

MicroLink ISDN/TLpro

User's Manual



Data Communications
Computer Graphics

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ELSA GmbH
Sonnenweg 11
52070 Aachen
Germany

ELSA Inc.
2150 Trade Zone Blvd., Suite 101
San Jose, CA 95131
USA

Internet <http://www.elsa.de>

Internet <http://www.elsa.com>

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1 Introduction

About this manual	This manual describes the installation, the features and the operation of the ELSA <i>MicroLink ISDN/TLpro</i> ISDN terminal adapter.0
Symbols and conventions	<p>The following conventions are used in this manual:</p> <p>◆ NOTE ◆ denotes important information.</p> <p>A filled-in box indicates a list of items:</p> <ul style="list-style-type: none"> ■ ... <p>Procedures consist of numbered steps:</p> <p>1. ...</p> <p>Bold text denotes the default values for AT commands and S registers.</p> <p>Brackets (< >) indicate ASCII characters and characters on a keyboard. For example, <CR> means carriage return and <BS> means backspace.</p>
S ₀ interface S/T interface	In this manual, the interface between the ISDN Network Terminator (NT) and the ISDN terminal device(s) is generally referred to as "S ₀ interface" or "S ₀ bus". In the USA this interface is commonly called "S/T interface", which is just another name for the same type of interface.
Changes to this manual	ELSA <i>MicroLink</i> ® products are subject to continual further development. It is therefore possible that the printed documentation does not correspond to the latest release. However, you will always find the latest information in the <i>ELSA ONLINE</i> Support BBS (see page 84 for ISDN and phone numbers).
Package contents	<p>Before you start installing your ELSA <i>MicroLink</i>® ISDN terminal adapter, please make sure that your package is complete:</p> <ul style="list-style-type: none"> ■ ELSA <i>MicroLink</i>® ISDN/TLpro terminal adapter ■ External power supply (AC adapter) ■ ISDN S₀ line connection cable ■ RS-232/V.24 serial cable ■ 9-pin/25-pin adapter ■ Disks with application software ■ Printed manuals
◆ NOTE ◆	<p>If any parts are missing, please contact your dealer.</p> <p>ELSA reserves the right to make changes to the package contents without prior notice.</p>

Notes:

2 Brief Description

MicroLink ISDN/TLpro from ELSA's ISDN product line is a terminal adapter which allows any device equipped with an RS-232/V.24 serial interface, such as a personal computer, to be connected to the Integrated Services Digital Network (ISDN) via a Basic Rate Interface or a Private Branch Exchange (PBX) with an S₀ interface.

Extended AT command set *MicroLink ISDN/TLpro* is an ideal solution for those communications users who, on the one hand wish to make use of modern ISDN features like fast connection establishment, high speed transfer, and display of the caller ID, but on the other hand don't want to do without the familiar AT command interface.

Transfer modes:

V.110 *MicroLink ISDN/TLpro* can be operated in accordance with ITU-T V.110 (I.463), providing transfer rates of 1200 to 38,400 bps in asynchronous mode.

In synchronous V.110 mode, *MicroLink ISDN/TLpro* supports speeds of 1200 to 64,000 bps.

V.120 In addition, *MicroLink ISDN/TLpro* supports the ITU-T standard V.120 (I.465) at 56,000 and 64,000 bps. This allows error-corrected connections with transfer rates up to 230,400 bps (asynchronous), as well as ISDN connections with remote stations in the USA.

X.75 Furthermore, *MicroLink ISDN/TLpro* also supports X.75/T.70NL connections to remote ISDN PC boards working with FOSSIL drivers.

V.42bis Using real-time data compression according to V.42bis in X.75 and V.120 mode, *MicroLink ISDN/TLpro* can achieve an effective data throughput of up to 230,400 bps.

T-Online The German T-Online online service can be used in both VT-100 and CEPT/KIT mode with *MicroLink ISDN/TLpro* using the commands **AT\N8** and **AT\N9** (see page 37).

◊ **NOTE** ◊ The supplied Btx software *ELSA btx for Windows* can be used for the German T-Online/Btx service only.

PPP conversion The Point-to-Point Protocol conversion allows the combination of asynchronous PPP computer software with synchronous PPP-ISDN access points (e.g. via Routers). The conversion complies with RFC 1662.

Automatic bit rate detection and rate adaptation The V.110 bit rate detection allows *MicroLink ISDN/TLpro* to automatically adapt to the transfer rate of a calling V.110 system. Thus you do not have to configure the communications software for transfer rate of the remote system. *MicroLink ISDN/TLpro* can automatically adapt the RS-232/V.24 bit rate to the ISDN line transfer rate.

Automatic protocol detection	Depending on its configuration, <i>MicroLink ISDN/TLpro</i> automatically detects the protocols X.75, V.120 (both with V.42bis as well) and V.110 (see also AT+N command, page 37) for incoming calls.
Automatic detection of 56,000 and 64,000 bps	If a connection with 56,000 bps is detected in the D channel for incoming calls (for example from the USA), the X.75 and V.120 protocols automatically switch to 56,000 bps.
D channel protocols	In the European version of <i>MicroLink ISDN/TLpro</i> , the AT+IDP command (see page 33) can be used to switch between the international DSS1 protocol (Euro-ISDN) and the German 1TR6 protocol. By default, the DSS1 protocol is enabled. In the US version the AT+IDP command can be used to switch between the National ISDN-1(NI-1) and the AT&T 5ESS protocols. By default, the NI-1 protocol is enabled.
Automatic connection monitoring	<i>MicroLink ISDN/TLpro</i> stops unwanted costs running up by automatically terminating connections after a period of line inactivity as defined by the user.
Status display for troubleshooting	The color-coded LED displays on the front panel (see page 17) allow you to monitor the status of the ISDN interface and the RS-232/V.24 interface. This makes it easier to track down errors if problems arise, such when the installation of the ISDN interface is faulty.
Call acceptance delay	This feature allows the acceptance of an incoming call to be delayed. This is useful, for example, in installations where several terminal devices using the same MSN (Multiple Subscriber Number) are connected to a common ISDN S ₀ interface.
MSN/EAZ	The European version of <i>MicroLink ISDN/TLpro</i> allows the assignment of Multiple Subscriber Numbers (MSN, DSS1 protocol only) or Terminal Selection Digits (EAZ, German 1TR6 protocol only).
Closed user groups	Incoming calls are automatically checked for the caller ID. This allows you to restrict the acceptance of calls to a private user group, thus protecting your system against unauthorized access (European version only).
Additional information	For added security, the European version of the <i>MicroLink ISDN/TLpro</i> can also display the telephone number of an incoming call before establishing the connection. In addition, connection costs can be displayed during and after a connection. Connection Status: information about the status of the connection can also be displayed (e.g. ALERTING).
Automatic cost monitoring	The European version of <i>MicroLink ISDN/TLpro</i> (DSS1 and 1TR6 protocol) monitors the charge information provided by the ISDN and can be used to guarantee that a user-defined number of charge units is not exceeded within a given period of time.

Flash ROM	Flash ROM technology allows the quick and easy update of software, simply by uploading the new file. The state-of-the-art is always just an update away.
Channel bundling	The channel bundling function allows the two B channels (data channels) of an ISDN Basic Rate Interface to be bundled to one logical connection. Under ideal conditions this doubles the effective data throughput of the connection. However, this depends on the actual type of data transferred.
230,400 bps	Using a suitable serial interface card, a line bit rate of 230,400 bps is possible.
Leased line operation	Additional to dial-up lines, <i>MicroLink ISDN/TLpro</i> can also be operated on ISDN leased lines of group 0 (type 4) and group 2 (type 1.1 and 1.2). This requires identical devices with the same firmware version to be used at both ends of the connection, so that protocols proprietary to the manufacturer can be used.

Notes:

3 Installation

This chapter describes installation of the *MicroLink ISDN/TLpro* terminal adapter.

3.1 Safety Notice

To ensure your safety and the proper operation of the *MicroLink ISDN/TLpro* and your computer system, please observe the following guidelines:

- Use only the original external power supply shipped with your ISDN terminal adapter.
- Refrain from using a power supply that has been opened or mechanically damaged. Touching the primary voltage (Europe: 230 V, USA: 120 V) with the hand or with metal parts results in an electric shock, which can be deadly.
- Use only the supplied ISDN S₀ line connection cable to connect your *MicroLink ISDN/TLpro* to an ISDN digital communications line.
- Do not touch the metal pins of the *MicroLink ISDN/TLpro* connection sockets. Even slight dirt or electrostatic discharging may cause malfunctions or, in extreme cases, damage the device.

3.2 System Requirements

The following are required for the successful installation of the *MicroLink ISDN/TLpro* terminal adapter:

- An IBM PC or compatible computer with a 9/25-pin serial communications interface (COM port): recommended is a 16550 (FIFO) buffered Universal Asynchronous Receiver/Transmitter (UART) to operate at speeds up to 115,200 bps.
- An NT-1 device (in the US only).
- An ISDN digital communications line.
- An available AC power outlet.

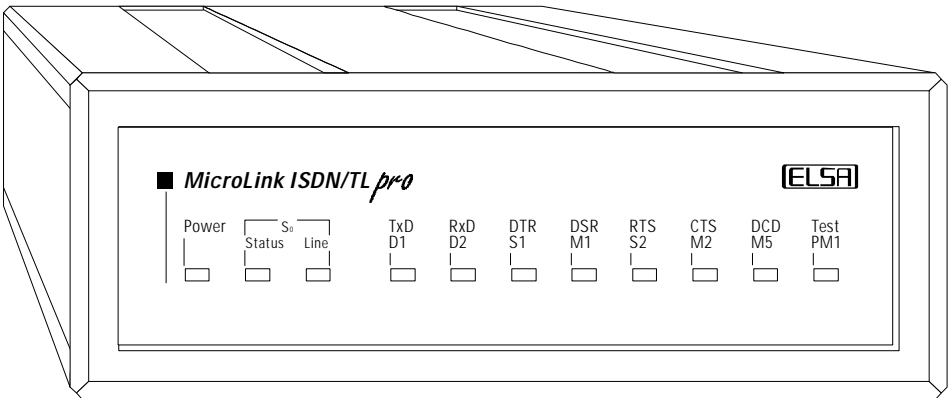
◇ **NOTE** ◇

MicroLink ISDN/TLpro can also be connected to the serial port of an Apple Macintosh computer. This connection requires a serial cable with a 9-pin male connector on one end (for connection to the Macintosh) and a 25-pin male connector on the other.

3.3 Installing the Terminal Adapter

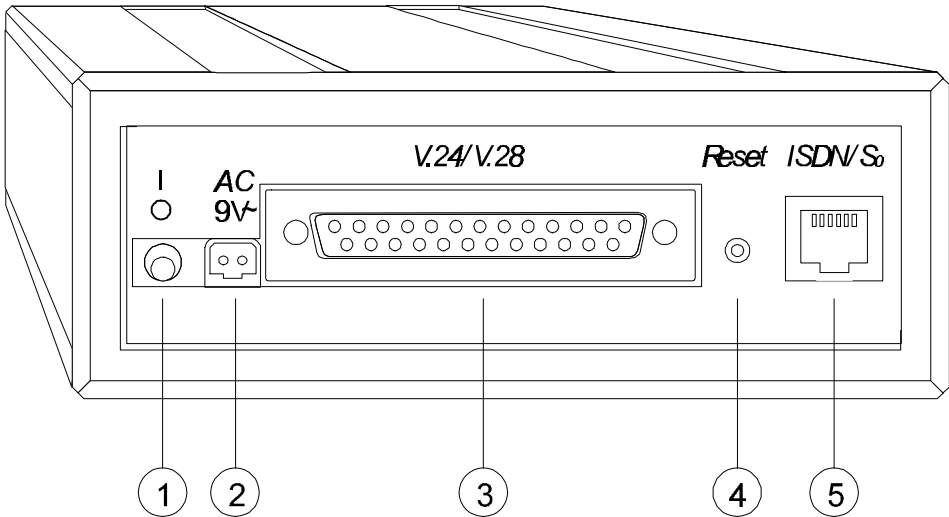
During the installation, refer to the following diagrams which show the front and back of your *MicroLink ISDN/TLpro*.

Front panel LEDs



The LEDs indicate the status of the RS-232/V.24 interface and the ISDN S_0 interface (see also chapter 4, page 17).

Back panel connectors



No	Meaning
1	ON/OFF switch
2	AC power connector
3	Serial line connection to computer
4	Reset switch
5	ISDN line connector (S_0 (S/T) bus interface)

Installation summary

The installation process involves the following steps:

- 1. Power supply** Connect the terminal adapter to an AC power outlet. See page 13.
- 2. Serial interface** Connect the terminal adapter to a computer serial port. See page 13.
- 3. ISDN line** Connect the terminal adapter to an ISDN digital communications line. See page 14.
- 4. Switching on** Turn on the terminal adapter. See page 14.

5. Selecting the D channel protocol

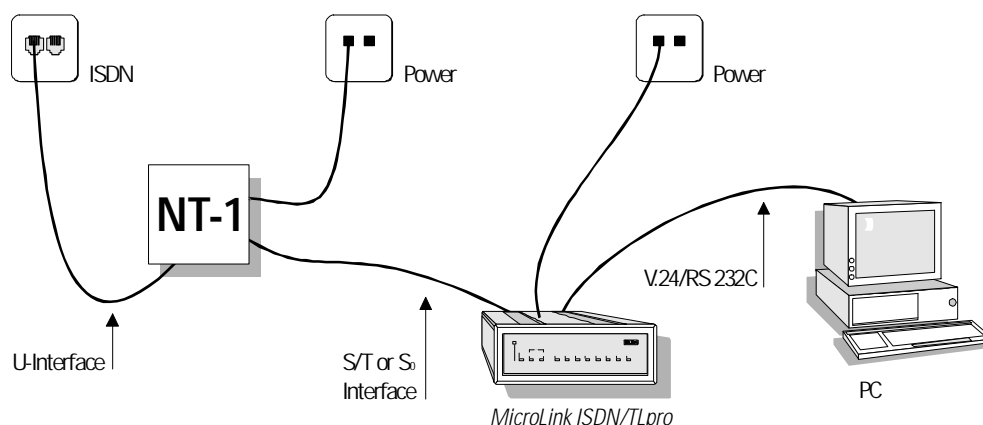
Select the channel protocol. See page 14.

US protocols: enter DN and SPID. See page 15.

◇ NOTE ◇

When connecting to an AC power outlet, use only the external power supply provided with the *MicroLink ISDN/TLpro*. Do not use a power supply designed for a different device.

Setup diagram



Connecting to an AC power outlet

The following procedure explains how to connect the *MicroLink ISDN/TLpro* to an AC power outlet. This connection is made using the supplied external power supply (AC adapter).

1. Verify that the voltage of the power line matches the voltage of the supplied AC adapter.
2. Insert the supplied AC adapter cord into the power connector labeled **AC 9V~** on the terminal adapter's back panel (see the "Back Panel Connectors" diagram, number 3).
3. Insert the wall transformer on the other end of the power cord into a grounded AC outlet.

Connecting to a computer serial port

The *MicroLink ISDN/TLpro*'s serial port connection is provided by an RS-232 25-pin D-type connector. This connector is located on the back panel of the terminal adapter. To make this connection:

1. If your computer is running, turn it off.
2. Insert the 25-pin end of the supplied RS-232/V.24 serial cable into the serial connector on your Data Terminal Equipment.

◇ NOTE ◇

If your computer or terminal has a 9-pin serial connector, use the supplied 9-to-25-pin adapter.

3. Insert the other cable end into the DTE connector labeled **V.24/V.28** on the *MicroLink ISDN/TLpro* back panel (see "Back Panel Connectors" diagram, number 3).

4. Use the standoffs on each end of the cable to secure the cable connector to the DTE serial port and to the terminal adapter.

Connecting to an ISDN line

The following procedure explains how to connect the *MicroLink ISDN/TLpro* to an ISDN digital communications line. This procedure assumes an installed ISDN communications line is available. If this is not the case, please contact your telephone company to obtain an ISDN line.

1. Connect your NT-1 device to your ISDN communications line. If you need assistance, please refer to the relevant manual.
2. Insert the RJ-11 end of the supplied ISDN S_0 line connection cable into the **ISDN/ S_0** connector on the back panel (see "Back Panel Connectors" diagram, number 4).
3. Insert the other end of the cable into the ISDN telephone wall socket.

Turning on the ISDN terminal adapter

Use the following procedure to turn on the *MicroLink ISDN/TLpro*.

1. Turn on the terminal adapter with the power switch on the back panel. The Test- and ISDN Line LEDs flash as the terminal adapter performs a brief self-test. After the tests complete, both LEDs should go OFF.
2. Start the communications software (e.g. *Telir for Windows*) and configure it as follows:
 - Use a baud rate of either 230,400 bps or 115,200 bps.
 - Select the COM port to which the *MicroLink ISDN/TLpro* is connected, e.g. COM 1 or COM 2.

For more information on performing these steps, refer to the manual for your communications software.

3. Enter local terminal (or "direct connect") mode. Again, refer to your communication software manual for assistance.
4. Type **AT** and press <CR> . An **OK** result code should be displayed on your computer screen. If not, compare the PC-to-Terminal Adapter connection with the "Setup" diagram.

Completing the installation

To complete the installation, the **AT+IDP** command (see page 33) must be used to define your D channel protocol, which controls the exchange of signals between your ISDN device and the nearest ISDN exchange. Refer to the following section for European or US models as appropriate:

European models

The European Community uses either of two D channel protocols:

- The DSS1 channel protocol, also referred to as Euro-ISDN, used in most European Community countries.
- The 1TR6 channel protocol, which is primarily used in Germany.

To ensure compatibility throughout Europe, European versions of the *MicroLink ISDN/TLpro* support both the international DSS1 channel protocol (Euro-ISDN) and the German 1TR6 channel protocol.

By default, the *MicroLink ISDN/TLpro* is configured for the DSS1 D-channel protocol. If your local switch requires the 1TR6 channel protocol., type **AT+IDP=1TR6** and press <CR> .

To return the *MicroLink ISDN/TLpro* to the DSS1 channel protocol, type **AT+IDP=DSS1** and press <CR> .

If required, further settings such as MSN (page 34) can be defined.

This completes the installation procedure for European models.

US models

US versions of the *MicroLink ISDN/TLpro* require a D channel protocol, a Directory Number (DN) and a Service Profile ID ("SPID" for short, see page 34) to be defined.

The D channel protocol determines how control signals are exchanged between the local switch and your ISDN terminal adapter. The *MicroLink ISDN/TLpro* supports two D channel protocols:

- National ISDN-1
- AT&T 5ESS Custom

By default, the *MicroLink ISDN/TLpro* is configured for the National ISDN-1 channel protocol. For the AT&T 5ESS channel protocol, type **AT+IDP=AT&T** and press <CR> .

To return to the National ISDN-1 channel protocol, type **AT+IDP=NI-1** and press <CR>. (In this command, the letter following the N is an upper-case i.)

Your local ISDN service provider may, depending on the protocol offered, have provided a unique SPID for each device attached to your digital communications line. The following table indicates the parameters required for the systems available:

ISDN Channel Protocol	Number of B-Channels	
	1 B-Channel	2 B-Channels
AT&T 5ESS Custom, point-to-point	No SPID or DN	No SPID or DN
AT&T 5ESS Custom, point-to-multipoint	1 SPID, 1DN	1- or 2 SPID and 1- or 2 DN
National ISDN-1	1 SPID, 1DN	2 SPID and 2 DN

For example, to enter the parameters for the National ISDN-1 protocol, two B channels, the following commands must be entered:

AT+ISPID1=0156596200 (For the 1st B-channel)

AT+IDN1=5659620 (For the 1st B-channel)

AT+ISPID2=0156596210 (For the 2nd B-channel)

AT+IDN2=5659621 (For the 2nd B-channel)

No SPID is necessary for the AT&T 5ESS Custom point-to-point configuration (so type **AT+ISPID1=** and **AT+ISPID2=**)

◇ **NOTE** ◇

Each SPID can only be used one at a time. Do not attempt to use one SPID with two ISDN devices simultaneously. This will result in a malfunction!

This completes the installation procedure.

Reset button

A brief press of the Reset button (see illustration on page 12) will reset the ISDN terminal adapter to its default state. If the Reset button is pressed for the duration of a self test (about one second), the factory default configuration will also be loaded (see **AT&F** command, page 30). However, ISDN numbers, the cost statistics, and the user configuration profiles which have been stored will not be reset. The Reset button can be pressed with a pointed instrument such as a ball-point pen

3.4 Installation under Windows 95

Installation

To install your *MicroLink ISDN/TLpro* under Windows 95, follow the instructions given here:

1. Start Windows 95
2. Switch on your terminal adapter.
3. From **My Computer** call the following menus:
4. **Control Panel, Modems**
5. Activate **Don't detect modem, I will select it from a list...**
6. Click on **Have Disk...**, then
7. **Browse...** for your floppy drive or CD-ROM drive (a:\ or d:\ respectively)
8. Select the file MDMELSA.INF (e.g. d:\).

◇ **NOTE** ◇

After copying this file the installation is complete and the ISDN terminal adapter *MicroLink ISDN/TLpro* is available for use. The standard software under Windows 95 (e.g. Microsoft Exchange, HyperTerminal etc.) has direct access to your terminal adapter.

4 Status Display and Diagnostics

The *MicroLink ISDN/TLpro* has 11 front panel LEDs for status display.

LED	Status	Meaning
Power	ON	<i>MicroLink ISDN/TLpro</i> is turned on and receiving power.
Status (see Note)	OFF FLASHING ON	No S_0 current, S_0 bus inactive. Negotiation in process. ISDN line active, connection to ISDN exchange ¹⁾ .
Line	OFF Slow flash (1 per second, 2 or 3 times) Fast flash (3 times per second) ON	No incoming call or connection. Incoming call received, but call is not suited to device. Incoming call not yet accepted. Connection is being established.
TxD (D1)	ON	<i>MicroLink ISDN/TLpro</i> is receiving either data from the remote system or a command from your computer.
RxD (D2)	ON	<i>MicroLink ISDN/TLpro</i> is sending data to the remote system or a result code to your computer.
DTR (S1)	ON	Terminal/computer ready for operation (see the AT&D command on page 29).
DSR (M1)	ON	<i>MicroLink ISDN/TLpro</i> is ready for operation (see the ATID command on page 29).
RTS (S2)	ON	Sending device is enabled (see the ATIQ command on page 39).
CTS (M2)	ON	<i>MicroLink ISDN/TLpro</i> is ready to send data (see the ATID and ATIQ commands on pages 29 and 39).
DCD (M5)	Red Green Orange	V.110, V.100 or PPP connection established (no error correction or fax connection). V.120, X.75, MNP 4, MNP 5, V.42(bis) connection established (error corrected connection). Channel bundling is enabled. See also the AT&C command on page 27.
Test (PM1)	ON	<i>MicroLink ISDN/TLpro</i> is performing its self-test.
Note: Most ISDN basic rate interfaces make this LED go ON. With some PBXs, such as Siemens Hicom, the green LED may not go ON before a connection has been established.		

1) In Europe - TEI negotiation OK

In the US - TEI negotiation OK layer 2 active, SPID negotiation OK (if SPID available)

Notes:

5 Operation

5.1 General

AT command set	<p>The AT command set has established itself as the world-wide standard for the syntax of modem control commands (AT = command ATtention prefix; see section 5.4, page 22).</p> <p>In order to give communications users the opportunity to work with their familiar command interface in the ISDN as well, <i>MicroLink ISDN/TLpro</i> was equipped with the AT command set.</p> <p>To send AT commands to the ISDN terminal adapter from a PC, you need a suitable communications software, also called "terminal program". <i>MicroLink ISDN/TLpro</i> is shipped with the famous communications program Telrx.</p>
Two operating states	<p>The two general operating states of <i>MicroLink ISDN/TLpro</i> are the command state and the online state (transmission state).</p>
Command input, execution	<p>After being switched on, the ISDN terminal adapter is in the command state. Commands can be accepted, interpreted and executed in this state only. After a successful connection with the remote station, the ISDN terminal adapter changes from the command state to the online state. Returning to the command state and changing back again is possible even within an existing connection (see Escape command, section 5.2, and ATO command, page 38).</p>
Data transmission	<p>Online state signifies that a telephone connection to another party exists: The ISDN terminal adapter is "online". This is the case with both a successful connection (outgoing call) and with the acceptance of an incoming call. In this state data exchange (data transmission) can take place between two connected data stations.</p> <p>Note that data exchange is only possible with remote ISDN systems that support either V.110, or X.75, or V.120.</p> <p>Connections to devices in the analog telephone network (such as analog telephones, analog fax devices and modems) are not possible.</p>

5.2 Escape Command

Changing to the command state	<p>The Escape command can only be recognized in the online state. It permits changing to the command state and thus allows a temporary escape from the online data transmission without disconnecting the line.</p> <p>In order to make sure that this command can be distinguished from the normal data flow, the following rules are in effect:</p>
Escape sequence	<p>The Escape command consists of a sequence of three Escape characters (default setting: + + +) and a valid command line.</p> <p>After the three Escape characters have been entered, the ISDN terminal adapter is in the command state. However, data transmission is interrupted only after the recognition of a valid command line.</p>
◇ NOTE ◇	<p>The Escape character should not be confused with the <ESC> character of the ASCII character set. The Escape character can be redefined via the register S2 (see page 47).</p>
Valid command line	<p>A valid command line begins with an AT or at and must be terminated with a Carriage Return (<CR>, see also section 5.4, page 22). The command A/ or a/ is not valid after the three Escape characters. Also, a valid command line in an Escape sequence is restricted to a maximum of 40 characters.</p>
Valid Escape sequence	<p>Upon the entry of the Escape sequence, the data transmission is interrupted and the command line is processed. If no further character follows the three Escape characters within one second (= Escape prompt delay = EPD), the ISDN terminal adapter replies with OK in advance and awaits a valid command line.</p>
Escape bit rate	<p>After the recognition of an Escape command, the serial port bit rate corresponds to the value set in register S93 (see page 53). This bit rate may differ from the currently used V.110 connect bit rate.</p> <p>The ATV1 command (see page 35) can be used to copy the V.110 direct mode bit rate to register S93.</p>
Return to online state	<p>The ATO command (see page 38) returns you to the online data transmission (unless the line was disconnected).</p>
Invalid Escape sequence	<p>If characters not representing a valid command line follow the OK after the Escape prompt delay, the ISDN terminal adapter changes back to the online state with a CONNECT message. The CONNECT message can be suppressed with the AT*Q1 command (see page 39).</p>
Escape prompt delay	<p>The delay of one second can be altered in register S12 (see page 48).</p>

5.3 Detection of Bit Rate and Data Format

Automatic detection	The ISDN terminal adapter automatically recognizes the bit rate between the ISDN terminal adapter and the computer/terminal (serial port rate), as well as the used data format.
ISDN line speed	<p>This bit rate detected by the terminal adapter is set on the ISDN line, too, if V.110 operation has been selected (see also AT%G1 command, page 30).</p> <p>If your communications software is, for example, configured to a transfer rate of 19,200 bps, the ISDN line speed in V.110 operation is set to 9600 bps as well. If the serial port bit rate is higher than 38,400 bps, the ISDN line speed is always set to 38,400 bps in V.110 mode.</p>
Supported rates	<p>The following computer serial port rates are supported and recognized:</p> <p>1200, 2400, 4800, 9600, 19,200, 38,400, 57,600, 76,800, 115,200 and 230,400 bps.</p>
◇ NOTE ◇	The bit rates 76,800 bps and 230,400 bps can only be used in conjunction with a special ultra-high-speed serial interface board.
Supported data formats	<p>The following data formats are automatically recognized:</p> <p>1 start bit, 7 data bits, no parity, 2 stop bits 1 start bit, 7 data bits, even parity, 1 or 2 stop bits ¹⁾ 1 start bit, 7 data bits, odd parity, 1 or 2 stop bits ¹⁾ 1 start bit, 8 data bits, no parity, 1 or 2 stop bits ¹⁾</p> <p>¹⁾ The ISDN terminal adapter automatically uses 1 stop bit.</p> <p>The default setting for the data format is: 8 data bits, no parity, 1 stop bit (8N1).</p>

5.4 The Command Line Buffer

AT command buffer The ISDN terminal adapter contains a command line buffer which can store up to 255 characters (including blanks) of a command line with exception of the **AT** prefix and the terminating <CR> (Carriage Return). Line feed characters <LF> are always ignored in the command state.

If the ISDN terminal adapter is to be given several commands, these can be entered individually with one **AT** command prefix **each** and one terminating <CR> **each**:

Command input in
several command lines

```
at\n3
OK
at\v8
OK
ats0?
000
OK
```

However, it is also possible to enter these commands successively after a **single** introductory **AT** in a single command line and to terminate with a **single** <CR>:

Command input in
one command line

```
at \n3 \v8 s0?
000
OK
```

For better legibility, the individual commands can be separated by blank spaces.

Upon reaching the end of the command line buffer no further commands can be entered. The command line can only be edited with backspace <BS> or executed with <CR>.

Exceptions

The following commands must be located in the last position of a command line (i.e. subsequent commands are not executed):

ATD (dial command),
ATA (call acceptance),
ATZ (initialization command),
ATO (return to online state),

as well as all commands which are used to enter or store ISDN numbers (e.g. **AT+P**) or ISDN Multiple Subscriber Numbers (e.g. **AT+IMSN**).

5.5 Channel Bundling

The channel bundling function allows the two B channels (data channels) of an ISDN Basic Rate Interface to be bundled to one logical connection. Under ideal conditions this doubles the effective data throughput of the connection. However, this depends on the actual kind of data transferred. Channel bundling is enabled with the **AT&N1** command (see page 36).

There are two types of channel bundling: static or dynamic bundling. The type of channel bundling used depends on the settings of register S175 (see page 61).

Static channel bundling

In static channel bundling, the second B channel connection (secondary connection) is established as soon as the first (primary) connection has been established. The secondary connection remains active until the primary connection is terminated. If the secondary connection cannot be established (or is refused) within 30 seconds, the called side aborts the primary connection (see register S175). **The CONNECT message is delayed until the secondary connection is established (default setting).** If the secondary connection fails (e.g. network busy), the calling side tells the answering side that the second B channel will not be used. A one-channel connection with 64 kbps or 56 kbps is established instead.

Dynamic channel bundling

In dynamic channel bundling (line on demand), the secondary connection is only established when the throughput limit defined in registers S176 and S177 (see page 61) is reached. If a secondary connection establishment fails, it is repeated every 15 seconds, as long as the reason for the secondary connection is still valid.

If channel bundling is enabled (**AT&N1**, see page 36), large amounts of data are distributed to both B channels in equal parts. While channel bundling is active, the DCD (M5) LED on the front panel of the device shines orange.

Since an individual connection must be established for each B channel, the secondary connection causes additional costs, which can be minimized by using dynamic channel bundling. Bit 6 of register S175 (see page 61) can be used to adapt the secondary connection establishment to the ISDN charge information.

5.6 ISDN Leased Line Operation

Besides normal dial-up lines, *MicroLink ISDN/TLpro* can also be operated at ISDN leased lines of group 0 (type 4) and group 2 (type 1.1 and 1.2). In this case, identical devices with the same firmware version should be used on both ends of the line, so the manufacturer-specific protocols can be used.

◇ **NOTE** ◇ The leased line operating modes must not be activated when the *MicroLink ISDN/TLpro* is connected to a normal ISDN Basic Rate Interface.

5.6.1 Leased Lines of Group 0, Type 4 (64S, ITU-T I.430)

ISDN leased lines of group 0 provide one B channel with a transmission rate of 64 kbps. A control channel (D channel) is not used.

Installation For ISDN leased line operation, a terminal adapter is connected to the S_0 bus on each end of the leased line in the same way as for a dial-up line. The B channel to be used can be selected via the register S162. In Germany, B channel 1 must always be used.

By default the terminal adapter is set to **AT&L0** (dial-up line operation).

◇ **NOTE** ◇ Because of the missing D channel in group 0 leased lines, a protocol cannot be negotiated between the connected devices. Therefore both devices should be set to a fixed B channel protocol (for example **AT\N2** for X.75).

The **AT&L** command (see page 35) is used to configure the device for group 0 leased line operation. Two group 0 operating modes are possible:

Manual connection establishment This mode is enabled with **AT&L1**. A B channel connection can be established manually by entering **ATD** on one end and **ATA** on the other end. Any additional dialing information included in the **ATD** command is ignored.

◇ **ATTENTION** ◇ The **ATA** command on the answering device must be entered at about the same time as the **ATD** command on the calling device, since otherwise the B channel negotiation phase may be aborted (time-out).

Automatic connection establishment This mode is enabled with **AT&L2**. It allows a connection to be established automatically after a certain delay defined in register S40. For this mode, one terminal device must be set to originate mode (**ATS0=0**) and the other device to answer mode (**ATS0=0**).

When an existing connection is lost, NO CARRIER is reported. When the connection is re-established, CONNECT is reported. NO CARRIER is also reported after a failed connection establishment. The device retries to establish the connection after the time defined in register S40.

Register S40 should be set to **different** values on both terminal adapters, since otherwise it may be impossible to reach a connection.

In **AT&L1** or **AT&L2** mode, an **AT+IDP?** command (see page 33) is answered with "No D channel protocol". The **AT&L0** command (resume dial-up line operation) restores the D channel protocol used last before the leased line mode was enabled.

An **AT+IDP=xxx** command (see page 33) entered in leased line mode will take effect when **AT&L0** is entered the next time.

5.6.2 Leased Lines of Group 2, Type 1.1 and 1.2 (S01, S02, ITU-T I.430)

There are two connection types - type 1.1 and type 1.2 - in group 2 leased line operation. Type 1.1 provides one B channel with a transmission rate of 64 kbps and one D channel with a transmission rate of 16 kbps. The ISDN exchange does not interpret the D channel information nor the B channel information. Type 1.2 additionally provides a second B channel.

For group 2 leased line operation, the terminal adapter must be set to **AT&L0** (dial-up line mode, see page 35).

To establish a group 2 leased line connection, one terminal device must be set to **AT+IDP=FV2N** (group 2 leased line, network side, see page 33) and the other terminal device to **AT+IDP=FV2U** (group 2 leased line, user side). The different settings are required because one device must select the B channel for the connection, and some other protocol-related differentiations must be made.

◇ **NOTE** ◇ The D channel protocol used for group 2 leased line connections is manufacturer-specific, but is based on the DSS1 protocol (frame structure, W elements).

A group 2 leased line connection is established in the same way as a dial-up line connection. The dialing information supplied with the **ATD** command (see page **Fehler! Textmarke nicht definiert.**) is received by the answering side and can be read from register S193 or can be automatically displayed after the RING message by setting register S157=7. The number issued with the **ATD** command can be any number.

To establish a type 1.2 (S02) leased line connection (two B channels), the channel bundling function can be enabled with **AT&N1** (see page 36). The D channel protocol settings and the connection establishment are performed in the same way as for type 1.1 connections.

5.7 Description of AT Commands

Command entry	All commands given to the modem must begin with the ASCII characters AT or at (At or aT are not valid) and end with <CR> (Carriage Return).
Exception	The only exception is the command A/ , which repeats the last command line. This command is entered without AT and must not be followed by <CR>.
Abort command	A command line or screen output (such as display of the register contents with AT%R) can be aborted with <Ctrl><X> or <Ctrl><C>.
Parameters	Commands which require an additional parameter may also be entered without the parameter. A missing parameter is regarded as parameter 0 (e.g. ATE = ATE0).
Identification of the default configuration	Parameter settings that apply to the default configuration of the ISDN terminal adapter, as set at the factory, are marked by the symbol *.

A Accept incoming call

ATA

This command accepts an incoming call. An incoming call is reported by the message RING (verbose form) or 2 (abbreviated form), unless the result codes from the ISDN terminal adapter are disabled. (See register S154/S155, page 56, and register S160, page 57, for more information about connection establishment).

Attention: If the automatic call acceptance function is enabled, a call cannot be accepted manually (i.e. with the **ATA** command) as the line is disconnected upon the entry of any character except for line feed (see register S0, page 46). However, the line is not disconnected if bit 6 of register S14 is set to 1 (default value = 0). With this setting it is possible for the computer to transmit characters to the ISDN terminal adapter while the connection is being established (see also page 48).

In connection with this command, please regard also register S152 ("Call indication delay"). No further commands can be executed in the same command line after an **ATA** (see also page 22).

%B ISDN line bit rate in V.110 mode

AT%B1200	: 1200 bps
AT%B2400	: 2400 bps
AT%B4800	: 4800 bps
AT%B9600	: 9600 bps
AT%B19200	: 19,200 bps
* AT%B38400	: 38,400 bps

In synchronous mode (**AT&M1** or **AT&M2**, see page 36) also:

AT%B48000 : 48,000 bps
AT%B56000 : 56,000 bps
AT%B64000 : 64,000 bps

The **AT%B** command is used to set the desired ISDN line bit rate (in bps = bits per second) in V.110 mode, unless the line bit rate is determined by the serial port bit rate (see **AT%G0** command, page 30). Regardless of this setting, in V.120 and X.75 operation a bit rate of 64,000 bps or 56,000 bps is always used.

%C Data compression

AT%C0 : No data compression
AT%C1 : V.42bis data compression
AT%C2 : V.42bis data compression
 * **AT%C3** : V.42bis data compression

This command determines whether V.42bis data compression is used in an error-corrected connection (X.75 or V.120 mode). This command is connected with the **AT%N** command (see page 37).

By default, the ISDN terminal adapter is set to **AT%C3** and uses V.42bis data compression. If this compression method is not supported by the remote side, the ISDN terminal adapter attempts to establish a connection without data compression, regardless of the **AT%C** setting.

&C DCD option

AT&C0 : DCD is always active
 * **AT&C1** : DCD indicates a connection
AT&C2 : DCD is dropped during disconnection only

Communications programs normally evaluate the DCD (Data Carrier Detect) interface line in order to determine whether a connection is present. The ISDN terminal adapter supports this function with the setting **AT&C1**.

D Connection establishment

ATDn

This command tells your *MicroLink ISDN/TL V.34* to dial the numbers and any special characters that follow **D** in the command line. You can type up to 36 numbers or any of the following special characters after the **D**. When you execute a command line that contains the **D** command, you can cancel dialing by pressing any key on your keyboard (except the space bar).

Your *MicroLink ISDN/TL V.34* does not execute commands that follow **D** in the command line (see also page 22). To include additional commands on the same command line with the **D** command, have them precede the **D** command

The special characters for redialling or dialing stored numbers must come immediately after the command **ATD** (see also **AT&Z** command, page 44). The special characters **I**, **N** and ***** can be entered at any position.

◇ **NOTE** ◇ The *MicroLink ISDN/TLpro* recognizes the type of call being made (e.g. ISDN, modem, fax or voice) and automatically switches to the necessary mode of operation.

Character	Meaning
S or /	Dial the number stored in nonvolatile memory location 0 using the AT&Z or ATIP command. Example: ATDS <CR>
S=n or /n	Dial the number stored in nonvolatile memory location n using the ATIP command. Example: ATS/0 <CR>
L	Redial the last number. Example: ATDL <CR>
;	In nonvolatile memory, store the digits preceding the semicolon and dial them when an ATO command is executed without a data connection *)
*	Phone number component (e.g. for controlling PBX systems)
#	1TR6 protocol: Dialing code for external calls (valid for some private ISDN branch exchanges). DSS1 protocol: "Sending Complete" (additional information, required for dialing in some European countries).
I	Establish an ISDN connection
N	Establish a modem connection

*) If **ATO** is entered several times in succession, all the digits (up to 36) are concatenated. An **ATH** command or an attempt to establish a connection clears the entire string of digits.

\$D Automatic dialing with DTR

- * **AT\$D0** : Disable DTR dialing
- AT\$D1** : Enable DTR dialing

If DTR dialing is enabled and the state of the DTR interface line changes from OFF to ON, the ISDN terminal adapter automatically dials the number stored in position 0 (see commands **ATIP**, page 39, and **AT&Z**, page 44). If no number is stored, *MicroLink ISDN/TLpro* reports ERROR.

&D DTR control

AT&Dn (n = 0..3; default value = 2)

These commands determine how the ISDN terminal adapter reacts to a transition of the DTR interface line from ON to OFF. This also depends on the current operating mode of the ISDN terminal adapter.

In command state:

n	Effect
0	no effect
1	no effect
2	an existing connection is terminated, digits stored with ATDn ; are cleared
3	same effect as (2), but the ISDN terminal adapter is also reinitialized (see AT&Y , page 44)

During a connection establishment:

n	Effect
0	no effect
1	connection establishment is aborted
2	same effect as (1)
3	same effect as (1), but the ISDN terminal adapter is also reinitialized (see AT&Y , page 44)

During an existing connection:

n	Effect
0	no effect
1	ISDN terminal adapter changes to the command state
2	same effect as <1>, but the connection is terminated before
3	same effect as <2>, but the ISDN terminal adapter is also reinitialized (see AT&Y , page 44)

If the ISDN terminal adapter is set to **AT&D2** or **AT&D3**, after a transition of DTR from ON to OFF calls cannot be accepted before DTR returns to ON. While DTR is OFF, the remote side will get a "remote station not ready" message.

\D DSR/CTS control

- * **ATID0** : DSR and CTS always on
- ATID1** : DSR indicates B channel switched through, CTS always on
- ATID2** : DSR always on, CTS follows DCD
- ATID3** : DSR indicates B channel switched through, CTS follows DCD

This command affects the meaning of the DSR and CTS interface lines. If a hardware data flow control is employed, the setting of the **ATID** command is meaningless for the CTS interface line in the online state.

E Command echo

ATE0 : Disable command echo

* **ATE1 : Enable command echo**

This command selects whether your ISDN terminal adapter echoes entered commands on the local screen or not.

&F Restore factory configuration

AT&F

This command loads the factory default settings of the firmware. The ISDN terminal adapter is thus reset to the delivery state. If a connection exists, this command is not executed.

Note that the **AT&F** command does **not** reset the stored numbers, the cost statistics, the configuration profiles and the ISDN settings (see also the **AT+I...** commands), or the serial port bit rate (DTE).

\F Display stored numbers

AT\F

This command displays the ISDN numbers stored with the **AT\P** or **AT&Z** command (see pages 39 and 44) from position 0 to 9.

%G Line bit rate control

* **AT%G0 : Line bit rate determined by serial port rate**

AT%G1 : Line bit rate set with AT%B

By default, in V.110 operation the ISDN line bit rate is always set to the bit rate used on the serial port (RS-232/V.24 interface), but limited to 38,400 bps. Regardless of this command, in X.75 or V.120 operation the ISDN bit rate is always fixed at 56,000 bps or 64,000 bps.

With the setting **AT%G1** the ISDN line bit rate is independent of the serial port bit rate and can only be set with the **AT%B** command (see page 26).

H Disconnection

ATH

When the ISDN terminal adapter is in the command state after an Escape command (see section 5.2) or after a DTR transition from ON to OFF with preceding **AT&D1** (see page 29), this command can be used to terminate an existing connection.

-H Dumb mode

- * **AT-H0 : Normal operation**
- AT-H1 : Dumb mode**

The **AT-H1** command places the ISDN terminal adapter into dumb mode. In this mode all echoes and messages (such as **OK**, **RING**, **CONNECT**) are suppressed (see also the commands **ATE0** and **ATO1**, pages 29 and 39), and a connection establishment is not aborted by entered characters (see register S14, bit 6, page 48). The only command accepted in dumb mode is **ATD** (establish a connection). To accept an incoming call, the ISDN terminal adapter must be configured to automatic call acceptance (see register S0, page 46). Other settings (such as handshake) remain active in dumb mode.

To make the dumb mode setting remain valid even after switching the terminal adapter off and on, it must be saved with the command line **AT-H1&W**. In this case normal operation can only be resumed by pressing and holding down the Reset button (see page 12).

I Display product information

- ATI0 : Display model number in nnn format**
- ATI1 : Display checksum**
- ATI2 : Display checksum result (OK or ERROR)**
- ATI3 : Display firmware version and release date**
- ATI4 : Display current parameter settings**
- ATI5 : Display serial number**
- ATI6 : Display product name and hardware release**
- ATI9 : Display the Plug&Play ID text**

The **ATI** command requests information from your *MicroLink ISDN/TL pro*.

ATI0 returns a three-digit ASCII string type number corresponding to the modem product code.

ATI1 returns a three-digit ASCII number corresponding to the checksum of the firmware ROM.

ATI2 calculates the checksum of the ROM and compares it with the checksum stored in the ROM. If both values are identical, **OK** is returned. Otherwise, **ERROR** is returned.

ATI3 returns the firmware version number and the firmware date. This command corresponds to the **AT%V** command.

ATI4 returns the current *MicroLink ISDN/TL pro* configuration.

ATI5 returns the *MicroLink ISDN/TL pro*'s internal factory serial number.

ATI6 returns the *MicroLink ISDN/TL pro*'s product name.

ATI9 returns the Plug&Play information text.

+ICLD Store numbers for closed user groups

- AT+ICLDn=s** : Store a number (n = 1..3)
AT+ICLDn= : Clear a number (n = 1..3)
AT+ICLD? : Clear stored numbers (n = 1..3)

This command can be used to restrict the call acceptance to certain remote systems (closed user group) in order to protect the system from unauthorized access.

If no number is contained in this list, any call is reported and (if applicable) accepted, if the Bearer Capability and MSN (Multiple Subscriber Number) or EAZ (1TR6 terminal selection digit) are valid.

As soon as there is at least one number stored in the list, an incoming call is only reported and accepted if the number of the remote system is contained in the list. Up to three numbers can be stored. Each number can consist of up to 20 digits (0..9). All changes are automatically saved in the non-volatile memory and will stay resident until the next change. No further commands can be executed in the same command line after this command.

The numbers must be entered as follows:

If the remote station is located

- **within a private branch exchange** : Extension number (e.g. 7800; 1TR6: with EAZ, if applicable)
- **within your city / country** : with city dialing code (e.g. 024191777800)
- **outside your country** : with country dialing code (e.g. 004924191777800)

+ICLI Set/display originator MSN

(DSS1)

- AT+ICLI=s** : Store originator MSN ¹⁾
AT+ICLI= : Clear originator MSN ¹⁾
AT+ICLI=/ : Clear originator MSN, suppress display to remote side ¹⁾
AT+ICLI? : Display stored originator MSN

This command is valid for the DSS1 protocol (Euro-ISDN) only. If the command is used in 1TR6 mode, it will not take effect before the ISDN terminal adapter is switched to the DSS1 protocol.

This command determines which Multiple Subscriber Number is displayed to the remote side in outgoing calls as the originator address. If a number is entered that was not assigned to the local system as MSN, the ISDN exchange will automatically insert one of the MSNs assigned to the system. The number **s** can consist of up to 16 digits (0..9). All changes are automatically saved in the non-volatile memory and will stay resident until the next change. No further commands can be executed in the same command line after this command.

If the **AT+ICLI=** command is used, the ISDN exchange will automatically insert one of the MSNs assigned to the local system.

The **AT+ICLI=/** command suppresses the display of any number by the ISDN exchange.

¹⁾ These functions may depend on regulations of the respective ISDN network provider.

+IDN Set/display directory number

(US protocol only)

AT+IDNn=s : Set Directory No. (n=1,2)
AT+IDNn= : Clear Directory No. (n=1,2)
AT+IDNn? : Display Directory No. (n=1,2)

With the relevant US protocol defined, the directory number can be set or displayed. The first B channel required **n=1**, the second B channel **n=2**.

The directory number can be up to 12 digits (0..9) long. Changes are stored in the non-volatile memory and are maintained until changed again.

+IDP Set/display D channel protocol

With European firmware:

- * **AT+IDP=DSS1** : Select DSS1 protocol (Euro-ISDN, default in Europe)
- AT+IDP=1TR6** : Select 1TR6 protocol (German ISDN)

With USA firmware

- * **AT+IDP=NI-1** : Select NI-1 protocol (National ISDN-1, USA default)
- AT+IDP=AT&T** : Select AT&T 5ESS protocol
- AT+IDP=FV2N** : Select group 2 leased line protocol (network side)
- AT+IDP=FV2U** : Select group 2 leased line protocol (user side)
- AT+IDP?** : Display selected protocol
- AT+IDP=?** : Display implemented protocols

The **AT+IDP** command selects the D channel protocol, which handles the control signals between the local station and the nearest ISDN exchange. Executing this command saves the D channel protocol setting in nonvolatile memory. As a result, this setting is preserved when the *MicroLink ISDN/TLpro* is turned off, reset, or reinitialized. This setting is automatically recalled the next time the *MicroLink ISDN/TL V.34* is turned on. In addition, the **AT&F** (factory reset) command does not reset the D channel protocol to the factory default setting.

◇ **NOTE** ◇ Do not execute this command during an existing connection or when you receive an incoming call.

All of the protocols above are point-to-multipoint. The AT&T 5ESS protocol also supplies point-to-point mode. In addition:

- The 1TR6 protocol is supported by the German ISDN only.
- DSS1 is used in most European countries and supported in Germany.

+IEAZ Set/display EAZ digit

(1TR6)

AT+IEAZ=n : Store EAZ (see table below)

AT+IEAZ? : Display EAZ

This command is valid for the 1TR6 protocol (German ISDN) only. If the command is used in DSS1 mode, it will not take effect before the ISDN terminal adapter is switched to the 1TR6 protocol.

This command is used to set the EAZ (**E**ndgerä**t**auswahl**z**iffer = terminal selection digit), a digit which can be appended to the normal ISDN number in the 1TR6 protocol to distinguish between several devices sharing the same ISDN line. Only calls with this EAZ are accepted by the ISDN terminal adapter. This command also determines the EAZ displayed to the remote side in outgoing calls as originator number. All changes are automatically saved in the non-volatile memory and will stay resident until the next change. The following settings are possible:

n	EAZ accepted in incoming calls	EAZ displayed to the remote side in outgoing calls
0	0	0
1..9	0 and 1..9, accordingly	1..9, accordingly
10..19	0..9, accordingly	0..9, accordingly
255	any	0

+IMSN Set/display accepted MSNs

(DSS1)

AT+IMSNn=s: Store MSN (n = 0, 1)

AT+IMSNn= : Clear MSN (n = 0, 1)

AT+IMSN? : Display stored MSNs

This command is valid for the DSS1 protocol (Euro-ISDN) only.

This command can be used to restrict call acceptance. If no number has been stored, any call will be accepted, regardless of its target MSN. Otherwise, only calls with one of the stored numbers will be accepted. Up to two numbers can be stored. The number **s** can consist of up to 16 digits (0..9). No further commands can be executed in the same command line after this command

Incoming calls without a target MSN will always be accepted. This applies, for example, to the "global" MSN of some network providers.

The numbers must be entered without country or city dialing codes. All changes are automatically saved in the non-volatile memory and will stay resident until the next change.

+ISPID Set/display Service Profile ID

(US protocols only)

AT+ISPIDn=s: Set Service Profile ID (n=1,2)

AT+ISPIDn= : Clear Service Profile ID (n=1,2)

AT+ISPIDn? : Display Service Profile ID (n=1,2)

With the relevant US protocol defined, the Service Profile ID (SPID) can be set or displayed. This number is (or, for channel bundling, these numbers are) allotted to you by the network provider. For

every SPID entered, be sure to enter the related DN (see **+IDN=**, above). The first B channel requires **n=1**, the second B channel **n=2**.

The directory number can be up to 16 digits (0..9) long. Changes are stored in the non-volatile memory and are maintained until changed again.

A second SPID should only be entered if the device is to use both channels simultaneously for channel bundling. If two separate devices are attached to one S_0 interface, then each requires its own SPID/DN pair to be entered as SPID1/DN1. SPID2/DN2 are left empty. With AT&T Point-to-Point connections no SPID is required and no entries should be made.

V

Computer line bit rate after connection

- * **ATVJ0** : Computer line bit rate (DTE rate) remains unchanged
- ATVJ1** : DTE rate matches connection (DCE) bit rate

For direct online connection (**ATVN1**) in modem mode and with V.110 in ISDN mode, it is desirable to maintain a fixed DTE rate.

%L

Bit rate adaptation in answer mode

- AT%L0** : Bit rate is adapted
- * **AT%L1** : Bit rate is adapted
- AT%L2** : Bit rate is not adapted, connection is terminated
- AT%L3** : Bit rate is adapted

This command determines whether in V.110 operation the bit rate is adapted to the bit rate of the remote system, if necessary.

The adapted bit rate is always equal or lower than the originally set ISDN line bit rate. For this reason no connection is reached if the calling system has a higher ISDN line bit rate than the answering system at connection establishment.

&L

Leased line operation (group 0)

- * **AT&L0** : Dial-up line operation
- AT&L1** : Group 0 leased line operation, manual connection establishment
- AT&L2** : Group 0 leased line operation, automatic connection establishment

This command can be used to configure the ISDN terminal adapter for group 0 leased line operation. When **AT&L1** or **AT&L2** is set, the currently selected D channel protocol (which is not needed for group 0 connections) is saved and restored upon the next **AT&L0** command.

For group 2 leased line connections, the terminal adapter must be set to dial-up line mode (**AT&L0**).

◇ **NOTE** ◇ In **AT&L1** or **AT&L2** mode, an **AT+IDP?** command (see page 33) is answered with "No D channel protocol". The **AT&L0** command (resume dial-up line

operation) restores the D channel protocol used last before the leased line mode was enabled. An **AT+IDP=xxx** command (D channel protocol selection, see page 33) entered in leased line mode will take effect when **AT&L0** is entered the next time.

The B channel to be used for this connection can be set with the register S162.

&M Synchronous transmission

- * **AT&M0 : Asynchronous transmission**
- AT&M1 : Synchronous transmission**
- AT&M2 : Synchronous transmission, automatic dialing upon DTR → ON**

This command can be used to set the ISDN terminal adapter to synchronous mode.

◇ **NOTE** ◇ Since synchronous transmission is performed in direct mode (without data buffering and data flow control), after connection establishment the serial port bit rate is the same as the ISDN line bit rate. The terminal adapter generates the send and receive clock signals.

When set to **AT&M1**, the ISDN terminal adapter switches to synchronous transmission after connection establishment.

AT&M2 has the same effect as **AT&M1**, but in addition the ISDN terminal adapter performs automatic dialing of the number stored in position 0 when the DTR interface line changes from OFF to ON (see also **AT\$D** command). If no number is stored, the terminal adapter reports ERROR.

-M Verbose CONNECT messages

- * **AT-M0 : Verbose CONNECT messages dependent on ATIV**
- AT-M1 : Verbose CONNECT messages independent of ATIV**

This command influences the text of the verbose CONNECT messages.

With the default setting **AT-M0** the text of the verbose CONNECT messages depends on the setting of the **ATIV** command (see page 42). The bit rate at which the connection was established is always displayed.

With the setting **AT-M1** no bit rate is displayed in the verbose CONNECT messages (the abbreviated CONNECT messages are the same as with **AT-M0**). If *MicroLink ISDN/TLpro* is set to **ATX0**, the **AT-M** command has no effect.

&N Channel bundling

- * **AT&N0 : Disable channel bundling**
- AT&N1 : Enable channel bundling**

With this command the channel bundling function can be enabled in order to achieve a higher data throughput. The protocol used for channel bundling is manufacturer-specific. Large amounts of data are distributed to both B channels in equal parts. This way the full transmission bandwidth provided by an ISDN Basic Rate Interface can be used.

By default the channel bundling function is disabled. It can be enabled with the **AT&N1** command. However, this only works if the error-corrected X.75 protocol is selected.

If the remote side does not support channel bundling, the ISDN terminal adapter automatically falls back to a one-channel connection or to a V.120 or V.110 connection.

◇ **NOTE** ◇ The use of the second B channel causes additional costs (see also register S175, page 61).

\N Operating mode

The **AT\N** command selects the *MicroLink ISDN/TLpro* operating mode. The following table shows the various modes that can be enabled using this command.

	\N0	\N1	\N2	\N3	\N4	\N5	\N6	\N7*	\N8	\N9	\N10
X.75-T-Online (CEPT/KIT)										■	
X.75-T-Online (VT-100)									■		
X.75			■	↓			↓ ¹⁾	↓ ¹⁾			
V.120					■	↓	■ ²⁾	↓ ²⁾			
V.110 normal	■			■		■		■			
V.110 direct		■									
HDLC-transparent											■

1) Used for outgoing calls (European version)

2) Used for outgoing calls (US version)

With **AT\N0** the ISDN terminal adapter operates in V.110 normal mode and establishes physical connections without error correction, regardless of the serial port bit rate.

With **AT\N1** the ISDN terminal adapter operates in V.110 direct mode. No data buffering takes place in these physical connections. However, data flow control is still performed if it is enabled on both the local and the remote side. The serial port bit rate is always the same as the ISDN line bit rate, to which the communications software must adapt itself. After returning to the command state (disconnection or Escape sequence) the bit rate set in register S93 (see page 53) is used again. The **AT\J** command (see page 35) can be used to determine whether the ISDN line bit rate should be stored in register S93 as well.

With **AT\N2** the ISDN terminal adapter attempts to establish an error-corrected X.75 connection. If the remote side does not support X.75, the connection is aborted.

With **AT\N3** the ISDN terminal adapter also attempts to establish an error-corrected X.75 connection. If the remote side does not support X.75, the ISDN terminal adapter automatically falls back to V.110 normal mode.

With **AT\N4** the ISDN terminal adapter attempts to establish an error-corrected V.120 connection. If this is not possible, the connection is aborted.

With **AT\N5** the ISDN terminal adapter also attempts to establish an error-corrected V.120 connection. If the remote side does not support V.120, the ISDN terminal adapter automatically falls back to V.110 normal mode.

With **AT\N6** the ISDN terminal adapter attempts to establish an error-corrected X.75 or V.120 connection. This applies to incoming calls only, outgoing calls are always performed with X.75 (US version: V.120).

With **AT\N7** (default setting for the European version) the ISDN terminal adapter attempts to establish an error-corrected X.75 or V.120 connection. This applies to incoming calls only, outgoing calls are always performed with X.75 (US version: V.120). If no connection can be reached, the ISDN terminal adapter automatically falls back to V.110 normal mode.

With **AT\N8** the ISDN terminal adapter attempts to establish an error-corrected connection to the German T-Online service (number 01910). In this mode, all VT-100 pages of T-Online can be displayed with a VT-100 compatible terminal program.

With **AT\N9** the ISDN terminal adapter attempts to establish an error-corrected connection to the German T-Online service (number 01910). In this mode, all Btx pages (CEPT) and KIT graphics pages of T-Online can be displayed with a Btx decoder program (for example *ELSAbtX*) or a KIT decoder.

With **AT\N10** the *MicroLink ISDN/TLpro* attempts to establish a non error corrected (HDLC transparent) connection. This mode requires the PPP conversion (see **AT%B**).

◇ **NOTE** ◇ The automatic switching between bit rates of 56,000 or 64,000 bps (see also register S163 and S164, page 58) works with any X.75 and V.120 variant.

O Return to online state

ATO

When the ISDN terminal adapter is in the command state after an Escape command (see section 5.2) or a DTR transition from ON to OFF with preceding **AT&D1** (see page 29), the **ATO** command can be used to return to the transmission phase and resume online data transmission.

If no connection exists and a number has been previously stored with **ATDn**; (see page **Fehler! Textmarke nicht definiert.**), this number is dialed upon the **ATO** command. No further commands can be executed in the same command line after an **ATO** command.

%P Asynchronous/synchronous conversion for PPP

- * **AT%P0** : No asynchronous/synchronous conversion for point-to-point protocol
- AT%P1** : Enable asynchronous/synchronous conversion for point-to-point protocol

The **AT%P** command enables or disables point-to-point protocol asynchronous/synchronous conversion. This conversion lets you use an ISDN Internet access with a standard TCP/IP application package, such as Internet Chameleon from NetManage, or the Windows 95 Internet Explorer, which require a transparent synchronous point-to-point protocol. Enabling this command requires the setting of the HDLC transparent mode or X.75, depending on the opposite (receiving- /sending-) device (with the commands **ATN10** or **ATN2**).

The default setting, **AT%P0**, disables point-to-point protocol asynchronous/ synchronous conversion.

\P Store numbers

AT\Pmn

With this command, up to ten (**m** = 0..9) ISDN numbers **n** (up to 36 digits each) can be stored in the non-volatile memory of the ISDN terminal adapter.

The commands **ATDS**, **ATDS=m**, **ATD/** or **ATD/m** (see page **Fehler! Textmarke nicht definiert.**) can be used to dial one of the stored numbers. These numbers are retained even after the ISDN terminal adapter is switched off. The **AT\Pm** command deletes the number stored in position **m**.

The **AT\P** command corresponds to the **AT&Z** command (see page 44). The numbers stored with **AT\P** can therefore be overwritten by the **AT&Z** command. The number stored in position 0 is also used for automatic dialing with DTR (see commands **AT\$D**, **AT&M**).

The stored numbers can be displayed on the screen with the **AT\F** command.

No further commands can be executed in the same command line after an **AT\P** command.

Q Enable/disable result codes

- * **ATQ0** : Enable result codes from the ISDN terminal adapter
- ATQ1** : Disable result codes from the ISDN terminal adapter
- ATQ2** : Disable result codes in answer mode

This command can be used to suppress the messages sent to the local computer by the ISDN terminal adapter (see section 5.9, page 64), either always (**ATQ1**) or in answer mode only (**ATQ2**).

***Q** Message after invalid Escape

- * **AT*Q0** : Enable CONNECT message after invalid Escape sequence
- AT*Q1** : Disable CONNECT message after invalid Escape sequence

This command can be used to suppress the CONNECT message after an invalid Escape command (see page 20).

\Q Data flow control on serial interface

- AT\Q0 : No handshake**
- AT\Q1 : XON/XOFF software handshake (bidirectional)**
- AT\Q2 : CTS hardware handshake (unidirectional)**
- * AT\Q3 : RTS/CTS hardware handshake (bidirectional)**
- AT\Q4 : XON/XOFF software handshake (unidirectional)**
- AT\Q5 : Same as \Q2, but CTS off until connection established**
- AT\Q6 : Same as \Q3, but CTS off until connection established**

This command can be used to select various handshake methods for data flow control on the RS-232/V.24 interface (serial port).

Attention: In asynchronous direct mode both parties must perform data flow control according to V.110 on the ISDN B channel.

If hardware handshake is selected with **AT\Q2** or **AT\Q3**, the data flow is controlled by the interface lines RTS (Request To Send) and CTS (Clear To Send). If the RTS line is OFF, the output of data to the computer is stopped. A change to ON resumes the output of the received data.

The commands **AT\Q1** and **AT\Q4** select software handshake using the characters XON (<DC1> = <Ctrl><Q>) and XOFF (<DC3> = <Ctrl><S>). When the ISDN terminal adapter receives an XOFF character from the computer, data output is stopped until an XON is sent. The **AT\X** command (see page 44) determines whether the XON and XOFF characters are also passed to the remote system or not. By default they are not transmitted.

With unidirectional handshake methods, handshake signals coming from the computer are ignored.

%R Display register contents

- AT%R0 : Display two registers per line**
- AT%R1 : Display one register per line / continuous display**

This command lists the current values of the S registers (see section 5.8) in columns decimally and hexadecimally. Registers containing a string are listed separately (one register per line) at the end of the list. Only relevant registers are displayed.

&R CTS in synchronous mode

- * AT&R0 : Synchronous operation: CTS follows RTS**
- AT&R1 : Synchronous operation: CTS always active**

This command controls the behavior of the CTS interface line in synchronous transmission.

S Read/write S register values

- ATS_n=x : Set register n to value x**
- ATS_n? : Read the value of register n**
- ATS_n : Make register n the default register**

AT? : Read the value of the default register

AT=x : Set the default register to value **x**

The register number **n** (0..255) and the register value **x** (0..255) are entered and displayed as numerical ASCII strings. The valid values for **x** may be restricted (for example, see register S2, page 47). The S registers are described individually in section 5.8, page 46.

Command lines with **ATS** (**ATS_n**, **ATS_n=x**, **ATS_n?**) make the referenced register the default register for subsequent **AT?** and **AT=x** commands. If **n** is omitted, register S0 is assumed. If an invalid register is referenced, either OK or ERROR is displayed (depending on register S96). In this case the register referenced before will remain the default register.

%S Set ISDN line bit rate (V.120, X.75, HDLC)

* **AT%S0** : ISDN line bit rate 64,000 bps

AT%S1 : ISDN line bit rate 56,000 bps

With this command you can set the line bit rates for bit 5 of register S171 and bit 7 of register S172. With the **ATI4** command you can display the contents of register S171 (bit 5).

&S DSR control

* **AT&S0** : DSR is always active

AT&S1 : DSR indicates B channel switched through

This command controls the meaning of the DSR interface line. Normally this line is always ON. With the setting **AT&S1** DSR indicates the activity of the data transmission channel.

\T Inactivity timer

AT\Tn (**n** = 0..255 * 10 seconds; default = 0)

This command controls the time after which the ISDN terminal adapter automatically terminates a connection, if no further data have been **sent** within this period (see also register S30, page 50). The default value 0 disables the inactivity timer.

◇ **NOTE** ◇ For more information, see Register **S30** on page 50.

UPX Start firmware upload in Flash ROM

ATUPX

If your *MicroLink ISDN/TLpro* is equipped with Flash ROM firmware, the command **ATUPX** readies the device to receive a firmware update from your PC. The firmware file is to be sent using the XModem protocol. This data is to be found on the CD-ROM or diskette enclosed with your *MicroLink ISDN/TLpro*. The latest firmware versions can be downloaded using ELSA's online service (Mail box *ELSA ONLINE*, GO ELSA in CompuServe, Internet: <http://www.elsa.de> or <http://www.elsa.com>).

If your device is not equipped with Flash ROM, then an error message will be displayed.

The data transfer rate for the upload is the speed that was last used, up to a maximum of 57,600bps.

V Form of result codes

ATV0 : Enable short form result codes (digits)

* **ATV1 : Enable long form (verbose) result codes**

This command allows you to choose whether the messages sent by the ISDN terminal adapter to the connected computer are displayed as digits or words. The result codes in short form and verbose form are listed in section 5.9, page 64.

%V Display firmware version

AT%V

This command displays the firmware version of the ISDN terminal adapter on the monitor.

&V Display configuration profiles

AT&V

This command displays the current configuration and the two stored configuration profiles 0 and 1 (see also the commands **AT&W** and **AT*W**, page 43) of the ISDN terminal adapter on the monitor.

\V CONNECT messages for error-corrected connections

ATV0 : No modified CONNECT messages

ATV1 : Identification of error-corrected connections

ATV2 : Identification of error-corrected connections and error correction type

* **ATV8 : Comprehensive CONNECT messages**

With the **ATV0** setting, messages reporting a successful connection are always displayed in the format **CONNECT xxxxx**, where **xxxxx** is the ISDN line bit rate of the connection.

With **ATV1** messages reporting a successful error-corrected connection are displayed in the format **CONNECT xxxxx/REL**.

With **ATV2** the ISDN terminal adapter also reports the error correction method used, for example **CONNECT xxxxx/REL-LAPB**.

With **ATV8** detailed connect messages are displayed, for example **CONNECT xxxxx/ISDN/V110**.

An overview of all possible **CONNECT** messages can be found in section 5.9, page 64.

◇ **NOTE** ◇ If *MicroLink ISDN/TLpro* is configured to **ATX0** or **AT-M1**, the **ATV** command has no influence on the verbose **CONNECT** messages.

&W Save current configuration profile

AT&Wn : Save configuration profile n (n = 0, 1)

This command can be used to save the current configuration of the ISDN terminal adapter in the non-volatile memory. Two different configuration profiles (0 and 1) can be stored.

The current values of the following commands and registers are saved:

%B	\D	%L	\N	%S	&R	S14	S30	S51	S152	S171	S177
%C	E	&L	%P	&S	X	S21	S31	S52	S153	S172	S178
&C	%G	&M	Q	\T	\X	S22	S36	S93	S162	S173	
&D	-H	-M	\Q	V	&Y	S27	S37	S95	S167	S175	
\$D	\J	&N	*Q	\W	S0	S28	S40	S151	S168	S176	

◇ **ATTENTION** ◇ Registers whose current value cannot be stored with the **AT&W** command are saved with their default values. Thus the **AT&W** command may overwrite those register values stored with **AT*W** (see below).

***W** Save extended configuration profile

AT*Wn : Save extended configuration profile n (n = 0, 1)

In addition to the parameters and registers stored with **AT&W**, this command also saves the values of the registers **S2**, **S3**, **S4**, **S5** and **S12** in the non-volatile memory of the ISDN terminal adapter.

X Reaction to busy line/CONNECT message

ATX0 : Busy line reported with NO CARRIER ¹⁾

ATX1 : Busy line reported with NO CARRIER

ATX2 : Busy line reported with NO CARRIER

ATX3 : Busy line reported with BUSY

* **ATX4** : Busy line reported with BUSY

This command selects whether a busy ISDN line is reported with **NO CARRIER** or with **BUSY** by the ISDN terminal adapter.

- 1) The **ATX0** command has an additional effect on the message reporting a successful connection: Regardless of the bit rate and type of the connection, only **CONNECT** (verbose form) or **1** (abbreviated form) is reported.

\X Handling of XON/XOFF characters

- * **ATX0** : XON/XOFF characters are not passed to the remote side
- ATX1** : XON/XOFF characters are passed to the remote side

This command influences the handling of the characters XON and XOFF which serve for data flow control if an XON/XOFF software handshake has been selected (see also **ATQ**).

The setting **ATX0** causes the XON/XOFF characters to be used only for the data flow control between the local ISDN terminal adapter and the computer and are **not** transmitted to the remote system.

With the setting **ATX1**, these characters likewise control the data flow between the local ISDN terminal adapter and the computer. However, the characters are **also** sent to the remote system.

&Y Select startup configuration profile

- * **AT&Y0** : Load configuration profile 0 at startup
- AT&Y1** : Load configuration profile 1 at startup

This command determines which of the two stored configuration profiles (0 or 1) is loaded and used when the ISDN terminal adapter is turned on or reinitialized after a DTR transition from ON to OFF (see **AT&D** command, page 29).

Z Load configuration profile

ATZn : Load configuration profile n (n = 0, 1)

Any existing connection is terminated. Afterwards, the parameter settings saved with **AT&W** or **AT*W** (configuration profile 0 or 1, see page 43) are loaded from the non-volatile memory of the ISDN terminal adapter and become effective.

No further commands can be executed in the same command line after an **ATZ** (see also page 22).

&Z Store numbers

AT&Zm=n : Store number n in position m

AT&Z=0 : Store number n in position 0

With this command, up to ten (m = 0..9) ISDN numbers n (up to 36 digits each) can be stored in the non-volatile memory of the ISDN terminal adapter.

The commands **ATDS**, **ATDS=m**, **ATD/** or **ATD/m** (see page **Fehler! Textmarke nicht definiert.**) can be used to dial one of the stored numbers. These numbers are retained even after the ISDN terminal adapter is switched off. The **AT&Zm=** command deletes the number stored in position **m**.

The **AT&Z** command corresponds to the **ATP** command (see page 39). The numbers stored with **AT&Z** can therefore be overwritten by the **ATP** command. The number stored in position 0 is also used for automatic dialing with DTR (see commands **AT\$D**, **AT&M**).

The stored numbers can be displayed on the screen with the **ATF** command.

No further commands can be executed in the same command line after an **AT&Z** command.

5.8 Registers

MicroLink ISDN/TLpro has internal registers you can use to modify the configuration of the ISDN terminal adapter (see **ATS_n** command, page 40).

Bit-mapped registers Be very careful with changing bit-mapped registers, i.e. registers which control more than one single function! The bit-mapped registers mainly serve for the display of the status of the ISDN terminal adapter. To change the configuration of your ISDN terminal adapter, you should use the more convenient and safe AT commands instead. The default values for the individual bits are printed in **bold** face.

Changing individual bits The following example illustrates how to change the value of a bit-mapped register. To set, for example, bit 6 of register S14 (allow polling during connection establishment), proceed as follows:

- First, use the **ATS14?** command to display the current value of register S14 (current value = 10).
- Add the decimal value of bit 6 = 1 (decimal value = $2^6 = 64$) to the current register value (new register value = $10 + 64 = 74$).
- Set register S14 to the new value (74) with the **ATS14=74** command. This will set bit 6 of S14 to 1 without affecting the other bits.

◇ **NOTE** ◇

To make the new value remain valid even after the ISDN terminal adapter is switched off, the active configuration profile must be saved with the **AT*W** command.

S0 Number of RINGs to auto-answer

Valid values	:	0..255 RING messages
Default value	:	0 (automatic call acceptance disabled)
Storage in non-volatile memory	:	AT&W or AT*W

The number of **RING** messages after which the ISDN terminal adapter automatically answers an incoming call is set in register S0. These messages reporting an incoming call (**RING**) are issued every five seconds, as long as the call is waiting on the line. A value of 0 disables auto-answer, i.e. incoming calls are not accepted.

With $S0 > 0$ the connection establishment can be aborted by any character (except for **<LF>**). However, the connection is not terminated if bit 6 of register S14 is set to 1 (default value = 0). With this setting the connected computer can still send signals to the ISDN terminal adapter during the establishment of a connection (see page 48).

◇ **NOTE** ◇

If the ISDN terminal adapter is set to **AT&L2**, **ATS0>0** will activate the answer mode and **ATS0=0** will activate the originate mode.

S1 RING counter

Valid values	:	0..255 RING messages
Default value	:	0
Storage in non-volatile memory	:	no

Register S1 contains the number of received incoming call messages (**RING** every five seconds). The contents of S1 is reset to zero when the call is accepted or withdrawn.

S2 Escape character

Valid values	:	0..127 (decimal)
Default value	:	43 (+)
Storage in non-volatile memory	:	AT*W

The escape command '+++' (see also section 5.2, page 20), which is used to change from the online state to the command state in an existing connection, can be redefined in register S2. Values > 127 disable the escape code detection.

S3 Carriage Return character

Valid values	:	0..127 (decimal)
Default value	:	13 (Carriage Return)
Storage in non-volatile memory	:	AT*W

The character for <CR> (Carriage Return, Enter) can be redefined in register S3.

S4 Line Feed character

Valid values	:	0..127 (decimal)
Default value	:	10 (Line Feed)
Storage in non-volatile memory	:	AT*W

The character for <LF> (Line Feed) can be redefined in register S4.

S5 Backspace character

Valid values	:	0..32, 127 (decimal)
Default value	:	8 (Backspace)
Storage in non-volatile memory	:	AT*W

The character for <BS> can be redefined in register S5.

S12 Escape prompt delay

Valid values	:	0..255 1/50 seconds
Default value	:	50 (1 second)
Storage in non-volatile memory	:	AT*W

The length of the escape prompt delay is set in register S12 (see also section 5.2, page 20).

S14 AT command interpreter

The contents of register S14 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S14 have the following meaning:

Bit	Dec.	Meaning	
0	0	none	
1	0	0 = command echo disabled	ATE0
	2	1 = command echo enabled	ATE1
2	0	0 = result codes enabled	ATQ0
	4	1 = result codes disabled	ATQ1
3	0	0 = short form result codes (digits)	ATV0
	8	1 = long form (verbose) result codes	ATV1
4	0	0 = normal operation	AT-H0
	16	1 = dumb mode	AT-H1
5	0	0 = bit rate detection enabled	
	32	1 = bit rate detection disabled	
6	0	0 = polling allowed during connection establishment	
	64	1 = polling not allowed during connection establishment	
7	0	0 = ISDN terminal adapter in answer mode	
	128	1 = ISDN terminal adapter in originate mode	

S21 RS-232/V.24 control and signaling lines

The contents of register S21 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S21 have the following meaning:

Bit	Dec.	Meaning	
0..1	0	none	
2	0	0 = CTS follows RTS (in synchronous operation)	AT&R0
	4	1 = CTS always active (in synchronous operation)	AT&R1
3..4	0	0 = ignore DTR status change	AT&D0
	8	1 = change to command state if DTR → OFF	AT&D1
	16	2 = disconnection if DTR → OFF	AT&D2
	24	3 = disconnection and reinitialization if DTR → OFF	AT&D3
5	0	0 = DCD signal is always active (ON)	AT&C0
	32	1 = DCD signal indicates existing connection	AT&C1

Bit	Dec.	Meaning
6..7	0	none

S22 Busy line result code

The contents of register S22 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S22 have the following meaning:

Bit	Dec.	Meaning	
0..3	0	none	
4..6	0	Busy line → NO CARRIER; only 'CONNECT' or '1'	ATX0
	64	Busy line → NO CARRIER	ATX3
	80	Busy line → NO CARRIER	ATX2
	96	Busy line → BUSY	ATX3
	112	Busy line → BUSY	ATX4
7	0	none	

S27 Synchronous/leased line operation

The contents of register S27 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S27 have the following meaning:

Bit	Dec.	Meaning	
0..1	0	0 = asynchronous operation	AT&M0
	1	1 = synchronous operation	AT&M1
	2	2 = synchronous operation, DTR dialing	AT&M2
2..3	0	0 = dial-up line operation	AT&L0
	4	1 = group 0 leased line operation, manual connection establishment	AT&L1
	8	2 = group 0 leased line operation, automatic connection establishment	AT&L2
4..7	0	reserved	

S28 Bit rate adaptation in V.110 mode

The contents of register S28 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S28 have the following meaning:

Bit	Dec.	Meaning	
0..1	0	none	
2..3	0	0 = V.110 bit rate adaptation enabled	AT%L0
	4	1 = V.110 bit rate adaptation enabled	AT%L1
	8	2 = V.110 bit rate adaptation disabled	AT%L2
	12	3 = V.110 bit rate adaptation enabled	AT%L3
4..7	0	none	

S30 Inactivity timer

Valid values	:	0..255 * 10 seconds
Default value	:	0 (timer disabled)
Storage in non-volatile memory	:	AT&W or AT*W

In Register S30 controls the time after which the ISDN terminal adapter automatically terminates a connection, if no further data have been **sent** within this period (see also **ATIT** command, page 41). The default value 0 disables the inactivity timer.

S31 DTR dialing

The contents of register S31 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S31 have the following meaning:

Bit	Dec.	Meaning	
0..4	0	none	
5	0	0 = DTR dialing disabled	AT\$D0
	32	1 = DTR dialing enabled	AT\$D1
6..7	0	none	

S36 Operating mode

This register selects the operating mode of the ISDN terminal adapter. The contents of register S36 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S36 have the following meaning:

Bit	Dec.	Meaning	
0..3	0	0 = normal mode (V.110)	AT\N0
	1	1 = direct mode (V.110)	AT\N1
	2	2 = X.75 without fallback	AT\N2
	3	3 = X.75 with fallback to V.110 normal mode	AT\N3
	4	4 = V.120 without fallback	AT\N4
	5	5 = V.120 with fallback to V.110 normal mode	AT\N5
	6	6 = X.75 or V.120 without fallback	AT\N6
	7	7 = X.75 or V.120 with fallback to V.110 normal mode	AT\N7
	8	8 = X.75 (VT-100 mode), for German T-Online service only	AT\N8
	9	9 = X.75 (CEPT and KIT mode), for German T-Online service only	AT\N9
4..6	0	reserved	
7	0	0 = channel bundling disabled	AT&N0
	128	1 = channel bundling enabled	AT&N1

S37 ISDN line bit rate

Register S37 indicates the selected ISDN line bit rate in V.110 operation. The contents of register S37 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits have the following meaning:

Bit	Dec.	Meaning	
0..4	5	5 = ISDN line bit rate 1200 bps	AT%B1200
	6	6 = ISDN line bit rate 2400 bps	AT%B2400
	7	7 = ISDN line bit rate 4800 bps	AT%B4800
	9	9 = ISDN line bit rate 9600 bps	AT%B9600
	13	13 = ISDN line bit rate 19,200 bps	AT%B19200
	21	21 = ISDN line bit rate 38,400 bps	AT%B38400
	22	22 = ISDN line bit rate 48,000 bps	AT%B48000
	23	23 = ISDN line bit rate 56,000 bps	AT%B56000
	24	24 = ISDN line bit rate 64,000 bps	AT%B64000
5	0	reserved	
6	0	0 = ISDN line bit rate depends on serial port bit rate	AT%G0
	64	1 = ISDN line bit rate determined by AT%B	AT%G1
7	0	0 = serial port bit rate remains unchanged	AT%J0
	128	1 = serial port bit rate adapted to ISDN line bit rate	AT%J1

S40 Leased line connection delay

Valid values	:	5..255 seconds
Default value	:	10 seconds
Storage in non-volatile memory	:	AT&W or AT*W

Register S40 controls the time after which the ISDN terminal adapter automatically establishes a group 0 leased line connection when set to **AT&L2**.

S46 Data compression

Register S46 can be used to enable or disable V.42bis online data compression. The contents of register S46 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S46 have the following meaning:

Bit	Dec.	Meaning	
0..3	0	0 = data compression disabled	AT%C0
	1	1 = V.42bis data compression enabled	AT%C1
	2	2 = V.42bis data compression enabled	AT%C2
	3	3 = V.42bis data compression enabled	AT%C3
4..7	0	reserved	

S51 Data flow control

The contents of register S51 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S51 have the following meaning:

Bit	Dec.	Meaning	
0..3	0	0 = no handshake	AT\Q0
	1	1 = XON/XOFF bidirectional	AT\Q1
	2	2 = RTS/CTS unidirectional	AT\Q2
	3	3 = RTS/CTS bidirectional	AT\Q3
	4	4 = XON/XOFF unidirectional	AT\Q4
	5	5 = same as \Q2, but CTS OFF until connection established	AT\Q5
	6	6 = same as \Q3, but CTS OFF until connection established	AT\Q6
4	0	0 = XON/XOFF characters are not passed to remote station	AT\X0
	16	1 = XON/XOFF characters are passed to remote station	AT\X1
5..7	0	none	

S52 RS-232/V.24 signaling lines

The contents of register S52 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S52 have the following meaning:

Bit	Dec.	Meaning	
0..1	0	0 = DSR always active, CTS always active	AT\D0&S0
	1	1 = DSR indicates B channel switched through, CTS always active	AT\D1&S1
	2	2 = DSR always active, CTS follows DCD	AT\D2
	3	3 = DSR indicates B channel switched through, CTS follows DCD	AT\D3
2..3	0	0 = DCD is always active (depending on register S 21, page 48)	AT&C0
	0	0 = DCD indicates existing connection (depending on register S 21, page 48)	AT&C1
	8	2 = DCD off for 0.5 seconds during disconnection	AT&C2
4..5	0	0 = DSR always active, CTS always active	AT\D0&S0
	32	1 = DSR indicates B channel switched through, CTS always active	AT\D1&S1
6..7	0	0 = CTS status determined by AT\Dn	
	64	1 = CTS follows RTS (asynchronous half-duplex simulation)	
	128	2 = CTS follows RTS after 0.5..0.6 seconds	

S87 Current ISDN line bit rate

Register S87 contains the ISDN line bit rate of the current connection. This register is read only. The individual bits of S51 have the following meaning:

Bit	Dec.	Meaning
-----	------	---------

Bit	Dec.	Meaning
0..4	0	0 = no connection established
	5	5 = ISDN connection with 1200 bps
	6	6 = ISDN connection with 2400 bps
	7	7 = ISDN connection with 4800 bps
	9	9 = ISDN connection with 9600 bps
	13	13 = ISDN connection with 19,200 bps
	21	21 = ISDN connection with 38,400 bps
	22	22 = ISDN connection with 48,000 bps
	23	23 = ISDN connection with 56,000 bps
	24	24 = ISDN connection with 64,000 bps
5	0	0 = one-channel connection
	32	1 = 2 nd ISDN connection with 128,000/112,000 bps (2 nd B channel with 64,000/56,000bps)
6..7	0	reserved

S93 Serial port bit rate

The contents of register S93 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S93 have the following meaning:

Bit	Dec.	Meaning
0..4	0	0 = no connection established
	5	5 = serial port bit rate 1200 bps
	6	6 = serial port bit rate 2400 bps
	7	7 = serial port bit rate 4800 bps
	9	9 = serial port bit rate 9600 bps
	13	13 = serial port bit rate 19,200 bps
	21	21 = serial port bit rate 38,400 bps
	22	22 = serial port bit rate 48,000 bps
	23	23 = serial port bit rate 56,000 bps
	24	24 = serial port bit rate 64,000 bps
5	0	reserved
6..7	0	0 = data format 8N1
	64	1 = data format 7E1
	128	2 = data format 7O1
	192	3 = data format 7N2

◇ **NOTE** ◇

This register is overwritten by each entered **AT** command prefix. With **ATJ1** this register is set to the value of register S87 (bit 0..4, ISDN line bit rate) after a connection establishment (V.110 connections only).

S95 Result codes

The contents of register S95 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S95 have the following meaning:

Bit	Dec.	Meaning	
0..3	0	0 = no modified CONNECT messages	ATV0
	1	1 = indication of error-corrected connections	ATV1
	2	2 = indication of error-corrected connections and error correction method	ATV2
	8	8 = extensive CONNECT result codes (ELSA standard)	ATV8
4	0	0 = CONNECT messages with bit rate (dependent on ATV)	AT-M0
	16	1 = CONNECT messages without bit rate	AT-M1
5	0	0 = CONNECT message after invalid escape sequence	AT*Q0
	32	1 = no CONNECT message after invalid escape sequence	AT*Q1
6..7	0 ¹⁾	0 = result codes enabled	ATQ0
	0 ¹⁾	0 = result codes disabled	ATQ1
	128	2 = result codes disabled in answer mode	ATQ2

¹⁾ Depending on register S14, page 48

S96 AT command interpreter

The contents of register S96 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S96 have the following meaning:

Bit	Dec.	Meaning
0..1	0	reserved
2	0	0 = message 'Press any key to continue' enabled
	4	1 = message 'Press any key to continue' disabled
3..4	0	0 = German user interface (default for European version)
	8	1 = English user interface (default for US version)
	16	2 = reserved
	24	3 = reserved
5..6	0	reserved
7	0	0 = disable error message for access of invalid or protected S register (→ OK)
	128	1 = enable error message for access of invalid or protected S register (→ ERROR)

S151 D channel protocol configuration

Register **S151** controls settings for the ISDN D channel. The contents of Register **S151** can be stored in the nonvolatile memory using the **AT*W** command. The individual bits have the following meaning:

Bit	Dec.	Meaning
0	0 1	0 = send error result code to network if device busy or not ready 1 = do not send result code to network if device busy or not ready
1	0 1	0 = Incoming calls confirmed with ALERT 1 = No ALERT signaling for incoming calls
2	0 4	0 = V.120: LLC (Low Layer Capability) not signaled in D-channel V.110: BC (Bearer Capability) and LLC (Low Layer Capability) not signaled in D-channel 1 = V.120: LLC (Low Layer Capability) signaled in D-channel V.110: BC (Bearer Capability) and LLC (Low Layer Capability) signaled in D-channel
3	0	reserved
4	0 16	0 = Incoming calls on B channel 1 will be accepted 1 = Incoming calls on B channel 1 will be ignored
5	0 32	0 = Incoming calls on B channel 2 will be accepted 1 = Incoming calls on B channel 2 will be ignored
6..7	0	reserved

Using Low Layer Capability for V.120 enables you to access all CompuServe V.120 nodes. Not enabling LLC can lead to problems with connections to some CompuServe V.120 nodes. When using the Bearer Capability for V.110, the bit rates 1200, 2400, 4800, 9600 and 19,200 bps can be signaled, but not 38,400 bps.

S152 Call indication delay

Valid values	:	0..50 1/10 seconds
Default value	:	0
Storage in non-volatile memory	:	AT&W or AT*W

Register S152 can be used to set a delay for the indication of incoming calls. An incoming call is reported to the computer after the delay time has elapsed, if it is still waiting on the line. This feature can be used to give priority to another ISDN device and thus prevent a "competition" between several ISDN devices on the same line with the same Bearer Capability/Service Indicator and Multiple Subscriber Number or EAZ digit. The default value 0 disables the call indication delay.

S153 CONNECT / NO CARRIER message

The contents of register S153 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S153 have the following meaning:

Bit	Dec.	Meaning
0	0 1	0 = remote number is not displayed after CONNECT 1 = remote number is displayed after CONNECT

Bit	Dec.	Meaning
1	0 2	0 = remote number is not displayed after RING 1 = remote number is displayed after RING
2	0 4	0 = MSN/EAZ dialed by the remote side is not displayed 1 = if bit 0 and/or bit 1=1, MSN/EAZ dialed by the remote side is displayed
3..5	0	reserved
6	0 64	0 = Result codes are not displayed: CONNECTING, ALERTING, CALL SENT 1 = Result codes are displayed: CONNECTING, ALERTING, CALL SENT
7	0 128	0 = reason of disconnection is not displayed 1 = reason of disconnection is displayed after NO CARRIER according to S154/S155

S154/S155 Error codes

If a connection error occurs (connection establishment failed or connection canceled), a value corresponding to the cause of the failure is written to Registers **S154** and **S155**:

- Register **S154** indicates where the error occurred.
- Register **S155** shows the exact reason for the failure.

Both registers are read only. For more information, refer to the appendix "Error Codes", page 75.

S156 Data packet repetitions received on D channel

Valid values	:	0..255 repetitions per 250 data packets
Default value	:	0
Storage in non-volatile memory	:	no

Register S156 shows the ratio of transmission errors received on the control channel (D channel) per 250 data packets, i.e. how many of 250 data packets had to be repeated. This register is read only. It can only be reset to zero by switching the terminal adapter off and on again.

S157 Data packet repetitions sent on D channel

Valid values	:	0..255 repetitions per 250 data packets
Default value	:	0
Storage in non-volatile memory	:	no

Register S157 shows the ratio of data packet repetitions sent on the control channel (D channel) per 250 data packets, i.e. how many of 250 data packets had to be resent due to transmission errors. This register is read only. It can only be reset to zero by switching the terminal adapter off and on.

S158 Current / last B channel

Register S158 indicates which B channel is currently being used or has been used last. This register is read only.

x	Meaning
000	no connection was established yet
001	current/last connection on B channel 1
002	current/last connection on B channel 2

S159 S₀ interface status

Register S159 shows the current status of the ISDN S₀ interface. This register is read only.

Bit	Dec.	Meaning
0	0	0 = no power on S ₀ bus detected
	1	1 = normal or restricted power condition on S ₀ bus
1	0	reserved
2	0	0 = S ₀ bus not activated
	4	1 = S ₀ bus activated
3	0	0 = no TEI assigned
	8	1 = TEI assigned
4..7	0	reserved

S160 Information about last call

Register S160 contains information about the last call that came in on the ISDN S₀ interface. This register is read only.

Dec.	Hex.	Meaning
000	00h	no incoming call yet
016	10h	call is currently being reported
017	11h	call was accepted
018	12h	call was withdrawn or answered by another device on the S ₀ bus
032	20h	call had wrong Bearer Capability (DSS1) or wrong Service Indicator (1TR6)
033	21h	call had wrong MSN or wrong EAZ
048	30h	DTR (line S1) was OFF, call was rejected
049	31h	ISDN adapter was already connected or establishing another connection (BUSY)
064	40h	number check not OK (see AT+ICLDn command)
065	41h	number check not OK, no number was given

S162 Selecting a preferred B channel

The contents of register S162 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S162 have the following meaning:

Bit	Dec.	Meaning
-----	------	---------

Bit	Dec.	Meaning
0..1	0	0 = any B channel is used leased line operation: B1 channel is used
	1	1 = B1 channel has priority, can be switched to B2 by the exchange if B1 busy leased line operation: B1 channel is used
	2	2 = B2 channel has priority, can be switched to B1 by the exchange if B2 busy leased line operation: B2 channel is used

S163/S164 Service Indicator/ Additional Service Indicator

Registers S163 and S164 show the Service Indicator or the Additional Service Indicator of the last connection or the last incoming call, if no connection could be established. These registers are read-only. The encoding is realized with 1TR6 code.

S163	S164	Meaning
007	169	Bit rate adaptation to 56,000 bps (automatic switching to 56,000 bps with V.120/X.75)
	other	Data transfer at 64,000 bps

S165 DSS1 (Euro-ISDN) error codes

Register S165 displays detailed error codes which can be used for localizing the source of a problem (e.g. no connection established or connection broken). This is a read-only register. A list of these error codes can be found in the appendix "Error Codes".

S167 Max. number of charge units for cost monitoring (DSS1/1TR6)

Valid values	:	0..255 * 10 units
Default value	:	0
Storage in non-volatile memory	:	AT&W or AT*W

Register S167 is used by the European version of *MicroLink ISDN/TLpro* only (DSS1 and 1TR6 protocol). It can be used to set a maximum allowed number of ISDN charge units that may be used within a certain number of days set in register S168. If this number of charge units is exceeded, no more connections can be established in this period of time (see also the list of error codes in the Appendix, page 75). If the limit is exceeded during an existing connection, the connection is terminated. Switching the ISDN terminal adapter off and on again will reset the number of remaining charge units for the current period to the value stored in register S167. If S167 is set to 0, no cost monitoring takes place.

S168 Time period for cost monitoring (DSS1/1TR6)

Valid values	:	0..255 days
Default value	:	0
Storage in non-volatile memory	:	AT&W or AT*W

Register S168 is used by the European version of *MicroLink ISDN/TLpro* only (DSS1 and 1TR6 protocol). It can be used to set the number of days within which the number of charge units set in register S167 can be used. For example, if you have set register S168 to 2, every two days the number of available charge units will be reset to the value stored in register S167.

With the default setting S168 = 0 the number of available charge units is **not** reset to the value of register S167 after the allowed number of units has been used up. To disable this cost lock, either register S169 must be set to a value > 0, or register S167 must be set to 0.

S169 Remaining charge units of cost monitoring period (DSS1/1TR6)

Valid values	:	0..255 * 10 units
Default value	:	0
Storage in non-volatile memory	:	no

Register S169 is used by the European version of *MicroLink ISDN/TLpro* only (DSS1 and 1TR6 protocol). It holds the number of remaining charge units which can still be used in the current cost monitoring period (see registers S167 and S168 and the list of error codes in the Appendix, page 75). When the ISDN terminal adapter is switched off and on, register S169 is reset to the value of register S167. To disable a cost lock (S169 = 0), either register S169 must be manually set to a value > 0, or register S167 must be set to 0.

S170 Remaining days of cost monitoring period (DSS1/1TR6)

Valid values	:	0..255 days
Default value	:	0
Storage in non-volatile memory	:	no

Register S170 is used by the European version of *MicroLink ISDN/TLpro* only (DSS1 and 1TR6 protocol). It holds the number of days remaining until the number of remaining charge units is reset to the maximum limit set in register S167 (see registers S167 and S168 and the list of error codes in the Appendix, page 75). When the ISDN terminal adapter is switched off and on, register S170 is reset to the value of register S168.

S171 Additional X.75 settings

Register S171 can be used to specify additional details for the X.75 protocol. The contents of register S171 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S171 have the following meaning:

Bit	Dec.	Meaning
-----	------	---------

Bit	Dec.	Meaning
0..2	0	0 = data block size 128 Bytes
	1	1 = data block size 256 Bytes
	2	2 = data block size 512 Bytes
	3	3 = data block size 1024 Bytes
	4	4 = data block size 2048 Bytes
3	0	reserved
4	0	No asynchronous/synchronous conversion for the point-to-point protocol AT%P0
	16	Enable asynchronous/synchronous conversion for the PPP AT%P1
5	0	0 = 64,000 bps (default for Europe) AT%S0
	32	1 = 56,000 bps with AT\N2, AT\N4, AT\N6, AT\N7 and AT\N10 (default for US) AT%S1
6..7	0	0 = no T.70NL header
	64	1 = no T.70NL header
	128	2 = T.70NL header, usable block size reduced by 2 bytes
	192	3 = T.70NL header, total block size extended by 2 bytes

S172 Additional V.120 settings

Register S172 can be used to specify additional details for the V.120 protocol. The contents of register S172 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S172 have the following meaning:

Bit	Dec.	Meaning
0	0	0 = data block size 127 Bytes
	1	1 = data block size 259 Bytes
1..6	0	reserved
7	0	0 = 64,000 bps (default for European version) AT%S0
	128	1 = 56,000 bps (default for US version) AT%S1

S173 Additional V.110 settings

Register S173 can be used to specify additional details for the V.110 protocol. The contents of register S173 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S173 have the following meaning:

Bit	Dec.	Meaning
0	0	reserved
1..2	0	0 = no parity, asynchronous
	2	1 = odd parity, asynchronous (additional bit)
	4	2 = even parity, asynchronous (additional bit)
	6	3 = "1" parity, asynchronous (additional bit)
3	0	0 = RTS, DCD, DSR normal operation, asynchronous
	8	1 = V.110 half-duplex operation, asynchronous (direct mode AT\N1 only)
4	0	0 = bit rate tolerance 12.5%, asynchronous
	16	1 = bit rate tolerance 25%, asynchronous

Bit	Dec.	Meaning
5	0 32	0 = 1 stop bit, asynchronous 1 = 2 stop bits, asynchronous
6..7	0 64 128 192	0 = 8 bits/character, asynchronous (no parity bit) 1 = 7 bits/character, asynchronous (no parity bit) 2 = 6 bits/character, asynchronous (no parity bit) 3 = 5 bits/character, asynchronous (no parity bit)

S175 Channel bundling

This register controls additional settings for B channel bundling. The contents of register S175 can be stored in the non-volatile memory using the commands **AT&W** or **AT*W**. The individual bits of S175 have the following meaning:

Bit	Dec.	Meaning
0..1	0	reserved
2	0 4	0 = static channel bundling (second B channel always active) ¹⁾ 1 = dynamic channel bundling (second B channel only active when needed) ²⁾
3	0 8	0 = connection hold time starts when throughput falls below the limit ³⁾ 1 = connection hold time starts with each charge unit ⁴⁾
4	0 16	0 = secondary connection with the same number as primary connection 1 = secondary connection with the same number as primary connection without SPC flag
5	0 32	0 = supplied number (CLIP) not required for identification of second B channel 1 = supplied number (CLIP) required for identification of second B channel
6	0 64	0 = CONNECT reported after primary connection establishment 1 = CONNECT reported after secondary connection establishment
7	0 128	0 = normal DSR function 1 = DSR off when secondary connection is established

¹⁾ The secondary connection must be established (or the abortion must be reported to the remote side) within 30 seconds, otherwise the primary connection is aborted.

²⁾ The secondary connection is established when the throughput limit is exceeded. If the secondary connection fails, establishment is retried every 15 seconds as long as the reason for the secondary connection lasts. Error messages resulting from these attempts are neither saved nor reported.

³⁾ The secondary connection is dropped after the time set in register S178 (connection hold time).

⁴⁾ The connection hold time starts with every charge information (beginning of a new charge unit), if the throughput limit is exceeded. When the throughput falls below the limit, the secondary connection is dropped after the connection hold time has elapsed. The connection hold time is equal to the length of one charge unit minus three seconds in order to drop the secondary connection three seconds before the next charge unit begins. During the first charge unit (where the length of the unit is not yet known), the connection hold time is determined by register 178.

S176 Throughput limit for channel bundling

Valid values	:	0..255 × 100 bytes/sec
Default value	:	70 (7000 bytes/sec)
Storage in non-volatile memory	:	AT&W or AT*W

Register S176 defines the data throughput limit that must be exceeded for the second B channel to be established. This register is only used if bit 2 of register S175 (dynamic channel bundling) is set.

The second B channel can only be established if the throughput limit is below the maximum throughput of one B channel (i.e. the value should not exceed $78 = 7800$ bytes/sec).

S177 Throughput averaging time for channel bundling

Valid values	:	0..32 seconds
Default value	:	0
Storage in non-volatile memory	:	AT&W or AT*W

Register S177 defines the time over which the average data throughput is calculated in order to smooth short fluctuations of the throughput (e.g. caused by handshaking). With the default value 0 no averaging takes place. This register is only used if bit 2 of register S175 (dynamic channel bundling) is set.

S178 Connection hold time for channel bundling

Valid values	:	$0..255 \times 10$ seconds
Default value	:	2 (20 seconds)
Storage in non-volatile memory	:	AT&W or AT*W

Register S178 defines the time (0 to 2550 seconds) over which the second B channel is held after the throughput falls below the limit defined in register S176. If the throughput falls under the limit and the connection hold time elapses, the second B channel is disconnected. This register is only used if bit 2 of register S175 (dynamic channel bundling) is set.

Bit 3 of register S175 controls the beginning of the connection hold time.

S190 Remote number

Register S190 is a string register which can store up to 36 characters. It contains the ISDN number of the currently or last connected remote system. If no connection has been established yet, no number is issued. The contents of the register can be reset to zero with **ATS190=0**.

S191 Charge units for current / last connection (DSS1/1TR6)

Register S191 is used by the European version of *MicroLink ISDN/TLpro* only (DSS1 and 1TR6 protocol). It is a string register which can store up to 10 characters. It contains the number of charge units or the total charge (depending on the network provider) for the current or last connection. The contents of the register can be reset to zero by **ATS191=0**. Depending on the network provider, in some cases the charge units may not be written to the register before the end of the connection.

S192 Total charge units

(DSS1/1TR6)

Register S192 is used by the European version of *MicroLink ISDN/TLpro* only (DSS1 and 1TR6 protocol). It is a string register which can store up to 10 characters. It contains the total number of charge units or the total charge (depending on the network provider) for all previous connections (except for any currently existing connection). The contents of the register can be reset to zero by **ATS192=0**.

S193 MSN / EAZ of last incoming call

(DSS1/1TR6)

Register S193 is used by the European version of *MicroLink ISDN/TLpro* only (DSS1 and 1TR6 protocol). It is a string register which can store up to 10 characters. It contains the Multiple Subscriber Number (MSN, with DSS1 protocol) or the EAZ (terminal selection digit, with 1TR6 protocol) dialed by the remote side for the last incoming call.

If no connection has been established yet, or if the last connection was caused by an outgoing call, no number is issued. The contents of this register can be cleared with **ATS193=0** or with the commands **AT&F** (factory reset, see page 30) or **ATZ** (see page 44).

5.9 Result Codes

AT commands with effects on result codes

Unless the result codes from the ISDN terminal adapter are disabled with the **ATQ1** command (see page 39), the ISDN terminal adapter will acknowledge command entries and issue messages - for example to report an incoming call or a successful connection.

With the default setting **ATV1** the ISDN terminal adapter sends the result codes in verbose form (followed by <CR> and <LF>). With **ATV0** the result codes are displayed in abbreviated form as digits (followed by <CR>).

V1	V0	Meaning
OK	0	command line executed
RING	2	incoming call
NO CARRIER	3	connection establishment failed, disconnected by the remote side, or inactivity time elapsed (see also registers S154/S155, page 56)
ERROR	4	error in command line
NO DIALTONE	6	no connection to ISDN exchange, or own line busy
BUSY	7	called system or ISDN network busy
CALL SENT	252	number complete, call is being processed
ALERTING	253	remote station indicates call
CONNECTING	254	call accepted by remote station, negotiating line protocol

Remote number

With incoming calls the ISDN supplies the number of the calling system, unless this feature is disabled at the remote side. Register S153 (see page 55) controls whether the number is displayed after the **RING** message and/or after the **CONNECT** message.

Examples:

RING;024191777800
CONNECT;024191777800
CONNECT 64000/ISDN/V120;024191777800

or, if abbreviated messages are enabled:

2;024191777800
1;024191777800
221;024191777800

In addition, the Multiple Subscriber Number (MSN) or EAZ dialed by the remote side can be displayed. This can be enabled in register S153 (see page 55).

Example:

RING;024191777800;MSN

CONNECT messages

The format of the **CONNECT** messages, i.e. the result codes indicating a successful connection, is influenced by the commands **AT-M**, **ATV**, and **ATX** (see pages 36, 42 and 43). The possible **CONNECT** messages are listed on the following page.

NO CARRIER

When the message **NO CARRIER** is displayed, the cause of the disconnection can be determined by means of the registers S153 and S154 (see page 55).
Example: **NO CARRIER;000;000** = normal disconnection by the remote side.

V1	V0	X0	X1 X2 X3 X4	-M0	-M1	V0	V1	V2	V8	Type of connection
CONNECT	1	■		■	■	■	■	■	■	Connection of any type with any line bit rate
CONNECT 1200 CONNECT 2400 CONNECT 4800 CONNECT 9600 CONNECT 19200 CONNECT 38400 CONNECT 48000 CONNECT 56000 CONNECT 64000 CONNECT 112000 CONNECT 128000	5 10 30 32 32 32 32 32 32 32 32		■	■		■		■	■	Connection with 1200..128,000 bps duplex and any transfer protocol
CONNECT 56000/REL CONNECT 64000/REL	32 32		■	■			■			V.120 or X.75 connection
CONNECT 56000/REL-LAPB CONNECT 64000/REL-LAPB	32 32		■	■				■		V.120 or X.75 connection
CONNECT 1200/ISDN/V110 CONNECT 2400/ISDN/V110 CONNECT 4800/ISDN/V110 CONNECT 9600/ISDN/V110 CONNECT 19200/ISDN/V110 CONNECT 38400/ISDN/V110 CONNECT 48000/ISDN/V110 CONNECT 56000/ISDN/V110 CONNECT 64000/ISDN/V110	202 203 204 205 206 207 208 209 210		■	■					■	V.110 connection with 1200..64,000 bps duplex
CONNECT 56000/ISDN/HDLC CONNECT 64000/ISDN/HDLC CONNECT 56000/ISDN/V120 CONNECT 64000/ISDN/V120 CONNECT 56000/ISDN/X75 CONNECT 64000/ISDN/X75 CONNECT 112000/ISDN/X75 CONNECT 128000/ISDN/X75	211 212 221 222 231 232 233 234		■	■					■	V.120 or X.75 connection without data compression
CONNECT 56000/ISDN/V120/V42BIS CONNECT 64000/ISDN/V120/V42BIS CONNECT 56000/ISDN/X75/V42BIS CONNECT 64000/ISDN/X75/V42BIS CONNECT 112000/ISDN/X75/V42BIS CONNECT 128000/ISDN/X75/V42BIS	225 226 235 236 237 238		■	■					■	V.120 or X.75 connection with data compression
CONNECT 56000/ISDN/X75/MLP CONNECT 64000/ISDN/X75/MLP CONNECT 112000/ISDN/X75/MLP CONNECT 128000/ISDN/X75/MLP	241 242 243 244			■	■	■	■		■	X.75 connection with 56,000..128,000 bps duplex
CONNECT 56000/ISDN/X75/V42BIS/MLP CONNECT 64000/ISDN/X75/V42BIS/MLP CONNECT 11200/ISDN/X75/V42BIS/MLP CONNECT 128000/ISDN/X75/V42BIS/MLP	245 246 247 248			■	■	■	■		■	X.75 connection with 56,000..128,000 bps duplex and V.42bis data compression
CONNECT ISDN/V110 CONNECT ISDN/V120 CONNECT ISDN/X75	*) *) *)		■		■	■	■		■	V.110, V.120 or X.75 connection with any line bit rate
CONNECT ISDN/V120/V42BIS CONNECT ISDN/X75/V42BIS	*) *)		■		■	■	■		■	V.110, V.120 or X.75 with data compression and any line bit rate

*) The **AT-M1** command has no effect on the abbreviated result codes. They are the same as with **AT-M0**.

Notes:

Appendices

A AT Command Summary

Command	Meaning
A	Accept incoming call
%B1200 %B2400 %B4800 %B9600 %B19200 %B38400 %B48000 %B56000 %B64000	V.110 line bit rate 1200 bps V.110 line bit rate 2400 bps V.110 line bit rate 4800 bps V.110 line bit rate 9600 bps V.110 line bit rate 19,200 bps V.110 line bit rate 38,400 bps V.110 line bit rate 48,000 bps (synchronous mode only) V.110 line bit rate 56,000 bps (synchronous mode only) V.110 line bit rate 64,000 bps (synchronous mode only)
%C0 %C1 %C2 %C3	No data compression V.42bis data compression V.42bis data compression V.42bis data compression
&C0 &C1 &C2	DCD always active DCD indicates existing connection DCD dropped only during disconnection
Dn	Establish connection
\$D0 \$D1	Disable DTR dialing Enable DTR dialing
&D0 &D1 &D2 &D3	Ignore DTR status change Change to command state if DTR → OFF Disconnection if DTR → OFF Disconnection and reinitialization if DTR → OFF
\D0 \D1 \D2 \D3	DSR and CTS always on DSR indicates B channel switched through, CTS always on DSR always on, CTS follows DCD DSR indicates B channel switched through, CTS follows DCD
E0 E1	Disable command echo Enable command echo
&F	Restore factory configuration
\F	Display stored numbers
%G0 %G1	Line bit rate determined by serial port rate Line bit rate set with AT%B
H	Terminate connection
-H0 -H1	Normal operation Dumb mode
I0 I1 I2 I3	Display model number in nnn format Display checksum Display checksum result Display firmware version and date

Command	Meaning
I4	Display current parameter settings
I5	Display serial number
I6	Display product name and hardware release
+ICLDn	Store numbers for closed user groups
+ICLIn	Set/display originator MSN
+IDNn	Setting and display of Directory Number (DN)
+IDPn	Set/display D channel protocol
+IEAZn	Set/display EAZ digit
+IMSNn	Set/display accepted MSNs
+ISPIDn	Set/display Service Profile ID (SPID)
\J0	Serial port rate remains unchanged after connection establishment
\J1	CONNECT bit rate is used on serial interface after connection establishment
%L0	Bit rate is adapted in answer mode
%L1	Bit rate is adapted in answer mode
%L2	Bit rate is not adapted in answer mode, connection is terminated if wrong bit rate
%L3	Bit rate is adapted in answer mode
&L0	Dial-up line operation
&L1	Group 0 leased line operation, manual connection establishment
&L2	Group 0 leased line operation, automatic connection establishment
&M0	Asynchronous transmission
&M1	Synchronous transmission
&M2	Synchronous transmission, automatic dialing upon DTR → ON
-M0	Verbose CONNECT messages dependent on ATV
-M1	Verbose CONNECT messages independent of ATV
&N0	Disable channel bundling
&N1	Enable channel bundling
\N0	Normal mode (V.110)
\N1	Direct mode (V.110)
\N2	Error-corrected X.75 mode without fallback to V.110
\N3	Error-corrected X.75 mode mode with fallback to V.110
\N4	Error-corrected V.120 mode without fallback to V.110
\N5	Error-corrected V.120 mode with fallback to V.110
\N6	Error-corrected X.75 or V.120 without fallback to V.110
\N7	Error-corrected X.75 or V.120 mode with fallback to V.110
\N8	Error-corrected X.75 (VT-100 mode)
\N9	Error-corrected X.75 (CEPT/KIT mode)
O	Return to online state
%P0	No asynchronous/synchronous conversion for the point-to-point protocol
%P1	Enable asynchronous/synchronous conversion for the point-to-point protocol
\Pmn	Store numbers (m = 0..9)
Q0	Enable result codes from the ISDN terminal adapter
Q1	Disable result codes from the ISDN terminal adapter
Q2	Disable result codes in answer mode
*Q0	Enable CONNECT message after invalid Escape sequence
*Q1	Disable CONNECT message after invalid Escape sequence

Command	Meaning
\Q0	No handshake
\Q1	XON/XOFF software handshake (bidirectional)
\Q2	CTS hardware handshake (unidirectional)
\Q3	RTS/CTS hardware handshake (bidirectional)
\Q4	XON/XOFF software handshake (unidirectional)
\Q5	Same as \Q2, but CTS off until connection established
\Q6	Same as \Q3, but CTS off until connection established
%R0	Display register contents, two registers per line
%R1	Display register contents, one register per line / continuous display
&R0	Synchronous operation: CTS follows RTS
&R1	Synchronous operation: CTS always active
Sn=x	Set register n to value x
Sn?	Read the value of register n
Sn	Make register n the default register
?	Read the value of the default (last referenced) register
=x	Set the default (last referenced) register to value x
%S0	ISDN line bit rate 64,000 bps
%S1	ISDN line bit rate 56,000 bps
&S0	DSR is always active
&S1	DSR indicates B channel switched through
\Tn	Inactivity timer (n = 0..255 * 10 seconds; default value = 0)
UPX	Firmware-Upload in Flash-ROM
V0	Enable short form result codes (digits)
V1	Enable long for (verbose) result codes
%V	Display firmware version
&V0	Display configuration profiles
\V0	No modified CONNECT messages
\V1	Identification of error-corrected connections
\V2	Identification of error-corrected connections and error correction method
\V8	Comprehensive CONNECT messages
&W0	Save configuration profile 0
&W1	Save configuration profile 1
*W0	Save extended configuration profile 0
*W1	Save extended configuration profile 1
X0	Busy line reported with NO CARRIER, connection reported with CONNECT or '1' only
X1	Busy line reported with NO CARRIER
X2	Busy line reported with NO CARRIER
X3	Busy line reported with BUSY
X4	Busy line reported with BUSY
\X0	XON/XOFF are not passed to the remote side
\X1	XON/XOFF are passed to the remote side
&Y0	Select profile 0 as startup configuration
&Y1	Select profile 1 as startup configuration
Z0	Load configuration profile 0
Z1	Load configuration profile 1
&Zm=n	Store numbers

B Technical Specifications

Power supply		9 V _{AC} , max. 500 mA
Power consumption		5 W
Design and dimensions		Desktop device with metal housing 108 x 36 x 200 mm (W x H x D)
Environment	Temperature	5..40°C
	Humidity	0..80%, non-condensing
ISDN Interface	S ₀ -Bus	Basic rate interface (S ₀ -bus, I.430) and ISDN-PBX-device with S ₀ -bus
Transmission modes	D channel protocols	Euro-ISDN/DSS1, 1TR6 (incl. SPV), National ISDN-1, AT&T 5ESS (also point-to-point) point to multipoint leased line operation (group 0 and 2): 1B (64 kbps, channel selectable), D+1B (64 kbps), D+2B (128 kbps); semi-permanent connections with 1TR6
	B channel protocols	V.110 (I.463) (asynchronous 1200..38,400bps), V.110 (I.463) (synchronous, 1200..64,000 bps) V.120 (56,000bps, 64,000bps,) X.75 with 64,000bps and 56,000bps X.75/T.70NL with 64,000bps and 56,000 bps X.75 (VT-100) X.75 (CEPT/KIT) PPP (to RFC 1662)
	Data compression	V.42bis (data throughput up to 23 Kbytes/s over one B channel)
	Channel bundling	Static and dynamic (data throughput up to 15 Kbytes/s without compression)
	Max. data throughput	230,400 bps asynchronous at the ED interface
	Error correction	When using ITU-T V.120 and X.75
	Protocol recognition	Automatic switching between V.110, V.120 and X.75
	Bit rate recognition	Automatic in V.110 mode (asynchronous) and automatic switching between 64,000/56,000 bps
Command set		Extended AT command set including EAZ- and MSN support, caller identification and charge unit counting, connection status

Computer interface

RS232/V.24/V.28, 25 pin D subminiature connector 1200..230,400 bps, asynchronous;
Data format:
8 data bits, no parity, 1 stop bit (8,n,1)

System monitoring

Automatic hang-up with an unused line, (can be disabled)

Status display

Colored LEDs to check ISDN interface and connection, V.24 display

Additional options

Control of closed user-groups by checking the caller number

FCC conformance

Yes, conforms to FCC rules Part 15, Class B

CE conformance

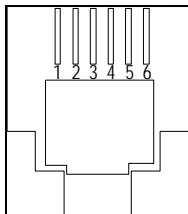
Yes; conforms to EN 50082/Part 1, EN 55022, Class B

Approvals

EU (except for France)
Germany
Switzerland
USA

CE 0188 X
BZT A116180E
BAKOM 96.0026.I.N
See FCC label on the housing

RJ-11 Socket Pin Assignment



Line	IAE	S ₀ Socket
-	-	1
T+	2a	2
R+	1a	3
R-	1b	4
T-	2b	5
-	-	6

CE Approval and FCC Rules



The CE seal indicates the compliance with rules laid down by the European Community on April 29, 1991 for the alignment and mutual recognition of the member states' laws concerning telecommunications devices.

All ISDN terminal devices with the CE approval may be connected to the Euro-ISDN in all countries of the EU, except in Germany and France. ISDN devices used in these countries must, at present, have the respective national approval in addition to the CE approval.

MicroLink ISDN/TLpro was the first German ISDN device approved by the BZT according to the new European procedure and may therefore be connected to the Euro-ISDN in all countries of the EU (except for France). *MicroLink ISDN/TLpro* therefore complies with:

NET 3 (ISDN Basic Rate Access)

Electromagnetic compatibility standards

Safety standards

FCC

This equipment has been tested and found to comply with limits for a Class B computing device according to the specifications in FCC (Federal Communications Commission) rules Part 15.

Interference

This equipment, like other electronic equipment, generates and uses radio frequency energy. If not installed and used according to the instructions in this manual, this equipment may cause interference with your radio and television reception.

If you believe that this equipment is causing interference with your radio or television reception, try turning the equipment off and on. If the interference problems stop when the equipment is switched off, then the equipment is probably causing the interference. You may be able to correct the problem by doing one or more of the following:

- Adjust the position of the radio or TV antenna.
- Move the device away from the radio or TV.
- Plug the power adapter of the device into a different outlet than the radio or TV uses.
- Consult the dealer or an experienced radio/TV technician for help.

If this device is malfunctioning, it may also be causing harm to the ISDN network. This device should be disconnected until the source of the problem can be determined and until repair has been made.

C RS-232/V.24 Interface

The interface between the ISDN terminal adapter and your computer consists of several data lines, control lines and signal lines. The status of most of these interface lines is indicated by LEDs on the front panel of the housing.

The pin assignment of the RS-232/V.24 interface for 9-pin or 25-pin connectors is as follows:

9-pin	25-pin	ITU-T	DIN	USA	Description	Signal direction
U*	1	101	E1	GND	Protective Ground	-
5	7	102	E2	GND	Signal Ground	-
3	2	103	D1	TxD	Transmit Data	→ ISDN adapter
2	3	104	D2	RxD	Receive Data	← ISDN adapter
6	6	107	M1	DSR	Data Set Ready	← ISDN adapter
8	5	106	M2	CTS	Clear to Send	← ISDN adapter
9	22	125	M3	RI	Ring Indicator	← ISDN adapter
1	8	109	M5	DCD	Data Carrier Detect	← ISDN adapter
4	20	108	S1	DTR	Data Terminal Ready	→ ISDN adapter
7	4	105	S2	RTS	Request to Send	→ ISDN adapter

* U = housing/shield

The interface lines have the following meanings:

Computer/terminal
ready for operation

DTR = *Data Terminal Ready*

The effect of this control line on the ISDN terminal adapter is determined by the **AT&D** command (see page 29).

Request data from
terminal adapter

RTS = *Request To Send*

This interface line is used for data flow control (hardware handshake).

Terminal adapter
ready for operation

DSR = *Data Set Ready*

This signal line is usually always active (ON), but is influenced by the commands **AT&D** and **AT&S** (see pages 29 and 41).

Terminal adapter
ready to send

CTS = *Clear To Send*

This output of the ISDN terminal adapter is normally always active (ON), but is influenced by the **AT&D** and **AT&Q** commands (see pages 29 and 39).

Incoming call

RI = *Ring Indicator*

This output is active (ON) when the ISDN terminal adapter detects an incoming call (see also **ATA** command, page 26). Incoming calls are only detected if the control line DTR is active (ON) or the terminal adapter is set to **AT&D0**.

Connection

DCD = *Data Carrier Detect*

This output of the ISDN terminal adapter normally becomes active (ON) when a successful connection has been established. It is influenced by the **AT&C** command (see page 27).

D Error Codes

When an error occurs, the registers S154 and S155 are loaded with error codes which can help you to find the reason for the problem. These registers can be read with the commands **ATS154?** and **ATS155?**.

Error codes S154/S155	Meaning	Reason and possible solution
AT command interface errors		
001/001	Connection establishment aborted by entering a character during connection establishment	Entering characters during connection establishment is normally not allowed. To allow it, set bit 6 of register S14 to 1 (allow polling during connection establishment).
001/002	Connection establishment aborted, the bit rate set with AT%B or in S37 cannot be used.	The AT%B command is only effective in V.110 mode. The bit rate set with AT%B must not be higher than 38,400 bps.
001/003	Call is no longer waiting on the line (after ATA or ATO)	Remote side has withdrawn the call, or other terminal device has accepted the call.
001/004	T-Online protocol error on the serial interface (Germany only)	Try to call again.
001/005	Disconnection with ATZ	Entering ATZ in the command state in an existing connection terminates the connection.
001/006	Inactivity time elapsed (disconnection)	The time in which no more data were sent has exceeded the value set in register S30 or with the AT\Tn command.
001/007	Disconnection by DTR → OFF	The DTR signal line was dropped, possibly by the communications program.
001/008	Cost limit set in register S167 exceeded	Check the values of the registers S167 to S170 . Switching the ISDN terminal adapter off and on will reset the registers.
Local errors		
051/001	D channel layer 1 establishment error	Check the cable connection to the ISDN S ₀ socket and disconnect other ISDN devices from the S ₀ bus to exclude possible error sources. Test the terminal adapter directly at the NT (Network Terminator).
051/002	D channel layer 2 establishment error	
051/003	B channel layer 1 establishment error	Check the B channel protocol of the remote side.
051/004	B channel layer 2 establishment error	
051/005	D channel layer 1 disconnection	Check the cable connection to the ISDN S ₀ socket and disconnect other ISDN devices from the S ₀ bus to exclude possible error sources. Test the adapter board directly at the NT (Network Terminator).
051/006	D channel layer 2 disconnection	
051/007	D channel layer 3 disconnection	Check the selected D channel protocol (AT+IDP?).
051/008	B channel layer 1 disconnection	Disconnected by the remote side or connection error.
051/009	B channel layer 2 disconnection	
051/010	B channel layer 3 disconnection	Re-establish the connection.
051/011	B channel layer 2 disconnection	Connection error caused connection restart - data loss possible.
051/012	B channel layer 3 disconnection	

Error codes S154/S155	Meaning	Reason and possible solution
051/128	V.110 transfer frame of the remote side not recognized	In V.110 mode with automatic bit rate adaptation in answer mode (AT%L1), the bit rate of the caller must be \leq your own bit rate.
051/129	V.110 transfer frame of the remote side aborted	Re-establish the connection.
051/133	Invalid V.110 bit rate (E bits)	A connection could not be established, because the V.110 bit rate used by the remote side is not supported. Contact the remote side and agree on a bit rate supported by both sides.
051/134	V.110 bit rate (E bits) not supported	
051/136	V.110 connection establishment error	Error messages during the connection establishment have no effect.
051/144	V.42bis error (compressed data cannot be decoded)	The remote side is not V.42bis compatible. Restart the transfer without data compression.
Error messages from ISDN (valid for 1TR6 protocols)		
052/000	Disconnection by the network, no reason specified or reason not translatable	Try to call again.
052/128	Normal disconnection	Both sides have terminated the connection properly.
052/131	Service not available on local or remote side, or wrong number	Check the remote number and the availability of the desired services (this applies also to private branch exchanges).
052/138	Own line busy	Your line is occupied by other terminal devices. Terminate other connections first.
052/144	Semi-permanent connections not supported by the network	Apply to your network operator for semi-permanent connections.
052/145	Requested service not available	Apply to your network operator for this service
052/160	Outgoing calls locked	Ask your network operator to unlock your line for outgoing calls.
052/161	Remote side busy	Try to call again later.
052/165	Semi-permanent connection not allowed between these stations	Apply to your network operator for semi-permanent connections.
052/181	Wrong remote number, service or service attribute	Check the remote number and the availability of the desired services (this applies also to private branch exchanges).
052/184	Remote number has changed	Ask for the new number of the remote side.
052/185	Remote terminal device not ready	Check whether the remote side is ready for operation.
052/186	No remote device has answered the call	Check whether the remote side is ready for operation and the remote EAZ or MSN used.
052/187	Remote terminal device busy	Try to call again later.
052/189	Incoming calls locked on the remote side	Ask the remote side to accept incoming calls.
052/190	Call refused by remote side	Contact the remote side.
052/217	Network busy	Try to call again later.

Error codes S154/S155	Meaning	Reason and possible solution
052/218	Call refused or disconnected by the remote side	Try to call again later or contact the remote side.
052/240	Local protocol error	Try to call again.
052/241	Remote protocol error	
Error messages from the ISDN (valid for DSS1, and US protocols)		
052/000	Disconnection by the network, no reason specified or reason not translatable	Try to call again.
052/128	Normal disconnection	Both sides have terminated the connection properly.
052/131	Data transfer service not available	Check the remote number and the availability of the desired services (this applies also to private branch exchanges).
052/138	B channel not available	Wait and try to reconnect
052/145	Possibly SPID wrong or used by another terminal	Check the SPID number.
052/181	Wrong remote number, service or service attribute	Check the remote number and the availability of the desired services (this applies also to private branch exchanges).
052/184	Remote number has changed	Ask for the new number of the remote side.
052/185	Remote terminal device not ready	Check whether the remote side is ready for operation.
052/186	No remote device has answered the call	Check whether the remote side is ready for operation and check the MSN or EAZ used.
052/187	Remote terminal device busy	Try to call again later.
052/190	Call refused by remote side	Contact the remote side.
052/217	Network busy	Try to call again later.
052/241	Remote error	Try to call again.
052/255	Unknown error message in the network	
MLP errors (channel bundling)		
065/001	MLP block error	The remote side is not ELSA MLP compliant. Re-establish the connection without channel bundling.
065/002	MLP disconnection (primary connection aborted)	The primary connection was aborted before the secondary connection. Possibly wrong behavior of the remote side.

Additional to the registers S154/S155, error codes indicating the source of problems with DSS1 (Euro-ISDN) connections can be read using the register S165. This register offers a detailed insight into the cause of errors.

S165 Error Code	Meaning
Error Code from the ISDN (for DSS1 Protocol only)	
001	Number not assigned
002	No path to requested transfer network
003	No path to target available
006	Channel not accepted
017	Remote station busy
018	Remote station does not respond
019	Remote station does not answer
021	Call cancelled
022	Number has changed
027	Remote station not ready
028	Incorrect number
029	Service feature rejected
034	No channel available
038	ISDN network not ready
041	Temporary error
042	ISDN network overloaded
044	Channel or service not available
047	Service not available
049	Service not available
050	Requested service is not ordered
057	Bearer capability not authorized
058	Bearer capability not presently available
063	Service or option not available
065	Service not available
066	Channel type not implemented
069	Requested property not available
070	Only service data transfer is available
079	Service or Option not available
088	Remote station does not support requested service
091	Invalid transfer network choice
127	Unknown ISDN error

E Answers to Frequently Asked Questions

General

How can I send AT commands to the ISDN terminal adapter?

To communicate with an ISDN terminal adapter board via AT commands, you need a suitable communications or terminal program (e.g. Telix). After starting Telix you can enter AT commands in the terminal screen which are then sent to the ISDN terminal adapter through the serial interface of your PC. See your Telix documentation for detailed information on how to use Telix.

What must I do to configure my ISDN terminal adapter for the correct D channel protocol (Euro-ISDN/DSS1, 1TR6, NI-1 or AT&T 5ESS) ?

1. European version:

All European ELSA *MicroLink*® ISDN adapters are preconfigured for Euro-ISDN (DSS1). You only need to enter the desired MSN (Multiple Subscriber Number, up to eight digits) of your ISDN line. With the **AT+IMSN** command you can assign up to two different MSNs to your ISDN terminal adapter. If, for example, you want your *MicroLink ISDN/TLpro* to react to the number 12345678, assign this number with the command **AT+IMSN0=12345678**. To display the MSNs currently assigned to the ISDN terminal adapter, enter the command **AT+IMSN?**.

If you want to operate your *MicroLink ISDN/TLpro* on a 1TR6 ISDN line (an older German ISDN standard), the D channel protocol of the terminal adapter must be set to 1TR6 with the command **AT+IDP=1TR6**. If you want to know which D channel protocol is currently active in the terminal adapter, enter the command **AT+IDP?**. The EAZ (terminal selection digit) is preset to 0. If, for example, you want to use 7 as EAZ digit, enter the command **AT+IEAZ=7**. If you want to know which EAZ digit is currently assigned to the terminal adapter, enter the command **AT+IEAZ?**.

The **AT&F** command (factory reset) will always reset the assigned EAZ digit to 0. However, the D channel protocol 1TR6 selected with **AT+IDP** is **not** reset to Euro-ISDN (DSS1) by an **AT&F** command.

2. US version:

All US terminal adapters are preconfigured for the National ISDN-1 protocol (NI-1). If you want to operate your *MicroLink ISDN/TLpro* on a 5ESS line (a preliminary AT&T ISDN standard), the D channel protocol of the terminal adapter must be set to 5ESS with the command **AT+IDP=AT&T**. If you want to know which D channel protocol is currently active in the terminal adapter, enter the command **AT+IDP?**.

Note that you must store a Service Profile ID (SPID number) in the non-volatile memory before you can establish your first connection (see **AT+SPID** command, page 34, for details).

What is the best initialization string for calling a BBS with my ISDN terminal adapter?

All ELSA *MicroLink*® ISDN terminal adapters come preconfigured especially for BBS operation. If you have changed the configuration, you can restore the factory default settings with the **AT&F** command and save them in the non-volatile memory with **AT*W**.

How can I accelerate data communications programs under Windows (e.g. CompuServe Information Manager)?

If you own a buffered UART interface chip (type 16550), in your Windows directory in the SYSTEM.INI file in section [386Enh] enter

COMxFIFO=1

For the variable x enter the number of the interface you chose (e.g. COM2FIFO=1; '2' stands for COM port 2). The supplied diagnostic program MODEMTST.EXE can be used to check which UART type is used on the selected interface. If it is not a 16550 UART, we recommend you to upgrade or replace your serial interface board.

My ISDN terminal adapter does not accept any AT commands. Is the configuration wrong, or is the terminal adapter defective?

If entered AT commands are not displayed on the screen and/or not executed by the ISDN terminal adapter, this can have several possible reasons. Please check the following settings:

- Is your communications software set to the COM port (serial interface) your ISDN terminal adapter is connected to?
- Is the interrupt line (IRQ) selected for this COM port the same as set in the communications software for this COM port? You can determine the IRQ of your serial interface with the supplied diagnostic program MODEMTST.EXE.
- If you have changed the configuration of your ISDN terminal adapter, try to restore the factory default settings with the **AT&F** command (even if this command does not appear on the screen). With this setting you should be able to enter an **AT** which is answered by the ISDN terminal adapter with OK.

The ISDN terminal adapter always reports NO CARRIER after a dial attempt. Why can't I establish a connection?

The reason for a failed connection establishment can be determined by means of the registers S154/S155. Read the register values with the command **ATS154?ATS155?** and look at the error code table in the Appendix (page 75) to find the specific reason for the failure.

US version: Did you store a valid Service Profile ID (SPID number) with **AT+SPID** (see page 34)? The terminal adapter must have a unique SPID to establish a connection. Note also that your ISDN line must provide a data communications service. Ask your network provider for details.

In V.110 operation I get a NO CARRIER message after each dial attempt. The registers S154/S155 contain the error code 051/128: V.110 transfer frame of the remote side not recognized. This problem does not appear in X.75 mode. What can be the reason?

Unlike X.75 or V.120 operation, where a constant line bit rate of 64,000 or 56,000 bps is used on the ISDN side, in V.110 mode the ISDN line bit rate can be set to values between 38,400 and 1200 bps. There are two ways to set the transfer speed in V.110 mode (**AT\N0**):

- If the ISDN terminal adapter is configured to **AT%G0** (default setting), the ISDN line bit rate is set according to the bit rate used on the serial port. In this case set the serial port rate of your communications program to the speed you wish to use on the ISDN side.
- If the terminal adapter is set to **AT%G1**, you can set a fixed ISDN line bit rate independently of the serial port rate using the command **AT%Bxxxxx**.

Please note that the line bit rate set by the caller must not be greater than the line bit rate set on the called side.

If you want to call, for example, the CompuServe ISDN node in Munich or ISDN Datex-P nodes which can be called via V.110 only and are using a fixed bit rate of 9600 bps, the ISDN terminal adapter must be configured with the commands **ATN0&G1%B9600**. If you try to call with a higher speed, no connection can be established and you will get a NO CARRIER message (see error codes 051/128 in the registers S154/S155, page 56). In this case the V.110 transfer frame of the caller does not match the transfer frame of the remote side.

Can I call a remote station using a different D channel protocol than my own ISDN line (DSS1, 1TR6, NI-1 or AT&T 5ESS) ?

The different D channel protocols are not relevant, since they only affect the connection between your local system and the nearest public ISDN exchange. Therefore, even if both sides are using different D channel protocols, a connection can be established between them.

How can I disable the online data compression to transfer files which have already been compressed (e.g. ZIP or ARC files) ?

The data compression is controlled by the **AT%C** command. The default setting **AT%C3** selects V.42bis data compression. Since it makes no sense to compress already compressed files again during the transfer, the V.42bis compression protocol is able to recognize compressed files and to disable the compression during the file transfer. It is thus not necessary to disable the data compression manually.

What can I test with the program MODEMTST?

Your ELSA *MicroLink*® ISDN terminal adapter is shipped with a diagnostic program named MODEMTST.EXE. You will always find the latest version in the *ELSA ONLINE* Support BBS (ISDN and phone numbers on page 74) and in the ELSA forum in CompuServe for download. MODEMTST offers the following functions:

- Test the serial ports (e.g. to determine the IRQ and the UART chip used)
- Display the configuration of the ISDN terminal adapter
- Display the parameter settings of the ISDN terminal adapter
- Establish a test connection (with the *ELSA ONLINE* BBS)

I frequently get CRC errors when uploading or downloading files to/from a BBS; sometimes even the connection is lost. What can be the reason?

CRC errors can have different reasons. One possible reason is an improper or missing handshake method. To take advantage of data compression protocols, the serial port bit rate (defined in the communications software) should normally be set higher than the ISDN line bit rate (e.g. 115,200 bps instead of 64,000 bps). However, this absolutely requires a handshake method for data flow control, either hardware handshake (RTS/CTS) or software handshake (XON/XOFF).

The same handshake method must be set in both the modem and the communications software. If this is not the case, CRC errors are likely to occur in data transfers. If you are using RTS/CTS handshake, the reason may also be the serial interface cable. If you are using an RS-232/V.24 adapter from 25-pin to 9-pin (also called "mouse adapter"), it is possible that the RTS and CTS lines (pins 4 and 5) are not connected. Please make sure that you use an RS-232/V.24 adapter with all lines connected.

Another possible error source is the serial interface of your computer. At bit rates of 19,200 bps and higher under DOS, and generally under Windows or OS/2, a UART chip of type 16550 should be used. This UART is equipped with a 16-byte FIFO buffer, allowing considerably higher transfer rates. UARTs of the types 8250 and 16450 are reliable up to 9600 bps only. At rates of 19,200 bps and higher, these UARTs may lose characters and will thus cause CRC errors.

OS/2

When using Telix for DOS or the communications program ZOC in a DOS box under OS/2, I frequently get CRC errors. When I run Telix directly under DOS, no errors occur. I am using a 16550 UART, so the UART type cannot be the reason.

The standard communications drivers shipped with OS/2 may cause problems when transferring data across the serial interface of your PC at high rates. In this case, the optimized communications drivers SIO.SYS and VSIO.SYS programmed by Ray Gwinn will help. They must be entered as devices in the CONFIG.SYS file instead of the standard OS/2 drivers COM.SYS and VCOM.SYS.

You can download these shareware drivers from the ISDN forum of the *ELSA ONLINE* Support BBS. The compressed file contains detailed installation instructions.

Telix

I get many CRC errors when transferring files with Telix for DOS. What can be the reason?

A common reason for frequent CRC errors is an improperly set handshake method. The same method must be enabled in both your modem and Telix. All ELSA modems are preset to RTS/CTS handshake (**AT\N3**). In Telix for DOS v3.22, XON/XOFF handshake is the default setting. Make the following changes in the Telix configuration (<A1t><O>) under "Terminal options":

J - XON/XOFF Software Flow Control Off
K - CTS/RTS Hardware Handshaking On

When exiting the configuration, select "Write setup to disk" to make the changes become active each time Telix is started.

How must Telix for Windows be configured for the ISDN terminal adapter?

Under Telix for Windows or other terminal programs an external ISDN terminal adapter can be accessed with AT commands just like a conventional analog modem. The following configuration settings are important for the operation with an ISDN terminal adapter:

- Select the COM port your ISDN terminal adapter is connected to.
- The serial port rate can be set to 115,200 bps. If you get frequent CRC errors at this speed, reduce it to 57,600 bps or install an optimized Windows communications driver, such as RHSICOMM.DRV, in your WIN.INI file.
- The data flow control should be set to CTS/RTS hardware handshake.
- The dial prefixes should **not** contain any analog modem dialing parameters like **P** (for pulse dialing), **T** (for tone/frequency dialing) or **W** (wait for dialtone).

In Telix for Windows you may for example copy the connect device "ELSA MicroLink 288ooTL" from the list of installable devices in the connect device manager ("Connect Devices" in the "Configuration" menu) and rename it, for example, to "ELSA MicroLink ISDN/TLpro". In this new device you can then make the configuration changes for *MicroLink ISDN/TLpro* as described above.

If you have Telix for Windows 1.10 or later, your terminal adapter should be detected and installed automatically if you scan the ports.

Btx / T-Online

I want to call the German Btx / T-Online online service with 64,000 bps. What must I do?

Include the **&FN9** command in the initialization string of your Btx or KIT decoder program. This setting allows you to establish error-corrected connections to German Btx/T-Online nodes (ISDN number 01910 in Germany). **ATN9** selects the CEPT or KIT access, where you can read all CEPT and KIT graphics pages, whereas **ATN8** selects VT-100 access, where you can read VT-100 compatible pages only.

F Product Support

You need help?

If you encounter any problems during the installation or operation of your ISDN terminal adapter, please consult this manual first.

If you have further questions, you can contact our Support team. In this case, please always provide the following information:

◇ IMPORTANT ◇

- Precise model name and firmware version of the ISDN terminal adapter (the firmware version can be displayed with the **ATi3** command, and the model name can be displayed with **ATi6**).
- The configuration of the terminal adapter.
The current parameter settings can be displayed with the command **ATi4**, the register values are displayed with **AT%R**. Special ISDN settings are displayed with **AT+I<...>?** commands. For example, the **AT+IMSN?** command displays the MSNs selected for the ISDN terminal adapter.
- Your operating system and hardware environment
- Name and version of your communications program
- A detailed error description. To be certain, try to reproduce the error at least three times and exactly describe the steps you took to deliberately trigger the error.

If you get an unexpected NO CARRIER message, you can determine the reason for the disconnection by means of the registers S154/S155 (see page).

Who to contact?

First you should contact the dealer or firm where you bought your ISDN adapter board. If there are still questions remaining, contact one of the following:

- The *ELSA ONLINE* Support BBS in Germany:

ISDN

+49/0-241-606-9820

8 data bits, no parity, 1 stop bit

V.110: 38,400..1200 bps

X.75, X.75 with V.42bis: 56,000 bps, 64,000 bps

V.120, V.120 with V.42bis: 56,000 bps, 64,000 bps

Modem

+49/0-241-606-9800

28,800..300 bps

8 data bits, no parity, 1 stop bit

MNP4, MNP5, V.42 and V.42bis

- The **ELSA forum in CompuServe**:
GO ELSA
- Or write to:
ELSA GmbH
Data Communications Support
Sonnenweg 11
52070 Aachen
Germany
Fax +49-241-606-6499
- In very urgent cases, call the **ELSA Hotline** in Germany:
Phone +49-241-606-6142
Monday to Thursday from 9 am to 4:30 pm (CET)
Friday from 9 am to 12 pm (CET)
- In the USA, you may also contact the ELSA subsidiary:
ELSA Inc.
2150 Trade Zone Blvd., Suite 101
San Jose, CA 95131
USA
Phone +1-408-935-0350
 +1-800-272-ELSA
Fax +1-408-935-0370
BBS +1-408-935-0380
Internet <http://www.elsa.com>

Configuration problems?

In the *ELSA ONLINE* Support BBS (forum ISDN, file area CONFIG) and in ELSA's CompuServe forum you will find information about the configuration of many applications for the use with ELSA *MicroLink*® ISDN terminal adapters.

Please first make sure that you are using the latest software and driver versions. The latest versions are always available for download in the *ELSA ONLINE* Support BBS and in ELSA's CompuServe forum. Here you will find lots of information and answers to frequently asked questions (FAQs).

Support BBS

The *ELSA ONLINE* Support BBS has been established as a service for customers and other persons interested in ELSA products (ISDN products, modems and graphics boards).

The Support BBS is divided into product-specific forums, which are structured similar to file directories. In these forums, you can exchange experiences with other users and ask questions to the ELSA Support team. Furthermore, the Support BBS always holds latest product information, examples and application software.

◇ ATTENTION ◇

Please pay attention to the forum structure of *ELSA ONLINE*. If you have a question, please always choose the appropriate forum, for example the ISDN forum if you have questions about an ISDN product. This facilitates our

support work and guarantees that your question is answered as soon as possible.

After connecting to the ELSA Support BBS, you will see the following opening screen:

Login screen of
ELSA ONLINE

```

Connected to ELSA ONLINE (Port 18)
via MicroLink ISDN-Adapter from 1234 at 64000 bps, protocol: X.75
////////////////////////////////////

      ELSA ONLINE Support-Mailbox

      ELSA GmbH, Aachen

Modem: +49/0-241-6069800      (28800.. 300 bps)
ISDN : +49/0-241-6069820      (64000..1200 bps)

      Durchgehend geoeffnet

////////////////////////////////////

Vor- und Nachname:
    
```

Enter your first and last name at the prompt "Vor- und Nachname". If you are a new user, you can now select the language for the BBS menus and texts.

◇ NOTE ◇

If you feel lost the first time you visit our BBS, don't be discouraged! There is no way to damage your or our computer system by making wrong entries. The BBS software is designed to give you any possible help to find your way. Most problems will disappear if you read the login bulletin and other provided help and information texts carefully.

Registration

To make sure you have access to the BBS when you need it, you should register as soon as possible. To register, you can call the ELSA Support BBS at any time, 24 hours a day.

When logging in for the first time, you will give yourself a password (4 to 10 characters). You are then an **unregistered user** with very limited rights. You cannot access the product forums before your registration.

The registration is performed via the menu option "REGISTER" and is at no additional cost for you (except for the costs for the call). To register, you must tell the system your address, phone number and, if available, your fax number. Your registration will be worked on within one working day. After that, you are a registered user, entitled to access the product information forums and ask questions to our Support team.

◇ NOTE ◇

When trying to access a software Support forum (such as TELIX or TELIXWIN) for the first time, you will be asked for the serial number of your software. You will find the Telix serial number on the original Telix disk label. After entering a valid serial number, you are entitled to access the forum and write E-mails to our Support team.

- CompuServe** You can reach our ELSA Support forum in CompuServe via *GO ELSA*. In this forum, we offer you the same support and service as in the *ELSA ONLINE* Support BBS.
- ◇ **ATTENTION** ◇ Please pay attention to the structure of the mail and file areas in the ELSA forum. Please always choose the appropriate mail area for your questions, for example "ELSA ISDN Adapters" or "ISDN Software" for questions about your ISDN product. This facilitates our support work and guarantees that your question is answered as soon as possible.
- If you have questions about CompuServe, CIM (CompuServe Information Manager) or the CompuServe registration, please contact the toll-free CompuServe Support directly.
- Repair?** If you are not sure whether your ISDN terminal adapter is defective or maybe only the configuration is wrong, please call the ELSA Hotline, before you send us the ISDN adapter board for repair.
- If you want to send in the ISDN terminal adapter for repair, please use suitable packing material and the original box to prevent damage to the device during the transport. Please always include a copy of the original purchase receipt as well!
- You can help us doing the repair as fast as possible by including a detailed error description with the device, in order to help us tracking down the error source. Please send your ELSA product directly to our Service department.

G Glossary

1TR6	<i>1TR6</i> is a specification by the German Telekom for ISDN terminal devices with S_0 interface. This specification defines the $\rightarrow D$ channel protocol and is used mainly in Germany. Most other European countries use the $\rightarrow DSS1$ protocol.
5ESS	<i>5ESS</i> is a US standard for the ISDN $\rightarrow D$ channel protocol developed by AT&T. It is a preliminary standard to the National ISDN-1 standard ($\rightarrow NI-1$).
Asynchronous transmission	In serial data transmission a method is needed to synchronize transmitter and receiver in order to enable the receiver to detect the beginning and end of a transmitted character. In <i>asynchronous transmission</i> this structuring is achieved by marking each byte to be sent with one start bit and one or two stop bits. Especially in the microcomputer sector, this start/stop method is one of the most commonly used transmission methods, since, unlike \rightarrow synchronous transmission, it is comparatively easy to perform.
AT command set	The extended <i>AT command set</i> (AT = command prefix <i>Attention</i>) has become a world-wide standard for the syntax of \rightarrow modem control commands. To give data communications users the possibility to maintain their familiar command interface when changing over to ISDN, ELSA <i>MicroLink</i> ® ISDN products can be controlled with AT commands as well.
B channel	\rightarrow Data channel
Basic Rate Interface	ISDN terminal connector providing two \rightarrow data channels (64,000 bps each) and one \rightarrow control channel (16,000 bps). The link between the Basic Rate Interface and the terminal device is the $\rightarrow S_0$ bus.
Baud	<i>Baud</i> (abbreviation: Bd) is the unit for the step rate (1 Bd = 1 step per second), i.e. the frequency of status changes on a transmission channel per second. Erroneously, the unit Baud is often confused with the transmission rate measured in \rightarrow bps. In the case of signals having only two states (as in the ISDN), the step rate is identical with the transmission rate.
CAPI	<i>Common ISDN API</i> (API = <i>Application Programming Interface</i>). This is a software interface developed by German ISDN adapter manufacturers in cooperation with the German FTZ, which is used for communication between ISDN adapters and ISDN application software.
CCITT	\rightarrow ITU-T
Communications software	In order to access <i>MicroLink ISDN/TLpro</i> from a personal computer, for example to choose transmission parameters or to start a data transfer (\rightarrow Download, \rightarrow Upload), a suitable <i>communications software</i> , also called <i>terminal program</i> , is needed. Such a program emulates an "intelligent terminal" on the PC, i.e. a simple input/output device equipped with additional features for saving received data and transmitting stored data. All ELSA

MicroLink® products supporting the →AT command set are shipped with the communications program **Telix**.

Control channel	ISDN signaling channel (also called <i>D channel</i>) for the transmission of control data (e.g. message about incoming call etc.) between the ISDN interface and the public exchange. In Europe the bit rate of a D channel is normally 16,000 bps, while the →data channels use 64,000 bps (in the US also 56,000 bps).
D channel	→Control channel
Data channel	ISDN transmission channel (also called <i>B channel</i>) for the transmission of data with a transmission rate of 64,000 bps (in the US also 56,000 bps).
Data format	To allow a data exchange between two stations in an →asynchronous transmission, the parties must agree on the length and structure of the bytes to be transferred. This specification is called <i>data format</i> . The most common data formats for asynchronous transmission are: 8N1 (1 start bit, 8 data bits, no parity bit and 1 stop bit = 10 bits per byte) and 7E1 (1 start bit, 7 data bits, 1 parity bit (even parity) and 1 stop bit = 10 bits per byte).
DSS1	A European standard developed by the →ETSI for the →D channel protocol (also called <i>Euro-ISDN</i>). In Germany, this standard has been introduced in 1993 and is likely to replace the older national 1TR6 protocol. For an intermediate period, ISDN interfaces in Germany will support both protocols.
EAZ	The <i>Endgeräteauswahlziffer</i> (German for <i>Terminal Device Selection Digit</i>) is used by the →1TR6 protocol to distinguish between several terminal devices connected to the same ISDN Basic Rate Interface. Unlike the →MSN in the →DSS1 protocol, this digit is appended to the ISDN number as the last digit.
Effective transfer rate	The <i>effective transfer rate</i> must be distinguished from the transmission rate. The transmission rate indicates the number of bits per second physically transmitted over a data line as a theoretical maximum value, whereas the transfer rate is a measure of the average amount of transmitted utilizable data per time. Control data and protocol headers, which are to be sent in addition, can reduce the effective speed of transmission. On the other hand, using data compression methods can result in an increase of the effective transfer rate to a multiple of the physical transmission bit rate.
ETSI	<i>European Telecommunications Standards Institute</i> . This standardization committee has developed a European standard for the →D channel protocol (→DSS1).
Euro-ISDN	→DSS1
Firmware	<i>Firmware</i> means the totality of control software integrated with the hardware of a device, which cannot be modified by the user.
FOSSIL	<i>Fido/Opus/SEAdog Standard Interface Layer</i> was developed for the use of hardware-independent interfaces in data communications and is supported by

	many standard communications programs (e.g. Telix, Telemate, Frontdoor or Binkly).
I.430	This →ITU-T standard describes layer 1 of the user/network interface of an ISDN →Basic Rate Interface.
I.463	→V.110
I.465	→V.120
ISDN	Abbreviation of <i>Integrated Services Digital Network</i> .
ITU-T	The <i>Telecommunications Standardization Sector</i> of the <i>International Telecommunications Union</i> (ITU) is working on the standardization of data and telephone services. The ITU-T standards of the V. series mainly deal with data transmission across telephone networks, while the I. and Q. series are standards for the ISDN. The ITU-T is the successor organization of the CCITT (<i>Comité Consultatif International Télégraphique et Téléphonique</i>).
MSN	<i>Multiple Subscriber Number</i> . The →DSS1 protocol allows several numbers to be assigned to one ISDN line by the responsible exchange. Normally these are three numbers, but may be up to eight. Similar to the →EAZ digits of the →1TR6 protocol, these numbers can be used to select one of several terminal devices connected to the same →S ₀ bus. Unlike the EAZ digit, which is appended to the actual number, an MSN can be up to eight digits long.
Multiple Subscriber Number	→MSN
National ISDN-1	→NI-1
NI-1	The <i>National ISDN-1</i> standard is a common specification in the US for the ISDN →D channel protocol.
NT	<i>Network Terminator</i> . This is a device installed on the terminal side of an ISDN →Basic Rate Interface which converts the signals coming from the exchange into the form needed by the →S ₀ interface, and vice versa.
Parity bit	The parity bit is a control bit that is sent in addition to a number of data bits in a data transmission. The data bits set to "1" are supplemented by the parity bit to an even or odd bit sum. The parity check is a simple method of error detection. However, this method is not very reliable, as for example double bit errors are not recognized. Therefore in data communications normally "no parity" is selected, which besides results in an increase of the transmission speed, since no additional parity bit has to be sent.
S₀ bus	Link between →Basic Rate Interface and terminal device. Up to eight ISDN terminal devices can be operated simultaneously on one S ₀ bus, and up to 12 connection sockets can be connected to the bus.

Synchronous transmission	<i>Synchronous transmission</i> is, like →asynchronous transmission, a method to synchronize transmitter and receiver. Unlike asynchronous transmission, in this method of data transmission the synchronization is not achieved by start and stop bits for an entire character, but by clock pulses for each single bit. Due to the elimination of the additional start and stop bits, synchronous transmission is faster, but also requires a considerably greater technical effort.
T.70NL	T.70NL is a data packet header used in the transmission standard →X.75. The T.70NL header must be enabled or disabled on both ends of the transmission.
TA	→Terminal adapter
TEI	<i>TEI (Terminal Endpoint Identifier)</i> is an identification code negotiated with the exchange in the →D channel protocol, in order to distinguish several terminal devices connected to the same S ₀ interface. <i>MicroLink TLpro</i> has a green LED that indicates whether a TEI has been assigned to the terminal adapter.
Terminal Endpoint Identifier	→TEI
Terminal adapter	<i>Terminal adapters</i> (TA) are used to connect non-ISDN devices to the ISDN. An a/b terminal adapter, for example, can be used to connect devices designed for analog telephone networks, such as analog telephones, class 2 and 3 fax devices, modems etc. <i>MicroLink ISDN/TLpro</i> is an external RS-232/V.24 terminal adapter, allowing the access of the ISDN through the serial RS-232/V.24 interface of a computer.
Transmission protocol	To transmit data files from one computer to another, a range of <i>transmission protocols</i> exists in order to provide a trouble-free file transfer. Over the years, protocols of different efficiency and convenience have been developed. In principle, they all work as follows: Data are usually transmitted as data blocks and are checked for errors and incompleteness on the receiving side. If an error has been detected, the defective block is requested once more and transmitted again. The →communications software Telix (supplied with every ELSA <i>MicroLink</i> ® product that uses the AT command set), supports many common transmission protocols, such as →Xmodem, Xmodem-1k, Ymodem and →Zmodem.
V.110	V.110 (also referred to as I.463) is an →ITU-T standard for the adaptation of asynchronous or synchronous serial data streams to the ISDN line bit rate of 64,000 bps for the transmission over an ISDN →B channel.
V.120	V.120 (also referred to as I.465) is an →ITU-T standard for the packing of asynchronous or synchronous data in (error-corrected) HDLC frames on an ISDN →B channel. Unlike →X.75, V.120 also supports a line bit of 56,000 bps as commonly used in the USA.

- V.42bis** The →ITU-T standard V.42bis describes a data compression method which can increase the →effective transfer rate of (previously uncompressed) data by a factor up to four. *MicroLink ISDN/TLpro* supports V.42bis. Thus effective line transfer rates of (theoretically) up to 256,000 bps can be achieved, if the serial interface supports these high rates.
- X.75** Similar to →V.120, X.75 is an →ITU-T standard for the error-corrected transmission of data with HDLC frames on an ISDN →B channel (64,000 bps).

H Warranty Conditions

This warranty is given to purchasers of ELSA products in addition to the warranty conditions provided by law and in accordance with the following conditions:

1. Warranty coverage

- a) The warranty covers the equipment delivered and all its parts. Parts will be replaced free of charge if, despite proven proper handling and adherence to the operating instructions, these parts became defective due to fabrication and material defects. Operating manuals and possibly supplied software are excluded from the warranty.
- b) Material and service charges shall be covered by us, but not shipping and handling costs involved in transport to the service station.
- c) Replaced parts become property of ELSA.
- d) ELSA are authorized to carry out technical changes (e.g. firmware updates) beyond repair and replacement of defective parts in order to bring the equipment up to the current technical state. This does not result in any additional charge for the customer. A legal claim to this service does not exist.

2. Warranty period

The warranty period is 36 months for color monitors, data communications and computer graphics products. It begins at the day of delivery from the authorized ELSA dealer. Warranty services do not result in an extension of the warranty period nor do they initiate a new warranty period. The warranty period for installed replacement parts ends with the warranty period of the device as a whole.

3. Warranty procedure

- a) If defects appear during the warranty period, the warranty claims must be made immediately, at the latest within a period of 7 days.
- b) In the case of any externally visible damage arising from transport (e.g. damage to the housing), the transport company representative and ELSA should be informed immediately. On discovery of damage which is not externally visible, the transport company and ELSA are to be immediately informed in writing, at the latest within 7 days of delivery.
- c) Only authorized ELSA dealers may accept warranty claims. ELSA will supply the purchaser with a list of names and addresses of authorized dealers on request.
- d) Transport to and from the location where the warranty claim is accepted and/or the repaired device is exchanged, is at the purchaser's own risk and cost.
- e) Warranty claims are only valid if a copy of the original purchase receipt is returned with the device.

4. Suspension of the warranty

All warranty claims will be deemed invalid

- a) if the device is damaged or destroyed as a result of acts of nature or by environmental influences (moisture, electric shock, dust etc.);
- b) if the device was stored or operated under conditions not in compliance with the technical specifications;
- c) if the damage occurred due to incorrect handling, especially to non-observance of the system description and the operating instructions;
- d) if the device was opened, repaired or modified by persons not authorized by ELSA;
- e) if the device shows any kind of mechanical damage;
- f) if, in the case of an ELSA Monitor, damage to the cathode ray tube (CRT) has been caused by mechanical load (e.g. from shock to the pitch mask assembly or damage to the glass tube), by strong magnetic fields near the CRT (colored dots on the screen), or through the permanent display of an unchanging image (phosphor burnt).

- g) if the warranty claim has not been reported in accordance with 3a).

5. Operating mistakes

If it becomes apparent that the reported malfunction of the device has been caused by unsuitable software, hardware, installation or operation, ELSA reserves the right to charge the purchaser for the resulting testing costs.

6. Additional regulations

- a) The above conditions define the complete scope of ELSA's legal liability. The warranty gives no entitlement to additional claims, such as any refund in full or in part. Compensation claims, regardless of the legal basis, are excluded. This does not apply if e.g. injury to persons or damage to private property are specifically covered by the product liability law, or in cases of intentional act or culpable negligence. Claims for compensation of lost profits, indirect or consequential detriments, are excluded. ELSA is not liable for retrieval of lost data unless ELSA employees intentionally or by culpable negligence caused its loss and the purchaser has guaranteed that the data can be retrieved with justifiable effort from data material kept in machine legible form.
- b) The warranty is valid only for the first purchaser and is not transferable.
- c) The court of jurisdiction is located in Aachen, Germany in the case that the purchaser is a merchant. If the purchaser does not have a court of jurisdiction in the Federal Republic of Germany or if he moves his domicile out of Germany after conclusion of the contract, ELSA's court of jurisdiction applies. This is also applicable if the purchaser's domicile is not known at the time of institution of proceedings.
- d) The law of the Federal Republic of Germany is applicable. The UN commercial law does not apply to dealings between ELSA and the purchaser.

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