Flexible multiplexer E1XL

Rev. D

Features

- Two E1 links (PCM-30)
- Distance up to 1.5 km
- Two synchronous interfaces: V.35, RS-530, RS-449, RS-232, X.21, Ethernet, or IDSL-modem
- Asynchronous mode for RS-232 interface
- Programmable timeslot assignment
- G.704 frame alignment
- CAS and CRC4 multiframe alignment
- G.703 2,048 kbps unframed mode
- Cronyx PCM2 modem compatibility
- Data rates from 64 to 2,048 kbps
- Timing from the digital interface of receive and transmit path (DTE emulation)
- «Three-to-one» multiplexer mode
- «Drop-Insert» multiplexer mode
- Digital, local, and remote loopbacks
- Integrated BER tester
- RS-232 port for monitoring and control purposes
- Alarm interface («dry contacts»)
- Stand-alone or rack-mount (19" 3U) design
- AC or DC built-in power supply unit
- Upgradeable firmware
- The Certificate No. ОС/1-СПД-19 of Electrosvyaz Sertification System issued by the Russian Ministry of Communications

Contents

Specifications

Digital interface

Data rate	64 to 1,984 kbps (Nx64) or to 2,048 kbps in the unframed mode
Timing signals	TXC, RXC, ETC, ERC
Modem signals	DTR, DSR, CTS, RTS, CD

E1 interface

Line coding	HDB3
Line impedance	120 Ohm balanced (twisted pair) or 75 Ohm unbalanced (coaxial), set with jumpers
Signal level at receiver input	0 to –36 dB (max. 1.5 km distance via 0.6 mm twisted pairs)
Transmit path synchronization	from the internal clock generator, or from E1/0 link receive path, or from E1/1 link receive path, or from digital port 0, or from digital port 1
Phase jitter attenuation	In receive or transmit paths, attenuation up to 120UIpp
Frame structure	According to G.704
Multiframes	CRC4, CAS (G.704)
Frequencies offset adjustment	controlled slip buffers in receive paths
Connector	removable terminal block

Alarm interface

Relay contacts current	max. 250 mA
Relay contacts voltage	max. 175V DC
Connector	Mini DIN, 6 pins

Control port

Interface type	RS-232
Data transfer protocol	asynchronous, 9600 kbps, 8N1
Connector	DB9 female

Diagnostics modes

Loopbacks	digital (via digital interface), or local (via G.703 line at a local device), or

	remote (via G.703 line at a remote device) activated using front panel switches or via control port
Bit error rate tester	activated using front panel switches or via control port

Description

Cronyx-E1/XL is a multipurpose device intended for connection to E1/PCM30 links.

Serving as an interface and rate converter the device receives data from a digital interface (64 to 2,048 kbps) and allocates it in E1 flow thereby using the necessary number of timeslots, or the whole 2,048 kbps bandwidth in the unframed mode.

Serving as a modem the device allows to build high-speed data links based on twisted pair or coaxial cables of up to 1.5 km in length.

Serving as a multiplexer the device enables to split E1 flow into several (maximum 30) data flows wherein DTE units using these separated data flows can be located at a distance of up to 1.5 km. Drop-Insert mode provides connection layouts of network equipment that considerably increase the efficiency of E1/PCM30 links.

Stand-alone version of the multiplexer can be at customer's option equipped with RS-530, RS-232, V.35, or X.21 interfaces ended with standard connectors as well as with built-in Ethernet or IDSL-modem units. There is also a multiplexer version with a multi-standard interface ended with HDB44 connector in which case the interface type is determined by the adapter cable. The multi-standard interface supports RS-232, RS-530, RS-449, RS-422, V.35, and X.21 standards.

Two Cronyx E1XL devices with Ethernet interface or a combination of Cronyx E1XL and Cronyx E1L devices with Ethernet interface form a Remote Bridge for interconnecting two LANs. In the unframed mode you can use a Cronyx E1XL device together with a Cronyx PCM2 modem.

The rack-mount version of the multiplexer represents two physical units one of which is inserted at the front side of the rack while another one is inserted at its back side. This version of the multiplexer is equipped with multi-standard interfaces only.

Setting of the multiplexer configuration is executed either using DIP switches, or via a control port with RS-232 interface. In case of power failure all configuration parameters are stored in a non-volatile memory.

If there is nobody at the far end to enable E1 link loopback it can be activated remotely from the local node. The in-band management of the remote device is executed over an additional monitoring channel which uses a special timeslot 0 bit (in compliance with G.704 requirements) or any bit of some other timeslot at user's option. This monitoring channel is not available in the unframed mode.

In addition to rack-mount and stand-alone versions of E1/XL multiplexer there are also versions available representing cards for IBM compatible PCs (Cronyx-Tau/E1 and Cronyx-Tau-PCI/E1 multiplexers).

On-board firmware of desktop multiplexers can be updated via a console port. New firmware versions enable to expand multiplexer capabilities. Downloading of special firmware versions allows to fully change multiplexer functionality. The updates are available at Cronyx web site www.cronyx.ru.

This User Manual describes the stand-alone version of the device.

Cronyx E1XL rack-mount multiplexers have some functional differences. Please follow corresponding instructions supplied with multiplexers of that type to operate them.

Package contents

The delivery package includes the following:

- E1/XL multiplexer in the ordered configuration
- Removable terminal blocks for connection to E1 lines — 2 ea.
- Power cord (for AC power models)
- User Manual

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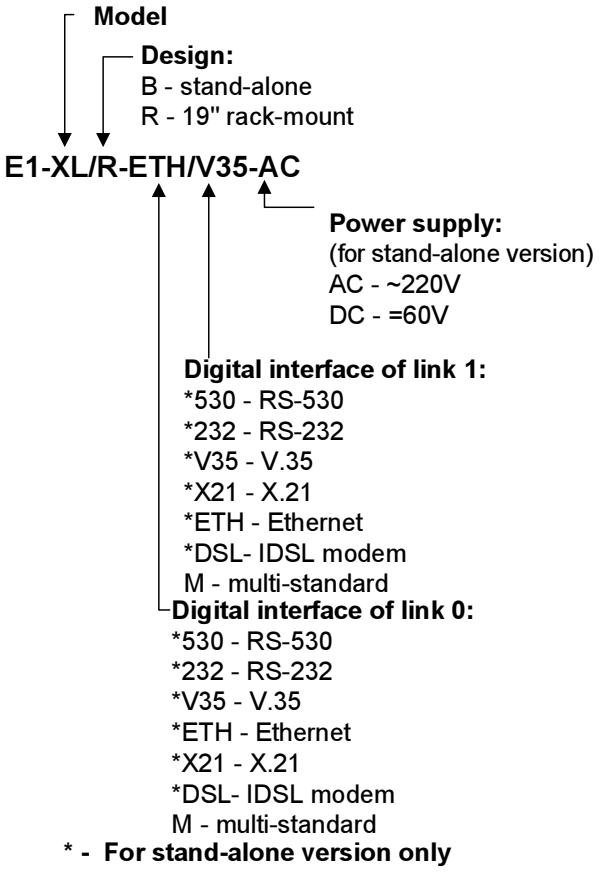
Ordering code



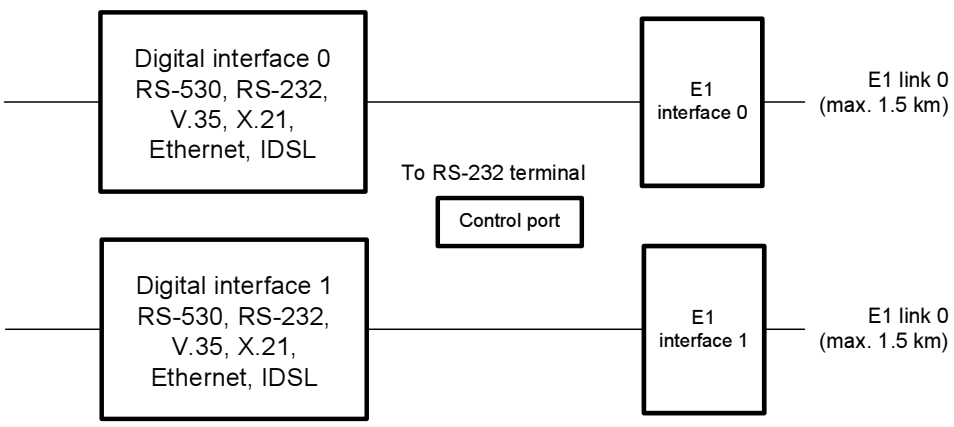
Operation modes

Two independent devices mode

Two data links are fully independent in this mode. Data entering the digital port input is assigned to selected timeslots of a corresponding E1 link. Unused timeslots are filled with ones.

Data from selected timeslots of a corresponding E1 link arrives at the digital port output. Unused timeslots are ignored.

In this mode the framing of data in E1 flow can be disabled so as data can be transmitted unframed. In this case data occupies all the 2,048 kbps bandwidth but its rate at the digital port may be limited.



E1-XL in two independent devices mode

Multiplexer mode

In multiplexer mode timeslots that are not used for digital port data transmission are translated undistorted between E1 links.

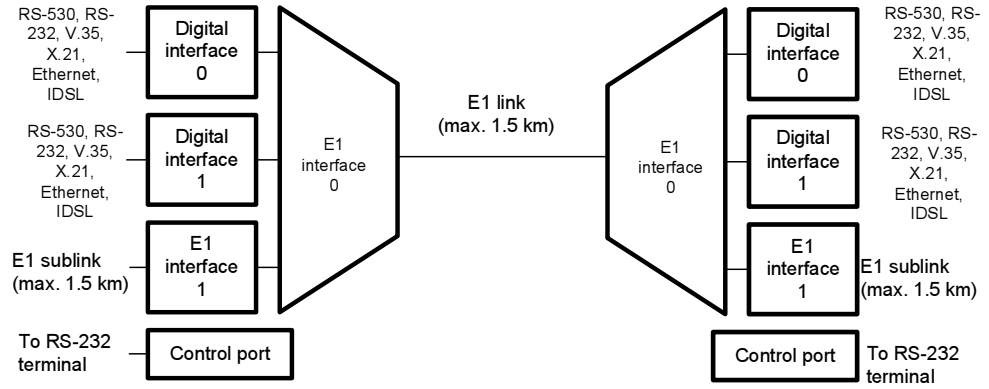
E1XL flexible multiplexer allows to allocate every digital port data in different E1 links, separate for both directions of data transmission. That is you can assign separate E1 links of data drop and insert for every digital port.

The most common configurations include:

- «Three-to-one» multiplexer
- «Drop-Insert» multiplexer

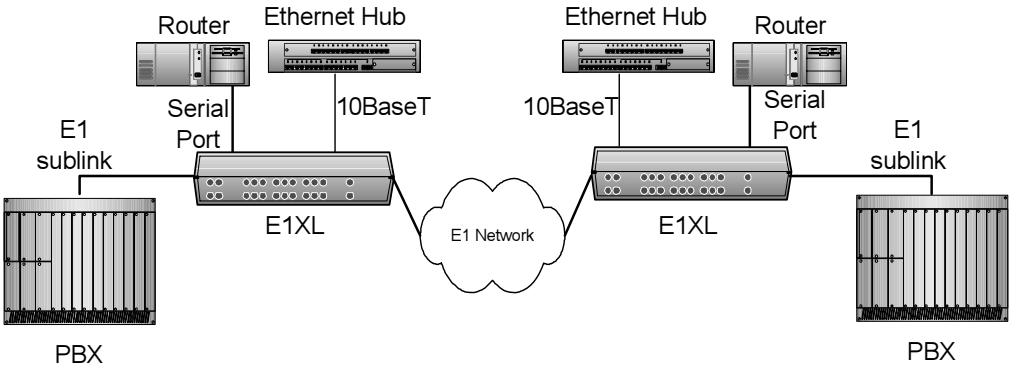
«Three-to-one» multiplexer

In this configuration both digital links transmit and receive data via E1/0 link but use different timeslots. Unused timeslots are translated into E1/1 link. Two devices connected by E1 link enable the transmission of data between digital ports. There should be no cross-connection between timeslots assigned to each digital port.



Two E1-XL multiplexers in “three-to-one” multiplexer mode

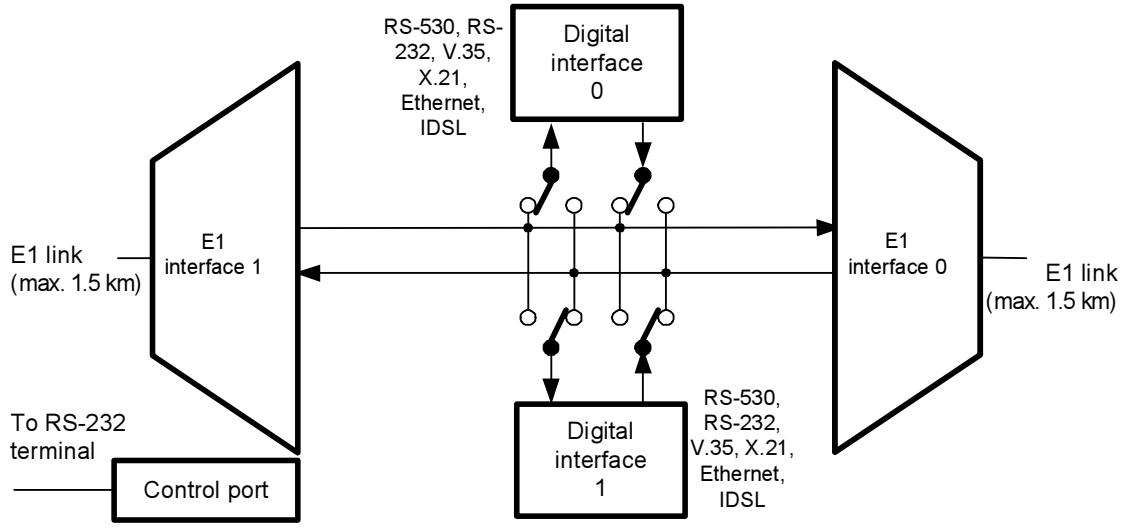
Below is an example of E1XL device application in «three-to-one» multiplexer mode. The following figure depicts the concurrent interconnection of routers, LANs, and PBXs via the same link.



An example of E1XL application in “three-to-one” multiplexer mode

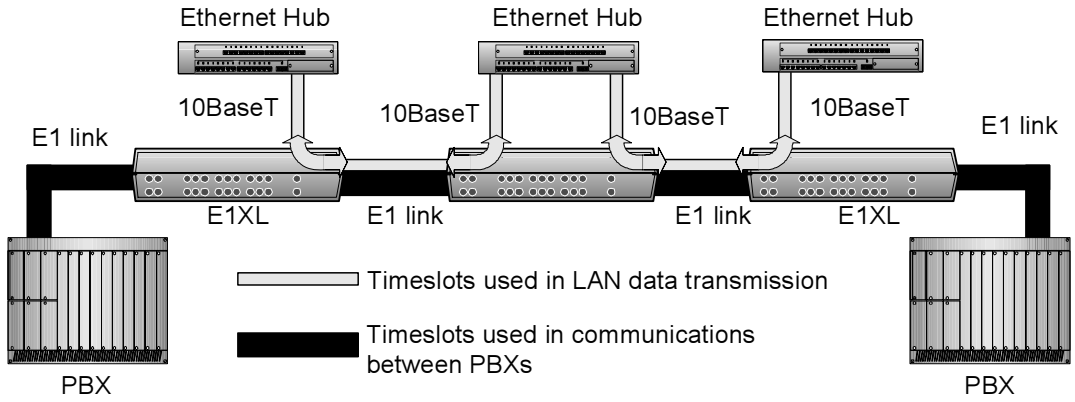
«Drop-Insert» multiplexer

In this mode a separate E1 link for independent data drop and insert can be assigned to each digital port.

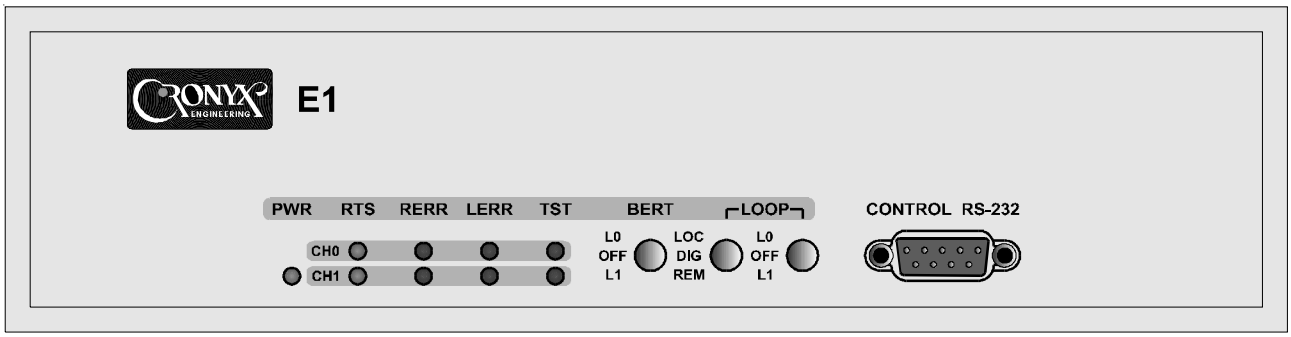


E1-XL in “Drop-Insert” multiplexer mode

The following is an example of E1XL device application in «Drop-Insert» mode. The figure below depicts three geographically distributed LANs interconnected using some timeslots of E1 link passing through LAN sites. Timeslots that are not engaged in transmission of data between LANs are used to connect two PBXs.



An example of E1XL application in "Drop-Insert" multiplexer mode



Front panel controls

Controls and indicators

Front panel controls

BERT – three-position switch activating bit error rate tester:

BERT	Bit error rate tester
L0	On, E1/0 line testing
OFF	Off, normal operation
L1	On, E1/1 line testing

LOOP – two three-position switches (LOOP1 and LOOP2) allowing to select a loopback type and a link number.

LOOP1	Loopback
LOC	E1 local loopback
DIG	Digital interface loopback
REM	E1 remote loopback

LOOP2	Point of loopback activation
L0	Link 0
0	Loopback disabled
L1	Link 1

The following table contains information on positions of LOOP1 and LOOP2 switches enabling certain loopbacks.

Loopback	LOOP1	LOOP2
Disabled	Any	OFF
E1/0 local loopback	LOC	L0
E1/1 local loopback	LOC	L1
E1/0 remote loopback	REM	L0
E1/1 remote loopback	REM	L1
Interface 0 digital loopback	DIG	L0
Interface 1 digital loopback	DIG	L1

Front panel indicators

Indicator	Function
PWR	AC power present
RTS	digital interface signals
RERR	remote device errors
LERR	local device errors
TST	testing modes

Ethernet port RTS indicator shows that the port has a fault-free cable connected.

TST indicator shows the selected testing mode:

Off	Normal operation
On	Bit error rate tester is enabled
Blink	Local loopback is enabled
Single flashes	Remote loopback is enabled
Double flashes	Digital loopback is enabled

In normal operation mode LERR indicator lights up in the absence of an input signal in E1 line, or when there is a loss of frame or multiframe alignment recorded. When the BER tester is enabled LERR indicator is on in the presence of errors in the line.

RERR indicator is on at the loss of synchronization at a remote device (bit A of timeslot 0).

Jumpers

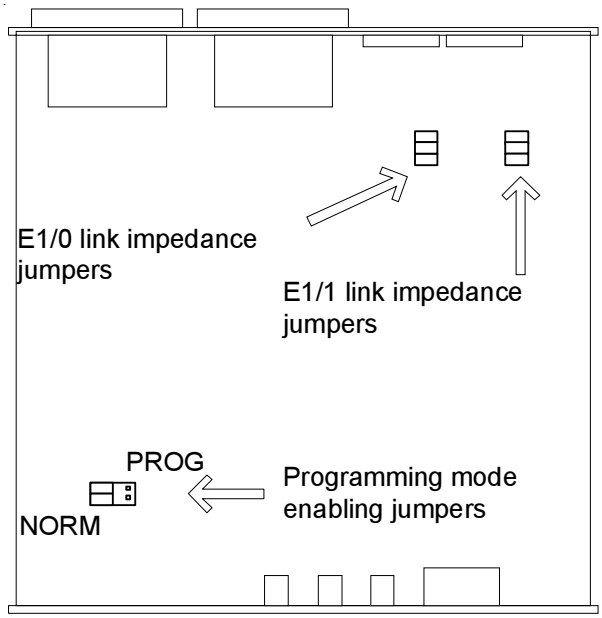
Positions of jumpers inside the multiplexer case are shown on the figure below.

To change the positions you should unfasten mounting screws fixing the top cover of the device and then remove the cover.

Warning!!! Before removing the cover always make sure that the device is disconnected from the 220V mains.

Line impedance

The default factory configuration of the multiplexer is intended for use with twisted pairs (120 Ohm). E1 line impedance is set by jumpers numbering three for each link. You should remove the jumpers for twisted pairs and replace them for coaxial cables (75 Ohm).



Programming mode

To download a new version of the on-board firmware you should reposition two internal jumpers from NORM to PROG. Upon completion of the programming procedure return the jumpers to NORM position.

DIP switches

The stand-alone version has the DIP switches located on the bottom cover of the device.

S1 group — link 0 timeslots.

S2 group — link 1 timeslots.

S3 group — modem configuration and timing modes.

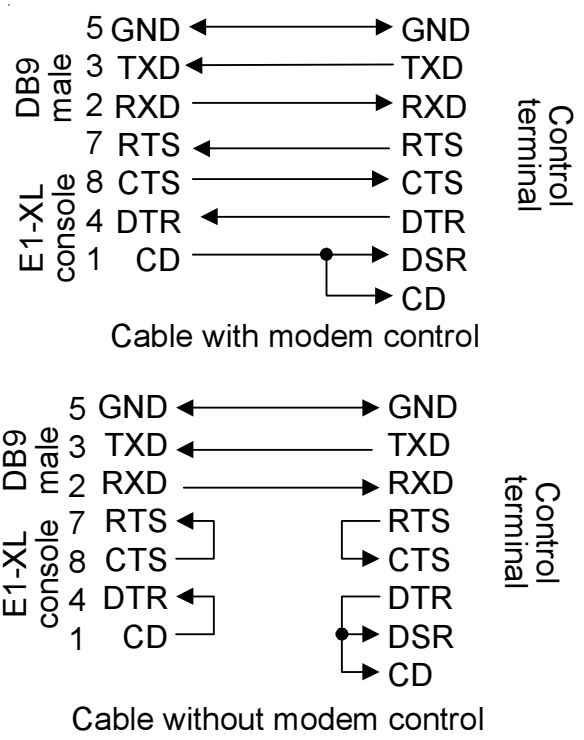
The following designations are used to show positions of the microswitches:

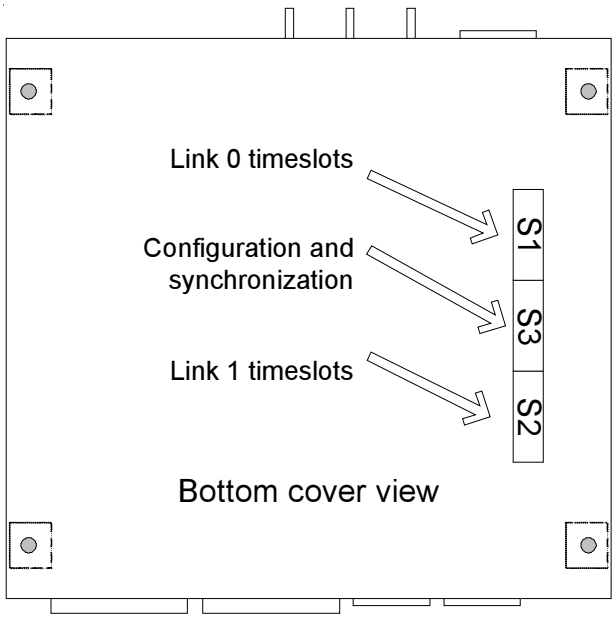
	OFF position
	ON position

Console

The front panel of the multiplexer is equipped with a DB9 connector intended for connection of a control terminal (a console) with RS-232 9600 kbps interface. The console can be used to monitor current operation modes of the device as well as link status and statistics on both local and remote errors. If the remote control is enabled (using S3-9 microswitch) a user can set device modes from the console and save them in a non-volatile memory.

The console connector has standard pin layout. It is recommended to use cables with the following connector pin assignments:





Configuration parameters

At every turning on of the multiplexer it is being configured according to the defined parameters. There are two sources of setting configuration parameters:

- DIP switches on the bottom cover of the device
- NVRAM storing parameters set from a console

Saving settings

S3-9 microswitch enables the remote control of the multiplexer, i. e. configuring its parameters from a terminal connected to the console port. In the remote control mode configuration parameters of the device are stored in its non-volatile memory (NVRAM). When the remote control is disabled NVRAM is not used and all parameters can be set using DIP switches only.

S3-9	Setting parameters
	Only DIP switches are used; remote control is disabled; NVRAM is not used
	A remote terminal is used; parameters are stored in NVRAM; DIP switches are not used

Selection of operation mode

S3-10 microswitch position determines E1XL link configuration:

S3-10 — Configuration	
	two independent links
	multiplexer

Selection of data insert link

In multiplexer mode S3-6 and S3-8 microswitches determine E1 links for digital ports 0 and 1 respectively where to transmit data.

S3-6 — insert link for port 0 (Insert0) S3-8 — insert link for port 1 (Insert1)	
	E1/0
	E1/1

Selection of data drop link

In multiplexer mode S3-5 and S3-7 microswitches determine E1 links for digital ports 0 and 1 respectively where to drop data from.

S3-5 — data drop link for port 0 (Drop0) S3-7 — data drop link for port 1 (Drop1)	
	E1/0
	E1/1

Transmit path synchronization

S3-1, S3-2 and S3-3, S3-4 pairs of microswitches allow to select a transmit path synchronization mode for E1/0 and E1/1 links respectively:

S3-1:S3-2 — E1/0 link synchronization	
S3-3:S3-4 — E1/1 link synchronization	
	INT — internal clock generator
	From Link X — from the receiver
	From Link X — from the other link receiver
	From Port X — from the digital interface

When a console is used to set configuration parameters you can also set the transmit path synchronization from the other link digital interface.

E1 link mode

In Dual mode E1 links can be configured to work either with or without frame alignment support (G.704). The parameter can be changed from the console only. When DIP switches are used to set configuration parameters the frame alignment support mode (G.704) is always enabled.

Parameter	Values when configuring using DIP switches	Values when configuring using a console
	General parameters	
Multiplexer mode	Dual, MUX, Drop-Insert	Dual, MUX, Drop-Insert
	E1 link parameters	
E1 link mode	Framed*	Framed, Unframed
Transmit path timing source	INT, Link 0, Link 1, Port 0,Port1	INT, Link 0, Link1, Port 0, Port 1
Initial timeslot	1 - 31	1 - 31
Number of timeslots	1 - 31 (in series)	1 - 31 (in random order)
CRC4 multiframe alignment	Disabled*	Enabled, Disabled
Timeslot 16 assignment	Data transmission*	Data transmission, CAS multiframe alignment
Location of monitoring channel in E1 frame	TS0, bit Sa4*	Any bit of any timeslot at your choice
Loss of sync action	Remote Alarm*	Remote Alarm, AIS
Sensitivity	-36 dB*	-36 dB, -12 dB
	Digital port parameters	
Selection of data insert link	E1/0; E1/1	E1/0; E1/1
Selection of data drop link	E1/0; E1/1	E1/0; E1/1
Receive path synchronization mode	RxC*	RxC, ERC
HDLC buffer	Off*	Off, On
CTS generation mode	CTS=1*	CTS=1, CTS=CD, CTS=RTS, CTS=CD*RTS
RXC/ERC clock pulses	Normal*	Normal, Inverted
TxC clock pulses	Normal*	Normal, Inverted
	Unframed mode parameters	
Automatic loopback activation on a remote request	not available	Allowed, Not allowed
Scrambler	not available	Disabled, Enabled
Data rate (kbps)		64, 128, 256, 512, 1024, 2048
	ALARM «dry» contacts parameters	
Operation from input pins of a remote device	From closing*	From closing, From opening

*** – The parameter can be changed from a console only**

Timeslot 16 assignment

E1/0 and E1/1 link timeslot 16 assignment mode can be changed from a console only. Timeslot 16 can be used for generation of standard CAS clock signals and signal bits (abcd=1111, xyxx=1011) in which case the timeslot cannot be used for data transmission. In multiplexer mode you should enable the data transmission via timeslot 16 in both E1/0 and E1/1 links to ensure a transparent translation of timeslot 16 from E1/0 into E1/1.

When DIP switches are used to set configuration parameters timeslot 16 is used for data transmission.

CRC4 multiframe alignment

When a console is used to set configuration parameters of the multiplexer you can enable a check of multiframe alignment on CRC4.

When DIP switches are used to set configuration parameters the check of multiframe alignment on CRC4 is disabled.

Location of the monitoring channel in E1 frame

The control of a remote device and statistics interchange are executed over a monitoring channel which uses a single bit of E1 frame. When a console is used to set configuration parameters you can arbitrarily select a bit of any timeslot for the monitoring channel.

When DIP switches are used to set configuration parameters the monitoring channel uses Sa4 bit of timeslot 0 in compliance with ITU-T G.704 recommendations.

Initial timeslot

S1-1…S1-5 and S2-1…S2-5 microswitches determine the number of the initial timeslot for data links 0 and 1 respectively.

In independent links mode link 0 settings refer to E1/0 link and link 1 settings refer to E1/1 link.

In «three-to-one» multiplexer mode settings for both links refer to E1/0 link and determine timeslots to be transmitted to digital interfaces 0 and 1.

In «three-to-one» multiplexer mode timeslot sets should not overlap. Nonselected timeslots are translated into E1/1 link.

In «Drop-Insert» multiplexer mode timeslot selection settings refer to the corresponding port. Selection of timeslots to be used in E1/0 and E1/1 links depends on the direction of data transmission set using S3-5…S3-8 microswitches.

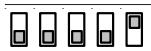
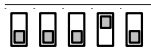
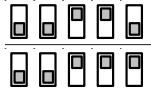
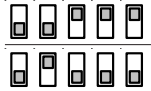
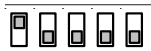
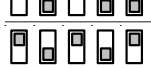
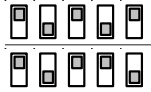
In the unframed mode the above settings are of no account.

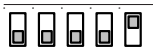
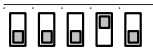
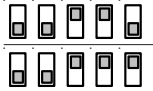
Number of timeslots

S1-6...S1-10 and S2-6...S2-10 microswitches determine the number of timeslots to be used for data transmission of links 0 and 1 respectively. In multiplexer mode all other timeslots are translated unchanged between E1/0 and E1/1 links. Data rate depends on the number of selected timeslots (Nx64 kbps).

Data rate in the unframed mode

When a console is used to set configuration parameters there are six options of the data rate in the unframed mode: 64, 128, 256, 512, 1024, or 2048 kbps. Note that the line bandwidth remains the same (2,048 kbps). You just decrease the rate at the digital port only.

S1-1...S1-5 — E1/0 initial timeslot S2-1...S2-5 — E1/1 initial timeslot	
	not used
	timeslot 1
	timeslot 2
	timeslot 3
	timeslot 4
	timeslot 5
	timeslot 6
	timeslot 7
	timeslot 8
	timeslot 9
	timeslot 10
	timeslot 11
	timeslot 12
	timeslot 13
	timeslot 14
	timeslot 15
	timeslot 16
	timeslot 17
	timeslot 18
	timeslot 19
	timeslot 20
	timeslot 21
	timeslot 22
	timeslot 23
	timeslot 24
	timeslot 25
	timeslot 26
	timeslot 27
	timeslot 28
	timeslot 29
	timeslot 30
	timeslot 31

S1-6...S1-10 — number — link 0 rate S2-6...S2-10 — number — link 1 rate	
	0 timeslots — 0 kbps
	1 timeslot — 64 kbps
	2 timeslots — 128 kbps
	3 timeslots — 192 kbps
	4 timeslots — 256 kbps
	5 timeslots — 320 kbps
	6 timeslots — 384 kbps
	7 timeslots — 448 kbps
	8 timeslots — 512 kbps
	9 timeslots — 576 kbps
	10 timeslots — 640 kbps
	11 timeslots — 704 kbps
	12 timeslots — 768 kbps
	13 timeslots — 832 kbps
	14 timeslots — 896 kbps
	15 timeslots — 960 kbps
	16 timeslots —1024 kbps
	17 timeslots — 1088 kbps
	18 timeslots — 1152 kbps
	19 timeslots — 1216 kbps
	20 timeslots — 1280 kbps
	21 timeslots — 1344 kbps
	22 timeslots — 1408 kbps
	23 timeslots — 1472 kbps
	24 timeslots — 1536 kbps
	25 timeslots — 1600 kbps
	26 timeslots — 1664 kbps
	27 timeslots — 1728 kbps
	28 timeslots — 1792 kbps
	29 timeslots — 1856 kbps
	30 timeslots — 1920 kbps
	31 timeslots — 1984 kbps

Digital port asynchronous mode

RS-232 digital port supports both synchronous, and asynchronous data transmission modes. The following data rates are available: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200 bps. The port provides a support of 8N1, 7P1, 8P1 asynchronous code format.

Loss of sync action

When a console is used to set configuration parameters you can choose one of the following two types of responses to a loss of E1 link synchronization:

Loss of sync action: Remote Alarm -

Establishes bit A of timeslot 0 in transmitted E1 frame.

Loss of sync action: AIS -

AIS is transmitted («blue code»).
When DIP switches are used to define configuration settings the parameter is always set to Remote Alarm.

Receive path synchronization

Receive path synchronization can be realized using either signals received from the line (RXC), or an external source (ERC). The synchronization from an external source is used when connecting to DCE devices which do not support an external synchronization from a digital port (RS-232, V.35, RS-530). In this case the modem issues data using clocks received at ERC input. The phase equalization of data at the output of RXD digital port for ERC clocks is executed using FIFO buffer. To ensure the correct buffer operation (with no overruns/underruns) the frequency of clocks received from the line should equal to the frequency at ERC input. This condition is met when the data link has a single timing source. Otherwise, recurrent errors will occur due to overruns or underruns of FIFO buffer. The rate of such errors depends on the difference between the two frequencies.

ERC mode can be enabled from a console only. When DIP switches are used to set configuration parameters of the modem ERC mode is disabled.

Clock inversion

In INT, From Link 0 and From Link 1 synchronization modes TXD data is delayed in relation to TXC clocks. The total delay is formed of delays occurring in the cable and in the digital interface of the equipment connected to the modem. As a result errors can occur at some data rates.

The problem can be solved in the following ways:

- Invert TXC by changing settings of the equipment connected to the modem
- Change the cable length
- Reverse TXC-a and TXC-b pins in one of the interface cable connectors
- When a console is used to set configuration parameters apply TxC clocks inversion

The similar problem can also occur when external clocks of ERC receive path are used. The problem can be solved in the same ways as above:

- Change the cable length
- Reverse ERC-a and ERC-b pins in one of the interface cable connectors
- When a console is used to set configuration parameters apply ERC clock inversion

Clock inversion parameters can be set from a console only. When DIP switches are used to set configuration parameters clocks always remain non-inverted.

CTS generation logic

When a console is used to set configuration parameters you can select one of the following four rules of CTS output signal generation:

CTS=1, CTS=CD, CTS=RTS, or CTS=CD*RTS.

When DIP switches are used to set configuration parameters CTS=1 rule is always applied.

Automatic loopback activation on a remote request

The parameter applies to the unframed mode only.

In complex configurations with a daisy chain of multiple devices this parameter can be used to choose a network section to be tested using a remote loopback. The parameter can be changed from a console only. When DIP switches are used to set configuration parameters the loopback activation on a remote request is always enabled.

Scrambler

The parameter applies to the unframed mode only.

The scrambler is used to eliminate long sequences of zeroes and ones in G.703 output signal. The scrambler can be enabled only if a console is used to set configuration parameters. When DIP switches are used to set configuration parameters it is always disabled.

Receive path sensitivity

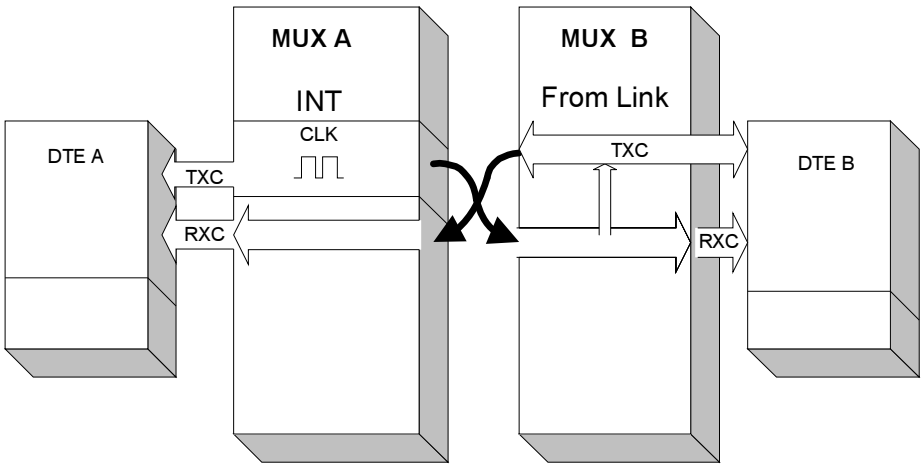
Receive path sensitivity determines the maximum length of E1 line. When a console is used to set configuration parameters of the multiplexer you can choose one of the following two sensitivity values: -12dB or -36dB.

When DIP switches are used to define configuration settings the reception path sensitivity is always set to -36dB.

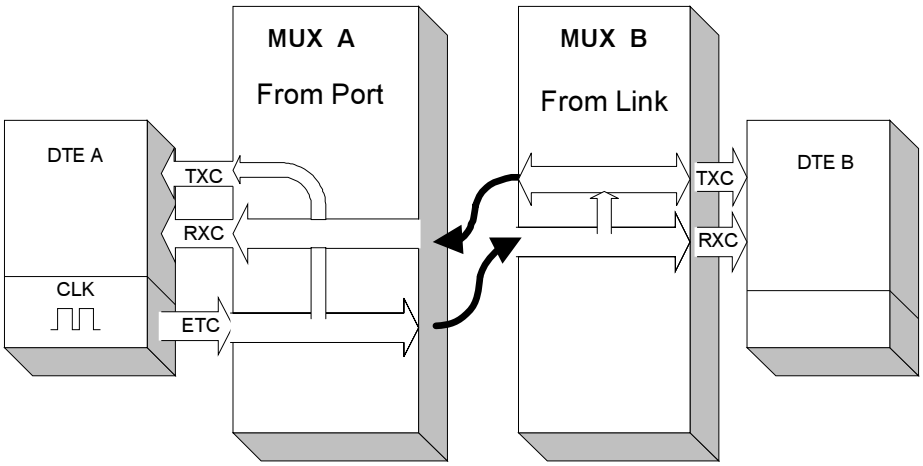
Synchronization modes

Single timing source

In independent links mode a single timing source for E1 path is usually used. The timing source can represent either an internal clock generator of an E1 multiplexer, or an external signal of a DTE device. The following figures depict examples of internal and external timing sources.



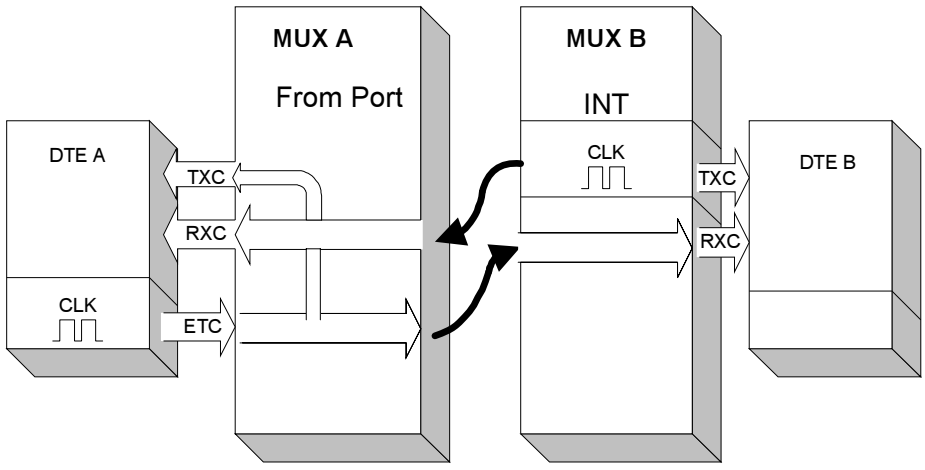
Single timing from multiplexer A



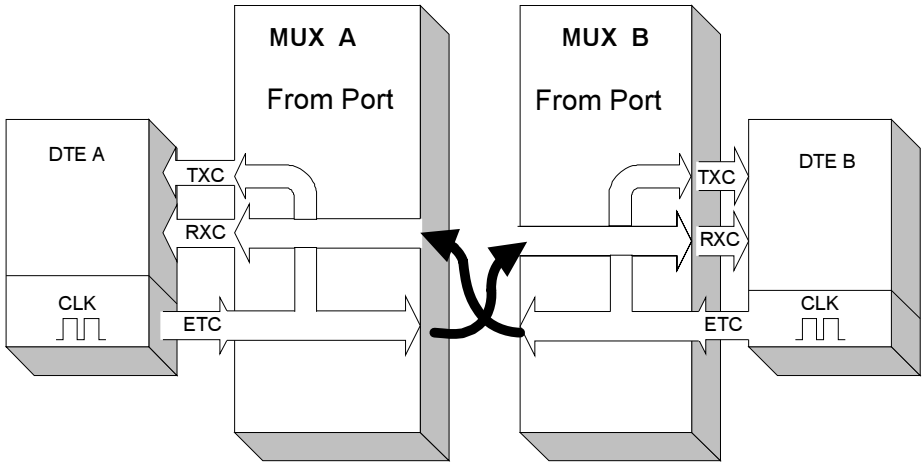
Single timing from DTE A

Separate timing sources

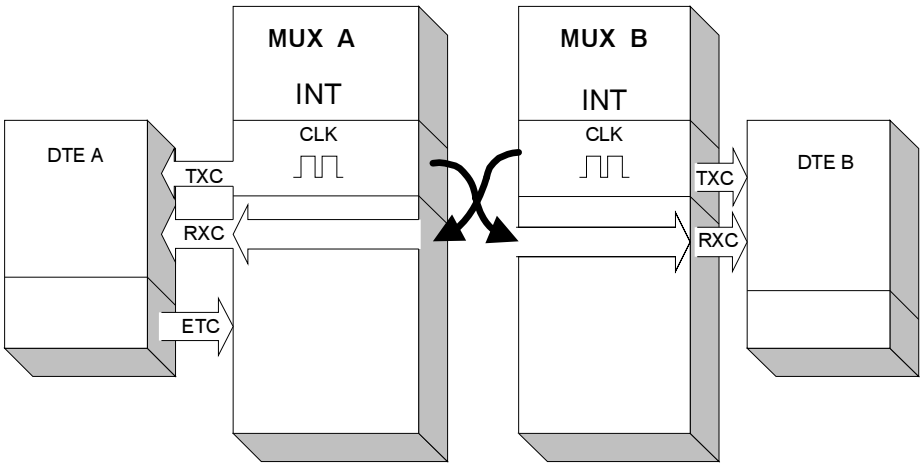
Receive and transmit lines of E1 path are fully independent and can have separate timing sources. Below is an example of such a mode.



Separate timing from DTE A and multiplexer B



Separate timing from DTE A and DTE B



Separate timing from multiplexers A and B

Synchronization in multiplexer mode

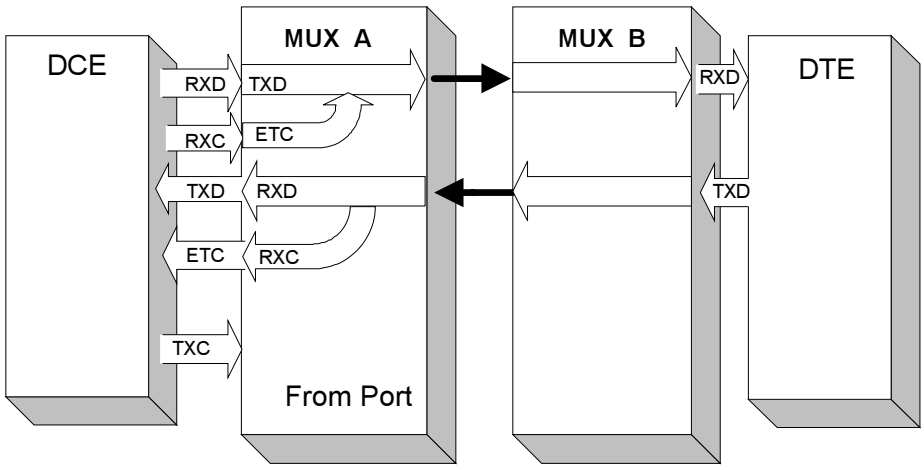
In multiplexer mode you should use receive paths of E1 links as timing sources for transmit paths of the opposite E1 links. Otherwise there will occur recurrent overruns/underruns of controlled slip buffers at retranslating timeslots between E1 links due to different clock frequencies that in turn will cause a retransmission (loss) of data frames.

DTE emulation

There are two clock pulse inputs (ERC and ETC) provided for connection of E1XL multiplexer to DCE via RS-232, V.35, or RS-530 digital interface in a synchronous mode. X.21 interface has ETC input only provided for.

DTE1 emulation mode

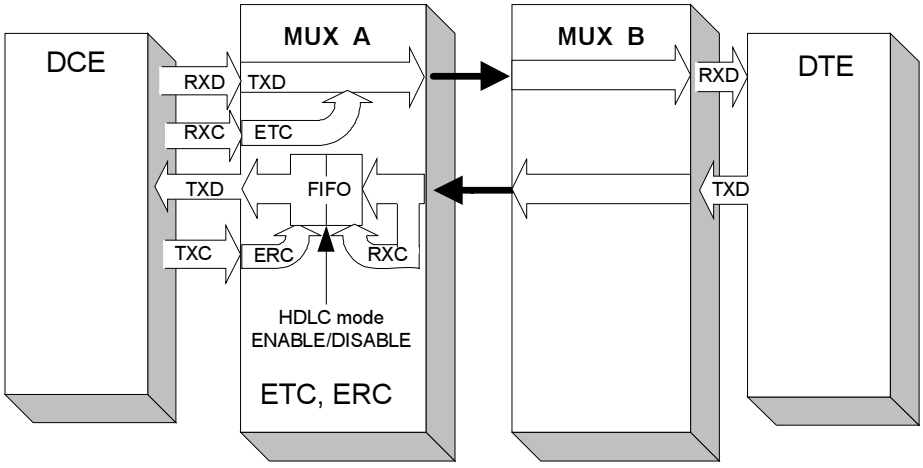
DTE1 emulation mode is used when connecting to DCE devices with a digital port (RS-232, V.35, RS-530, X.21) as an external timing source. In this case a pair of devices interconnected via a digital port (RS-232, V.35, RS-530, X.21) transparently translates the clock frequency.



DTE1 emulation mode with external transmit clocks

DTE2 emulation mode

DTE2 emulation mode is used when connecting to DCE devices which do not support an external synchronization from a digital port (RS-232, V.35, RS-530). In this case E1XL multiplexer receives data at the digital port using clocks received at ETC input and transmits data using clocks received at ERC input. The phase equalization of data at the output of RXD digital port for ERC clocks is executed using FIFO buffer. To ensure the correct buffer operation (with no overruns/underruns) the frequency of clocks received from the line should equal to the frequency at ERC input. This condition is met when the data link has a single timing source. Otherwise, recurrent errors will occur due to overruns or underruns of FIFO buffer. The rate of such errors depends on the difference between the two frequencies. If the data transmitted in the link is in HDLC format you can compensate the frequencies offset enabling HDLC buffer mode.



DTE2 emulation mode with external transmit and receive clocks

Timing source specifications

Clock pulses can be sourced from either the internal clock generator of E1XL multiplexer, or an external synchronization input of the digital port. The source of clock pulses used to generate an output E1 signal determines parameters such as phase jitter and the accuracy of the frequency. Circuit technologies used in E1XL multiplexer ensure the phase jitter and accuracy of output frequency to meet the corresponding requirements of ITU-T in those modes where the multiplexer is selected as a timing source. If the timing source represents any other device connected to E1XL digital port (DTE1 and DTE2 emulation modes) always make sure that clock signal parameters comply with ITU-T standards.

X.21 interface

Electric specifications of X.21 interface signals meet the corresponding requirements of ITU-T V.11. The interface has a different set of signals as compared with all other interfaces:

X.21 DB-15	RS-232
2	Transmit (A)
9	Transmit (B)
4	Receive (A)
11	Receive (B)
7	ETC (A)
14	ETC (B)
6	Sig Timing (A)
13	Sig Timing (B)
3	Control (A)
10	Control (B)
5	Indication (A)
12	Indication (B)
1	Shield
8	GND

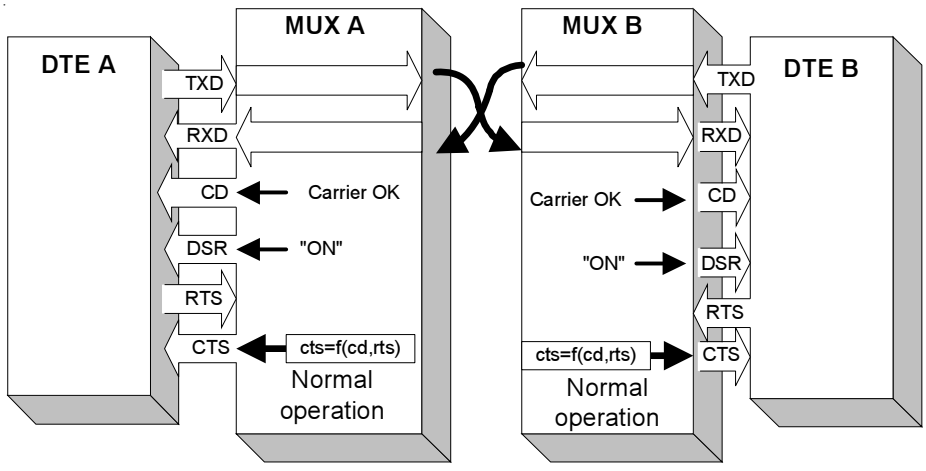
X.21 interface uses the single clock signal for received and transmitted data. To ensure the correct data reception you should strictly follow the requirement of using a single timing source. Two interconnected devices should have settings that allow to use the same clock generator as a timing source for both devices.

Indication signal corresponds to CD signal whereas Control signal corresponds to RTS signal.

Loopbacks

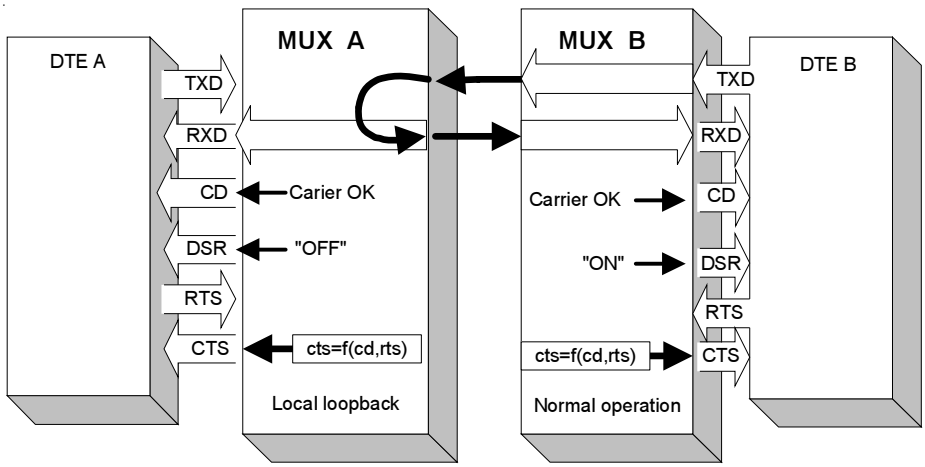
Normal operation

LOOP2 switch is in «0» position.



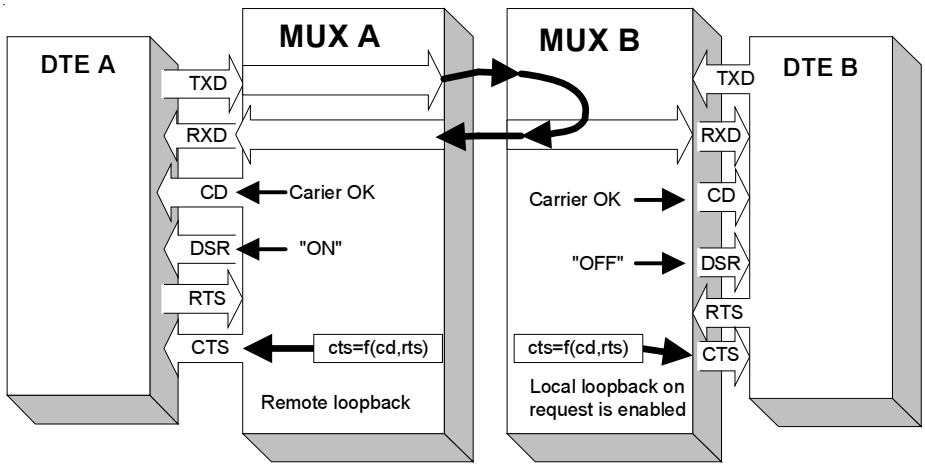
Local loopback

LOOP1 switch is in LOC position; LOOP2 switch is used to choose the number of E1 link.



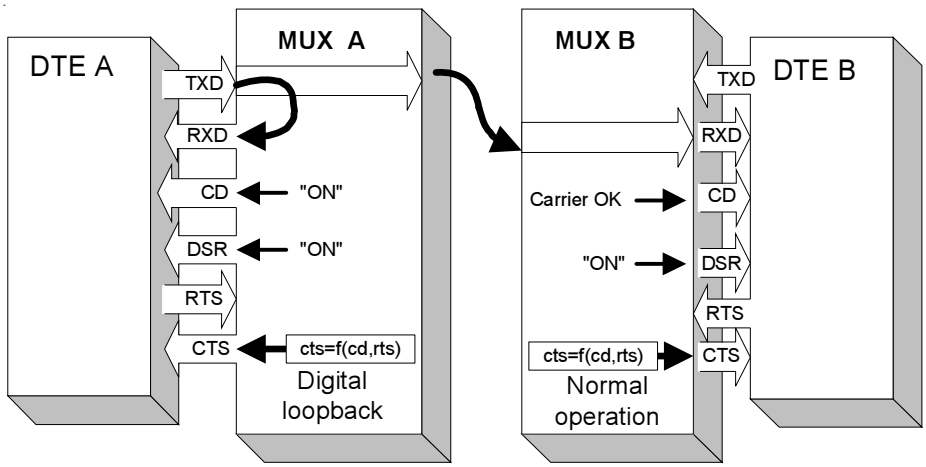
Remote loopback

LOOP1 switch is in REM position; LOOP2 switch is used to choose the number of E1 link. The remote device automatically enables and disables local loopbacks on requests from the local device.



Digital loopback

LOOP1 switch is in DIG position; LOOP2 switch is used to choose the number of the digital interface.



Alarm interface

Alarm interface is used to activate an external alarm device (e. g. a bell, buzzer, panel indicator etc.) when a failure occurs, e. g. loss of carrier, loss of synchronization, power failure etc. The activation is executed using «dry» relay contacts (i. e. the contacts not linked to any electric circuits of the modem). The interface also has a pair of input pins. The state of the pins (closed/open) is transmitted to the remote device turning on the relay. If the multiplexer is installed in an unattended room these input pins can be used for connection of e.g. remote climatic sensors, door unlocking signals etc.

Warning! The input pins should be connected with a switch isolated from electric circuits. Failure to comply with this requirement may damage your multiplexer.

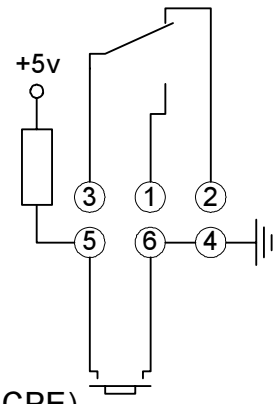
When power supply and the carrier are present pin 3 is shorted to pin 1. At a power failure or a loss of the carrier pin 3 gets disconnected from pin 1 and shorted to pin 2 (an alarm state).

External input contacts has two operation modes: normally open and normally closed. The default setting is normally open mode. When pin 5 gets shorted to pin 4 the remote device switches to an alarm state.

You can set the normally closed mode from a console in which case the sensor should be normally closed and its opening causes an alarm at the remote device.

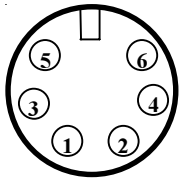
Alarm circuit diagram

Alarm state is shown



External input sensor (CPE)

Alarm connector of /B design



Pin	
1	Shorted to the common pin (3) in normal operation state. Open when an error occurs.
2	Open in normal operation state. Shorted to the common pin (3) when an error occurs.
3	Common pin
4	GND
5	Input pin
6	GND

Back panel connectors

There are digital interface connectors and removable terminal blocks of E1 links located on the back panel.

Digital ports with V.35 interface use standard M-34 female connectors:

DB-25	RS-232	Direction
P	TD-a	Input
S	TD-b	Input
R	RD-a	Output
T	RD-b	Output
U	ET-a	Input
W	ET-b	Input
Y	TC-a	Output
AA	TC-b	Output
BB	ERC-a	Input
Z	ERC-b	Input
V	RC-a	Output
X	RC-b	Output
C	RTS	Input
H	DTR	Input
E	DSR	Output
D	mode	Output
F	DCD	Output
A	CGND	—
B	SGND	—

Digital ports with RS-232 and RS-530 interfaces use DB25 female connectors:

Pin DB25	RS-530	signal	Direction
2	TXD-a	TXD	Input
14	TXD-b	—	Input
3	RXD-a	RXD	Output
16	RXD-b	—	Output
24	ETC-a	ETC	Input
11	ETC-b	—	Input
15	TXC-a	TXC	Output
12	TXC-b	—	Output
17	RXC-a	RXC	Output
9	RXC-b	—	Output
21	ERC-a	ERC	Input
18	ERC-b		Input
4	RTS-a	RTS	Input
19	RTS-b	—	Input
20	DTR-a	DTR	Input
23	DTR-b	—	Input
6	DSR-a	DSR	Output
22	DSR-b	—	Output
5	CTS-a	mode	Output
13	CTS-b	—	Output
8	CD-a	CD	Output
10	CD-b	—	Output
1,7	GND	GND	—

Digital ports with X.21 interface use DB15 female connectors:

DB-15 female	RS-232	Direction
2	T(A)	Input
9	T(B)	Input
4	R(A)	Output
11	R(B)	Output
7	ETC (A)	Input
14	ETC (B)	Input
6	S(A)	Output
13	S(B)	Output
3	C(A)	Input
10	C(B)	Input
5	I(A)	Output
12	I(B)	Output
1, 8	GND GND —	

Digital ports with a multi-standard interface use HDB44 female connectors:

Pin	V.35	RS-530	signal	X.21
10	TXD-a	TXD-a	TXD	Transmit (A)
25	TXD-b	TXD-b	—	Transmit (B)
8	RXD-a	RXD-a	RXD	Receive (A)
9	RXD-b	RXD-b	—	Receive (B)
6	ETC-a	ETC-a	ETC	ETC (A)
7	ETC-b	ETC-b	—	ETC (B)
2	TXC-a	TXC-a	TXC	SigTiming(A)
3	TXC-b	TXC-b	—	SigTiming(B)
5	RXC-a	RXC-a	RXC	—
4	RXC-b	RXC-b	—	—
17	ERC-a	ERC-a	ERC	—
18	ERC-b	ERC-b	—	—
14	RTS	RTS-a	RTS	Control (A)
29	—	RTS-b	—	Control (B)
11	DTR	DTR-a	DTR	—
26	—	DTR-b	—	—
13	DSR	DSR-a	DSR	—
28	—	DSR-b	—	—
15	mode	CTS-a	mode	—
30	—	CTS-b	—	—
12	CD	CD-a	CD	Indication (A)
27	—	CD-b	—	Indication (B)
1,16	GND	GND	GND	GND
31	SEL-0*	SEL-0*	SEL-0*	SEL-0
33	SEL-1	SEL-1*	SEL-1	SEL-1*
35	SEL-2	SEL-2	SEL-2*	SEL-2
37	SEL-3	SEL-3*	SEL-3*	SEL-3*
39	SEL-4*	SEL-4	SEL-4	SEL-4
41	SEL-5*	SEL-5	SEL-5	SEL-5
43	SEL-6*	SEL-6	SEL-6	SEL-6
32	DCE	DCE	DCE	DCE

* - The pin should be shorted to GND

Management using a console

The front panel of the multiplexer is equipped with a DB9 connector intended for connection of a control terminal (a console) with RS-232 interface (9600 kbps, 8N1). The console can be used to monitor current operation modes of the device as well as link status and statistics on both local and remote errors. If the remote control is enabled (using S3-9 microswitch) a user can set device modes from the console and save them in a non-volatile memory.

Some parameters can be set from the console only. For a list of parameters see page 12.

The console user interface is implemented as a simple hierarchical menu. To select a command you should enter its number.

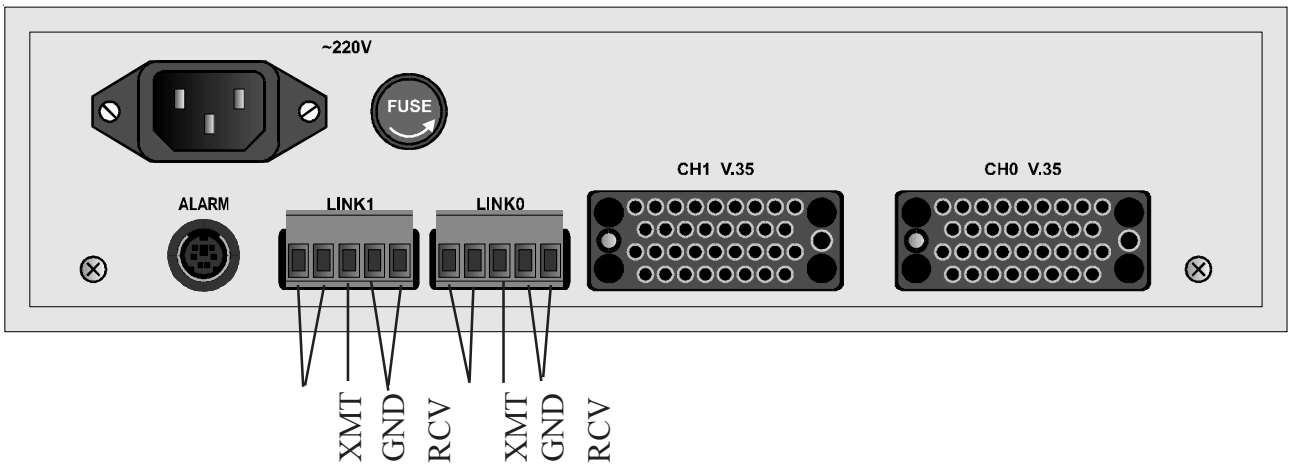
```
Cronyx E1-XL V/V revision C, 18/01/2001

Mode: Smart, Mux
Link 0: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Port 0, High gain, Use16, no CRC4, Mon=Sa4
Port 0: 960 kbps, Drop0/Insert0, CTS=1, Cable direct RS-530
        DTR, RTS, ETC, ERC, DSR, CTS, CD, TXC, RXC
Port 1: 960 kbps, Drop0/Insert0, CTS=1, Cable direct V.35
        DTR, RTS, ETC, no ERC, DSR, CTS, CD, TXC, RXC
                  1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Port 0 timeslots: ################..............  - from Link 0 to Link 0
Port 1 timeslots: ................################ - from Link 0 to Link 0

  1. Statistics
  2. Loopback...
  3. Test...
  4. Configure...
  0. Reset

Command:
```

«Statistics» mode is intended for viewing information on current configuration, link modes, and error counters.



Back panel connectors

```
Statistics: Session #2, 0 days, 23:47:17

Mode: Smart, Mux
Link 0: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Port 0, High gain, Use16, no CRC4, Mon=Sa4
Port 0: 960 kbps, Drop0/Insert0, CTS=1, Cable direct RS-530
        DTR, RTS, ETC, ERC, DSR, CTS, CD, TXC, RXC
Port 1: 960 kbps, Drop0/Insert0, CTS=1, Cable direct V.35
        DTR, RTS, ETC, no ERC, DSR, CTS, CD, TXC, RXC
                 1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Port 0 timeslots: ###############..............  - from Link 0 to Link 0
Port 1 timeslots: ..............###############  - from Link 0 to Link 0

                BPV     OOS     Err     Event   Status
Link 0:         0       0       0       0       Ok
 far end:       0       0       0       0       Ok
Link 1:         0       0       0       0       Ok
Port 0:         -       -       -       0       Ok
Port 1:         -       -       -       0       Ok
```

«C» key is used to reset all the error registers of the local device. «R» key allows to change the screen refresh mode.

Counter	Error description
BPV	Bipolar violation
OOS	Out of frame seconds
Err	For E1 links – number of seconds during which BER tester errors or line code errors occurred during normal operation in the unframed mode. For Ethernet ports – overruns of Ethernet bridge internal buffers.
Event	Seconds of events related to the link. Event meanings depend on the interface type.

Event counter meanings:

Interface type	Event	Cause
Serial	FIFO buffer error	A condition of the use of a single timing source in the link is not met in DTE2 mode (timing from ERC clocks)
Async	FIFO buffer error	1. Data rate or asynchronous code format set at the port do not match settings defined on the connected device. 2. An excessive deviation from the rating value of the data rate in the connected device.
IDSL	FIFO buffer error	A condition of the use of a single timing source in the link is not met.
E1	Controlled slip (Slip operation)	A condition of the use of a single timing source in the link is not met.
Ethernet	Collision	High load of the Ethernet network segment

The multiplexer transmits error counter values to a remote device and receives remote error counter values via a monitoring channel.

E1 link states are shown as a set of flags:

Flag	Link state
Ok	Normal operation; both frame and multiframe alignments are present
LOS	Loss of signal
AIS	Alarm indication signal received («blue code»)
LOF	Loss of frame alignment
LOMF	Loss of multiframe alignment
FARLOF	Loss of frame alignment at a remote modem
AIS16	Alarm indication signal received in timeslot 16
FARLOMF	Loss of multiframe alignment at a remote modem
CRCE	Checksum error
RCRCE	Checksum error at a remote modem

«Loopback» menu is used to control local, digital, and remote loopbacks:

```
Loopback

Mode: Smart, Mux
Link 0: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Port 0, High gain, Use16, no CRC4, Mon=Sa4
Port 0: 960 kbps, Drop0/Insert0, CTS=1, Cable direct RS-530
        DTR, RTS, ETC, ERC, DSR, CTS, CD, TXC, RXC
Port 1: 960 kbps, Drop0/Insert0, CTS=1, Cable direct V.35
        DTR, RTS, ETC, no ERC, DSR, CTS, CD, TXC, RXC
                  1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Port 0 timeslots: ################..............  - from Link 0 to Link 0
Port 1 timeslots: ................################ - from Link 0 to Link 0

  1. Link 0 loop - disabled
  2. Link 1 loop - disabled
  3. Port 0 loop - disabled
  4. Port 1 loop - disabled
  5. Link 0 remote loop - disabled
  6. Link 1 remote loop - disabled
```

«Test» menu allows to enable/disable a built-in bit error rate tester:

```
BER Test


  1. Link 0 test - stopped
  2. Link 1 test - stopped
```

The use of a console to control the BER tester and loopbacks is allowed only if front panel switches are in neutral positions. Loopback and BER tester modes cannot be stored in a non-volatile memory.

«Configure» menu allows to set operation modes of the modem provided that S3-9 microswitch is in ON position:

```
Configure

Mode: Smart, Mux
Link 0: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Port 0, High gain, Use16, no CRC4, Mon=Sa4
Port 0: 960 kbps, Drop0/Insert0, CTS=1, Cable direct RS-530
        DTR, RTS, ETC, ERC, DSR, CTS, CD, TXC, RXC
Port 1: 960 kbps, Drop0/Insert0, CTS=1, Cable direct V.35
        DTR, RTS, ETC, no ERC, DSR, CTS, CD, TXC, RXC
                 1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Port 0 timeslots: ################..............  - from Link 0 to Link 0
Port 1 timeslots: ................################ - from Link 0 to Link 0

  1. Mode: Mux
  2. Link 0...
  3. Link 1...
  4. Port 0...
  5. Port 1...
  6. Alarm input: Normal
  7. Factory settings...
  8. Save parameters
  9. Restore parameters
```

After setting parameters you should use «Save parameters» command to save them in a non-volatile memory (NVRAM). Configuration parameters saved last can be restored with «Restore parameters» command. «Mode» command allows to choose one of the two flexible multiplexer modes available: two independent devices mode (Dual) or multiplexer mode (Mux).

«Link 0» menu allows to set parameters for E1/0 link:

```
Link 0
Mode: Smart, Mux
Link 0: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Port 0, High gain, Use16, no CRC4, Mon=Sa4
Port 0: 960 kbps, Drop0/Insert0, CTS=1, Cable direct RS-530
        DTR, RTS, ETC, ERC, DSR, CTS, CD, TXC, RXC
Port 1: 960 kbps, Drop0/Insert0, CTS=1, Cable direct V.35
        DTR, RTS, ETC, no ERC, DSR, CTS, CD, TXC, RXC
                 1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Port 0 timeslots: ################..............  - from Link 0 to Link 0
Port 1 timeslots: ................################ - from Link 0 to Link 0

  1. Framing: E1
  2. Transmit clock: Rcv
  3. Timeslot 16: Use
  4. Crc4: No
  5. Receiver gain: High
  6. Monitoring channel bit: Sa4
  7. Loss of sync action: Remote Alarm
```

«Timeslots» menu is used to define timeslots assigned for data transmission.

```
          1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Timeslots: #.............................
```

Select timeslots to be used for transmission of data from the digital COM port using arrow keys to move the cursor along the timeslots line and space key to change timeslot assignments. Symbol «#» shows that the given timeslot is used for transmission of the digital port data. E1/1 link parameters are similarly set using «Link 1» menu.

```
Port 0

Mode: Smart, Mux
Link 0: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Port 0: 115200 baud, 8n1, Drop0/Insert0, CTS=1, Cable not attached
        DSR, CTS, no CD
Port 1: 960 kbps, Drop0/Insert0, CTS=1, Cable not attached
        DSR, CTS, no CD, TXC, RXC
                  1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Port 0 timeslots: ################.................. - from Link 0 to Link 0
Port 1 timeslots: .................################ - from Link 0 to Link 0

  1. Timeslots...
  2. Drop from: Link 0
  3. Insert to: Link 0
  4. Mode: Async
  5. Baud rate: 115200
  6. Char format: 8n1
  7. CTS = 1
```

Digital COM port 0 parameters are configured using «Port 0» menu.

```
Port 1
Mode: Smart, Mux
Link 0: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Port 0: 960 kbps, Drop0/Insert0, CTS=1, Cable not attached
        DSR, CTS, no CD, TXC, RXC
Port 1: 960 kbps, Drop0/Insert0, CTS=1, Cable not attached
        DSR, CTS, no CD, TXC, RXC
                  1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Port 0 timeslots: ################.................. - from Link 0 to Link 0
Port 1 timeslots: .................################ - from Link 0 to Link 0
  1. Timeslots...
  2. Drop from: Link 0
  3. Insert to: Link 0
  4. Mode: Sync
  5. Transmit clock: Normal
  6. Receive clock: Receive
  7. CTS = 1
  9. HDLC buffer: Disabled
```

The synchronous mode has a different set of parameters:

```
Factory settings

Mode: Smart, Mux
Link 0: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Port 0: 115200 baud, 8n1, Drop0/Insert0, CTS=1, Cable not attached
        DSR, CTS, no CD
Port 1: 960 kbps, Drop0/Insert0, CTS=1, Cable not attached
        DSR, CTS, no CD, TXC, RXC
                 1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Port 0 timeslots: ################..............  - from Link 0 to Link 0
Port 1 timeslots: ................################ - from Link 0 to Link 0

  1. Dual mode, skip TS16 (CAS framing)
  2. Dual mode, use TS16 for data
  3. Mux mode, translate TS16, sync from Link 0
  4. Mux mode, translate TS16, sync from Link 1
  5. Drop-insert mux, sync from Link 0
  6. Drop-insert mux, sync from Link 1
```

To speed up the procedure of setting configuration parameters you can select one of the four factory settings intended for the most common applications of the multiplexer and then adjust parameters as required:

Dual mode, skip TS16 (CAS framing)

Two independent devices mode. CAS multiframe alignment is used.

```
Mode: Dual, Smart
Link 0: TP, Sync=Int, High gain, Skip16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Int, High gain, Skip16, no CRC4, Mon=Sa4
Port 0: 1920 kbps, CTS=1
Port 1: 1920 kbps, CTS=1
             1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Timeslots 0: ################.################
Timeslots 1: ################.################
```

Dual mode, use TS16 for data

Two independent devices mode. Timeslot 16 is used for data transmission.

```
Mode: Dual, Smart
Link 0: TP, Sync=Int, High gain, Use16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Int, High gain, Use16, no CRC4, Mon=Sa4
Port 0: 1984 kbps, CTS=1
Port 1: 1984 kbps, CTS=1
             1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Timeslots 0: ################################
```

```
Timeslots 1: ################################
```

Mux mode, translate TS16

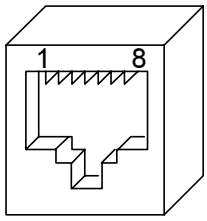
«Three-to-one» multiplexer mode. Timeslot 16 is transparently translated between E1 links.

```
Mode: Mux, Smart
Link 0: TP, Sync=Link 1, High gain, Use16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Port 0: 960 kbps, Drop0/Insert0, CTS=1
Port 1: 960 kbps, Drop0/Insert0, CTS=1
             1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Timeslots 0: ################.................
Timeslots 1: .................################
```

Drop-Insert mux

«Drop-Insert» multiplexer mode. Data from port 0 is transmitted to E1/1 link and received from E1/0 link. Data from port 1 is transmitted to E1/0 link and received from E1/1 link. Timeslot 16 is transparently translated between E1 links.

```
Mode: Mux, Smart
Link 0: TP, Sync=Link 1, High gain, Use16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Link 0, High gain, Use16, no CRC4, Mon=Sa4
Port 0: 64 kbps, Drop0/Insert1, CTS=1
Port 1: 64 kbps, Drop1/Insert0, CTS=1
             1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Timeslots 0:
#...............................
Timeslots 1:
#...............................
```



1	TD+
2	TD-
3	RD+
4	Not used
5	Not used
6	RD-
7	Not used
8	Not used

Ethernet interface

Ethernet interface complies with 10BaseT standard. Two devices with this interface form a Remote Bridge and are used to interconnect two LANs. The Remote Bridge is capable of filtering packets, i. e. it passes over those packets only that have recipients in the LAN on the other side of the link. Cronyx E1-XL with Ethernet interface can compress Ethernet packets by truncating stuff bits required to form fixed length packets.

Cronyx E1-XL with Ethernet interface can work together with other devices equipped with Ethernet interface made by Cronyx - PCM2, E1L and BRDG.

A Remote Bridge formed of two Cronyx devices has the following specifications:

Interface type	10BaseT (UTP)	
Connector type	RJ45	
Operation modes	Half Duplex	Full Duplex
Filtering rate	15000	packets/sec.
LAN table size	10000	MAC addresses

The following figure depicts a statistics screen for devices with Ethernet interface. Besides Ethernet interface parameters Coll column also shows the number of seconds during which collisions occurred for local and remote devices respectively.

```
Statistics: Session #21, 0 days, 00:00:29

Mode: Smart, Dual
Link 0: TP, Sync=Int, High gain, Use16, no CRC4, Mon=Sa4
Link 1: TP, Sync=Int, High gain, Use16, no CRC4, Mon=Sa4
Port 0: 1984 kbps, Half duplex
         TXC, RXC
Port 1: 1984 kbps, Half duplex
         TXC, RXC
                  1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Port 0 timeslots: ################################
Port 1 timeslots: ################################

                BPV     OOS     Err     Event   Status
Link 0:         0       0       0       0       Ok
 far end:       0       0       0       0       Ok
Link 1:         0       0       0       0       Ok
 far end:       0       0       0       0       Ok
Port 0:         -       -       0       0       Ok
Port 1:         -       -       0       0       Ok
```

```
 Port 0

 Mode: Smart, Dual
 Link 0: TP, Sync=Int, High gain, Use16, no CRC4, Mon=Sa4
 Link 1: TP, Sync=Int, High gain, Use16, no CRC4, Mon=Sa4
 Port 0: 1984 kbps, Half duplex
         Link error, TXC, RXC
 Port 1: 1984 kbps, Half duplex
         Link error, TXC, RXC
                  1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
 Port 0 timeslots: ################################ - from Link 0 to Link 0
 Port 1 timeslots: ################################ - from Link 0 to Link 0

   1. Timeslots...
   4. Duplex: Half
   5. Filtering: Enabled
```

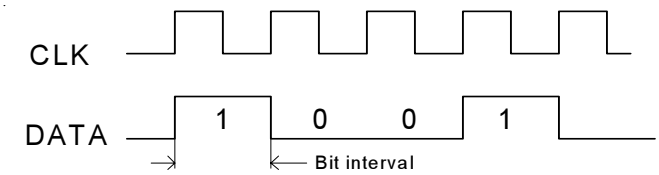
Configuration parameters related to Ethernet interface can only be changed from a terminal connected to the console port.

Upgrade of on-board firmware

On-board firmware of the stand-alone multiplexer version can be overwrited using a PC and a special software via the console port. Firmware updates are available at Cronyx web site www.cronyx.ru. The software package includes detailed instructions describing the download procedure.

Synchronous data transmission

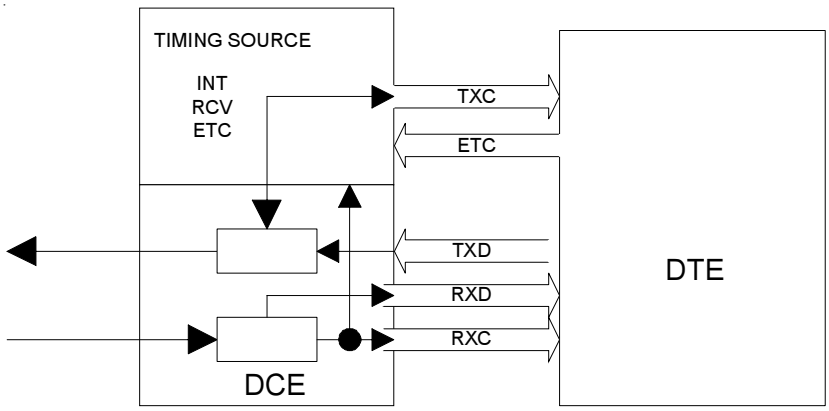
In synchronous data transmission mode data is changed in algoristic intervals associated with special clocks. The time period during which data cannot be changed is called a “bit interval”. A receiver should read data at time points close to the midpoint of the bit interval. If the data are read on the confines of the bit interval it leads to errors. A transmitter usually changes data using one of the clock edges (e. g. the rising edge) while a receiver reads the data using the other edge (the falling one in this example).



Different interfaces use different ways of clock transmission. V.35, RS-530, RS-232 etc. interfaces have special clock lines allotted for each data direction (receive and transmit). RXD data is accompanied by RXC clocks while TXD data is accompanied by TXC clocks.

Modem line interfaces (G.703, xDSL etc.) use self-synchronizing codes (HDB3, Manchester, 2B1Q etc.) allowing to transmit both data and clocks over the same wires. Self-synchronizing codes are noted for they do not contain long sequences of the same level. It allows to use a PLL to derive clocks and data from the signals received at the receiver side.

There can be two types of V.35, RS-530, and RS-232 interfaces – DCE and DTE. Modems have DCE interfaces whereas PC-like devices have DTE interfaces. DCE devices are timing sources for both directions of data transmission. Both RXC (receive clock) and TXC (transmit clock) signals are output ones for them. Here, RXC is a signal received by a modem from a line and derived by a PLL. It accompanies RXD data received by the modem and has the same direction.



Data entered the modem (TXD) is accompanied by TXC signals. The source of TXD data signal is a DTE device. TXC clocks are received from the modem and can have one of the following three timing sources: an internal modem generator (INT), a clock derived by the PLL from the signals received from the line (RCV), or an external source (EXT). The external source usually represents a signal received at ETC interface input.

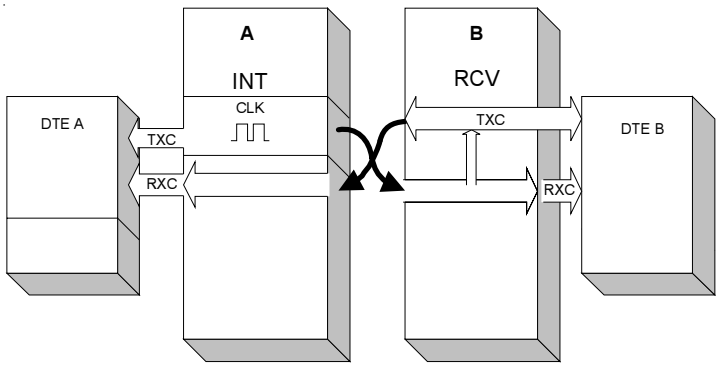
In addition to the bit synchronization the serial data transmission also requires to have byte boundaries determined. For this purpose the bit flow is divided into frames. The beginning of a frame serves as a byte reference point. Digitized voice data are transmitted using the frame format described in ITU G.704. Computer networks mostly use HDLC standard of bit flow to frames alignment.

HDLC frame format

Frames are separated by certain bit chains called “flags”. HDLC protocol flag is 01111110. A procedure of stuffing (insertion/throwing of zeroes in sequences of more than five ones) is used in order this chain not to be found in data.

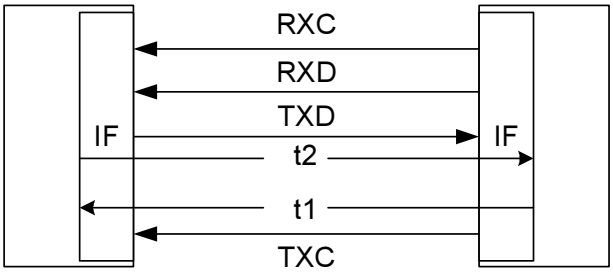
Considerations on building synchronous links

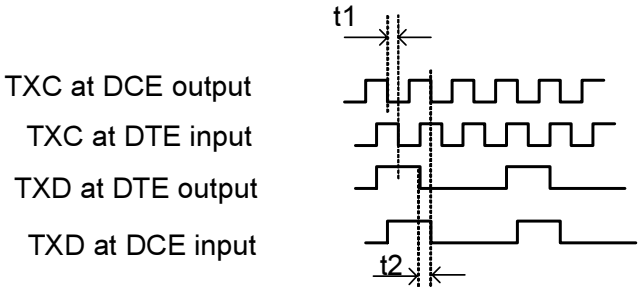
Synchronous links are usually built based on the principle of using a single timing source. It means that a data link between two DTE devices uses the same clock generator for timing all the data flows in the link. The transmission of clocks is executed either in the DCE-DTE butting in the case of specialized lines, or using self-synchronizing codes when data is transmitted over communication lines. In the simplest example of two V.35 routers connected using synchronous leased line modems an internal clock generator of one of the modems (INT) is used as a timing source. The second modem derives clocks from the signals it receives from the line (RCV). Both routers as DTE devices receive clocks from the modems.



Single timing from Device A

The problem that can arise even in this simplest case is in the fact that data received at the modem (TXD) and clocks accompanying the data (TXC) have different directions and are transmitted time-lagged. TXC signals arrive in DTE with t1 delay caused by internal modem circuits, connecting cable, and router interface used. Using a TXC clock edge a router changes TXD data which returns to the modem with t2 delay. If t1 + t2 equals to a half-cycle of the clock, then the change of the data at the input will fall just on the edge used by the modem to consider data valid.

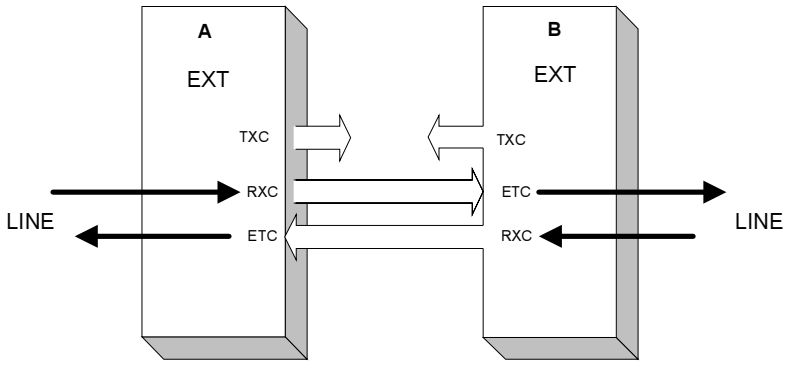




Data is changed using the rising edge and it is read using the falling one.
The figure depicts an occurrence of the error when data is read in DCE at the very moment it is being changed.

It leads to an erroneous reception of data from the router. The probability of such a situation grows as the data rate increases. The problem can be solved by inverting TXC clocks. To implement this you should change the corresponding setting for one of the devices.

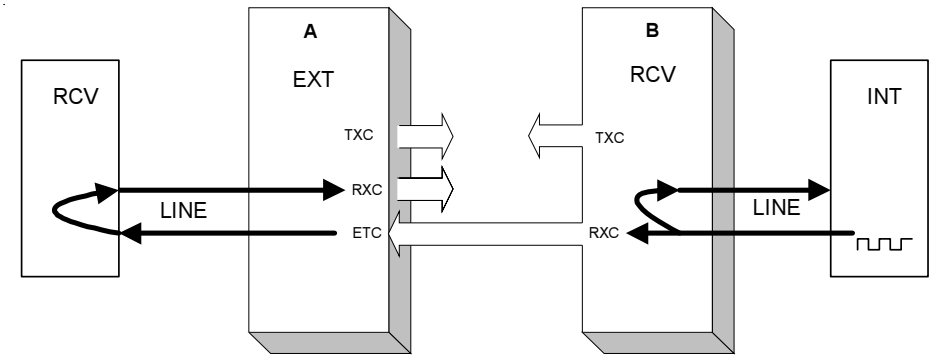
Sometimes there is a need in connection of two DCE devices via V.35, RS-232, RS-530 etc. interface. The simplest way to realize such a connection is to use the mode of external synchronization of transmit paths in both devices (EXT).



Connection of two DCE devices via the digital interface. Clock transmission path is shown.

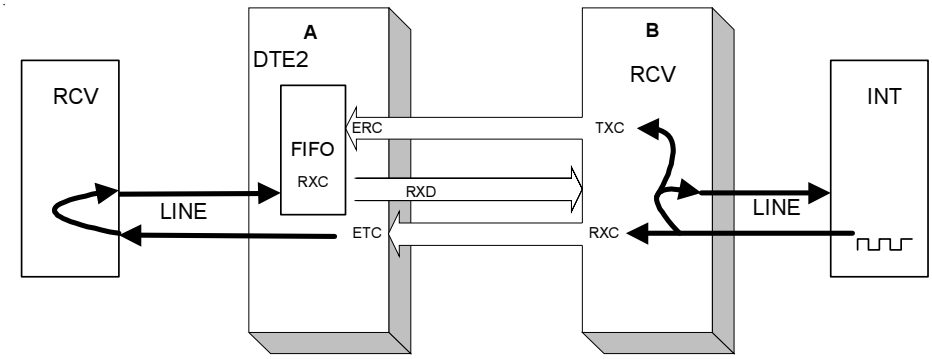
In this mode the modem transmits data to the line using a clock received at the input of ETC interface. The data received by the first modem from the line along with the accompanying clock enter RXD and RXC outputs. Then the data and the clock are transmitted to TXD and ETC inputs of the second modem which transmits them farther on to the line. The return flow has the similar path. In this scheme the retransmission of data and clocks received from the line occurs, i. e. the timing source is located outside the devices considered.

It may be possible that none of the devices supports the mode of external transmit path synchronization (EXT). In this case you can select ETC input as a transmit path timing source for one of the modems only. Here, the modem which does not have such a mode defined will receive data at TXD input using clocks of its internal generator (INT) or the ones received from the line (RCV).



Connection of two DCE devices via the digital interface. Device B does not have ETC input.
Clock transmission path is shown.

If all the devices used in the link are set to have a single timing source then the clocks at RXC output will have the same frequency (from the same source) as transmit path clocks of the second modem will have. There will be no errors in the link if the phase shift between these clocks does not equal to exactly a half-cycle that is unlikely to happen. Cronyx synchronous modems have DTE2 emulation mode that allows to eliminate any chance for the occurrence of such a situation. In this mode the digital interface has a FIFO buffer enabled in the received data path.

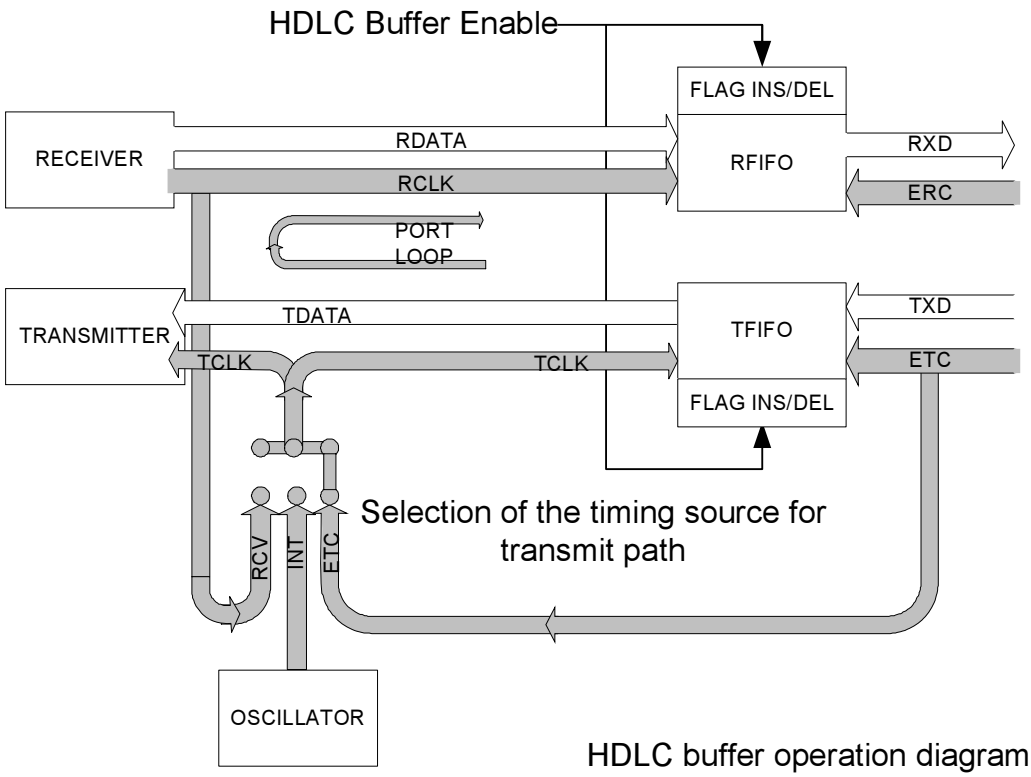


Connection of two DCE devices via the digital interface. Device A uses FIFO buffer.
Clock transmission path is shown.

Data is written to the buffer using clocks received from the line whereas the reading of the data is executed using clocks transmitted to ERC pins of the interface connector (external receive clocks). Thus, FIFO buffer equalizes the clocks phase. In this case Cronyx modem emulates DTE interface receiving transmit clocks at ETC input and receive clocks at ERC input. The requirement of using a single timing source remains in force. If it is impossible to ensure the use of a single timing source in the link then the clocks on one side of the buffer will differ in frequency from the clocks on the other side of the buffer. It causes recurrent buffer overruns/underruns depending on what side of the buffer has clocks of higher frequency.

If data transmitted over the link represents HDLC format packets the frequencies offset can be compensated owing to the fact that data in HDLC flow has gaps stuffed with special bit chains (01111110) called “flags”.

Cronyx modems allow to enable FIFO buffers in HDLC mode. In this case the control logic inserts HDLC flags between frames if the buffer tends to an underrun but throws odd HDLC flags if the buffer is threatened with an overrun. The frequencies offset which can be compensated in that way depends on the length of HDLC packets and on the number of flags between the packets (this mode is not available when less than two flags are used between the packets). The typical length of HDLC frames in IP networks is 1,500 bytes and the minimum number of flags between the frames is 2. In this case the maximum frequencies offset which can be compensated using such a buffer is not less than 200 ppm.



HDLC buffer operation diagram

Connector pin assignments

V.35 cable for connecting to DCE with external transmit clocks

(DTE1 emulation mode)

Cronyx E1 M34 (male)		Direction	DCE M34 (male)	
TXD-a	P	←	R	RXD-a
TXD-b	S	←	T	RXD-b
RXD-a	R	→	P	TXD-a
RXD-b	T	→	S	TXD-b
ETC-a	U	←	V	RXC-a
ETC-b	W	←	X	RXC-b
RXC-a	V	→	U	ETC-a
RXC-b	X	→	W	ETC-b
TXC-a	Y	Not connected		
TXC-b	AA	Not connected		
ERC-a	BB	Not connected		
ERC-b	Z	Not connected		
CTS	D	Not connected		
RTS	C	←	F	CD
DTR	H	←	E	DSR
DSR	E	→	H	DTR
CD	F	→	C	RTS
GND	A	↔	A	GND
GND	B	↔	B	GND

V.35 cable for connecting to DCE with external transmit clocks, for a multi-standard interface

(DTE1 emulation mode)

HDB44 (male)		Direction	M34 (male)	
TXD-a	10	←	R	RXD-a
TXD-b	25	←	T	RXD-b
RXD-a	8	→	P	TXD-a
RXD-b	9	→	S	TXD-b
ETC-a	6	←	V	RXC-a
ETC-b	7	←	X	RXC-b
RXC-a	5	→	U	ETC-a
RXC-b	4	→	W	ETC-b
RTS	14	←	F	CD
DTR	11	←	E	DSR
DSR	13	→	H	DTR
CD	12	→	C	RTS
TXC-a	2	Not connected		
TXC-b	3	Not connected		
ERC-a	17	Not connected		
ERC-b	18	Not connected		
CTS	15	Not connected		
GND	1	↔	A	GND
GND	16	↔	B	GND
SEL-x	31,39,41,43,32 Connect to GND 1			

V.35 cable for connecting to DCE with external receive and transmit clocks

(DTE2 emulation mode)

Cronyx E1 M34 (male)		Direction	DCE M34 (male)	
TXD-a	P	←	R	RXD-a
TXD-b	S	←	T	RXD-b
RXD-a	R	→	P	TXD-a
RXD-b	T	→	S	TXD-b
ETC-a	U	←	V	RXC-a
ETC-b	W	←	X	RXC-b
RXC-a	V	Not connected		
RXC-b	X	Not connected		
TXC-a	Y	Not connected		
TXC-b	AA	Not connected		
CTS	D	Not connected		
ERC-a	BB	←	Y	TXC-a
ERC-b	Z	←	AA	TXC-b
RTS	C	←	F	CD
DTR	H	←	E	DSR
DSR	E	→	H	DTR
CD	F	→	C	RTS
GND	A	↔	A	GND
GND	B	↔	B	GND

V.35 cable for connecting to DCE with external receive and transmit clocks, for a multi-standard interface

(DTE2 emulation mode)

HDB44 (male)		Direction	M34 (male)	
TXD-a	10	←	R	RXD-a
TXD-b	25	←	T	RXD-b
RXD-a	8	→	P	TXD-a
RXD-b	9	→	S	TXD-b
ETC-a	6	←	V	RXC-a
ETC-b	7	←	X	RXC-b
RXC-a	5	Not connected		
RXC-b	4	Not connected		
RTS	14	←	F	CD
DTR	11	←	E	DSR
DSR	13	→	H	DTR
CD	12	→	C	RTS
TXC-a	2	Not connected		
TXC-b	3	Not connected		
CTS	15	Not connected		
ERC-a	17	←	Y	TXC-a
ERC-b	18	←	AA	TXC-b
GND	1	↔	A	GND
GND	16	↔	B	GND
SEL-x	31,39,41,43,32			
	Connect to GND 1			

V.35 cable for a multi-standard interface

HDB44 (male)		Direction	M34 (female)
TXD-a	10	←	P
TXD-b	25	←	S
RXD-a	8	→	R
RXD-b	9	→	T
ETC-a	6	←	U
ETC-b	7	←	W
TXC-a	2	→	Y
TXC-b	3	→	AA
RXC-a	5	→	V
RXC-b	4	→	X
ERC-a	17	←	BB
ERC-b	18	←	Z
RTS	14	←	C
DTR	11	←	H
DSR	13	→	E
CTS	15	→	D
CD	12	→	F
GND	1	↔	A
GND	16	↔	B
SEL-x	31,39,41,43		
	Connect to GND 1		

RS-232 cable for a multi-standard interface

HDB44 (male)		Direction	DB25 (female)
TXD	10	←	2
RXD	8	→	3
ETC	6	←	24
TXC	2	→	15
RXC	5	→	17
ERC	17	←	21
RTS	14	←	4
DTR	11	←	20
DSR	13	→	6
CTS	15	→	5
CD	12	→	8
GND	1	↔	1
GND	16	↔	7
SEL-x	31,35,37		
	Connect to GND 1		

RS-530 cable for a multi-standard interface

HDB44 (male)		Direction	DB25 (female)
TXD-a	10	←	2
TXD-b	25	←	14
RXD-a	8	→	3
RXD-b	9	→	16
ETC-a	6	←	24
ETC-b	7	←	11
TXC-a	2	→	15
TXC-b	3	→	12
RXC-a	5	→	17
RXC-b	4	→	9
ERC-a	17	←	21
ERC-b	18	←	18
RTS-a	14	←	4
RTS-b	29	←	19
DTR-a	11	←	20
DTR-b	26	←	23
DSR-a	13	→	6
DSR-b	28	→	22
CTS-a	15	→	5

CTS-b	30	→	13
CD-a	12	→	8
CD-b	27	→	10
GND	1	↔	1
GND	16	↔	7
SEL-x	31,33,37 connect to GND 1		

RS-449 cable for a multi-standard interface

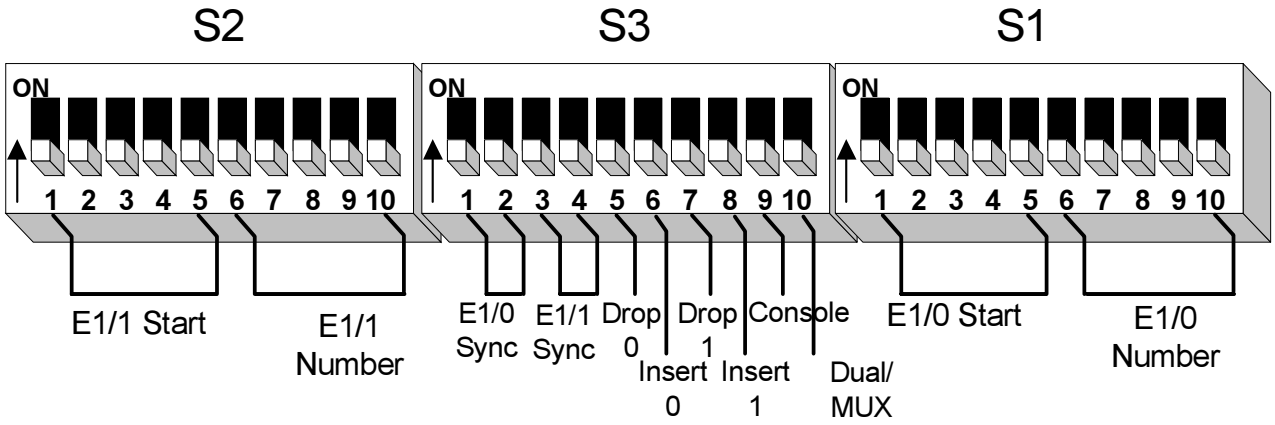
HDB44 (male)		Direction	DB37 (female)
TXD-a	10	←	4
TXD-b	25	←	22
RXD-a	8	→	6
RXD-b	9	→	24
ETC-a	6	←	17
ETC-b	7	←	35
TXC-a	2	→	5
TXC-b	3	→	23
RXC-a	5	→	8
RXC-b	4	→	26
ERC-a	17	←	3
ERC-b	18	←	21
RTS-a	14	←	7
RTS-b	29	←	25
DTR-a	11	←	12
DTR-b	26	←	30
DSR-a	13	→	11
DSR-b	28	→	29
CTS-a	15	→	9
CTS-b	30	→	27
CD-a	12	→	13
CD-b	27	→	31
GND	1	↔	1
GND	16	↔	19
SEL-x	31,33,37 Connect to GND 1		

Cable for connecting two devices with a multi-standard interface

HDB44 (male)		Direction	HDB44 (male)	
TXD-a	10	←	8	RXD-a
TXD-b	25	←	9	RXD-b
RXD-a	8	→	10	TXD-a
RXD-b	9	→	25	TXD-b
ETC-a	6	←	5	RXC-a
ETC-b	7	←	4	RXC-b
RXC-a	5	→	6	ETC-a
RXC-b	4	→	7	ETC-b
RTS	14	←	12	CD
DTR	11	←	13	DSR
DSR	13	→	11	DTR
CD	12	→	14	RTS
TXC-a	2	Not connected		
TXC-b	3	Not connected		
ERC-a	17	Not connected		
ERC-b	18	Not connected		
GND	1	↔	1	GND
GND	16	↔	16	GND
SEL-x	31,39,41,43,32 Connect to GND 1 on both connectors			

X.21 cable for a multi-standard interface

HDB44 (male)		Direction	DB15 (female)
TXD-a	10	←	2
TXD-b	25	←	9
RXD-a	8	→	4
RXD-b	9	→	11
ETC-a	6	←	7
ETC-b	7	←	14
TXC-a	2	→	6
TXC-b	3	→	13
RTS-a	14	←	3
RTS-b	29	←	10
CD-a	12	→	5
CD-b	27	→	12
GND	1	↔	1
GND	16	↔	8
SEL-x	33,37 Connect to GND 16		



E1/0 Start - E1/0 link initial timeslot

E1/1 Start - E1/1 link initial timeslot

E1/0 Number - number of E1/0 link timeslots

E1/1 Number - number of E1/1 link timeslots

E1/0 Sync - timing source of E1/0 transmit path

E1/1 Sync - timing source of E1/1 transmit path

	internal clock generator
	from the receiver
	from the receiver of the other link
	from the digital interface

Drop 0 - E1 link option for dropping data to the digital port 0

Drop 1 - E1 link option for dropping data to the digital port 1

	E1/0
	E1/1

Insert 0 - E1 link option for the insertion of data from the digital port 0

Insert 1 - E1 link option for the insertion of data from the digital port 1

	E1/0
	E1/1

Console - Permissions on setting configuration parameters using a console

	Only DIP switches are used; remote control is disabled; NVRAM is not used
	A remote terminal is used; parameters are stored in NVRAM; DIP switches are not used

Dual/MUX - Selection of E1XL flexible multiplexer operation mode

	two independent links
	multiplexer