ISDN Connect Data and Voice Terminal Adapter User Guide

CONFIGURATION OPTIONS

The ISDN Connect range is supplied in two configuration options:

CONNECT 250	An advanced data TA with analogue connection supporting V.120 and PPP data protocols.
CONNECT 350	As Connect 250 with additional X.25 data protocol over 'B' and 'D' Channels.

All parameters specific to the X.25 protocol described in the manual are only available to the CONNECT 350.

The front panel of the unit contains an indication of which model you have.

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ABOUT THIS MANUAL

This manual tells you everything that you need to know about using the CONNECT for high-speed data and voice communications across an ISDN network. It is divided into the following sections:

PRODUCT_OVERVIEW

A top-level overview of the functions and facilities of the CONNECT. The concept of the 'ISDN Modem' and the comprehensive support of International and Industry standards is explained. A summary of the items contained within the package is also provided.

QUICK START

As an 'ISDN Modem', the CONNECT is as easy to use as a traditional PSTN modem and will connect directly onto existing applications and systems. This section tells you how you can quickly get up and running before exploring the many other possibilities of ISDN and the CONNECT.

GUIDE TO ISDN

ISDN provides new opportunities for dial-up communications and many benefits as compared with the standard telephone network. This section gives you general information about ISDN and the special features that it provides.

CONTROLS AND INDICATORS

This section explains the function of the physical controls, indicators and connectors on the CONNECT.

INSTALLATION

This explains how to install the CONNECT, check that it is correctly connected to the ISDN network and correctly connected to your terminal equipment. It also explains what to do if you have more than one device connected to your ISDN line and you wish to be able to address each one individually.

BASIC OPERATION

This is an overview of the basic operation of the CONNECT, how it communicates with your terminal equipment and how calls across ISDN are made.

HAYES AT COMMANDS

The CONNECT is compatible with the Hayes Standard AT Command Set, as used on modems and extended for ISDN. This section gives a comprehensive description of how Hayes AT commands are used and a description of all the commands and their functions.

ANALOGUE PORT CONFIGURATION

The CONNECT includes an analogue port so that you can make normal voice calls e.g. from a phone or fax over your ISDN line. This section gives details on how to configure this port.

TROUBLESHOOTING

A guide for solving problems, covering typical causes and their solutions.

SAFETY AND APPROVALS

This section covers operational safety and lists the approvals to which the Connect complies.

PRODUCT OVERVIEW

Functions and facilities
Inventory

Functions and facilities

The CONNECT is a Terminal Adapter (TA), i.e. the ISDN equivalent of a modem on the PSTN (the analogue telephone network). It allows standard serial data terminals (DTEs), such as personal computers, to be interconnected across the ISDN. The CONNECT is as easy to install and use as a modem and will operate with all existing terminals and communications applications that use the Hayes Standard AT Command Set.

In addition, the CONNECT has an analogue interface port that emulates a standard PSTN line. This port allows devices such as a phone, fax, or answer-phone to make calls over your ISDN line.

An ISDN connection provides three potential communications channels. Two ('B') Channels provide links running at 64000 bps which give greater throughput than the fastest modem. These ‘B’ Channel links support calls to other ISDN lines or (for voice calls) other PSTN analogue lines. The third link is a lower speed ‘D’ Channel data link, that allows calls to be made to a third party data network such as a public packet switch network. It is possible to have several ISDN devices sharing a single ISDN line through a facility known as the 'S' Bus. This allows all the connected devices to contend for the channels and to be separately addressable. The CONNECT range supports all these ISDN services.

An ISDN line can support ‘data’ and ‘voice’ calls. In general ‘data’ calls are those made from the CONNECT’s data port. ‘Voice’ calls are calls made from the CONNECT’s analogue port. On the ISDN line, incoming calls are identified as ‘data’ or ‘voice’ calls and are automatically routed by the CONNECT to the appropriate port.

The data terminal interface provided by the CONNECT conforms to the Hayes Standard AT Command Set as extended for ISDN. The CONNECT will therefore inter-work with the vast number of standard communications packages and products available today which have been designed to operate with modems which also conform to the Hayes Standard AT Command Set. The CONNECT will also give access to additional services provided by ISDN in a way that is easily implemented with existing communications packages as standard command formats and structures are adhered to.

For point-point calls, the CONNECT supports the two main International Standards for the transfer of data over ISDN, i.e. V.120 and X.25 Rate Adaption. For remote access to the Internet or other TCP/IP networks the CONNECT supports asynchronous to synchronous PPP conversion. The standard used can be selected on a call-by-call basis by the use of appropriate Hayes AT commands. This means that you can inter-work with any of the many other ISDN devices that conform to any one (or more) of these standards.

For maximising data throughput, the 64000 bps 'pipe' provided by ISDN must be utilised as fully as possible. For the majority of applications that are based around PC communications, the CONNECT provides an asynchronous interface that will run at up to 115200 bps. This speed is an option on most modern communications packages.

Through the provision of an integral PAD, the CONNECT also allows access over ISDN into X.25 Packet Switched Networks, either over an ISDN ‘B’ Channel or via the ISDN ‘D’ Channel.

In summary, the CONNECT provides the following facilities:-

- Connection of asynchronous DTEs at data rates up to 115200 bps.
- Call control using the Hayes Standard AT Command Set for ISDN.
- 'B' Channel circuit switched calls.
- V.120 Rate Adaption (asynchronous DTEs up to 115200 bps).
- X.25 Rate Adaption (asynchronous DTEs up to 115200 bps).
- Asynchronous to synchronous PPP conversion (asynchronous DTEs up to 115200 bps).
- X.25 PAD using Hayes AT commands for access to an X.25 network via ISDN over 'B' or 'D' Channel.
- Error correction across the ISDN link.
- Connection of multiple devices onto the ISDN 'S' Bus.
- LEDs to indicate status.
- An analogue socket for connecting analogue devices to the ISDN line. Network dial tone and announcements are automatically routed to the analogue device. Dialling is via DTMF tones.
- The control of analogue calls from the data port using standard modem data call commands.

Inventory

The CONNECT package contains the following parts:

- Main unit
- Power supply with mains lead
- ISDN line cord
- ‘Modem’ cable (25 way to 9 way)
- Telephone ring adapter
- User guide (on disk)
- Quick start guide

QUICK START

Overview

If you are already using modems that support the Hayes Standard AT Command Set, you will find it easy the switch over to ISDN with the CONNECT as it is fully compatible with standard Hayes AT commands. It is recommended that you read the full User Guide to familiarise yourself with all the facilities provided by ISDN and the CONNECT, but this section gives you a quick way of getting started and gaining confidence. If you have problems, you can also refer to the Troubleshooting section of this manual.

Installation

The ISDN input on the CONNECT is at the rear on the left hand side, labelled LINE. Connect this to your ISDN socket with the cable provided.

Connect your data terminal equipment, using your existing modem cable, to the 25 way V.24 connector at the rear of the CONNECT.

Connect your analogue device to the analogue socket at the rear of the CONNECT.

The power input connector into the CONNECT is on the rear panel, labelled PWR.

Connect the CONNECT to the mains power supply via the power brick provided.

Switch on the power.

Making and clearing an analogue call

Pick up the handset on the analogue device attached to the CONNECT. You should hear dial-tone. Dial a number and make a call in the normal way.

To clear the call, replace the handset. The call will be cleared.

Making and clearing a data call

Ensure that you are using standard Hayes AT commands, not proprietary extensions.

You can increase the interface speed up to 115200 bps (assuming your terminal supports it) to gain the speed benefit provided by ISDN. Note that the CONNECT automatically detects the baud rate of the Hayes AT commands and there is no need to change any settings.

Make your call in the normal way. You will see the CD indicator come on to show that the call is active. The RD and SD indicators flash to show the transfer of data.

The call is cleared in the normal way.

If you are communicating with another CONNECT device, with configuration as delivered, the V.120 Rate Adaption is selected automatically and you do not need to make any changes to your application set-up. V.120 Rate Adaption will also automatically take care of situations where both ends are operating at different interface speeds, providing the terminals connected support flow control. The flow control method configured into the CONNECT is RTS/CTS.

Working with Windows

The CONNECT is easy to use with Windows applications. As the CONNECT's interface to the PC emulates a modem, no special driver software is required - a standard modem driver can be used. To work with Windows applications, it is recommended that you should configure the following on the PC:

1. Ensure the CONNECT is installed and turned on as outlined above.

2. From the Windows Screen click on
   - The Start Button
   - Then Highlight Settings
   - Click on Control Panel
   - Click on the MODEMS Icon

3. If no modem already installed then Windows will give you the choice of finding the modem itself. Click on 'NEXT' and allow Windows to interrogate the CONNECT. After a few moments the screen will come back 'Standard Modem'.

4. Click on 'NEXT' then 'FINISH'.

5. At the 'MODEM PROPERTIES' screen, click on 'PROPERTIES' and ensure that the Maximum Speed is set to 115200. If it is set at 57600 then increase this to 115200.

6. Click on the OK box – ***Your CONNECT is now Installed.***

7. If you already have a modem installed and wish to add the CONNECT to other modems already chosen, then follow point 1& 2 as above. At the Modem properties box – click add, and follow instructions 3-6 as above.

8. Now you can use your CONNECT as you would any ordinary modem with you standard software.

GUIDE TO ISDN

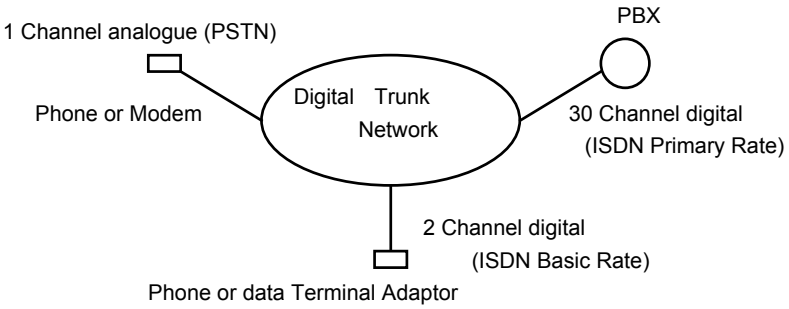
The ISDN Network
ISDN Benefits
The 'S' Bus
'D' Channel Data
Other ISDN Services

The ISDN Network

For several years most public network operators have been upgrading their trunk telephony networks to digital technology. In many instances, local exchanges are also being upgraded to digital equipment, so that the entire network is digital. However in most cases subscribers still have a conventional analogue phone or, for data, a modem. This means that the digital connection in the exchange is converted

to analogue before being passed to the subscriber. The drive behind network digitisation has been to reduce operating costs and to provide a platform on which new services can be easily provided. One such service is ISDN.

In simple terms, ISDN is no more than the delivery of the capabilities of the digital network directly to the subscriber instead of delivery in analogue PSTN form, as shown in the diagram below.



ISDN is available in two forms, Primary Rate, where circuits are delivered in bulk (up to 30 on a single line) and Basic Rate, where 2 circuits are delivered on a single line. Each circuit is referred to as a 'B' Channel and is capable of carrying a 64000 bps data stream or 3.1KHz telephony voice encoded on the 64000 bps stream. In addition, there is also a 16000 bps 'D' Channel used for signalling (e.g. call set-up) information to be transferred between the network and the terminal. In some networks, this 'D' Channel can also be used for the transfer of data.

It is important to remember that ISDN is delivered from the same network that PSTN comes from, using the same copper wires to the subscriber's socket on the wall. The only difference is that the termination devices at the subscriber's end and in the exchange allow the digital circuits to be carried across the same line. This means in principle that ISDN can be made available almost anywhere that PSTN is available.

ISDN Benefits

ISDN gives you a direct digital connection into the digital trunk network. There are several benefits that this brings. In summary these are:

Rapid call connection.

Fast data throughput.

Lower transmission error rates.

Line sharing - via the 'S' Bus (also referred to as the Passive Bus).

Additional supplementary services.

Call connect times are sub one second for ISDN calls. This is due to the use of digital signalling both into the network and between communicating devices. When you dial a call on PSTN you give it the called number either via loop disconnect (i.e. the equivalent of using a telephone rotary dialler) or MF tones (i.e. the equivalent of a touch-tone phone). Whichever you use, it takes several seconds to tell the network

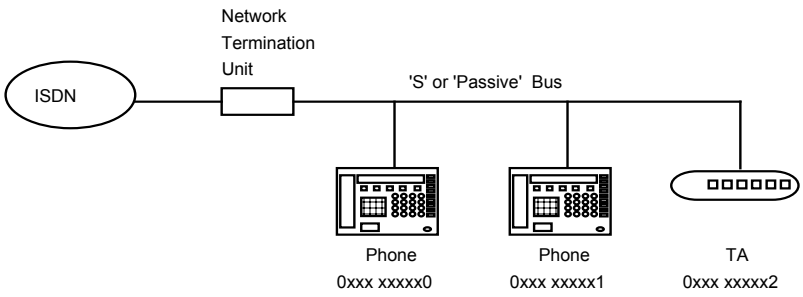
what number you are calling. With ISDN, the called number is passed into the network digitally at high speed. For example this could be from a stored number key on the phone or from a PC. Once you are connected to the remote end there are further time savers compared, say, to modems. It can take a long time for modems to establish a link between themselves as they have to 'train up' using an exchange of various tones. This can take as much as 30 seconds. With ISDN this process is very much quicker as it takes place entirely digitally. There are many situations where fast call set-up is an advantage, e.g. in a point-of-sale application where customer waiting time must be minimised or in a large scale polling application where a lot of expensive equipment time can be tied up while dialling is taking place.

With a call established over ISDN you have access to a digital 'pipe' running from the calling to the called terminal that gives you a throughput of 64000 bps. This is several times faster than even the fastest modem. This means that it takes much less time to do what you need, i.e. you save your time and calls cost less. It also means that applications for which modems are not really fast enough (e.g. video surveillance) can now be run on a dial-up basis. This can be much cheaper, and more flexible, than the alternative of renting a leased circuit just to get the performance you require.

Digital technology is less prone to errors than analogue technology and therefore the error rates experienced with ISDN connections are substantially less than those with PSTN connections.

The 'S' Bus

The Basic rate ISDN connection provided to you is what is referred to as an 'S' Bus or 'Passive Bus'. This allows several ISDN devices to share the 2 'B' and 1 'D' channels on an ISDN line, as shown below.



An 'S' Bus consists of a number of extension points wired with standard 4-wire cable from the main network termination unit and is as easy to provide as PSTN extension sockets. When a call comes in, all ISDN devices will see it. Any device can make an outgoing call, as long as one of the channels is free.

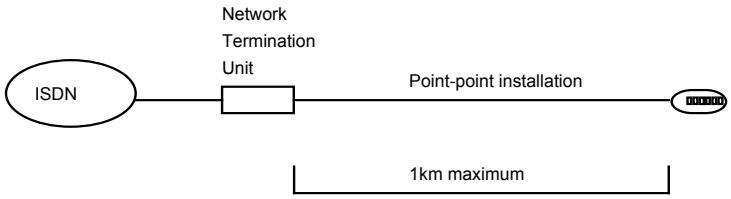
Voice calls and data calls are identified separately by the network, so only devices of the appropriate type will respond to the call. Furthermore, it is possible to use a facility called 'Multiple Subscriber Numbering' where several telephone numbers can be assigned to the line. Devices will then be programmed with their own number and will only respond if that particular number is called. An alternative mechanism is 'Sub-addressing' where the same telephone number is used, but each unit is programmed with an additional address, which must be specified by the calling end.

Multiple Subscriber Numbering tends to be used where calling devices may be on the PSTN (e.g. a normal phone) as PSTN devices have no way of providing a called sub-address. Sub-addressing gives greater scope (you can have a lot more sub-addresses than separate numbers) but the caller has to be on ISDN.

In some instances it is also possible to assign a separate number to each of the 2 ISDN 'B' channels. In this case, devices that are required to call and answer on only one number must be programmed with the channel number ('B1' or 'B2') that is to be used.

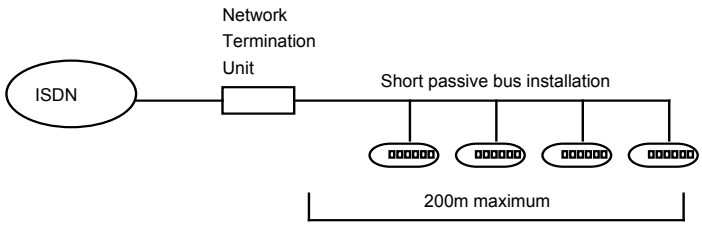
In summary, the benefit of the 'S' Bus is that a single ISDN line can satisfy the needs for several communications functions, e.g. in a retail outlet or on an office desk, so long as a maximum of only 2 devices need to call or be called on a 'B' Channel at any one time. Another device can also use the 'D' Channel for data (if supported by the network) at the same time. This means that what was achieved using several physical lines (with their associated costs) can now be achieved with one.

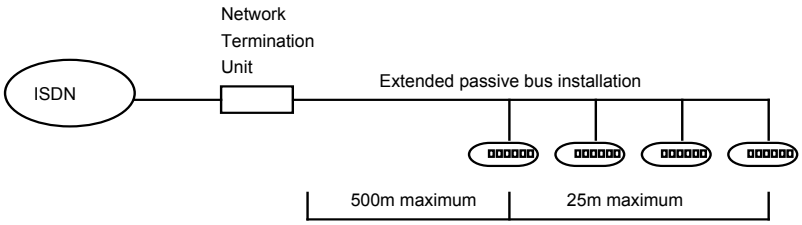
The simplest case of a Passive Bus installation is shown below:



In this case only one terminal is connected to the NTU. This is known as a point-to-point installation. The maximum length of the cable from the terminal to the NTU is typically 1km.

A Passive Bus can usually accommodate up to eight terminals, in which case the two following configurations are possible:





In the first case, the short Passive Bus, the terminals are randomly distributed on the bus cable. In this case no terminal should be more than 200m from the NTU.

The second case, an extended Passive Bus, allows terminals to be further from the NTU (up to 500m) as long as they are all grouped together within 25m of each other.

For the correct and error free operation of a Passive Bus the insertion of line terminating resistors at certain points in the bus is required. This is usually dealt with by switchable options within the NTU and by the use of two types of auxiliary socket (terminated and unterminated).

Users wishing to construct a Passive Bus should be aware that the maintenance of wiring polarity within the bus is crucial. It is also important to keep the transmit signal pair (pins 3 and 6) and receive signal pair (pins 4 and 5) as twisted pairs.

'D' Channel Data

Some networks support the transfer of data on the 'D' Channel into one or more X.25 Packet Switched Networks. This is lower speed than data over the 'B' Channel (i.e. less than 16000 bps), but is ideal for applications which need the frequent transfer of low volumes of data, for example Credit Card Authorisation or Telemetry.

Other ISDN Services

As well as supplementary services like Multiple Subscriber Numbering already described, several other services are also available on ISDN, and more services will be provided as time goes by. Services available now include, for example, Calling Line Identification (CLI) which allows you to see the number of the person calling before you answer the call and 3-Way calling which allows you to have two calls active at once and shuttle between them or run them in conference.

CONTROLS AND INDICATORS

Front Panel
Rear Panel

Front Panel

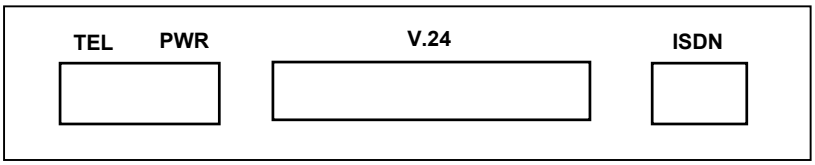
The illustration below shows the front panel of the CONNECT:

Eight LED indicators are used as follows:

HK On/off Hook	This indicator tracks the state of the analogue port being on when the device attached is off hook.
AA Auto Answer	This indicator is on when auto answer mode is selected.
CD Carrier Detect	This indicator tracks the status of the V.24 signal DCD. An on condition usually denotes a data call is in progress.
RS Ready to Send	This indicator tracks the status of the V.24 signal RTS. An on condition usually indicates that the attached device is ready to receive data, i.e. flow control has not been applied.
RD Receive Data	This indicator is on when data is sent from the CONNECT to the attached data terminal. It is likely to be permanently on during synchronous data calls.
SD Send Data	This indicator performs the same function as RD, but for data travelling in the opposite direction.
TR Terminal Ready	This indicator is on in response to the V.24 signal DTR being active.
AR Adapter Ready	This indicator is on when the CONNECT is powered up and the ISDN connection is activated. It flashes if the ISDN link is not activated. Note - on some networks the ISDN link is only activated when a call is in progress.

Rear Panel

The illustration below shows the rear panel of the CONNECT:



The ports and switches are used as follows:

ISDN	An RJ45 socket for connection of the unit to the ISDN using the eight way line cord provided.
V24	A standard 25 way female 'D' type connector for the attachment of the user's data terminal equipment. This connector is a SELV circuit as defined in standard BS7002.
PWR	Socket for the output cord from the mains power supply unit.
TEL	An RJ11 socket for connection of an analogue device such as phone or fax to the CONNECT. Please note that adapter cables can be provided for country specific telephone connectors.

INSTALLATION

Overview
Power Connection
ISDN Network Connection
Analogue Device Connection
Data Terminal Connection
LEDs

Overview

Installation of the CONNECT involves:

- Connecting to mains power.
- Connecting to the ISDN network.
- Connecting to the data terminal equipment.
- Connecting analogue equipment.

Basic connection tests can then be made to ensure the CONNECT is properly operational and connected to the ISDN network.

Power Connection

The CONNECT is connected to the mains power supply, using the power brick provided. The power input connector is on the rear panel of the CONNECT.

ISDN Network Connection

The CONNECT is connected to the ISDN network by plugging the ISDN cable supplied between the network termination (NTU) provided by the network operator and the line connector on the rear panel of the CONNECT.

Analogue Device Connection

Connect your analogue device (e.g. phone or fax) to the socket marked TEL on the rear of the CONNECT. If necessary use an adapter cable to convert the RJ11 socket on the CONNECT to the local telephone connector standard.

Data Terminal Connection

The CONNECT requires the use of a standard serial interface cable for connection to personal computers or other terminals. Some terminals have 9 pin rather than 25 pin serial port connectors. The connection from the terminal is made to the 25 pin female 'D' type connector on the rear of the unit. This is similar to the connector found on most analogue modems. Appropriate types of lead are shown below.

Terminal to CONNECT Cable, 25 pin to 25 pin

	2	------	TxD	------	2	
	3	------	RxD	------	3	
	4	------	RTS	------	4	
Terminal	5	------	CTS	------	5	CONNECT
	6	------	DSR	------	6	
	7	------	GND	------	7	
	8	------	DCD	------	8	
	20	------	DTR	------	20	
	22	------	RI	------	22	
	(female)				(male)	

Terminal to CONNECT Cable, 9 pin to 25 pin

	1	------	DCD	------	8	
	2	------	RxD	------	3	
	3	------	TxD	------	2	
	4	------	DTR	------	20	
Terminal	5	------	GND	------	7	CONNECT
	6	------	DSR	------	6	
	7	------	RTS	------	4	
	8	------	CTS	------	5	
	9	------	RI	-------	22	
	(female)				(male)	

The connector on the CONNECT has the following pin connections:

Pin	Signal	Name	Source	Circuit	LED
2	Transmit Data	TxD	Terminal	103	SD
3	Receive Data	RxD	CONNECT	104	RD
4	Request to Send	RTS	Terminal	105	RS
5	Clear to Send	CTS	CONNECT	106	
6	Data Set Ready	DSR	CONNECT	107	
7	Signal Ground	GND		102	
8	Data Carrier Detect	DCD	CONNECT	109	CD
20	Data Terminal Ready	DTR	Terminal	108	TR
22	Ring Indicator	RI	CONNECT	125	

The circuit numbers are as defined by CCITT but in general the signals are now referred to by name. Pins 2, 3 and 7 carry the data and ground signal, the remainder are used for control purposes. The control signals have different effects depending on the values placed in the CONNECT command registers using Hayes AT commands. If in doubt refer to the Hayes AT Commands section of this manual.

LEDs

The HK LED indicates whether the analogue device connected to the CONNECT is off hook.

The data signals TxD, RxD, DCD, RTS and DTR all have associated LEDs. The SD (send data) and RD (receive data) LEDs flash when data is being sent or received. The CD, RS and TR LEDs usually indicate the state of DCD, RTS and DTR interface signals respectively.

Initial Connection

Connect a simple analogue device (e.g. a phone which supports tone dialling) to the analogue socket and pick up the handset. You should hear dial-tone and be able to dial a call in the normal way. Once this is possible you know that you are connected to the ISDN line correctly.

Connect a computer or simple asynchronous DTE to the serial port on the CONNECT. There are several simple checks which can be performed to verify the operation of the CONNECT and cable installation. These tests assume that the CONNECT is as delivered and has not previously been used and configured by someone else.

If you have problems with any of the checks, please contact your supplier for advice.

LED Check

Load the PC with a standard communications package with which you are familiar. Set the package parameters for operation in a full duplex terminal emulation mode. Ensure the baud rate is set to one that the CONNECT supports.

Once you are running the communications package, the RS and TR LEDs will be on. If the LEDs do not come on then the reason could be:

- The communication package is not configured to drive RTS (hardware flow control) or DTR.
- The cable between the PC and CONNECT has the RTS or DTR signal missing or broken.

Sending an 'A'

Type **A** on the PC keyboard.

If all is well, a single 'A' should be displayed on the PC screen. If this happens proceed to the next step. If the 'A' is not present, the reason could be:

- Incorrect letter pressed.
- The communications package is configured to a baud rate or format not recognised by the CONNECT.
- The cable between the PC and CONNECT is incorrect.

Completing the 'AT' Sequence

Type **T** and press **<CR>**

<CR> is used to represent the carriage return function on the DTE keyboard (which may be labelled as Enter or Return).

The CONNECT should respond by echoing the character 'T' after the previous 'A' and then displaying the message 'OK'.

With the above steps completed you can go on to making a data call. See next section in this manual for details.

Device Addressing on the 'S' Bus

If several devices are sharing your 'S' Bus connection, you probably want to be able to address them independently. To do this you will either be using separate numbers for the two 'B' Channels or Multiple Subscriber Numbering, depending on what your network connection provides.

If you are using separate numbers for each 'B' Channel, you can configure the CONNECT to only operate with one specific 'B' Channel for incoming and outgoing

calls by setting the !C4 and !C5 registers appropriately. See the Hayes AT Commands section for more details.

If you want more than two devices to be separately addressable or if you do not have the option of a separate number for each 'B' Channel, then you need to subscribe to the Multiple Subscriber Numbering facility on your network. In this case the number that you wish to assign to the CONNECT for data calls is put into the !C6 register. See the Hayes AT Commands section for more details.

The number you wish to assign for analogue calls is configured by the command *90*number# on the analogue port. See Analogue Port Operation section for more details.

BASIC DATA OPERATION

Types of Devices Supported
Basic Control
Data Calls on ISDN
Flow Control
Making a V.120 Data Call
Making a Call into the Internet
Making a Call Into an X.25 Network via a 'B' Channel
Making a Call Into an X.25 Network via the 'D' Channel
Making an Analogue Call

Types of Devices Supported

The CONNECT is designed to connect to the serial port on most personal computers, and looks to that port just like a traditional modem. It is possible to connect other devices to the CONNECT providing they meet certain criteria:

The device must support asynchronous serial data, conforming to RS232 or V.24/V.28, using one of the following rates and formats:

7 bits with parity (odd, even).
8 bits with no parity.
One or more stop bits.
9600, 19200, 38400, 57600 or 115200 bps.

Basic Control

Most analogue modems use the Hayes Standard AT Command Set to control calls and set certain parameters, such as whether to automatically answer incoming data calls. In turn, because it is such an established standard, most communications software packages developed for personal computers support Hayes AT commands.

The CONNECT also understands Hayes AT commands. This means that it can be used with existing communications software, thus easing the transition from analogue data transmission to ISDN. The AT command set was developed by Hayes Microcomputer Products, Inc., who have extended the specification to cover some of the new options presented by ISDN. The CONNECT supports the Hayes Standard AT Command Set for ISDN.

Later in this section are examples of additional Hayes AT initialisation commands required to set up ISDN calls. These will need to be inserted into the initialisation sequence of the communications package to be used with the CONNECT. This is normally the only change required. Most users should not need to refer to the complete Hayes AT Command section of this manual.

Data Calls on ISDN

Calls - How Many? There are two communication channels available on an ISDN line, 'B' Channels which operate at 64000 bps. Data calls can be made on either of the 'B' Channels.

It is important to remember that if the CONNECT is sharing the ISDN line with another ISDN device, the two 'B' Channels are shared with that device.

Communications - How? Since the CONNECT accepts data at rates of below 64000 bps some method of rate conversion is required. The CONNECT supports two rate conversion methods, V.120 and X.25 Rate Adaption. The CONNECT also supports asynchronous to synchronous PPP conversion, which provides a similar function for access to the Internet.

It is not necessary to understand in detail what these terms mean. The key issue is that communication is only possible if the sending and receiving ISDN devices are using the same transport method. One of the additional parameters that an ISDN Terminal Adapter has to be given before making a data call is the transport method to be used.

Note that the X.25 Rate Adaption method also allows you to dial into X.25 Packet Networks that support direct ISDN access. In this situation you firstly call into the network and can then set up calls to the services on the X.25 network that you want to access. See the section below for more details.

Flow Control

The application of flow control to a received user data stream (i.e. its temporary halting) usually happens as a consequence of two things. Either the user explicitly requests a halt, when reading a long stream of text maybe, or an application package running on a PC requires a temporary halt for its own internal processing needs (this effectively happens without the user's knowledge).

The CONNECT uses the Hardware (RTS/CTS) flow control method - check that the DTE is configured to match or data loss may occur.

Making a V.120 Data Call

Initialisation

The first operation is to configure the CONNECT to V.120 rate adaption. Note - this is the default mode.

This is done by entering the following Hayes AT command:

Type **AT%A2=2** and press **<CR>.**

The CONNECT should respond with '**OK**'.

These extra Hayes AT commands can be used as an initialisation sequence in a communications application whenever this type of call is required.

After this sequence is sent the CONNECT then accepts the 'standard' Hayes AT commands for dialling, escape sequence and hang-up.

Dialling

To dial a call:

If the number you wish to dial is **xxxxxxxxxx** Type **ATDxxxxxxxxxx** and press **<CR>.**

Wait for the response '**CONNECT 115200**' assuming 115200 is the baud rate in use.

Other responses indicate a call could not be made. Explanations of these results are given in the Hayes AT Commands section later in the manual.

Escape from Data Mode

This is used to get back to command mode during a data call.

Type **+++** only.

Wait for the response '**OK**'.

Hayes AT commands can be entered.

The call remains in place until a hang-up command is entered.

Hang up Data Call

Having escaped from Data Mode, type **ATH** and press **<CR>.**

Wait for response '**OK**'.

The CONNECT is now back in the idle command state, ready to accept new commands or make another call.

Making a Call into the Internet

The Connect is easy to use with standard Internet access software. As the Connect's interface to the PC emulates a modem, no special driver software is required - a standard modem driver can be used. You can use either PPP or V.120 rate adaption. To access the Internet it is recommended that you should configure the following on your PC:

Select the 'Standard Modem' driver.

Increase the interface speed to 115200 bps to make best use of the ISDN line speed.

Select Hardware (RTS/CTS) flow control.

Depending on whether you are using V.120 or PPP, add the following Hayes commands to the modem initialisation string.

V.120: %A2=2%E8=0

PPP: %A2=15

Making a Call Into an X.25 Network via a 'B' Channel

Initialisation

Type **AT%A2=6** and press **<CR>.**

Dialling

First make a connection to the X.25 Packet Switched Network, using the '**ATDxxxxxx**', where **xxxxxx** is the number of the X.25 access node.

Wait for the response '**OK**' which shows that the connection has been made.

Now generate an X.25 Call Request across the X.25 Packet Switched Network, using the '**ATDxxxxxx**', where this time the number is the X.25 NUA being called. Note that the Calling NUA in the X.25 Call Request is as set up in the **&Z3** register.

Wait for the response '**CONNECT 115200**' assuming 115200 is the baud rate in use.

Escape from Data Mode

Type **+++** only.

Wait for response '**OK**'.

Hang up Call

Type **ATH** and press **<CR>** to generate an X.25 Clear Request to clear the X.25 call across the network.

Wait for response '**OK**'.

Type **ATH** and press **<CR>** again to clear the ISDN call.

Wait for response '**OK**' a second time.

Making a Call Into an X.25 Network via the 'D' Channel

Initialisation

Type **AT%A2=5** and press **<CR>.**

Note – the TEI (Terminal Endpoint Identifier) must also be set correctly to identify the Connect to the remote network. See Hayes Commands section.

Dialling

Generate an X.25 Call Request across the X.25 Packet Switched Network, using the '**ATDxxxxxx**', where the number is the X.25 NUA being called. Note that the Calling NUA in the X.25 Call Request is as set up in the **&Z3** register.

Wait for the response '**CONNECT 115200**' assuming 115200 is the baud rate in use.

Escape from Data Mode

Type **+++** only.

Wait for response '**OK**'.

Hang up Call

Type **ATH** and press **<CR>** to generate an X.25 Clear Request to clear the X.25 call across the network.

Wait for response '**OK**'.

Making an Analogue Call

Initialisation

Type **AT%A2=3** and press **<CR>.**

Dialling

Generate an outgoing voice call, using the '**ATDxxxxxx**', where the number is the telephone number being called.

Wait for the response '**CONNECT 115200**' assuming 115200 is the baud rate in use.

The analogue port on the Connect is now connected to the called party.

Hang up Call

The Connect is automatically in Command Mode and an Escape sequence is not required.

Type **ATH** and press **<CR>** to clear the call.

Wait for response '**OK**'.

Alternatively, the call can be cleared by putting the device connected to the Connect's analogue port on hook.

HAYES 'AT' COMMANDS

Your computer or terminal (DTE) communicates with the CONNECT using a V.24 (RS232) interface.

The CONNECT implements the Hayes Standard AT Command Set for ISDN at the V.24 interface. This Command Set provides extended data call support.

This section describes the Hayes Standard AT Command Set for ISDN, and the information and result codes it returns to your DTE.

CONNECT States
Command Structure
Data Call Commands
Registers

CONNECT States

The CONNECT supports two distinct states: the command state and the data state. When in the command state, the CONNECT will accept commands from the DTE and respond to them. When a data call is connected, the CONNECT is usually in the data state, and everything sent from the DTE to the CONNECT is sent as data to the number you have called.

The CONNECT is taken from the command state to the data state by dialling or answering a data call. The CONNECT can be taken from the data state back to the command state using the escape sequence. This does not drop the data call - the ATH command is then used to drop the call.

Command Structure

When in the command state, the CONNECT is able to accept commands from the DTE and respond to them.

Each command is composed of a number of parts. The simplest way to illustrate this is with an example:

AT%A2=2<CR>

Part	Meaning
AT	Command line prefix
%A2=2	Command
<CR>	Command line terminator

Command Line Prefix

Each line of commands sent by your DTE to the CONNECT has to start with the characters 'AT' or 'at' (but not 'At' or 'aT'). The CONNECT uses this command line prefix to determine the DTE speed and parity.

Commands and Registers

Between the command line prefix and the command line terminator your DTE can supply one or more commands. You don't need separating characters between commands. The commands on a line are limited to a maximum of 250. (You will note from their descriptions that some commands shouldn't be followed by others, as the following commands will be ignored.)

In the example, the command is to assign a value of 2 to register %A2.

Each command is identified by a command letter ('A') which may have a command prefix ('%A') and a command suffix ('%A2'). If a suffix is not supplied, a suffix of zero is assumed.

Registers are commands that store a value. You assign a value to a register using the "register=value" format used in the example, and you examine the value stored in a register using "register?"

For example, the command:

AT%A2?<CR>

will return the value stored in register %A2:

002

There are two types of registers taking two types of values: number registers and string registers.

Number registers store a numeric value from a range of acceptable values, as in AT%A2=2<CR> above.

String registers store a string of ASCII characters. When assigning a value to a string register, the value must be enclosed in delimiting characters (either ' or ").

For example:

AT%B13='FRED'
AT%B14="4321"

If the delimiting character is required within a string, it must be entered twice.

Command Line Terminator

The command line terminator is the ASCII carriage return character (decimal value 13). When the CONNECT receives this character it begins processing the commands on the line.

All commands on a line are processed in turn until either the end of the line is reached (which will produce an 'OK' result code unless a command has taken the CONNECT into the data state) or an error is found. If an error is found, the 'ERROR' result code is returned and no further commands on the line are processed. (This is a good reason for keeping down the number of commands in a line.)

Processing is complete, and the CONNECT is ready to receive another command line, after the CONNECT has returned any information requested and the final result code. (Normally there shall be only one result code.)

Call Types

The type of a call is determined by the values in certain %A registers:

Call Type	%A2
V.120 Rate Adaption	2
Analogue voice calls	3
X.25 Rate Adaption	4
X.25 to PSD network over 'D' Channel	5
X.25 to PSD network over 'B' Channel	6
PPP async to sync conversion	15

To change the type of data call to be used before making or answering a data call, you first need to set the %A2 register.

There are sets of registers for each type of data call:

Call Type	Registers
V.120 Rate Adaption	%E, !C4/!C5
X.25 Rate Adaption	%B, %D, %L, !B, !C4/!C5
X.25 to PSD network (over 'D' Channel)	%B, %D, %L
X.25 to PSD network (over 'B' Channel)	%B, %D, %L, !B, !C4/!C5
PPP async to sync conversion	!C4/!C5

The Escape Sequence

The escape sequence is used to take the CONNECT from the data state to the command state. The escape sequence is as follows:

No data character received from the DTE for the time (referred to as the 'guard time') of 1s, then,

Three escape characters, '+++', received with less than the guard time between each character, then,

Nothing received from the DTE for the guard time of 1s.

The escape characters are transmitted over the ISDN connection to the remote terminal.

Data Call Commands

In addition to the commands listed below, there are response only commands that are provided for compatibility with other products that use the Hayes Standard AT Command Set. They have no effect.

The response only commands are: B, C, F, L, M, N, P, T, Y, comma, &G, &J, &P, &R, &S and &X.

A (Answer)
D (Dial)
E (Echo)
H (Hang Up)
I3 (Firmware Part Number)
Q (Result Code Display)
V (Result Code Form)
X (Result Code Set)
&C (Carrier Detect)
&D (Data Terminal Ready)
&F (Load Factory Profile)
&K (Flow Control)
&V (View Profiles)
&Z3 (Store Directory Number)
Data Call Result Codes

A (Answer)

Format: ATA<CR>

Causes the CONNECT to answer an incoming data call.

An incoming data call is indicated by the 'RING' result code and the RI signal.

If successful, the CONNECT enters the data state after issuing 'CONNECT xxxx'.

The command is not valid if there is no incoming data call, returning 'ERROR'.

D (Dial)

Format: ATD{DN}<CR>

{DN} is a directory number of up to 23 ASCII characters from the set 0..9, * and #. This form of the ATD command causes the CONNECT to dial an outgoing data call to the supplied directory number. Any commands that follow this form of the ATD command will be ignored.

Note that if a call is being made over ISDN into a packet switched network (i.e. %A2=6) then a second ATD command is required to make a packet call to the desired destination on the network.

If the CONNECT receives a character from the DTE after an ATD command that causes the dialling of an outgoing call, and before the call is connected, the attempt to make an outgoing call will be abandoned.

E (Echo)

Format: ATEn<CR>

Suffix n	Description
0	Echo off.
1 (default)	Echo on.

Tells the CONNECT whether or not to echo the characters that the DTE sends to it when in command mode. When echo is on, all characters received from the DTE are echoed back to it.

H (Hang Up)

Format: ATH<CR>

Causes the CONNECT to drop the data call in progress.

The command is not valid if there is no data call in progress, but always returns 'OK'.

You need to take the CONNECT from the data state to the command state using the escape sequence before you can use the ATH command to drop a data call.

Note that if a call has been made to a packet switched network (i.e. %A2=6) and a subsequent packet call has been made to the desired destination on the network, then an ATH command will clear the packet call only. Another packet call can then be made with an ATD command or the call into the packet network can be cleared with a second ATH command.

I3 (Firmware Part Number)

Format: ATI3<CR>

Causes the CONNECT to return the part code and revision level for all its firmware components.

Q (Result Code Display)

Format: ATQn<CR>

Instructs the CONNECT whether to send result codes to the DTE or not.

Suffix n	Description
0 (default)	Result codes enabled.
1	Result codes suppressed.
2	Result codes are suppressed when answering a call, otherwise enabled.

V (Result Code Form)

Format: ATVn<CR>

Instructs the CONNECT to send result codes as numbers or words. This does not affect the form of information sent in response to commands.

Suffix n	Description
0	Result codes sent as numbers.
1 (default)	Result codes sent as words.

X (Result Code Set)

Format: ATXn<CR>

Causes the CONNECT to limit the data call result codes used to a given set.

Suffix n	Data call result codes
0	0 - 4
1	0 - 4, 12, 14, 18, 28, 31
2	0 - 4, 12, 14, 18, 28, 31
3 (default)	0 - 4, 6, 7, 12, 14, 18, 28, 31
4	0 - 4, 6, 7, 12, 14, 18, 28, 31

(Some data communications applications are not able to cope if they receive a 'CONNECT xxxx' result code (12, 14, 18, 19, 28, 31) as they are expecting a 'CONNECT' (1) result code.)

Data result codes affected by the X command:

Numbers	Words
0	OK
1	CONNECT
2	RING
3	NO CARRIER
4	ERROR
6	NO DIALTONE
7	BUSY
12	CONNECT 9600
14	CONNECT 19200
18	CONNECT 57600
28	CONNECT 38400
31	CONNECT 115200

&C (Carrier Detect)

Format: AT&Cn<CR>

Tells the CONNECT what to do with the V.24 DCD (data carrier detect) signal.

Suffix n	Description
0	Ignore connection status; keep DCD on.
1 (default)	DCD tracks status of data connection.

&D (Data Terminal Ready)

Format: AT&Dn<CR>

Tells the CONNECT what to do if the Data Terminal Ready (DTR) signal from the DTE is lost.

Suffix n	Description
0	No action.
2 (default)	Data call is cleared and Auto Answer is suspended until DTR is raised..

&F (Load Factory Profile)

Format: AT&F<CR>

Sets the following commands and registers to their factory default settings. The command does not clear the data call (if in progress) and does not affect the &Z, %A, !B and !C registers.

Commands:

E Q V X &C &D &K

Registers:

S0 S37 %B %D %E %L

Format: AT&F<CR>

This form of the command sets **ALL** registers back to the factory default settings.

&K (Flow Control)

Format: AT&Kn<CR>

Indicates to the CONNECT the method of flow control used between the CONNECT and the DTE when in the data state. There is no flow control when the CONNECT is in the command state.

Suffix n	Description
0	No flow control.
3 (default)	Bidirectional RTS/CTS signals.

RTS/CTS flow control operates on the basis that the DTE must cease transmission if CTS is off, similarly the CONNECT will not transmit data to the DTE if RTS is off.

&V (View Profiles)

Format: AT&V<CR>

The &V command tells the CONNECT to return information on the values for certain commands and registers:

E Q V X &C &D &K &Z S0 S37 %A %B
%D %E %L !B !C

&Z3 (Store Directory Number)

Format: AT&Z3={DN}<CR>

This command instructs the CONNECT to store a directory number. A directory number consists of a string of characters from the set 0 - 9, *, #.

To clear any of the &Z3 registers enter the following: AT&Z3=<CR>

The contents of the &Z directory number stores can be displayed using the &V command.

NOTE: &Z3 is used for the calling NUA of X.25 calls.

Data Call Result Codes

The data call result codes supported by the CONNECT are:

Numbers	Words
0	OK
1	CONNECT
2	RING
3	NO CARRIER
4	ERROR
6	NO DIALTONE
7	BUSY
12	CONNECT 9600
14	CONNECT 19200
18	CONNECT 57600
28	CONNECT 38400
31	CONNECT 115200

Registers

In addition to the commands, you can vary the way the CONNECT operates by setting registers. To set a register, use

AT{register}={value}<CR>

And to examine a register, use

AT{register}?

{register} is the name of the register being set or examined. If no register name suffix is supplied, a suffix of zero is assumed. {value} is the number or string the register is being set to. If no value is supplied, a value of zero or an empty string is assumed. (See the section "Commands and Registers" for more details.)

Registers are grouped together by prefix and by letter. (For example: Registers which affect V.120 parameters begin with %E.)

All registers are stored in non-volatile memory. You can restore certain registers to their factory default values by using the &F command or **all** registers using &F9. See the descriptions of this command for details of the registers involved.

S Registers
%A Registers
%B Registers (X.25 Virtual Circuit Parameters)
%D Registers (CSD X.25 Parameters)
%E Registers (CSD V.120 Parameters)
%L Registers (X.25 PAD Parameters)
!B Registers ('B' Channel LAPB Parameters)
!C Registers (Basic Configuration Parameters)

S Registers

S0 (Rings On Which To Auto-answer A Data Call)
S37 (Maximum Rate Adaption Speed)

S0 (Rings On Which To Auto-answer A Data Call)

Range	Default	Description: Number
0 to 1	0	Defines the number of RING result codes after which the CONNECT will auto-answer a data call. If set to zero, auto-answering is disabled.

S37 (Maximum Rate Adaption Speed)

This register forces the baud rate for incoming calls:

Value	Rate
0 (default)	Same as last AT speed
9	9600
12	19200
13	38400
18	57600
31	115200

%A Registers

The contents of the %A registers are key in determining the operating mode of the CONNECT.

%A2 (Data Protocol)

%A2 (Data Protocol)

Selects the protocol to be used for ISDN data calls.

Value	Description: Number
2 (default)	V.120 Rate Adaption (115200 bps max. user data rate).
3	Voice calls controlled from the data port. The voice call is routed to the analogue port on the Connect. In this mode of operation any incoming voice call is indicated on the data port and any incoming data call is rejected. Voice calls can also be cleared by putting the device connected to the analogue port on hook.
4	X.25 Rate Adaption (115200 bps max. user data rate).
5	X.25 to a packet switched data network via the 'D' Channel. The max user data rate is 115200 bps – the 'D' Channel network will throttle back to a lower aggregate data rate (e.g. 2400 bps).
6	X.25 to a packet switched data network reached by a circuit switched data call over the 'B' Channel (115200 bps max. user data rate). This involves a two stage call set up. Firstly a circuit switched call must be established to the X.25 node, followed by a virtual call to an X.25 destination. The ATD command is used for both call requests.
15	PPP asynchronous to synchronous conversion (115200 bps max. user data rate).

%B Registers (X.25 Virtual Circuit Parameters)

These parameters apply to all types of X.25 calls. For registers %B0 to %B3, if set to their default values of zero, the values used are taken from the corresponding %D registers.

%B0 (Receive Window Size)
%B1 (Transmit Window Size)
%B2 (Receive Packet Size)
%B3 (Transmit Packet Size)
%B13 (Network User Identification String)
%B18 (User Data)

%B0 (Receive Window Size)

Defines the maximum number of X.25 packets that may be received before an acknowledgement is sent

Value	Description: Number
0 (default)	Use the default value (%D), without negotiation.
1 to 7	Negotiate receive window size

%B1 (Transmit Window Size)

Defines the maximum number of X.25 packets that may be sent before an acknowledgement is expected

Value	Description: Number
0 (default)	Use the default value (%D), without negotiation.
1 to 7	Negotiate transmit window size.

%B2 (Receive Packet Size)

Defines the maximum number of bytes that can be received in an X.25 packet.

Value	Description: Number
0 (default)	Use the default value (%D), without negotiation.
7	Negotiate for a maximum 128 bytes per packet.
8	Negotiate for a maximum 256 bytes per packet.
9	Negotiate for a maximum 512 bytes per packet.
10	Negotiate for a maximum 1024 bytes per packet.

%B3 (Transmit Packet Size)

Defines the maximum number of bytes that can be sent in an X.25 packet.

Value	Description: Number
0 (default)	Use the default value (%D), without negotiation.
7	Negotiate for a maximum 128 bytes per packet.
8	Negotiate for a maximum 256 bytes per packet.
9	Negotiate for a maximum 512 bytes per packet.
10	Negotiate for a maximum 1024 bytes per packet.

%B13 (Network User Identification String)

Maximum of 32 ASCII characters. Packet switched network dependant. Default is an empty string. The network user identification (NUI) string is used to identify your terminal to the packet switched network if necessary.

%B18 (User Data)

Up to 12 ASCII characters. Default is an empty string. The X.25 user data field sent when the X.25 call is made.

%D Registers (CSD X.25 Parameters)

These registers apply to all X.25 calls (where %A2=4 or %A2=6).

%D0 (Default Receive Window Size)
%D1 (Default Transmit Window Size)
%D2 (Default Receive Packet Size)
%D3 (Default Transmit Packet Size)
%D9 (Logical Channel Group Number)
%D10 (Logical Channel Number)

%D0 (Default Receive Window Size)

Defines the default maximum number of X.25 packets that may be received before an acknowledgement is sent. Used if %B0=0.

Range	Default	Description: Number
1 to 7	2	Default receive window size.

%D1 (Default Transmit Window Size)

Defines the default maximum number of X.25 packets that may be sent before an acknowledgement is expected. Used if %B1=0.

Range	Default	Description: Number
1 to 7	2	Default transmit window size.

%D2 (Default Receive Packet Size)

Defines the default maximum number of bytes that can be received in an X.25 packet. Used if %B2=0.

Value	Description: Number
7	Maximum 128 bytes per packet.
8 (default)	Maximum 256 bytes per packet.
9	Maximum 512 bytes per packet.
10	Maximum 1024 bytes per packet.

%D3 (Default Transmit Packet Size)

Defines the default maximum number of bytes that can be sent in an X.25 packet. Used if %B3=0.

Value	Description: Number
7	Maximum 128 bytes per packet.
8 (default)	Maximum 256 bytes per packet.
9	Maximum 512 bytes per packet.
10	Maximum 1024 bytes per packet.

%D9 (Logical Channel Group Number)

Range	Default	Description: Number
0 to 7	4	LCGN used for outgoing calls.

%D10 (Logical Channel Number)

Range	Default	Description: Number
0 to 255	0	LCN used for outgoing calls.

%E Registers (CSD V.120 Parameters)

These registers apply to all V.120 calls (where %A2=2).

Note - some Internet Service Providers require that you use V.120 in the MFO mode. This is set by the %E8 register - see below.

%E8 (Multiple Frame Operation Mode Selection)

%E8 (Multiple Frame Operation Mode Selection)

In multiple frame operation (MFO) mode frames are acknowledged and retransmitted if errors occur. Ensure MFO is on if you experience problems with loss of data, though with ISDN it is not usually necessary.

Value	Description: Number
0	MFO mode on.
1 (default)	MFO mode off.

%L Registers (X.25 PAD Parameters)

The X.25 PAD parameters are as defined in CCITT recommendation X.3, and affect how data is displayed and transmitted using an X.25 packet switched data network.

%L3 (Selection Of Data Forwarding Characters)
%L4 (Idle Timer)
%L10 (Line Folding)

%L3 (Selection Of Data Forwarding Characters)

This register is used to specify the characters which, when received from the DTE, will cause the current packet of data to be transmitted. If set to zero, the packet is not transmitted until either the idle timer (%L4) expires, or the packet becomes full (%B3). The values listed below may be added together to combine the character sets indicated.

Value	Character set
0 (default)	None.
1	A to Z, a to z, and 0 to 9.
2	CR.
4	ESC, BEL, ENQ and ACK.
8	DEL, CAN and DC2.
16	ETX and EOT.
32	HT, LF, VT and FF.
64	NUL, SOH, STX, BS, SO, SI, DLE, DC1, DC3, DC4, NAK, SYN, ETB, EM, SUB, FS, GS, RS and US.

%L4 (Idle Timer)

Range	Default	Description: Number
0 to 255	0	Specifies the duration of the timer (in units of 1/20 second) that, when it expires, causes the contents of the current packet to be forwarded. If set to zero, there is no timed data forwarding

%L10 (Line Folding)

Range	Default	Description: Number

0 to 255	0	Specifies the line length required. When the specified number of characters have been sent to the DTE a carriage return and line feed are sent to ensure that lines don't exceed the required length. A value of zero disables line folding.

!B Registers ('B' Channel LAPB Parameters)

These define the layer 2 (link access protocol) parameters for X.25 calls (where %A2=4 or %A2=6).

!B1 (LAPB T1 Timer)
!B2 (LAPB T4 Timer)
!B3 (LAPB N2 Retry Count)
!B5 (Active/Passive)

!B1 (LAPB T1 Timer)

Range	Default	Description: Number
1 to 255	3	Sets the value, in seconds, of the LAPB T1 timer.

!B2 (LAPB T4 Timer)

Range	Default	Description: Number
1 to 255	15	Sets the value, in seconds, of the LAPB T4 timer.

!B3 (LAPB N2 Retry Count)

Range	Default	Description: Number
1 to 255	4	Sets the number of times the LAPB protocol will retry sending before giving up and applying recovery procedures.

!B5 (Active/Passive)

Value	Description: Number
0	X.25 is Active i.e. initiates link initialisation.
1	X.25 is Passive and waits for the network to initialise the link.

!C Registers (Basic Configuration Parameters)

Registers !C3, !C4 and !C5 need to be set to indicate the way in which the 'D' Channel and each 'B' Channel are configured for use with your ISDN network connection.

!C4 ('B1' Channel Configuration)
!C5 ('B2' Channel Configuration)
!C6 (MSN Directory Number)
!C7 (Terminal Endpoint Identifier (TEI))

!C4 ('B1' Channel Configuration)

Value	Description: Number
0	The 'B1' Channel is not used for data calls.
4 (default)	The 'B1' Channel can be used for data calls.

Some networks give the user the option of allocating a specific directory number to each 'B' Channel. If this option is taken up the user can force the CONNECT only to operate on a particular 'B' Channel by appropriately setting the !C4 and !C5 registers. This has the benefit of allowing incoming calls to be directed to a specific CONNECT without the need to subscribe to the multiple subscriber number service.

!C5 ('B2' Channel Configuration)

Value	Description: Number
0	The 'B2' Channel is not used for data calls.
4 (default)	The 'B2' Channel can be used for data calls.

Some networks give the user the option of allocating a specific directory number to each 'B' Channel. If this option is taken up the user can force the CONNECT only to operate on a particular 'B' Channel by appropriately setting the !C4 and !C5 registers. This has the benefit of allowing incoming calls to be directed to a specific CONNECT without the need to subscribe to the multiple subscriber number service.

!C6 (MSN Directory Number)

If a directory number is stored in this register, and the user is provisioned for the multiple subscriber number service, then incoming calls are only responded to when the indicated directory number destination matches that stored in this register. Only the digits needed to distinguish between the number range allocated to the user need be programmed.

If a number is programmed in without having the service provisioned then all incoming calls will be responded to.

If the service is provisioned but it is desired that all incoming calls be responded to then this register should be left empty.

The number entered must be within quotes, e.g. AT!C6="123"<CR>. To clear the register enter AT!C6=""<CR>

!C7 (Terminal Endpoint Identifier (TEI))

The TEI identifies the Connect to the network and differentiates it from other devices on the ISDN line.

Value	Description: Number
0-63	Fixed TEI, 0-63.
64 (default)	Variable TEI – the Connect requests a TEI from the network.

A fixed TEI is normally only required when 'D' Channel data calls are to be made, in which case the TEI required will be provided by the network operator. 'B' Channel calls can normally be made using either a fixed or variable TEI.

If this register is changed, the Connect must be disconnected from the network or re-powered before the new TEI will take effect.

Note – if a fixed TEI is used it is important to ensure that no other device on the ISDN line uses the same TEI.

ANALOGUE PORT OPERATION

The analogue port on the CONNECT emulates a normal analogue telephone line and can be used to connect existing analogue terminal equipment that uses tone dialling, such as telephone, fax or modem, over an ISDN line.

The analogue port on the CONNECT recognises when the telephone goes off hook and routes the network dial-tone from the ISDN line to the telephone. The CONNECT will then recognise the tone dialled DTMF dial digits sent from the telephone and convert them to the appropriate ISDN messages.

When the CONNECT sees an incoming call from the ISDN line, it will identify whether it is a data call or voice call (note - a call coming from a group 3 fax or a modem is still classed as a voice call). If the call is a voice call, the CONNECT will apply a ringing voltage to the analogue port and the attached terminal will ring.

In addition, the analogue port on the CONNECT can be configured so that it will only ring on a particular directory number. This can be used if you have multiple numbers on your ISDN line.

To configure the directory number, connect a telephone to the analogue port, pick up the handset and dial the following:

*90*Directory Number#

where Directory Number is the number you wish to select. You only need to enter the least significant digit(s) of the number you wish to configure. For example if you had numbers 1000 to 1009 on your ISDN line and you wanted to set the CONNECT analogue port to ring on only 1008, you would enter *90*8#.

To clear this setting, dial *90*#. The analogue port will then respond to all incoming voice calls.

TROUBLESHOOTING

This section describes typical problems that may arise, the symptoms, possible causes and solutions. If you have problems that you cannot resolve after consulting this section, please consult your supplier.

A useful confidence check is to use a standard terminal (or terminal emulation on a PC) with which you are familiar and dial a known ISDN number.

Symptom	Possible Causes	Solution
No activity on the CONNECT, no communications with terminal, no LEDs on.	Power switched off.	Check power switch at mains.
	Power supply not connected.	Check CONNECT is connected to mains power via the power supply provided.
	Power fuse blown.	Replace with fuse of correct value (3A).
LED activity (at least the AR LED on or flashing), but no communications with terminal.	CONNECT not connected to terminal.	Connect CONNECT and terminal with appropriate cable (see Installation section).
	Inappropriate cable connections between CONNECT and terminal.	As above.
	Terminal operating at baud rate not supported by the CONNECT.	See Basic Operation section for baud rates accepted.
Cannot make data calls (NO CARRIER or BUSY result codes returned).	Wrong number called.	Check number called.
	ISDN terminal dialled already in call or not functional.	Check status of called device.
	Incompatible rate adaption with terminal called.	Check rate adaption in use at called end and select on the CONNECT accordingly. See Basic Operation section.
	The CONNECT is not properly connected to the ISDN network - this is the case if the AR	Check the ISDN cable and repower the CONNECT.

	LED stays flashing after the call attempt is made.	
CONNECT will not accept incoming calls.	The CONNECT is not set to auto-answer the call or the DTR line to the CONNECT is held low, which has the same effect. Note that in these cases the CONNECT sends a 'RING' result code to the terminal which is expected to answer the call itself.	Set auto-answer on - see the Hayes AT Commands - S Registers section.
	Another terminal on the ISDN line has taken the call.	Check the configuration of terminals connected.
	The ISDN line is configured with two numbers and the number called already has a call established to another terminal.	Check the configuration of the ISDN line and the number called. Note that the CONNECT can be set to only use one of the two ISDN channels - see the Hayes AT Commands - !C Registers setting.
Calls can be set up but data cannot be transmitted between the devices connected.	Incompatible rate adaption with terminal called.	Check rate adaption in use at called end and select on the CONNECT accordingly. See Basic Operation section.
	RTS/CTS flow control is set on CONNECT and terminal is holding RTS low or RTS is not connected in cable.	Check the cable and the setting of flow control on the terminal.
Data is lost during a call.	Terminal connected requires flow control and flow control is not set or incompatible with CONNECT.	Ensure flow control settings on terminal and CONNECT are compatible - see Hayes AT Commands - Data Call Commands section.
	Terminal or application cannot keep up with the baud rate selected.	Reduce the baud rate selected on the terminal. The CONNECT automatically autobauds to the new rate on the next AT command.
ISDN network connection is lost (AR LED is flashing) when	The ISDN cables in use are a mixture of cross-over and straight	Make sure all ISDN cables are to the same specification.

another terminal is connected to the ISDN line.	through. Note that for a single terminal installed on an ISDN line either configuration will work, but if there are several devices all the cables must be of the same type.	
When dialling the Internet, connection is made but log-on attempt fails.	The Internet Service Provider requires the CONNECT to be set to V.120 MFO mode.	Set Hayes Registers %A2=2 and %E8=0. Alternatively, use PPP async to sync conversion with %A2=15.
No dial-tone when handset of telephone connected to the analogue port is raised.	Telephone not properly connected to the CONNECT.	Check the connection.
	The CONNECT is not properly connected to the ISDN network - this is the case if the AR LED stays flashing after the handset is lifted.	Check the ISDN cable and repower the CONNECT.
Busy tone heard when handset is lifted.	Both the ISDN channels are busy.	Wait for channel to become available.
Dial-tone heard on telephone, but no response to dialling, or clicking heard whilst dialling.	Telephone uses pulse dialling.	Set telephone to tone dialling, or change to tone dial telephone.

SAFETY AND APPROVALS

SAFETY WARNINGS
APPROVAL - CE MARK

SAFETY WARNINGS

LETHAL VOLTAGES

LETHAL VOLTAGES ARE PRESENT WITHIN THE POWER BRICK SUPPLIED WITH THIS EQUIPMENT. ACCESS TO ENCLOSED EQUIPMENT MUST BE RESTRICTED TO AUTHORISED PERSONNEL.

MODIFICATIONS

CHANGES OR MODIFICATIONS WHICH ARE NOT EXPRESSLY APPROVED BY CHIRON TECHNOLOGY LIMITED COULD VOID THE USER'S AUTHORITY TO OPERATE THIS EQUIPMENT.

ELECTROSTATIC SENSITIVE DEVICES

THE CIRCUIT BOARD IN THIS EQUIPMENT HAS ELECTROSTATICALLY SENSITIVE DEVICES FITTED. ELECTROSTATIC SENSITIVE DEVICES CAN BE DAMAGED IF THEY ARE SUBJECT TO A DISCHARGE OF STATIC ELECTRICITY.

POWER SUPPLY

THIS APPARATUS IS INTENDED FOR USE WHEN POWERED BY THE POWER SUPPLY UNIT PROVIDED. OTHER USAGE MAY INVALIDATE ANY APPROVAL GIVEN TO THIS APPARATUS.

IF THE MAINS FUSE REQUIRES REPLACEMENT ENSURE THAT IT IS REPLACED BY THE SAME TYPE AND RATING (3A) OF FUSE.

THE POWER SUPPLY OUTPUT IS 9VDC @ 0.6A.

APPROVAL - CE MARK

The ISDN Connect Terminal Adapter carries the CE approval marking in accordance with the CE Marking Directive 93/68/EEC. The CE label may be found on the underside of the unit. The CONNECT complies with the following European Directives:-

* 73/23/EEC (Low Voltage Directives)
  By compliance with safety specifications:-

  EN60950 User Safety
  EN41003 Network Safety

* 89/336/EEC (Electro Magnetic Compatibility Directive) as amended by 92/31/EEC.
  By compliance with EMC specifications:-

  EN55022 Emissions Class A
  EN50082-1 Immunity Performance Criteria A