# Multiplexer

# FMUX/S-4E1-E2

## 4 E1 Channels
## E2 Link

Installation and Operation Manual

Document Version: 1.0E / 14.12.2007

# Contents

## Safety precautions

An exclamation point enclosed in a triangle warns the user about important operations and maintenance instructions for the device.

It is mandatory to observe the existing safety rules during installation, operations, and technical maintenance of the device. Installation, technical maintenance, and repair operations must be performed only by qualified and certified personnel. Installation, technical maintenance, and repair operations must not be performed by the operator or the user.

Multiplexer equipment «FMUX» manufactured by «Cronyx» in compliance with Technical Specifications 150.RUS ТУ is compliant with the following requirements:

- «Technical Requirements to secondary time trunking equipment for 2/8 Mbit/s digital transmission systems» approved by the Ministry of Information Technologies and Communications of the Russian Federation, January 17, 1997;
- «Technical Requirements to tertiary time trunking equipment for 2/34 Mbit/s digital transmission systems» approved by the Ministry of Information Technologies and Communications of the Russian Federation, January 17, 1997.

Multiplexer equipment «FMUX» has the following application conditions: in public network as secondary and tertiary time trunking equipment of plesiochronous digital hierarchy.

*Cronyx* reserves the right to make changes to technical characteristics and design of the device without the prior notification of customers.

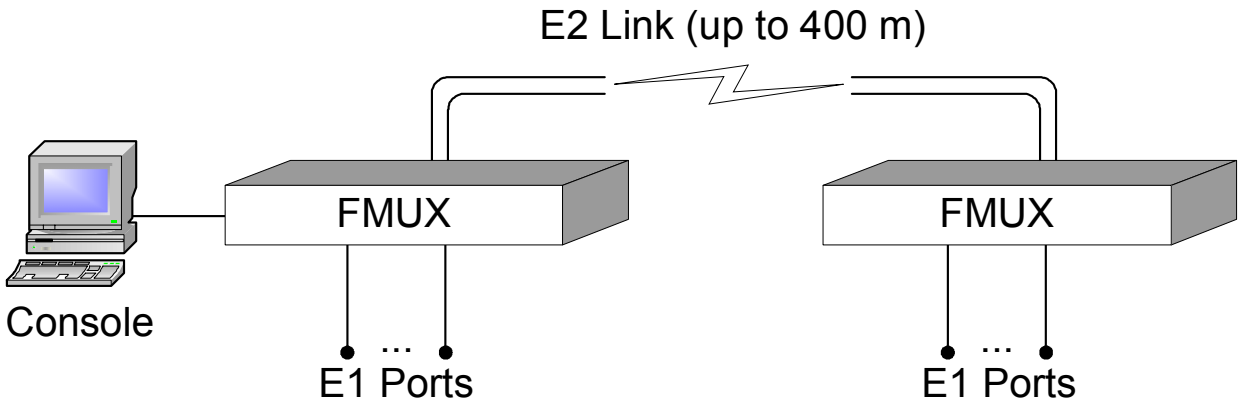
# Section 1. Introduction

## 1.1. Application

The FMUX/S-4E1-E2 is a 4 channel multiplexer, allowing to transmit up to four E1 channels over a E2 link.

Each of the E1 channels is transmitted independently. The synchronization frequency of each link is non dependent on the synchronization frequencies of the other links.

The picture shows the diagrams of the item's use:

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Hereinafter the 'E1' term is used to denote a data transmission channel with an interface complying with the ITU-T G.703 standard for transmitting data with a rated bit rate of 2,048 kbit/s in both framed mode in accordance with the ITU-T G.704 (or PCM-30) standard, and unframed mode.

## 1.2. FMUX/4 family overview

Main characteristics of the FMUX/4 family multiplexers:

- transmission of up to 4 E1 channels over a fiber optic link (or over a E2 link);
- single-mode or multi-mode fiber;
- up to 170 km distance;
- capability to operate over a single fiber;
- availability of models with a Ethernet (10/100Base-T) digital port or a universal port (V.35/RS-530/RS-232/X.21);
- Ethernet virtual local area network (VLAN) support;
- compliance with ITU-T G.703, G.704, G.742, G.751, G.823, G.955, O.151, and IEEE 802.3 standards;
- local and remote loops;
- built-in error rate meter (BER tester);
- RS-232 console port;
- remote management over SNMP via a dedicated Ethernet (10Base-T) port;
- emergency alarms ('dry relay contacts');
- compact design (1U) for rack-mounting;
- built-in power supply unit for mains or battery supply.

The device may be managed via the RS-232 interface using an ASCII terminal (console), or via Ethernet using the SNMP protocol.

The indicators on the front panel of the multiplexer show link availability, serviceability of the link transceiver, loop switched-on states, and testing modes.

The built-in BER tester allows measuring error rate in the link. The measurements are performed using fixed or pseudo-random code according to the O.151 standard (the pattern length is $2^{23}$-1=8,388,607 bits).

Remote login from the local device to the remote one is provided to allow remote control, when there are no personnel on the remote side of the link. Commands are transmitted to the remote deice via an additional service channel.

The device is equipped with an emergency alarm relay, the 'dry' contacts of which may switch on an external device to call the operations personnel (according to G.742 and G.751).

The multiplexer has the capability of firmware upgrade. The instructions for upgrading the firmware may be found at the www.cronyx.ru website.

## 1.3. Ordering information

The FMUX/S-4E1-E2 device may be ordered with two power options as follows:

1. FMUX/S-4E1-E2/BNC-SNMP-AC (176-264 VAC, 50 Hz)
2. FMUX/S-4E1-E2/BNC-SNMP-DC (36-72 VDCx)

## 1.4. Technical specifications

### E1 interface

| | |
|---|---|
| Nominal bit rate | 2048 kbit/s |
| Connector | RJ-48 (female, 8-pin) |
| Coding | HDB3 |
| Frame structure | transparent G.703 stream transmission in both framed (G.704, PCM-30), and unframed mode |
| Error detection | bipolar violation |
| Link impedance | 120 Ohms, symmetrical (twisted pair) |
| Receiver signal level | 0 to -36 dB |
| Phase jitter suppression | in the receiving path |
| Overvoltage protection | TVS |
| Overcurrent protection | Fuse |

### E2 interface

| | |
|---|---|
| Connectors | BNC |
| Coding | HDB3 |
| Error detection | bipolar violation |
| Link impedance | 75 Ohms unbalanced (coaxial) |

| | |
|---|---|
| Receiver signal level | 0 to -2.8 dB, or<br>2.6 to -5.6 dB, or<br>3.6 to -6.8 dB,<br>set from the console |
| Permitted cable length | 0 to 170 m, or<br>150 to 350 m, or<br>200 to 400 m<br>(for the ATT734A cable),<br>set from the console |
| Overvoltage protection | TVS |
| Overcurrent protection | Fuse |

### Emergency alarm interface

| | |
|---|---|
| Connector type | DB-9 (female) |
| Relay contact type | Up to 600 mA |
| Relay contact voltage | Up to 110 VDC or 125 VAC |

### Console port

| | |
|---|---|
| Interface type, | RS-232 DCE connector, DB-9 (female) |
| Data transfer protocol | Asynchronous, 9,600 bit/s,<br>8 bits/character, 1 stop bit, no parity |
| Modem signals | DTR, DSR, CTS, RTS, CD |

### SNMP management port

| | |
|---|---|
| Interface type | Ethernet 10Base-T |
| Connector | RJ-45 |

### Diagnostic modes

| | |
|---|---|
| Loops | Local, remote |
| Error rate control | Built-in |
| Management | over the RS-232 management port,<br>over SNMP (for '-SNMP' models), or<br>from a remote device |

## Dimensions and weight

Design ..... 1U for a 19” rack
Size ..... 444 mm x 262 mm x 44 mm
Weight ..... 3.4 kg

## Electric power supply

AC power source ..... 176–264 VAC, 50 Hz
DC power source ..... 36–72 VDC
Power consumption ..... No more that 12.5 W

## Operating conditions

Temperature ..... 0 to 50 °C
Relative humidity ..... Up to 80 %, without condensation

# Section 2. Installation

## 2.1. Site requirements

The multiplexer unit should be grounded before switching on, there is a ground terminal screw on the front panel provided for this purpose.

When installing the multiplexer, allow for at least 10 cm of free space next to the front panel for interface cable connections.

The ambient temperature must be 0 to +50 °C at 80% humidity, no condensation.

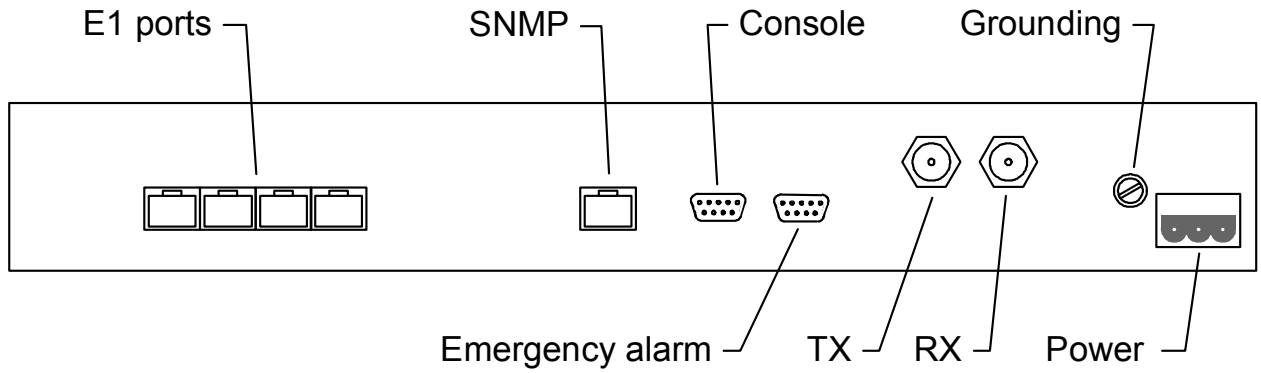
## 2.2. Delivered items

Delivered items include:

- the FMUX unit of a corresponding design – 1 piece;
- bracket for mounting the FMUX unit in a 19” rack – 2 pcs.;
- self-adhesive stand for the FMUX unit – 4 pcs.;
- AC power cord (for the '-AC' model) – 1 piece;
- removable part of the power supply connector terminal unit (for the '-DC model') – 1 piece;
- user's guide – 1 piece.

## 2.3. Cable connections

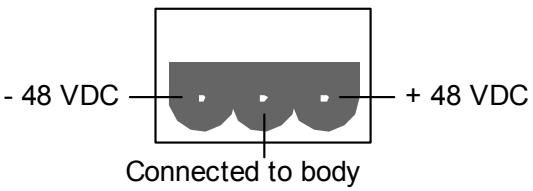
The front panel of the multiplexer contains connectors as follows: E2 link (TX and RX), the E1 ports, the SNMP Ethernet 10Base-T port, the console, the emergency alarm and the power supply.




### Power supply connector

A standard mains connector (IEC 320 C14) is used to connect the AC power cord (for the '-AC' model). The power cord is supplied with the device.

To connect the DC power supply cable (for the '-DC' model), the power supply connector is used, shown below (view from multiplexer's front panel side):




The corresponding removable part of the power supply connector is supplied with the device.

## Ground terminal

There is a M4 screw on the front panel for device grounding.

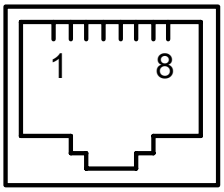
Before switching the device on, and before connecting other cables, the multiplexer unit must be properly grounded.

## E2 link TX and RX connectors

Standard BNC connectors are used for connecting E2 link. Be careful to connect the receiving cable to the RX connector, and the transmitting cable to the TX connector. Do not allow cable bending at sharp angles.

## E1 port connectors

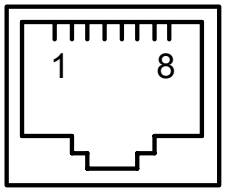
An RJ-48 connector is used for E1 port connections:




1 - output A
2 - output B
3 - not used
4 - input A
5 - input B
6 - not used
7 - not used
8 - not used

## SNMP port connector

An RJ-45 female socket is used for the connection of the Ethernet port (10Base-T, IEEE 802.3 standard) for management via the SNMP protocol:




1 - TX +
2 - TX -
3 - RX +
4 - not used
5 - not used
6 - RX -
7 - not used
8 - not used

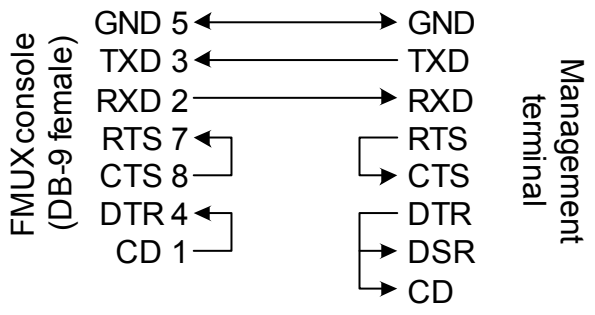
Use direct cable for connection to the hub.

## Console port connector

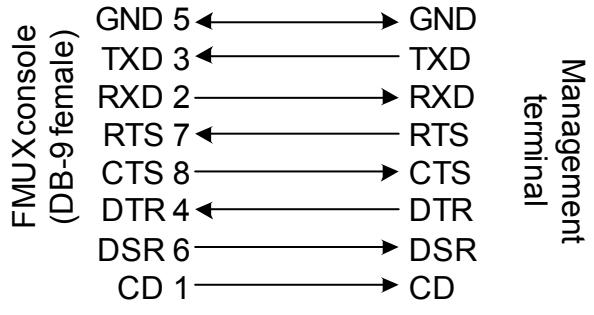
A DB-9 (female) connector is used for console connection. The console port has a standard RS-232 DCE interface, and utilizes the following settings: asynchronous mode, 9,600 baud speed, 8 bits per character, 1 stop bit, no parity. Use a direct cable for connection to a PC COM port.

An RTS signal from the managing terminal to the device console port must be provided when connecting the console.

It is recommended to use the following cable diagrams:



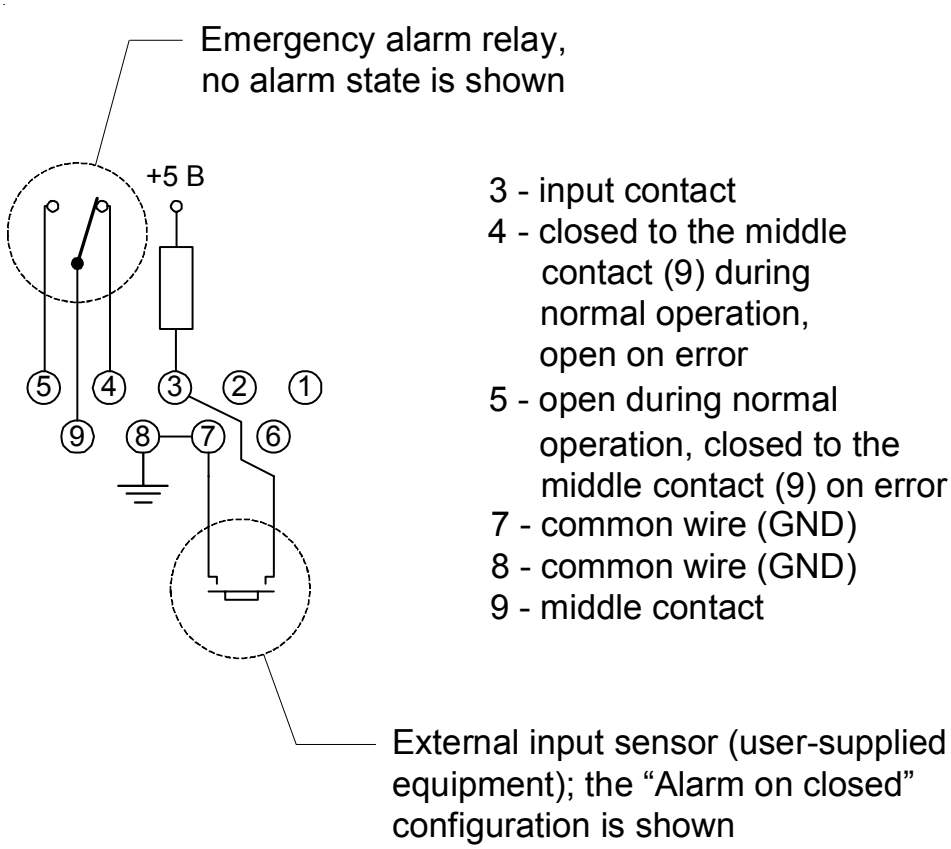

Cable without modem control




Cable with modem control

## Emergency alarm connector

A DB-9 (female) connector is used for emergency alarm connection:



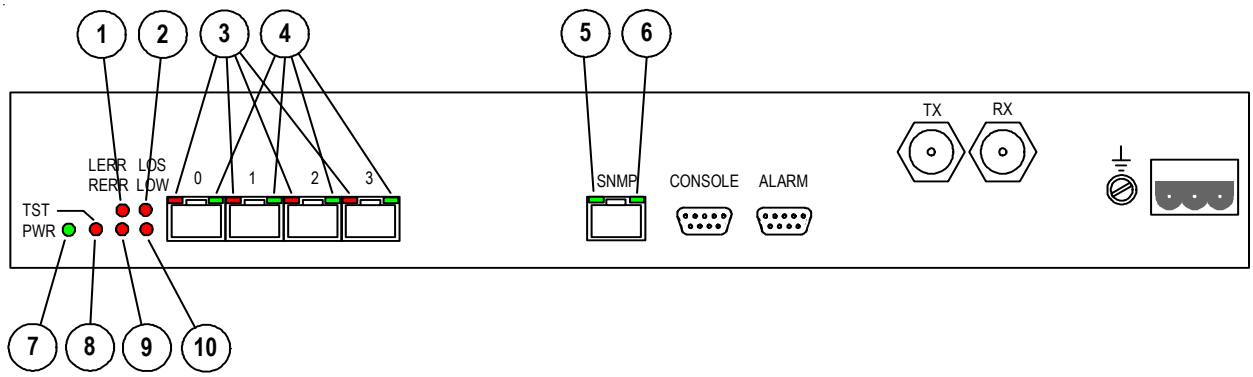

The external input sensor (contacts 3 and 7) must be isolated from other electrical circuits.

Contacts 1, 2, and 6 are reserved and should not be used.

# Section 3. Operations

## 3.1. Indicators

The front panel contains indicators, showing the status of the device. The list of indicators and their functions are specified in the table below. Reference number on the figure correspond to numbers in the table.




| No. | Indicator | State | Description |
|---|---|---|---|
| 1 | LERR | Red | Errors on the link:<br>• lights or flashes during a high error rate in the link input signal;<br>• lights when receiving a test pattern from the link with loop enabled on the link;<br>• lights or flashes when there are BER tester errors in the link test mode (the TST indicator lights). |
| 2 | LOS | Red | Lights at the link receiver carrier loss. |
| 3 | PORT LOS | Red | E1 port errors:<br>• flashes during HDB3 coding errors in the corresponding E1 port;<br>• lights during loss of carrier in the corresponding E1 port;<br>• lights when receiving the AIS signal at the input of the corresponding E1 port. |

| | | | |
|---|---|---|---|
| 4 | PORT STATE | Green | E1 operating mode:<br>• lights - normal operation;<br>• does not light - port is not used;<br>• flashes - loop enabled on the port;<br>• double flashes - tributary loop enabled on the port. |
| 5 | SNMP EACT | Green | Ethernet data transmission in progress. |
| 6 | SNMP ELINK | Green | Ethernet cable connected. |
| 7 | PWR | Green | Device power present. |
| 8 | TST | Red | Test modes:<br>• flashes when the bit error rate tester is enabled towards the link;<br>• flashes when the loop is enabled on the link;<br>• double flashes when remote loop is enabled. |
| 9 | RERR | Red | Errors in the remote device (when the link transceiver carrier is present):<br>• loss of the link receiver carrier at the remote end;<br>• link synchronization loss at the remote end. |
| 10 | LOW | Red | Not used. |

## 3.2. Emergency alarms

The multiplexer is equipped with an emergency alarm interface.

The emergency alarm interface is designed for switching on an external executive device (bell, buzzer, or console indicator) during an abnormal situation. It is switched on by 'dry' (that is, not connected to any multiplexer electrical circuits) relay contacts.

Contact 9 is closed to contact 4 during normal operating mode. In the 'alarm' state contact 9 disconnects from contact 4, and closes with contact 5 (see the 'Emergency alarm connector' connection diagram in the 'Cable connections' section).

The relay switches to the 'alarm' state in the following situations:

- power failure;
- no signal or loss of frame synchronisation on the link;
- for links in the 'In use' state: no signal in one of the E1 ports;
- a signal from en external input sensor on the remote device is received – contact 3 on the emergency alarm connector of the remote device is closed to contact 7 (or open, of the on open mode is set in the configuration menu – 'Sensor input: Alarm on open').

If the multiplexer is installed in an unserviced room, then the external input sensor contacts may be used, for example, for transmitting climate sensor signal, door opening signals, etc.

The external input sensor contacts must be closed by an actuator, which is isolated from electrical circuits! Non compliance with this requirement may lead to multiplexer malfunction.

The external sensor has two operating modes: closing-sensitive and opening-sensitive. By default the *on close* mode is set – when contact 3 closes to 7, the remote device switches to the alarm state.

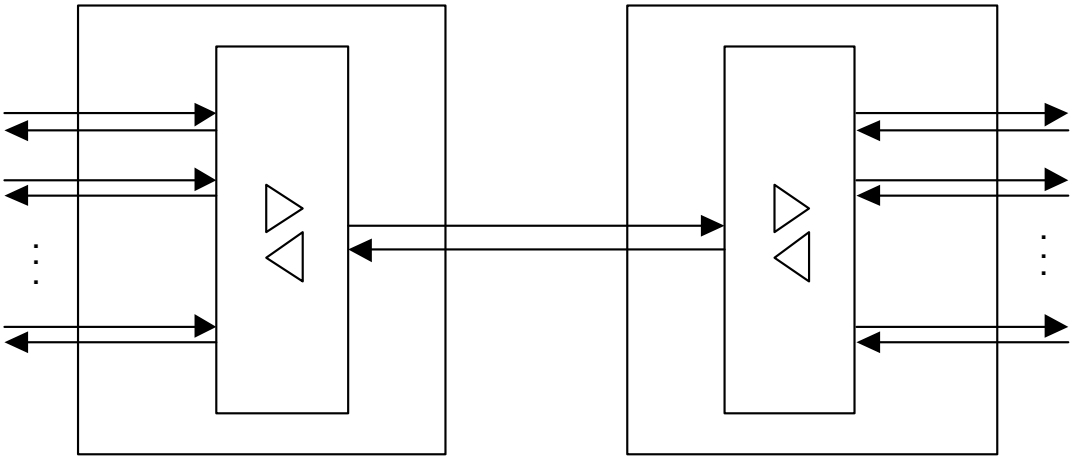
It is possible to set the on open mode from the console (see the description of the 'Sensor input' command in the “'Configure' menu” section), in this case the sensor must be normally closed, and when it opens, the 'alarm' state is set on the remote device.

## 3.3. Device responses to emergencies

| Local device | | | Remote device | |
|---|---|---|---|---|
| **Condition** | **Indicators and relay** | **AIS Output to E1 Ports** | **Indicators and Relay** | **AIS Output to E1 Ports** |
| Power failure | All indicators: Off<br>Relay: Alarm | | LOS: On<br>Relay: Alarm | To all ports |
| Loss of input signal from link | LOS: On<br>Relay: Alarm | To all ports | RERR: On | |
| High link input signal error rate | LERR: On<br>Relay: Alarm | To all ports | RERR: On | |
| E1 port N configured as «Unused» | PORT N STATE: Off | | | |
| Loss of E1 port N input signal (port is «In use») | PORT N LOS: On<br>Relay: Alarm | | | To port N |
| Loss of E1 port N input signal (port is «Unused») | PORT N STATE: Off | | | To port N |
| AIS is being received at the E1 port N | | | | To port N |
| Local link loopback is enabled | TST: flashes | To all ports | | |
| Remote link loopback is enabled | TST: flashing by double flashes | | TST: flashes | To all ports |
| E1 port N loopback is enabled | PORT N STATE: flashes | | | To port N |
| E1 port N tributary loopback is enabled | PORT N STATE: flashing by double flashes | To port N | | |

## 3.4. Loops

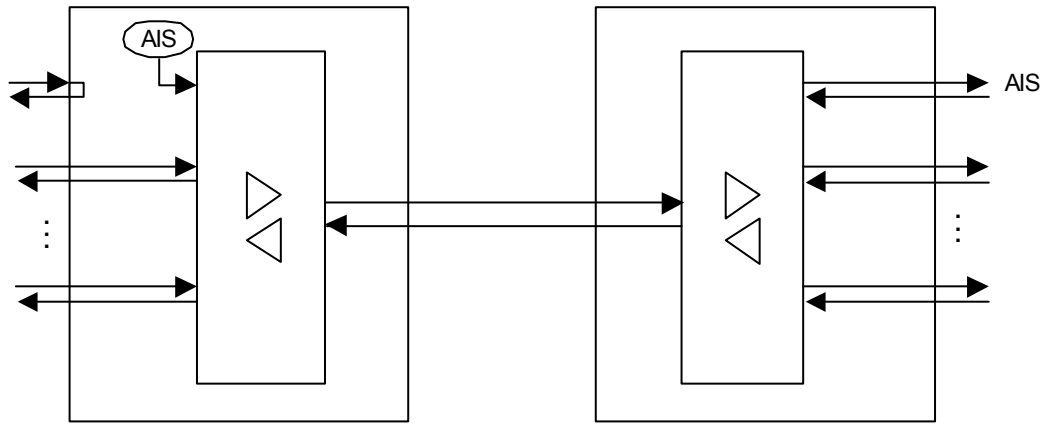
### Normal mode




In the normal mode, the indicators must be in the following states:

| Indicator | Color | Normal state |
|---|---|---|
| PWR | Green | On |
| TST | Red | Off |
| LOS | Red | Off |
| LOW | Red | Off (not used) |
| LERR | Red | Off |
| RERR | Red | Off |
| PORT LOS | Red | Off |
| PORT STATE | Green | On, when the port is in use |
| SNMP ELINK | Green | On, when the Ethernet cable is connected to the SNMP port |
| SNMP EACT | Green | Flashes when Ethernet data transmission is in progress over the SNMP port |

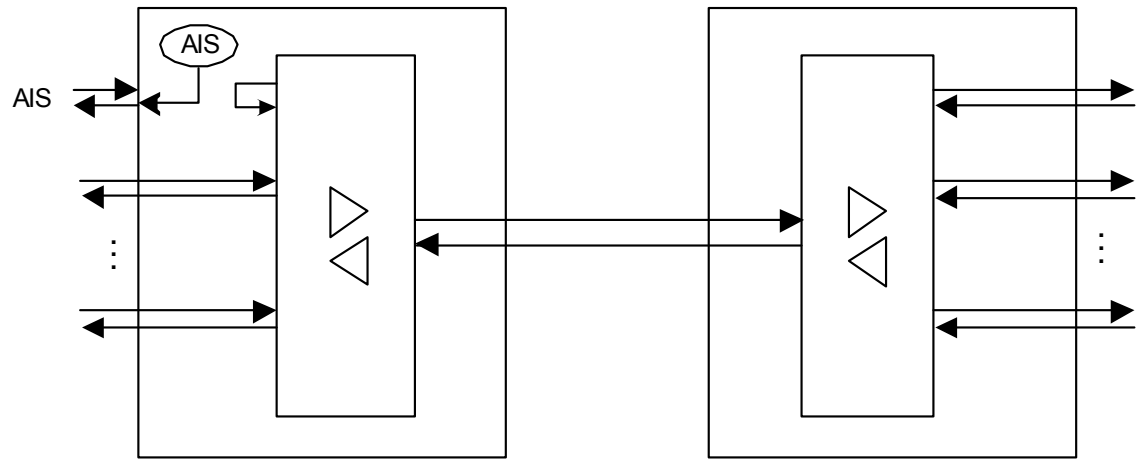
## Port loop




Local multiplexer,
loop enabled on port 0,
the PORT STATE indicator of port 0 flashes

Remote multiplexer

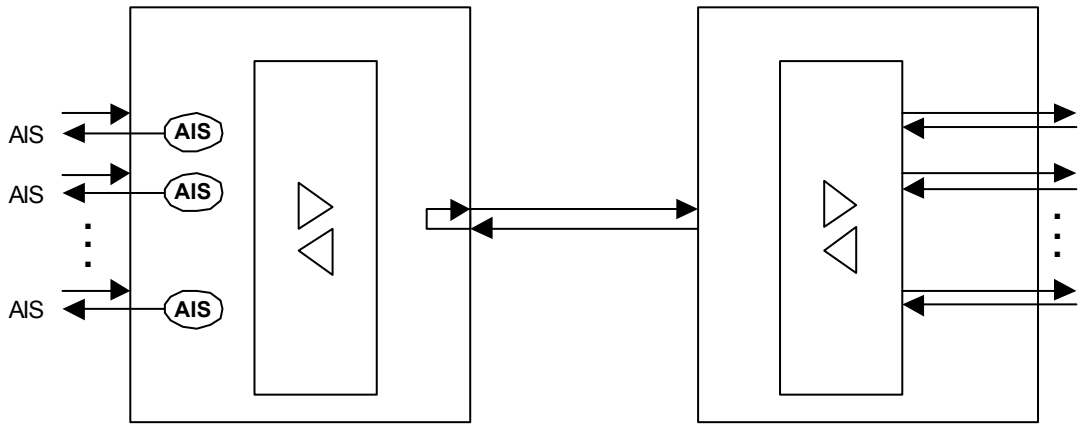
## Tributary loop




Local multiplexer,
tributary loop enabled on port 0,
the PORT STATE indicator of port 0 flashes

Remote multiplexer

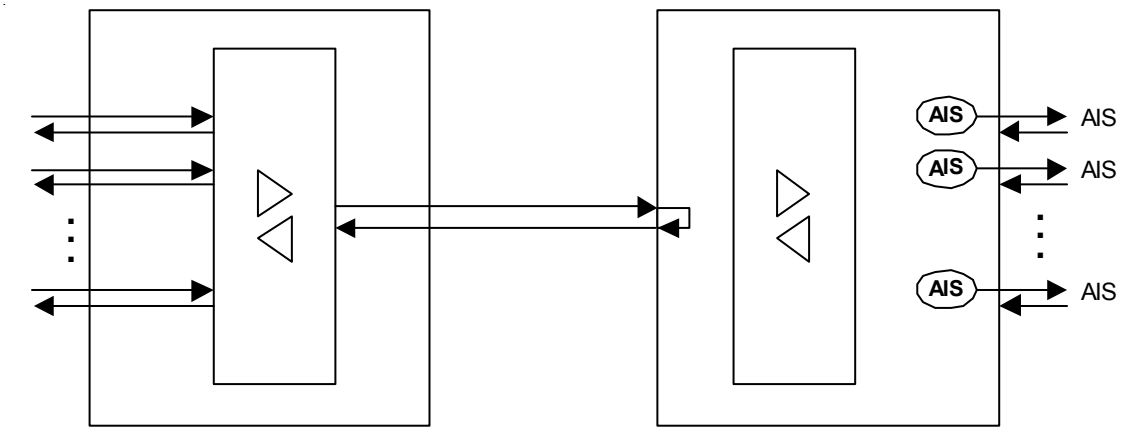
## Local loop on the link




Local multiplexer,
local loop enabled,
TST indicator flashes

Remote multiplexer

## Link remote loop




Local multiplexer,
remote loop request on,
TST indicator double flashes

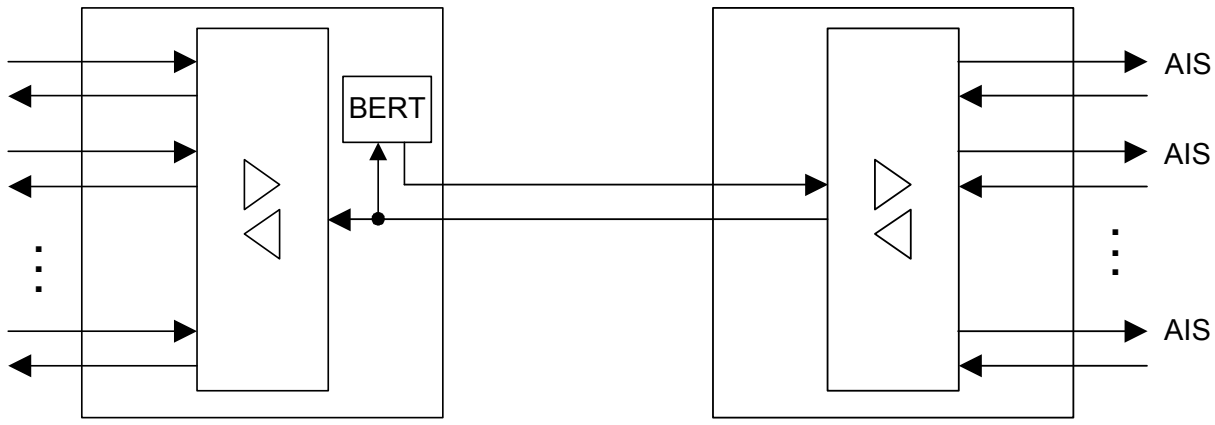
Remote multiplexer,
local loop enabled by remote
request, TST indicator flashes

## 3.5. Built-in BER tester

The FMUX multiplexer is equipped with a built-in BER tester, which allows to measure the bit error rate in the link. The measurements are performed using fixed or pseudo-random code according to the O.151 recommendation (the pattern length if — $2^{23}$-1=8,388,607 bits). The BER tester is controlled from the console (see the "Test' menu' section).

The BER tester calculates the error rate, by comparing the data transmitted to link to the data received from the link. When the BER tester is enabled on the local device, test data is transmitted to the link. If during this no test data are received from the link, the 'Test pattern not detected' message will be displayed on the console. When no multiplexed data from the transmission links are received from the link, the AIS signal is output to all E1 ports of the multiplexer.

This situation is shown on the diagram below:

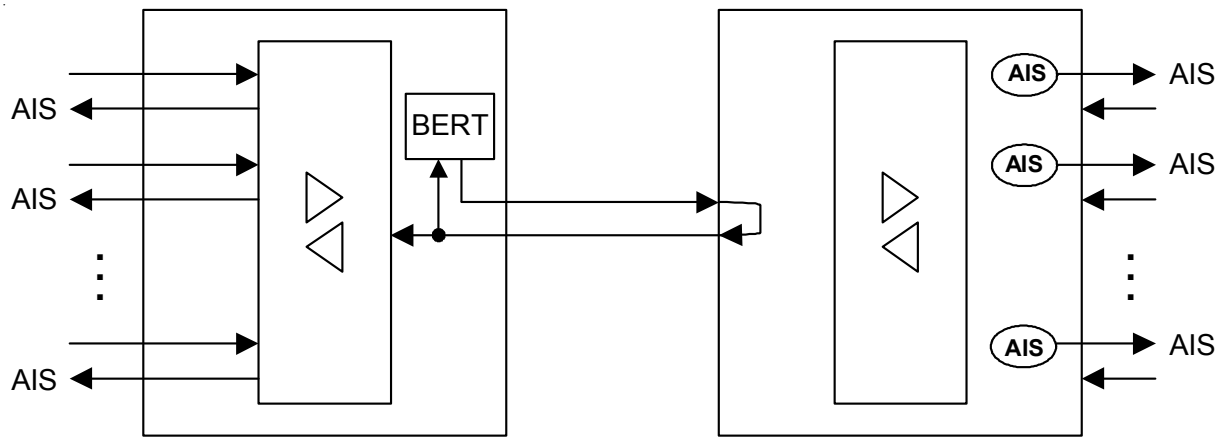



Local multiplexer:
BER tester enabled
"Test pattern not detected" state,
TST, LERR, RERR indicators on

Remote multiplexer:
AIS output to all E1 ports
LERR indicator on

When working with the BER tester the following two options should be considered.

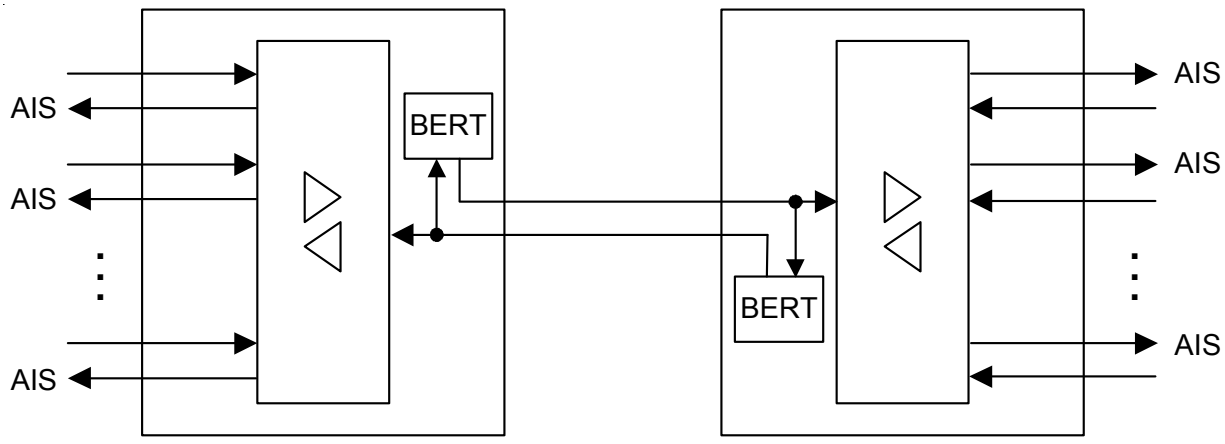
1. Link testing via the remote loop. A BER tester is enabled on the local device, and a loop directed towards the link is enabled on the remote device:




Local multiplexer:
BER tester enabled,
AIS output to all E1 ports
TST indicator on, LERR indicator on
on errors

Remote multiplexer:
loop on the optical link enabled,
AIS output to all E1 ports,
TST indicator flashes regularly,
LERR indicator on

2. BER testers are enabled in both directions. BER testers are enabled on the local and the remote device (such configuration allows separate measurements of link error rates in both transmission directions):




Local multiplexer:
BER tester enabled,
AIS output to all E1 ports
TST indicator on, LERR indicator on
on errors

Remote multiplexer:
BER tester enabled,
AIS output to all E1 ports
TST indicator on, LERR indicator on
on errors

# Section 4. Control via the console port

The front panel of the multiplexer is equipped with a DB9 connector (female) with a RS-232 interface, for connecting a control terminal (console). The console may be used to view current device modes, link states, local and remote error statistics, to select device modes and save them in non-volatile memory. For the console, the data rate is equal to 9,600 bits/s, 8 bits per character, no parity, 1 stop bit.

When the terminal is connected, the RTS signal (for stream control) must be provided.

## 4.1. Upper level menu

The console interface is designed as a simple hierarchical menu. To select a command, you must enter its number. To return to the upper-level menu, you must press <Enter> (or <Return>). An example of the main menu is given in the picture:

```
Cronyx FMUX / 4E1-SNMP revision D, 28/07/2004

Mode: Normal; Sensor=Open
Link: Ok

  1. Link statistics
  2. Port statistics
  3. Event counters
  4. Loopback...
  5. Test...
  6. Configure...
  7. Login to remote FMUX
  0. Reset

Command: _
```

The upper line contains device model name, revision code and firmware date.

The '**Mode**' line shows the 'alarm' state and the state of the external input sensor:

- 'Normal' – normal state – or «Alarm» – the 'alarm' state;

- 'Sensor= ...' – the state of the external input sensor contacts: 'Open' or 'Closed'; if the 'Sensor input: Alarm on open" option is selected in the configuration menu, then an additional message is shown:'Alarm on open').

For more information see the 'Emergency alarms' section.

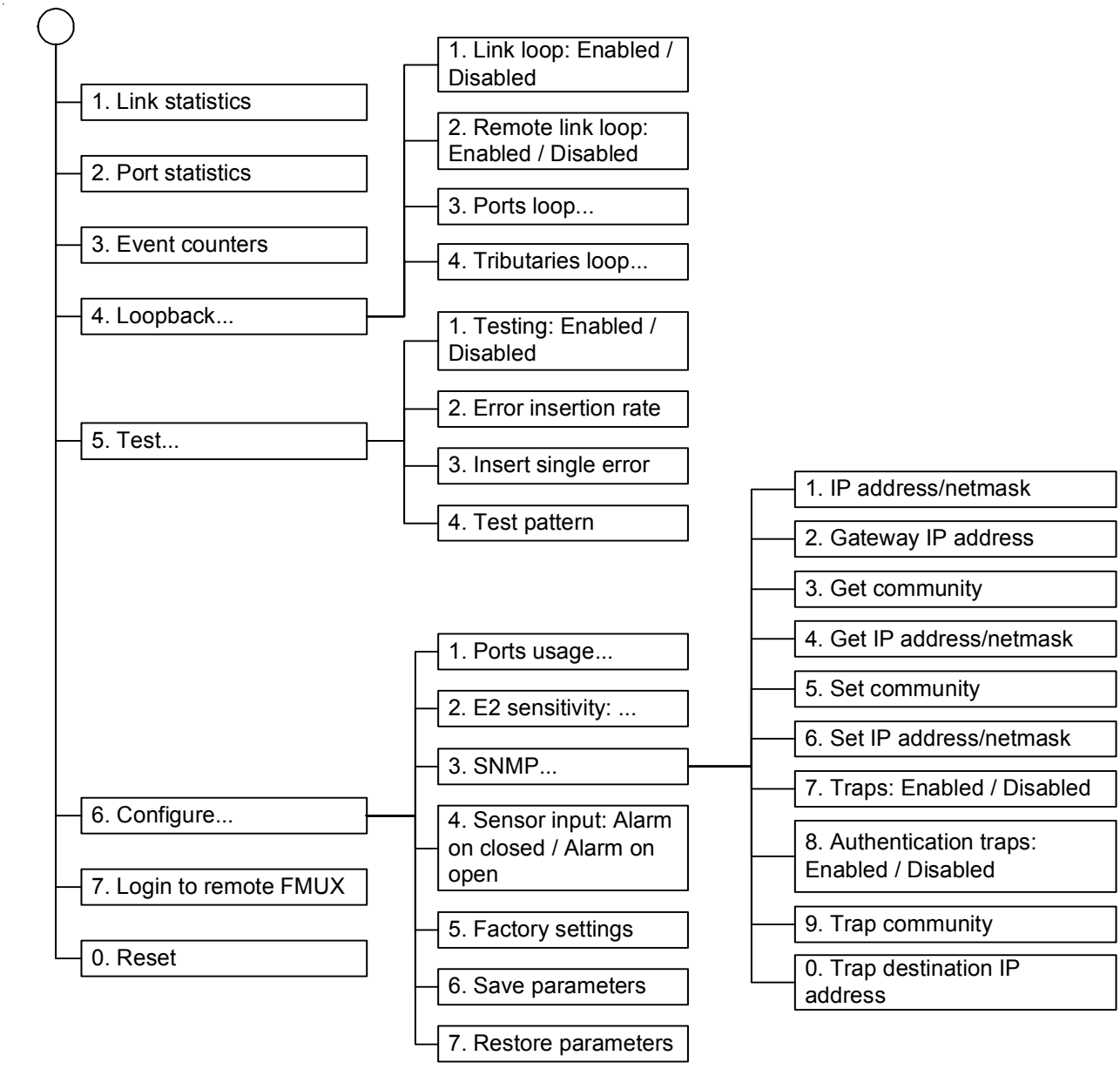
The '**Link**' line shows the state of the link:

- 'OK' - normal mode, frame synchronization present;
- 'LOS' – loss of signal in the link;
- 'LOF' – loss of frame synchronization;
- 'AIS' – the AIS signal is being received;
- 'dB=...' – E2 link receiver signal level;
- 'Loop' – local loop is enabled on the link: the received signal is turned back
- 'Remote loop' – a request for a remote loop is enabled.

When the BER tester is enabled, the 'Link' line also shows information about test results:

- 'Test pattern not detected' – if the test pattern was not detected in the received data;
- 'Test error rate=...' – the error rate in the received data, $10^{-1}$ to $10^{-8}$ (shown in place of the 'Test pattern not detected' message);
- 'Time total/loss=.../...' – the total test time (hours:minutes:seconds)/time in the 'Test pattern not detected' state (in seconds);
- 'Bit errors=...' – data bit error counter;
- 'Code=...' – test sequence code.

## 4.2. Menu structure



## 4.3. 'Link statistics' menu

The '*Link statistics*' mode is designed for viewing port operating modes and statistics counters:

```
Link statistics: Session #1, 0 days, 0:12:19

Mode: Normal; Sensor=Open
Link: Ok
                          -Errored seconds-
                CV        Receive  Transmit Status
Link:           0         0        0       Ok
 remote:        0         0        0       Ok

C - clear counters, R - refresh mode, any key to break....
```

The information on the screen is updated once per three seconds. To return to the upper-level menu, you must press <Enter> (or <Return>). Press 'R' to toggle the imposition mode. In the imposition mode the screen will not be cleared when information is updated. To reset the statistics counters to zero, press 'C'.

The '**Link statistics**' line contains the current session number and time passed from switching on or restarting the multiplexer (the Reset command). The session number is incremented after each restart of the device.

The lines from the upper part of the screen – **'Mode'** and **'Link'** – are described in the 'Upper level menu' section.

Below are link states and statistics counters:

- **'Link'** – for the link of the local multiplexer;
- **'Remote'** – for the link of the remote multiplexer.

Link '**State**' is displayed as a set of flags:

- 'OK' – normal reception, frame synchronization present;
- 'LOS' – loss of signal in the link;
- 'AIS' – link failure signal reception (the 'all ones' code);
- 'LOF' – loss of frame synchronization;
- 'FARLOF' – loss of frame synchronization on the remote multiplexer.

Statistics counters:

- **'CV'** – the number of code violations;

Under the **'-Errored seconds-'** message, column headings are located:

- **'Receive'** – the number of seconds, during which frame synchronization has been lost in the link;
- **'Transmit'** – number of seconds, during which transmitter errors have been detected.

## 4.4. 'Port statistics' menu

The '*Port statistics*' mode is used for viewing current information, link operating modes and statistic counters.

```
Port statistics: Session #6, 0 days, 5:17:01

Mode: Normal; Sensor=Open
Link: Ok
E1 port 0: Receive level=-0dB
E1 port 1: Receive level=-0dB
E1 port 2: Receive level=-0dB
E1 port 3: Unused
                          -Errored seconds-
                CV        Receive  Transmit Status
E1 port 0:      0         0        -        Ok
 remote:        0         0        -        Ok
E1 port 1:      0         0        -        Ok
 remote:        0         0        -        Ok
E1 port 2:      0         0        -        Ok
 remote:        0         0        -        Ok

C - clear counters, R - refresh mode, any key to break...
```

The information on the screen is updated once per three seconds. To return to the upper-level menu, you must press <Enter> (or <Return>). Press 'R' to toggle the imposition mode. In the imposition mode the screen will not be cleared when information is updated. To reset the statistics counters to zero, press 'C'.

The '**Port statistics**' line contains the current session number and time passed from switching on or restarting the multiplexer. The session number is incremented after each restart of the device.

The lines from the upper part of the screen – **'Mode'** and **'Link'** – are described in the 'Upper level menu' section.

Then the state of each E1 port is displayed:

- 'Receive level=...dB' – signal level at the receiver input: 0 to -40 dB (-40 dB – when the port cable is disconnected); 'Unused' – if the port is not used;
- 'Loop' – loop is enabled;
- 'Tributary loop' – tributary loop is enabled;
- 'Transmit AIS' – the AIS signal is output to the port (the 'all ones' code);
- 'Remote loop' – remote port loop is enabled;
- 'Test' – the BER tester is enabled.

The lower part of the screen shows E1 port states and statistic counters. The displayed information is related to the local device, and – when access to the remote device is available – to the remote device (the **'remote' lines**). States are not shown for unused ports.

Statistics counters:

- **'CV'** – number of data code violations;

Under the **'-Errored seconds-'** message, column headings are located:

- **'Receive'** – the number of seconds, during which frame synchronization has been lost in the link;

(The **'Transmit'** column is not used for this multiplexer model, and shows a '-' for each E1 port.)

Port **'State'** is displayed as a set of flags:

- 'OK' - normal mode, frame synchronization present;
- 'LOS' – loss of signal in the link;
- 'AIS' – link failure signal is received (the 'all ones' code);

## 4.5. 'Event counters' command

Use the '*Event counters*' command to get more detailed information about counters.

```
Alive: 0 days, 0:07:51 since last counter clear

Link counters

0  - out of sync on transmit
0  - loss of framing on transmit
0  - out of sync on receive
0  - loss of framing on receive
0  - out of sync on monitoring channel
0  - loss of framing on monitoring channel
0  - payload checksum errors

Press any key to continue...
```

**'Link counters'** – E2 link counters:

- 'out of sync on transmit' – the counter of synchronization losses of the transmitter;
- 'loss of framing on transmit' – the counter of short-time cycle synchronization losses of the transmitter;
- 'out of sync on receive' – the counter of synchronization losses of the receiver;
- 'loss of framing on receive' – the counter of short-time cycle synchronization losses of the receiver;
- 'out of sync on monitoring channel' – the counter of synchronization losses of the monitoring channel;
- 'loss of framing on monitoring channel' – counter of short-time synchronization losses of the monitoring channel;
- 'payload checksum errors' – counter of data checksum errors.

## 4.6. 'Loopback' menu

The '*Loopback*' menu is designed for loop management:

```
Loopback

Mode: Normal; Sensor=Open
Link: Ok

  1. Link loop: Disabled
  2. Remote link loop: Disabled
  3. Ports loop...
  4. Tributaries loop...

Command: _
```

The following loops are implemented:

- '**Link loop**' – local loop on the link. The data received from the link are turned back;
- '**Remote link loop**' – remote loop on the link. A request to enable loop on the remote multiplexer is transmitted towards the link;
- **'Ports loop...'** – move to the E1 port loop control menu;
- **'Tributaries loop...'** – move to the E1 port tributary loop control menu;

Loop modes are not stored in the nonvolatile memory.

### 'Ports loop' menu

The *'Ports loop'* menu is designed to control E1 port loops:

```
Port loopback

Mode: Normal; Sensor=Open
Link: Ok

  1. E1 port 0 loop: Disabled
  2. E1 port 1 loop: Disabled
  3. E1 port 2 loop: Disabled
  4. E1 port 3 loop: Disabled

Command: _
```

**'E1 port 0...3 loop'** – loop control on E1 ports. When a loop is 'Enabled', data received from the port are turned back.

### 'Tributaries loop' menu

The *'Tributaries loop'* menu is designed to control E1 port tributary loops:

```
Tributary loopback

Mode: Normal; Sensor=Open
Link: Ok

  1. E1 port 0 tributary loop: Disabled
  2. E1 Port 1 tributary loop: Disabled
  3. E1 Port 2 tributary loop: Disabled
  4. E1 Port 3 tributary loop: Disabled

Command: _
```

**'E1 port 0...3 tributary loop'** – tributary loop control on E1 ports. When the loop is 'Enabled', data received for the port from the link are turned back. The AIS signal is output to the corresponding E1 port.

## 4.7. 'Test' menu

The '*Test*' menu is designed to control the BER tester.

```
Bit Error Test

Mode: Normal; Sensor=Open
Link: LOF,
    Test error rate=0.0, Time total/loss=00:00:46/3, Bit errors=0

  Time total: 00:00:46
   Sync loss: 00:00:03
  Bit errors: 0
  Error rate: 0.0

  1. Testing: Enabled
  2. Error insertion rate: No errors inserted
  3. Insert single error
  4. Test pattern: Pseudo-random

<C> - clear errors counter, <R> - refresh mode, <Enter> - exit
```

The information on the screen is updated once per three seconds. To return to the upper-level menu, you must press <Enter> (or <Return>). Press 'R' to toggle the imposition mode. In the imposition mode the screen will not be cleared when information is updated. To reset the statistics counters to zero, press 'C'.

The '**Testing: ...**' command enables or disables the test pattern generation.

The **'Error insertion rate: ...'** command selects the error insertion rate, $10^{-7}$ to $10^{-1}$ errors/bit, or disables the error insertion mode – in this case the 'No errors inserted' message is output instead of a numerical value.

The **'Insert single error'** command inserts a single error.

The **'Test pattern: ...'** command allows using a pseudo-random code as a test pattern, or specifying a fixed 8-bit code.

Test results information is displayed in the following lines:

- **'Time total: ...'** – total testing time;
- **'Sync loss: ...'** – time during which test pattern synchronization has been lost;
- **'Bit errors: ...'** – data error counter;

- **'Error rate: ...'** – error rate in the received data, $10^{-1}$ to $10^{-8}$. If testing is not enabled, then this field shows the 'Testing disabled' message; if the test pattern has not been detected in the received data, the 'Test pattern not detected' message is output.

Error rate measurement device modes are not saved in the nonvolatile memory.

## 4.8. 'Configure' menu

The '*Configure*' menu allows to select multiplexer operating modes:

```
Configure

Mode: Normal; Sensor=Open
Link: Ok

  1. Ports usage...
  2. E2 sensitivity: 0...-2.8 dB (cable 0...170 meters)
  3. SNMP...
  4. Sensor input: Alarm on closed
  5. Factory settings
  6. Save parameters
  7. Restore parameters

Command: _
```

After setting the parameters, you should save them in the non-volatile memory (NVRAM) using the '**Save parameters**' command. If the current parameters have been set unsuccessfully, the saved configuration may be restored using the '**Restore parameters**' command. If required, all settings may be restored to a known initial state using the '**Factory settings**' menu item.

### 'Ports usage...' menu

The '*Ports usage...*' menu is designed for selecting the set of E1 ports for use:

```
Ports usage

Mode: Normal; Sensor=Open
Link: Ok

  1. E1 port 0: In use
  2. E1 port 1: In use
  3. E1 port 2: In use
  4. E1 port 3: In use

Command: _
```

If a port is 'Unused', its LOS and STATE indicators are off, and the port state does not affect the 'alarm' signal.

### 'E2 sensitivity' command

The '*E2 sensitivity'* command sets the permitted signal level for the E2 receiver input. Three settings options are possible:

- '0...-2.8 dB (cable 0...170 meters)»
  – 0 to -2,8 dB (for 0 to 170 m cable lengths);
- '-2.6...-5.6 dB (cable 150...350 meters)»
  – -2.6 to -5.6 dB (for 150 to 350 m cable lengths);
- '-3.6...-6.8 dB (cable 200...400 meters)»
  – -3.6 to -6.8 dB (for 200 to 400 m cable lengths);

Cable length ranges corresponding to the specified signal level value ranges are specified for the ATT734A cable type.

## 'SNMP' menu

The '*SNMP*' menu is designed for setting network IP addresses and SMNP protocol parameters:

```
SNMP

Mode: Normal; Sensor=Open
Link: Ok
MAC address: 00-09-94-ff-ff-ff


  1. IP address/netmask: 144.206.181.187 / 24
  2. Gateway IP address: 144.206.181.254
  3. Get community: public
  4. Get IP address/netmask: 144.206.181.0 / 24
  5. Set community: cronyx
  6. Set IP address/netmask: 144.206.181.0 / 24
  7. Traps: Enabled
  8. Authentication traps: Disabled
  9. Trap community: alert
  0. Trap destination IP address: 144.206.181.72

Command: _
```

The following parameters should be set for the operation of the SNMP port:

- **'IP address/netmask: ...'** – the multiplexer SNMP port IP address and subnet mask length;
- **'Gateway IP address: ...»** – routing gateway IP address.

The following parameters must be set for management over the SNMP protocol:

- **'Get community: ...'** – the password for information query;
- **'Get IP address/netmask: ...'** – the IP address and subnet mask length for information query access restriction;
- **'Set community: ...'** – the password for parameter settings;
- **'Set IP address/netmask: ...'** – the IP address and subnet mask length for parameter setting access restriction;
- **'Traps: ...'** – enabling or disabling ('Enabled' or 'Disabled') emergency state trap sending;
- **'Authentication traps: ...'** – enabling or disabling ('Enabled' or 'Disabled') unauthorized access traps;
- **'Trap community: ...'** – password for sending emergency event traps;

- **'Trap destination IP address: ...'** – the IP address for sending emergency event traps.

### 'Sensor input' command

The '*Sensor input*' command switches the alarm signal generation mode of the remote device to the external input sensor. The external sensor has two operating modes: 'Alarm on closed' (default) and 'Alarm on open'. In the 'Alarm on closed' mode, when contact 3 connects to contact 7, the remote device goes into the emergency alarm status. (See section "Emergency alarm" for more details).

### 'Factory settings' command

The '*Factory settings*' command restores the device modes to their initial state:

- E1 ports usage mode – all ports are used («In use»);
- alarm signal input sensor contacts mode – on closed ('Sensor input: Alarm on closed').

The '*Factory settings*' command does not affect the IP address and SNMP protocol parameter settings (see the 'SNMP' menu).

## 4.9. 'Login to remote FMUX' command

The '*Login to remote FMUX*' command allows connecting to the remote multiplexer menu. An example of the remote menu is given below. To disconnect from the remote menu, type ^X (Ctrl-X).

```
Remote login...
(Press ^X to exit)

Cronyx FMUX / 4E1-SNMP revision D, 28/07/2004

Mode: Normal; Sensor=Open
Link: Ok

  1. Link statistics
  2. Port statistics
  3. Event counters
  4. Loopback...
  5. Configure...
  0. Reset

Remote (^X to exit): _
```

In the remote login mode, it is possible to view the device modes, link state, and local and remote error statistics. It is also permitted to set device modes (see the 'Configure' menu) and port loops. It is not possible to enable the BER tester, or set loops on the link links.

## 4.10. 'Reset' command

The '*Reset*' causes the multiplexer to reset. The modes stored in the nonvolatile memory (NVRAM) are set during this.

# Section 5. Management via SNMP

The multiplexer may be equipped with an SNMP management port (for '-SNMP' models). The SNMP management port is located on the front panel, and has a standard Ethernet 10Base-T interface (RJ-45). The SNMP protocol may be used for viewing current device modes, link states, and local and remote error statistics. Protocol version supported is SNMPv1.

## 5.1. SNMP parameter settings

The following parameters must be configured from the console to access the device over the SNMP protocol:

- 'IP address/subnet mask' – the IP address of the Ethernet port, and the length of the subnet mask;
- 'Gateway IP address' – the IP address of the routing gateway.
- 'Get community' – information query access password;
- 'Get IP address/netmask' – the IP address and length of the subnet mask for the restriction of information query access;

Information query access is permitted only for the hosts, whose IP addresses equal to the one specified by the "Get IP address" parameter. The higher-order bits are used for IP address comparison, the number of which is specified by the 'Subnet mask' parameter.

Additional parameters must be configured for access to parameter settings:

- 'Set community' – parameter *settings* access password;
- 'Set IP address/subnet mask' – the IP address and the subnet mask length for the restriction of access to parameter *settings*;

Access rights to parameter settings must be granted to authorized hosts only.

In case of emergencies, the device is able to sent SNMP messages (traps). The following parameters must be specified to enable this:

- 'Traps' – allow traps;
- 'Authentication traps' – allow sending unauthorized access attempt traps;
- 'Trap community' – password for sending traps;
- 'Trap destination IP address' – the IP address for sending traps to.

SNMP traps are sent when the following events occur:

- multiplexer power-up or reload – the 'COLD START' trap;
- unauthorized access attempt over the SNMP protocol – the 'AUTHENTICATION FAILURE' trap;
- loss of signal or cycle synchronization on the link – the 'LINK DOWN' trap;
- switch of the link to the normal mode – the 'LINK UP' trap;
- loss of signal at the E1 port – the 'PORT DOWN' trap;
- appearance of signal at the E1 port – the 'PORT UP' trap.

## 5.2. Management information blocks (MIBs)

The following management information blocks (MIBs) are implemented in the multiplexer:

- RFC1213 (MIB-II) – a standard management information block, including common system parameters (system), network interfaces (if), the IP protocol (ip, icmp), the UDP protocol (udp), and SNMP protocol statistics (snmp);
- CRONYX-FMUX-MIB – a specialized management information block, containing the states of E1 ports and of the link.

The CRONYX-FMUX-MIB management information block specification files are available from the www.cronyx.ru website.