

ISDN TA Plus Reference Manual

Case Communications Ltd 1994

X450-309551 Issue 2

0-1

Rev.1

Unit 15, Riverside Business Centre, Victoria Street, High Wycombe, Bucks HP11 2LT

Web: www.casecomms.com

Email: sales@casecomms.com

Tel (UK): 08700 263 740

Tel (International): +44 (0) 1494 833 740

Fax (UK): 08700 263 741

Fax (International): +44 (0) 1494 833 741

STATUTORY NOTICES

APPROVED for connection to telecommunication systems specified in the instructions for use subject to the conditions set out in them.

NS/1282/5/N/603101

NS/1282151N1603422

All users must make themselves familiar with the statutory notices in the front of this manual and in the Appendix entitled Country-Specific Information.

LITHIUM BATTERY

The lithium used in the battery of this unit will react violently with water and most gases. Discharged batteries must not be crushed, incinerated or disposed of in the normal waste. Used batteries should be collected and disposed of in an approved land fill. The manufacturer and your local waste authority will provide more detailed information about their disposal.

Accidental charging and short circuiting of the battery may cause overheating and possible rupture.

Replace only with the same or equivalent type recommended by the equipment supplier.

Case Communications Limited has made all reasonable efforts to ensure the accuracy of the content of this document but the information contained herein does not constitute a warranty of performance of the equipment and/or software described and no specifications given form part of any contract This document does not constitute a licence to use or copy any software described herein and any such software must only be used in accordance with the terms of the licence supplied therewith

Case Communications Limited reserves the right to make alterations to the equipment and software described without notice and assumes no liability for any loss or damage caused as a result of use of this document whether because of out of date or inaccurate information or otherwise

Product and manufacturers' names referred to in this document are used for identification purposes only and Case Communications Limited acknowledges the Intellectual property rights of their respective owners in the same

This document is the copyright of Case Communications Limited and may not be reproduced, copied or stored in any computerised retrieval system by any means whatsoever without the express written permission of Case Communications Limited

Published by Case Communications Technical Publications Department

Preface

The ISDN TA Plus is available in two versions:

Standalone TA

Rackmount TA (designated by the suffix R) for use in the Network 16 Rack System.

This manual provides full information for installing, configuring and using the ISDN TA Plus as supplied for use in the United Kingdom.

PART 1 of the manual has been laid out in a sequence that will allow you rapidly to become familiar with the essential features of the TA and to get it operational for straightforward use on the ISDN.

PART 2 takes you step-by-step through the many features of the TA that allow it to carry out complex tasks in a variety of environments.

Throughout this manual the ISDN TA Plus and TA Plus R are described as 'the TA'. Where necessary they are differentiated by 'standalone' or 'rackmount'.

The Network 16 Rack System which houses the rackmount version is referred to as 'the rack system', and the Network 16 Controller Module is referred to as 'the controller module'. Both these items are described in separate manuals.

For an explanation of terms used in this manual, see the Pocket Books of Telecommunications and Computer Communications.

Terms and Conventions

This manual uses the following terms and conventions:

- < C R > represents a carriage return.
- <LF> represents a line feed.
- <Ctrl> represents a control character. The character following defines which control character to type.

Text that is to be input is shown in a **bold** typeface. Text that is output is shown in a **normal** typeface.

STATUTORY NOTICES (continued)

MAINS LEAD - IMPORTANT FOR UK USE

The wires **in the mains lead of this apparatus are coloured** in accordance with the following code:

Green & Yellow: Earth Blue: Neutral Brown: Live

As these **colours** may not correspond with the **coloured** markings identifying the terminals in your plug, proceed as follows:

The wire which is **coloured** Green & Yellow must be connected to the terminal in the plug which is marked by the letter E or by the safety earth symbol \perp , or **coloured** green, or green & yellow.

The wire which is **coloured** Blue must be connected to the terminal in the plug which is marked with the letter N or **coloured** black.

The wire which is **coloured** Brown must be connected to the terminal in the plug which is marked with the letter L or **coloured** red.

If the **moulded** mains plug is removed from the lead of this equipment, the plug must be disposed of immediately.

The Safety Status of the interconnection ports for the connection of other equipment to this apparatus, as defined in EN41003;1991 and EN60950; 1988 is as follows:-

<u>Voltages</u>	<u>Ports</u>
SELV	Ports marked DTE' , DTE2 and COMMAND PORT
TNV	Port marked LINE
Excessive Voltage	Mains Input IEC Connector
ELV	No ports
Other	No ports

Contents

1	Introduction	1-3
1.1	Overview	1-3
1.1.1	Data Channels	1-4
1.2	Physical Description	1-5
1.2.1	The LEDs	1-5
1.2.2	The Buttons	1-6
1.3	The Connections	1-7
2	Installation	2-1
2.1	Pre-Installation	2-1
2.1.1	Requirements	2-1
2.1.2	Siting	2-1
2.2	DTE and Command Terminal	2-3
2.2.1	Controlling the TA	2-3
2.2.2	DTE Configuration	2-5
2.2.3	Command Terminal Configuration	2-5
2.3	Installing the Standalone TA	2-6
2.3.1	Power Supply Connection	2-6
2.3.2	DTE Port Connection	2-6
2.3.3	Command Port Connection	2-6
2.3.4	Line Connection	2-6
2.4	Installing the Rackmount TA	2-7
2.4.1	Power Supply Connection	2-7
2.4.2	DTE Port Connection	2-7
2.4.3	Command Port Connection	2-7
2.4.4	Line Connection	2-7
3	Getting Started	3-1
3.1	Starting Up	3-1
3.2	Commanding the TA	3-2
3.2.1	Multiple Ports	3-2
3.2.2	The AT Command Set	3-3
3.2.3	The V.25bis Command Set	3-3
3.3	The AT Command Format	3-4

3.3.1	Basic Format	3-4
3.3.2	Example Commands	3-4
3.3.3	Combining Commands	3-4
3.3.4	Repeating Commands	3-5
3.3.5	Editing a Command Line	3-5
3.3.6	Command Option Numbers	3-5
3.3.7	The OK and ERROR Responses	3-5
3.3.8	Response Codes	3-5
3.3.9	Port Selection	3-6
3.4	Making a Call	3-8
3.4.1	Dialling	3-8
3.4.2	Call Progress	3-8
3.4.3	Connection	3-9
3.4.4	Disconnection	3-9
3.4.5	Receiving Calls	3-9
4	TA Configurations	4-3
4.1	Factory Configurations	4-4
4.1.1	X.21 Factory Configurations	4-5
4.1.2	V.24 Factory Configurations	4-8
4.2	User Configurations	4-12
4.3	Loading a Configuration from the Front Panel	4-13
4.3.1	From the Front Panel	4-13
4.3.2	By AT Command	4-14
4.4	Manipulating TA Configurations	4-15
4.5	Resetting the TA	4-17
5	Advanced Configurations	5-1
5.1	Display and TA Mode Commands	5-1
5.2	X.21 Interface Commands	5-2
5.3	V.24 Interface Commands	5-3
5.4	Data Format Commands	5-4
5.4.1	Rate Adaption	5-4
5.4.2	Synchronous Operation	5-4
5.4.3	Asynchronous Operation	5-5
5.5	ISDN Facilities	5-6
5.5.1	Port Mapping	5-6
5.5.2	Multiple Subscriber Numbering	5-8
5.5.3	Sub-addressing	5-10
5.5.4	Calling Line Identification	5-11
5.6	Security Control	5-12

5.7	Remote Configuration	5-14
6	Operational Facilities	6-1
6.1	The ISDN Number Directory	6-1
6.1.1	Storage of ISDN Numbers	6-2
6.1.2	Display of Directory Entries	6-3
6.1.3	Deletion of Directory Entries	6-3
6.2	Making Outgoing Calls	6-4
6.2.1	Front Panel Dialling	6-4
6.2.2	Control Signal Dialling	6-5
6.2.3	Dialling by AT Command	6-5
6.2.4	Call Connection Sequence	6-6
6.2.5	The Blacklist	6-7
6.3	Answering Calls	6-8
6.4	Security in Operation	6-10
6.5	Command Response Codes	6-12
7	Diagnostic Facilities	7-1
7.1	Introduction	7-1
7.2	Test Details	7-2
7.2.1	Local Digital Loopback	7-2
7.2.2	Remote Digital Loopback	7-3
7.3	Testing Via the Front Panel	7-4
7.3.1	Local Digital Loopback	7-4
7.3.2	Remote Digital Loopback	7-4
7.4	Testing by Command	7-5
7.4.1	Local Digital Loopback	7-5
7.4.2	Remote Digital Loopback	7-5
7.5	Testing Via DTE Interface Signals	7-6
7.5.1	Local Digital Loopback	7-6
7.5.2	Remote Digital Loopback	7-6
7.5.3	Test State Indication	7-7
8	The AT Commands	8-1
8.1	AT Command Summary	8-2
8.2	AT Command Descriptions	8-4
9	S-Registers	9-1
9.1	Introduction	9-1
9.2	Manipulating S-Registers	9-3
9.3	Non-Bit-Mapped S-Registers	9-4

10	V.25bis Commands	10-1
10.1	Command Structure	10-2
10.2	Commands	10-3
10.3	Responses	10-6

Appendices

A	Product Specification	A-1
B	Interface Descriptions	B-1
B.1	Standalone Interfaces	B-1
	B.1.1 Full V.24 Interface	B-1
	B.1.2 Full X.21 Interface	B-2
	B.1.3 Command Port Interface	B-2
	B.1.4 ISDN Interface	B-3
B.2	Rackmount Interfaces	B-4
	B.2.1 V.24 Primary Interface	B-4
	B.2.2 X.21 Primary Interface	B-5
	B.2.3 Full V.24 Interface	B-5
C	Country Specific Information	C-1
C.1	Supplementary Services	C-1
C.2	Blacklisting	c-2
D	Technical Reference	D-1
D.1	Standalone TA Links and Switches	D-1
D.2	Rackmount TA Links and Switches	D-3
E	AT Command/S-Register Cross References	E-1
E.1	AT Command to S-Register	E-1
E.2	S-Register to AT Command	E-3

Figures

1-1	The ISDN Basic Rate Interface	1-3
1-2	The Standalone TA Front Panel	1-5
1-3	The Standalone TA Rear Panel	1-7
2-1	DTE/TA Configuration (Standalone TA)	2-4
4-1	X.21 Factory Configuration 0	4-5
4-2	X.21 Factory Configuration 1	4-6
4-3	X.2 1 Factory Configuration 2	4-7
4.4	V.24 Factory Configuration 0	4-8
4-5	V.24 Factory Configuration 1	4-9
4-6	V.24 Factory Configuration 2	4-10
4-7	V.24 Factory Configuration 3	4-11
4-8	TA Software Configurations	4-15
5-1	Port Mapping	5-6
5-2	Two-Number Lines	5-7
5-3	Line Sharing	5-7
5-4	Incoming Call Barring	5-8
5-5	MSN Example Application	5-9
5-6	Sub-addressing Example Application	5-10
7-1	Local Digital Loopback	7-2
7-2	Remote Digital Loopback	7-3
D-1	Standalone Card Layout	D-1
D-2	Rackmount Card Layout	D-3

Tables

4-1	Loading a Configuration	4-13
4-2	Configuration Recall and Save Commands	4-16
6-1	TA Response Codes	6-12

PART 1

BASIC OPERATION

Chapter 1	Introduction
Chapter 2	Installation
Chapter 3	Getting Started

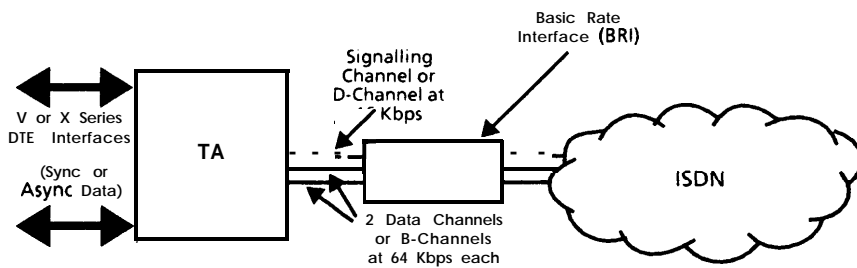
1.1 Overview

The ISDN TA Plus is an ISDN Basic Rate Terminal Adaptor. It is available as either a standalone unit or a rackmount card which is suitable for use in the Network 16 rack system.

The TA is able to:

- Interface two non-ISDN devices to a single ISDN Basic Rate Interface (BRI).
- Handle call setup and call clearing activities.
- Deal with the possible difference in speed between a non-ISDN device and a logical data channel (or B-Channel) on the BRI. This is known as rate adaption.

The TA is designed to co-exist with other ISDN devices on a single ISDN termination.



The D-channel is used to set up and clear down calls and to pass any other control information between the user equipment and the network.

Figure 1-1 The ISDN Basic Rate Interface

As the TA is compliant with international standards on call setup (Q.931) and rate adaption (V.110 and X.30), it is capable of interworking with

ISDN equipment available from other manufacturers which is also compliant.

The TA is configured and controlled by the **AT** command language, which allows you to configure the TA in a number of different ways to suit your computer and its application software. In addition to dialling via **AT** commands, calls can also be initiated by a DTE control signal interface or via the front panel.

For some applications, the TA will need no configuration. However, for the majority of applications some configuration will be required, so a number of pre-stored factory configurations are provided. These are designed to minimise the setup required as they relate to common applications of the product.

Each DTE port on the TA has its own configuration. It is possible therefore to have a different application running on DTE port 1 from that running on DTE port 2.

The following variants of the TA are available:

- Standalone V.24
- Standalone X.21
- Rackmount V.24 (primary signals only - see Appendix B.2.1)
- Rackmount X.21 (primary signals only - see Appendix B.2.2)

1.1.1 Data Channels

Existing users of Case modems and similar devices will notice a difference in the user interface with both terminal and front panel operation. This is because the TA is a multi-channel device which allows each channel to be separately controlled and configured. The Getting Started chapter explains clearly how these multiple channels can be controlled.

Despite this difference, existing and new users will find that the user interface has been designed to be intuitive, flexible and compatible in many ways with existing products.

1.2 Physical Description

The TA has two physical variants: standalone and rackmount. Both variants have the same controls and indicators on their front panels. The standalone TA has its own connections on the rear panel - the rackmount TA connects to the line, DTEs, etc, via the rack system.

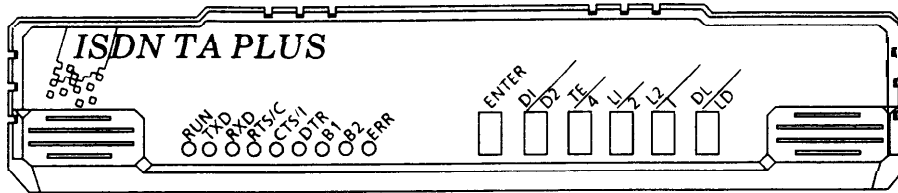


Figure 1-2 The Standalone TA Front Panel

1.2.1 The LEDs

The LEDs on the front of the TA have the following meanings:

RUN	On if power-up self-check passed. Flashes when in test mode.
TXD	Flashes at half-second interval if the data channel is enabled and clear to transmit data.
RXD	Flashes at half-second interval if the data channel is enabled and clear to receive data.
RTS/C	Request To Send or Control interface.
CTS/I	Clear To Send or Indicate interface.
DTR	Data Terminal Ready.
B1	On if the B1 channel is available. Flashes at one-second intervals if a call is in progress. Off if the channel is not available.
B2	On if the B2 channel is available. Flashes at one-second intervals if a call is in progress. Off if the channel is not available.
ERR	Error indication for diagnostic purposes.

1.2.2 The Buttons

The TA has six push-buttons on the front panel:

ENTER (ENT on the rackmount)	<p>The ENTER button is similar in function to the Return key on a terminal. To perform an operation from the front panel it is necessary to select the appropriate buttons and then initiate the operation by depressing the ENTER button for at least 3 seconds.</p> <p>If the TA is powered up with this button depressed, it will be reset to its factory default condition. Note that all user configurations and the directory will be cleared and the active configuration will be reset on both data ports.</p>
D1/D2	<p>Use to select the port that front panel commands and the RUN, TXD, RXD, RTS/C, CTS/I and DTR LEDs relate to. The button should be latched into select port 2 and latched out for port 1.</p>
TE/4	<p>TE is currently unused.</p> <p>Use as 4 in conjunction with the DULD, 2 and 1 buttons to select a directory entry or configuration.</p>
L1/2	<p>Use as L1 to initiate a local test loop.</p> <p>Use as 2 in conjunction with the DL/LD, 4 and 1 buttons to select a directory entry or configuration.</p>
L2/1	<p>Use as L2 to initiate a remote test loop.</p> <p>Use as 1 in conjunction with the DL/LD, 4 and 2 buttons to select a directory entry or configuration.</p>
DULD	<p>Use as DL to dial a number.</p> <p>Use as LD to load a configuration.</p>

Note that each of the last four buttons is dual function and must be latched into select either of the two functions it controls.

1.3 The Connections

The standalone TA connections are on the rear panel. The layout is shown in Figure 1-3.

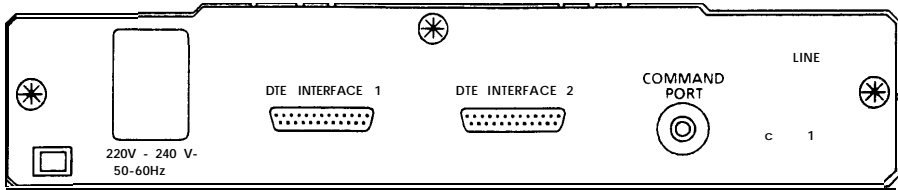


Figure 1-3 The Standalone TA Rear Panel

The rackmount TA unit connects with sockets on the rack system. For more information, see the installation instructions in Section 2.4 and the Network **16** Reference Manual.

- | | |
|--------------------------|---|
| DTE INTERFACE 1,2 | These are both female 25-way D-type connectors for direct connection of V.24 devices, or 25-way to 15-way conversion cables for connection of X.21 devices. |
| COMMAND PORT | 3.5 mm stereo jack socket to accept the command port adapter. |
| LINE | RJ45 socket for connection of the line cord to the ISDN BRI. |

There is also a standard 3-pin mains socket for connection of mains power via the mains lead.

2.1 Pre-Installation

2.1.1 Requirements

To install the TA you will need to provide access to an ISDN BRI termination.

DTE Cables

Two straight-through cables if you have a **V.24** standalone TA.

Cables are provided for **X.21** standalone and rackmount TA.

Rackmount

If you have a rackmount TA you will need to provide:

A Network 16 rack and power supply.

A Network 16 Controller Module with associated terminal and cable to configure the TA via the command port. If there is no Controller Module, you just need the terminal and cable.

Standalone

An asynchronous terminal and a pin-to-pin cable to connect the TA (via the command port jack socket) to the terminal port.

A mains power socket outlet installed near the TA, easily accessible and capable of supplying **100 mA** at the nominal voltage and frequency.

2.1.2 Siting

The TA is designed for use in a domestic, office or computer room environment. The standalone TA should be sited:

- Sufficiently close to the mains power outlet so as not to cause strain on the connecting cable, and so as to allow a person to touch the outlet and the TA simultaneously.

. Sufficiently close to the ISDN termination so as not to cause strain on the connecting cord.

- Away from sources of heat such as radiators or direct sunlight.
- Away from sources of radiation such as motors and video displays.

2.2 DTE and Command Terminal

Your data DTE will probably be one of the following:

- A 'dumb' terminal (VDU) connected directly to the TA.
- A PC containing a software package which facilitates communication with the TA, or which puts the PC in "terminal emulation" mode.
- A terminal connected to a computer which is able to communicate with the TA.

It will transmit and receive data in one of the following ways:

- Asynchronous mode only.
- Synchronous mode only.
- Asynchronous or synchronous mode (switchable).

Consult the DTE's manual for the relevant information.

2.2.1 Controlling the TA

To control your TA, you will need to send AT commands to it. (V.25bis commands are a special case, discussed in Chapter 10.)

Depending on the type of DTE you will use, there are three ways in which your DTE and TA can be configured to allow both data and commands to be handled satisfactorily. These are illustrated in Figure 2-1 and explained below.

A. DTE for Asynchronous Data and Asynchronous Commands

If your DTE works in straightforward asynchronous mode, you can connect it to the TA's DTE port and use this connection both for data and for commands entered from the DTE's keyboard.

B. DTE for Synchronous Data and Asynchronous Commands

If your DTE works in synchronous mode for data, and is easily switchable to asynchronous mode for commands, you can connect it to the TA's DTE port and use this connection both for synchronous data and for asynchronous commands entered from the DTE's keyboard.

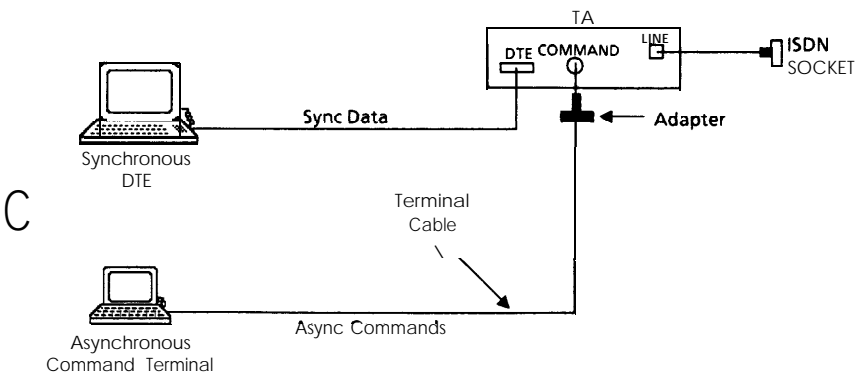
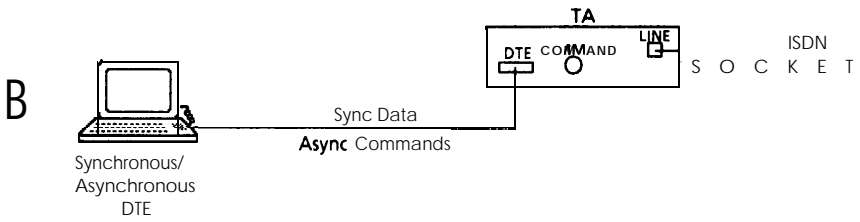
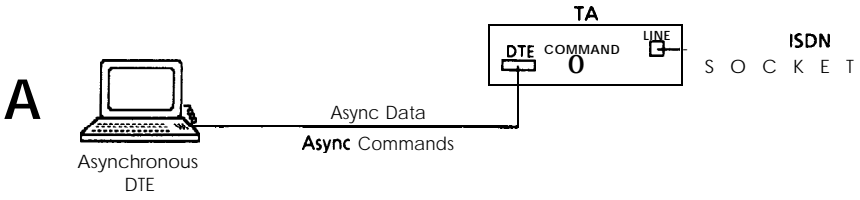


Figure 2-1 DTE/TA Configurations (Standalone TA)

C. DTE for Asynchronous or Synchronous Data, and Command Terminal for Asynchronous Commands

If your DTE operates in synchronous mode only (or is not easily switchable between synchronous and asynchronous), or is a PC or computer that does not have an AT compatible communications package, you will need a separate asynchronous command terminal. This can conveniently be connected to your TA's separate command port.

2.2.2 DTE Configuration

For entering asynchronous commands via the DTE port, your DTE may communicate in either of the following character formats:

- 1 start bit, 7 data bits, odd or even parity, 1 stop bit, or
- 1 start bit, 8 data bits, no parity bit, 1 stop bit.

and at any one of the following baud rates:

38400,19200,9600,4800, 2400,1200 or 600 bps.

Your DTE should be set to suit the requirements of the remote DTE with which you wish to communicate. (If these are not known, or if you want to access a number of different remote DTEs, set your DTE initially to 9600 bps, 7 data bits, even parity and 1 stop bit.)

The TA will not automatically set itself to suit the DTE setting. These are default settings and may be altered by using the /Un and" Un commands.

2.2.3 Command Terminal Configuration

Your separate asynchronous command terminal must have the following character format:

- 1 start bit, 7 data bits, even parity, 1 stop bit.

The data rate must be 9600 bps for a standalone TA or 1200 bps for a rackmount TA.

2.3 Installing the Standalone TA

2.3.1 Power Supply Connection

WARNING: Do not connect the TA to the mains socket or to the ISDN line at this stage.

The standard TA is supplied for use on 220-240 VAC mains supplies. The voltage for which it is set is shown on the rear panel. Check that the voltage shown is correct for your mains supply before proceeding further. If it is not, refer to your supplier.

The mains cable from the TA is provided with a moulded plug for connection to a standard UK mains socket outlet. If this plug is not suitable for your socket, refer to the Appendix entitled 'Country-Specific Information' for details of how to change it. Do not use an adapter.

When you are sure the TA is correctly rated for your mains supply, plug the mains lead into the mains supply to earth the TA. Do not switch on until all other connections have been made.

2.3.2 DTE Port Connection

Connect the 25-way D-type plug on the DTE cable to the TA's DTE INTERFACE port.

2.3.3 Command Port Connection

The port is provided on a stereo jack socket labelled COMMAND PORT. An adapter cable to convert this to a standard 25-way D-type socket (ISO 2110) is provided (see Appendix B for details). Connect your terminal cable to the adapter.

2.3.4 Line Connection

Unless the separate earth connection has been used, the mains plug must *first* be inserted in a power outlet (to earth the TA), *before* connecting the TA to the line.

Connect the TA's ISDN interface lead into the ISDN BRI termination provided by the PTT.

2.4 Installing the Rackmount TA

The TA should only be used in a rack system for which it has been designed and approved. Full installation details are given in the manual for the rack system.

2.4.1 Power Supply Connection

The rackmount TA draws its power from the rack power supply. There is no power switch on the TA.

2.4.2 DTE Port Connection

The connections for the TA's DTE port are via the 96-way connectors between the TA circuit board and the rack system. Connections to the DTE are made from the back of the rack. See the rack system manual for details of the pin allocations.

2.4.3 Command Port Connection

The connections for the TA's command port are via the 96-way connectors between the TA circuit board and the rack system.

The command port for the rackmount TA is normally routed to the rack Controller Card. Appendix B contains details of how to route the command port via the DTE connector.

2.4.4 Line Connection

The TA's connections for the line are via the 96-way connectors between the TA circuit board and the rack system. Connections to the ISDN line are made from the back of the rack. See Appendix B.2 for details.

3.1 Starting Up

Having successfully completed installation (see Chapter 2) you are now ready to start using the TA. This section explains the basics of communicating with the TA and setting up a call.

To start, you will need a terminal connected to the command port or either DTE port for a standalone TA, or to the rack for a rackmount TA.

Initially, both DTE interfaces will be set to the default configuration based on DTE type (Factory configuration O for X.21 or V.24 – see Section 4.1).

Note that the TA can be reset to the default condition at any time by powering down and powering back up with the ENTER button depressed for five seconds.

CAUTION - This reset will also clear ALL directory and security password entries.

3.2 Commanding the TA

3.2.1 Multiple Ports

Unlike a modem, the TA has multiple ports, each of which is separately controllable and configurable.

There are three ports in the TA:

Number	Name	Description
0	COM	Command port
1	DTE1	DTE port 1
2	DTE2	DTE port 2

Commands can be entered into the TA via any of these ports. The ports can be setup for suitable baud rates and data formats for terminal communications.

All configuration and operational commands affect each port independently, with the exception of the main part of the ISDN number directory, which is shared between both data ports (see Section 6.1).

When issuing a command, it is important to select the port which you want the command to affect (i.e. **COM**, **DTE1**, **DTE2**). This is achieved by preceding the intended command with the port selection command **-Yn** where **n** is the port number. The port selection command thus allows all ports to be configured without the need to move the terminal connection from port to port.

Once a port is selected, all subsequent commands will affect that port until a different port is selected using the **-Yn** command. The default settings will display the currently selected port in the terminal prompt (**AT-Zn**) and will also indicate the port affected by the command in its event message (**AT/S1**).

3.2.2 The AT Command Set

The TA uses the 'AT' command set. These commands are used to exercise the powerful features of your TA, such as:

- . Making user configurations.
- . Saving ISDN numbers in the directory.
- . Auto-dialling ISDN numbers.
- . Performing TA tests.

Section 3.3 provides an explanation of the AT command language with simple working examples. We recommend you to read this even if you have used AT commands before.

The AT commands are listed alphabetically in Chapter 8.

3.2.3 The V.25bis Command Set

CCITT has defined the V.25bis Recommendation for commands. However, it is much more limited than the AT command set, as it only covers dialling an ISDN number. Your TA has been equipped with a V.25bis command set to make it compatible with hosts using software based on this language. Details are in Chapter 10.

3.3 The AT Command Format

3.3.1 Basic Format

AT (attention) is the prefix to commands to the TA. It must be typed:

AT or at

in all upper or all lower case (not mixed cases).

Carriage return (<CR >) is the terminator to commands, causing the TA to action them. It is produced by the RETURN, ENTER OR ↵ key on your DTE.

For example, if from your keyboard you type:

AT< CR>

the TA will respond with:

```
OK
DTE_PORT1 >
```

AT by itself (followed by <CR >) is a command without any required action. Your TA responding with OK indicates that it has recognised the AT. This sequence is useful for checking that the TA is responding correctly.

3.3.2 Example Commands

A useful command is *C, which will display a summary of your TA's configuration. To execute this command, type:

AT* C< CR>

Another useful command is *S, which will display a summary of your TA's S-register settings (S-registers are discussed in Chapter 9). To execute this command, type:

AT* S< CR>

3.3.3 Combining Commands

If you wish to enter two or more commands, they can be combined on a single command line up to a maximum of 80 characters, for example:

AT* C* S< CR>

will display your TA's configuration and then the S-register summary.

You can use space characters between commands to increase their legibility, for instance:

```
AT *C *S< CR>
```

will give an identical response to the previous sequence.

The following commands cannot form part of a command string: % D, % W, o/o X and o/o Z. Some other commands (e.g. &F*n*) will cause subsequent commands to be ignored.

3.3.4 Repeating Commands

You can cause the TA to repeat the last command sequence entered. If you now type:

```
AI
```

this will cause the previous AT *C *S sequence to be repeated. Note that this is an exception to the rule: it requires neither the AT prefix nor the <CR > terminator.

3.3.5 Editing a Command Line

If you make a mistake when entering a command line, you can use the backspace key to reposition the cursor and you can then correct the mistake by overtyping. Note, however, that you cannot backspace over the AT.

3.3.6 Command Option Numbers

Some commands require you to enter a number (often represented by *n*) to specify one of a list of options (e.g. AT*E**n*). If you omit the number, 0 is assumed (for example AT*E* is the same as AT*E*0).

3.3.7 The OK and ERROR Responses

When a 'configuration' command is successfully executed, the message OK is returned by the modem. No messages are generated with 'dialling' commands. An ERROR response indicates incorrect command syntax.

3.3.8 Response Codes

Responses to entered commands can be sent by the TA to the terminal in various forms, as selected by certain commands (X*n* and/S*i*).

3.3.9 Port Selection

To select the required port, use the **AT-Yn** command, where **n** is the port number, i.e. 0 for command port, 1 for DTE 1, and 2 for DTE2.

The standalone TA will default the COM port settings to have echo, verbose, prompt and extended response codes ON and will power up pointing to DTE1. Therefore, when you type **AT< CR >** the response should be:

```
DTE_PORT 1>
```

The extended response setting (/S 1) will display the port name, i.e. /DTE 1 or /DTE2, to be appended to all event messages. For example, the RINGING message that appears during dialling is displayed as RING ING/DTE 1.

Important information for rack users with controller software version earlier than 01/04/A:

The rackmount TA will default the COM port settings to have echo, verbose, prompt and extended response codes OFF and will power up pointing to DTE1. When using a Controller Module (with software version earlier than 01/04/A) to connect to the TA you should, on connection to the channel, enter the following command sequence:

```
AT -YE1V1-Z1/S1-Y1 < CR >
```

This will not be echoed to the terminal. The command will switch echo, verbose response codes, prompt and extended response codes ON and should respond with:

```
OK  
DTE_PORT 1>
```

Before disconnecting from the channel, you must set the command port back to its previous condition.

```
AT -Y E0V0-Z0/S0 -Yn <CR>< esc > where n = 1 to point to DTE1  
2 to point to DTE2
```

Note that the port which is set on exit will be the port which is controlled by the Controller Module when applying tests, etc. However, events will be reported from all ports (with no port identification appended to messages).

If you disconnect from the channel without typing this sequence, a Local Response Error will occur.

It is useful to programme these sequences into function keys on your terminal.

3.4 Making a Call

When you have successfully completed installation and set up a terminal to control the TA, you should be ready to make a call (assuming default configuration). Provided that both ports on the TA are of the same type (X.21 or V.24), it is a good idea to set up a call between the two ports on the TA (you can do this using the link settings - refer to Appendix D).

3.4.1 Dialling

To dial a number from a terminal connected to the command port, you must first select the data port to dial from, for example, type `AT-Y2 <CR >` if DTE2 is the required port. Then dial the number by typing for example, `ATDO1 23456789 <CR>`. For other methods of call setup, see Section 6.2.

3.4.2 Call Progress

During the progress of the call connection, various messages will appear on the screen.

For a successful call setup from DTE2 to DTE 1 the following messages should appear:

<code>RING/DTE1</code>	Notification of incoming call.
<code>RINGING/DTE2</code>	Called party line is 'ringing'.
<code>CONNECT xxxxx /DTE2</code>	Call connected (where xxxxx is the connection speed).
<code>CONNECT xxxxx /DTE 1</code>	Call connected (where xxxxx is the connection speed).

If the call is unsuccessful, the following messages may appear:

<code>BUSY</code>	Called party or line is busy.
<code>ABORTED</code>	Call aborted by calling party.
<code>DISCONNECTED</code>	Call dropped by called party.

For an explanation of all possible call progress messages, see Section 6.2.4.

3.4.3 Connection

Once a `CONNECT` message appears, you are able to pass data between the two connected terminals at the specified data rate (xxxxx).

3.4.4 Disconnection

To disconnect the call, type **ATH <CR>**. The TA will drop the call and respond with the message:

```
OK
DTE_PORT_1>
DISCONNECTED/16/DTE2
ABORTED/DTE1
```

The numeric response code '16' is the clearance cause. For an explanation of clearance causes see the Xn command in Chapter 8.

If you are controlling the TA via an asynchronous DTE connected to the DTE port, two actions are required to disconnect a call:

1. Type + + + (the escape sequence). This produces the message:

```
OK/DTE1
```

2. Now type **ATH** and press RETURN. This produces the message:

```
OK
DTE_PORT_1>
ABORTED/DTE1
```

3.4.5 Receiving Calls

The TA is configured to automatically answer calls. It will indicate an incoming call with the message **RING ING** and on successful answer will display the **CONNECT** message. For a full explanation of the incoming call acceptance procedure, see Section 6.3.

PART 2

ADVANCED OPERATION

Chapter 4	TA Configurations
Chapter 5	Advanced Configuration
Chapter 6	Operational Facilities
Chapter 7	Diagnostic Facilities
Chapter 8	The AT Commands
Chapter 9	S-Registers
Chapter 10	V.25bis Commands

4.1 Factory Configurations

The TA is supplied with four factory stored configurations (numbered 0 to 3) for each interface type (i.e. X.21 and V.24). The TA will know the interface type for each port and will default to Factory Configuration 0 on initial power up. The following sections detail the factory configurations listed below:

X.21 Factory Config. No.	Description
0	Synchronous data, auto-detect of speed (incoming), manual dial.
1	Synchronous data, 9600 bps, control signal dial.
2	Synchronous data, 64 kbps, V.25bis HDLC commands via DTE port.
3	Synchronous data, 19200 bps, V.25bis byte synchronous commands via DTE port.

V.24 Factory Config. No.	Description
0	Asynchronous data, 19200 bps, manual dial, AT commands via DTE port.
1	Asynchronous data, 9600 bps, manual dial, AT commands via DTE port.
2	Synchronous data, 19200 bps, DTR dial.
3	Synchronous data, 9600 bps, DTR dial, V.25bis byte synchronous commands via DTE port.

Factory configurations are loaded either by using the **AT** command **&Fn**, or from the front panel (see Section 4.3). Each DTE port has its own configuration; therefore, loading Factory Configuration 1 on DTE port 1 will have no effect on the configuration of DTE port 2.

4.1.1 X.21 Factory Configurations

X.21 Factory Configuration 0

(Synchronous data, auto-detect of speed (incoming), manual dial)

This configuration's parameters are set up as follows:

-R 1	Rate Adaption	Auto-detect
&Q1	Operation Mode	Sync, async dial
-P3	Port Mapping	B1 or B2
"U23	Data Rate	64 kbps
&co	I Control	On
'AJO	End-to-End Controls	None
&IO	Constant Speed I/F	Disabled
*VO	DTE Command Mode	None

Applications:

This configuration is primarily designed to allow outgoing calls at 64 kbps on a clear channel or to accept incoming calls at any speed. When accepting incoming calls the DTE speed will follow that indicated in the call setup message and the clock will reflect this. The rate adaption scheme will also follow that indicated in the call setup message for incoming calls. The rate adaption will be X.30 for outgoing calls.

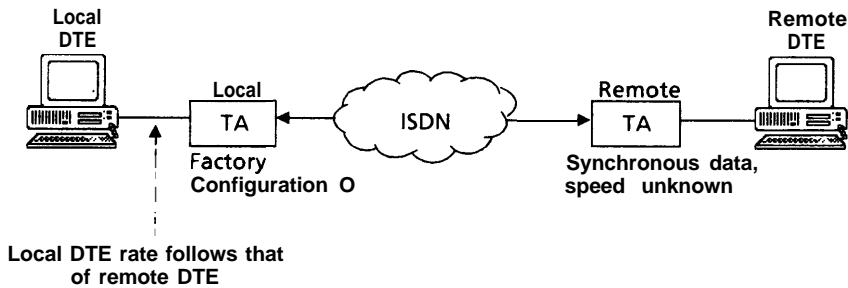


Figure 4-1 X.21 Factory Configuration 0

This is the preferred configuration for synchronous applications where the configuration of the remote TA is unknown.

X.21 Factory Configuration 1

(Synchronous data, 9600 bps, control signal dial)

This configuration's parameters are set up as follows:

-R3	Rate Adaption	X.30
&Q2	Operation Mode	Sync, C dial
-P3	Port Mapping	B1 or B2
"U13	Data Rate	9600 bps
&C0	I Control	On
&J0	End-to-End Controls	None
&I1	Constant Speed I/I?	Enabled
*VO	DTE Command Mode	None

Applications:

This configuration is suitable for backup of synchronous medium speed leased circuits (9600 bps) where the DTE supports a secondary port and can assert the 'C' control for dialling. It can also be used for obtaining extra bandwidth on demand to a known location and peak-hour loading, where additional bandwidth is required only occasionally.

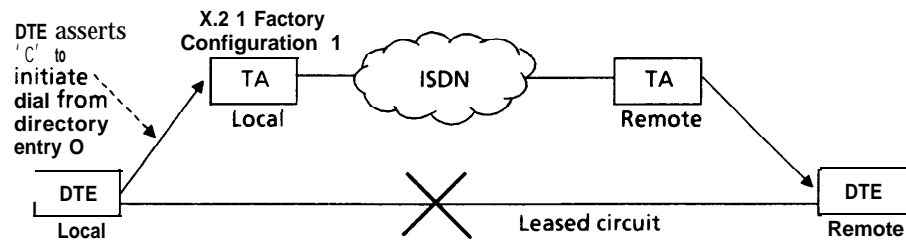


Figure 4-2 X.21 Factory Configuration 1

The diagram depicts a backup application. Typically, a second aggregate channel of a multiplexer can be used for backup should the primary aggregate fail.

When the 'C' control is asserted, the local TA will attempt to connect to the number stored in directory entry 0. When the 'C' control is dropped the call will be terminated. If a connection attempt fails, and one or more alternative numbers have been specified in the same directory entry (see Section 6.1), attempts will then be made to connect to one of these.

X.21 Factory Configuration 2

(Synchronous data, 64 kbps, V.25bis HDLC commands via DTE port)

This configuration's parameters are set up as follows:

-R3	Rate Adaption	X.30
&Q2	Operation Mode	Sync, manual dial
-P3	Port Mapping	B1 or B2
"U23	Data Rate	64 kbps
&CO	I Control	On
%J0	End to End Controls	None
&I1	Constant Speed I/F	Enabled
*V3	DTE Command Mode	V.25bis HDLC

Applications:

This configuration is suitable for backup of synchronous high speed leased circuits (64 kbps) where the DTE supports a secondary port and can assert the 'C' control for dialling. It can also be used for obtaining extra bandwidth on demand to a known location and peak-hour loading, where additional bandwidth is required only occasionally.

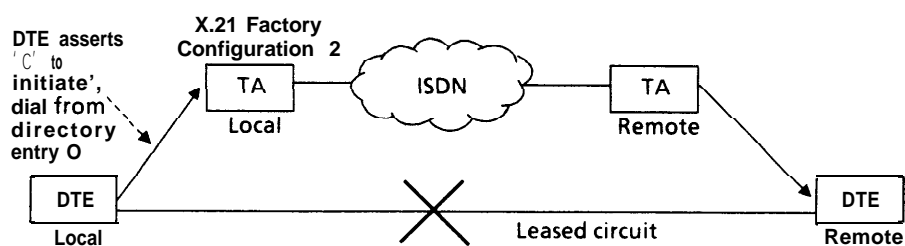


Figure 4-3 X.21 Factory Configuration 2

The diagram depicts a backup application. Typically, a second aggregate channel of a multiplexer can be used for backup should the primary aggregate fail.

When the 'C' control is asserted, the local TA will attempt to connect to the number stored in directory entry O. When the 'C' control is dropped the call will be terminated. If a connection attempt fails, and one or more alternative numbers have been specified in the same directory entry (see Section 6.1), attempts will then be made to connect to one of these.

X.21 Factory Configuration 3

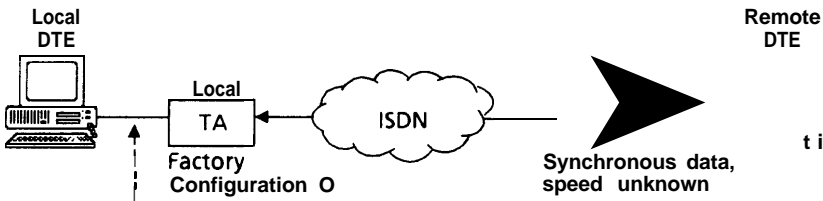
(Synchronous data, 19200 bps, V.25bis byte synchronous commands via DTE port)

This configuration's parameters are set up as follows:

-R 1	Rate Adaption	Auto-detect
&Q1	Operating Mode	Sync, manual dial
-P3	Port Mapping	B1 or B2
"U17	Data Rate	19200 bps
&co	I Control	On
%J0	End-to-End Controls	None
&I0	Constant Speed I/F	Disabled
*V2	DTE Command Mode	V.25bis Sync

Applications:

This configuration is primarily designed to allow outgoing calls at 64 kbps on a clear channel or to accept incoming calls at any speed. When accepting incoming calls the DTE speed will follow that indicated in the call setup message and the clock will reflect this. The rate adaption scheme will also follow that indicated in the call setup message for incoming calls. The rate adaption will be X.30 for outgoing calls.



Local DTE rate follows that of remote DTE

Figure 4-1 X.21 Factory Configuration 0

This is the preferred configuration for synchronous applications where the configuration of the remote TA is unknown.

4.1.2 V.24 Factory Configurations

V.24 Factory Configuration 0

(Asynchronous data, 19200 bps, manual dial)

This configuration's parameters are set up as follows:

-R2	Rate Adaption	V.110
&Q0	Sync/Async Mode	Async
-P3	Port Mapping	B1 or B2
“U17	Data Rate	19200 bps
/U7	Data Format	8/N/1
&co	DCD/DSR Control	On
%R1	CTS Control	Follow RTS
%J0	End-to-End Controls	None
&I1	Constant Speed I/F	Enabled
*V0	DTE Command Mode	None

Applications:

This configuration is suitable for asynchronous connection at 19200 bps.

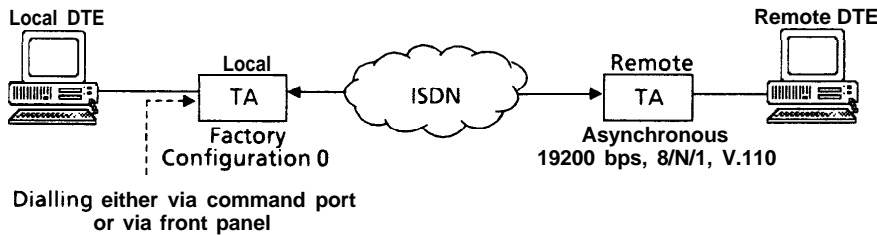


Figure 4-4 V.24 Factory Configuration 0

This is the preferred configuration for applications where connections are expected to be made to, or accepted from, known TAs when the speed is fixed at 19200 bps. **Dialling** can be initiated either via **AT** commands on the command port or from the front panel buttons. A typical application would be File transfer.

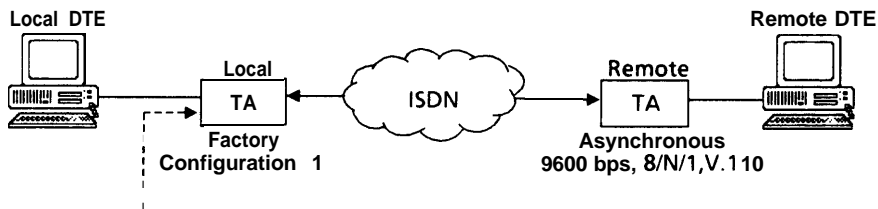
V.24 Factory Configuration 1

(Asynchronous data, 9600 bps, manual dial)

-R2	Rate Adaption	V.110
&Q0	Operation Mode	Async/async dial
-P3	Port Mapping	B1 or B2
“U13	Data Rate	9600 bps
/u 7	Data Format	8/N/1
&co	DCD/DSR Control	On
%R1	CTS Control	Follow RTS
%J0	End-to-End Controls	None
&I1	Constant Speed I/F	Enabled
*V0	DTE Command Mode	None

Applications:

This configuration is suitable for asynchronous connection at 9600 bps.



Dialling either via command port
or via front panel

Figure 4-5 V.24 Factory Configuration 1

This is the preferred configuration for applications where connections are expected to be made to, or accepted from, known TAs when the speed is fixed at 9600 bps. Dialling can be initiated either via **AT** commands on the command port or from the front panel buttons. A typical application would be file transfer.

V.24 Factory Configuration 2

(synchronous data, 19200 bps, DTR dial)

This configuration's parameters are set up as follows:

-R2	Rate Adaption	V.110
&Q2	Operation Mode	Sync/DTR Dial
-P3	Port Mapping	B1 or B2
"U17	Data Rate	19200 bps
	Data Format	
&CO	DCD/DSR Control	On
%R1	CTS Control	Follow RTS
%J0	End-to-End Controls	None
&I1	Constant Speed I/F	Enabled
&V0	DTE Command Mode	None

Applications:

This configuration can be used to provide additional bandwidth when the capacity of a leased circuit is reached. Backup of synchronous medium-speed leased circuits (19200 bps) is also possible.

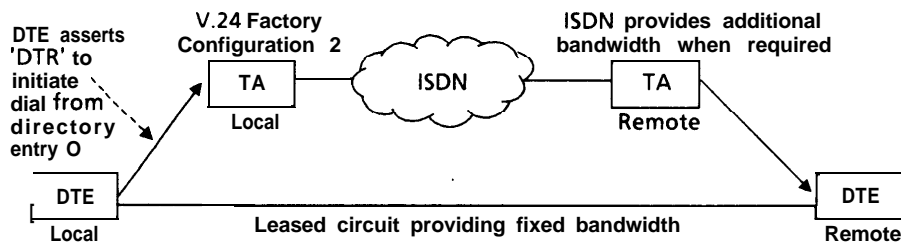


Figure 4-6 V.24 Factory Configuration 2

The diagram depicts a bandwidth on demand application. An example of the type of equipment where this is applicable would be a LAN bridge or router, packet switch exchanges and possibly multiplexer. In each case the DTE requires a second DTE port which can raise 'DTR' to initiate a call.

When the 'DTR' control is asserted, the local TA will attempt to connect to the number stored in directory entry O. When the 'DTR' control is dropped, the call will be terminated. Alternative numbers can be specified by using the / modifier within the directory entry.

When the 'C' control is asserted, the local TA will attempt to connect to the number stored in directory entry O. When the 'C' control is dropped the call will be terminated. If a connection attempt fails, and one or more alternative numbers have been specified in the same directory entry (see Section 6.1), attempts will then be made to connect to one of these.

V.24 Factory Configuration 3

(Synchronous data, 9600 bps, V.25bis byte synchronous commands via DTE port)

This configuration's parameters are set up as follows:

-R2	Rate Adaption	V.110
&Q2	Operating Mode	Sync/manual dial
-P3	Port Mapping	B1 or B2
"U13	Data Rate	9600 bps
	Data Format	
&co	DCD/DSR Control	On
%R 1	CTS Control	Follow RTS
%J0	End-to-End Controls	None
&I1	Constant Speed I/F	Enabled
*V2	DTE Command Mode	V.25bis Sync

Applications:

This configuration is suitable for synchronous connection at 9600 bps.

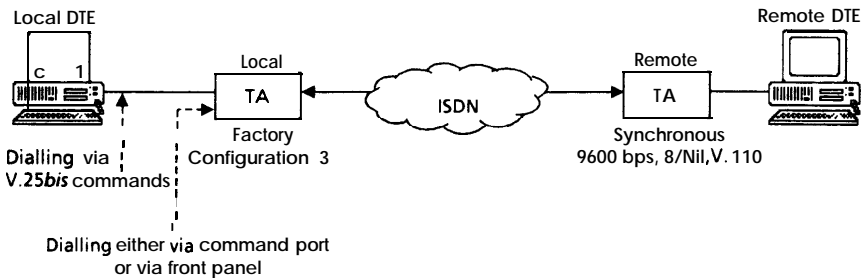


Figure 4-7 V.24 Factory Configuration 3

This is the preferred configuration for V.25bis dialling applications where connections are expected to be made to, or accepted from, known TAs when the speed is fixed at 9600 bps. Dialling can be initiated either via AT commands on the command port or from the front panel buttons, or via V.25bis commands on the DTE port.

4.2 User Configurations

You can create up to four special customised user configurations for each DTE port and store them in the TA's non-volatile memory.

To achieve this:

1. Choose the factory configuration that is closest to the configuration you want (see Section 4.1) and load it using the **&Fn** command or from the front panel, as described in Section 4.3. YOU will then have an 'active' copy of that configuration profile in memory.
2. Amend the active copy using the appropriate AT command(s) - see Chapters 5 and 8.
3. Store the amended configuration profile as a user configuration using the **&Wn** command, as described in Chapter 8.

4.3 Loading a Configuration

4.3.1 From the Front Panel

To load either a factory or user configuration from the front panel:

1. Power down the TA.
2. Select the port to load using the **D1/D2** button.
3. Select your configuration by pressing the appropriate buttons shown in **Table 4-1**.

CONFIGURATION	BUTTON SELECTION		
	TE/4	L1/2	L2/1
Factory 0	out	out	out
Factory 1	out	out	in
Factory 2	out	in	out
Factory 3	out	in	in
User 0	in	out	out
User 1	in	out	in
User 2	in	in	out
User 3	in	in	in

Table 4-1 Loading a Configuration

4. Push in the **DULD** button to select load.
5. Execute the load by pressing the **ENTER** button whilst powering up the TA. *Do not keep the button depressed for longer than about five seconds after power-up, otherwise the TA will reset.*
6. Return all latching buttons to the 'out' position.

4.3.2 By AT Command

To load a factory configuration by command, key the following:

AT-Ym&Fn <CR> where m is the port number, 1 or 2
n is the factory configuration number 0, 1,2
or 3

To load a user configuration by command, key the following:

AT-YmZn <CR> where m is the port number, 1 or 2
n is the user configuration number 0, 1,2 or 3

4.4 Manipulating TA Configurations

Apart from loading configurations (as described in Section 4.3), there are various additional facilities available for manipulating configuration profiles by using **AT** commands. The following list is a summary of these facilities.

- &Fn** Recall (i.e. load) a factory configuration
- Zn** Recall (i.e. load) a user configuration
- &Wn** Save the active configuration as a user configuration
- *C** Display the active configuration
- Tn** Copy the active configuration from port **n** to the current port

A diagrammatic representation of the configurations and commands is given in Figure 4-8.

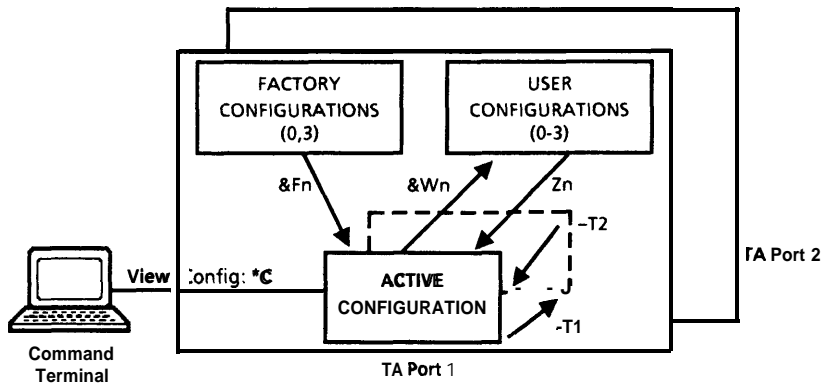


Figure 4-8 TA Software Configurations

The 'active' configuration for a given port is the one currently in operation defining the characteristics of that port. It is accessible from the command terminal. The active configuration is always retained in non-volatile memory when the TA is switched off.

When you recall/load a configuration (factory or user), it is copied into the active area, replacing the previous active configuration. You can then change and save the new active configuration so that it becomes a new user configuration (O-3) in memory.

The relevant commands are summarised in Table 4-2.

CONFIGURATION	RECALL COMMAND	SAV COMMAND
Factory 0	&F0	
Factory 1	&F1	
Factory 2	&F2	
Factory 3	&F3	
User 0	Z0	&W0
User 1	Z1	&W1
User 2	Z2	&W2
User 3	Z3	&W3

Table 4-2 Configuration Recall and Save Commands

4.5 Resetting the TA

You can reset the TA to its original default state as follows:

1. Switch off the TA.
2. Ensure all front panel buttons are out.
3. Hold the **ENTER** button depressed.
4. Switch on the TA.
5. Release the **ENTER** button after 5 seconds.

The message:

RESTART/CP

will be displayed on the terminal connected to the command port.

This reset clears all user configurations and ISDN numbers from memory, makes factory configuration O the active configuration, and allows you to start afresh.

This chapter describes the various types of commands and their typical applications. Full details of the commands can be found in Chapter 8.

5.1 Display and TA Mode Commands

These commands are used to determine the kind of display produced by various functions and to activate/deactivate various modes in which the TA may operate.

The following commands must be addressed to the port to which the command terminal is connected (selected using the `-Yn` command):

<code>En</code>	Echo commands
<code>-Zn</code>	Port prompt
<code>Qn</code>	Quiet mode
<code>Vn</code>	Verbose response codes
<code>Xn</code>	Response code levels
<code>/Sn</code>	Extended response code enable
<code>&On</code>	S-Register output format

The following commands provide device dependent information and are port independent:

<code>ln</code>	Identity codes
<code>*Q9</code>	Set serial number

The following command is applicable to each data port:

<code>&Sn</code>	Front panel switch control
----------------------	----------------------------

5.2 X.21 Interface Commands

These commands are used to determine how the TA interacts with the DTE and with X.21 control signals on the DTE interface.

The commands directly affecting the interface are:

&Cn	Indicate control
&In	Constant speed interface
!Jn	End-to-End control signals
&Qn	Synchronous/asynchronous mode and C control
-Rn	Rate adaption
"Un	DTE Rate

Various timeout control commands affect the interface:

*Bn	Rate Adaption Synchronisation timeout period
*Tn	Rate Adaption Synchronisation loss timeout

5.3 V.24 Interface Commands

These commands are used to determine how the TA interacts with the DTE, and with V.24 control signals on the DTE interface.

The commands directly affecting the interface are:

&Cn	DCD and DSR control
&In	Constant speed interface
%J n	End-to-end control signals
&Qn	Synchronous/asynchronous mode and DTR
%R n	RTS/CTS control
-Rn	Rate adaption
/Un	Asynchronous data format
“Un	DTE rate
*Wn	DSR control
/On	DSR control while tests active

Various timeout control commands also affect the interface:

/An	RTS timeout control
*Tn	Rate adaption synchronisation loss timeout
*Bn	Rate adaption synchronisation and RTS timeout period

5.4 Data Format Commands

-Rn	Rate adaption
&Qn	Async/sync mode and DTR/C control
"Un	DTE rate
&In	Constant speed interface
/Un	Asynchronous format

5.4.1 Rate Adaption

Rate adaption is the method of converting **64** kbps synchronous data on the B-channel, to a lower speed on the DTE ports in either synchronous or asynchronous format. The TA supports both V. **110** and X.30 rate adaption.

The **-Rn** command allows you to select the rate adaption scheme you wish to use. In general, you would use X.30 for X.21 interfaces, and V.110 for V.24 interfaces. By using a setting of **R 1** the TA will automatically select X.30 for outgoing X.21 calls and V.110 for outgoing V.24 calls. For incoming calls this setting will mean that the TA will follow the rate adaption scheme requested in the incoming call request message.

5.4.2 Synchronous Operation

Synchronous operation is selected using the **&Qn** command with settings of **&Q1, &Q2, &Q3** or **&Q10**.

DTE Rate/Clocking

The DTE rate defines the clock rate that is presented on the DTE interface, and also the rate adaption speed. It is set using the "U n command.

For outgoing calls, the speed set will be included in the call request message for verification by the remote TA.

For incoming calls, if Constant Speed Interface is enabled (via the **&In** command with settings of **&I1** or **&I2**), then the call will only be accepted if the incoming speed matches that set with " **Un**. If Constant Speed Interface is disabled (setting **&I0** or **&I3**), then the DTE rate will be set to that defined in the incoming call request packet for the duration of the call. In this case, the DTE must be able to follow the clock provided by the TA.

The TA always takes its clock from the BRI. Clocks presented on the DTE ports are therefore derived from this central clocking source.

5.4.3 Asynchronous Operation

Asynchronous operation is selected by means of the **&Qn** command, with a setting of **&Q0**, **&Q4**, **&Q5**, **&Q6** or **&Q11**.

DTE Rate/Format

The DTE rate defines the rate at which asynchronous data is processed on the DTE interface, and also the rate adaption speed. It is set using the **Un** command.

For incoming calls, the call will be accepted only if the incoming speed matches that set with **Un**.

The data format is set using the **/Un** command.

5.5 ISDN Facilities

The ISDN basic rate interface provides two independent data channels (B-channels) on one physical connection. Up to eight devices may be connected to one line, with up to two simultaneous data connections possible. A number of facilities are provided by the ISDN to enable users to uniquely identify each terminal/device and also to have control over who is dialling in. These are described in the following sections, with application examples given where appropriate.

Note that the supplementary services, Calling Line Identification (CLI), Multiple Subscriber Numbering (MSN) and Sub-addressing are available on the ISDN basic rate interface by arrangement and *must* be subscribed to before they can be used by the TA (see Appendix C for country-specific service availability).

5.5.1 Port Mapping

Port mapping is achieved by using the `-Pn` command. The setting determines how calls are mapped between the ISDN data channels (B-channels) and the physical DTE ports.

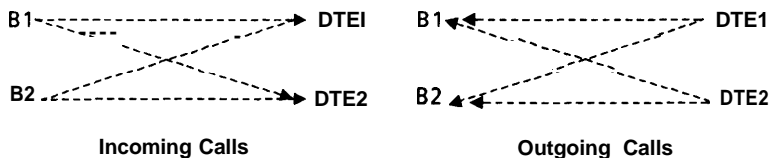


Figure 5-1 Port Mapping

The default setting, shown above, is such that the B-channels B1 and B2 will map to both DTE ports, which means that any incoming call can be received by either DTE and any outgoing call may be sent on either B-channel. In practice, priority is given to the DTE1 port for incoming calls and the B 1 channel for outgoing calls. Thus, when an incoming call is received, the TA will first try to setup the call to DTE1 and if this fails (due to 'port busy', or 'incompatible format' for example), it will try to set up the call to DTE2. On an outgoing call from either DTE port, channel B1 will be used if free but, if not, channel B2 will be used.

Instead of being mapped to both B-channels (as outlined above), each DTE port may alternatively be mapped to one channel or even none. These other settings are illustrated below with example applications.

Single Channel Mapping

Two-Number Lines

In some countries, ISDN BRI lines can be provided with two numbers for each line, where each B-channel has a unique number associated with it (check Appendix C for availability). Mapping each DTE port to one B-channel (e.g. DTE1 to B1 and DTE2 to B2) provides a unique number for each terminal:

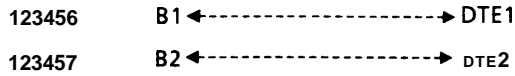


Figure 5-2 Two-Number Lines

This is equivalent to having two physically separate lines.

Line Sharing

Where more than two devices are connected to the line, it may be desirable to allocate one B-channel to one group of devices and the other B-channel to another group (use in conjunction with MSN or sub-addressing for device selection - see Sections 5.5.2 and 5.5.3). If two-number lines are used (see above), each group may have a unique number. Alternatively, one device may require sole access to one B-channel and the remaining devices are to share the other B-channel. Under these circumstances, both DTEs on a TA may be mapped to the same B-channel, for example:

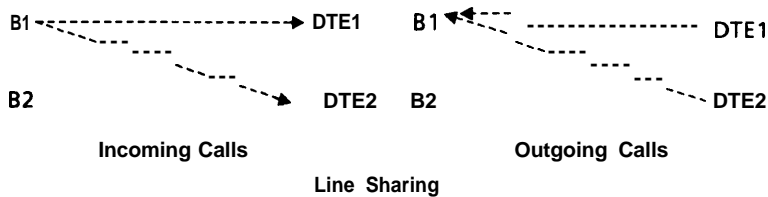


Figure 5-3 Line Sharing

Incoming calls will always be offered to DTE1 first. If both DTE ports have identical configurations, then the call will never be answered by DTE2.

Zero Channel Mapping

Incoming Call Barring

If a device is required to make outgoing calls only, then the DTE should not be mapped to either B-channel. This will mean that no incoming calls are offered to the DTE port, but outgoing calls can still be made on either B-channel, for example:

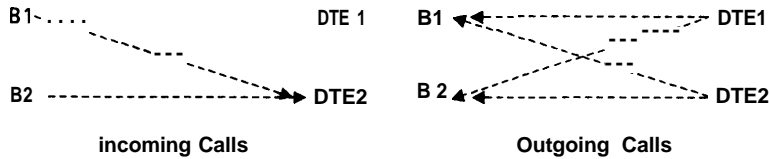


Figure 5-4 Incoming Call Barring

The above diagram illustrates the case where DTE1 is unmapped and DTE2 is mapped to both channels. Incoming calls will only be offered to DTE2, but outgoing calls from both DTE 1 and DTE2 may be sent on either B-channel.

Out of Service DTE Port

If a DTE port on the TA is unused or disconnected, then this DTE should be unmapped so that no incoming calls can be accepted on that port.

Port Mapping Warning

Selective call barring using port mapping commands P1 and P2 should only be practiced on two-numbered lines, as this is the only situation where incoming calls can be guaranteed to be presented on a particular B-channel.

Where single-numbered or MSN lines are in use then selective call barring using port mapping is not recommended. In these cases the only useful settings are P0 and P3.

5.5.2 Multiple Subscriber Numbering

The MSN service allows a range of numbers to be used on one ISDN line for the purpose of terminal selection. Typically, a block of ten numbers is assigned, with the last digit being used to identify the terminal.

This facility must first be obtained from the ISDN provider. It can then be activated on each port using the **-Nn** command. One or more MSN numbers must be defined for the port in the ISDN number directory using the **c Ctrl-W** modifier (see Section 6.1 and Chapter 8 for more details).

For incoming calls, the called number will be checked against all MSNs in the directory for each port, to look for a match. If no match is found, it will not respond to the call. If MSN is not enabled on the port, no check will be made, i.e. the TA will respond to a call to any number in the range.

For outgoing calls, the first MSN stored in the directory for the port will be sent as calling party number information to the receiving TA, i.e. this number will be used in CLI checking, if the CLI facility is enabled at the receiving end (see Section 5.5.4). If MSN is not enabled for the sending port, no calling party number information will be provided by the network.

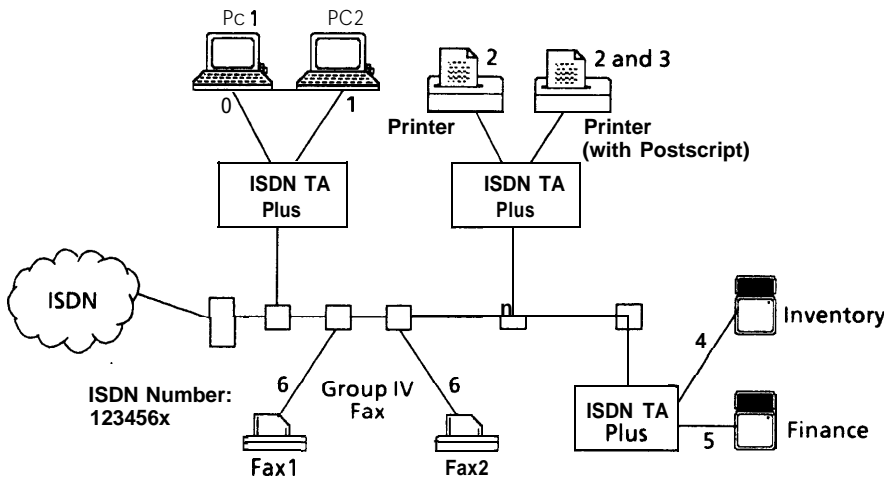


Figure 5-5 MSN Example Application

In the above example, MSN allows callers to select a specific device by dialling the relevant number:

Number dialled Device

1234560	Pc 1
1234561	PC2
1234562	Both printers
1234563	Printer with Postscript capability

1234564	Inventory system
1234565	Finance system
1234566	Both fax machines

5.5.3 Sub-addressing

Sub-addressing allows the caller to specify extra addressing information, over and above the ISDN number. It is a more flexible alternative to MSN for terminal selection, allowing the user to specify a unique alphanumeric string of up to four characters as the identifier for each port.

This facility must first be obtained from the ISDN provider. A sub-address can then be stored for each port using the `-An` command and activated using the `-Sn` command.

For incoming calls, the sub-address will be checked against the string stored for each port of a given TA. If it does not match for either port, the TA will not respond to the call. If Sub-addressing is not enabled on a port, no check will be made, i.e. that port will respond to a call presenting any sub-address.

For outgoing calls, the sub-address of the calling device is not sent for CLI purposes (see Sections 5.5.4).

To make calls to a device with Sub-addressing enabled, the sub-address must be included in the dial string, using the `<Ctrl-U>` modifier (see Section 6.2).

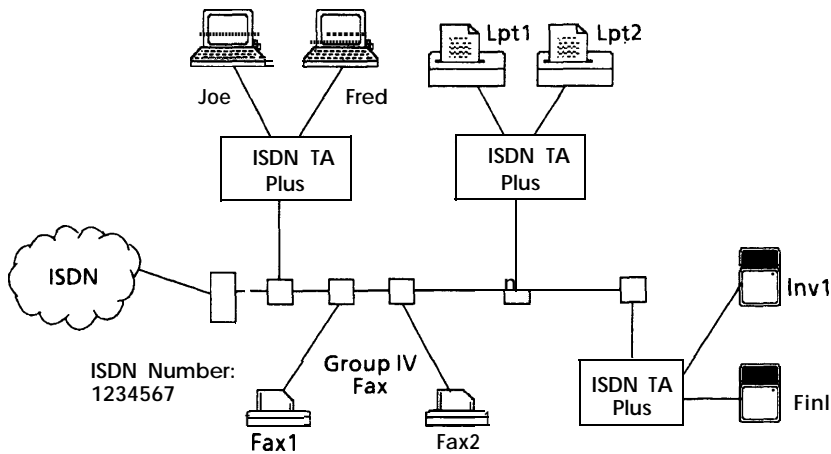


Figure 5-6 Sub-addressing Example Application

In the above example, Sub-addressing allows callers to select a specific device by dialling the number and appending the relevant sub-address:

Number Dialed	Sub-address	Device
1234567	Joe	PC (Joe)
1234567	Fred	PC (Fred)
1234567	Lpt1	Printer 1
1234567	Lpt2	Printer 2
1234567	Inv1	Inventory system
1234567	Finl	Finance system
1234567	Fax1	Fax 1
1234567	Fax2	Fax 2

This facility may also be used in combination with port mapping (see Section 5.5.1), especially with regard to sharing lines. In the case of two-number lines, selection will be allowed by both number and sub-address.

5.5.4 Calling Line Identification

Calling Line Identification is a security feature which allows an incoming call to be accepted or rejected depending on the calling number.

It is a supplementary service which must be obtained by subscription from the ISDN line supplier.

A list of acceptable calling numbers may then be stored in the ISDN number directory and the facility enabled for each port of the TA.

On call set up, the network presents the number of the calling party to the TA. The TA can then check this against its list of allowed CLIs. If the number is not in the list, then the call will be rejected.

The following AT commands are used for CLI (see Section 6.1 and Chapter 8 for more details):

- Qn** to enable/disable CLI.
- Nm &Z <Ctrl-K>** to store the numbers in the CLI directory.

The CLI facility can be enabled and the numbers defined independently for each port. If CLI is not enabled on a given port, then the calling number will not be checked against the list for that port.

For outgoing calls, the calling number is automatically presented to the called party originates from the network, except where MSN is in use, in which case it is provided by the calling TA (see Section 5.5.2).

5.6 Security Control

The purpose of security control on the TA is to guard against 'wrong-number' and malicious callers.

The TA incorporates four elements of security: Incoming Call Barring, CLI, Level 1 and Level 2. All security features are independently configured for each port on the TA.

Incoming Call Barring

-Pn Map port

If a device is required to make outgoing calls only, then to protect against unwanted callers, the port can be unmapped from the B-channels using the command setting **-PO**. This will mean that no incoming calls are offered to the DTE port, but outgoing calls can still be made on either B-channel.

(For more information on port mapping, see Section 5.5.1.)

CLI

-Qn Calling line identification facility
NM&Z Store an ISDN number

Calling Line Identification is a security feature which allows an incoming call to be rejected if the calling number is not on the destination TA's list.

The **<Ctrl-K>** modifier (CLI number store) is used. For more information on CLI, see Section 5.5.4.

Level 1 and Level 2 Security

Once a call has been accepted at the network level there are two options available for security checking before a data connection is established. These are proprietary techniques and must be enabled at both ends of the call. They may be used in conjunction with, or instead of CLI.

The two security options available are Level 1 and Level 2. Level 1 is appropriate to closed user groups, while Level 2 is appropriate to central access via a Controller Module.

The security level is invoked and the passwords and identifier keys are defined using the following AT commands:

- "E Security control level selection
- "Z Password store (8 characters)
- "W Key/user identifier store (three characters)

In the case of Level 1 security, the password/key pairs defined within TAs on a network would normally be the same. Wherever these differ from each other, however, the password and key of the called device can be specified with the dial number (using the modifiers < Ctrl-G > and < Ctrl-I >), either manually when making a call, or within the relevant directory entry (see Chapter 8). These strings will then override, for the duration of the call, the password and key stored in the calling device (which would be the strings that are normally sent). The override facility is applicable also to Level 2 security.

See Section 6.4 for more details.

5.7 Remote Configuration

The TA provides the user with the ability to obtain a copy of the current active configuration profile from a remote TA, to edit this information, and to send the revised profile back to the remote device to replace the previous active configuration profile. Security control may be used to prevent unauthorised remote configuration (see Section 5.6).

The AT commands involved are:

<code>%En</code>	Remote configuration control
<code>%Xn</code>	Remote upload
<code>%Z</code>	Enter remote configuration edit mode
<code>%W</code>	Exit remote configuration edit mode
<code>%Dn</code>	Remote download

Prior to issuing commands to upload or download a configuration, a call must first be setup to the remote TA. For each configuration transfer (upload or download), the call is momentarily dropped and then re-established automatically by the TA.

To illustrate the use of the remote configuration commands, the general procedure is given below. Before starting, you must ensure that the setting of command `%En` on the relevant ports of both the local and the remote TAs allows for remote configuration (see Chapter 8).

1. `ATDnnnn` Dial the remote number (may include dial modifiers such as password, key, sub-address, etc)
Typical response: RINGING/DTE 1
CONNECT 64000/DTE 1
2. `AT%Xn` Upload a copy of the remote TA's active configuration on port n, where n = 0, 1 or 2. A value of 0 represents the remote port to which you are currently connected; 1 and 2 represent remote ports DTE 1 and DTE2, respectively.
Typical response: ABORTED/DTE 1
RINGING/DTE1
CONNECT 64000/DTE 1
MONITOR GRANTED/DTE1
3. `AT%Z` Allow the uploaded remote configuration to be edited. To display the remote configuration, use the `*C` command - the configuration table will be headed REMOTE

CONFIGURATION. Edit the configuration using the relevant AT commands.

- 4. **AT%W** Return to local configuration and control.
- 5. **AT%Dn** Download the new configuration to port **n** of the remote TA, where **n** = 0, 1 or 2, as before.
Typical response: **ABORTED/DTE1**
RINGING/DTE1
CONNECT 64000/DTE 1
RECONFIGURE GRANTED/DTE1

Note: On completion of remote configuration, the call will remain in progress until it is dropped by using the ATH command or by some other means; configuration changes made to the remote TA will not be actioned until this time.

5.8 V.25bis Mode

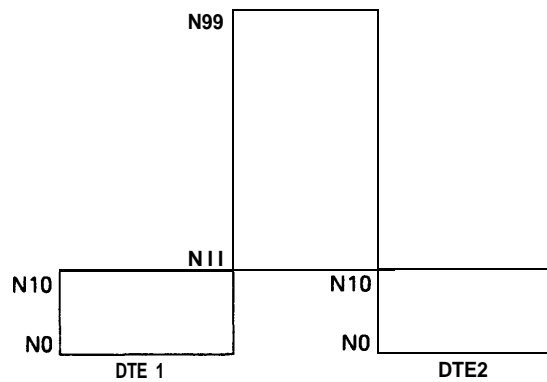
The following commands allow you to select V.25bis mode so that you can enter V.25bis commands (described in Chapter 10).

*Vn	Select V.25bis command mode
010 On	Bisync character format

This chapter describes the operational facilities offered by the TA, and details the relevant AT commands and front-panel buttons.

6.1 The ISDN Number Directory

The TA directory provides storage for up to 110 ISDN dial numbers, each having a length of up to 50 characters. These number entries are structured as three distinct lists, one of which is common to both ports (DTE1 and DTE2), the other two being specific to each. The following is a diagrammatical representation of the directory structure, showing the distribution of entries between the two ports:



Directory entry numbers NO to N10 are private to each port and can only be accessed if the directory command is issued to the particular port. However, numbers stored in directory locations N11-N99 are accessible to both DTE ports.

The **Nm&Z** command is used for storing dial numbers in specific locations (see Section 6.1.1).

For instance, to store a dial-out number in DTE1's directory, you might type:

AT-YI N5&Z0123456789

This number will be stored in location 5 for DTE1, and will not be accessible to DTE2. It will then be possible to dial the number, from DTE1, purely by reference to location 5 (see Section 6.2).

Note that there is no directory associated with the command port (COM).

Incoming Numbers

As well as storing numbers for dialling out, the directory can also store numbers which are used by the ISDN supplementary services CLI and MSN (see Section 5.5). When the relevant service is subscribed to and enabled on the TA, these stored numbers are used to determine whether or not to accept an incoming call.

As for outgoing numbers, each CLI or MSN number in the directory can be associated with one or both DTE ports. The same command is used for storing incoming numbers, but with the addition of a modifier (see Section 6.1.1).

6.1.1 Storage of ISDN Numbers

The command to store an ISDN number in the directory is:

Nm&Z Where m is the directory-entry location (0-99)

Modifiers

The modifiers listed below may be used with the **Nm&Z** command (see Chapter 8 for more details).

Outgoing numbers:

:text:	Store a remark with directory numbers
< >	Secret number modifier (number will not be displayed)
/	Alternative number delimiter
U	Repeat dial modifier
<Ctrl-G>	Store a password
<Ctrl-I>	Store a user identifier/key
<Ctrl-U>	Store a sub-address number

Incoming numbers:

<Ctrl-K>	Store a CLI number
<Ctrl-W>	Store an MSN number

6.1.2 Display of Directory Entries

- &Nn** Display entries in the ISDN directory
- Nm?** Display a single directory entry

Directory entries may be displayed using the appropriate command.

There are three ways of recalling and dialling outgoing numbers stored in the directory:

By selecting one of the locations O-7 using front panel buttons (see Section 6.2.1).

By raising DTR/C signal on the DTE interface, when the TA will dial the number stored in location O (see Section 6.2.3).

By AT command from the terminal or computer program (see Section 6.2.4).

6.1.3 Deletion of Directory Entries

- &N99** Delete entries in the ISDN directory

All entries in the ISDN directory are deleted by submitting this command.

6.2 Making Outgoing Calls

Calls from the TA maybe initiated by front panel operation, control signals or AT commands.

6.2.1 Front Panel Dialling

The front panel buttons can be used to dial any of the ISDN numbers pre-stored in locations 0-7 or the ISDN directory:

1. Select the port to dial from, by using the **D1/D2** button.
2. Push in the **DULD** button to select the dial option.
3. Select the directory location of the number you wish to dial, by using the **L2/1**, **L1/2** and **TE/4** buttons, as follows:

Location	TE/4	L1/2	L2/1
0	out	out	out
1	out	Out	In
2	Out	In	out
3	Out	In	In
4	In	out	out
5	In	Out	In
6	In	In	out
7	In	In	In

4. Press and release (after three seconds) the **ENTER** button to initiate dialling.
5. Return all latching buttons (except the **D1/D2** button) to the 'out' position.

On successful call connection, the **TXD** and **RXD** LEDs will flash at half-second intervals and either the **B1** or **B2** LED will flash at one-second intervals, depending on which channel the call is on. (If another call is in progress, then both the **B1** and **B2** LEDs will be flashing.) Note that the setting of the **D1/D2** button will affect the **TXD**, **RXD**, **RTS/C**, **CTS/I** and **DTR** LEDs, since these always show the status of the currently selected DTE.

If the call is unsuccessful, then the **RXD** and **TXD** LEDs will be off. If the **B1** and **B2** LEDs are also off, and the **RUN** LED is on, this indicates that the ISDN line is not connected or may be faulty.

To disconnect the call:

1. Select the required port, by using the **D1/D2** button.
2. Return the **DULD** button to the 'out' position.
3. press the **ENTER** button and release it after three seconds.

The **TXD** and **RXD** LEDs will go out and the **B1** or **B2** LED will stop flashing, but will remain on.

Note that another situation in which the TA will drop a call is if the remote TA disconnects or if an **ATH** command is issued.

6.2.2 Control Signal Dialling

Call connection to the number stored in directory location NO may be made automatically, by raising the DTR (V.24) or C (X.21) signal of the DTE.

To make a TA port accept such dialling instructions you must first configure the port for control signal dialling by means of the command setting **&Q2** (synchronous) or **&Q5** (asynchronous).

You must then store the required number in directory location NO (see Section 6.1) for the relevant port. Note that you may specify automatic redial and alternative numbers within the directory entry to allow some degree of re-routing/retry (see Section 6.1.1).

Once the port has been set up in the above manner, the DTE can initiate a call by raising the DTR/C signal. The TA will dial the number stored in location NO for the relevant port.

To terminate the call, the DTE must drop the DTR/C signal.

Alternatively, the call can be disconnected by using the H command or via the front panel (see Section 6.2.1). As always, the TA will also drop the call if the remote TA disconnects.

6.2.3 Dialling by AT Command

The **D** command can be used to dial a number from the command port. This command can either contain the full dial string or reference a directory entry. The following dial modifiers may be used (see Chapter 8):

Nm	Directory-entry specifier for stored number
I	Alternative number delimiter
U	Redial until answered

<Ctrl-G>	Password
<Ctrl-I>	User identifier/Key
<Ctrl-U>	Sub-Address Number

The call can be disconnected by using the H command or via the front panel (see Section 6.2.1). The TA will drop the call if the remote TA disconnects.

6.2.4 Call Connection Sequence

During the process of call connection, various messages will appear on the terminal connected to the command port.

On entering the dial command the TA will respond with either of the following:

OK	Command accepted.
ERROR	Dial command syntax is incorrect.

The TA will then attempt to dial the number, which will produce one of the following responses:

RINGING	Call connection initiated.
BUSY	Called party line is busy.
DISCONNECTED	Network rejects call (i.e. number is not to a valid service).
NO DIALTONE	ISDN line not connected/not available.

One of the following events will then occur:

CONNECT xxxxx	Call connected (where xxxxx is the connection speed).
ABORTED	Call aborted by TA, i.e. conditions for connection not established.
DISCONNECTED	Remote device has rejected call (e.g. incompatible port types, no CLI match etc).
ACCESS DENIED	Security access failed (see Section 6.4).
NO ANSWER	No response from remote device within three minutes.

Once the CONNECT message has been displayed, the call has been set up and the channel is available to pass data at the specified rate.

If, during a call, the rate adaption synchronisation is lost, the RETRAIN message will be displayed.

6.2.5 The Blacklist

In many countries, for PSTN, there are rules relating to the minimum time intervals that must elapse between automatic **dialling** attempts. Currently there are no rules for ISDN, but the TA implements its own 'blacklisting' procedures based on those used for modems. The specific rules are defined in Appendix C.2.

The blacklisting only affects dialling with automatic retry i.e. whenever the U modifier is used.

The number specified with the U modifier is automatically dialled at the intervals defined by the blacklist specification, until one of the following conditions is met:

- A call is successfully established (i.e. a CONNECT message is obtained).
- The dial attempt is aborted by an H command or from the front panel.
- The maximum number of redial attempts has been made (defined in S-register S36 - see Chapter 9).

6.3 Answering Calls

When an incoming call request is received by the TA, it will make a series of checks against the information provided by the network before deciding whether the port is eligible to accept the call. These checks will be made first by port 1, and then, if that port is ineligible, by port 2. The TA gives priority to port 1 for incoming calls.

Port Busy

The incoming call on a B-channel will be checked against the port mapping (-Pn). See Section 5.5.1.

Sub-address

If sub-addressing is enabled on the port (-Sri), the sub-address set (-An) will be checked for a match with the dialled sub-address number. See Section 5.5.3.

Multiple Subscriber Numbering

If MSN is enabled on the port (-Nn), the MSNS set in the directory (Nm&Z<Ctrl-W> modifier) will be checked for a match with the dialled number. See Section 5.5.2.

Synchronous/Asynchronous Mode

The incoming call format is checked against that set (&Qn).

Rate Adaption

The incoming call rate adaption must match that set (-Rn). If auto-detect is set (-R 1) then the rate adaption scheme will assume the incoming call setup for the duration of the call.

Constant Speed Interface

If the constant speed interface is enabled for the port (&l), then the data rate of the incoming call must match the port's DTE rate ("U n).

Calling Line Identification

If CLI is enabled on the port (-Qn), the CLIS set in the directory (Nm&Zc Ctrl-K> modifier) will be checked for a match with the incoming number. See Section 5.5.4.

If the call is not eligible up to this point, it will be offered to the other port.

Auto-answer

If the port is eligible, then the TA will generate a **RING** message, which will be repeated every six seconds until answered. By default (S-register **SO= 1**), this call will be answered automatically on the first ring. If **SO = 0**, then the call can be answered manually using the **A** command or by raising the **DTR/C** signal if configured in **CDSTL** mode (**&Q 10, &Q 11**). For **SO= n**, the call will be answered automatically on the **n**th ring or manually using the **A** command or by raising the **DTR/C** signal, as for **SO = 0**.

Note that if the call is not answered at this point, it will not be offered to the other port.

Level 1 and 2 Security Check

If Level 1 or 2 security is enabled in the TA, the password and key must be validated before a data connection can be established. See Section 6.4.

If security fails, the message **ACCESS DEN IED** will appear on the terminal. Note that if the call is rejected at this point, it will not be offered to the other port.

If all the above criteria are met, the incoming call will be accepted and a connection established. The message **CON NECT xxxxx** will appear on the terminal, where **xxxxx** is the speed during this connection.

6.4 Security in Operation

The four elements of security incorporated by the TA (Incoming Call Barring, CLI, Level 1 and Level 2) are independently configured for each port on the TA, as explained in Section 5.6.

Once configured, Incoming Call Barring and CLI are transparent to the user when the TA is in operation.

Level 1 and 2 security are specific to Case and require that both calling and called TAs are configured with the same level of security.

Level 1- Closed User Group

This option involves the exchange of an encrypted password and key between two consenting devices, before a connection can be established between them. If the two password/key pairs are identical, then the link is authenticated. If no 'legal' response is received, the device will report **ACCESS DEN IED** and then drop the call.

To use both TAs this method of control, must be set for Level 1 security. The password and key of the called TA must be pre-configured using "Zp and" Wk. When a call is made, the calling TA would normally send its own password and key, which have also been pre-configured using "Zp and "Wk. If, however, the two pairs are not identical, the expected pair can be specified in the dial string, using the <Ctrl-G> and <Ctrl-I> modifiers, and these will override the stored pair for the duration of the call. The modifiers actually trigger the generation of a **Password:** prompt and a **Key:** prompt, respectively.

A typical dial sequence with modifiers might be as follows:

```
ATD0555123456 <Ctrl-G>  
Password : pppppppp <Ctrl-I>  
Key : kkk
```

Level 2- Central Access

This option is used to activate security control where a device is being used in conjunction with a rack system. It provides controlled access when dialling into a central site. If the user or the time of the call is invalid, the device will report **ACCESS DEN IED** and then drop the call.

To use this method of control, both central and remote devices must be set for Level 2 security. Users are allocated a user identifier (key) and

password in the Controller Module Security table, and their allowed days and times of access can be set. The key and password of the remote device can be pre-configured to match the relevant pair in the security table, using "Zp and "Wk. When a call is made, the calling device would normally send its non pre-configured password/key pair for matching at the other end. If, however, the two pairs are not identical, the expected pair can be specified in the dial string, using the < Ctrl-G > and < Ctrl-I > modifiers, and these will override the stored pair for the duration of the call.

The central-site TA does not need a password or key set in this mode if it is only accepting incoming calls.

6.5 Command Response Codes

During operation of the TA, information in response to commands will be presented to the terminal. These responses are explained, where appropriate, throughout the manual. Table 6-1 provides a complete list of the responses which may result from commands issued to the TA. Whether or not certain of these responses are allowed to appear will depend on the settings of the X and S commands (see Chapter 8).

TA Response Codes

Numeric (Terse) Form	Verbose Form, Standard Response	Extended Response	Description
0	OK		Command line completed
1	CONNECT		Connected
2	RING		Incoming ring
3	NO CARRIER		Remote end has dropped call
4	ERROR		Command disallowed
5	CONNECT 1200		Connected
6	NO DIAL TONE		No response from network
7	BUSY		Called party busy
8	NO ANSWER		No answer from called party
9	CONNECT 600		Connected
10	CONNECT 2400		Connected
12	RDL GRANTED		Remote loop allowed
13	RDL DENIED		Remote loop disallowed
15	ABORTED		Call aborted by user
16	TIMEOUT		Call timed out
26	BLACKLIST		Further attempts to dial number disallowed
27	LDL IN PROGRESS		Local Digital Loop in progress
28	CONNECT 4800		Connected

Table 6-1 TA Response Codes

Numeric (Terse) Form	Verbose Form, Standard Response	Extended Response	Description
30	CONNECT 9600		Connected
31	VOICE		Voice call detected
32	RINGING		Called party ringing
36	RETRAIN		Rate adaption scheme has lost synchronisation
38	DISCONNECTED	/nn	Disconnected plus clearance cause number 'nn'
40	NOT STORED		Not stored
43	CONNECT 14400		Connected
45	CONNECT 19200		Connected
49	CONNECT 38400		Connected
62	MONITOR GRANTED		Upload of configuration successful
63	MONITOR DENIED		Upload unsuccessful
64	RECONFIGURE GRANTED		Download of configuration successful
65	RECONFIGURE DENIED		Download unsuccessful
66	RECONFIGURE FAILED		Download unsuccessful due to a line problem
67	MONITOR FAILED		Upload unsuccessful due to a line problem
70	ACCESS GRANTED		Security access is granted
71	ACCESS DENIED		Security access is denied
72	CONNECT 48000		Connected
73	CONNECT 56000		Connected
74	CONNECT 64000		Connected
79	NO SECURITY		Security handshake failed

Table 6-1 TA Response Codes (continued)

Numeric (Terse) Form	Verbose Form, Standard Response	Extended Response	Description
80		/LOSS OF RTS	Loss of RTS for greater than time set in S56
81		/CONSTANT RTS	Constant RTS far greater than time set in SIO
119	TEST TERMINATED		Currently active test is terminated
129		/V.110	CCITT V.110 rate adaption format
130		/X.30	CCITT X.30 rate adaption format
131		ICLEAR	Clear channel
199	RESTART		Device reset. All configuration and directory information reset

Table 6-1 TA Response Codes (continued)

7.1 Introduction

The TA is able to run diagnostic tests to help locate the source of operational problems. The tests supported by the TA are described in Section 7.2. They are:

- Local Digital Loopback
- Remote Digital Loopback

These tests can be activated by the following (as described in Section 7.3, 7.4 and 7.5 respectively):

- Front panel buttons
- AT commands
- Signals in the DTE interface (for V.24 operation only)

Sequence of Testing

The local digital loopback test should be activated first, as this checks the digital interface of the TA and the connection to the local DTE.

The remote digital loopback test should be activated next. This test checks the connection from the local DTE, over the ISDN, to the remote TA's digital interface.

7.2 Test Details

7.2.1 Local Digital Loopback

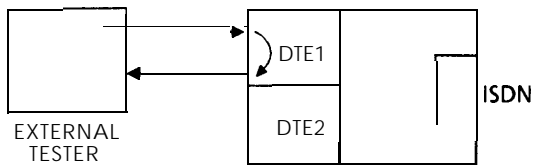


Figure 7-1 Local Digital Loopback

Local digital loopback is used to check that the digital interface of the TA is functional. The loopback can be applied to either port of the TA. It is possible to have both ports in loopback simultaneously.

Local digital loopback will loop any data received on the selected port back to the originator. Note that if a call is in progress on the selected port when a local digital loopback is activated, then the call will be cleared.

If your host equipment does not allow generation and checking of test sequences, an external data tester must be used. Data sent to the TA whilst it is in local digital loopback will be transmitted back to the user according to the format set on the TA. For example, if your TA is a V.24 device configured for asynchronous operation at 9600 bps, 8 data bits and 1 stop bit, you must ensure that the external test source is configured similarly.

It is not necessary for the TA to be connected to the ISDN for a local digital loopback to be applied. In the case of synchronous data, when the TA is not connected to the ISDN, clocks will be generated within the TA for the purpose of the loopback.

7.2.2 Remote Digital Loopback

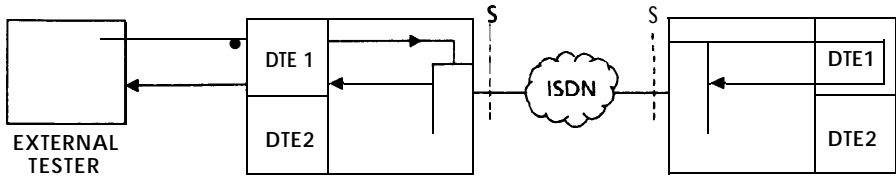


Figure 7-2 Remote Digital Loopback

Remote digital loopback is used in conjunction with an external tester to check the local DTE, the S interface of both TAs, the ISDN line and the majority of digital circuitry within the answering TA. Data integrity is determined by the generation and checking of test sequences by the external tester.

This kind of test is available in both asynchronous and synchronous configurations and can be applied to either port of the TA or both ports simultaneously.

7.3 Testing Via the Front Panel

You can use the buttons on the front panel of the TA to perform the loopback tests.

7.3.1 Local Digital Loopback

1. Ensure all buttons are out.
2. Select the port to which the loopback should be applied using the **D1/D2** button (button latched out for DTE1, button latched in for DTE2).
3. Select a local digital loopback by depressing the **L1** button.
4. Activate the loopback by depressing the **ENTER** button. The **RUN LED** will flash to indicate that the loopback has been applied.
5. Now transmit a test pattern and check correct reception.
6. To remove the loopback, ensure that the port is selected using the **D1/D2** button and that the **L1** button is out. Depress the **ENTER** button to remove the loopback. The **RUN LED** will stop flashing and should stay lit.

7.3.2 Remote Digital Loopback

1. Select the DTE port to which the test should be applied using the **D1/D2** button.
2. Make a call to establish a connection with the remote TA.
3. Depress the **L2** button at the local TA.
4. Attach the external tester to the appropriate DTE port.
5. Depress the **ENTER** button.

After pressing the **ENTER** button, the TA will momentarily drop the connection and immediately re-establish it. The following messages will be echoed to the terminal:

```
ABORTED/DTE1  
RINGING/DTE1  
CONNECT 64000/DTE 1  
RDL IN PROGRESS/DTE1
```

To remove the test, release the **L2** button and depress the **ENTER** button. This will also drop the call.

7.4 Testing by Command

The following commands are relevant to the TA diagnostics:

&Tn	Select TA test operation
S18=n	Set test timer
/On	DSR control while tests active(V.24 only)
In	Display TA identity codes

7.4.1 Local Digital Loopback

1. Select the DTE port to which the test should be applied using **AT-Yn**.
2. If required, set the test timer using **ATS18 = n** (where n = 1 to 255 seconds). To disable the timer, use **ATS 18 = 0** (default).
3. Select the local loopback test using **AT&T3**.
4. Remove the loopback using **AT&T0** or wait for the test timer to expire.

7.4.2 Remote Digital Loopback

Remote loopback can be established using the **&T** command:

1. Select the DTE port to which the test is to apply using **AT-Yn**.
2. If required, set the test timer using **ATS 18 = n** (where n = 1 to 255 seconds). To disable the timer, use **ATS18 = 0** (default).
3. Make a call to establish a connection with the remote TA.
4. Attach the external tester to the appropriate DTE port.
5. Apply the remote loopback tests using **AT&T6**.

On this command, the TA will momentarily drop the connection and immediately re-establish it. The following messages will be echoed to the terminal:

```
ABORTED/DTE1
RINGING/DTE1
CONNECT 64000/DTE 1
RDL IN PROGRESS/DTE1
```

To remove the test, use the **AT&T0** command or wait for test timer to expire. This will also drop the call.

7.5 Testing Via DTE Interface Signals

For V.24 ports, some tests can be controlled by signals from the DTE. (Note that for the rackmount TA only the Local Digital Loopback is available via the DTE signals.)

In the factory default configuration, these facilities are disabled via link settings. To enable, the link for the required test type for the DTE port to be tested must have been set as detailed in step 1 of the relevant loopback procedure (Section 7.5.1 and 7.5.2).

7.5.1 Local Digital Loopback

1. The TA's appropriate internal link (**LK18** or **LK20** for the standalone, or **LK2** or **LK3** for the rackmount) must first have been set to enable LL on the required DTE port (see Appendix D).
2. Enable the DTE local loopback test facility in software using **AT&T 14**. (Note that **AT&T13** disables the facility.)
3. Initiate the test by a signal (> + 3 V) on pin 18 (LL) of the DTE port.
4. Transmit a test pattern from the DTE and check that there is no corruption on the returned data.
5. Terminate the test by returning pin 18 (LL) to the low (<-3 V) state.

7.5.2 Remote Digital Loopback

1. The TA's appropriate internal link (**LK17** or **LK19** for the standalone, or **LK1** or **LK4** for the rackmount) must first have been set to enable LMT on the required DTE port (see Appendix D).
2. Enable the DTE remote loopback test facility in software using **AT&T12**. (Note that **AT&T11** disables the facility.)
3. Make a call to establish a connection with the remote TA.
4. Initiate the test by a signal (> + 3 V) on pin 21 (**LMT**) of the DTE port.
5. Transmit a test pattern from the DTE and check that there is no corruption on the returned data.
6. Terminate the test by returning pin 21 (**LMT**) to the low (<-3 V) state.

7.5.3 Test State Indication

The test state is indicated to the DTE by a signal from the TA on pin 25. The signal on pin 25 will go high whenever the TA is performing a test, regardless of the method used to start the test. This can be used to indicate to the DTE that the TA has entered test mode and is not available for normal transmission.

This chapter contains a description of all the AT commands that are incorporated in your TA. The commands are listed alphabetically, with symbols in the following sequence:

& * / 0/ . " -

Full instructions for entering AT commands are given in Section 3.3.

In addition to the commands that must have the AT prefix, the following do not require the prefix or the terminator.

+++ **Escape Sequence**

You must enter this sequence when your TA is on-line and you intend to use the main DTE to enter commands.

d + + + d where d is a period of silence defined in S-register S12. Its factory default is 0.5 seconds.

This sequence will produce the response OK, put the TA into command mode, and keep the current call live.

To return to the on-line mode, use the O command, or to clear the call use H.

Note that the + character can be changed by altering the contents of S-register S2.

A/ Repeat Last Command(s)

This sequence will cause the TA to repeat the previous command or command string.

8.1 AT Command Summary

A	Answer (Go Off-Hook)
/An	RTS Timeout Control
-An	Sub-address Store
&Bn	Delayed Busyout
*Bn	Timeout Increments for *Tn and /An
&Cn	DCD & DSR/Indicate Control
*C	Display Active Configuration
Dn	Dial a Number
&Dn	DTR/I Control
/O D n	Remote Download
En	Echo Commands
/O En	Remote Configuration Control
"En	Security Control
&Fn	Recall Factory Configuration
H	Go On-Hook
&Hn	On-Screen Help
In	TA Identity Codes
&In	Constant Speed Interface
/O J n	End-to-End Control Signals
Kn	Call Timer
/Kn	Reset Call Timer
&Mn	Mode Selection
Nm?	Display a Single Directory Entry
Nm&Z	Store an ISDN Number
&Nn	Display Entries in the ISDN Directory
&N99	Delete Entries in the ISDN Directory
-Nn	Multiple Subscriber Number Facility
O	Return to Online
&On	S-Register Output Format
/On	DSR Control while Tests Active
/O On	Byte Synchronous Character Format for <i>V.25bis</i>
-Pn	Map Port
Qn	Quiet Mode
&Qn	Sync/Async Mode and DTR/C Control
*Q9	Initialise Serial Number
/O Q n	<i>V.25bis</i> Special Lead Sequence
-Qn	Calling Line Identification Facility
&Rn	Request To Send-Clear To Send

/Rn	Timeout Increments for RTS-CTS Delay
/oR n	RTS/CTS Control
-Rn	Rate Adaption
Sn?	Display Single S-Register Setting
Sn =	Set an S-Register to a Value
&Sn	Front Panel Switch Control
*S	Display S-Register Summary
/Sn	Extra Response Codes
-Sn	Sub-Address Facility
&Tn	Select TA Test Operation
*Tn	Rate Adaption Synchronisation Loss Timeout
-Tn	Copy Active Conjunction
/U n	Asynchronous Format
"Un	DTE Rate
Vn	Verbose Response Codes
&Vn	Dumb Mode
*Vn	V.25bis Command Mode
&Wn	Save User Configuration
*Wn	DSR Control
o/o W	Stop Modifying the Remote Configuration
"Wk	Key Store
Xn	Response Codes
o/o Xn	Remote Upload
-Yn	Select Port
Zn	Recall User Configuration
o/o Z	Modify the Remote Configuration
"Zp	Password Store
-Zp	Port Prompt

8.2 AT Command Descriptions

A **Answer (Go Off-Hook)**

This command will cause the TA to request the exchange to accept the call.

When using rate adaption, if synchronisation is not achieved by the end of the answering sequence, the TA disconnects and responds with:

NO CARRIER

If the answer sequence is aborted by dropping DTR, the TA disconnects and responds with:

ABORTED

/An **RTS Timeout Control**

This command allows you to set a timeout facility to automatically disconnect the TA.

/AO Timeout disabled. Default.

/A1 Loss-of-RTS timeout.

/A1 causes the TA to disconnect when RTS goes low for a period held in S-register S10.

S-register S10 determines the duration of the RTS timeout (S10 is measured in increments of 1 second or 0.1 seconds, depending on the setting of the *Bn command).

-An **Sub-address Store**

This command allows you to store a port sub-address of up to four alpha numeric characters.

-Annnn where nnnn is the port sub-address.

The Sub-addressing facility is enabled/disabled using -Sn command. See also Section 5.5.3.

&Bn Delayed Busying

This command is used for maintenance purposes to prevent incoming calls.

- &B0** Normal connections. Default.
- &B1** Busy-out the line.
- &B2** Busy-out the line and initiate local digital loopback.

&B 1 or **&B2** will busy-out the ISDN line 5 seconds after the current call has ended, or immediately if no call is active. **&B0** is used to clear the busied line and restore normal connections.

***Bn Timeout Increments for *Tn and /An**

This command is used to select whether the value in S-register S10 is measured in increments of 1 second or **0.1** seconds (S10 is used by the ***Tn** and/**An** commands).

- *B0** **S10** is in 0.1 second increments (range 0-25.5 seconds). Default.
- *B1** **S10** is in 1 second increments (range 0-255 seconds).

&Cn DCD & DSR/Indicate Control

This command controls the action of DCD and DSR for V.24 operation and the Indicate (I) signal for X.21 operation.

- &C0** DSR & DCD/I are maintained in the ON condition. Default.
- &C1** DCD & /I DSR is on only when the TA is on-line and ready to transmit data.
- &C2** DSR & DCD/I are on in command mode. During the connect sequence and when on-line, DSR & DCD/I represent their normal state.
- &C3** DSR is always on except that it goes off for a period of 2 seconds immediately after a call is dropped. DCD/I are maintained in the on condition while the TA is offline, and are maintained on when the TA is online and ready to transmit data.

***C Display Active Configuration**

This command displays the TA's active **configuration** on your terminal.

Dn **Dial a Number**

This command is used to dial a specified ISDN number with, if required, special instructions (known as modifiers).

Dnn where **nn** is the ISDN number

To dial a number with no modifiers, enter the number you want to dial immediately after the command, e.g. **ATDO1 23456789**.

To dial a number with modifiers, select the required modifiers from the list below, and incorporate them in the dialling sequence as instructed.

Note that ISDN numbers must not contain spaces.

Dialling Modifiers

The versatility of dialling with the TA is increased by using dial modifiers. For outgoing calls the following modifiers may be added to the dialled number:

Nm	Directory-entry specifier
/	Alternative number delimiter
u	Redial until answered
<Ctrl-G> <text>	Password.
<Ctrl-I> <text>	User identifier/Key
<Ctrl-U> <sub>	Sub-address

These can either be input directly in conjunction with an ATD command i.e.

ATD <text >

or can be stored in the telephone directory using:

ATNm&Z<text> where **m** is the directory number from 0-99

See N and Section 6.1 for more details.

The stored number can then be dialled by typing:

ATDNm

The list of dial commands **<text>** includes one or more blocks of numbers, directory numbers and modifiers. If there is more than one number then each must be separated by the alternate number

delimiter /. The maximum number of characters allowed in one <text > string is 80.

For on-screen help on dial modifiers, type **AT&HI**.

The following examples illustrate the use of these modifiers:

Nm Dial a Number Stored in a Specified Entry

This will cause the TA to dial a number in the directory, rather than an explicitly-specified number.

ATDNm

The number is dialled from entry m in the TA's ISDN directory, where m is 0-99.

/ Dial an Alternative Number

This is used to separate numbers. When one or more alternatives are being specified.

ATDn n/nn/Nm

The first number is dialled, and if the call attempt is unsuccessful, the second number is dialled. If this is also unsuccessful, yet another number is dialled (from the ISDN directory in this case). Once a call is established, or there are no more numbers left, the command is terminated.

U Redial Until Answered

This modifier causes the TA to keep dialling the number until it gets an answer within the limit set in S-register S36 (see Chapter 9). It is keyed immediately before the number.

ATDUnn

where nn is the telephone number

Most countries have rules governing the number of rediallings allowed and the interval between them: see details in Section 6.2.5 and Appendix C.

< Ctrl-G > Password Override

ATD<Ctrl-G>ppppppppnn

where pppppppp is the password

This command overrides the password which is stored in the TA with the 'Zp command. The new value is used for the duration of call setup (see Section 5.5 for more details).

< Ctrl-I > User Identifier/Key Override

ATD<Ctrl-I> kkkm where kkk is the key

This command overrides the user identifier/key which is stored in the TA with the " Wk command. The new value is used for the duration of call setup (see Section 5.5 for more details).

< Ctrl-U > Sub-address Number

ATDnn <Ctrl-U> ssss

Sub-addressing is a facility provided within the ISDN to uniquely identify an ISDN device which is sharing the same number and line with other devices. Currently, the sub-address is a string of up to four alphanumeric characters.

When dialling a TA which has a sub-address set (using the -An command), the sub-address must be included in the dial string or the call will be rejected by that device.

All the above modifiers could be used together in a large number of combinations. For example:

ATD<Ctrl-I> kkk <Ctrl-G> pppppppp <Ctrl-U> ssss nn /UNm

&Dn DTR/I Control

Included for communications software compatibility. See &Qn.

%Dn Remote Download

This command will download the new configuration to become active on a specified port of the remote TA.

%Dn where n is 0, 1 or 2.

The setting n = 0 will affect the remote port (DTE1 or DTE2) to which you are currently connected. The setting n = 1 or 2 will explicitly select remote port DTE 1 or DTE2, respectively.

A download will interrupt data transmission as the call is momentarily dropped and then re-established. The setting of

command %En on the relevant ports of both the local and the remote TA must allow for remote download. See also Section 5.7.

En **Echo Commands**

This command determines whether command characters entered at the terminal will be echoed back.

- E0 Disable echo. Default for rackmount.
- E1 Enable echo. Default for standalone.

%En **Remote Configuration Control**

This command allows you to select the specific remote configuration control facilities that you require at the local TA. An appropriate selection is also required at the remote TA.

There are three facilities which can be enabled/disabled:

- (1) Configure remote device using AT commands, i.e. upload from/edit/download to a remote device.
- (2) Receive new active configuration from a remote device (download from remote).
- (3) Transmit active configuration to a remote device (upload to remote).

These facilities are combined to provide eight command options:

Command	(1)	(2)	(3)	Remarks
%E0	no	no	no	Disabled
%E1	no	no	yes	Upload to remote
%E2	no	yes	no	Download from remote
%E3	no	yes	yes	Up/download to/from remote
%E4	yes	no	no	Configuration of a remote device
%E5	yes	no	yes	Configuration of a remote device + upload to remote
%E6	yes	yes	no	Configuration of a remote device + download from remote
%E7	yes	yes	yes	Default - all facilities enabled

Care must be taken when changing the configuration of a remote device. For example, if the remote TA's configuration control setting is %E7, and this is subsequently changed to %E4, you will no longer have control over the remote TA's configuration.

See also Section 5.7.

"En **Security Control**

This command is used to enable or disable the security features of your TA.

- "E0 Security disabled. Default.
- "E1 Security Level 1 enabled.
- "E2 Security Level 2 enabled.

If security is enabled, you will need to use commands "Wk and "Zp. See also Section 5.6.

&Fn **Recall Factory Configuration**

This command recalls (loads) one of the factory configurations and stores it either in the TA's active configuration, or the copy of the remote configuration.

- &Fn where n is the factory configuration number (0-3).

H **Go On-Hook**

The H command will immediately disconnect the current call on the port.

&Hn **On-Screen Help**

- &H0 Help on 'help'.
- &H1 Help on dial modifiers.
- &H2 Help on directories.

In **TA Identity Codes**

This command is used to check hardware and software identity.

- 10 Displays your TA's product code in decimal. Default is 242. This code may be changed (to allow compatibility with certain software packages) by using S-register S38 .

- I1** Requests that a checksum is performed on your TA's firmware ROM. The response is four hex digits.
- I2** Validates the checksum by comparing it with a stored value. Returns the response OK or ERROR.
- I3** Displays the firmware release number.
- I4** Displays your TA's three-digit identity code in decimal. The code is 978 for standalone, or 980 for rackmount.
- I6** Displays your TA's ten-digit serial number. For details of how to set the serial number see the commands **I9** and ***Q9**.
- I9** Command delimiter for initialisation of the serial number. See the description of command ***Q9** for further details.

I3 and I4 are useful for programmers writing software to control the TA. They allow a check to ensure that connection is made to a TA of the correct type and firmware release number.

&In Constant Speed Interface

If this option is enabled, the DTE interface speed will be fixed by the "Un command. If it is disabled, the DTE rate will be governed by the rate adaption scheme speed for incoming calls, but will still be fixed by the "Un command for outgoing calls.

- &I0** Constant speed interface disabled. The CONNECT response shows the rate adaption scheme speed. The CONNECT response is sent at the DTE speed. The speed will then change to the rate adaption speed.
- &I1** Constant speed interface enabled. Call only accepted if incoming rate matches DTE rate. Default.
- &I2** Constant speed interface enabled. Call only accepted if incoming rate matches DTE rate.
- &I3** Constant speed interface disabled. The CONNECT response shows the DTE interface speed. The CONNECT response is sent at the rate adaption speed.

%Jn End-to-End Control Signals

For connections at less than 56K, DTE control signals are sent through to the remote TA. For V.24, DTR is sent, and for X.21, Control (C) is sent. Issuing this command at the local TA will determine how the local DTE control signals (DSR, CTS, I) are mapped to the remote control signals (DTR, C).

- %J0** No pass-through. Default.
- %J1** DTR/C passed to remote DSR/I.
- %J2** DTR/C passed to remote CTS/I.
- %J3** DTR/C passed to remote DSR and CTS/I.

Kn Call Timer

This command will display the call timers within the TA.

- K0** Current, or previous call time.
- K1** Accumulated call-time since power-up or timer reset.
- K2** Accumulated non-call-time since power-up or timer reset.

The display format is:

hh:mm:ss where h h is hours, mm is minutes, ss is seconds

/K Reset Call Timers

This command zeros all call timers.

&Mn Mode Selection

&MO, &M 1 and &M 2 are included for communications software compatibility. They are equivalent to &Q0, &Q1 and &Q2.

Nm? Display a Single Directory Entry

This command is used to display a single entry from the TA's directory, where m represents the entry (O-99) that you want to display.

Nm&Z Store an ISDN Number

This command is used to store an ISDN number in the TA's directory. You can also use modifiers, for example to include ASCII text identifying the service, and to store an associated TA configuration.

Nm&Znn where m is the directory location (O-99) and nn the number and modifiers. If m is omitted this is equivalent to O.

Modifiers for Outgoing Numbers

:: Store a Remark with an ISDN Number

ISDN numbers may have remarks stored with them, which are displayed when the directory is listed.

Each remark entered must be within colon delimiters.

For example, to store the ISDN number 0123456789 with the remark 'Head Office' you would type:

AT NI &Z: Head Office: 0123456789

If other instructions are included:

AT N1 &Z: Head Office: U, 0123456789

Note that spacing is not necessary: we've used it just for clarity.

< > Secure Telephone No

Angled brackets may be used to designate secure ISDN numbers, i.e. numbers that you do not wish to appear on the screen.

To do this, type the phone number between angled brackets:

AT N1 &Z <0123456789>

As a number enclosed within < > will not be displayed during dialling or in the directory display, it is advisable to include suitable remark text in the entry with such numbers (see :: above), so that you can at least see which site or service is being dialled.

For example, if the number is stored as:

AT N1&Z : Mainframe :<0123456789>

it will be displayed (in the directory) as just:

Mainframe

< Ctrl-G > Store a Password

AT Nm&Znn<Ctrl-G>pppppppp

This modifier allows a password to be associated with a stored number for Levels 1 or 2 security. This password will be used to override the password which is stored in the TA with the "Zp command. The new value is used for the duration of call setup (see Section 5.6 and 6.4 for more details).

< Ctrl-I > Store a User Identifier/Key

AT Nm&Znn<Ctrl-I>kkk

This modifier allows a user identifier/key to be associated with a stored number for Levels 1 and 2 security. This will be used to override the key stored in the TA using the "Wk command. The new value is used for the duration of call setup (see Sections 5.6 and 6.4 for more details).

Modifiers for Incoming Numbers

The directory also stores numbers which are used to determine whether to accept an incoming call. There are two types of number: Calling Line Identification (CLI) and Multiple Subscriber Numbering (MSN).

Note that these numbers cannot be used for dialling out.

< Ctrl-K > Calling Line Identification

CLI is a facility provided by the ISDN, which identifies the calling number of the device (CLI) to the called party. If CLI checking is enabled on the called port (using the -Qn command), the directory is searched for a match with all CLI numbers set for that port. If a match is not found then the call is rejected.

CLI numbers are entered into the directory as follows:

ATNm &Z <Ctrl-K>pnn

where: m is the directory entry (0-99)
p is the port identifier
nn is the CLI number

The port identifier denotes the port(s) to which the CLI number applies: 0 = ports 1 and 2; 1 = port 1; 2 = port 2.

The numbers are compared for as many digits as are specified. So if only five digits are specified then the incoming call will only be compared for the last five digits. For example, consider the following entry:

```
ATN22 &Z <Ctrl-K>00252514000
```

The network may present up to a 20-digit CLI, but only the last 10 digits will be compared with directory entry 22.

<Ctrl-W> Multiple Subscriber Numbering

MSN is an ISDN facility providing multiple telephone numbers for the same line. This allows unique identification of a device which is sharing a line with other devices. If MSN checking is enabled on the called port (using the **-Nn** command), the directory is searched for a match with the called number and all MSN numbers set for that port. If a match is not found then the call is rejected.

MSN numbers are entered into the directory as follows:

```
ATNm &Z <Ctrl-W> pn
```

where: **m** is the directory entry (0-99)
 p is the port identifier
 nn is the MSN number

The port identifier denotes the port(s) to which the MSN number applies: 0 = ports 1 and 2; 1 = port 1, 2 = port 2.

The numbers are compared for as many digits as are specified. So if only five digits are specified then the incoming call will only be compared for the last five digits. For example, consider the following entry:

```
ATN22 &Z <Ctrl-W> 1514123
```

The network may present up to a 20-digit MSN, but, at most, only the last six digits will be compared with directory entry 22 for port 1.

&Nn Display Entries in the ISDN Directory

This command lists the following ISDN directory numbers:

```
&NO     All directory numbers for the port.
```

- &N1** All outgoing telephone numbers for the port.
- &N2** All CLI numbers for the port.
- &N3** All MSN numbers for the port.

The locations on the displayed list are designated NO to N99. Empty locations are not listed. After each screen-full of information, the display will pause. Press the space bar to proceed to the next screen and Q or q to quit.

Deletion of the whole directory is achieved as follows:

&N99 Clear Entries in the ISDN Directory

This command will clear all entries in the ISDN directory.

-Nn Multiple Subscriber Number Facility

- NO** Disable MSN facility. Default.
- N1** MSN facility.

MSNS are set in the directory using the < Ctrl-W > modifier. See also Section 5.5.2.

o Return to On-Line

This command is only needed if you are using the data DTE for commands, and have previously entered the escape sequence (default + + +) to interrupt a communications session.

This command causes the TA to go back online.

&On S-Register Output Format

This command selects the S-register display format for when you request it by the command Sri?. See Chapter 9.

- &O0** Output in decimal. Default.
- &O1** Output in hexadecimal.
- &O2** Output in binary.

The binary output is useful for examining bit-mapped S-registers.

/On DSR Control while Tests Active

This command is used to select the state of DSR (Data Set Ready) while tests are active.

/00 DSR active in test modes.
/01 DSR inactive in test modes. Default.

The factory default (/0 1) complies with the relevant CCITT recommendation. /00 allows DSR to be turned on where your DTE needs it to transmit or receive characters.

%On Byte Synchronous Character Format for V.25bis

This command allows ASCII or EBCDIC character format to be used if *V2 is selected.

%00 V.25bis byte synchronous will work in ASCII. Default.
%01 V.25bis byte synchronous will work in EBCDIC.

Note that when using EBCDIC, all characters are 8 bits with no parity when offline.

-Pn Map Port

This command determines how calls are mapped between logical B-channels and physical ports. It applies to both incoming and outgoing calls. See also Section 5.5.1.

-P0 Unmap current port.
-P1 Map current port to B1.
-P2 Map current port to B2.
-P3 Map current port to B1 or B2. Default.

Qn Quiet Mode

This command determines whether response codes are sent to the DTE when commands are executed. The full response code table is given with the Xn command.

Q0 Response codes are sent. Default.
Q1 Response codes are *not* sent.

&Qn Sync/Async Mode and DTR/C Control

This command has two purposes: the first is to switch the TA between synchronous and asynchronous modes, and the second is to specify how the TA interacts with the V.24 DTR (Data Terminal Ready) signal or the X.21 C (Control) signal from your DTE. (DTR/C low means that the DTE is not ready, whereas DTR/C high means that the DTE is ready.)

- &Q0** Asynchronous mode. DTR/C ignored. Default.
- &Q1** Synchronous mode. The TA will answer and dial with DTR/C low, but will disconnect if DTR does not go high after the time defined in S-register S25. When on-line, if DTR/C goes low, the TA will wait for S25 time before the call is disconnected.
- &Q2** Synchronous mode. When DTR/C goes high, the TA dials the ISDN number held in directory location NO. When on-line, if DTR/C goes low, the TA disconnects.
- &Q3** Synchronous mode. DTR conformstoV.24108/2. The TA will not dial or answer when DTR is low. When on-line, if DTR goes low, the TA disconnects.
- &Q4** Asynchronous mode. The TA will answer or dial with DTR/C low, but will disconnect if DTR/C does not go high after the time defined in S-register S25. When on-line, if DTR goes low, the TA will wait for the S25 timeout before the call is disconnected.
- &Q5** Asynchronous mode. When DTR/C goes high, the TA dials the ISDN number held in directory location NO. When on-line, if DTR/C goes low, the TA disconnects.
- &Q6** Asynchronous mode. DTR conformstoV.24108/2. The TA will not dial or answer when DTR is low. When on-line, if DTR goes low, the TA disconnects.
- &Q10** Synchronous mode. This conforms to V.24 108/1 (CDSTL, Connect DataSet To Line). When DTR goes high, the TA goes on-line, and when it goes low it disconnects. It allows a host to answer a call manually when S-register SO is set to zero.
- &Q11** Asynchronous mode. This conforms to V.24 108/1 (CDSTL, Connect DataSet To Line). When DTR goes high, the TA goes on-line, and when it goes low, it disconnects. Allows host to answer call manually when S-register SO is set to zero.

Note that, in cases where the S25 timeout is used, if S25 = 0, dropping DTR/C will not cause a disconnection.

***Q9 Initialise Serial Number**

This command is used to initialise the TA serial number, which is stored in the non-volatile memory. The command line should immediately follow the **AT19** command, and contain **10** printable

ASCII characters. If less than 10 characters are used, the TA will respond with **ERROR**. Once the TA has been initialised, it cannot be overwritten until a non-volatile RAM corruption has occurred. The serial number is displayed by the TA in response to the AT16 command, in the following format:

1234567890

If the serial number contains any unprintable characters, then these characters will be replaced by the '-' character.

Command format:

AT19<CR> TA responds **ERROR**

AT* Q9nnnnnnnnnn<CR> where nnnnnnnnnn is the serial number to be stored.

%Qn V.25bis Special Lead Sequence

This command is used to control CTS, DSR and DCD from the TA when operating in V.25bis modes. The command has no effect in AT command mode.

%Q0 Normal mode, defined by **&Cn**, **&Rn** and ***Wn**.

%Q1 V.25bis recommendation, CTS, DSR and DCD follow DTR when off-line.

%Q2 CTS and DCD follow DTR when off-line.

This command overrides the **&Cn** and ***Wn** settings. When the % Q 1 command is set, the TA will force CTS, DSR and DCD to follow DTR when off-line. Once the TA is connected the CTS, DSR and DCD lines will follow their normal state. On a call failure, or disconnect the CTS, DSR and DCD signals will return to following DTR. If the % Q2 command is set, the operation of % Q 1 is modified so that DSR follows its normal state rather than DTR.

-Qn Calling Line Identification Facility

-Q0 Disable CLI facility. Default.

-Q1 Enable CLI facility.

CLIS are set in the directory using the **<Ctrl-K>** modifier. See Section 5.5.4.

&Rn Request To Send-Clear To Send

RTS-CTS delay is specified by S-register S26 if the TA is on-line and ready for data.

&R0 RTS-CTS delay is set by S26. Default.

&R1 RTS is ignored.

Note that RTS-CTS operation is affected by control signal pass-through (see %Jn), if &R0 has been executed.

/Rn Timeout Increments for RTS-CTS Delay

/R0 S26 in 10 ms increments.

/R1 S26 in 1 ms increments.

%Rn RTS/CTS Control

This command allows you to control the state of CTS from your TA. This facility is applicable to V.24 operation only.

%R0 CTS follows RTS when on-line.

%R1 CTS is always on when the TA is off-line, and follows RTS when on-line. Default.

%R2 CTS is on in command mode.

%R3 CTS is always on.

-Rn Rate Adaption

This command allows you to select the rate adaption scheme you wish to use. See also Section 5.4.1.

-R0 Follow DTE port interface type for all calls, i.e. X.21 will use X.30, and V.24 will use V.110.

-R1 Auto-detect. Follows DTE port interface type for outgoing calls but follows the scheme in call setup for incoming calls. Default.

-R2 Force V.110.

-R3 Force X.30.

Sn? Display Single S-Register Setting

This command will display the setting of a single S-register, where n is the S-register location to be examined.

The &On command selects the format for this display.

Sn = Set an S-Register to a Value

This command will set the contents of an S-register to a new value.

Sn = xxx where n is the S-register location and xxx is the new value in decimal (prefix it with > for hexadecimal).

&Sn Front Panel Switch Control

This command allows you to disable the front panel switches and reprogram the AL button to perform different functions.

- &s0 Front panel switches disabled.
- &S1** Front panel switches enabled with LI selecting a digital loop. Default.
- &S2** Front panel switches enabled with LI busying the ISDN line.
- &S3** Front panel switches enabled with LI selecting a loop and busying the ISDN line.

'Busying' means that the TA is disabled from answering a call.

Information on digital loop is given in Chapter 7.

***S Display S-Register Summary**

This command will display the values of all S-registers. The display may include some registers not used by this TA. See Chapter 9.

/Sn Extra Response Codes

This command is used to select whether response codes preceded by / will be issued or not. (A table of these codes is given with the Xn command.)

- /s0 Extra responses off.
- /s1 Extra responses on. Default.

-Sn Sub-address Facility

- S0 Disable Sub-addressing facility. Default.
- s1 Enable Sub-addressing facility.

This command is used to select whether or not to enable a sub-address stored using the -An command. See Section 5.5.3.

&Tn Select TA Test Operation

This command is used to select a test operation. See Chapter 7. It is used in conjunction with S-register timer S18, which determines the length of time that a test is performed.

- &T0** Stops the test currently in progress.
- &T3** Selects Local Digital Loopback.
- &T4** Enables the local TA to run a Remote Digital Loopback when requested by the remote TA.
Default.
- &T5** Prohibits the local TA from running a Remote Digital Loopback when requested by the remote TA.
- &T6** Initiates Remote Digital Loopback (CCITT V.54 Loop 2).
- &T11** Disables selection of V.54 tests on pin 21 of the **DTE** interface.
- &T12** Enables selection of V.54 tests on pin 21 of the DTE interface.
- &T13** Disables selection of V.54 tests on pin 18 of the DTE interface.
- &T14** Enables selection of V.54 tests on pin 18 of the DTE interface.

***Tn Rate Adaption Synchronisation Loss Timeout**

- *T0** Synchronisation timeout disabled.
- *T1** Synchronisation timeout enabled. Default.

If a rate adaption scheme is in use and synchronisation loss is detected for a period greater than that specified in S-register S10, the call will be dropped. See also ***Bn**.

-Tn Copy Active Configuration

This command is used to copy the active configuration from the specified port n to the current port.

- T1** Copies active configuration from port 1.
- T2** Copies active configuration from port 2.

Inn Asynchronous \bar{F} Format

This command enables you to specify the data format that your TA will output or expect to receive when in asynchronous mode.

See "Un for the data rate.

/U1	7 data, no parity, 1 stop.
/U2	7 data, no parity, 2 stop.
/U3	7 data, odd parity, 1 stop.
/U4	7 data, odd parity, 2 stop.
/U5	7 data, even parity, 1 stop.
/U6	7 data, even parity, 2 stop.
/U7	8 data, no parity, 1 stop.
/U8	8 data, no parity, 2 stop.
/U9	8 data, odd parity, 1 stop.
/U10	8 data, odd parity, 2 stop.
/U11	8 data, even parity, 1 stop.
/U12	8 data, even parity, 2 stop.

"Un DTE Rate

This command is used to specify the rate at which the TA expects data to be transmitted from the DTE in synchronous or asynchronous modes. See /U n for the data format.

"U8	600 bps	} Asynchronous/ synchronous
"U9	1200 bps.	
"U10	2400 bps.	
"U11	4800 bps.	
"U13	9600 bps.	
"U17	19,200 bps.	
"U20	38,400 bps.	
"U21	48,000 bps.	} Synchronous
"U22	56,000 bps.	
"U23	64,000 bps. }	

Vn Verbose Response Codes

This command determines how the TA communicates with the user, i.e. whether response codes are expressed as words or numeric code. These are referred to as verbose/terse, or long/short form.

Response codes are listed with the Xn command.

- V0 Selects numeric (terse) codes. Default for Rackmount.
- V1 Selects word (verbose) codes. Default for Standalone.

Numeric codes are followed by a single <CR>. Word codes are followed by <CR>< LF>.

&Vn Dumb Mode

This command is applicable to the DTE port only and determines whether the TA will accept AT commands and/or the escape sequence (default + + +).

- &V0** Commands are accepted from the DTE when the TA is off-line, or when on-line by using the escape sequence. Default.
- &V1** Commands are only accepted when the TA is off-line. The escape sequence is ignored.
- &V2** Commands and escape sequence are ignored.

***Vn V.25bis Command Mode**

This command allows your TA to accept V.25bis commands. (V.25bis commands are listed in Chapter 10.)

- *V1** TA accepts asynchronous V.25bis control.
- *V2** TA accepts byte synchronous V.25bis control.
- *V3** TA accepts HDLC synchronous V.25bis control.

The *V 1 command can be entered through either of the DTE ports or the command port. It enables the port whose configuration is being altered (see -Yn).

The *V2 and *V3 commands are only valid when commands are directed at the DTE port configuration.

&Wn Save User Configuration

This command allows you to store a newly customised configuration for each port from the active area where n is the user configuration number (0-3).

*Wn **DSR Control**

Applicable to V.24 operation only.

- *WO Normal DSR control (see &Cn).
- *WI DSR follows DTR. This is used for hosts which on raising DTR, expect DSR to be returned by the TA. (This is overridden by /On when in test mode.)

%W **Stop Modifying the Remote Configuration**

This command terminates the operation on the remote configuration copy started by the %Z command. Subsequent commands will affect the local TA's own active configuration.

See also Section 5.7.

"Wk **Key Store**

This command is used to store three alphanumeric characters as a key (for use in conjunction with the Controller Module for authentication of Level 1 or 2 security).

"Wkkk where kkk is the key

See also Section 5.6.

Xn **Response Codes**

This command is used to turn off TA response codes which cannot be interpreted by the DTE's operating software, where n specifies the filter (0-6) to be used for masking out unwanted codes. The default setting is X6.

In the following table, the asterisks shown under each filter indicate the response codes that *will* be sent. Whether these are in terse or verbose form is determined by the Vn command. Also, when the /S 1 command parameter is set, the TA can send not only standard verbose responses, but also extra responses, which are shown prefixed with a slash (/).

Response code 38 or **DISCONNECTED** has appended a numeric extended code when in verbose mode. This code is the clearance cause number as supplied by the network.

There are numerous cause numbers, and for a full list and description one should refer to the documentation supplied by the network provider. In UK refer to BT Network Requirements BTNR191 Issue 2 Oct. 1990.

The most common causes are as follows:

Cause Number	Cause Description
1	Unallocated number e.g. number does not exist.
16	Normal clearing e.g. Remote has typed ATH, or called channel has been 'busied out'.
17	User busy, e.g. both channels of the remote TA have calls in progress.
21	Call rejected.
88	Incompatible Destination e.g. call request is incompatible with answering TA. This could be caused by requesting an asynchronous connection to a TA configured for synchronous.
90	Destination address incomplete e.g. not enough digits in number dialled.

n =							RESPONSE CODE	
0	1	2	3	4	5	6	TERSE	VERBOSE
*	*	*	*	*	*	*	0	OK
*	*	*	*	*	*	*	1	CONNECT
*	*	*	*	*	*	*	2	RING
*	*	*	*	*	*	*	3	NO CARRIER
*	*	*	*	*	*	*	4	ERROR
		*	*	*	*	*	5	CONNECT 1200
			*	*	*	*	6	NO DIAL TONE
*	*	*	*	*	*	*	7	BUSY
	*	*	*	*	*	*	8	NO ANSWER
	*	*	*	*	*	*	9	CONNECT 600
	*	*	*	*	*	*	10	CONNECT 2400
	*	*	*	*	*	*	12	RDL GRANTED
*	*	*	*	*	*	*	13	RDL DENIED
*	*	*	*	*	*	*	15	ABORTED
*	*	*	*	*	*	*	16	TIMEOUT
	*	*	*	*	*	*	26	BLACKLIST
	*	*	*	*	*	*	27	LDL IN PROGRESS
	*	*	*	*	*	*	28	CONNECT4800
	*	*	*	*	*	*	30	CONNECT9600
					*	*	31	VOICE
					*	*	32	RINGING
*	*	*	*	*	*	*	36	RETRAIN
*	*	*	*	*	*	*	38	DISCONNECTED/nnnn
*	*	*	*	*	*	*	40	NOTSTORED
	*	*	*	*	*	*	43	CONNECT 14400
	*	*	*	*	*	*	45	CONNECT 19200
*	*	*	*	*	*	*	49	CONNECT38400
	*	*	*	*	*	*	62	MONITOR GRANTED
					*	*	63	MONITOR DENIED
					*	*	64	RECONFIGURE GRANTED
					*	*	65	RECONFIGURE DENIED
					*	*	66	RECONFIGURE FAILED
*		*	*	*	*	*	67	MONITOR FAILED
*	*	*	*	*	*	*	70	ACCESS GRANTED
	*	*	*	*	*	*	71	ACCESS DENIED
	*	*	*	*	*	*	72	CONNECT48000
	*	*	*	*	*	*	73	CONNECT 56000
	*	*	*	*	*	*	74	CONNECT64000
	*	*	*	*	*	*	79	NOSECURITY
							80	/LOSS OF RTS
*	*	*	*	*	*	*	81	/CONSTANT RTS
							119	TESTTERMINATED
							129	/V.110
							130)/(30
							131	ICLEAR
							199	RESTART

Responses marked / will appear only when /S1 is set.

%Xn Remote Upload

This command will upload a copy of the active configuration on a specified port of the remote TA where n is 0, 1 or 2.

The setting n = 0 will affect whichever remote port (DTE1 or DTE2) you are currently connected to. The setting n = 1 or 2 will explicitly select remote port DTE 1 or DTE2, respectively.

An upload will interrupt data transmission as the call is momentarily dropped and then re-established. The setting of command %En on the relevant ports of both the local and the remote TA must allow for remote upload. See also Section 5.7.

-Yn Select Port

- Y0** All subsequent commands apply to COM port.
- Y1** All subsequent commands apply to DTE1. Default.
- Y2** All subsequent commands apply to DTE2.

See also Section 3.2.1.

Zn Recall User Configuration

This command will recall a previously-configured user configuration, so that it becomes the active configuration, where n is the user configuration number (0-3).

%Z Modify the Remote Configuration

This command allows you to alter the locally-held copy of the remote TA's active configuration. Subsequent commands will affect only this copy, until the % W command is issued.

See also Section 5.7.

"Zp Password Store

This command is used to store an eight-character alphanumeric password. The TA will return ERROR if other than eight characters are entered.

"Zpppppppp where **pppppppp** is the password to be stored.

Note that passwords are case-sensitive.

See also Section 5.6.

-Zn Port Prompt

This command displays the port which is being addressed. It must be addressed to the port to which the command terminal is connected.

-Z0 Disable port-number prompt. Default on Rackmount.

-Z1 Enable port-number prompt. Default on Standalone.

9.1 Introduction

S-registers are special 8-bit stores which are used to access features that are not available through AT commands, and to store features set by standard commands.

Indiscriminate changing of S-registers can result in conflicting settings which may cause the TA to malfunction.

S-registers are used in two main ways: those that contain whole characters ('non-bit-mapped' registers), and those whose bits are used for different purposes ('bit-mapped' registers).

Non-Bit-Mapped Registers

These may be sub-divided into three types:

Counters and other whole numbers. Counters are absolute values. A zero setting will usually disable the counter.

Timers, often expressed as values from 0 to 255. Timers are stated in increments relative to their use. Setting at zero usually disables the timer so that the function will run until commanded to stop..

ASCII character registers, used to define a single ASCII character that will cause the TA to perform a certain function when it receives that character.

Bit-Mapped Registers

These registers are used to store features normally set with AT commands. The 8 bits are grouped as necessary for the various options.

Appendix E contains cross-reference tables for mapping AT commands to S-registers and vice versa.

These tables contain details of commands which may not be implemented in the TA (refer to Chapter 8).

Access to some bits is prohibited; attempts to change these cause the message ERROR to appear.

Bit-mapped registers can best be inspected in binary format (&O2).

9.2 Manipulating S-Registers

The following commands may be used to inspect and change the contents of S-registers:

*S	Display S-register summary
Sn?	Display single S-register setting
Sn =	Set an S-register to a value
&On	S-register output format

9.3 Non-Bit-Mapped S-Registers

S0 Answer After Specified Number of Rings, or Disable Auto-answer

Counter Range: 0-255 Default: 1

The number entered in the S0 register determines the number of times an incoming call signal is received, before the call is answered. If S0 is set at 0, the autoanswer facility is disabled.

S1 Ring Counter

Counter Range: 0-255 Default: 0

This register records the number of incoming ring signals detected. It cannot be over-written by the user.

S2 Escape Character

ASCII Range: 0-127 Default: 43H (ASCII +)

This register contains the code interpreted as the AT escape character.

S3 Carriage Return Character

ASCII Range: 0-127 Default: 13H (ASCII CR)

This register contains the code interpreted, and output, as the carriage return character, when the TA is in command mode.

S4 Line Feed Character

ASCII Range: 0-127 Default: 10H (ASCII LF)

This register contains the code which is output as the line feed character when the TA is in command mode.

S5 Backspace Character

ASCII Range: 0-127 Default: 8 (ASCII BS)

This register contains the code that is interpreted as the backspace character when the TA is in command mode.

S7 **Wait for Answer Tone**

Timer Range: 0-255 (seconds) Default: 20 (seconds)

This register contains the time that the TA waits for a valid carrier tone to be sent from the remote TA. The timeout commences after the last digit is dialled.

S10 **Disconnect Delay Timer**

Timer Range: 0-255 (tenths of a second, or seconds)
Default: 25 (2.5 or 25 seconds)

This register is referenced by the *T and /A commands. In the case of the former, it contains the time that the TA waits, after rate adaption synchronisation has been lost, before disconnecting the line (see *T). In the case of the latter, it contains the time that the TA waits, after loss of RTS, before disconnecting the line (see /A).

The *B command can be used to specify whether the timer units are to be 0.1 seconds or 1 second. Setting the timer value to zero will disable the timer.

S12 **Escape Sequence Guard Time**

Timer Range: 0-255 (0.02 seconds) Default: 50 (1 second)

The escape sequence guard time is the time required to elapse immediately before and after sending the AT escape sequence (default + + +). In one-fiftieth seconds.

S18 **Test Timer**

Timer Range: 0-255 (seconds) Default: 0 (manual termination)

This register is used in conjunction with the command &T to cause tests to run for a set period. The value 0 causes the test to run until it is manually terminated by the user.

S25 **Delay to DTR Timer**

Timer Range: 0-255 (seconds) Default: 10 (seconds)

This is used with the &Q 1 and &Q4 commands.

S36 Maximum Number of Redial Attempts

Counter Range: **0-7** Default: 7

The modem normally makes up to 7 attempts to dial a number. This number can be changed by entering a new number, within the range indicated above. This is used with the U modifier.

S38 Modem Product Code

Counter Range: 0-255 Default: 242

This register determines the response to the 10 command. Different values may be required for compatibility with some communication software.

Before you can issue **V.25bis** commands, you must first put the TA port into **V.25bis** mode by issuing the relevant *V command to the port **configuration**. You exit by the **BAK** command.

The TA includes some commands that are additional to the standard **V.25bis** set.

The **V.25bis** command language was originally specified to facilitate dialling over the **analogue** PSTN, and consequently there are aspects of the command set that are not applicable to the digital ISDN. Specifically, these comprise any command or command parameters that refer to calling identification or forbidden (black-listed) number.

To accommodate existing DTEs that may specify these inapplicable commands, the TA will not take any action when these commands are issued but will respond positively.

In the command descriptions that follow, the commands that are not applicable are shown with the N/A symbol.

10.1 Command Structure

- **Asynchronous V.25bis commands** must be entered in the format:

Command <CR> <LF>

When switching from synchronous data mode to asynchronous command mode, enter <CR> <LF> first to clear the buffer.

Note that autobaud does not function in V.25bis mode: before changing to V.25bis use the "U" command to set the data speed for the DTE interface. The data format is fixed at 7 bits plus even parity.

- **Byte synchronous V.25bis commands** must be entered via the DTE port in-the format:

<SYN> <SYN> <STX> Command <ETX>

where: <SYN> represents a synchronous-idle character (hex 16)

<STX> represents a start-of-text character (hex 02)

<ETX> represents an end-of-text character (hex 03)

The hex values given above apply when using ASCII.

Characters should be sent as consecutive 8-bit words of 7 data bits and odd parity when using ASCII.

- **HDLC synchronous character-oriented V.25bis commands** must be entered via the DTE port in the format:

<F><A><C> Command <FCS><F>

where: <F> represents the HDLC flag character

<A> represents 11111111

<c> represents 11001000

<FCS> represents a checksum automatically calculated

<A> and <c> are given as in the CCITT Recommendation *with the LSB shown first*. Because the command field is a U1 frame transmitted with the P bit set to 1 and the global address, <A> and <c> have to be set as above.

Characters should be sent as consecutive 8-bit words of 7 data bits with the eighth bit as "don't care".

10.2 Commands

Summary

BAK	Additional command	Return to AT command language
CIC	V.25bis command	Connect to incoming call
CLA	Additional command	Clear all or one directory entry
CRI	V.25bis command	Call request with identity number
CRN	V.25bis command	Dial a telephone number
CRS	V.25bis command	Dial a stored telephone number
CSP	Additional command	Change DTE speed
DIC	V.25bis command	Disable autoanswer
DLN	Additional command	Dial last number
EON	Additional command	Echo V.25bis commands
EOF	Additional command	No echo of V.25bis commands
PRI	N/A	Program identity number
PRN	V.25bis command	Store telephone number in directory
RCS	Additional command	Display active config (async only)
RLD	N/A	Display delayed numbers
RLF	N/A	Display blacklisted numbers
RLI	N/A	Request identity number
RLN	V.25bis command	Display telephone directory

Description

CIC Connect incoming call. If the TA has been instructed not to answer incoming calls, this command can be used to re-instruct it to answer a call.

CLA Clear ISDN directory entries.

CLAx for a particular entry xx
CLA** for all entries.

CRI Dial a number with an identity number.

CRInnn;iii

where: nnn = telephone number and its modifiers
; = required syntax separating the number
III = identity number (up to 20 characters). N/A

CRN Dial an ISDN number. This implementation of V.25bis allows the use of all the AT dial modifiers except; (see the D command).

CRNnnn

where nnn is the ISDN number and dial modifiers.

CRS Dial a stored number. The V.25bis directory is the same as the AT directory except that it does not use location O.

CRSxx

where xx is a two-digit number.

CSP Change the DTE speed.

CSPnnn

where n n n specifies the DTE speed and corresponds to the values specified in the " U command.

DIC Disregard incoming call. When an incoming call's response (**INC**) is displayed, this command can be used to instruct the TA not to answer that particular call. The command must be sent within five seconds of the incoming call's response being displayed, otherwise the call is connected.

DLN Redial last number.

EON Echo on. This command instructs the TA to echo commands back to the DTE.

EOF Echo off. This command instructs the TA not to echo commands back to the DTE.

PRI Program identity number. N/A.

PRliii

where iii is the identity number (up to 20 characters).

PRN Store a telephone number and its modifiers (a maximum of 20 characters).

PRNxx; nnn

where: xx = directory number (1 to 20)
; = required syntax separating the number
nnn = the telephone number and its modifiers.

RLD Request delayed number list. (**RLDxx** for a particular entry.)

- RLF Request blacklisted number list. N/A. (RLFxx for a particular entry.) Note that the TA blacklist mechanism only affects numbers dialled with the U modifier (automatic dialling by the TA). Only these numbers can be “delayed” or “blacklisted”.
- RLI Request identity number. N/A.
- RLN Request ISDN number list. (RLNxx for a particular entry.)

10.3 Responses

Summary

CFI	V.25bis response	Call failure indicator
EOL	Additional response	End-of-list message after LSD, LSF or LSN response
INC	V.25bis response	Incoming call (ring detected)
INV	V.25bis response	Invalid command entered
LSN	V.25bis response	Response to the RLN command
ONL	Additional response	Indicates a connection to a remote TA
O F L	Additional response	Indicates a disconnect from line
VAL	V.25bis response	Indicates TA has accepted command

Description

CFI Call fail indication. Indicates that the TA has been unsuccessful in connecting a call. The response includes a two-letter code which specifies the reason for failure.

NS	Number not in memory
AB	Abort call due to timeout
ET	Number busy
RT	Ring tone timeout
NT	Tone not detected on line
DT	No dial tone/disconnected

EOL Indication of the end of an LSD, LSF or LSN listing.

INC Incoming call. Indicates that ringing is detected (signifying an incoming call). When there is a conflict, an incoming call has priority over a dial number request.

INV Invalid. Indicates that the TA cannot understand or execute a command.

LSN Number status. This is the response to the RLN command. The response is in the form:

```
LSNO1;123456789 ;ZPSIII  
LSN02; 234567891; ZPSTTT  
LSN03; 345678912;ZPSIII
```

LSN04;456789123 ;ZPSTTT
LSN05;567891234; ZPSTTT
EOL

Note: In the response lists, LSNxx precedes each directory entry. The actual ISDN number follows between two separators (;). This is followed by the status of the ISDN number in the form ZPSTTT where:

Z is U to represent an unrestricted call
is D to represent a delayed call
is F to represent a blacklisted call
P is the delay time in minutes for a delayed call
S is the number of dialled attempts that have failed
TTT is the time that a blacklisted call has to wait before the restriction is lifted.

ONL Indicates that the TA has gone on-line and connected to a remote TA.

OFL Indicates that the TA has terminated the call and returned to the off-line state.

VAL Indicates that the TA has accepted the valid command just input.

Appendix A Product Specification

Physical Description

Standalone Unit: 2 full DTE interfaces
Rackmount Card: Single slot with primary interface signals

Dimensions

Standalone Unit: 280 mm (L) x 190 mm (W) x 40 mm (H)
Weight: 1.63 kg
Single Slot Rackmount: 302 mm (D) x 20 mm (W) x 157 mm (H)
Weight: 0.4 kg

Front Panel

Buttons: 6 push-buttons to allow loading of configurations, dialling pre-stored numbers and tests
Indicators: 9 LEDs showing interface conditions

DTE Interfaces

Number of interfaces: 2
Interface type: V.24, X.21
Physical: Via one 25-way D-type and splitter cables on rackmount. Via two 25-way D-types and conversion cables for standalone.

ISDN Interface

Number of interfaces: 1
Interface type: S-interface
Physical: Via 8-way terminal block on rear of rack for rackmount. Via socket and flying lead on standalone.

Command Port

Access:	Via a Controller Module if using a rackmount card. On the standalone unit access is via a jack socket.
Speed/Format:	For standalone 9600 bps, 7 data bits, even parity, 1 stop bit. For rackmount 1200 bps, 7 data bits, even parity, 1 stop bit.

Configuration

Factory Configurations:	4 factory configurations for each interface type.
User Configurations:	4 user configurations for each interface type.
Remote Configuration:	By upload/download of configurations on a B-channel.
Command Language:	Extended AT and V.25bis.

Data Formats

Data Types:	Synchronous or asynchronous
Rate adaption:	X.30 or V.110

Synchronous Options

Clocking:	Internal
Speeds:	600,1200,2400,4800,9600, 14400, 19200,38400,48000,56000, 64000

Asynchronous Options

Speeds:	600,1200,2400,4800,9600, 14400, 19200,38400
Data bits:	7 or 8
Stop bits:	0,1,0r2
Parity:	Odd, Even, None

Call Control

Call Setup/Disconnect:	By command (AT), DTR (V.24), or C (X.21) Front panel dialling Alternate number facility
Number directory:	Up to 110 numbers of 50 characters each. Numbers can be tagged for CLI and MSN use
Security:	Password and key exchange (closed user groups)

ISDN Facilities Supported:

Calling Line Identification:	Yes
Multiple Subscriber Numbering:	Yes
Sub-addressing:	Yes

Diagnostic Facilities

Loopbacks:	Local and remote loopbacks supported
Self-test:	Run on power up

Environmental

Power Requirements for Standalone Unit:	220-240V 100 mA 50-60 Hz
Operating Temperature:	+ 5°C to + 40°C
Storage Temperature:	-25°C to + 55°C
Operating Humidity:	To 95% R.H. non-condensing at + 40°C
Storage Humidity:	To 95% R.H. non-condensing at + 55°C
Altitude:	800 to 1100 millibars

Appendix B Interface Descriptions

B.1 Standalone Interfaces

B.1.1 Full V.24 Interface

CCT	DESCRIPTION	V.24 NAME	DTE PORT PIN NUMBER	SIGNAL DIRECTION
	Screen		1	
102	Signal ground or common return		7	
103	Transmitted Data	TxD	2	From DTE
104	Received Data	RxD	3	To DTE
105	Request to send	RTS	4	From DTE
106	Clear to send	CTS	5	To DTE
107	Data set ready	DSR	6	To DTE
108	Data terminal ready	DTR	20	From DTE
109	Data carrier detect	DCD	8	To DTE
114	Transmit clock	TxC	15	To DTE
115	Receive clock	RxC	17	To DTE
125	Ring Indicator	RI	22	To DTE
140	Remote loopback	LMT	21	From DTE
141	Local loopback	LL	18	From DTE
142	Test indicator	TI	25	To DTE

Note: The transmit and receive clocks (TxC and RxC) are tied together.

B.1.2 Full X.21 Interface

X.21 CCT	DESCRIPTION	X.21 PIN NUMBER		DTE PORT PIN NUMBER		SIGNAL DIRECTION
		A	B	A	B	
	Screen	1		1		
G	Common return	8		7		
T	Transmitted Data	2	9	2	14	From DTE
R	Received Data	4	11	3	16	To DTE
c	Control	3	10	4	19	From DTE
l	Indicate	5	12	5	13	To DTE
s	Signal element timing	6	13	15	12	To DTE

B.1.3 Command Port Interface

The command port is presented on the rear panel on a 3.5mm jack socket. A command port cable is provided to convert this to a 25-way D-type socket. The pinout of this cable is:

JACK PLUG	V.24 NAME	25-WAY PIN NUMBER
Ring	TxD	2
Tip	RxD	3
Sleeve	Signal Ground	7

B.1.4 ISDN Interface

The ISDN interface is terminated in an RJ45 socket on the rear panel. A cable is provided to convert this into a plug suitable for connection to your local ISDN BRI interface. The pinout for the socket is:

RJ45 PIN NUMBER	CIRCUIT
1	
2	
3	Tx
4	Rx
5	Rx
6	Tx
7	
8	

B.2 Rackmount Interfaces

All interfaces for the rackmount are presented on the rear of the rack.

B.2.1 V.24 Primary Interface

CCT	DESCRIPTION	V.24 NAME	DTE PORT 1 PIN NUMBER	DTE PORT 2 PIN NUMBER	SIGNAL DIRECTION
	Screen		1	1	
102	Signal ground or common return		7	7	
103	Transmitted Data	TxD	2	14	From DTE
104	Received Data	RxD	3	16	To DTE
105	Request to send	RTS	4	19	From DTE
106	Clear to send	CTS	5	13	ToDTE
107	Data set ready	DSR	6	23	To DTE
108	Data terminal ready	DTR	20	21	From DTE
109	Data carrier detect	DCD	8	12	ToDTE
114	Transmit clock	TxC	15	10	To DTE
115	Receive clock	RxC	17	9	To DTE
141	Local loopback	LL	18	11	From DTE
142	Test indicator	TI	25	22	To DTE

Note: The transmit and receive clocks (TxC and RxC) are tied together.

B.2.2 X.21 Primary Interface

X.21 CCT	DESCRIPTION	X.21 PIN NUMBER		DTE PORT 1 PIN NUMBER		DTE PORT 2 PIN NUMBER		SIGNAL DIRECTION
		A	B	A	B	A	B	
	Screen	1	-	1	-	1	-	
G	Common return	8	-	7	-	7	-	
T	Transmitted Data	2	9	2	14	20	21	From DTE
R	Received Data	4	11	3	16	22	25	To DTE
C	Control	3	10	4	19	18	23	From DTE
I	Indicate	5	12	5	13	6	8	To DTE
S	Signal element timing	6	13	15	12	17	9	To DTE

B.2.3 ISDN Interface

RACK TERMINAL NUMBER	COLOUR	CONNECTOR PIN NUMBER	CIRCUIT
1	Red	4	Rx+
2	Green	5	Rx -
3	Orange	6	Tx -
4	Black	3	Tx +
5			
6			
7			
8			

C.1 Supplementary Services

ISDN -2 lines can be provided in one of two categories:

- 2-number lines
- 1-number lines

2-Number Lines

With 2-number lines each B-channel will have a unique number associated with it.

Multiple subscriber numbering is not therefore relevant to such lines.

Sub-addressing can be used with 2-number lines.

Calling Line Identification can be used with 2-number lines.

Mapping channels within the TA also serves a useful function with 2-number lines as the channel on which a given call will be accepted is predictable.

1-Number Lines

Here the line number is not associated with a specific B-channel.

Multiple subscriber numbers allow 1-number lines to have multiple logical numbers associated with them.

Sub-addressing is also valid with 1-number lines although it is unlikely to be used in conjunction with multiple subscriber numbering.

Calling line identification can be used with 1-number lines.

Port mapping is however not applicable to 1-number lines as the B-channel used is not predictable. It is recommended that port mapping is set to B1 or B2 (AT-P3) for single numbered lines.

C.2 Blacklisting

In many countries there are rules relating to how often and what time intervals should elapse between dialling attempts. Below is a definition of the dialling blacklist rules that are used on the TA.

When the dial command includes the U modifier (automatic re-dial), the number is placed on the blacklist when the number is first dialled, and cleared only if the call is successful, i.e. the call results in a CONNECT message. Up to 20 numbers can be contained in the blacklist at one time. Should this limit be exceeded then the blacklist will need to be cleared before dialling can continue.

The following rules apply to numbers entered in the blacklist.

- (i) After one unsuccessful connection attempt, ten seconds will elapse before a second dial attempt for the same number.
- (ii) After a second unsuccessful attempt, 120 seconds will elapse before the third dial attempt.
- (iii) Another four attempts are allowed at 120 second intervals.
- (iv) Should all seven attempts to dial a number be unsuccessful, the TA will be disabled from calling that number again for four hours.
- (v) Any attempt to dial the number during a blacklisted period will result in the BLACKLIST response.

Note: These rules do not apply to manual dialling.

D.1 Standalone TA Links and Switches

The locations of the links and switches on the standalone TA are shown in Figure D-1 below.

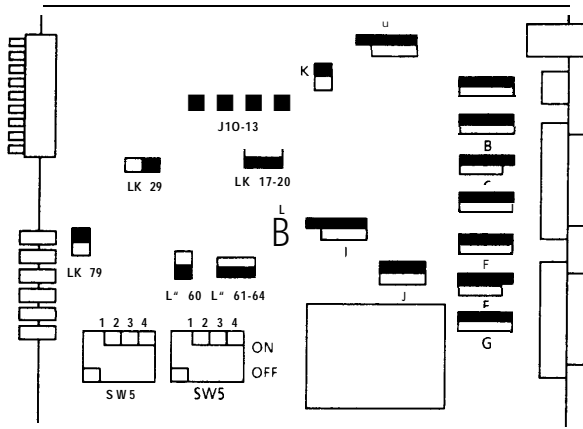


Figure D-1 Standalone Card Layout

	Description	Position A	Position B	Default
LK17	DTE2 LMT selection	LMT enabled	LMT disabled	B
LK18	DTE2 LL selection	LL enabled	LL disabled	B
LK19	DTE1 LMT selection	LMT enabled	LMT disabled	B
LK20	DTE1 LL selection	LL enabled	LL disabled	B
LK79	Diagnostics selection	Diagnostics mode	Normal mode	B
LK29	Watchdog interrupt	Disabled	Enabled	B
LK61	COM-TXD source	Corn port	DTE1/2 Sec TxD	A
LK62	DTE Sec TxD source	SCC1	SCC3	A
LK63	DTE2 Sec RxD source	SCC3	SCC2	A
LK64	DTE1 Sec RxD source	SCC1	SCC2	A
LK60	Battery protection	Prot diode out	Prot diode in	A
J10-13	Isolation Links			Fitted
E, F, G, I, J, L	DTE1 type selection	V.24	X.21	Set as required.
A, B, C, D, H, K	DTE2 type selection	V.24	X.21	Set as required.

Switch positions for DTE settings: DTE1 = SW5,
DTE2 = SW6

	SWx/1	SWx/2	SWx/3
V.24	ON	ON	ON
X.21	OFF	ON	ON

D.2 Rackmount TA Links and Switches

The locations of the links and switches on the rackmount TA are shown in Figure D-2.

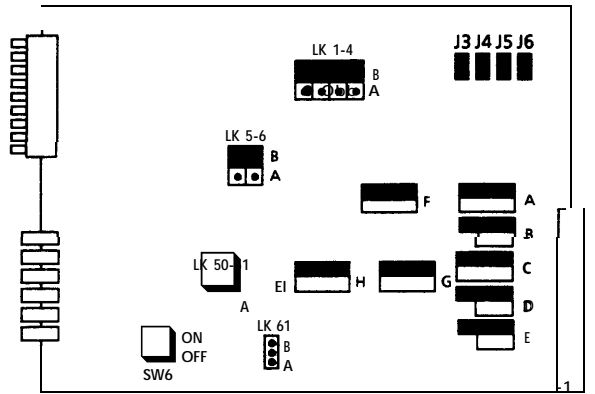


Figure D-2 Rackmount Card Layout

	Description	Position A	Position B	Default
LK1	DTE2 LMT Selection	LMT enabled	LMTdisabled	B
LK2	DTE2 LL Selection	LL enabled	LL disabled	B
LK3	DTE1 LL Selection	LL enabled	LL disabled	B
LK4	DTE 1 LMT Selection	LMT enabled	LMT disabled	B
LK5	Diagnostics selection	Diagnostics mode	Normal mode	B
LK6	Watchdog interrupt	Disabled	Enabled	B
LK50	COM-TxD source	Corn port	DTE 1 Sec TxD	A
LK51	DTE1 Sec RxD	Sccl	SCC2	A
LK61	Battery protection	Prot. diode out	Prot. diode in	A
J3-6	Isolation links	–	–	Fitted
Banks	Interface type	V.24	X.21	Factory
A-H	selection			set as
				required.

	SW6/1	SW6/2	SW6/3
V.24	OFF	OFF	OFF
X.21	ON	OFF	OFF

SW 6/4 is not used.

Appendix E

AT Command/ S-Register Cross References

E.1 AT Command to S-Register

AT	S-REG	AT	S-REG	A T	S-REG	AT	S-REG
A	14	&A	32	*A	33	1A	59
B	27	&B	16,23	*B	60	/B	60
C		&C	21	*C	-	/c	64
D	14	&D	31	*D	66	ID	55
E	14	&E	31	*E	29	/E	
F	31,52	&F		*F	33	IF	53
G		&G	23	*G	33	/G	63
H		&H		*H	82	/H	63
I		&I	31,32	*I	67	/I	63
J		&J	21	*J	-	/J	63
K		&K	32	*K	33	/K	
L	22	&L	27	*L	55	IL	66
M	22	&M	27	*M	59	/M	58
N		&M		*N	-	IN	60
O		&O	66	*O	29	/O	54
P	14	&P	22	*P	-	/P	64
Q	14,29,60	&Q		*Q	-	IQ	65
R	14	&R	21	*R	59	/R	59
S		&S	32	*S	-	/s	60
T	14	&T	16,54	*T	59	/T	54
U		&u	33	*u	33	/u	46
V	14	&v	14	*v	33	/V	58
W		&W		*W	60	/W	58
X	22,32	&X	27	*X	29	Ix	55
Y	22	&Y	31	*Y	29	/Y	64
Z		&Z		*z	-	/z	58

% A		"A	83	- A	85,86,,87,88
1/0 B	67	"B		- B	54
0/0 C	76	"C	68	-C	84
1/0 D		"D	83	-D	84
1/0 E	81	"E	83	- E	75
1/0 F	60	"F	65	-F	76
1/0 G	69	"G		-G	
1/0 H		"H	60	-H	
0/0 I		"I		-I	
1/0 J	69	"J		-J	
1/0 K	68	"K		-K	90
1/0 L	82	"L		-L	91
1/0 M		"M		-M	76
1/0 N	67	"N	82	-N	84
1/0 O	83	"O	81	-O	
0/0 P	69	"P		-P	89
1/0 Q	77	"Q	67	-Q	84
1/0 R	78	"R		-R	89
% S		"S		-S	84
% T	65	"T		-T	
1/0 U	68	"U	61	-u	
1/0 V		"V		-v	90
1/0 W		"W		-W	
1/0 X		"X		-x	90
1/0 Y		"Y		-Y	
0/0 Z		"Z		-z	89

E.2 S-Register to AT Command

S-REGISTER	AT	BIT STATUS							
		7	6	5	4	3	2	1	0
S14	EO	x	x	x	x	x	x	0	x
	EI	x	x	x	x	x	x	1	x
	Q0	x	x	x	x	x	0	x	x
	Q1	x	x	x	x	x	1	x	x
	Vo	x	x	x	x	0	x	x	x
	V1	x	x	x	x	1	x	x	x
	&V0	x	x	x	0	x	x	x	x
	&V1	x	x	x	1	x	x	x	x
	T	x	x	0	x	x	x	x	x
	P	x	x	1	x	x	x	x	x
	&V0	x	0	x	x	x	x	x	x
	&V1	x	1	x	x	x	x	x	x
	A	0	x	x	x	x	x	x	x
	D	1	x	x	x	x	x	x	x
S16	&T1 Disabled	x	x	x	x	x	x	x	0
	&T1 Enabled	x	x	x	x	x	x	x	1
	&B0	x	x	x	x	x	x	0	x
	&B1	x	x	x	x	x	x	1	x
	&T3 Disabled	x	x	x	x	x	0	x	x
	&T3 Enabled	x	x	x	x	x	1	x	x
	&T4	x	x	x	x	0	x	x	x
	&T5	x	x	x	x	1	x	x	x
	&T6 Disabled	x	x	x	0	x	x	x	x
	&T6 Enabled	x	x	x	1	x	x	x	x
	&T7 Disabled	x	x	0	x	x	x	x	x
	&T7 Enabled	x	x	1	x	x	x	x	x
	&T8 Disabled	x	0	x	x	x	x	x	x
	&T8 Enabled	x	1	x	x	x	x	x	x

S-REGISTER	AT	BIT STATUS							
		7	6	5	4	3	2	1	0
S21	&J0	x	x	x	x	x	x	x	0
	&J1	x	x	x	x	x	x	x	1
	&D4 Disabled	x	x	x	x	x	x	0	x
	&D4 Enabled	x	x	x	x	x	x	1	x
	&R0	x	x	x	x	x	0	x	x
	&R1	x	x	x	x	x	1	x	x
	&DO	x	x	x	0	0	x	x	x
	&D1	x	x	x	0	1	x	x	x
	&D2	x	x	x	1	0	x	x	x
	&D3	x	x	x	1	1	x	x	x
	&co	x	0	0	x	x	x	x	x
	&C1	x	0	1	x	x	x	x	x
	&C2	x	1	0	x	x	x	x	x
	&C3	x	1	1	x	x	x	x	x
	Yo	0	x	x	x	x	x	x	x
Y1	1	x	x	x	x	x	x	x	
S22	L0	x	x	x	x	x	x	0	0
	L1	x	x	x	x	x	x	0	1
	L2	x	x	x	x	x	x	1	0
	L3	x	x	x	x	x	x	1	1
	MO	x	x	x	x	0	0	x	x
	M1	x	x	x	x	0	1	x	x
	M2	x	x	x	x	1	0	x	x
	M3	x	x	x	x	1	1	x	x
	Xo	x	0	0	0	x	x	x	x
	x1	x	1	0	0	x	x	x	x
	x2	x	1	0	1	x	x	x	x
	x3	x	1	1	0	x	x	x	x
	x4	x	1	1	1	x	x	x	x
x5	x	1	1	0	x	x	x	x	

S-REGISTER	AT	BIT STATUS							
		7	6	5	4	3	2	1	0
s22 contd.	X6	x	1	1	1	x	x	X	X
	&P0	0	x	x	x	x	x	X	X
	&P1	1	x	x	x	x	x	X	X
S23	&T4	x	x	x	x	x	x	X	0
	&T5	x	x	x	x	x	x	X	1
	&B0	x	x	x	x	x	0	0	X
	&B1	x	x	x	x	x	0	1	X
	&B2	x	x	x	x	x	1	0	X
	&G0	0	0	x	x	x	x	X	X
	&G1	0	1	x	x	x	x	X	X
	&G2	1	0	x	x	x	x	X	X
	&G3	1	1	x	x	x	x	X	X
S27	&M0	x	x	x	x	x	x	0	0
	&M1	x	x	x	x	x	x	0	1
	&M2	x	x	x	x	x	x	1	0
	&M3	x	x	x	x	x	x	1	1
	&L0	x	x	x	x	0	0	X	X
	&L1	x	x	x	x	0	1	X	X
	&L2	x	x	x	x	1	0	X	X
	&L3	x	x	x	x	1	1	X	X
	&X0	x	x	0	0	x	x	X	X
	&X1	x	x	0	1	x	x	X	X
	&x2	x	x	1	0	x	x	X	X
	B0	0	0	x	x	x	x	X	X
	B1	0	1	x	x	x	x	X	X
	B2	1	0	x	x	x	x	X	X
B3	1	1	x	x	x	x	X	X	

S-REGISTER	AT	BIT STATUS							
		7	6	5	4	3	2	1	0
S29	*O0	x	x	x	x	X	X	0	X
	*O1	x	x	x	x	X	X	1	X
	*X0	x	x	x	x	X	0	X	X
	*x1	x	x	x	x	X	1	X	X
	Q2 Disabled	x	x	x	x	0	X	X	X
	Q2 Enabled	x	x	x	x	1	X	X	X
	*EO	x	x	x	0	x	X	X	X
	*E1	x	x	x	1	x	X	X	X
	*Y0	0	0	x	x	x	x	x	x
	*Y1	0	1	x	x	x	x	x	x
*Y2	1	0	x	x	x	x	x	x	
S31	F0	x	x	x	x	x	0	0	0
	F1	x	x	x	x	x	0	0	1
	F2	x	x	x	x	x	0	1	0
	F3	x	x	x	x	x	0	1	1
	F4	x	x	x	x	x	1	0	0
	F5	x	x	x	x	x	1	0	1
	F6	x	x	x	x	x	1	1	0
	F7	x	x	x	x	x	1	1	1
	&E0	x	x	0	0	0	x	x	x
	&E1	x	x	0	0	1	x	x	x
	&E2	x	x	0	1	0	x		x
	&E3	x	x	0	1	1	x	x	x
	&E4	x	x	1	0	0	x	x	x
	&E5	x	x	1	0	1	x	x	x
	&E6	x	x	1	1	0	x	x	x
	&Y0	x	0	x	x	x	x	x	x
&Y1	x	1	x	x	x	x	x	x	

S-REGISTER	AT	BIT STATUS							
		7	6	5	4	3	2	1	0
S31 contd.	&I0	0	x	x	x	x	x	x	x
	&I1	1	x	x	x	x	x	x	x
S32	&so	x	x	x	x	x	0	0	x
	&S1	x	x	x	x	x	0	1	x
	&S2	x	x	x	x	x	1	0	x
	&S3	x	x	x	x	x	1	1	x
	&I2 Disabled	x	x	x	x	0	x	x	x
	&I2 Enabled	x	x	x	x	1	x	x	x
	&A0	x	x	x	0	x	x	x	x
	&A1	x	x	x	1	x	x	x	x
	&K0	x	0	0	x	x	x	x	x
	&K1	x	0	1	x	x	x	x	x
	&K2	x	1	0	x	x	x	x	x
	&K3	x	1	1	x	x	x	x	x
	X5, X6 Disabled	0	x	x	x	x	x	x	x
X5, X6 Enabled	1	x	x	x	x	x	x	x	
S33	*AO	x	x	x	x	x	x	x	0
	*AI	x	x	x	x	x	x	x	1
	*GO	x	x	x	x	x	x	0	x
	*G1	x	x	x	x	x	x	1	x
	*UO	x	x	x	x	x	0	x	x
	*U1	x	x	x	x	x	1	x	x
	*FO	x	x	x	x	0	x	x	x
	*F1	x	x	x	x	1	x	x	x
	*KO	x	x	x	0	x	x	x	x
	*K1	x	x	x	1	x	x	x	x
	&U0	x	0	0	x	x	x	x	x
	&U1	x	0	1	x	x	x	x	x
	&U2	x	1	0	x	x	x	x	x
	&U3	x	1	1	x	x	x	x	x

S-REGISTER	AT	BIT STATUS							
		7	6	5	4	3	2	1	0
S54	n-0	x	x	x	x	X	0	0	0
	/T1	x	x	x	x	X	0	0	1
	/T2	x	x	x	x	X	0	1	0
	/T3	x	x	x	x	X	0	1	1
	/T4	x	x	x	x	X	1	0	0
	/T5	x	x	x	x	x	1	0	1
	/T6	x	x	x	x	x	1	1	0
	/T7	x	x	x	x	x	1	1	1
	/O0	x	x	x	0	x	x	x	x
	101	x	x	x	1	x	x	x	x
	-80	x	x	0	x	x	x	x	x
	-B 1	x	x	1	x	x	x	x	x
	&T11	x	0	x	x	x	x	x	x
	&T12	x	1	x	x	x	x	x	x
	&T13	0	x	x	x	x	x	x	x
&T14	1	x	x	x	x	x	x	x	
S55	/X0	x	x	x	x	x	x	0	0
	/X1	x	x	x	x	x	x	0	1
	/X2	x	x	x	x	x	"x	1	0
	ID0	x	x	x	x	0	0	x	x
	/D1	x	x	x	x	0	1	x	x
	/D2	x	x	x	x	1	0	x	x
	/D3	x	x	x	x	1	1	x	x
	*LO	0	0	0	0	x	x	x	x
	*L1	0	0	0	1	x	x	x	x
	*L2	0	0	1	0	x	x	x	x
	*L5	0	1	0	1	x	x	x	x
	*L6	0	1	1	0	x	x	x	x
	*L7	0	1	1	1	x	x	x	x
	*L8	1	0	0	0	x	x	x	X

S-REGISTER	AT	BIT STATUS							
		7	6	5	4	3	2	1	0
S55 contd.	*L9	1	0	0	1	x	x	X	X
	*L10	1	0	1	0	x	x	X	X
	*L13	1	1	0	1	x	x	X	X
	*L14	1	1	1	0	x	x	X	X
S58	/MO	x	x	x	X	x	o	0	X
	/M1	x	x	x	X	x	0	1	X
	/M2	x	x	x	X	x	1	0	X
	IM3	x	x	x	X	x	1	1	X
	/W0	x	x	x	0	x	x	X	X
	/W1	x	x	x	1	x	x	X	X
	/Z0	x	x	o	X	x	x	X	X
	/Z1	x	x	1	X	x	x	X	X
	/V0	x	o	x	X	x	x	X	X
/V1	x	1	x	X	x	x	X	X	
S59	*T0	x	x	x	X	x	x	0	0
	*T1	x	x	x	X	x	x	0	1
	*T2	x	x	x	X	x	x	1	0
	*T3	x	x	x	X	x	x	1	1
	/A0	x	x	x	X	o	o	X	X
	/A1	x	x	x	X	0	1	X	X
	/A2	x	x	x	X	1	0	X	X
	IA3	x	x	x	X	1	1	X	X
	*M0	x	o	o	0	x	x	X	X
	*M1	x	0	0	1	x	x	X	X
	*M2	x	0	1	0	x	x	X	X
	*M3	x	0	1	1	x	x	X	X
	*M4	x	1	0	0	x	x	X	X
	*R0	o	x	x	X	x	x	X	X
*R1	1	x	x	X	x	x	X	X	

S-REGISTER	AT	BIT STATUS							
		7	6	5	4	3	2	1	0
S60	* Wo	x	x	x	x	X	x	X	0
	*W1	x	x	x	x	X	X	X	1
	*BO	x	x	x	x	X	X	0	x
	*B1	x	x	x	x	x	x	1	x
	/B0	x	x	x	x	x	0	x	x
	/B1	x	x	x	x	x	1	x	x
	Q3 Disabled	x	x	x	x	0	x	x	x
	Q3 Enabled	x	x	x	x	1	x	x	x
	INO	x	x	x	0	x	x	x	x
	/N1	x	x	x	1	x	x	x	x
	"HO	x	x	0	x	x	x	x	x
	"H1	x	x	1	x	x	x	x	x
	/s0	x	0	x	x	x	x	x	x
	/S1	x	1	x	x	x	x	x	x
%FO	0	x	x	x	x	x	x	x	
%F1	1	x	x	x	x	x	x	x	
S63	/H0	x	x	x	x	x	x	0	0
	/H1	x	x	x	x	x	x	0	1
	/H2	x	x	x	x	x	x	1	0
	/H3	x	x	x	x	x	x	1	1
	/I0	x	x	x	0	0	x	x	x
	/I1	x	x	x	0	1	x	x	x
	/I2	x	x	x	1	0	x	x	x
	/I3	x	x	x	1	1	x	x	x
	/G0	x	0	x	x	x	x	x	x
	/G1	x	1	x	x	x	x	x	x

S-REGISTER	AT	BIT STATUS								
		7	6	5	4	3	2	1	0	
S64	/C0	X	X	X	X	X	X	X	0	0
	/C 1	X	X	X	X	X	X	X	0	1
	/C2	X	X	X	X	X	X	X	1	0
	/C3	X	X	X	X	X	X	X	1	1
	/Po	X	X	X	0	0	X	X	X	X
	/P1	X	X	X	0	1	X	X	X	X
	/P2	X	X	X	1	0	X	X	X	X
	/Y0	0	0	X	X	X	X	X	X	X
	/Y1	0	1	X	X	X	X	X	X	X
	N 2	1	0	X	X	X	X	X	X	X
N 3	1	1	X	X	X	X	X	X	X	
S65	/Q0	X	X	X	X	X	X	X	0	0
	/Q 1	X	X	X	X	X	X	X	0	1
	/Q2	X	X	X	X	X	X	X	1	0
	/Q3	X	X	X	X	X	X	X	1	1
	IJO	X	X	X	X	0	X	X	X	X
	/J1	X	X	X	X	1	X	X	X	X
	"FO	X	0	0	X	X	X	X	X	X
	"F1	X	0	1	X	X	X	X	X	X
	"F2	X	1	0	X	X	X	X	X	X
	"F3	X	1	1	X	X	X	X	X	X

S-REGISTER	AT	BIT STATUS							
		7	6	5	4	3	2	1	0
S66	*D0	x	x	x	x	x	0	0	0
	*D1	x	x	x	x	x	0	0	1
	*D2	x	x	x	x	x	0	1	0
	*D3	x	x	x	x	x	0	1	1
	*D4	x	x	x	x	x	1	0	0
	*D5	x	x	x	x	x	1	0	1
	*D6	x	x	x	x	x	1	1	0
	/LO	x	x	x	0	x	x	X	X
	/L1	x	x	x	1	x	x	X	X
	&O0	x	0	0	x	x	x	X	X
	&O1	x	0	1	x	x	x	X	X
	&O2	x	1	0	x	x	x	X	X
	/RO	0	x	x	x	x	x	X	X
/R1	1	x	x	x	x	x	X	X	
S67	*V0	x	x	x	x	x	x	0	0
	*V1	x	x	x	x	x	x	0	1
	*V2	x	x	x	x	x	x	1	0
	*V3	x	x	x	x	x	x	1	1
	%B0	x	x	x	x	0	x	X	X
	%B1	x	x	x	x	1	x	X	X
	%NO	x	x	x	0	x	x	X	X
	%N1	x	x	x	1	x	x	X	X
	*Io	x	x	0	x	x	x	X	X
	*I1	x	x	1	x	x	x	X	X
	"Q0	0	0	x	x	x	x	X	X
	"Q1	0	1	x	x	x	x	X	X
	"Q2	1	0	x	x	x	x	X	X
"Q3	1	1	x	x	x	x	X	X	

S-REGISTER	A T	BIT STATUS							
		7	6	5	4	3	2	1	0
S68	% K0	x	x	x	x	x	0	0	0
	% K1	x	x	x	x	x	0	0	1
	% K2	x	x	x	x	x	0	1	0
	% K3	x	x	x	x	x	0	1	1
	% KS	x	x	x	x	x	1	0	1
	% K7	x	x	x	x	x	1	1	1
	% U0	x	o	o	o	x	x	X	X
	% U1	x	0	0	1	x	x	X	X
	% U2	x	0	1	0	x	x	X	X
	% U3	x	0	1	1	x	x	X	X
	% U5	x	1	0	1	x	x	X	X
	% U7	x	1	1	1	x	x	X	X
	"co	o	x	x	x	x	x	X	X
	"cl	1	x	x	x	x	x	X	X
S69	% P0	x	x	x	x	x	o	0	0
	% P1	x	x	x	x	x	0	0	1
	% P2	x	x	x	x	x	0	1	0
	% P3	x	x	x	x	x	0	1	1
	% P4	x	x	x	x	x	1	0	0
	'AJO	x	x	o	o	x	x	X	X
	% J1	x	x	0	1	x	x	X	X
	% J2	x	x	1	0	x	x	X	X
	% J3	x	x	1	1	x	x	X	X
	% G0	o	o	x	x	x	x	0	X
	% G1	0	1	x	x	x	x	X	X
	% G2	1	0	x	x	x	x	X	X
	% G3	1	1	x	x	x	x	X	X

S-REGISTER	AT	BIT STATUS							
		7	6	5	4	3	2	1	0
S75	-EO	x	x	x	x	x	0	0	0
	-E 1	x	x	x	x	x	0	0	1
	-E2	x	x	x	x	x	0	1	0
	-E3	x	x	x	x	x	0	1	1
	-E4	x	x	x	x	x	1	0	0
	-ES	x	x	x	x	x	1	0	1
	-E6	x	x	x	x	x	1	1	0
	-E7	x	x	x	x	x	1	1	1
S76	%co	x	x	x	x	x	x	0	0
	%c1	x	x	x	x	x	x	0	1
	%C2	x	x	x	x	x	x	1	0
	%C3	x	x	x	x	x	x	1	1
	-FO	x	x	x	x	0	x	x	x
	-F 1	x	x	x	x	1	x	x	x
	-MO	x	0	0	x	x	x	x	x
	-M 1	x	0	1	x	x	x	x	x
-M 2	x	1	0	x	x	x	x	x	
S77	%Q0	x	x	x	x	x	x	x	0
	%Q1	x	x	x	x	x	x	x	1
S78	%RO	x	x	x	x	x	x	0	0
	%R1	x	x	x	x	x	x	0	1
	%R2	x	x	x	x	x	x	1	0
	%R3	x	x	x	x	x	x	1	1

S-REGISTER	AT	BIT STATUS							
		7	6	5	4	3	2	1	0
S81	%E0	x	x	x	x	x	o	0	0
	%E1	x	x	x	x	x	o	0	1
	%E2	x	x	x	x	x	o	1	0
	%E3	x	x	x	x	x	o	1	1
	%E4	x	x	x	x	x	1	0	0
	%E5	x	x	x	x	x	1	0	1
	%E6	x	x	x	x	x	1	1	0
	%E7	x	x	x	x	x	1	1	1
	"00	x	x	x	o	0	x	x	X
	"01	x	x	x	o	1	x	x	X
"02	x	x	x	1	0	x	X	X	
"03	x	x	x	1	1	x	x	x	
S82	"NO	x	x	x	x	x	x	0	0
	"N1	x	x	x	x	x	X	0	1
	"N2	x	x	x	x	x	x	1	0
	"N3	x	x	x	x	x	x	1	1
	*HO	x	x	x	x	0	X	X	X
	*H1	x	x	x	x	1	X	X	X
	%LO	o	x	x	x	x	x	x	x
%L1	1	x	x	x	x	X	X	X	
S83	"E0	x	x	x	x	X	X	0	0
	"E1	x	x	x	x	X	X	0	1
	"E2	x	x	x	x	X	X	1	0
	"DO	x	x	x	x	X	0	X	X
	"D1	x	x	x	x	x	1	X	X
	"AO	x	x	x	o	x	X	X	X
	"A1	x	x	x	1	x	X	X	x
	%00	x	o	x	x	x	X	x	x
%O1	X	1	X	X	X	X	X	x	

S-REGISTER	AT	BIT STATUS							
		7	6	5	4	3	2	1	0
S84	-co	x	x	x	x	x	x	0	0
	-c 1	x	x	x	x	x	x	0	1
	-C2	x	x	x	x	x	x	1	0
	-C3	x	x	x	x	x	x	1	1
	-D0	x	x	x	0	x	x	x	x
	-D 1	x	x	x	1	x	x	x	x
	-QO	x	x	0	x	x	x	x	x
	-Q 1	x	x	1	x	x	x	x	x
	-so	x	0	x	x	x	x	x	x
	-s 1	x	1	x	x	x	x	x	x
	-NO	0	x	x	x	x	x	x	x
-N 1	1	x	x	x	x	x	x	x	
S89	-Po	x	x	x	x	x	x	0	0
	-P 1	x	x	x	x	x	x	0	1
	-P2	x	x	x	x	x	x	1	0
	-P3	x	x	x	x	x	x	1	1
	-RO	x	x	x	x	x	0	x	x
	-R 1	x	x	x	x	0	1	x	x
	-R2	x	x	x	x	0	x	x	x
	-R3	x	x	x	x	1	0	x	x
	-Zo	0	x	x	x	1	1	x	x
	-z 1	1	x	x	x	x	x	x	x
S90	-Vo	x	x	x	x	x	x	0	0
	-V1	x	x	x	x	x	x	0	1
	-V2	x	x	x	x	x	x	1	0
	-K0	x	x	x	x	0	x	x	x
	-K1	x	x	x	x	1	x	x	x
	-Xo	x	0	0	x	x	x	x	x
	-x 1	x	0	1	x	x	x	x	x
	-x2	x	1	0	x	x	x	x	"x