (Sa). To toggle between these two options use the ← or → keys . Press DATA to edit. The bits of the NFAS/NMFAS word are then displayed. They can be individually modified. The ← or → keys move the cursor to the bit that must be changed. To alter the bit, use the alphanumeric keys. To exit the editing mode, press <F4> (ENTER) to update the edited value or <F1> (EXIT), which cancels editing mode.

- **ABCD Bits**: The DEFAULT option keeps all the ABCD bits set to 1000. The USER option allows programming of the 30 timeslot 16 ABCD words. This option is valid for the PCM30 and PCM30C frames only. To toggle between these two options use the ← or → keys. Press DATA to edit. Two channels per line and the corresponding ABCD word are displayed. Inside the editing screen, press <F2> (EDIT) to edit the bits. The ← or → keys move the cursor to the bit to be changed. Press ↑ or ↓ to change the frame to be edited. Press <F4> (ENTER) to update the edited value or <F1> (EXIT) to cancel editing mode.

```
                TX/RX FRAMED
Slots Config: USER                    ←
Tx Slots:
    [○●●●●●●●●●●●●●●●]
    [○●●●●●●●●●●●●●●●]
Rx Slots:
    [○●●●●●●●●●●●●●●●]
    [○●●●●●●●●●●●●●●●]


BACK          MENU          ASTX          NEXT
   F1           F2            F3            F4
```

- **Slots Config**: When choosing the AUTO option the TSW200E1 tries to synchronize to the pseudo-aleatory patterns that it gets from the slots, selecting those ones automatically. When choosing the USER option, the user can select the TX and Rx slots as desired using the parameters described bellow.
- **Tx Slots**: Selects the timeslot*(s)* for transmission. The user can choose from 01 to 31. Up to 31 can be transmitted. This item selects the timeslot for the transmitter as well as for the INSERT mode when this mode is ON.
- **Rx Slots**: Selects the timeslot*(s)* for reception. The user can choose from 01 to 31. This item selects the timeslot for the receiver as well as for the DROP mode when it is ON.

Press DATA to edit the transmit and receive slots. The ←, ↑, → or ↓ keys move the cursor to the slot to change. The <F2> (○) and <F3> (●) keys are used to select or to de-select a slot. When DATA is pressed again it is possible to select all slots. The CLEAR key de-selects all slots. Pressing <F1> (AS TX) copies to the receive slots the configuration of the transmit slots.

For the PCM30/30C, timeslot 16 cannot be chosen. It is used for control in the CAS word signalling. See Appendix B for more information.

```
              TX/RX  FRAMED

Error Type:       BIT            ←
Error Insert:     SINGLE
Line Code:        HDB3
Termination:      HI-Z UNBAL
Tx Clock Source:  INTERNAL
Clock Deviation:  +50 ppm
BACK        MENU                  NEXT
  F1          F2          F3        F4
```

- **Error Type**: This option allows selection of the error type, which will be inserted in the test. The available options are: BIT, FAS and CRC. To toggle between these options use the ← or → keys.
- **Error Insert**: This option selects of the error insertion mode. It can be SINGLE (inserts

one error each time the error key is pressed) or a rate of insertion from 10^{-1} to 10^{-7} errors can be selected. (Ex: 10E-1, inserts automatically one error at each 10 bits). For the FAS and CRC errors, the user can: use the ERROR key to input SINGLE errors, in the SINGLE mode or choose automatic error insertion, with bit error rate of from 10^{-3} to 10^{-5} Use the ← or → keys to select.

- **Line Code**: Allows the user to choose HDB3 or AMI line codes. Use the ← or → keys to select.

- **Termination**: It is possible to choose the cable termination impedance as 75 ohms UNBAL, 120 ohms BAL, HIGH-Z UNBAL or HIGH-Z BAL. Use the ← or → keys to toggle among these options.

- **Tx Clock Source**: Selects the source of the transmission clock. There are three options that can be selected using the ← or →keys:

  - **External clock:** the transmit data are in sync with the external circuit clock, which must be set up to internal or regenerated clock. The external clock must be provided by the V.35 interface **(Note: connect the TSW200E1 ground to the ground of the equipment which is providing the clock).**

  - **Internal clock**: the Test Set itself provides the transmission clock. In this case, the external circuit must be prepared to receive external clock.

  - **From Rx**: the clock is regenerated from reception.

- **Clock Deviation**: Allows programming the clock deviation from -50 to +50 ppm.

```
┌─────────────────────────────────────────┐
│            TX/RX FRAMED                  │
│                                          │
│   Test Period:        CONTINUOUS  ←      │
│   Histo Resolution:   MINUTES            │
│   Drop & Insert:      ON ON              │
│   Interface:          RS232              │
│   Alarm & Error Buzz: OFF OFF            │
│   Loopback:           NONE               │
│                                          │
│   BACK       MENU              NEXT       │
└─────────────────────────────────────────┘
     F1         F2          F3        F4
```

- **Test Period**: Defines the test duration. It can be CONTINUOUS or timer limited. This timer can be set for up to 10000 hours. To choose between these two options use the ← or → keys. The timer can be edited by pressing DATA. When editing the timer the starting test time must be set.

- **Histo Resolution**: Allows the user to choose the histogram resolution as MINUTES or HOURS. To choose between these two options use the ← or → keys.

- **Drop & Insert**: This option is used to take out or to insert data from the selected timeslot*(s)* from another interface. The choices are OFF OFF, ON OFF, OFF ON or ON ON, using the ← or → keys. The ON state indicates that the mode is active and the OFF state indicates that the mode is inactive.

- **Interface**: This option is available only when Drop&Insert is not set for OFF OFF. It selects which interface will be used to drop or to insert data. It is possible to choose RS232, V35, V36, X.21 or RS530.

- **Alarm & Err Buzz**: Allows the user to turn on or off the alarm and error buzzers. The choices are OFF OFF, ON OFF, OFF ON or ON ON. When ON, the corresponding

buzzer is active and when OFF, the buzzer is inactive.

- **Loopback**: Allows the equipment to be configured to perform a local loopback test (LOCAL), remote (REMOTE) or no loop at all (NONE). For the local loopback, the same data transmitted by the equipment are internally sent to its reception. So, the equipment can be in sync when the test is started, without receiving external data. For the remote loopback, the equipment sends the data it is receiving.

```
┌─────────────────────────────────────┐
│           TX/RX FRAMED               │
│                                      │
│              M.2100                  │
│                                      │
│   Period:            1 day      ←    │
│   Allocation:        35.50%          │
│                                      │
│                                      │
│                                      │
│   BACK        MENU                   │
└─────────────────────────────────────┘
     F1          F2         F3        F4
```
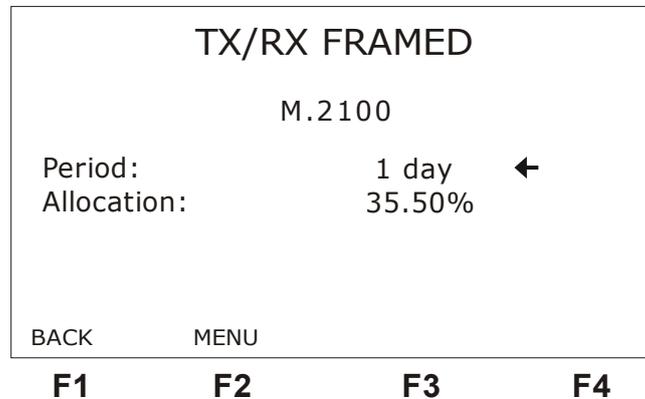
The TSW200E1 calculates parameters following ITU-T Rec. M.2100. The user must preset these parameters. This configuration establishes the test time for M.2100. The TSW200E1 tests up to 8 periods. After that, it starts to write over the old tests. That means that at each 8 periods the TSW200E1 starts a new cycle.

5.3.2 - TX/RX FRAMED Mode test example

The figures below demonstrate two ways of performing the test using this mode.
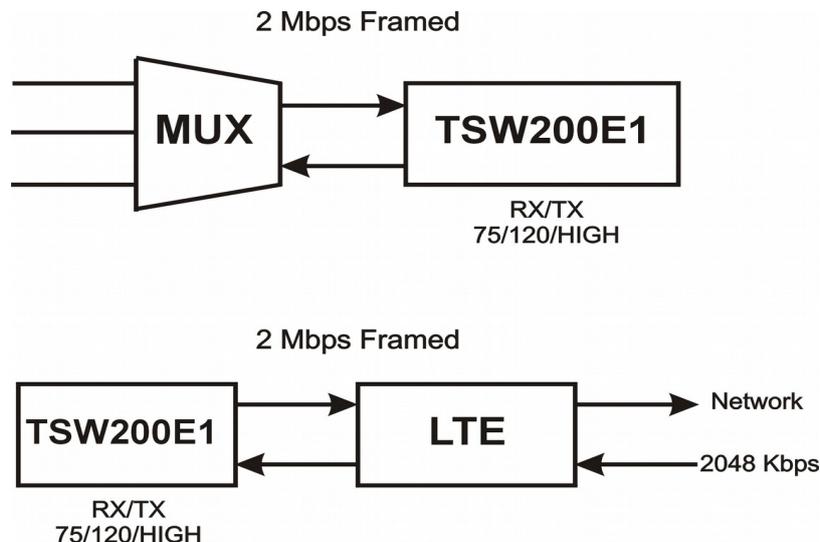
5.4 - The THROUGH FRAMED Mode

In this mode, the TSW200E1 is inserted in the circuit under test and the received framed

signal got by the TSW200E1 is sent to its transmitter. The clock employed is the receive clock, as the equipment is inserted in the middle of the circuit under test.

If it is desired to listen to the audio output of one receive timeslot during the test, it is necessary to turn the loudspeaker on. This is done by means of the AUDIO function key. To turn off the loudspeaker, press the AUDIO key again. In this case, to avoid the selected timeslot to be checked by any selected test pattern, configure the PATTERN parameter for the IDLE option.

For transmission, if no timeslot is selected in the Tx Slots, the TSW200E1 transmits every incoming signal, without caring for the selected pattern and thus remaining transparent to the system.

The frame structured data can be replaced by a test pattern in one or more timeslots. To do this, it is necessary to select one or more timeslots in the TX Slots. If no timeslot is selected in the RX Slots option, the Test Set will simply replace this pattern and transmit, without analysing the incoming data.

The Sa bits of the NFAS words and the timeslot 16 bits ABCD can be programmed, allowing the insertion of signalling tones in the A, B and C bits.

5.4.1 - THROUGH FRAMED Mode Configuration

The Through Framed mode configuration parameters are the same as the TX/RX Framed mode configuration parameters as described in section 5.3.1.

5.4.2 - Through Framed Test example
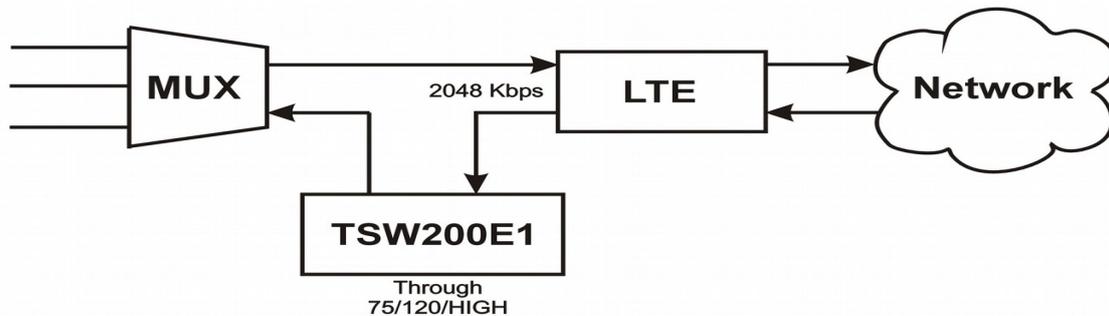
5.5 - MUX Mode

In this mode, the TSW200E1 is used to test multiplexers. A test pattern is sent through one or more channels of the multiplexer, by the V.24/RS232, V.35/V.11, V.36/V.11, X.21/V.11 or RS530 interfaces. The multiplexer-generated 2 Mbps frame-structured data flow is then analysed by the TSW200E1 G.703 - 2 Mbps interface.

5.5.1 - MUX Mode Configuration

The MUX mode configuration parameters are a little different from the TX/RX Framed mode. It has one more parameter to select the interface to be used to send the test patterns to the multiplexer. As it does not transmit using the G.703-2M interface, it does not have the parameters that set up the transmission by that interface. Below the list of the MUX mode parameters follows:

- **PCM**: see section 5.3.1
- **Pattern**: see section 5.3.1

- **Polarity**: see section 5.3.1
- **Tx Clk Src**: see section 5.3.1
- **Interface**: Selects the interface to use. It is possible to choose between V.24/RS232, V35, V36, X.21 or RS530. To change the option place the cursor at the proper line and use the ← or → keys to toggle between the interfaces.
- **Termination**: see section 5.3.1
- **Line Code**: see section 5.3.1
- **Rx Slots**: see section 5.3.1
- **Error Type**: see section 5.3.1
- **Error Insert**: see section 5.3.1
- **Test Period**: see section 5.3.1
- **Histo Resolution**: see section 5.3.1
- **Alarm & Error Buzz**: see section 5.3.1

5.5.2 - A MUX test example

The figure shown below demonstrates one test in the MUX mode.
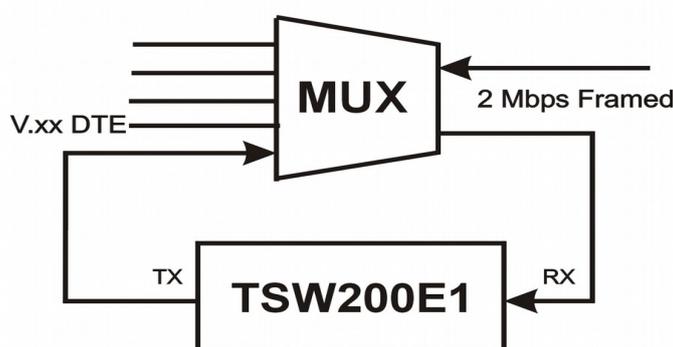
5.6 - The DEMUX mode

The DEMUX mode allows the user to perform demultiplexer tests. The TSW200E1 transmits 2 Mbps data in one or more timeslots from the multiplexer side. Frame structure is supported. From the other side of the multiplexer, data in one or more channels can be monitored using one of the following interfaces: V.24/RS232, V.35/V.11, V.36/V.11, X.21/V.11 or RS530.

The counter options in the DEMUX mode are BIT ERROR, BLK ERROR, BLOCKS, SLIP (as in ITU-T Rec. G.822), PAT.LOSS, RX RATE and TIME. For the BIT ERROR counter, the TSW200E1 performs the following error analyses:

- errored seconds (ERRORED SEC.)
- severely errored seconds (SEV. ERR. SEC.)
- degraded minutes (DEGRADED. MIN.)
- available seconds (AVAILAB. SEC.)
- unavailable seconds (UNAVAIL. SEC.)
- error-free seconds (ERR. FREE SEC.)
- rate between errored bits and the total number of bits transmitted (BER)
- rate between errored blocks and the total number of blocks transmitted (BLER)

according to ITU-T Rec. G.821.

5.6.1 - DEMUX Mode Configuration

The DEMUX mode parameters are a little different from the TX/RX Framed mode parameters. The transmission is done through the G.703-2M interface while the reception is done by other interfaces. It is then necessary to choose the receive interface. The DEMUX mode parameters list follows:

- **PCM**: see section 5.3.1
- **Pattern**: see section 5.3.1
- **Polarity**: see section 5.3.1
- **Idle Code**: see section 5.3.1
- **NFAS/NMFAS**: see section 5.3.1
- **ABCD Bits**: see section 5.3.1
- **Interface**: Selects the interface to use. Options are V.24/RS232, V35, V36, X.21 or RS530. Place the cursor at the proper line and use the ← or → keys to select.
- **Termination**: see section 5.3.1
- **Line Code**: see section 5.3.1
- **Tx Slots**: see section 5.3.1
- **Error Type**: see section 5.3.1
- **Error Insert**: see section 5.3.1
- **Test Period**: see section 5.3.1
- **Histo Resolution**: see section 5.3.1
- **Alarm & Error Buzz**: see section 5.3.1

5.6.2 - DEMUX test example
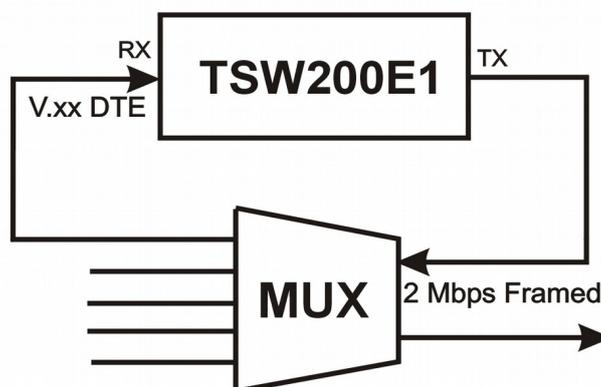
5.7 - The MONITOR Mode

The function of this mode is to monitor the receive data. It is possible to display the eight-bit code word from any selected timeslot or frame. During the test, the choice of the timeslot and the frame to be analysed can be altered.

It is also possible to analyse the FAS, NFAS, MFAS and NMFAS words. For the PCM30

and PCM30C frames, it is possible to simultaneously monitor and visualise the CAS state of the 30 telephone channels.

The TSW200E1 does not transmit in the Monitor mode. The connection used employs the 2 Mbps G.703 interface receive port (RX) only.

5.7.1 -   MONITOR Mode Configuration

The Monitor mode has few setup parameters, for the only setup is for the G.703-2M interface reception. The description of the parameters follows:

- **PCM**: see section 5.3.1
- **Frame**: Selects the frame to display, from 00 to 15.
- **Time slot**: Selects the timeslot to display in the test, from 00 to 31.
- **Termination**: see section 5.3.1
- **Line Code**: see section 5.3.1

5.7.2 -   Performing the MONITOR Test

After plugging the Test Set correctly and setting up the parameters defined in the previous item, it is possible to start the test by pressing the START/STOP key.

The following screen will be displayed:

```
            MONITOR-RUN
               DATA
             00000000

    FRAME :      00       ←
    TIMESLOT:    00



                WORDS       ABCD1       ABCD2
    F1          F2          F3          F4
```
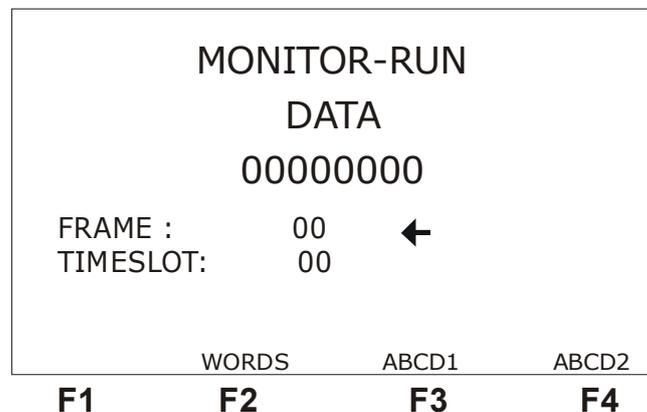
In this screen it is possible to monitor the selected timeslot and frame data. During the test it is possible to select another timeslot and frame to be monitored. To do this, move the cursor appropriately with the ↑ and ↓ keys. Use the ← or → keys to change the number of timeslot or frame.

If it is desired to visualise the status words, press <F2> (WORDS) and then the FAS, NFAS, MFAS and NMFAS words will be displayed, as shown below.

```
┌─────────────────────────────────────────┐
│           MONITOR - RUN                   │
│               WORDS                       │
│                                           │
│   FAS      =     00000000                 │
│   NFAS     =     00000000                 │
│   MFAS     =     0000                     │
│   NMFAS    =     0000                     │
│                                           │
│                                           │
│  DATA                    ABCD1     ABCD2  │
└─────────────────────────────────────────┘
      F1        F2        F3        F4
```

If the frame structure is PCM30 or PCM30C, it is possible to monitor the CAS state for all 30 telephone channels simultaneously. To do this, press <F3> (ABCD1 – channels 1 to 15) or <F4> (ABCD2 - channels 16 to 30). The channel marked with "✓" indicates busy channel; otherwise, the channel is idle. This analysis takes into account the selected idle code.

Appendix A details the PCM30C and PCM31C frames, making it easy to locate the status and channel words. For example, when it is desired to monitor in real-time the signalling changes of the associated channel (CAS) for any telephone channel, choose the value 16 for the timeslot parameter, and change the frame to monitor the ABCD bits of each channel (Example: Frame=1 indicates channels 1 and 16, Frame=2 indicates channels 2 and 17, etc.).

The figure below demonstrates the realization of a test in the Monitor mode.
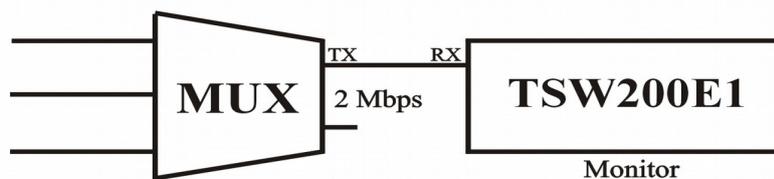
5.8 -   FREQUENCY/LEVEL Mode

In this mode, the TSW200E1 allows one sinusoidal signal or data from the microphone to be inserted in any timeslot of a 2048 kbps G.704 frame. This sinusoidal signal can have user-definable level (from -55 to +3 dBm0) and frequency (1 to 4000 Hz).

Simultaneously, the TSW200E1 analyses and evaluates, for the same timeslot of a received frame, the level and the frequency of a sinusoidal signal sampled using PCM A-law. The level ranges from -55 to +5 dBm0 and the frequency ranges from 1 to 4000 Hz. The TSW200E1 also monitors, in dBm0, a tone in any timeslot, decoding the structured 2048 kbps signal. Thus it allows the audio output of one timeslot to be user monitored in the internal loudspeaker.

The frequency/level mode allows testing a voice frequency multiplexed card. The test can be done by setting analogue loopback on the subscriber end. The performance of this loopback is evaluated in the 2048 kbps interface.

Besides this analogue loopback, it is possible to employ an analogue frequency/level test to

inject a signal. The signal received by the subscriber interface is then measured, while the TSW200E1 is used to inject the coded sinusoidal signal in the 2048 kbps interface. The TSW200E1 then measures the inserted analogue signal, for that interface.

5.8.1 - FREQUENCY/LEVEL Mode Configuration

The Frequency/Level mode configuration is pretty straightforward. The figures below display the two setup screens. The parameters descriptions follow.

```
┌─────────────────────────────────────────┐
│          FREQUENCY / LEVEL              │
│                                          │
│   PCM:              PCM30C      ←        │
│   Idle Code:        10011001             │
│   Termination:      75 ohms UNBAL        │
│   Tx Slots:         01                   │
│   Line Code:        HDB3                 │
│   Polarity:         NORMAL               │
│                                          │
│          MENU                   NEXT     │
└─────────────────────────────────────────┘
       F1        F2        F3        F4
```
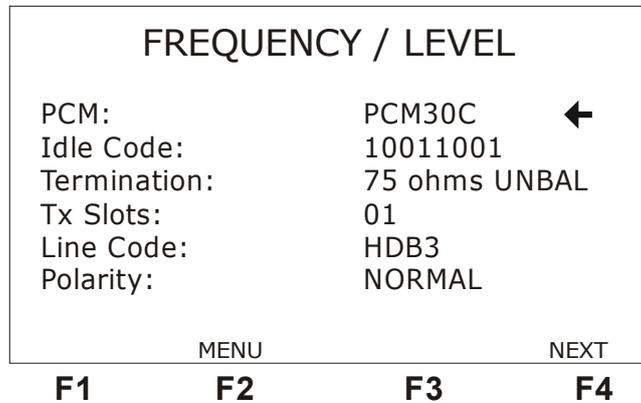
- **PCM**: see section 5.3.1
- **Idle Code**: see section 5.3.1
- **Termination**: see section 5.3.1
- **Txslots**: Selects the timeslot to display in the test. Editing is identical to that of the TX/RX Framed mode. The selected timeslot will be the same for transmission and for reception. Select only one time slot.
- **Line Code**: see section 5.3.1
- **Polarity**: see section 5.3.1

```
┌─────────────────────────────────────────┐
│          FREQUENCY / LEVEL              │
│                                          │
│   Frequency Value:   2100 Hz    ←        │
│   Level Value:       +03  dBm0           │
│   Tx Source:         MIC                 │
│   Loopback:          NONE                │
│                                          │
│                                          │
│   BACK         MENU                      │
└─────────────────────────────────────────┘
       F1        F2        F3        F4
```
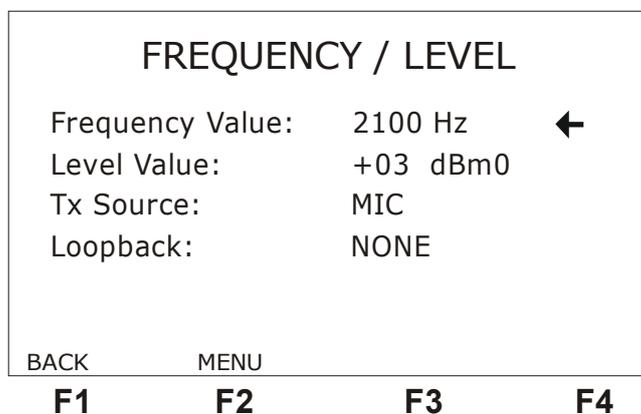
- **Frequency Value**: Selects a frequency value, from 100 to 4000 Hz, for the sinusoidal signal to be sent. To edit, press DATA. The ← or → keys move the cursor to the bit that must be changed. Use the alphanumeric keyboard to change the bits. When done, press <F4> (ENTER) to confirm editing and <F1> (EXIT) to cancel editing.

- **Level Value**: Selects the level, from -55 to +3 dBm0, of the sinusoidal signal to be transmitted. To edit, press DATA. The ← or → keys move the cursor to the bit to change. Use the alphanumeric keyboard to change the bits. When done, press <F4> (ENTER) to confirm editing or <F1> (EXIT) to cancel editing.
- **Tx Source**: Selects the source of the data transmitted by the equipment. These data can be the tone generated internally by the equipment (TONE), whose parameters are the frequency and the level above described. The source can also be the audio signal input by the microphone (MIC).
- **Loopback**: Allows the equipment to be configured to perform a local loopback test (LOCAL) or no loop at all (NONE). For the local loopback, the same data transmitted by the equipment are internally sent to its reception. So, the equipment can be in sync when the test is started, without receiving external data.

5.8.2 - Performing the FREQUENCY/LEVEL Test

After connecting and setting up the Test Set correctly, the test can be started. To do this, press the START/STOP key. The following screen will be displayed:

```
                      TRANSMITTER
              Frequency:  2100Hz
              Level:             +03 dBm0
                       RECEIVER
              Frequency:  2100 Hz
              Level:        +03.0 dBm0
              Peak+:               128
              Peak -:              128

                   Selected Time Slot: 01
        SLOTDN     SLOTUP                AUDIO ON
```

F1	F2	F3	F4

This screen displays the results of the level and frequency of the received signal and it also informs the level and frequency which were set up at the transmission.

The values displayed in front of the labels Peak+ and Peak- represent the greatest absolute values received within the A-law coding employed by the equipment.

It is possible to change the frequency and level values of the transmitted sinusoidal signal without stopping the test. To do this, use the ←, ↑, →, ↓ and DATA keys. Use the <F4> (AUDIO ON/OFF) key to turn the audio on or off. The audio data are the data received and decoded by the equipment.

<F1>(SLOT↓) and <F4>(SLOT↑) change the slot to transmit and to receive.

5.9 - The ROUND-TRIP DELAY Mode

The delay measurements are derived from the time elapsed between transmission and reception of a selected pattern where a marker has been inserted. So, the test can be performed only for looped-back circuits. The test can be performed either for framed or unframed circuits.

5.9.1 - ROUND-TRIP DELAY Mode Configuration

The figure below displays the unframed circuits configuration screen.

```
          ROUND-TRIP DELAY

   Interface:        RS232         ←
   Pattern:          63
   Polarity:         NORMAL
   Tx Clk Source:    INTERNAL
   Tx Rate:          0064000 bps


   FRAMED       MENU
     F1          F2          F3          F4
```
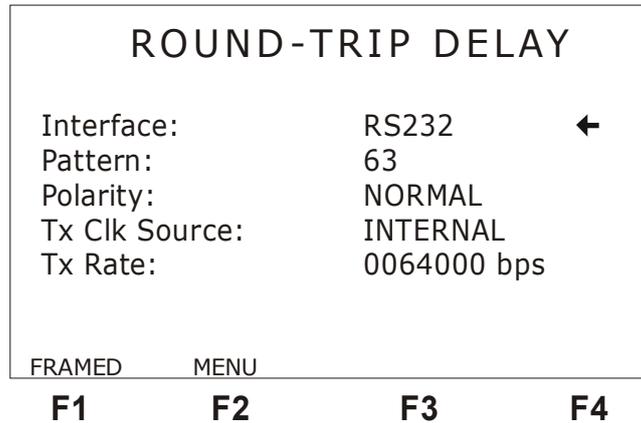
To toggle to the structured circuits setup screen, press <F1> (FRAMED). The following screen will be shown:

```
       ROUND-TRIP DELAY

   PCM:                PCM30    ←
   Pattern:            2E3-1/07
   Polarity:           NORMAL
   Idle Code:          11111111
   NFAS/NMFAS:         DEFAULT
   ABCD Bits:          DEFAULT
   UNFRAM      MENU               NEXT
     F1          F2        F3       F4
```
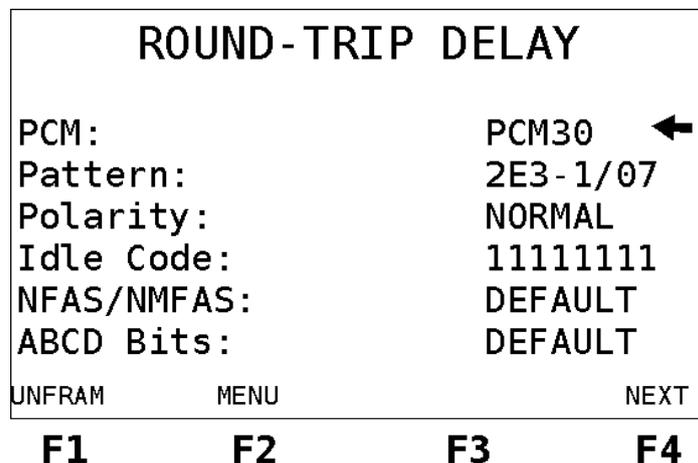
The setup for structured mode has three screens. To navigate among the screens use <F4> (NEXT) and <F1> (BACK) keys. A description of the setup parameters for the Round-Trip Delay mode follows.

- **Interface**: Available for the non-framed mode only. Selects which interface to use. The options are V.24/RS232, V35, V36, X.21, RS530 or G.703-2M. To change an option, place the cursor at the proper line and use the → or ← keys to select the interfaces.
- **Tx Clk Src**: Can assume the following values:
  - ◆ **Internal**: when the Test Set itself provides the transmit clock. In this case, the external circuit must be prepared to receive external clock.
  - ◆ **External**: when the transmit data are in sync with the external circuit clock. This external circuit must be set up for internal or regenerated clock. For the G.703-2M case, the external clock must be provided by the V.35 interface. **Note**:

connect together the grounds of the TSW200E1 and of the clock-providing equipment.

- ◆ **From RX**: when the clock is regenerated from reception. This option is available only for the G.703 interface.
- **Tx Rate**: see section 4.1
- **Pattern**: see section 5.3.1
- **Polarity**: see section 5.3.1
- **Line Code**: see section 5.3.1
- **PCM**: see section 5.3.1
- **Idle Code**: see section 5.3.1
- **NFAS/NMFAS**: see section 5.3.1
- **ABCD Bits**: see section 5.3.1
- **Termination**: see section 5.3.1
- **Tx Slots**: see section 5.3.1
- **Rx Slots**: see section 5.3.1

As the test is performed in loopback mode, the timeslots selected must be the same for transmission and reception.

5.9.2 - Performing the ROUND-TRIP DELAY test

After connecting and setting up the Test Set correctly, press START/STOP key to start the test. Remember that the circuit must be in loopback. The following screen will be displayed:

```
┌─────────────────────────────────────────┐
│                                          │
│                                          │
│        Round-Trip Delay:                 │
│          0000000 us                      │
│                                          │
│        Zero Correction:                  │
│          0000000 us                      │
│                                          │
│                                          │
│                                          │
│         SEND      SET-ZERO    RESET       │
└─────────────────────────────────────────┘
   F1       F2        F3         F4
```
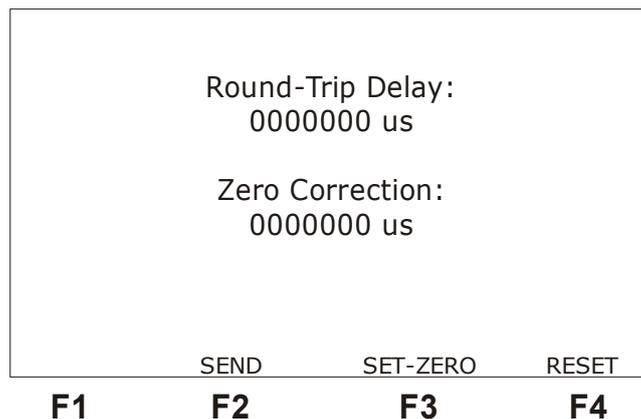
<F3> (SET ZERO) allows subtraction of one local delay from the total measurement (Zero Correction). An example of how this can be used is to remove the round-trip delay from a local equipment from the total delay measurement for a remote loopback. To do this, start the test-setting loopback for the local equipment and press <F2> (SEND). An error is then inserted. Then, press <F3> (SET ZERO). Now, set up the loopback in the remote equipment and press <F2> (SEND) again. The resulting "round-trip delay" is the delay introduced by the network and by the remote loopback, notwithstanding the local equipment delays. The delay is re-evaluated each time <F2> (SEND) is pressed. Pressing <F4> (RESET) sets "Zero Correction" to zero.

The "Round-trip Delay" evaluation can be done for framed circuits similarly as for unframed circuits.

6 -   Memory and Printout

The TSW200E1 test data (counters and histograms) and the configuration data (that of the BERT/BLERT and E1/G.704 modules) can be stored in memory to be displayed or printed later. The setup data cannot be printed. The TSW200E1 has eleven memories (MEMO1 to MEMO10, LAST) to store performed tests and five setup memories. Other than these, the Factory Default standard configuration can be loaded. The last performed test results are automatically stored in the LAST memory until another test is run.

To save, to visualise or to print the finished test result or a memory position, it is necessary to get to the screen displayed below. This screen is reached from many screens (OK screen, Module screen or Mode menu screen, inside each module). It is reached when <F2> (MEMORY) is pressed.

```
                   MEMORY
    LAST:      TITLE1    26/05/04 14:45
    MEMO1:     TITLE2    25/05/04 14:45
    MEMO2:     TITLE3    24/05/04 14:45
    MEMO3:     TITLE4    23/05/04 14:45
    MEMO4:     TITLE5    22/05/04 14:45
    MEMO5:     TITLE6    21/04/04 14:45
    MEMO6:     TITLE7    20/04/04 14:45
    MEMO7:     TITLE8    19/04/04 14:45
    MEMO8:     TITLE9    18/04/04 14:45
    MEMO9:     TITLE10   17/03/04 14:45
    MEMO10:    TITLE11   16/03/04 14:45
    CONFIGURATION:   Factory Default
   LOGO                    VIEW      MODULE

     F1          F2         F3         F4
```

As shown in the above figure, a user-edited title is displayed beside each memory, as the date and hour of the test starting time.

6.1 -   Saving a Test and Displaying a Saved Test

To save the last performed test, use the ← and → keys to move the cursor to the desired memory position. Press <F2> (SAVE) to store the last test results data. The new data will overwrite the previously saved data.

To edit a memory title, place the cursor at the corresponding line and press DATA. The title can have up to eight characters. In the editing mode, use the ← and → keys to move the cursor and the alphanumeric keys to edit the title. Press the alphanumeric key where the desired letter is as many times as necessary to display it, just as the typical mobile phone keyboard works. Pressing the CLEAR key erases the title. When done, press <F4> (ENTER) to confirm or <F1> (EXIT) to cancel.

To visualise the memory data, place the cursor at the memory to be visualised and press <F3> (VIEW). The menu screen will be displayed. This screen displays the performed test mode, the visualised memory and the test data and time. To see the results, the procedures are the same as when the test is being run.

6.2 -   Saving and Loading a Configuration

The TSW200E1 has five memories designed to save the setup parameters. So, if more than

one kind of setup is often used, it is possible to save the setup. It can be easily loaded, thus avoiding setting each of the parameters individually.

To save a configuration, setup the Test Set as desired and go back to the Memory screen. After that, place the cursor in the last line and use the ← and → keys to select the desired position. Press <F2> (SAVE) and then all setup parameters are stored.

To load a configuration memory, choose from which memory it is desired to load using the ← and → keys. Next, press <F3> (LOAD) and the equipment will be set up according to the selected memory.

6.3 - *Printing Results*

The test results can be printed during execution or later, from the equipment memory.

Printing can be serial or parallel, using the appropriate cable. The serial and parallel cables are provided. For parallel printing, the user must provide a printer with adequate buffering capability to hold the data while it is being printed, for there is no flow control.

First connect the TSW200E1 to the printer using the appropriate cable (serial or parallel) on the back panel connector.

If it is desired to print while the test is running, it is necessary to setup printing before the test starts. For serial printing, the data transmission rate must be chosen. Some serial communication parameters are predetermined: 8-bit word, no parity, 1 stop bit and no flow control.

Pressing the PRINT key in any memory visualisation screen causes the TSW200E1 to display the print management screen shown below.

```
┌─────────────────────────────────────┐
│              PRINT                   │
│                                      │
│   MEMO DATA =  LAST RESULTS    ←     │
│                                      │
│   TYPE       = SERIAL                │
│   TX CLOCK   = 50 bps                │
│                                      │
│                                      │
│                                      │
│                                      │
│          EXIT            PRINT       │
└─────────────────────────────────────┘
   F1        F2        F3        F4
```
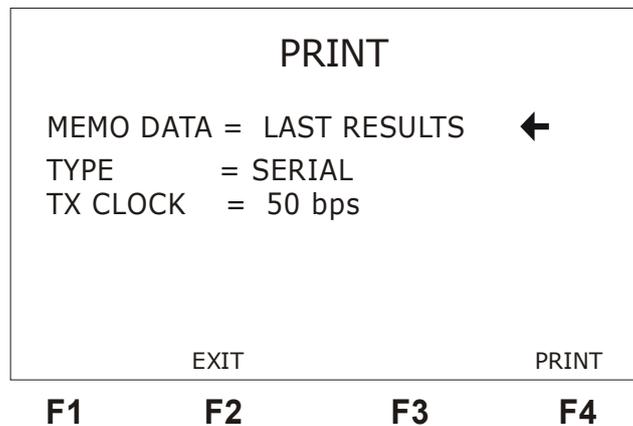
Use the ↑ or ↓ keys to place the cursor at the appropriate line and use the ← or → keys to set up the parameter as desired. Place the cursor at the MEMO DATA line and select the data source (last test result, LAST, or memories 1 to 10, MEMO1 to MEMO10). After that, select the print TYPE and the data transmission speed in TX CLK. After this, press PRINT or <F4> and the results will be printed. To get out of this screen, press <F1> (BACK).

If on-line printing is desired, set up the equipment and go back to the setting screen for the desired test. Start the test. While the test is running, press PRINT. Many printings can be done during the same test. The histograms are not printed during the test, but only from the equipment memories.

If the user has no printer, Windows HyperTerminal can be used to upload serially the results to the computer. To do this, open the HyperTerminal (in Start/Programs/Accessories/Communications/HyperTerminal – file hypertrm.exe). Connect the

equipment to the computer serial port by the serial cable. As the HyperTerminal starts, it will ask for the connection name. Choose one. On the next screen, displayed below, choose **connect using**: select COM X port (selects the desired number of the communication port, usually 1 or 2). Click OK.

In the screen below, set up the port: set the Bits per second with the same rate as defined in the TSW200E1, 8 data bits, no parity, 1 stop bit and no flow control. Then, click OK.
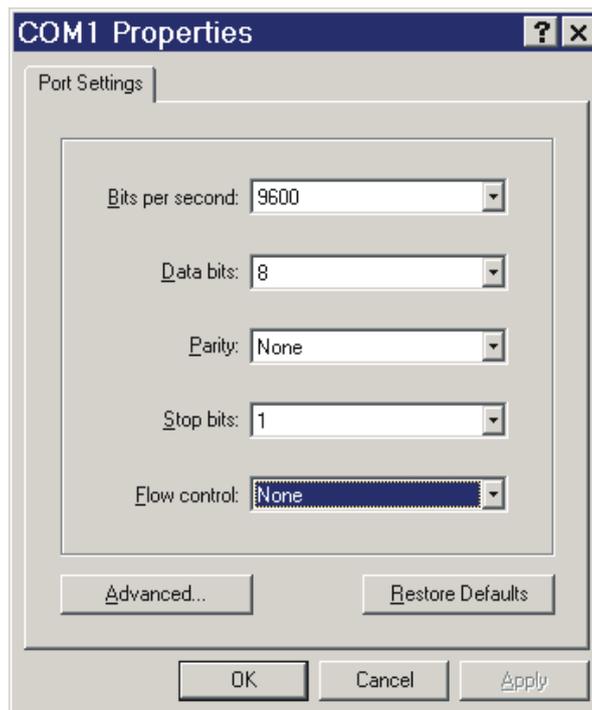
From this moment on, the computer will receive data by the selected serial port. At the TSW200E1, press the PRINT or <F4> key and the data will be sent to the computer. The ASCII-only text appears in the screen.

To save data, use the mouse to highlight the desired text. Select **Edit** and **Copy**. Exit the present screen, but not the HyperTerminal. Click over CAPTURE.TXT. The Windows Notepad program will open. Select **Edit** and **Paste**. The text will appear on the Notepad screen. Now select **File** and **Save as**. Edit the filename and press enter. To read, use Windows Notepad.

Three different cables can be used to print. The correct interface type must be set up at the equipment. The cable options are serial, parallel or the serial-parallel converter, which can be ordered along with the equipment. For this cable, the TSW200E1 must be set up for serial printing.

7 - Remote Control

The purpose of the remote control is to command execution of the BERT Synchronous and TX/RX Framed tests without any personnel assistance in the same room where the test is performed. This facility allows checking the test results or changing some of the configuration parameters.

The equipment remote control is based on its serial communication with a computer by means of a terminal. So, the user must connect the computer to the TSW200E1 by means of a serial cable and the Remote Printer connector. The equipment must be turned on and must be displaying either the BERT Synchronous screen or the TX/RX Framed screen. The serial communication parameters are set: 9600 bps, 8 data bits, no parity, 1 stop bit and no flow control.

The command list is not long, but varies if the equipment is in the configurator mode or running a test and it depends on each test.

When the unit displays either the BERT Sybchronous or the TX/RX Framed config screens and it receives a remote control command, the auto power-off feature is automatically disabled. This feature is turned back on when leaving this modules or the next time the unit is turned on.

Command	BERT Configurator	Running BERT	TXRX Configurator	Running TXRX	Examples
h	Lists the available commands for the situation				h
cf	Lists the programming of the configuration parameters that can be changed remotely at the module				cf
st	Starts the test	-	Starts the test	-	st
sp	-	Stops the test	-	Stops the test	
e1	Changes to the TXRX Framed mode configurator	-	-	-	e1
b	-	-	Changes to the BERT Synchronous mode configurator	-	b
ck[x]	Selects internal clock (x=i), external (x=e), or from rx (x=f)	-	-	-	cki cke ckf
tx[x]	Chooses the transmission rate. Values between 1200Hz and 10MHz				tx1200 tx2048000 tx8000000
s[x]	-	-	Chooses the transmission and reception slots, accepting as arguments: n=no		sn sa s21 s14

Command	BERT Configurator	Running BERT	TXRX Configurator	Running TXRX	Examples
			slot, a=all, or 1 to 31 to alter the selection of the slot of that number		
p[x]	-	-	Selects the type of frame sent, accepting as arguments: 0=PCM30, 0c=PCM30C, 1=PCM31, 1c=PCM31C, a=AUTO	-	p0 p0c p1 p1c pa
cl	-	Clears or restarts the test	-	Clears or restarts the test	cl
pr	-	Prints the test results	-	Prints the test results	pr

8 - Software Update

To update the equipment's software, insert or remove modules, look for UPW Operation Manual.

9 - Glossary of Technical Terms

2-wire

Communication in which two modems are interconnected by only a wire pair. See full-duplex.

4-wire

Communication in which two modems are interconnected by two wire pairs. See full-duplex.

AIS (*Alarm Indication Signal)*

Alarm Indication Signal: signal that gets active when any alarm condition arises.

BPS (Bits per second) or bits/s

Number of bits transmitted or received per second

CAS (*Channel Associated Signalling)*

Used for 2 Mbps PCM30 and PCM30C.

CCITT

Abbreviation of ***Comité Consultatif International Téléphonique et Télégraphique***, an organization that sets international communications standards. CCITT, now known as ITU (the parent organization) has defined many important standards for data communications.

CPE

(Pronounced as separate letters) Short for ***customer premises equipment***, communications equipment that resides on the customer's premises (i.e., it is owned or leased by the customer). Client-owned equipment.

CRC (*Cyclic Redundancy Check)*

CRC-4 consists in an error detection method used for 2 Mbps frames, where for each transmitted data block a set of bits is added, which allows error detection within the block. A CRC-4 (C1 C2 C3 C4) word, placed at the N *sub-multiframe*, is the remainder of the operation: multiplication by x^4 and division by the generated polynomial $x^4 + x + 1$, of the polynomial representing the N-1 *sub-multiframe*. In this process, the C1 bit is defined as the most significant bit of the remainder and C4 is the least significant bit.

DCE (*Data Communications Equipment)*

A device that communicates with a Data Terminal Equipment (DTE) device in RS-232C communications. Usually a modem.

DTE (*Data Terminal Equipment)*

A device that controls data flowing to or from a computer. The term is most often used in reference to serial communications defined by the RS-232C standard. It is usually a video terminal, a microcomputer, etc.

Duplex

Data communication between two devices that can happen both ways, that is, from a device to the other and vice-versa. See full-duplex.

FAS (*Frame Alignment Signal)*

Used for timeslot 0 for alternated (even) frames for the 2 Mbps frames or for bit 7 of each X.50 frame octet.

FCS (*Frame Check Sequence*)

Used to detect errors based on CRC.

Full-Duplex

It is the simultaneous communication between two devices. For modems, that implies both devices are transmitting and receiving data simultaneously. It can happen using two pairs of wires (4-wire), where each pair is used to transmit for each modem, or using only one pair, when the signals sent by each modem mix up in the wires, being split after reaching the destination.

HDB3

The HDB3 code is a bipolar signalling technique (i.e. relies on the transmission of both positive and negative pulses). It is based on Alternate Mark Inversion (AMI), but extends this by inserting violation codes whenever there is a run of four or more 0's, to prevent long runs of 0's in the data stream, which may otherwise prevent a DPLL from tracking the centre of each bit. This violation code must always have inverted polarity regarding the previous violation.

Homologation

After thoroughly testing a modem, assuring compatibility with industry communication patterns, Brazilian Telebrás is the telecommunications company that allows a product to be considered homologated. This is an essential condition for a product to be volume-produced and used in Brazil's huge telecommunication system.

Interface

A boundary across which two independent systems meet and act on or communicate with each other. In computer technology, there are several types of interfaces.

ITU-T (International Telecommunication Union)

International organization within the United Nations System where governments and the private sector coordinate global telecom networks and services. It defines the rules and standards for telecommunications transmission. CCITT successor.

LAN (*Local Area Networks*)

 A computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANs over any distance via telephone lines and radio waves. A system of LANs connected in this way is called a wide-area network (WAN).

Link

 Connection between two devices.

LOF (*Loss Of Frame*)

 FAS loss. This term is used at the ITU-T Recommendations G.826 and M.2100.

LOS (*Loss Of Signal*)

 This term is used at the ITU-T Recommendations G.826 and M.2100.

Modem

 Contraction of the words **Mod**ulator and **Dem**odulator. It indicates a class of devices that allow digital data to be transmitted over normal telephone lines, modulating the signal at the transmit side and demodulating it at the receive side.

Synchronous/Asynchronous Mode

 For the synchronous mode, data are transmitted according to a separate clock signal, which is used at the reception to identify the data. In this case, the transmitter and receiver must be in sync.

 For the asynchronous mode, there is no separate clock signal: the characters of any data are preceded by start bits and followed by stop bits, which provide synchronism at the receive end.

ms

 Millisecond; equivalent to a thousandth (10^{-3}) of a second.

MFAS (*MultiFrame Alignment Signal)*)

 Used at timeslot 16 for frame 0 for the 2 Mbps frames.

NFAS (*Non-Frame Alignment Signal)*)

 These are the odd frames (for timeslot 0) that do not have the frame alignment signal for the 2 Mbps frames.

NMFAS (*Non MultiFrame Alignment Signal)*)

 It does not posses the multiframe alignment signal for the 2 Mbps frames and it is associated to the MFAS word (bits 5 to 8 of timeslot 16, frame 0). This word is only used for the PCM30 and PCM30C standards.

PCM (*Pulse Code Modulation*)

 Short for *pulse code modulation,* a sampling technique for digitising analogue signals,

especially audio signals. PCM samples the signal 8000 times a second; each sample is represented by 8 bits for a total of 64 Kbps. There are two standards for coding the sample level. The Mu-Law standard is used in North America and Japan while the A-Law standard is use in most other countries.

Protocol

An agreed-upon format and set of rules for transmitting data between two devices. The protocol determines the type of error checking to be used, the data compression method, if any, how the sending device will indicate that it has finished sending a message, how the receiving device will indicate that it has received a message and the timings involved in the intercommunication.

REMOTE ALARM

Counter for the occurrence of remote alarms.

RMF ALARM

Remote multiframe alarm.

Remote

It is said of the device that is far away. In a connection between two modems, the local one is the one next to the operator and the remote one is located far away. In a test in a workbench, the modems can be side by side. It is usual to call one of them local and the other, remote, so as to set the modems to operate correctly.

Test-Set

Equipment to test communication links. Usually this device is able to simulate many conditions and/or devices.

Appendix A - RS232, V.35/V.11, V.36/V.11, X.21/V.11, RS530 and G.703 Interface Signals

A.1 – V.24/RS 232 Interface

The table below describes the TSW200E1 RS232 interface connector pinout.

Pin	Circuit (V.24)	Name	Description	Category/Source
2	103	DTX	Data Transmit Ready	Data / DTE
3	104	DRX	Data Receive Ready	Data / DCE
4	105	RTS	Ready to Send	Control / DTE
5	106	CTS	Clear to Send	Control / DCE
6	107	DSR	Data Set Ready	Control / Modem
7	102	0V	Signal Ground	-----------------------
8	109	DCD	Data Carrier Detect	Control / DCE
15	114	TCK	Transmit Clock	Sync/DCE
17	115	RCK	Receive Clock	Sync/DCE
20	108	DTR	Data Terminal Ready	Control / DTE
24	113	TCKE	Test Set Transmit Clock	Sync/DTE

A.2 – V.35/V.11 Interface

To use the V.35 interface an optional cable is needed. This table describes the TSW200E1 V.35/V.11 interface connector pinout.

Pin - M34	Circuit (V.35)	Name	Description	Electrical spec	Category/ Source
B	102	0V	Signal Ground	V.28	--------------
P **S**	103	DTX-A DTX-B	Data Transmit Ready	V.35	Data / Test Set
R **T**	104	DRX-A DRX-B	Data Receive Ready	V.35	Data / Modem
C	105	RTS	Ready to Send	V.28	Control / Test Set
D	106	CTS	Clear to Send	V.28	Control / Modem
E	107	DSR	Data Set Ready	V.28	Control / Modem
F	109	DCD	Data Carrier Detect	V.28	Control / Modem
Y **AA**	114	TCK-A TCK-B	Transmit Clock	V.35	Sync / Modem
V **X**	115	RCK-A RCK-B	Receive Clock	V.35	Sync / Modem
H	108	DTR	Data Terminal Ready	-	Control / Test Set
U **W**	113	TCKE-A TCKE-B	Test Set Transmit Clock	-	Sync / Test Set

A.3 – V.36 / RS-449 and V.11 Interface

To use the V.36 interface an optional cable is needed. This table describes the TSW200E1 V.36/V.11 interface connector pinout.

Pin DB37	Circuit (V.36)	Name	Description	Electrical spec	Category / Source
19	102	0V	Signal Ground	-	--------------
4 **22**	103	DTX-A DTX-B	Data Transmit Ready	V.11	Data / Test Set
6 **24**	104	DRX-A DRX-B	Data Receive Ready	V.11	Data / Modem
7 **25**	105	RTS-A RTS-B	Ready to Send	V.11	Control / Test Set
9 **27**	106	CTS-A CTS-B	Clear to Send	V.11	Control / Modem
11 **29**	107	DSR-A DSR-B	Data Set Ready	V.11	Control / Modem
13 **31**	109	DCD-A DCD-B	Data Carrier Detect	V.11	Control / Modem
5 **23**	114	TCK-A TCK-B	Transmit Clock	V.11	Sync / Modem
8 **26**	115	RCK-A RCK-B	Receive Clock	V.11	Sync / Modem
30 **12**	108	DTR-A DTR-B	Data Terminal Ready	V.11	Control / Test Set
17 **35**	113	TCKE-A TCKE-B	Test Set Transmit Clock	V.11	Sync / Test Set

A.4 –X.21/V.11 Interface

To use the X.21 interface an optional cable is needed. This table describes the TSW200E1 X.21 interface DB15 connector pinout.

Pin	Circuit (X.21)	Name	Description	Electrical Spec	Category / Source
1	G	GND	Shield	---------	---------
8	Ga	0V	0V	---------	---------
2 9	T	DTX-A DTX-B	Data Transmit Ready	V.11	Data / Test Set
4 11	R	DRX-A DRX-B	Data Receive Ready	V.11	Data / Modem
3 10	C	RTS-A RTS-B	Control	V.11	Control / Test Set
5 12	I	CTS-A CTS-B	Indicator	V.11	Control / Modem
6 13	S	RCK-A RCK-B	Receive Clock	V.11	Sync / Modem

A.5 –G.703 (Co-directional 64 kbps) Interface

Connector	Name	Description	Ruler Pin	Category / Source
Ruler	Tx	Transmit Terminal	12	Data / Test Set
Ruler	Rx	Receive Terminal	34	Data / Modem

A.6 –G.703 - 2 Mbps Interface

Connector	Name	Description	Category / Source
Female BNC	Tx	Transmit Terminal	Data / Test Set
Female BNC	Rx	Receive Terminal	Data / Modem

A.7 – RS530 Interface

Pin DB25	Circuit (RS530)	Name	Description	Category/ Source
1 7	102	0V	Signal Ground	---------------
2 14	103	DTX-A DTX-B	Data Transmit Ready	Data / Test Set
3 16	104	DRX-A DRX-B	Data Receive Ready	Data / Modem
4 19	105	RTS-A RTS-B	Ready to Send	Control / Test Set
5 13	106	CTS-A CTS-B	Clear to Send	Control / Modem
6 22	107	DSR-A DSR-B	Data Set Ready	Control / Modem
8 10	109	DCD-A DCD-B	Data Carrier Detect	Control / Modem
15 12	114	TCK-A TCK-B	Transmit Clock	Sync / Modem
17 9	115	RCK-A RCK-B	Receive Clock	Sync / Modem
20 23	108	DTR-A DTR-B	Data Terminal Ready	Control / Test Set
24 11	113	TCKE-A TCKE-B	Test Set Transmit Clock	Sync / Test Set

Appendix B – 2 Mbps PCM Frame Structure

Following ITU-T Recommendation G.704, the 2048 Kbps PCM frame consists in 256 bits organized in 32 octets (bytes), better known as timeslots. There are four PCM types: PCM30, PCM30C, PCM31, PCM31C. The PCM30 structure has CAS on timeslot 16. For PCM31, timeslot 16 is a normal signalling channel. The PCM30C and PCM31C have CRC-4.

B.1 – PCM30C

SMF(*)	Frame	Timeslot 0								Timeslots 1 to 15	Timeslot 16(CAS)								Timeslots 17 to 31
I	0	FAS								8 bits per slot	MFAS				NMFAS				8 bits per slot
		C1	0	0	1	1	0	1	1		0	0	0	0	x	y	x	x	
	1	NFAS								8 bits per slot	channel 1				channel 16				8 bits per slot
		0	1	A	Sa	Sa	Sa	Sa	Sa		A1	B1	C1	D1	A16	B16	C16	D16	
	2	FAS								8 bits per slot	channel 2				channel 17				8 bits per slot
		C2	0	0	1	1	0	1	1		A2	B2	C2	D2	A17	B17	C17	D17	
	3	NFAS								8 bits per slot	channel 3				channel 18				8 bits per slot
		0	1	A	Sa	Sa	Sa	Sa	Sa		A3	B3	C3	D3	A18	B18	C18	D18	
	4	FAS								8 bits per slot	channel 4				channel 19				8 bits per slot
		C3	0	0	1	1	0	1	1		A4	B4	C4	D4	A19	B19	C19	D19	
	5	NFAS								8 bits per slot	channel 5				channel 20				8 bits per slot
		1	1	A	Sa	Sa	Sa	Sa	Sa		A5	B5	C5	D5	A20	B20	C20	D20	
	6	FAS								8 bits per slot	channel 6				channel 21				8 bits per slot
		C4	0	0	1	1	0	1	1		A6	B6	C6	D6	A21	B21	C21	D21	
	7	NFAS								8 bits per slot	channel 7				channel 22				8 bits per slot
		0	1	A	Sa	Sa	Sa	Sa	Sa		A7	B7	C7	D7	A22	B22	C22	D22	
II	8	FAS								8 bits per slot	channel 8				channel 23				8 bits per slot
		C1	0	0	1	1	0	1	1		A8	B8	C8	D8	A23	B23	C23	D23	
	9	NFAS								8 bits per slot	channel 9				channel 24				8 bits per slot
		1	1	A	Sa	Sa	Sa	Sa	Sa		A9	B9	C9	D9	A24	B24	C24	D24	
	10	FAS								8 bits per slot	channel 10				channel 25				8 bits per slot
		C2	0	0	1	1	0	1	1		A10	B10	C10	D10	A25	B25	C25	D25	
	11	NFAS								8 bits per slot	canal11				channel I26				8 bits per slot
		1	1	A	Sa	Sa	Sa	Sa	Sa		A11	B11	C11	D11	A26	B26	C26	D26	
	12	FAS								8 bits per slot	channel 12				channel 27				8 bits per slot
		C3	0	0	1	1	0	1	1		A12	B12	C12	D12	A27	B27	C27	D27	
	13	NFAS								8 bits per slot	channel 13				channel 28				8 bits per slot
		E1	1	A	Sa	Sa	Sa	Sa	Sa		A13	B13	C13	D13	A28	B28	C28	D28	
	14	FAS								8 bits per slot	channel 14				channel 29				8 bits per slot
		C4	0	0	1	1	0	1	1		A14	B14	C14	D14	A29	B29	C29	D29	
	15	NFAS								8 bits per slot	channel 15				channel 30				8 bits per slot
		E2	1	A	Sa	Sa	Sa	Sa	Sa		A15	B15	C15	D15	A30	B30	30C	30D	

(*) Sub-Multiframe

B.2 – PCM31C

SMF(*)	Frame	Timeslot 0								Timeslots 1 to31
I	0	FAS								8 bits per slot
		C1	0	0	1	1	0	1	1	
	1	NFAS								8 bits per slot
		0	1	A	Sa	Sa	Sa	Sa	Sa	
	2	FAS								8 bits per slot
		C2	0	0	1	1	0	1	1	
	3	NFAS								8 bits per slot
		0	1	A	Sa	Sa	Sa	Sa	Sa	
	4	FAS								8 bits per slot
		C3	0	0	1	1	0	1	1	
	5	NFAS								8 bits per slot
		1	1	A	Sa	Sa	Sa	Sa	Sa	
	6	FAS								8 bits per slot
		C4	0	0	1	1	0	1	1	
	7	NFAS								8 bits per slot
		0	1	A	Sa	Sa	Sa	Sa	Sa	
II	8	FAS								8 bits per slot
		C1	0	0	1	1	0	1	1	
	9	NFAS								8 bits per slot
		1	1	A	Sa	Sa	Sa	Sa	Sa	
	10	FAS								8 bits per slot
		C2	0	0	1	1	0	1	1	
	11	NFAS								8 bits per slot
		1	1	A	Sa	Sa	Sa	Sa	Sa	
	12	FAS								8 bits per slot
		C3	0	0	1	1	0	1	1	
	13	NFAS								8 bits per slot
		E1	1	A	Sa	Sa	Sa	Sa	Sa	
	14	FAS								8 bits per slot
		C4	0	0	1	1	0	1	1	
	15	NFAS								8 bits per slot
		E2	1	A	Sa	Sa	Sa	Sa	Sa	

(*) SMF - Sub-MultiFrame

Appendix C - V.35/V.11, V.36/V.11, X.21/V.11, RS530 Cable Pinouts and E1 120 Ohm Interface Pinout

C.1 – V.35/V.11 Cable

HD26 MALE	M34 MALE	NAME
01	B	GND
02	NC	
03	NC	
04	W	TCKE-B
05	U	TCKE-A
06	NC	
07	F	DCD
08	NC	
09	E	DSR
10	NC	
11	NC	
12	NC	
13	D	CTS
14	X	RCK-B
15	V	RCK-A
16	H	DTR
17	C	RTS
18	T	DRX-B
19	R	DRX-A
20	AA	TCK-B
21	Y	TCK-A
22	S	DTX-B
23	P	DTX-A
24	NC	
25	NC	
26	NC	

C.2 – V.36/V.11 Cable

HD26 MACHO	DB37 MACHO	NOME
1	19	GND MALHA
1	25,30	RTS-B, DTR-B
2	27	CTS-B
3	9	CTS-A
4	VAGO	
5	VAGO	
6	11	DSR-A
7	VAGO	
8	35	TCKE-B
9	VAGO	
10	17	TCKE-A
11	22	DTX-B
12	4	DTX-A
13	VAGO	
14	26	RCK-B
15	8	RCK-A
16	VAGO	
17	7,12	RTS-A, DTR-A
18	24	DRX-B
19	6	DRX-A
20	23	TCK-B
21	5	TCK-A
22	VAGO	
23	VAGO	
24	29	DSR-B
25	31	DCD-B
26	13	DCD-A

C.3 – X.21/V.11 Cable

HD26 MALE	D15 MALE	Name
01	01,08	GND
01	10	RTS-B
02	12	CTS-B
03	05	CTS-A
04	NC	
05	NC	
06	NC	
07	NC	
08	NC	
09	NC	
10	NC	
11	09	DTX-B
12	02	DTX-A
13	NC	
14,20	13	RCK-B, TCK-B
15,21	06	RCK-A, TCK-A
16	NC	
17	3	RTS-A
18	11	DRX-B
19	04	DRX-A
20	NC	
21	NC	
22	NC	
23	NC	
24	NC	
25	NC	
26	NC	

C.4 – RS530 Cable

HD26 MALE	DB25 MALE	NAME
1	1,7	GND (SHIELD)
1	19,23	RTS-B, DTR-B
2	13	CTS-B
3	5	CTS-A
4	-	
5	-	
6	6	DSR-A
7	-	
8	11	TCKE-B
9	-	
10	24	TCKE-A
11	14	DTX-B
12	2	DTX-A
13	-	
14	9	RCK-B
15	17	RCK-A
16	-	
17	4,20	RTS-A, DTR-A
18	16	DRX-B
19	3	DRX-A
20	12	TCK-B
21	15	TCK-A
22	-	
23	-	
24	22	DSR-B
25	10	DCD-B
26	8	DCD-A

C.5 – E1 120 Ohm Interface (RJ45)
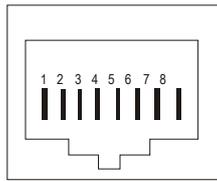
1	Rx Ring 1
2	Rx Tip 1
4	Tx Ring
5	Tx Tip
7	Rx Ring 2
8	Rx Tip 2

Appendix D – TSW200E1 Character Set

D.1 – Hex-ASCII Conversion Table

				B0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
				B1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	BINARY			B3	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
				B3	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
B7	B6	B5	B4	HEXA	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	0	0	0	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	HT	LF	VT	FF	CR	SO	SI
0	0	0	1	1	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
0	0	1	0	2	SP	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
0	0	1	1	3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
0	1	0	0	4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
0	1	0	1	5	P	Q	R	S	T	U	V	W	X	Y	Z	[		]	^	Ñ
0	1	1	0	6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
0	1	1	1	7	p	q	r	s	t	u	v	w	x	y	z	{		}	'	DEL

D.2 – Hex-EBCDIC Conversion Table

B7	B6	B5	B4	HEXA	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
				B0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
	BINARY			B1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
				B3	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
				B3	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
0	0	0	0	0	NUL	SOH	STX	ETX	ETX	PF	LC	DEL		RLF	SMM	VT	FF	CR	SO	SI
0	0	0	1	1	DEL	DC1	DC2	DC3	RES	NL	BS	IL	CAN	EM	CC		ITS	IGS	IRS	IUS
0	0	1	0	2	DS	SOS	FS		BYP	LF	ETB	ESC			SM			ENQ	ACK	BEL
0	0	1	1	3			SYN		PN	RS	UC	EOT					DC4	NAK		SUB
0	1	0	0	4	SP										Ç	.	<	(	+	½
0	1	0	1	5	&										!	$	*	)	;	Ø
0	1	1	0	6	-	/									:	,	%	-	>	?
0	1	1	1	7											:	#	@	'	=	"
1	0	0	0	8		a	b	c	d	e	f	g	h	i						
1	0	0	1	9		j	k	l	m	n	o	p	q	r						
1	0	1	0	A		'	s	t	u	v	w	x	y	z						
1	0	1	1	B																
1	1	0	0	C	{	A	B	C	D	E	F	G	H	I						
1	1	0	1	D	}	J	K	L	M	N	O	P	Q	R						
1	1	1	0	E	|		S	T	U	V	W	X	Y	Z						
1	1	1	1	F	0	1	2	3	4	5	6	7	8	9						

Appendix E – Test Patterns: 2048 and QBF (Quick Brown Fox)

E.1 – 2048 pattern

The 2048 pattern has the following transmit sequence. The parenthesised number is in hexadecimal value:

4 x PAD (FF)
6 x SYNC (16)
1 x STX (02)
64 graphic chars (from 20 to 5F hexadecimal)
64 x U (55)
64 x @ (40)
31 x PAD (FF)
1 x U (55)
31 x NUL (00)
1 x U (55)
1 x ETX (03)
1 x EOT (04)
2 x PAD (FF)

E.2 – FOX pattern

THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG 123 456 7890 + - X **:** = $ % ()

Appendix F – DCE Simulation Adaptors and Cables Pinout

F.1 – DB25-to-DCE (RS232) Adaptor Cable

DB25 FEMALE (to Tiger)	DB25 Female (to DTE)
2(DTX)	3(DRX)
3(DRX)	2(DTX)
4(RTS), 5(CTS), 6(DSR) e 8(DCD)	-
-	4(RTS), 5(CTS), 6(DSR) and 8(DCD)
7(GND)	7(GND)
15(TCK) and 17(RCK)	24(TCKE)
24(TCKE)	15(TCK) and 17(RCK)

F.2 – M34-to-DCE (V.35) Adaptor Cable

M34 Female (to Tiger)	M34 Female (to DTE)
B(GND)	B(GND)
P(DTX-A)	R(DRX-A)
S(DTX-B)	T(DRX-B)
R(DRX-A)	P(DTX-A)
T(DRX-B)	S(DTX-B)
C(RTS), D(CTS), E(DSR) and F(DCD)	-
-	C(RTS), D(CTS), E(DSR) and F(DCD)
V(RCK-A) and Y(TCK-A)	U(TCKE-A)
U(TCKE-A)	V(RCK-A) and Y(TCK-A)
X(RCK-B) and AA(TCK-B)	W(TCKE-B)
W(TCKE-B)	X(RCK-B) and AA(TCK-B)

F.3 – DB37-to-DCE (V.36) Adaptor Cable

DB37 Female (to Tiger)	DB37 Female (to DTE)
4(DTX-A)	6(DRX-A)
22(DTX-B)	24(DRX-B)
6(DRX-A)	4(DTX-A)
24(DRX-B)	22(DTX-B)
19(GND)	19(GND)
7(RTS-A), 9(CTS-A), 11(DSR-A) and 13(DCD-A)	-
-	7(RTS-A), 9(CTS-A), 11(DSR-A) and 13(DCD-A)
25(RTS-B), 27(CTS-B), 29(DSR-B) and 31(DCD-B)	-
-	25(RTS-B), 27(CTS-B), 29(DSR-B) and 31(DCD-B)
8(RCK-A) and 5(TCK-A)	17(TCKE-A)
17(TCKE-A)	8(RCK-A) e 5(TCK-A)
26(RCK-B) and 23(TCK-B)	35(TCKE-B)
35(TCKE-B)	26(RCK-B) and 23(TCK-B)

F.4 – DCE X.21 Cable

NAME	DB15 Female (to Tiger)	DB15 Female (to DTE)	NAME
GND	1	1,8	GND
GND	1	12	CTS-B
CTS-B	2	10	RTS-B
CTS-A	3	3	RTS-A
TCKE-A,RCK-A	10,15	6	RCK-A
TCKE-B,RCK-B	8,14	13	RCK-B
DTX-B	11	11	DRX-B
DTX-A	12	4	DRX-A
RTS-A	17	5	CTS-A
DRX-B	18	9	DTX-B
DRX-A	19	2	DTX-A

F.5 – DB25-to-DCE (RS530) Adaptor Cable

DB25 Female (to Tiger)	DB25 Female (to DTE)
1, 7 (GND)	1, 7(GND)
2 (DTX-A)	3(DRX-A)
3(DRX-A)	2 (DTX-A)
4 (RTS-A), 5 (CTS-A), 6 (DSR-A), 8 (DCD-A)	-
-	4 (RTS-A), 5 (CTS-A), 6 (DSR-A), 8 (DCD-A)
10 (DCD-B), 13 (CTS-B), 19 (RTS-B), 22(DSR-B)	-
-.	10 (DCD-B), 13 (CTS-B), 19 (RTS-B), 22(DSR-B)
11(TCKE-B)	12 (TCK-B),9 (RCK-B)
12 (TCK-B),9 (RCK-B)	11(TCKE-B)
14(DTX-B)	16(DRX-B)
16(DRX-B)	14(DTX-B)
15 (TCK-A), 17(RCK-A)	24 (TCKE-A)
24(TCKE-A)	15 (TCK-A), 17(RCK-A)

Appendix G – Printer and Serial Cable Pinout

G.1 – Serial Adaptor Cable

DB15 MALE	DB25 FEMALE
2	2
3	3
1	7

G.2 – Parallel Adaptor Cable

DB15 Male	Centronics Male
1	16,17,19,30,33
2	11
3	-
4	-
5	8
6	6
7	4
8	2
9	-
10	1
11	-
12	9
13	7
14	5
15	3