Operation Manual

Frame Relay

Annex to TSW200E1's Operation Manual

Copyright

Sumário

1 -   Introduction

Frame Relay is the protocol that defines an interface between the customer premises equipment (CPE) and the WAN network. It is the frame transport technology based upon the protocol that uses permanent virtual circuits (PVC) to carry data from a place to another. It is normally used to interconnect LANs through WAN. The PVC can carry a certain number of logical connections.

Before a Frame Relay service can be enabled for a client, it is necessary to establish that it is "alive" (*Frame Relay Heartbeat*). This characteristic requires management of the link between the CPE and the network, to check if the frames are being correctly transmitted and received. These tests include the periodic check of the active link, of the full status and of the PVC status (Appendix A describes the Frame Relay structure). The periodicity is defined by the polling time variable (see Section 2, below).

1.1 -   Main Characteristics

- Interfaces: RS232, V.35/V.11, V.36/V.11, X.21/V.11, RS530 and G.703-2M;
- Speeds from 64K up to 2048 Kbps;
- TURN UP Test:
  - Active link checking (Frame Relay *Heartbeat*);
  - Idle flag detection (7E hexadecimal);
  - Status inquiry and status message analysis;
  - Link integrity checking;
  - Frame Relay error checking through FCS;
- PING test:
  - End to end connectivity checking for TCP/IP protocol operating networks.
- FOX Test:
  - End to end connectivity checking for networks not operating under TCP/IP protocol and which cannot be tested by PING;
  - Network "stress" checking by monitoring the continuous frame rate, employing a user-defined rate (CIR – Committed Information Rate).
- Monitor Test (Optional Mode)
  - Monitors the number of bits received by a certain DLCI (Data Link Connection Identifier).
- Loopback Test (Optional Mode)
  - This test is used to count the frames, so that the user can be aware if the circuit defined by a DLCI is losing some frame.

2 - Frame Relay Module Operation

The FRAME RELAY module uses a transmitter and a receiver for the selected interface, except on MONITOR mode. The test is performed in a User-Network interface (UNI), allowing the Heartbeat Test to be run. This checks if the network is active. The Heartbeat Test is the continuous transmission of idle flags periodically interwoven with managing frames. These frames are requests made by the Data Terminal Equipment (DTE) and the responses provided by the network (DCE). The types of frames are the following:

- LIV: sequentially numbered messages for checking the link integrity.
- FULL: message containing the status of every PVCs (Permanent Virtual Circuit or DLCIs - Data Link Connection Identifier) defined for that interface.
- PVC: message with the status of the specific PVC (DLCI).

The status inquiry message is sent from the terminal. It is sent to ask for the PVCs status or to check link integrity. The status message, sent by the DCE, is sent as a response to the status inquiry message. The link integrity is periodically checked through the exchange (send/receive) of the number sequence between network and terminal. The periodicity is given by the polling time variable.

The terminal sends the managing frame at the given number of seconds, as defined by the POLLING TIME (T391) parameter. At every N managing frames, the FULL STATUS request is sent. This number of frames, N, is defined by the POLLING CYCLE (N391) parameter.

The network answers each status inquiry message with the status message. The response sent contains the link integrity checking and the information elements that define the response type. When the contents of the response type information element specify full status, then the status message must contain the PVC status information for every PVC that is configured for the DTE/DCE interface.

After a response is sent, the time is measured. If there is no request before a certain predefined time, the equipment issues an error message (NO REQUEST). The RESPONSE TIME (T392) parameter defines this predefined time.

The status inquiry messages and the status messages are sequentially numbered. If the receiver finds an out-of-sequence message, the sequence error counter is incremented.

The TSW200E1 can logically emulate the network terminal or the CPE. For this, the user must select the TERMINAL option for the Emulation parameter. In this case, the TSW200E1 will continuously sent the status inquiries (requests) and will process the status messages (responses) sent by the network.

To test the network terminal or the CPE, the TSW200E1 can be used, emulating the network itself. To do this, use the NETWORK option, in the Emulation parameter. The TSW200E1 will be prepared to respond to the inquiries sent by the terminal, keeping link integrity.

The TSW200E1 can also be configured to emulate an NNI (network to network interface). In this case, it will generate and process the status inquiries and the status messages.

It is important to note that the Emulation parameter (NETWORK/TERMINAL/NNI) changes conceptually the TSW200E1 operating mode, even if it is connected to other equipments that are configured as DTE or DCE. Normally the TSW200E1 is connected to the DCE (as a modem, for instance), through a direct cable. But it is possible to connect the TSW200E1 to the DTE (as a switch), and in that case the cross cable should be used to invert the interface signals.

When operating in the Frame Relay mode, the TSW200E1 can check the end-to-end connectivity of TCP/IP protocol networks.

While the PVC status gives a general understanding of the remote final link, it does not check the complete connectivity between a network user and another user located at the other side of the network. This check is done by the PING test. The PING test is only possible if the remote terminal is operational and if it is using TCP/IP protocol. To check end-to-end connectivity for networks that do not operate under TCP/IP, the FOX test is used.

The FRAME RELAY mode allows five tests: TURN UP, PING, FOX, MONITOR and LOOPBACK. These tests are described in the following sections.

2.1 - Choosing the test to perform

When the user chooses the Frame Relay module from the Module menu, the following screen will be displayed:

```
┌────────────────────────────────────────┐
│            FRAME  RELAY                 │
│                                         │
│  TURN UP                          ◄     │
│  PING                                   │
│  FOX                                    │
│  MONITOR                                │
│  LOOPBACK                               │
│                                         │
│                                         │
│  MEMORY      MODULE       ENTER         │
└────────────────────────────────────────┘
     F1          F2           F3          F4
```
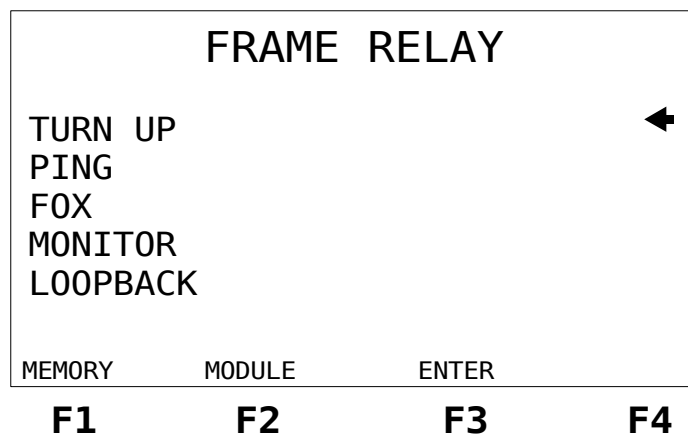
On that screen, it is possible to choose which of the three types of test will be performed. To select one of them, move the cursor using the keys ↑ and ↓ until the arrow points to the desired test. Press <F3> (ENTER). The first configurator screen for the chosen test will be displayed.

If it is desired to go back to the module menu, press <F2>(MODULE). To inspect memory press <F1> (MEMORY). The test results can be printed from the equipment memory. Pressing the PRINT key in any memory visualization screen causes the TSW200E1 to display the print management screen. For more details about printing results consult the TSW200E1 Operation Manual section 6.3.

2.2 - The TURN UP test

The TURN UP test checks link integrity through the interchange of management frames with the network. It analyses if the frames are being correctly transmitted and received and it verifies periodically (using polling time and polling cycle) if the link is active, which are the PVCs that are active and the respective status (Active, Inactive, New and Deleted) of the DLCIs configured for that node.

2.2.1 - TURN UP Test Configuration

The TURN UP test has two configuration screens that are shown below, along with the description of the configuration parameters for each of them. To alternate between these two screens, press <F1>(BACK) and <F4> (NEXT). To go back to the test menu screen, press <F2> (MENU).

To change these parameters, take the cursor to the desired line. Some of the parameters are edited using the DATA key. Some others can be altered using the keys← and →.

```
┌─────────────────────────────────────────────┐
│                                             │
│               TURN UP                       │
│                                             │
│    DLCI:             0016            ←       │
│    Emulation:        NETWORK                 │
│    Interface:        G703-2M                 │
│    Test Period:      CONTINUOUS              │
│    Tx Clock Source:  INTERNAL                │
│    Tx Rate:          64 kbps                 │
│                                             │
│                                             │
│          MENU        CFG G703    NEXT        │
└─────────────────────────────────────────────┘
     F1          F2          F3          F4
```

- DLCI: Allows editing of the DLCI (Data Link Connection Identifier). It can assume any value from 0016 up to 1007. To edit this value press DATA and use the alphanumeric keys. Press <F1> (EXIT) to cancel editing. When done, press <F4> (ENTER).
- Emulation: Selects the logical type of emulation for the TSW200E1: NETWORK, TERMINAL or NNI
- Interface: Selects the operating interface as RS232, V35, V36, X.21, RS530 or G.703-2M. When choosing the G.703-2M interface, it is necessary to configure many parameters. To do this, press <F3> (CFG G703). For the detailed description of these parameters, please see the following pages of this manual.
- Test Period: selects if the test runs continuously or for a determined amount of time. To edit the test total time press DATA. Use the alphanumeric keys and the ←, ↑, → and ↓ keys to move the cursor. Key in the Time to Begin test and the Test Time. To cancel editing, press <F1> (EXIT). To confirm and end editing press <F4> (ENTER).
- Tx Clock Source: Allows choosing the transmission clock source as EXTERNAL or INTERNAL.
- Tx Rate: Allows choosing the transmission rate from 64Kbps up to 2048 Kbps. Available only if Tx Clock Source is set to INTERNAL.
- Clock Edge: Allows choosing if data are valid on the positive or negative clock edge. The options are NORMAL or INVERTED. It is only available if the previous option was chosen as EXTERNAL.

```
┌─────────────────────────────────────┐
│             TURN  UP                 │
│                                      │
│  LMI Type:          CCITT      ←     │
│  Polling Time:      02               │
│  Polling Cicle:     10               │
│  Polling Verify:    10               │
│                                      │
│                                      │
│    BACK         MENU                 │
└─────────────────────────────────────┘
     F1           F2        F3      F4
```

- LMI Type: Selects which type of management will be used: ANSI (ANNEX-D), CCITT (ANNEX-A), FRF (LMI) or AUTO, where the equipment automatically adjusts itself to the kind of management which it is receiving.
- Polling Time: time interval, in seconds, between the sending of status inquiries. Allows choosing from 02 to 99. Valid only for the TERMINAL option.
- Polling Cycle: Defines the number of management frames that are necessary to send the FULL STATUS request. For example: if this number is 5, four LIV STATUS request are sent and one FULL STATUS is sent for each cycle of 5 management frames. Allows the options from 01 to 99. Valid only when the TERMINAL option is selected.
- Polling Verify: Time interval, in seconds that the TSW200E1 waits for a status enquiry, when configured as NETWORK, before issuing the NO REQUEST message. It can be edited with the DATA, ← and → keys.

When the G703-2M interface is chosen, then the <F3> key label will display CFG G703. If the <F3> key is pressed, the G703-2M configuration screens are shown, as displayed below.

```
┌─────────────────────────────────────┐
│           FRAME  RELAY               │
│                                      │
│  Framing:           PCM30C     ←     │
│  Line Code:         HDB3             │
│  Termination:       75Ω UNBAL        │
│  Idle Code:         11111111         │
│  NFAS/NMFAS:        DEFAULT          │
│  ABCD:              DEFAULT          │
│         TURN  UP              NEXT    │
└─────────────────────────────────────┘
     F1           F2        F3      F4
```

- Framing: Selects the frame structure. The structures are PCM30, PCM30C, PCM31, PCM31C and UNFRAMED.
- Line Code: Allow the user to choose the line code as HDB3 or AMI.
- Termination: The termination impedance of the cable used can be chosen as 75 ohms UNBAL, 120 ohms BAL, HIGH-Z UNBAL or HIGH-Z BAL.

- Idle Code: Selects the Idle Code to be transmitted in the deselected channels. Press the DATA key to edit.
- NFAS/NMFAS: The USER option allows the programming of the NFAS/NMFAS word (Sa). The DEFAULT option programs the word "0100000000001011". To toggle between these two options use the ← or → keys .
- ABCD Bits: The DEFAULT option keeps all ABCD bits at 1000. The USER option allows programming the 30 ABCD words of timeslot 16, but only for the PCM30 and PCM30C structures.

- Tx Slots: Selects the timeslot(s) for transmission. Options are 01 to 31.
- Rx Slots: Selects the timeslot(s) for reception. Options are 01 to 31.

To go back to the selected test configuration screen, press F2.

2.2.2 -   Performing the TURN UP Test

After correctly configuring and connecting the test set, press START/STOP to start the test. The following figures show how to perform the TURN UP test.

This test allows checking of the status of the PVCs (defined by each respective DLCIs) which are configured at that node. If there is no error the test ends displaying the screen sporting the DLCIs numbers and their respective status (Active, Inactive, New or Deleted).

After the test is started, the equipment displays automatically the sequence of three screens, if no error is detected. The user can disable the automatic changing of screens using <F2> (AUTO), <F1> (BACK) or <F4> (NEXT).

For TERMINAL configuration, the test starts by sending the status inquiry frame if there is a transmission clock and it remains on the first screen until it gets a response frame. If there is no transmission clock, the message NO TXCLK is shown and the equipment remains on that screen while this error persists. The same happens to the receive clock: the message shown is NO RXCLK. If the receive clock is detected, the equipment performs the FLAG detection. If there is no FLAG, the node under test is not connected to the Frame Relay network and the message NO FLAG is shown while the error persists. However, if the transmit and receive clock and the FLAG are active, the messages will be TXCLK OK, RXCLK OK and FLAG OK. In that case, the first response frame is awaited for until the time set for the variable "POLLING TIME" is met. If it times out and the response does not come, the message NO RESPONSE will be shown and the equipment remains on that screen waiting for the response.

If the test is being done for the NETWORK configuration, the equipment starts to simulate the network function. The test remains on the first screen until it receives an inquiry frame. The checking of the transmit and receive clocks and of the flag detection is done in a similar way for the

DTE case. If the clocks and the FLAG are detected, the messages displayed will be TXCLK OK, RXCLK OK and FLAG OK. In that case, the first response frame is awaited until the time set for the variable "POLLING VERIFY" is met. If it times out and an inquiry frame does not arrive, the message NO REQUEST will be shown and the equipment remains on that screen until the frame arrives.

```
┌─────────────────────────────────────┐
│            TURN UP                  │
│                                     │
│          TX CLK OK                  │
│          RX CLK OK                  │
│           FLAG OK                   │
│        NO RESPONSE                  │
│                                     │
│                                     │
│                                     │
│       MANUAL           NEXT         │
└─────────────────────────────────────┘
   F1        F2        F3        F4
```
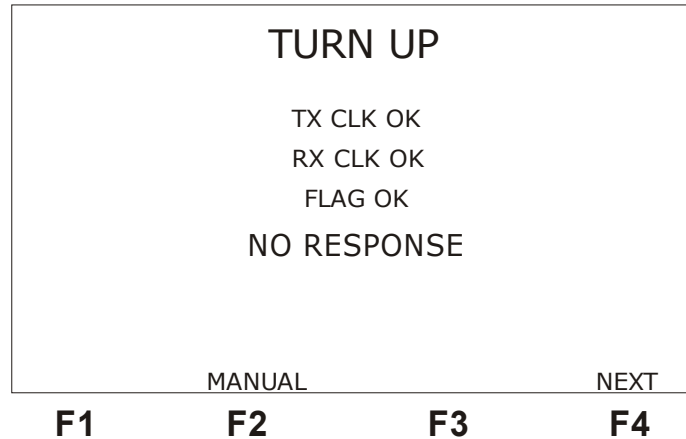
When the first response frame arrives, the screen changes to display the type of frame that is arriving. It only goes back to the initial screen if an error occurs: no clocks, no flags or response time-out. If everything is normal, the second screen will display bigger letters each time that the new frame arrives.

```
┌─────────────────────────────────────┐
│            TURN UP                  │
│                                     │
│                                     │
│          LIV STATUS                 │
│                                     │
│           LINK UP                   │
│                                     │
│                                     │
│       MANUAL           NEXT         │
└─────────────────────────────────────┘
   F1        F2        F3        F4
```
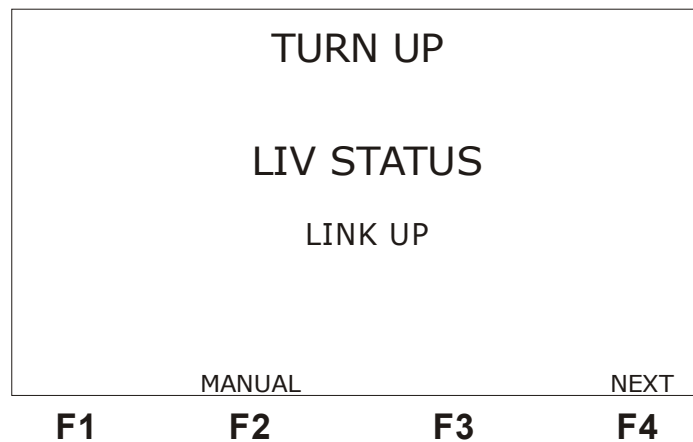
If the equipment is configured as TERMINAL, (N-1) LIV STATUS frames must arrive. N is defined in the POLLING CYCLES parameter. Then, one FULL STATUS frame must arrive. The arrival of this last frame brings the DLCIs status information and causes the equipment to automatically display the final screen.

If the equipment is configured as NETWORK, the arrival of the FULL REQUEST causes it to go to the screen below.

```
┌─────────────────────────────────────────┐
│              TURN UP                     │
│                                          │
│                                          │
│   DLCI NUMBER          STATUS            │
│      0020              Active            │
│                                          │
│                                          │
│                                          │
│                                          │
│   BACK        MANUAL              NEXT   │
└─────────────────────────────────────────┘
       F1          F2          F3      F4
```

To check the test event log, press <F4> (NEXT). The event log will record the moment that a condition is detected and the moment that it ends. See the event log screen in the next figure.

```
┌─────────────────────────────────────────┐
│              EVENT LOG                   │
│                                          │
│  20/09/2004  09:46:14  - NO TX CLK       │
│  20/09/2004  09:46:14  - NO RX CLK       │
│  20/09/2004  09:46:15  - OK RX CLK       │
│  20/09/2004  09:46:15  - OK TX CLK       │
│  20/09/2004  09:46:18  - DLCI 0016 Atc   │
│                                          │
│                                          │
│    BACK        AUTO                      │
└─────────────────────────────────────────┘
       F1          F2          F3      F4
```

If any errored frame arrives, the equipment automatically displays the error counters screen. On that screen, the total number of transmitted and received frames and the total number of sequence, FCS and other errors are displayed. The equipment only gets out of that screen if the counters are restarted, by pressing the CLEAR key. The user can manually change screens using the <F1> (BACK) and <F2> (NEXT) keys.

```
┌─────────────────────────────────────────┐
│              TURN UP                     │
│                                          │
│                                          │
│     TX FRAMES    =  70                   │
│     RX FRAMES    =  70                   │
│     ERR FRAMES   = 0                     │
│     FCS ERRORS   = 0                     │
│     SQN ERRORS   = 0                     │
│                                          │
│                                          │
│    BACK        MANUAL             NEXT   │
└─────────────────────────────────────────┘
       F1          F2          F3      F4
```

The counters are described below:

- TX FRAME: indicates the total number of transmitted frames during the test in progress.
- RX FRAME: indicates the total number of received frames during the test in progress.
- ERR FRAME: indicates the total number of frames that do not comply to the link protocol rules, or too big frame, or non-integer number of octets.
- FCS ERROR: indicates the total number of FCS errors (CRC based error detection) found.
- SQN ERROR: indicates the total number of sequence errors in status response frames.

2.3 - The PING test

The PING test is useful to check the end-to-end connectivity of the TCP/IP protocol network. This test consists in sending fixed sized frames with a message of the kind "are you there?" through the network to the specific destination DLCI. When the final remote node is correctly configured, the TSW200E1 that is connected to that point will send the response acknowledging connectivity. For this situation, the local TSW200E1 will be "pinging" the remote terminal and checking (or not) the connectivity of that link.

To PING test the remote terminal, a remapping of the network DLCIs and IPs must happen. This will define which DLCIs are connected to the same network and which is the IP address used by those particular PVC terminals. The DLCI and the source and destination IP addresses must be edited in the TSW200E1 before running the test. It is important to note that the TSW200E1 only allows editing of DLCIs for the interval from 16 to 1007: the DLCIs from 0 to 15 and from 1008 to 1023 are reserved.

2.3.1 - PING Test Configuration

The PING test has three configuration screens, which are shown below. The parameters in each screen are then described. To toggle from one of these screens to another, use the <F1>(BACK) and <F4> (NEXT) keys. To return to the MENU screen, press <F2> (MENU).

To edit these parameters, place the cursor on the desired line. Some of them are edited using the DATA key. Some others can be changed using the ← and →keys.

```
              PING

PING:              REQUEST       ←
Emulation:         NETWORK
Interface:         RS232
Test Period:       0001:00:00
Tx Clock Source:   INTERNAL
Tx Rate:           64 kbps


        MENU                 NEXT
   F1        F2        F3        F4
```

- PING: REQUEST (question) or REPLY (answer).
- Emulation: Selects the kind of emulation mode for the TSW200E1: as TERMINAL, NETWORK or as NNI.
- Interface: Selects the operating interface as RS232, V35, V36, X.21, RS530 or G.703-2M. If the G703-2M interface is chosen, many related parameters must be configured. To do this, press <F3> (CFG G703). For the description of these parameters, see section 2.2.1 of this manual.
- Test Period: selects if the test runs continuously or for a determined amount of time. To edit the test total time press DATA. Use the alphanumeric keys and the ←, →, ↑ and ↓ keys to move the cursor. Key in the Time to Begin test and the Test Time. To cancel editing, press <F1> (EXIT). To confirm and end editing press <F4> (ENTER).
- Tx Clock Source: Allows choosing the transmission clock source as EXTERNAL or INTERNAL
- Tx Rate: Allows choosing the transmission rate from 64Kbps to 2048 Kbps. It is only available if the Tx Clock Source option was chosen as INTERNAL.
- Clock Edge: Allows choosing if the data is valid in the positive or negative clock transition. The NORMAL or INVERTED options are available. It is only available if the previous option was chosen as EXTERNAL.

```
              PING

LMI Type:          CCITT        ←
Polling Time:      02
Polling Cicle:     10
Polling Verify:    10



   BACK       MENU                 NEXT
   F1        F2        F3        F4
```

- LMI Type: Selects which type of management will be used: ANSI (ANNEX-D), CCITT (ANNEX-A), FRF (LMI) or AUTO, where the equipment adjusts itself

automatically to the kind of management which it is perceiving.

- Polling Time: Time interval, in seconds, between sending status inquiries. Allows the options from 02 to 99. Valid only when the TERMINAL option is chosen.
- Polling Cycle: Defines the number of managing frames needed to send the FULL STATUS request. Example: If this number is 5, four LIV STATUS requests are sent, and one FULL STATUS request is sent for each cycle of 5 management frames. It allows the choice of 01 up to 99. Valid only when the TERMINAL option is chosen.
- Polling Verify: Time interval, in seconds that the TSW200E1 waits for a status enquiry, when configured as NETWORK, before issuing the NO REQUEST message. It can be edited with the DATA, ← and → keys.

```
┌─────────────────────────────────────┐
│                PING                  │
│                                      │
│  DLCI:         0016          ◄       │
│  Size:         2000                  │
│  Ping Rate:    01                    │
│  Ping Count:   CONTINUOUS            │
│  Source IP Add:200.200.200.200       │
│  Dest. IP Add: 200.200.200.201       │
│   BACK         MENU                  │
└─────────────────────────────────────┘
     F1          F2         F3      F4
```

- DLCI: Allows the editing of the DLCI (Data Link Connection Identifier) parameter. It can be chosen from 0016 up to 1007. To edit this value, press DATA and use the alphanumeric keys. Press <F1> (EXIT) to cancel editing and press <F4> (ENTER) to end editing.
- Size: Allows editing the data field length (0000 to 2000)in the ping frame (echo request) . To edit this value, press DATA and use the alphanumeric keys. Press <F1> (EXIT) to cancel editing and press <F4> (ENTER) to end editing.
- Ping Rate: Sets a delay from 0 to 99 seconds between two consecutives ping frames. To edit this value, press DATA and use the alphanumeric keys. Press <F1> (EXIT) to cancel editing and press <F4> (ENTER) to end editing.
- Ping Count: Defines the amount of ping frames sent during the test. The test can send PINGs continuously or send the edited amount of frames. To edit this value, press DATA and use the alphanumeric keys. Press <F1> (EXIT) to cancel editing and press <F4> (ENTER) to end editing.
- Source IP Address: Allows the editing of the source IP address (from 000.000.000.000 to 255.255.255.255). Press DATA to edit. Use the alphanumeric keys to key in the number and the ← and → keys to move the cursor. To end editing, press <F4> (ENTER) to confirm.
- Dest. IP Address: Allows editing of the destination IP address (from 000.000.000.000 to 255.255.255.255). Editing is the same as for the previous item.

2.3.2 - Performing the PING Test

The next figure displays the PING test example. It shows the DLCIs 20 and 21 connected in the network. The terminal which is connected to the DLCI 21 received the following addresses: Source = 020.001.000.002, Destination = 020.001.000.001. The TSW200E1 shall be programmed with DLCI 20, Source IP Address: 020.001.000.001 and Dest. IP Address: 020.001.000.002.

This test will verify the connectivity of a remote terminal with IP address 020.001.000.002. This terminal is connected to the DLCI 21. The TSW200E1 is connected to the DLCI 20 and has IP address 020.001.000.001.
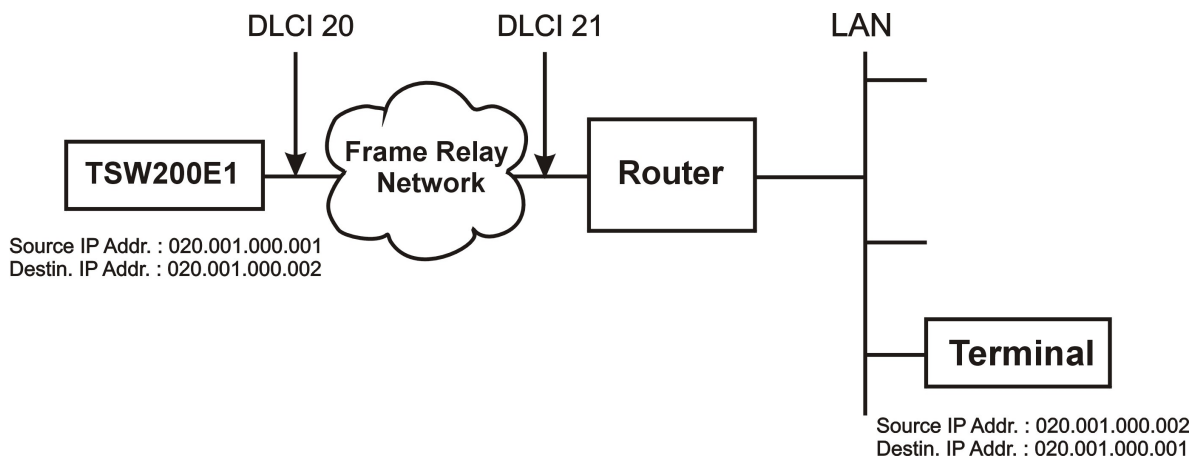
After correctly connecting and configuring the test set, the test can be started by pressing the START/STOP key. The equipment checks if there is a flag or if there are transmit and receive clocks as described in the section 2.2.2. Then it displays in the screen below the information about this verification.

If the TSW200E1 is set as TERMINAL and if it does not get any response (status) to its status inquiries during the time interval set in polling time, the equipment will signal with "NO RESPONSE". Similarly, if the TSW200E1 is configured as NETWORK, and if it does not get any status inquiry, during the time interval configured in Response Time, the equipment will signal with "NO REQUEST".

After verifying that the basic signals are on, the test set goes automatically to the next screen. If the link is on (link up) it is signalled and the interface configured PVCs are monitored. The equipment displays the complete status of the full Frame Relay network. It also shows the frames status inquiries (REQUEST) and the RESPONSE status that were correctly received.

If there is no error, the test goes on. If the test set is configured for Ping REQUEST, the TSW200E1 starts to continuously send a fixed-sized frame, in fixed-time intervals. As soon as the TSW200E1 gets an answer from the destination equipment, the elapsed time is shown on the screen below. The minimum, medium and maximum times are shown. The time of the last test is also shown. Avoid changing screens while the response time measuring is in course, this could interfere in the result.

```
┌─────────────────────────────────────────────┐
│                PING REQUEST                   │
│                                               │
│     SLOW    TIME   =   00002 ms    ←          │
│     AVERAGE TIME   =   00001 ms               │
│     FAST    TIME   =   00001 ms               │
│     LAST    TIME   =   00002 ms               │
│                                               │
│                                               │
│                                               │
│     BACK        AUTO                          │
└─────────────────────────────────────────────┘
       F1          F2          F3          F4
```
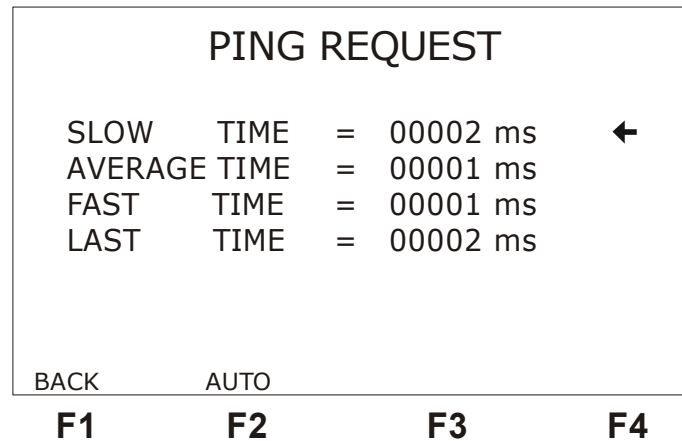
The description of each of the times is shown below:

- SLOW TIME: indicates the maximum time, that is, the slowest time of the turnaround trip of the test frames.
- AVG. TIME: indicates the average time of the turnaround trip of the test frames. (AVG = average).
- FAST TIME: indicates the minimum time, that is, the fastest time of the turnaround trip of the test frames.
- LAST TIME: indicates the last measured time of the turnaround trip of the test frames.

If the test set is configured for Ping REPLY, it automatically answers to the received PING frames but it does not send any PING request. Then the response times (Slow, Avg, Fast and Last Time) are not displayed. The screen below is shown.

```
┌─────────────────────────────────────────────┐
│                 PING REPLY                    │
│                                               │
│               ECHO REQUEST                    │
│                                               │
│                 ECHO REPLY                    │
│                                               │
│                                               │
│                                               │
│     BACK        AUTO                          │
└─────────────────────────────────────────────┘
       F1          F2          F3          F4
```
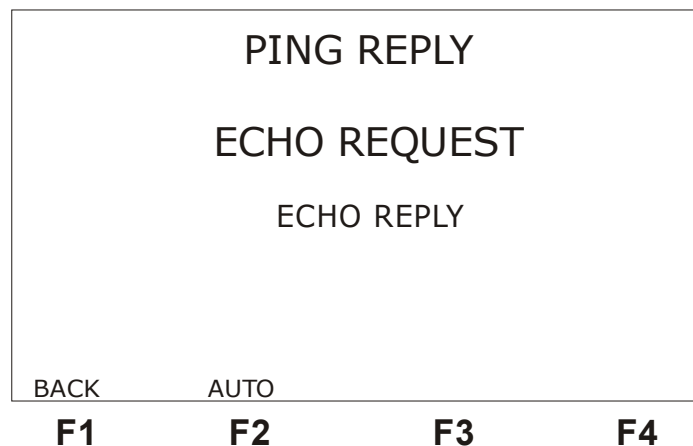
When the test set receives an ECHO REQUEST, this expression is displayed in large letters on the screen. When it responds, the expression ECHO REPLY is displayed in large letters on the screen. If there is only ECHO REQUEST, it is likely that the received IP address is different from the configured Source IP Address. In this case, the TSW200E1 does not generate ECHO REPLY, but it signals that it received an ECHO REQUEST.

For the received Ping frames an error checking is done (HeaderCheckSum and DataCheckSum) and if errored frames are received, the ERR FRAME counter is incremented. This

counter, as well as others, is displayed on the screen below.

```
                    PING

        TX FRAMES   =  70
        RX FRAMES   =  70
        ERR FRAMES  =  0
        FCS ERRORS  =  0
        SQN ERRORS  =  0


    BACK        MANUAL                   NEXT
     F1          F2              F3        F4
```

- TX FRAME: indicates the total number of transmitted frames during the test in progress.
- RX FRAME: indicates the total number of received frames during the test in progress.
- ERR FRAME: indicates the total number of frames that disobey the link protocol rules, or too big frame, or non-integer number of octets.
- FCS ERROR: indicates the total number of FCS errors found. The error detection is CRC-based.
- SQN ERROR: indicates the total number of sequence errors in status response frames.

Two screens are presented. One displays the DLCI informations and the other the test event log. The event log records the moment that a condition is detected and the moment that it is cleared. The event log screen can be reached from the DLCI information screen.

```
                PING REQUEST

     DLCI NUMBER         STATUS
          0020           Active




    BACK        MANUAL                   NEXT
     F1          F2              F3        F4
```

```
┌──────────────────────────────────────────┐
│              EVENT LOG                     │
│                                            │
│ 20/09/2004  09:46:14  - NO TX CLK          │
│ 20/09/2004  09:46:14  - NO RX CLK          │
│ 20/09/2004  09:46:15  - OK RX CLK          │
│ 20/09/2004  09:46:15  - OK TX CLK          │
│ 20/09/2004  09:46:18  - DLCI 0016 Atc      │
│                                            │
│                                            │
│   BACK         AUTO                        │
└──────────────────────────────────────────┘
     F1           F2           F3           F4
```

2.4 -   The FOX test

The FOX test is used to verify the end-to-end connectivity of a network inside of networks that do not employ the TCP/IP protocol. It can be used in end-to-end tests with another TSW200E1 or through a router performing loop for a specific DLCI.

The end-to-end connectivity through a network is checked by the transmission of frames to a specific DLCI and through counting the received frames. The DLCI must be user-edited. It should be noted that the TSW200E1 allows editing of DLCIs only from 16 to 1007, for the DLCIs from 0 to 15 and from 1008 to 1023 are reserved.

Another application of the FOX test is to strain the network by generating frames with different rates of utilization. This allows an understanding of the ways the network will respond to different traffic demands. The frame size and the utilization rates (CIR) are user-editable.

2.4.1 -   FOX Test Configuration

The FOX test has three configuration screens which are shown below. The description of the configuration parameters of each screen follows. To alternate between these screens use the <F1>(BACK) and <F4> (NEXT) keys. To go back to the menu test screen, press <F2> (MENU).

To edit any parameter, move the cursor to the appropriate line. Some of the parameters are edited using the DATA key. Others can be changed using the keys ← and →.

```
┌──────────────────────────────────────────┐
│                 FOX                        │
│                                            │
│   Emulation:        TERMINAL      ←        │
│   Interface:        RS232                   │
│   Test Period:      CONTINUOUS             │
│   Tx Clock Source:  INTERNAL               │
│   Tx Rate:          64 kbps                │
│                                            │
│                                            │
│              MENU              NEXT         │
└──────────────────────────────────────────┘
     F1           F2           F3           F4
```
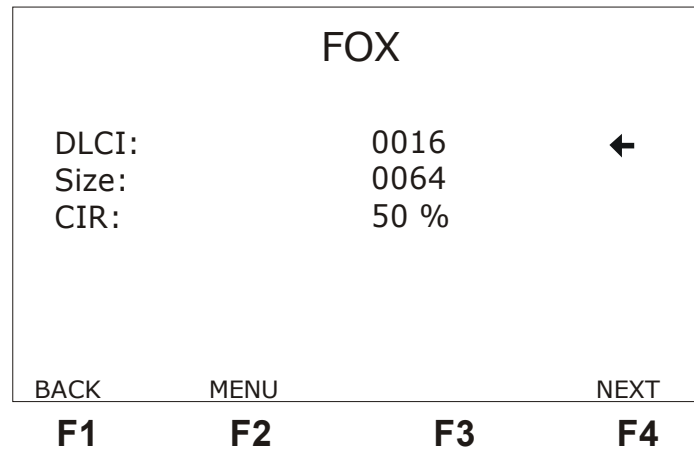
- Emulation: Selects the emulation mode of the TSW200E1: as TERMINAL, NETWORK or NNI.
- Interface: Selects the interface of operation as RS232, V35, V36, X.21 or G.703-2M. To choose the interface G703-2M, it is necessary to configure many interface-related parameters. To do this, press the <F1> (CFG G703) key. For a description of these parameters, see section 5.3.1 of the TSW200E1 manual.
- Test Period: selects if the test runs continuously or for a determined amount of time. To edit the test total time press DATA. Use the alphanumeric keys and the ←, ↑, → and ↓ keys to move the cursor. Key in the Time to Begin test and the Test Time. To cancel editing, press <F1> (EXIT). To confirm and end editing press <F4> (ENTER).
- Tx Clock Source: Allows choosing the transmit clock source as EXTERNAL or INTERNAL
- Tx Rate: Allows choosing the rate of transmission from 64Kbps up to 2048 Kbps. It is only available if Tx Clock Source was chosen previously as INTERNAL.
- Clock Edge: Allows choosing if data are valid on the positive or negative clock edge. The options are NORMAL or INVERTED. It is only available if the previous option was chosen as EXTERNAL.

```
                    FOX

    LMI Type:          CCITT      ◀
    Polling Time:      02
    Polling Cicle:     10
    Polling Verify:    10



      BACK        MENU                NEXT
       F1          F2          F3      F4
```

- LMI Type: Selects which type of management will be used: ANSI (ANNEX-D), CCITT (ANNEX-A), FRF (LMI) or AUTO, where the equipment adjusts itself automatically to the kind of management which it is perceiving.
- Polling Time: Time interval, in seconds, between sending status inquiries. Allows the options from 02 to 99. Valid only when the TERMINAL option is chosen.
- Polling Cycle: Defines the number of managing frames needed to send the FULL STATUS request. Example: If this number is 5, four LIV STATUS requests are sent, and one FULL STATUS request is sent for each cycle of 5 management frames. It allows the choice of 01 up to 99. Valid only when the TERMINAL option is chosen.
- Polling Verify: Time interval, in seconds that the TSW200E1 waits for a status enquiry, when configured as NETWORK, before issuing the NO REQUEST message. It can be edited with the DATA, ← and → keys.

```
┌─────────────────────────────────────────┐
│                  FOX                     │
│                                          │
│                                          │
│   DLCI:              0016         ←      │
│   Size:              0064                │
│   CIR:               50 %                │
│                                          │
│                                          │
│                                          │
│                                          │
│                                          │
│   BACK        MENU                NEXT   │
└─────────────────────────────────────────┘
     F1          F2          F3       F4
```

- DLCI: Allows editing of the DLCI (Data Link Connection Identifier). It can assume any value from 0016 up to 1007. Press DATA to edit this value, and then use the alphanumeric keys. To cancel editing press <F1> (EXIT). To end editing, press <F4> (ENTER).
- Size: Allows editing of the frame size (from 0064 up to 4096). To edit this value press DATA and then use the alphanumeric keys. To cancel editing press <F1> (EXIT). To end editing, press <F4> (ENTER).
- CIR: Allows editing of the frame transmission rate. The ← and → allow choosing the unit as kbps or %. Press DATA to edit this value, and then use the alphanumeric keys. To cancel editing press <F1> (EXIT). To end editing, press <F4> (ENTER). If the edited CIR is higher than the maximum transmission rate, the maximum CIR will be used in the test.

2.4.2 - Performing the FOX Test

The following figure exemplifies a way to perform the FOX test.
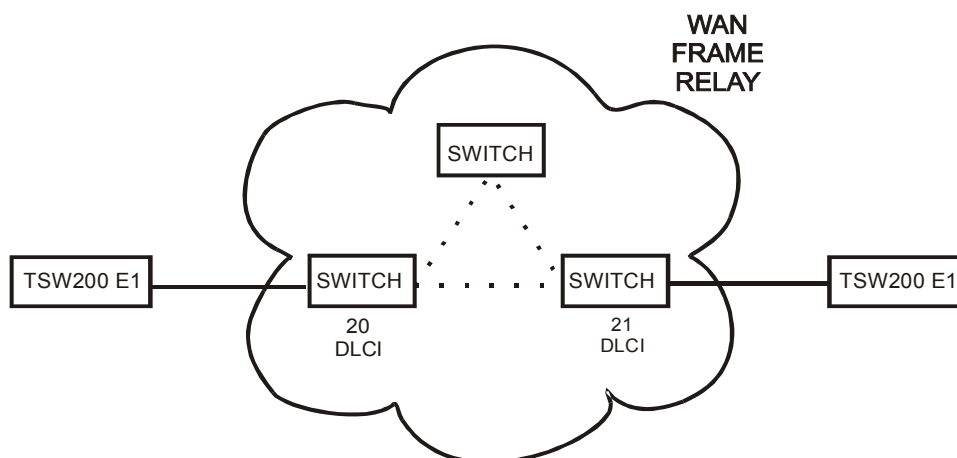
After correctly connecting and configuring the test set, the test can be started: press the START/STOP key.

The first step of the test is the detection of the idle flag (7Eh-01111110) and of the receive and transmit clocks. In the screen below, it is shown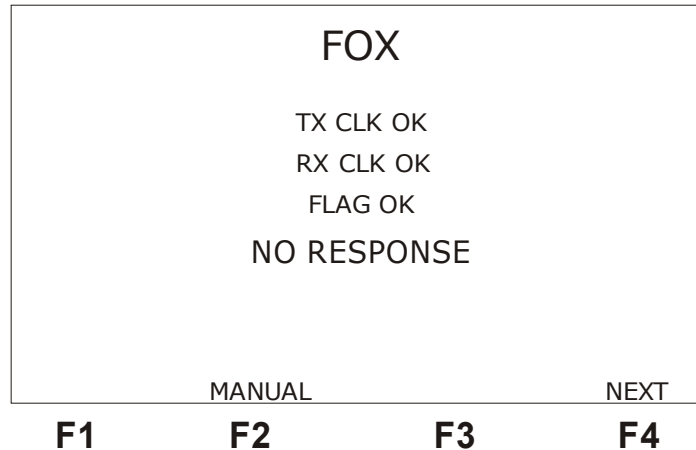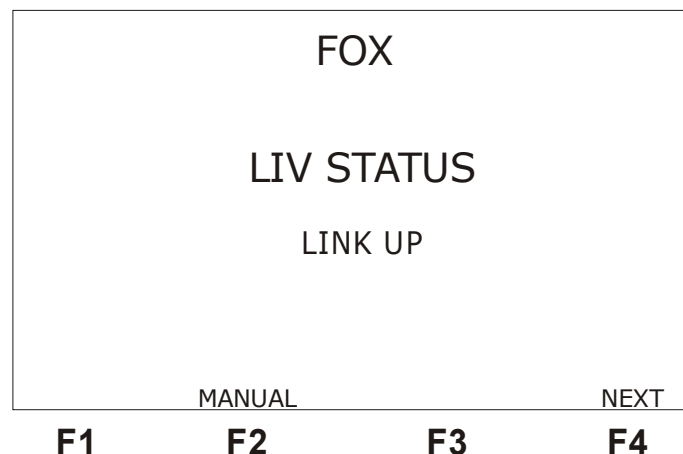 the result of this detection. If any of these basic signals is detected, the user gets a message. For example, on the upper right corner, NO RXCLOCK, NO TX CLOCK, NO RESPONSE. The screen changes automatically only if everything is correct.

```
+--------------------------------------------------+
|                                                  |
|                    FOX                           |
|                                                  |
|                TX CLK OK                          |
|                                                  |
|                RX CLK OK                          |
|                                                  |
|                FLAG OK                            |
|              NO RESPONSE                          |
|                                                  |
|                                                  |
|                                                  |
|          MANUAL                    NEXT          |
+--------------------------------------------------+
     F1            F2           F3          F4
```

If the TSW200E1 is configured as TERMINAL and if it does not get responses (*status*) to its requests (*status inquiries*) during the time interval previously configured in polling time, it will signal with a "NO RESPONSE" message. Similarly, if the TSW200E1 is configured as NETWORK, and it does not get any request (*status inquiry*), during the time interval configured previously in Response Time, it will signal with a "NO REQUEST" message.

If the user does not want the screens to change automatically, he/she should press the <F2> (MANUAL/AUTO) key. To alternate between the screens use the <F1> (BACK) and <F4> (NEXT) keys.

After checking the basic signals, the TSW200E1 starts to simulate the test Frame Relay *heartbeat*. It checks if the link is active (*link up*) and it monitors the PVCs that are configured in the interface, providing the complete *status* of the full Frame Relay network. The screen shown below displays the status *inquiries* that are requested and the received responses. On that screen, the different received frames are shown. For example, if the request was a *status inquiry*, the answer should be the status. On the other hand, if the request was *full request*, the answer should be *full status*.

```
+--------------------------------------------------+
|                                                  |
|                    FOX                           |
|                                                  |
|                                                  |
|                LIV STATUS                         |
|                                                  |
|                 LINK UP                           |
|                                                  |
|                                                  |
|                                                  |
|                                                  |
|          MANUAL                    NEXT          |
+--------------------------------------------------+
     F1            F2           F3          F4
```

The following screen is automatically shown if an error occurs.

```
                    FOX


        TX FRAMES   =  70
        RX FRAMES   =  70
        ERR FRAMES  = 0
        FCS ERRORS  = 0
        SQN ERRORS  = 0



    BACK       MANUAL              NEXT
    F1          F2          F3      F4
```

The counters shown on this screen are:
- TX FRAME: indicates the total number of transmitted frames during the test in progress.
- RX FRAME: indicates the total number of received frames during the test in progress.
- ERR FRAME: indicates the total number of frames that do not obey the protocol rules. Or it indicates if the frame is too big or if there is a non-integer number of octets.
- FCS ERROR: indicates the total number of errors of FCS (CRC-based error detection) found.
- SQN ERROR: indicates the total number of sequence errors in status response frames.

The next screen appears automatically if there is no error.

```
                    FOX


        CIR  = 64 %  40960 bps
        FECN = 0000       ←
        BECN = 0000
        DE   = 0000



    BACK       AUTO        BREAK
    F1          F2          F3      F4
```

In the first line of that screen, the TSW200E1 displays the CIR value, in percent of the rate (TX RATE) and in bps. This value is continuously measured during the test. This value can vary around the value that was configured to the test, due to variations in traffic and in the number of PVCs in the interface under test.

During the test, it is possible to set the bits FECN, BECN and OF. The cursor on the right side of the display indicates which of the bits will be set by the ERROR key. To move the cursor, use the ↑ and ↓ keys. Once the ERROR key is pressed, the next frame to be transmitted will be sent with the appropriate bit set. On the next frame, this bit is reset and it remains on this state until the ERROR key is pressed again.

In the receiving end, at the remote side, the counter of the respective bit shall be incremented. On the screen, at the same line that allows choosing which bit to set, it is shown the counter of the received bit:

- FECN: indicates the total number of frames in which the FECN bit is set.
- BECN: indicates the total number of frames in which the BECN bit is set.
- DE: indicates the total number of frames in which the DE bit is set.

When the <F3> (BREAK) key is pressed, the TSW200E1 stops sending FOX frames. It then sends only the management frames (status inquiry). The FOX frames are transmitted again if the key is pressed one more time. This is useful to toggle quickly between heavy and light traffic situations in the network and also to monitor visually if the transmitted frames from one end are all getting to the other end.

Two other screens are presented. One displays the DLCI informations and the other the test event log.

```
┌─────────────────────────────────────────┐
│                  FOX                     │
│                                          │
│   DLCI NUMBER          STATUS            │
│      0020              Active            │
│                                          │
│                                          │
│                                          │
│   BACK       MANUAL              NEXT    │
└─────────────────────────────────────────┘
     F1          F2          F3         F4
```

The event log records the moment that a condition is detected and the moment that it is cleared. The event log screen can be reached from the DLCI information screen by pressing <F4> (NEXT).

```
                    EVENT LOG

20/09/2004  09:46:14  - NO TX CLK
20/09/2004  09:46:14  - NO RX CLK
20/09/2004  09:46:15  - OK RX CLK
20/09/2004  09:46:15  - OK TX CLK
20/09/2004  09:46:18  - DLCI 0016 Atc




  BACK          AUTO

   F1            F2            F3            F4
```

2.5 -   The MONITOR test (Optional Mode)

The MONITOR test only uses the receiver of the selected interface. That means it does not transmit. It only receives frames from one end of the communication and displays in a graph the load (number of bits per second) that has arrived in a PVC (defined by a certain DLCI). To monitor both sides of the communication it is necessary to have two equipments, one monitoring the transmission and the other, the reception. See an example of how the test can be run in the following figure.
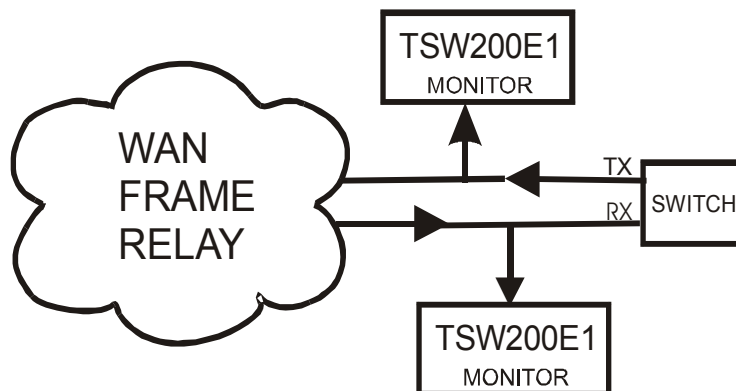
The following screen displays the MONITOR test configuration parameters.

```
┌─────────────────────────────────────────┐
│              MONITOR                      │
│                                           │
│  DLCI:            0016            ←        │
│  Interface:       RS232                    │
│  Test Period:     CONTINUOUS               │
│  Resolution:      99                       │
│                                           │
│                                           │
│              MENU                          │
└─────────────────────────────────────────┘
   F1          F2          F3          F4
```
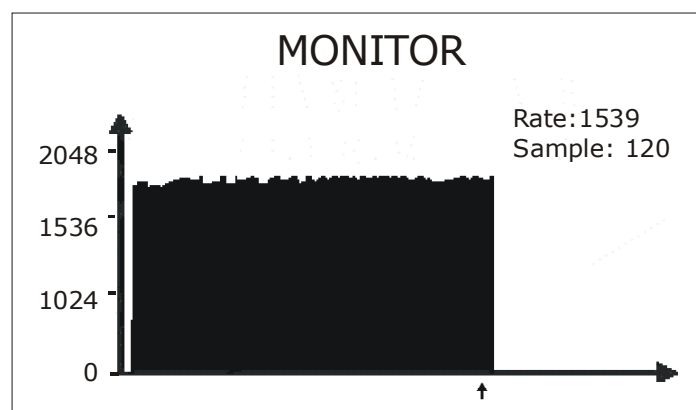
- DLCI: Allows editing of the DLCI (Data Link Connection Identifier). It can assume any value from 0016 up to 1007. Press DATA to edit this value, and then use the alphanumeric keys. To cancel editing press <F1> (EXIT). To end editing, press <F4> (ENTER).
- Interface: Selects the interface of operation as RS232, V35, V36, X.21 or G.703-2M. To choose the interface G703-2M, it is necessary to configure many interface-related parameters. To do this, press the <F1> (CFG G703) key. For a description of these parameters, see section 5.3.1 of the TSW200E1 manual.
- Test Period: selects if the test runs continuously or for a determined amount of time. To edit the test total time press DATA. Use the alphanumeric keys and the ←, ↑, → and ↓ keys to move the cursor. Key in the Time to Begin test and the Test Time. To cancel editing, press <F1> (EXIT). To confirm and end editing press <F4> (ENTER).
- Resolution: defines the interval, in seconds, between each column drawn in the graph.

The graph displays the last 120 samples of the test that was carried out. See on the figure below a test example. The rate and the number of the sample as defined by the small arrow-shaped cursor, below the graph, are displayed. To move the cursor, use the ← and →or the or ↑ and ↓ keys.

```
┌─────────────────────────────────────────┐
│              MONITOR                      │
│                                           │
│                        Rate:1539          │
│                        Sample: 120        │
│   2048 ▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄               │
│        █████████████████                  │
│   1536 █████████████████                  │
│        █████████████████                  │
│   1024 █████████████████                  │
│        █████████████████                  │
│      0 █████████████████         →        │
│                      ↑                    │
└─────────────────────────────────────────┘
```

2.6 - The LOOPBACK test (Optional Mode)

This test is used to count the frames, so that the user can be aware if the circuit defined by a DLCI is losing frames.

When the TSW200E1 is configured as a terminal, it sends the management frames (LIV REQUEST, FULL REQUEST). If the TSW200E1 is configured to act as a network, it continuously sends the management frame (LIV RESPONSE, STATUS RESPONSE). If it is configured as NNI, it does both sides of the management. Data arriving at the configured DLCI are transmitted back in the same DLCI.

2.6.1 - LOOPBACK Test Configuration

This test has two configuration screens, displayed below alongside the description of the configuration parameters for each one. To alternate between these screens, use the F1 (BACK) and F4 (NEXT) keys. To go back to the test menu screen, press F2 (MENU).

To change these parameters, move the cursor up to the desired line. Some of the parameters are edited by using the DATA key. Others can be changed by using the ← and → keys.

```
                LOOPBACK

      DLCI:              0016          ←
      Emulation:         NNI
      Interface:         G703-2M
      Test Period:       CONTINUOUS
      Tx Clock Source:   INTERNAL
      Tx Rate:           64 kbps


                MENU       CFG G703    NEXT
        F1         F2          F3       F4
```

- DLCI: allows editing the DLCI (Data Link Connection Identifier). It can be any value from 0016 up to 1007. To edit this value, press the DATA key and use the alphanumeric keys. To cancel editing, press F1 (EXIT). When finished editing, press F4 (ENTER) to confirm.
- Emulation: Selects the TSW200E1 emulation logic type as NETWORK, TERMINAL or NNI.
- Interface: selects the operating interface as RS232, V35, V36, X.21, RS530 or G.703-2M. When choosing the G.703-2M interface, many interface-related parameters must be configured. To do this, press the F3 (CFG G703) key. For a description of these parameters, please see the following pages.
- Test Period: selects if the test is continuous or timed. Press DATA to edit. Use the alphanumeric keys and the ←,→,↑ and ↓ keys to move the cursor. Enter the time to begin the test and the test time. To cancel editing, use the F1 (EXIT) key. When done editing, press F4 (ENTER) to confirm.
- Tx Clock Source: Allows choosing the transmission clock source as EXTERNAL, INTERNAL or FROM RX (only when the chosen interface is G703-2M).

- Tx Rate: Allows choosing the transmission rate as any speed between 64 Kbps and 2048 Kbps. It is only available if the previous option was chosen as INTERNAL.
- Clock Edge: Allows choosing if data is valid in the positive or negative clock transition. The options are NORMAL and INVERTED. It is only available if the previous option was chosen as EXTERNAL.

```
┌─────────────────────────────────────────┐
│                 LOOPBACK                 │
│                                          │
│   LMI Type:         CCITT        ←        │
│   Polling Time:     02                    │
│   Polling Cycle:    10                    │
│   Polling Verify:   10                    │
│                                          │
│                                          │
│                                          │
│   BACK        MENU                        │
└─────────────────────────────────────────┘
     F1          F2          F3          F4
```

- LMI Type: Chooses the management type to be used: CCITT (ANNEX-A), ANSI (ANNEX-D), FRF (LMI. or FR. FORUM) or AUTO. For the AUTO management, the equipment will automatically adjust itself to the management type that it is receiving.
- Polling Time: Time interval, in seconds, between the sending of status inquiries. The allowed options are from 02 to 99. It is valid only when the TERMINAL option is chosen. It can be edited with the DATA, ← and → keys.
- Polling Cycle: Defines the number of management data frames that are needed to send a FULL STATUS inquiry. Example: if this number is 5, four LIV STATUS inquiries and one FULL STATUS inquiry are sent at each cycle of 5 management frames. The user can choose from 01 to 99. It can be edited with the DATA, ← and → keys. It is only valid when the TERMINAL option is chosen.
- Polling Verify: Time interval, in seconds that the TSW200E1 waits for a status enquiry, when configured as NETWORK, before issuing the NO REQUEST message. It can be edited with the DATA, ← and → keys.

2.6.2 - Running the Loopback Test

After correctly connecting and configuring the test set, the test can be started by pressing the START/STOP key. When this test is running, the screen shown below is the only one displayed by the equipment.

```
┌─────────────────────────────────────────────┐
│              LOOPBACK                         │
│                                               │
│   TX FRAMES =                          0      │
│   RX FRAMES =                          0      │
│                                               │
│                                               │
│                                               │
│              0000:00:30                       │
│                                               │
└─────────────────────────────────────────────┘
     F1          F2          F3          F4
```

In this screen are presented:
- the received frame counters: RX FRAMES
- the transmitted frame counters: TX FRAMES
- the test elapsed time

A difference between the TSW200E1 counters means that the equipment has reached its processing capability. If more details about the processing limits are needed, please contact Wise.

To end the test, press the START/STOP key again.

3 -   Glossary of Technical Terms

The meaning of many technical terms, as used throughout this manual, is now presented.

ANSI
American National Standards Institute

BECN
Backward Explicit Congestion Notifier

CIR
Committed Information Rate. It is the minimum data transfer rate assured by the telephone company to the subscriber that acquires a frame relay link. The equipment is capable of generating traffic on a frame relay link to check if there will be no information congestion, so as to check if the promised CIR is correct.

CPE
Customer Premise Equipment

CSU
Customer Service Unit

FCS
Frame Check Sequence. Useful to detect CRC-based errors

FECN
Forward Explicit Congestion Notifier

LAN
Local Area Networks

LMI
Local Management Interface

Protocol
Set of rules that specify the message format and the timings pertinent to the communication between two systems.

PVC
Permanent Virtual Circuit

TCP/IP
Transmission Control Protocol/Internet Protocol

WAN
Wide Area Networks

Appendix A– Frame Relay Protocol

A.1 - Frame Relay Structure

The Frame Relay data transmission service fulfils the following functions:
- Frame border setting, alignment and data transparency;
- Frame multiplexing and demultiplexing according to the address field (DLCI);
- The data transparency is guaranteed by the bit stuffing technique;
- Frame inspection to ensure that each frame is formed by an integer number of octets before zero insertion (bit stuffing) and after zero deinsertion , at the receive side;
- Frame size inspection to ensure that the size of each frame is between specified limits;
- Transmission error detection (but not error recovery).

Essentially, the frame delivery process for the frame relay services consists in forwarding of frames with the format shown below.

8	7	6	5	4	3	2	1	
Idle Flag								Octet 1
Address Field - 1° octet								Octet 2
Address Field - 2° octet								Octet 3
Information Field (N-6) octets								Octet 4 . . . Octet N-3
FCS (Frame Check Sequence) - 1° octet								Octet N-2
FCS (Frame Check Sequence) - 2° octet								Octet N-1
Idle Flag								Octet N

A.2 - Idle Flag Sequence

These Flag fields delimit a frame. Every frame must start and end with a sequence of flags consisting of the first bit 0, followed by six bits 1 and another bit 0 (0111 1110 - 7E hexadecimal). The Flag immediately before the address field marks the start of the frame and the Flag that follows the FCS marks the end of the frame.

Using this technique of frame delimiting implies in the adoption of *bit stuffing* to assure data transparency. That technique presumes the insertion of a bit 0 each time a sequence of five bits one

is found in the transmitted information. At the receiving end, for each sequence of five bits one received, the following bit must be suppressed if it is equal to 0. If this bit is one, than the receiver knows it is the end of the frame.

A.3 - Address Field

For address field composed of two octets, the following structure applies:

Most significant DLCI (6 bits)				C/R	EA = 0
Less significant DLCI (4 bits)	FECN	BECN	DE	EA = 1

DLCI - Data Link Connection Identifier.
EA - when at 1, indicates that it is the final of the address field. But if EA is at 0, this means that another address octet is coming.
C/R - reserved to the command and response bit. For command C/R is equal to 0; for response, it is equal to 1.
FECN and BECN – used to notify congestion situations.
OF - In case of congestion, the frame that has OF equal to 1 is preferably discarded.

FCS (Frame Check Sequence)

Used to accommodate a CRC-based error detection sequence.

PVC Management Procedure

Before the Frame Relay service is enabled for a client, it is necessary to be sure that it is "alive" (*Frame Relay Heartbeat*). Then, it is indispensable to have a correct link management between CPE and the network, checking if the frames are being correctly transmitted and received. These tests include the checking of active link, *full status polling times* and PVC status.
The PVC management frame format is shown below.

8	7	6	5	4	3	2	1	
0	1	1	1	1	1	1	0	Flag
0	0	0	0	0	0	0	0	Address field
d0	0	0	0	0	0	0	1	DLCI = 0
0	0	0	0	0	0	1	1	UI P = 0
0	0	0	0	1	0	0	0	Protocol Discriminator
0	0	0	0	0	0	0	0	Dummy call reference
Message Especific Information Elements								
FCS								
0	1	1	1	1	1	1	0	Flag

In these procedures, every messages are transmitted with DLCI = 0 and the FECN, BECN and OF bits are not used and must be kept at 0.

These procedures are based in the periodic transmission by the DTE of a message status inquiry and of a status message by the DCE.

The message specific information elements are: type of message, type of response, link integrity check and PVC status. See on the frames below how these information elements are structured.

Message Especific Information Elements
Message Type
Content Type
Link Verification
PVC Status (when Status message)

- Type of Message

BITS 8 7 6 5 4 3 2 1	Message Type
0 1 1 1 0 1 0 1	*status enquiry*
0 1 1 1 1 1 0 1	*status*

- Type of Content

8	7	6	5	4	3	2	1	Octet
0	1	0	1	0	0	0	1	1
Response type content lentgh								2
Response type								3

Note: Octet 3 – type of response

BITS 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	full status (status of all PVCs in DTE/DCE iinterface)
0 0 0 0 0 0 0 1	Link Integrity Check
0 0 0 0 0 0 1 0	status os a simple asynchronous PVC

- Link integrity check

BIT								Octet
8	7	6	5	4	3	2	1	
0	1	0	1	0	0	1	1	1
Link integrity check content lenght								2
Sent sequences number								3
Received sequences number								4

- PVC Status

8	7	6	5	4	3	2	1	Octet
0	1	0	1	0	1	1	1	1
PCV Status content lenght								2
0 ext.	0 spare	data link connection indentification (6 most significant bits)						3
1 ext.	data link connection indentification (2° 4 most significant bits)			0	0 spare		0	3a
1 ext.	0	0 spare	0	New "N"	Delete "D"	Active "A"	0 reserv.	4

Status Inquiry

This message is sent to request PVC status or to request link integrity check. The message status inquiry information elements are:

Information Elements	Direction	Type	Lenght
Message Type	both	required	1
Content Type	both	required	3
Link Integrity Check	both	required	4

Status

This message is sent as an answer to the status inquiry to indicate the virtual circuits status or to check link integrity. The information elements in the message status are:

Information Elements	Direction	Type	Lenght
Message Type	both	required	1
Content Type	both	required	3
Link integrity check	both	optional / required(*)	4
PVC status	both	optional / required(*)	5 - 7

* Optional or required, according to the type of response.