

Javelin 640 and 640R Reference Manual

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STATUTORY NOTICES

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

NS/1404/2/K/601392

NS/1404/2/L/601695



Case Communications Ltd declare that this product conforms with the protection requirements of Council Directive 89/336/EEC on the approximation of the laws of the member states relating to electromagnetic protection.

This equipment has been tested using shielded DTE cables supplied by Case Communications Ltd. These cables, or equivalents, must be used to ensure compliance with this declaration

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All PCB assemblies contain Electrostatic Sensitive Devices (ESDs) which may be permanently damaged if incorrectly handled. This equipment must be handled in accordance with BS5783 code of practice for the handling of electrostatic sensitive devices

This modem has been tested to BS6328 part 2 and BS6301, and is approved for connection to EPS8 leased line.

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

Czech Republic Safety Statement

Přístroj musí být umístěn v blízkosti síťové zásuvky. K odpojení přístroje od sítě slouží vidlice síťového přívodu.

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 modem supplier.

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Preface

The Javelin 640 is available in two versions:

Javelin 640 Standalone modem.

Javelin 640R Rackmount modem for use in the Network 16 Rack System.

This manual provides full information for installing, configuring and using the Javelin 640 and Javelin 640R modems 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 modem and to get it operational for straightforward use.

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

Throughout this manual the Javelin 640 and Javelin 640R are described as 'the modem' where features are common to both. Where necessary they are differentiated by 'standalone' or 'rackmount' respectively.

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

Terms and Conventions

This manual uses the following terms and conventions:

- DTE 'Data Terminal Equipment', e.g. the computer or terminal attached to the modem.
- DCE 'Data Communications Equipment', e.g. the modem.
- <CR> represents a carriage return.
- <LF> represents a line feed.
- <Ctrl> represents a control character (hold down the **CONTROL** key whilst pressing the required character).

Commands entered at the keyboard are shown in 'Modern Bold' font, for example, **ATE1**.

Responses from the modem that are displayed on the screen are shown in 'Modern' font, for example, ERROR.

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

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PART 1

BASIC OPERATION

Chapter 1	Introduction
Chapter 2	Installation
Chapter 3	Getting Started

1.1 The Javelin 640 and 640R Modems

The Javelin 640 and 640R modems are capable of passing asynchronous data at up to 38400 bps, and synchronous data at 48000, 56000 and 64000 bps. They are designed to operate over leased (private wire) lines.

Each modem communicates point-to-point with a remote Javelin 640 or 640R modem using proprietary baseband protocol.

The modem is transparent to all asynchronous data formats and speeds up to 19200 bps. However, because of the over-sampling technique used, high bit distortions can occur when operating at or over 19200 bps. This may result in occasional data errors when connected to equipment that operates in a similar manner.

The modem is simple to use and very flexible. It is sufficiently straightforward for you to quickly master the basic procedures of using it, and yet it offers a wide range of facilities.

The principal features of the modem are:

- Storage of 12 pre-set configurations.
- Facilities for the user to customise and store up to 4 of the pre-set configurations.
- Comprehensive modem configuration using AT commands, which can be from a Javelin 640 or Javelin 640R modem at a remote site.
- A port selectable to ITU-T V.24/V.28 (EIA RS-232-C) or X.21 standards for connecting to the DTE.
- A separate command port for connection to a terminal or PC, so that commands may be entered while the modem is in use.
- Modem Management. The modem may be controlled by the Network 16 Controller Card or Network 6, and managed as part of a network using a high-level network management system.

1.2 Physical Description of the Standalone Modem

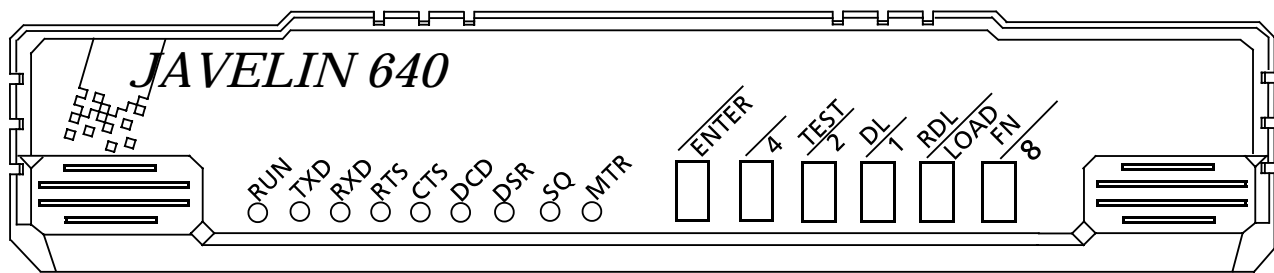


Figure 1-1 The Standalone Modem Front Panel

1.2.1 The Indicators

The indicators are on the front panel of the modem, which is shown in Figure 1-1.

- | | |
|------------|--|
| RUN | A continuous light means that power is on and the modem is functioning correctly. A flashing light indicates that a test is being performed. |
| TXD | Transmit Data. A flashing light indicates that data is being transferred from the local DTE. (See Note 1 below.) |
| RXD | Receive Data. A flashing light indicates that the modem is sending data to the local DTE. |
| RTS | Request To Send. A continuous light indicates that the local DTE is ready to send data. In full-duplex operation this is normally lit at all times. When the modem is configured for X.21 operation, a continuous light indicates that the control input is active (See Note 1 below.) |
| CTS | Clear To Send. A continuous light indicates that the modem is ready to transmit data to a remote modem. In full-duplex mode this is normally lit at all times. |
| DCD | Data Carrier Detect. Lit to indicate recognition of a carrier signal from the remote modem. In full-duplex mode this is normally lit at all times. When the modem is configured for X.21 operation, a continuous light shows that 'Indicate' is active. |

DSR	Data Set Ready. Lit to indicate that the modem has control of the line and is in data transmit mode. During a self-test with signal injection, indicates errors.
SQ	Signal Quality. This light is on at all times on a 'slave' modem. For a modem configured as a 'master' modem, a continuous light indicates that the signal quality received from the remote modem is acceptable. A momentary switching off of the light indicates that an error has occurred. A sustained off state indicates that the modem either cannot communicate with the remote modem, or cannot reliably pass data.
MTR	Master Mode. A continuous light indicates that the modem has been configured to be a 'master' modem. For a modem configured as a 'slave', the LED will not be lit.

Note 1. If an unterminated DTE cable is connected to your modem, the **TXD** and **RTS** LEDs may give inaccurate indications. As a result, the indicators on the remote modem may also give a false reading. For example, when in X.21 operation, if an unterminated cable is connected to your modem it is possible for the **RTS** indicator to light, even though **RTS** itself has not been raised – as a result, the remote modem is likely to indicate **DCD** as being present, although in reality it is not. This is a very rare occurrence and should not be a cause for concern.

1.2.2 The Controls

The controls are on the front of the modem, which is shown in Figure 1-1. The names above the line are for on-line operation of the modem. The names below the line are for configuration loading. The left-hand button is a non-latching switch. The other five have a latching action.

ENTER	Use to load a configuration.
4	Use in conjunction with the ENTER , 2 , 1 and 8 buttons to select a configuration.
<u>TEST</u> 2	Use as TEST to activate a test sequence for local or remote tests with your modem. Use as 2 in conjunction with the ENTER , 4 , 1 and 8 buttons to select a configuration.

DL
1

If the modem is powered on with the **DL** button latched-in and the **ENTER** button depressed, the modem will be configured as a 'slave'.

DL is also used to select a local digital loop test feature between the modem and the DTE.

Use as **1** in conjunction with the **ENTER**, **4**, **2** and **8** buttons to select a configuration.

RDL
LOAD

Use as **RDL** to select a remote digital loopback.

Use as **LOAD** to select a load configuration option.

FN
8

If the modem is powered on with the **FN** button latched-in and the **ENTER** button depressed, the modem will be configured as a 'master'.

Use as **8** in conjunction with the **ENTER**, **4**, **2** and **1** buttons to select a configuration.

More-detailed descriptions of the uses of the buttons are given in the descriptions of the functions for which they are needed.

1.2.3 The Connections

The connections are made from the rear panel of the modem. The 230 volt version is shown in Figure 1-2.

Pin assignments and suggested cable configurations are detailed in Appendix B.

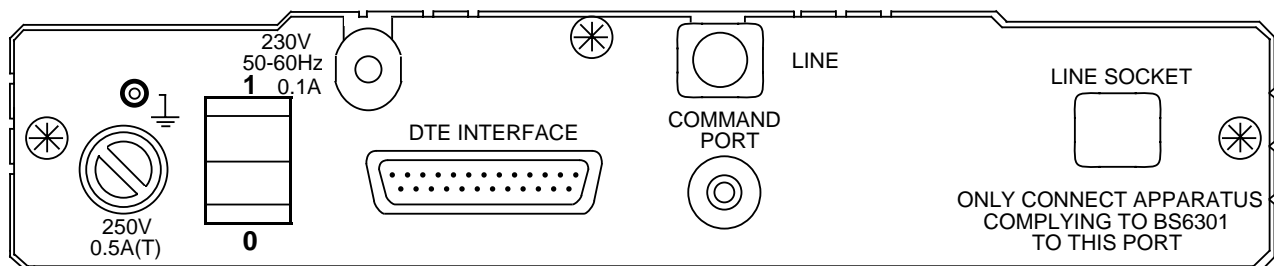


Figure 1-2 The Standalone Modem Rear Panel

DTE INTERFACE Female 25-way D-type connector (ISO 2110) to connect the modem to your local DTE.

COMMAND PORT 3.5 mm stereo jack socket to accept the command port adapter.

EARTH

For connecting the modem to external earth. If this is not used, then the modem must be earthed through the mains cable, which must be plugged in *before* the line is connected.

POWER

2-metre mains cable fitted with a moulded plug for connection to a standard power outlet. To isolate the modem from the power source, *first* remove the line connection, *then* remove the mains plug from the power outlet.

See Appendix D for details on connecting power to a DC modem.

FUSE

500 mA (T) anti-surge 250 V mains fuse. You must *first* disconnect the modem from the line and *then* from the power supply before replacing this fuse. Always replace the fuse with one of the same rating.

SWITCH

Modem power ON (1) or OFF (0).

LINE (socket)

A standard socket for connection to your leased line. Fitted with a blanking plug. The Appendix entitled 'Technical Guide' contains instructions for removing the blanking plug. See also the Appendix entitled 'Country-Specific Information'.

LINE

Fitted with a 2-metre leased line cable, terminated with a standard plug (for use instead of a cable connected to the modem's socket: refer to the Appendix entitled 'Technical Guide').

1.3 Physical Description of the Rackmount Modem

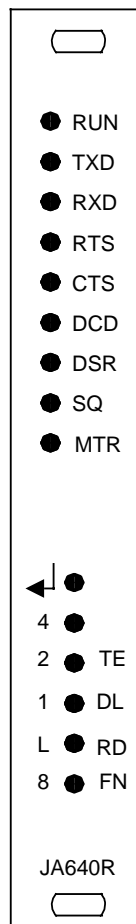


Figure 1-3 The Rackmount Modem Front Panel

1.3.1 The Indicators

The indicators have the same meanings as for the standalone modem (Section 1.2.1).

1.3.2 The Controls

The control buttons have the same function as the equivalent buttons in the standalone modem (Section 1.2.2). The names on the *left* of the buttons are for configuration loading. The names on the *right* of the buttons are for on-line operation of the modem.

1.3.3 The Connections

The plug-in modem card connects with sockets on the rack system. The interfaces on the rack are described in the rack manual.

2.1 Pre-Installation

In addition to your DTE, and depending on the way you set up and intend to use your modem, you may need:

- A cable to connect the modem to the DTE (your computer or terminal). See Appendix B for details of the modem pin connections. The cable will need to be V.24 25-pin or X.21 15-pin depending on your DTE.
- A leased telephone line (see the postcard at the rear of this manual if you need to order one from BT).
- For asynchronous command of your modem, a separate asynchronous command terminal with a V.24/RS-232-C serial port and a V.24 cable. This terminal is only needed for use with the modem while commands are entered.
- For the standalone modem, a mains power socket outlet installed near the modem, easily accessible, and capable of supplying 1.0 amps at the nominal voltage and frequency.

Please refer to Appendix C for country-specific information.

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

- Sufficiently close to the mains power outlet so as not to cause strain on the connecting cable.
- Sufficiently close to the leased line 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.

If the modem is intended for transmission over distances in excess of 5 km, see the notes in the Appendix entitled 'Technical Guide' about long cable lengths.

2.2 DTE Requirements

2.2.1 Data DTE

Your data DTE will probably be one of the following:

- A 'dumb' terminal (VDU).
- A PC.
- A terminal connected to a computer.

It will transmit and receive data in either synchronous or asynchronous mode. Consult the DTE's manual for the relevant information.

2.2.2 Command Terminal

For controlling the modem, you require a separate asynchronous command terminal with 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 modem or 1200 bps for a rackmount modem.

This terminal will be connected to the standalone modem's command port.

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

2.3 Installing the Standalone Modem

2.3.1 Power Supply Connection

WARNING: Do not connect the modem to the mains socket or to the telephone line at this stage.

The standard modem is supplied for use on 230 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 modem 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.

A special version of the modem is available for use on 24-48 VDC supplies. Details are given in the Appendix entitled 'Technical Guide'.

When you are sure the modem is correctly rated for your mains supply, ensure that the modem is switched off (0 position) then plug the mains lead into the mains supply. Do not switch on until all other connections have been made.

2.3.2 DTE Port Connection

See Figure 2-1. The way that you connect your DTE will depend on whether it has a V.24 or X.21 interface. See Appendix B for details.

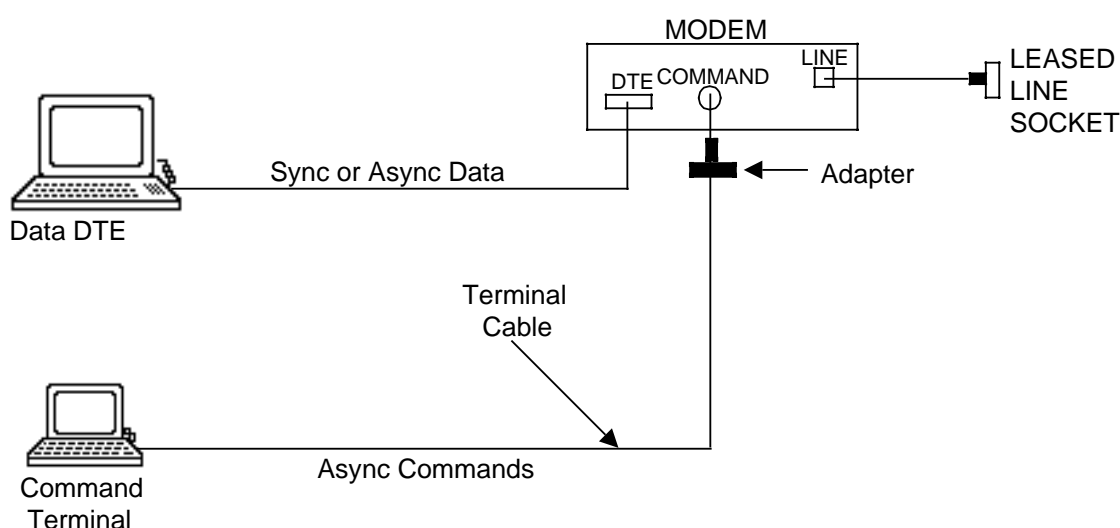


Figure 2-1 Standalone Modem Connections

2.3.3 Command Port Connection

The command port allows you to connect a separate asynchronous command terminal for entering commands, as shown in Figure 2-1.

All configuration commands must be given to the modem via the command port. This command port may be used for entering asynchronous configuration commands while the modem is in either synchronous or asynchronous operating mode for DTE data.

The port is provided on a stereo jack socket. An adapter cable to convert this to a standard 25-way D-type V.24 socket is provided (see Appendix B for details).

The data format and speed for the command port is fixed at 7 data bits, even parity, 9600 bps.

2.3.4 Line Connection

The modem is supplied with a cord and standard plug ready for connection to a leased line circuit. If the leased line is terminated with a different style socket, or a terminal block, you can make a connection from the modem terminal block (see the Appendix entitled 'Technical Guide').

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

2.4 Installing the Rackmount Modem

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

2.4.2 DTE Port Connection

The connections for the modem's DTE port are via the 96-way connectors between the modem circuit board and the rack system. Connections to the DTE are made from the back of the rack. See Appendix B.1.

2.4.3 Command Port Connection

The connections for the modem's command port are via the 96-way connectors between the modem circuit board and the rack system. Connections to the command terminal are made from the back of the rack. Refer to Appendix B.2.2.

The format and speed for the command port is fixed at 7 data bits, even parity, 1200 bps.

2.4.4 Line Connection

The modem's connections for the line are via the 96-way connectors between the modem circuit board and the rack system. Connections to the line are made from terminal blocks on the back of the rack.

Terminal	Cable Colour	Description
1	Black	2-wire leased line
2	Orange	2-wire leased line
3		Not used
4		Not used
5		Not used
6		Not used
7		Not used
8		Not used

Note that in order to meet the EMC requirements for CE marking the ferrite core supplied with the card (part number A172-000002) must

be looped twice through the line cord at the rear of the frame corresponding to the slot into which the rackmount is fitted, and secured with a Tyrap. The core should be located approximately five inches from the end of the linecord nearest the frame.

See the rack system manual for further details.

2.5 Confidence Check

When the modem installation is complete, a brief test may be carried out to check that the modem is functioning.

For both the rackmount and the standalone modem the simplest test is to depress the **DL** button. Data transmitted by the DTE will be echoed back to it. This is called a local digital loop test. It checks the DTE interface and the modem's processor, but not the leased line circuit.

This chapter covers basic details of how to set up your modem in a straightforward environment.

3.1 Starting Up

Before using the modem, ensure that it has been installed correctly as described in Chapter 2.

The modem's default configuration is factory configuration 0. This is V.24, 19200 bps, internal synchronous clock, slave mode (described in Section 4.1). If this is suitable for your requirement, you may not need to reconfigure the modem. If this is so, follow the procedure below, checking that the modem and command terminal respond as indicated.

1. Switch on the DTE and the command terminal.
2. Switch on the modem. The LED indicators on the front panel will reflect the status of the DTE interface. **TXD**, **RXD** and **OH** should be off.
3. Load the default factory configuration 0, as follows. Make sure all the buttons on the modem's front panel are **OUT**. Press the **LOAD (L)** button, press and release the **ENTER** button, then release the **LOAD (L)** button.
4. Type the command **AT** on the command terminal keyboard and press **RETURN**. The message **OK** should be displayed on the screen.

If factory configuration 0 is not suitable for your operation, go to Section 3.1.1 to change the modem to master mode, or to Chapter 4 to choose and load a more suitable configuration.

Your modem should now be ready for use.

3.1.1 Changing Master/Slave Setting

The start-up factory default configuration 0 sets the modem to slave mode. However, for a pair of modems to communicate it is necessary for one to be set to master and the other to slave.

There are three ways in which you can change the master/slave setting:

- **Using the AT command language**

1. Switch on your command terminal. A cursor should appear in the top left corner of the screen. Either:
 - a) Type: **AT"A1** followed by a carriage return, to set the modem into master mode, or
 - b) Type: **AT"A** followed by a carriage return, to set the modem into slave mode.

- **Via the front panel buttons**

1. Switch off the modem, and make sure all the front panel buttons are in the out position.
2. Depress the **FN** button to set the modem to master mode, or the **DL** button to set the modem to slave mode, and depress the **ENTER (I)** button.
3. Switch on the modem while holding the **ENTER (I)** button depressed.
4. Continue to depress the **ENTER (I)** button for two seconds before releasing it, then return the **FN** or **DL** button to the out position.

- **Via the selected factory configuration**

This is done by loading the companion configurations for slave and master operation at each end of the modem link. Refer to Chapter 4 of this manual for details.

PART 2

ADVANCED OPERATION

Chapter 4	Modem Configurations
Chapter 5	Advanced Configuration
Chapter 6	Diagnostic Facilities
Chapter 7	The AT Commands
Chapter 8	The S-Registers

4.1 Pre-Set Configurations

4.1.1 Introduction

In order to be able to match a wide variety of situations, your modem incorporates very versatile communications capabilities. These include, for example:

- data transmission speeds,
- data transmission methods (e.g. synchronous/asynchronous).

To simplify the task of configuring your modem, you can choose one of the twelve pre-configured configurations (eight "factory configurations" and four "user configurations") that cover standard applications. They are described in this section.

If none of these twelve configurations is exactly what you need, you can choose the one nearest to your requirements, modify it as necessary with AT commands from your command terminal, and store it as a new "user configuration" in battery backed-up memory, as described in Section 4.2.

Then, to configure your modem, you only need to load the appropriate configuration, either from the front panel as described in Section 4.3, or by command (&Fn) as described in Section 4.4.

See the configuration notes in Section 4.1.4.

4.1.2 Pre-Set Configurations List

The following standard configurations are provided:

Configuration	Description
Factory 0	V.24, synchronous, 19200 bps, internal clock, slave modem.
Factory 1	V.24, synchronous, 19200 bps, internal clock, master modem.
Factory 2	V.24, synchronous, 19200 bps, external clock, master modem.
Factory 3	X.21, synchronous, 64000 bps, external clock, master modem.
Factory 4	X.21, synchronous, 64000 bps, internal clock, master modem.
Factory 5	X.21, synchronous, 64000 bps, internal clock, slave modem.
Factory 6	V.24, asynchronous, 9600 bps, master modem.
Factory 7	V.24, asynchronous, 9600 bps, slave modem.
User 0	V.24, synchronous, 9600 bps, internal clock, slave modem.
User 1	V.24, synchronous, 9600 bps, internal clock, master modem.
User 2	V.24, synchronous, 9600 bps, external clock, master modem.
User 3	V.24, synchronous, 9600 bps, internal clock, slave modem, front panel switches disabled.

Note that your modem's internal link options must be set for the interface chosen (either X.21 or V.24). See the Appendix entitled 'Technical Guide' for details.

4.1.3 Pre-Set Configurations Details

Factory Configuration 0 - V.24, Synchronous, 19200 bps, Internal Clock, Slave Modem

19200 bps is the highest speed which would normally be used with V.24. Your modem's internal link options must be set to V.24 (see the Appendix entitled 'Technical Guide' for details).

```
Local Configuration Screen

V1 Result's          LONG FORM      *R0 RTS Clamp      OFF
&C1 DCD/DSR to DTE  NORMAL        *T1 DCD Timeout    LOSS
&Q1 Operation Mode   SYNC          "A0 Leased Line Mode SLAVE
&R0 RTS/CTS Delay    0 mS         "U17 DTE Rate      19200
&S1 Switches         ENABLED       /B1 Carrier        CONSTANT
&X0 DTE Timing       INTERNAL      /U7 Async Format    8/N/1
%E7 Remote Control    USER & LINE  -V0 Interface      V24
%J0 Control Pass Thru NONE
```

Factory Configuration 1 - V.24, Synchronous, 19200 bps, Internal Clock, Master Modem

This is the 'master' version of configuration 0. Your modem's internal link options must be set to V.24 (see the Appendix entitled 'Technical Guide' for details).

```
Local Configuration Screen

V1 Result's          LONG FORM      *R0 RTS Clamp      OFF
&C1 DCD/DSR to DTE  NORMAL        *T1 DCD Timeout    LOSS
&Q1 Operation Mode   SYNC          "A1 Leased Line Mode MASTER
&R0 RTS/CTS Delay    0 mS         "U17 DTE Rate      19200
&S1 Switches         ENABLED       /B1 Carrier        CONSTANT
&X0 DTE Timing       INTERNAL      /U7 Async Format    8/N/1
%E7 Remote Control   USER & LINE  -V0 Interface      V24
%J0 Control Pass Thru NONE
```

Factory Configuration 2 – V.24, Synchronous, 19200 bps, External Clock, Master Modem

This is the external synchronous clock version of factory configuration 1. Your modem's internal link options must be set to V.24 (see the Appendix entitled 'Technical Guide' for details).

Local Configuration Screen

V1	Result's	LONG FORM	*R0	RTS Clamp	OFF
&C1	DCD/DSR to DTE	NORMAL	*T1	DCD Timeout	LOSS
&Q1	Operation Mode	SYNC	"A1	Leased Line Mode	MASTER
&R0	RTS/CTS Delay	0 mS	"U17	DTE Rate	19200
&S1	Switches	ENABLED	/B1	Carrier	CONSTANT
&X1	DTE Timing	EXTERNAL	/U7	Async Format	8/N/1
%E7	Remote Control	USER & LINE	-V0	Interface	V24
%J0	Control Pass Thru	NONE			

Factory Configuration 3 - X.21, Synchronous, 64000 bps, External Clock, Master Modem

This is the external synchronous clock version of factory configuration 4. Your modem's internal link options must be set to X.21 (see the Appendix entitled 'Technical Guide' for details).

```
Local Configuration Screen

V1 Result's          LONG FORM      *R0 RTS Clamp      OFF
&C1 DCD/DSR to DTE  NORMAL        *T1 DCD Timeout    LOSS
&Q1 Operation Mode   SYNC          "A1 Leased Line Mode MASTER
&R0 RTS/CTS Delay    0 mS         "U23 DTE Rate      64000
&S1 Switches         ENABLED       /B1 Carrier        CONSTANT
&X1 DTE Timing       EXTERNAL     /U7 Async Format    8/N/1
%E7 Remote Control   USER & LINE -V1 Interface      X21
%J0 Control Pass Thru NONE
```

Factory Configuration 4 - X.21, Synchronous, 64000 bps, Internal Clock, Master Modem

This is the normal setting for X.21 synchronous operation. Your modem's internal link options must be set to X.21 (see the Appendix entitled 'Technical Guide' for details).

Local Configuration Screen

V1	Result's	LONG FORM	*R0	RTS Clamp	OFF
&C1	DCD/DSR to DTE	NORMAL	*T1	DCD Timeout	LOSS
&Q1	Operation Mode	SYNC	"A1	Leased Line Mode	MASTER
&R0	RTS/CTS Delay	0 mS	"U23	DTE Rate	64000
&S1	Switches	ENABLED	/B1	Carrier	CONSTANT
&X0	DTE Timing	INTERNAL	/U7	Async Format	8/N/1
%E7	Remote Control	USER & LINE	-V0	Interface	X21
%J0	Control Pass Thru	NONE			

Factory Configuration 5 – X.21, Synchronous, 64000 bps, Internal Clock, Slave Modem

This is the 'slave' version of configuration 4. Your modem's internal links option must be set to X.21 (see the Appendix entitled 'Technical Guide' for details).

```
Local Configuration Screen

V1 Result's          LONG FORM      *R0 RTS Clamp      OFF
&C1 DCD/DSR to DTE  NORMAL        *T1 DCD Timeout    LOSS
&Q1 Operation Mode   SYNC          "A0 Leased Line Mode SLAVE
&R0 RTS/CTS Delay    0 mS         "U23 DTE Rate      64000
&S1 Switches         ENABLED       /B1 Carrier        CONSTANT
&X0 DTE Timing       INTERNAL      /U7 Async Format    8/N/1
%E7 Remote Control   USER & LINE  -V0 Interface      X21
%J0 Control Pass Thru NONE
```

Factory Configuration 6 – V.24, Asynchronous, 9600 bps, Master Modem

This is the normal configuration for asynchronous operation. Your modem's internal link options must be set to V.24 (see the Appendix entitled 'Technical Guide' for details).

Local Configuration Screen

V1	Result's	LONG FORM	*R0	RTS Clamp	OFF
&C1	DCD/DSR to DTE	NORMAL	*T1	DCD Timeout	LOSS
&Q0	Operation Mode	ASYNCR	"A1	Leased Line Mode	MASTER
&R0	RTS/CTS Delay	0 mS	"U13	DTE Rate	9600
&S1	Switches	ENABLED	/B1	Carrier	CONSTANT
&X0	DTE Timing	INTERNAL	/U7	Async Format	8/N/1
%E7	Remote Control	USER & LINE	-V0	Interface	V24
%J0	Control Pass Thru	NONE			

Factory Configuration 7 – V.24, Asynchronous, 9600 bps, Slave Modem

This is the 'slave' version of configuration 6. Your modem's internal link options must be set to V.24 (see the Appendix entitled 'Technical Guide' for details).

Local Configuration Screen					
V1	Result's	LONG FORM	*R0	RTS Clamp	OFF
&C1	DCD/DSR to DTE	NORMAL	*T1	DCD Timeout	LOSS
&Q0	Operation Mode	ASYNC	"A0	Leased Line Mode	SLAVE
&R0	RTS/CTS Delay	0 mS	"U13	DTE Rate	9600
&S1	Switches	ENABLED	/B1	Carrier	CONSTANT
&X0	DTE Timing	INTERNAL	/U7	Async Format	8/N/1
%E7	Remote Control	USER & LINE	-V0	Interface	V24
%J0	Control Pass Thru	NONE			

User Configuration 0 – V.24, Synchronous, 9600 bps, Internal Clock, Slave Modem

Your modem's internal link options must be set to V.24 (see the Appendix entitled 'Technical Guide' for details).

Local Configuration Screen

V1	Result's	LONG FORM	*R0	RTS Clamp	OFF
&C1	DCD/DSR to DTE	NORMAL	*T1	DCD Timeout	LOSS
&Q1	Operation Mode	SYNC	"A0	Leased Line Mode	SLAVE
&R0	RTS/CTS Delay	0 mS	"U13	DTE Rate	9600
&S1	Switches	ENABLED	/B1	Carrier	CONSTANT
&X0	DTE Timing	INTERNAL	/U7	Async Format	8/N/1
%E7	Remote Control	USER & LINE	-V0	Interface	V24
%J0	Control Pass Thru	NONE			

User Configuration 1 - V.24, Synchronous, 9600 bps, Internal Clock, Master Modem

This is the 'master' version of user configuration 0. Your modem's internal link options must be set to V.24 (see the Appendix entitled 'Technical Guide' for details).

```
Local Configuration Screen

V1 Result's          LONG FORM      *R0 RTS Clamp      OFF
&C1 DCD/DSR to DTE  NORMAL        *T1 DCD Timeout    LOSS
&Q1 Operation Mode   SYNC          "A1 Leased Line Mode MASTER
&R0 RTS/CTS Delay    0 mS         "U13 DTE Rate      9600
&S1 Switches         ENABLED       /B1 Carrier        CONSTANT
&X0 DTE Timing       INTERNAL      /U7 Async Format    8/N/1
%E7 Remote Control   USER & LINE -V0 Interface      V24
%J0 Control Pass Thru NONE
```

User Configuration 2 – V.24, Synchronous, 9600 bps, External Clock, Master Modem

Your modem's internal link options must be set to V.24 (see the Appendix entitled 'Technical Guide' for details).

Local Configuration Screen

V1	Result's	LONG FORM	*R0	RTS Clamp	OFF
&C1	DCD/DSR to DTE	NORMAL	*T1	DCD Timeout	LOSS
&Q1	Operation Mode	SYNC	"A1	Leased Line Mode	MASTER
&R0	RTS/CTS Delay	0 mS	"U13	DTE Rate	9600
&S1	Switches	ENABLED	/B1	Carrier	CONSTANT
&X1	DTE Timing	EXTERNAL	/U7	Async Format	8/N/1
%E7	Remote Control	USER & LINE	-V0	Interface	V24
%J0	Control Pass Thru	NONE			

User Configuration 3 – V.24, Synchronous, 9600 bps, Internal Clock, Slave Modem, Front Panel Switches Disabled

Your modem's internal link options must be set to V.24 (see the Appendix entitled 'Technical Guide' for details).

```
Local Configuration Screen

V1 Result's          LONG FORM      *R0 RTS Clamp      OFF
&C1 DCD/DSR to DTE  NORMAL        *T1 DCD Timeout    LOSS
&Q1 Operation Mode  SYNC          "A0 Leased Line Mode SLAVE
&R0 RTS/CTS Delay   0 mS         "U13 DTE Rate      9600
&S0 Switches        DISABLED     /B1 Carrier        CONSTANT
&X0 DTE Timing      INTERNAL     /U7 Async Format    8/N/1
%E7 Remote Control  USER & LINE -V0 Interface      V24
%J0 Control Pass Thru NONE
```

4.1.4 Configuration Notes

- The same DTE rate must be set at each end of the link (you can use the "Un command – see Chapter 7). Two communicating modems will not successfully train if one has a DTE rate of 64000 bps, while the other is set to a different DTE rate*.
 - When two modems are connected, one must be configured to be a 'master' modem, with the other configured to be a 'slave'. Both can be operated with internal or external clocks, but the master modem is always the source of the line clock. The slave receive clock will be derived from the master. If the slave modem is configured to accept an external clock, then data is re-timed within the slave by clocking data into a buffer. Consequently, in this mode data errors can occur.
 - The `-Vn` command, which is used to select the V.24/X.21 mode of operation of the DTE interface, is automatically set by loading a factory configuration. Your modem's internal link options will however have to be set to reflect the chosen option. See the Appendix entitled 'Technical Guide' for details of the link settings.
- * Note that if both DTE rates are different, but neither rate is 64000 bps, they will successfully train but data will be corrupted.

4.2 Customised Configurations

You can create up to four special customised configurations and store them in the modem's non-volatile memory to replace the pre-set user configurations.

To achieve this:

1. Choose the pre-set configuration that is closest to the configuration you want (see Section 4.1) and load it as described in Section 4.3.
2. Amend the configuration with the appropriate command(s) – see Chapters 5 and 7.
3. Store the amended configuration as a new user configuration, as described in Section 4.4.

4.3 Loading a Configuration from the Front Panel

1. Switch on your modem.
2. Press the **LOAD** button.
3. Select your configuration by pressing the appropriate buttons shown in Table 4-1.

CONFIGURATION	BUTTON SELECTION			
	4	2	1	8
Factory 0	Out	Out	Out	Out
Factory 1	Out	Out	In	Out
Factory 2	Out	In	Out	Out
Factory 3	Out	In	In	Out
Factory 4	In	Out	Out	Out
Factory 5	In	Out	In	Out
Factory 6	In	In	Out	Out
Factory 7	In	In	In	Out
User 0	Out	Out	Out	In
User 1	Out	Out	In	In
User 2	Out	In	Out	In
User 3	Out	In	In	In

Table 4-1 Loading a Configuration

4. Press and release the **ENTER** button. The **RUN** indicator will illuminate to confirm that the configuration has been loaded.
5. Return all other buttons to the 'Out' position

Configurations can also be manipulated by AT commands – see Section 4.4.

CONFIGURATION	RECALL COMMAND	SAVE COMMAND
Factory 0	&F0	—
Factory 1	&F1	—
Factory 2	&F2	—
Factory 3	&F3	—
Factory 4	&F4	—
Factory 5	&F5	—
Factory 6	&F6	—
Factory 7	&F7	—
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 Modem

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

1. Switch off the modem.
2. Ensure that all buttons are in the out position.
3. Hold the **ENTER** (|) button depressed.
4. Switch on the modem.
5. Release the **ENTER** (|) button after at least 2 seconds.

The message:

```
RESTART  
199
```

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

This initialises all the user configurations to factory defaults, makes factory configuration 0 the active configuration, and allows you to start afresh.

This chapter describes the AT command procedures and tells you which commands are relevant for various aspects of modem configuration. Each command is fully described in Chapter 7.

5.1 The AT Command Set

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

- Modifying a modem configuration.
- Saving and restoring modem configurations.
- Receiving status information from the modem.
- Performing modem tests.

Section 5.2 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 remainder of this chapter describes various modem features and lists the relevant commands.

Commands associated with fault diagnosis are listed in Chapter 6.

All the AT commands are listed alphabetically and fully described in Chapter 7.

Associated with the AT commands is information stored in a number of 'S-registers' in the modem's memory. These are described in Chapter 8.

5.2 The AT Command Format

5.2.1 Basic Format

AT (attention) is the prefix to commands to the modem. 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 modem 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 modem will respond with:

OK

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

5.2.2 Example Commands

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

AT*C<CR>

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

AT*S<CR>

5.2.3 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 modem'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, %X and %Z. Some other commands (e.g. &Fn) will cause subsequent commands to be ignored.

5.2.4 Repeating Commands

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

```
A/
```

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.

5.2.5 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.

5.2.6 Command Option Numbers

Some commands require you to enter a number (often referred to as n) to specify one of a list of options (e.g. ATE_n). If you omit the number, 0 is assumed (for example ATE is the same as ATE₀).

5.2.7 The OK and ERROR Responses

When a command is successfully executed, the message OK is returned by the modem. The response ERROR indicates a command syntax error.

5.2.8 Response Codes

The result of entering commands can be sent to the terminal in various forms, as selected by certain commands (X_n and /S_n).

5.3 Display and Modem 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 modem may operate.

En	Echo commands
Qn	Quiet mode
&Sn	Front panel switch control
Xn	Response codes
/Sn	Extra response codes
Vn	Verbose response codes
"An	Master/slave selection

5.4 DTE Interface Commands

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

The commands directly affecting the interface are:

&Qn	DTE operation mode
-Vn	DTE interface selection
&Cn	DSR and DCD control
&Rn	RTS-CTS delay
"Un	DTE rate
*Wn	DSR control
/On	DSR control while tests active
*Tn	Carrier messages
%Jn	Control signal pass-through

5.5 Modem Link Commands

These commands affect the modem link operation.

&Xn	Modem timing (synchronous)
"R	Manual retrain

5.6 Remote Configuration

Remote configuration commands enable you to obtain a copy of a remote modem's active configuration, alter it, and send it back to become the remote modem's new active configuration.

The commands involved are:

%En	Remote configuration control
%X	Remote up-load
%Z	Modify the remote configuration
%W	Stop modifying the remote configuration
%D	Remote down-load

To illustrate the use of the remote configuration commands, the general procedure is given below.

First, you must ensure that the setting of command **%En** allows remote configuration.

Then, use the following commands:

AT%X	This up-loads a copy of the remote modem's current active configuration. This does not affect data transmission. After the message MONITOR GRANTED is displayed, you may enter the next command.
AT%Z	This allows the remote configuration to be edited. At this point you may confirm that you are in remote configuration edit mode by using the *C command – the configuration table will be headed REMOTE CONFIGURATION SCREEN. You may now change items in the configuration by using the relevant commands, followed by:
AT%W	This returns to local configuration and control.
AT%D	This down-loads the new configuration to the remote modem. This affects data transmission.

If the above operation has been successful, the message RECONFIGURE GRANTED will be displayed.

6.1 Introduction

Operational problems may be caused by any of the following:

- Faulty local, or remote, DTE.

- Faulty local, or remote, modem.

- Faulty line.

- DTE communications software set up incorrectly.

The modem can run the following diagnostic tests to help locate the source of operational problems:

- Local Digital Loopback.

- Remote Digital Loopback, with or without self-test (Section 6.2.2).

Tests can be activated by:

- The front panel buttons (Section 6.3).

- AT commands (Section 6.4).

Sequence of Testing

The Local Digital Loopback test should be activated first, as this test checks the connection between the local DTE and the local modem (it does not test the baseband circuits).

The Remote Digital Loopback test should be activated next. This test checks the connection from the local DTE, over the leased line, to the remote modem's modulator/demodulator.

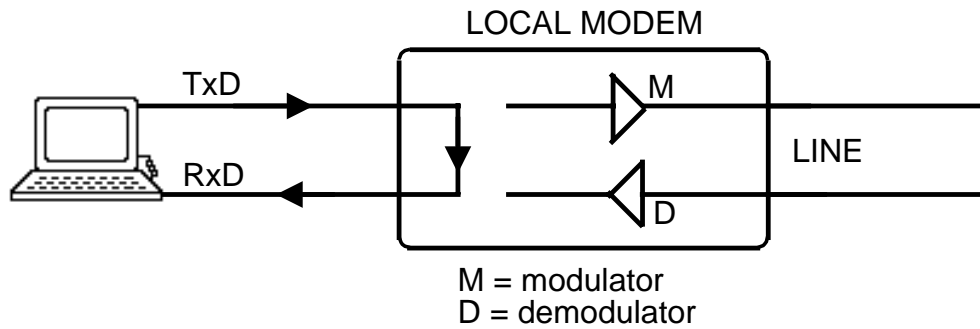
Analysis of each test result should indicate the source of possible faults.

6.2 Test Details

6.2.1 Local Digital Loopback

Using an External Test Source

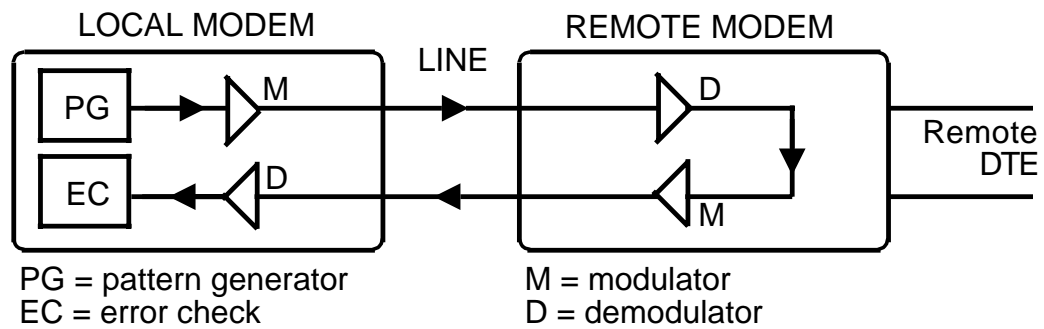
An external source (terminal or test set) is required to generate a test pattern, which is sent to the local modem. It must be checked when it returns to the external source.



6.2.2 Remote Digital Loopback

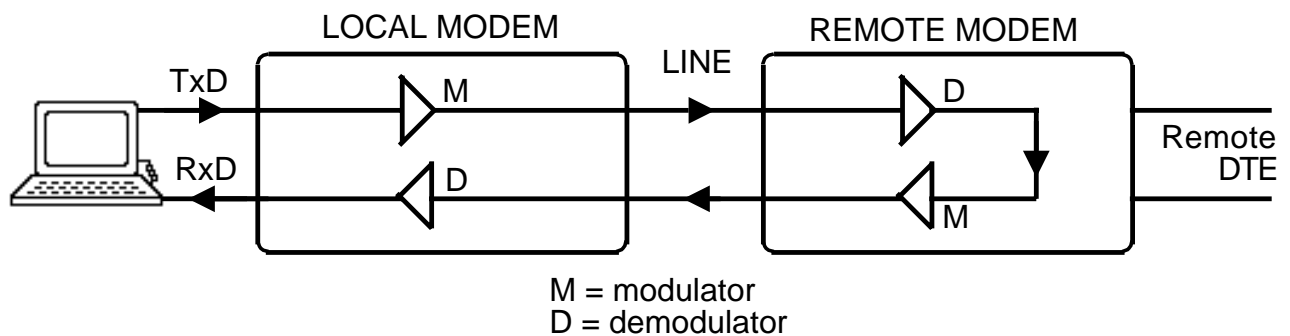
Using the Modem's Test Pattern Generator (Self-Test)

The modem's test pattern generator transmits a known message through the modem to the remote modem and back to the local modem, which compares the message received with the message sent. It then reports any errors, and displays an error count at the end of the test.



Using an External Test Source

An external source (terminal or test set) is required to generate a test pattern, which is sent through both modems. It must be checked when it returns to the external source.



6.3 Testing via the Front Panel

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

6.3.1 Local Digital Loopback

1. Press the front panel **DL** button.
2. The **DCD** indicator should light and the **RUN** indicator flash.
3. Attach an asynchronous or synchronous terminal or test set running from the modem's clock, to the DTE port of your modem, and transmit a test pattern. If the pattern is echoed back to the terminal, local digital loop is working correctly. If the pattern is not echoed, or is corrupted (**TXD** and/or **RXD** indicators flash), check terminal settings and DTE cable. If these are correct, the modem is faulty.

6.3.2 Remote Digital Loopback

Using the Modem's Test Pattern Generator (Self-Test)

1. Establish a connection with the Javelin 640 remote modem.
2. On the local modem, depress the **TEST (TE)** button, then the **RDL (RD)** button, and leave both buttons depressed. The **RUN** indicator should flash to show that the test is in progress.
3. The **DSR** indicator will flash each time a test mismatch occurs.
4. To terminate the test, release the **TEST (TE)** and **RDL (RD)** buttons (in any order). The total number of errors will be displayed on your terminal. If your modem is operating correctly you will get the response 000 ERRORS.
5. You may inject errors (to check that the test pattern is working correctly) if an appropriate **/Tn** option is set, by using the **ENTER** button.

Using an External Test Source

This test uses the modem's data channel and can be initiated from either the master or the slave modem.

1. Establish a connection with the remote modem.

2. On the local modem, depress the **TEST (TE)** button followed by the **RDL (RD)** button, then release the **TEST (TE)** button.
3. Attach a terminal or test set (asynchronous or synchronous depending on the operating mode of your modem), running from the modem's clock, to the DTE port of your modem.
4. Transmit a test pattern. If the pattern is echoed back to the terminal, the remote digital loop is working correctly. If the pattern is not echoed, or is corrupted (**TXD** and/or **RXD** indicators flash), check terminal settings and DTE cable. If these are correct, the modem or line is faulty.

6.4 Testing by Command

The following commands are available for testing:

&Tn	Select modem test operation
/Tn	Test pattern
/On	DSR control while tests active
In	Display modem identity codes

6.4.1 Local Digital Loopback

This procedure tests connections between the local DTE and local modem.

1. If required, set the test timer with the command **ATS18=n** (n = 1 to 255 seconds).
2. Enter the command **AT&T3**, and press **RETURN**.
3. To terminate the test manually, enter the command **AT&T0**, and press **RETURN**. The modem responds with the message **OK**.

6.4.2 Remote Digital Loopback

This test checks the local DTE, the local modem, the remote modem, and the line. It can be used with, or without, the modem's self-test feature.

1. Ensure that the remote modem is conditioned to accept an RDL test (&T4).
2. If required, set the test timer with the command **ATS18=n** (n = 1 to 255 seconds).
3. Enter the command **AT&T6** (without self-test) or **AT&T7** (with self-test) and press **RETURN**.
4. To terminate the test manually, enter the command **AT&T0** and press **RETURN**. The modem responds with the message **OK**.

If you had selected the self-test feature, the error count is also displayed.

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

& * / % " -

Full instructions for entering AT commands are given in Section 5.2.

In addition to the commands that must have the AT prefix, there is one which does not require the prefix or the terminator:

A/ Repeat Last Command(s)

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

All the commands on the following pages require both the AT prefix and the <CR> terminator, either per command or per string of commands.

In addition to the commands listed, commands /B, /R and /U are included in the modem for compatibility. They should not be altered from the factory setting.

"An Master/Slave Mode

This command is used to place the modem in either master or slave mode.

- "A0** Slave mode.
- "A1** Master mode.

***C Display Active Configuration**

This command displays your modem's active configuration on your terminal.

Examples of configuration screens are given in Section 4.1.3.

&Cn DCD and DSR Control

This command determines how the DCD (Data Carrier Detect) and DSR (Data Set Ready) controls are used.

- &C0** DCD and DSR are maintained in the ON condition. State of data carrier is disregarded.
- &C1** DCD follows the state of the receive carrier. DSR and DCD are ON only when the modem is on-line and ready to transmit data.

&C0 is mainly used in full-duplex asynchronous operations.

%D Remote Down-Load

This command is used to send back the altered remote modem's configuration to become its new active configuration. This will interrupt any on-going data transmission.

En Echo Commands

This command determines whether command characters entered at the port to which you are connected will be echoed back.

- E0** Disable echo.
- E1** Enable echo.

Echo should normally be enabled if the port is operating in full-duplex, and disabled in half-duplex mode.

%En Remote Configuration Control

This command allows you to select which remote configuration control facilities you require at the local modem (i.e. the one you are currently configuring). An appropriate selection is also required at the remote modem.

- a) Will the local modem accept remote configuration commands from the command terminal?
- b) Will the local modem accept as its active configuration, a configuration sent from the remote modem?
- c) Will the local modem accept commands from the remote modem to send the local modem's current active configuration to the remote modem?

Command	(a)	(b)	(c)	Remarks
%E0	no	no	no	Disabled
%E1	no	no	yes	
%E2	no	yes	no	
%E3	no	yes	yes	
%E4	yes	no	no	
%E5	yes	no	yes	
%E6	yes	yes	no	
%E7	yes	yes	yes	

Care must be taken when changing the configuration of a remote modem. For example, if the remote modem's active configuration is %E7 and it is subsequently changed to %E4 you will have no further configuration control over the remote modem.

A working example of this and the other remote configuration commands is given in Section 5.6.

&Fn Recall Factory Configuration

This command recalls one of the factory configurations to become the modem's active configuration where n is the factory configuration number (0-7).

In **Modem Identity Codes**

This command is used to check hardware and software identity.

- I0** Displays your modem's product code in decimal. Default is 418 for standalone, or 420 for rackmount. This code may be changed by using S-register S38 (to allow compatibility with certain software packages).
- I1** Requests that a checksum is performed on your modem's firmware ROM.
- I2** Validates that the checksum is correct by comparing it with a stored value. Returns the response OK or ERROR.
- I3** Displays the firmware release number.
- I4** Displays your modem's identity code (as I0).

I3 and I4 are useful for programmers writing software to control the modem. They allow a check for connection to the correct modem type with correct firmware release number.

%Jn **Control Signal Pass-Through**

This command is used to determine whether remote DTR (Data Terminal Ready) is passed through to the local modem or not.

- %J0** Normal operation, no pass-through.
- %J1** DTR passed through as DSR.
- %J2** DTR passed through as CTS.
- %J3** DTR passed through as DSR and CTS.

With %J2 or %J3, CTS can be dropped by dropping the remote DTR. CTS cannot be raised by remote DTR unless the local RTS is high.

&On **S-Register Output Format**

This command selects the S-register display format when you request it by the command Sn?. See Chapter 8.

- &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.

- /O0** DSR active in test modes.
- /O1** DSR inactive in test modes.

The factory default (off) complies with the ITU-T recommendation. /O0 allows DSR to be turned on where your DTE needs it to transmit or receive characters.

Qn Quiet Mode

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

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

&Qn Sync/Async Mode

This command switches the modem between synchronous and asynchronous mode.

- &Q0** Asynchronous mode.
- &Q1** Synchronous mode.

"R Manual Retrain

This command will cause the modem to initiate a retrain to synchronise with the remote modem.

&R Request To Send/Clear To Send

- &R0** RTS/CTS delay is set by S26, and the modem requires RTS before data is transmitted.
- &R1** RTS is ignored.

RTS/CTS operation is affected by control signal pass-through (see %Jn).

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 an S-register content 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 enable or disable the front panel switches.

&S0 Front panel switches disabled.

&S1 Front panel switches enabled with DL selecting a local digital loop.

***S Display S-Register Summary**

This command will display the values of all S-registers in the format selected by the &O command.

/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 X command.)

/S0 Extra responses off.

/S1 Extra responses on.

&Tn Select Modem Test Operation

This command is used to select a test operation. See Chapter 6. It can be used in conjunction with S-register timer S18, which determines the length of time that a test is performed.

- &T0** Stops test currently in progress.
- &T3** Initiates Local Digital Loopback.
- &T4** Enables the local modem to run a Remote Digital Loopback when requested by the remote modem.
- &T5** Prohibits the local modem from running a Remote Digital Loopback when requested by the remote modem.
- &T6** Initiates Remote Digital Loopback Without Self-test.
- &T7** Initiates Remote Digital Loopback With Self-test.

***Tn Carrier Messages**

This command is used to enable or disable carrier messages being displayed after the appropriate timeouts.

- *T0** Carrier messages disabled.
- *T1** No Carrier and Private Line Failed messages will be displayed after timeout period set in S-register S10.

/T Test Pattern

This command enables you to select a type of test pattern.

- /T0** MARKS pattern.
- /T4** MARKS pattern with error injection. An error is injected each time the **ENTER** (⏎) button is pressed.

"Un DTE Rate

This command is used to specify the rate at which the modem expects data to be transmitted from the DTE when in synchronous mode. It does not affect the speed of communications between the modem, which is fixed at 64000 bps.

"U9	1200 bps.
"U10	2400 bps.
"U11	4800 bps.
"U12	7200 bps.
"U13	9600 bps.
"U15	14400 bps.
"U17	19200 bps.
"U21	48000 bps.
"U22	56000 bps.
"U23	64000 bps.

The same rate must be set at each end of the link.

Vn Verbose Response Codes

This command determines how the modem communicates with the user, i.e. whether response codes are expressed as words or numeric code. Referred to as verbose/terse, or long/short form. Response codes are listed with the Xn command.

V0	Selects numeric (terse) codes.
V1	Selects word (verbose) codes.

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

-Vn DTE Interface Selection

This command is used to select the mode of operation of the DTE interface. The modem's internal link options must be set the same as the setting of this command.

-V0	The modem's DTE interface is in V.24 operation.
-V1	The modem's DTE interface is in X.21 operation.

Selecting factory configurations specific to V.24/X.21 will set the -Vn command automatically.

&Wn Save User Configuration

This command allows you to store a customised configuration from the active area to replace the contents of a user configuration where n is the user configuration number (0-3).

***Wn DSR Control**

***W0** Normal DSR control (see &Cn).

***W1** DSR follows DTR. This is used for hosts which on raising DTR expect DSR to be returned by the modem. (Overridden by /On when in test mode and by %Jn when in normal 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 modem.

Xn Response Codes

This command is used to select which responses (results) will be sent from your modem to the command terminal in response to commands.

In the following table, asterisks under each Xn command indicate the response codes that will be sent. Whether these are in terse or verbose form is determined by the Vn command. The modem can send not only standard responses, but also extra responses when the /S1 command is set.

COMMAND		RESPONSE CODE		COMMENTS
X0	X6	TERSE	VERBOSE	
*	*	0	OK	Command actioned
*	*	1	CONNECT	Connected
*	*	3	NO CARRIER	Modem carrier lost
*	*	4	ERROR	Command syntax error
	*	5	CONNECT 1200	Connected at 1200 bps
	*	10	CONNECT 2400	Connected at 2400 bps
	*	12	RDL GRANTED	Test modes only
	*	13	RDL DENIED	Test modes only
*	*	16	TIMEOUT	Connection timed-out
	*	27	LDL IN PROGRESS	Local digital loop
	*	28	CONNECT 4800	Connected at 4800 bps
	*	29	CONNECT 7200	Connected at 7200 bps
	*	30	CONNECT 9600	Connected at 9600 bps
*	*	36	RETRAIN	
	*	43	CONNECT 14400	Connected at 14400 bps
	*	45	CONNECT 19200	Connected at 19200 bps
	*	50	PRIVATE LINE FAILED	
	*	62	MONITOR GRANTED	
	*	63	MONITOR DENIED	
	*	64	RECONFIGURE GRANTED	
	*	65	RECONFIGURE DENIED	
	*	66	RECONFIGURE FAILED	
	*	68	MONITOR FAILED	
	*	72	CONNECT 48000	Connected at 48000 bps
	*	73	CONNECT 56000	Connected at 56000 bps
	*	74	CONNECT 64000	Connected at 64000 bps
	*	82	/CONSTANT CARRIER	
	*	119	TEST TERMINATED	Timeout response

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

&Xn Modem Timing

This command determines the timing source for the modem transmitter.

- &X0** Internal timing (supplied by the modem). Use in simple point-to-point applications, whether master or slave end.
- &X1** External timing (supplied to modem on pin 24). Use where the modem link is an extension of a network which requires timing synchronisation throughout. (The ext clock tolerance must be within ± 50 ppm.)

%X Remote Up-Load

This command is used to request a copy of the remote modem's active configuration. This does not interrupt data transmission.

Zn Recall User Configuration

This command will recall a user configuration to become 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 modem's active configuration. Subsequent commands will affect only this copy, until the %W command is issued.

8.1 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 modem 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 modem to perform a certain function when it receives that character.

Bit-Mapped Registers

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

It is not necessary to access these registers in normal modem use, and they are not discussed further in this manual.

8.2 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

8.3 Non-Bit-Mapped S-Registers

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 modem 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 modem 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 modem is in command mode.

S10 Lost Carrier Timer

Timer Range: 3-180 (each unit is 0.1 seconds) Default: 100 (10 seconds)

This register contains the time that the modem waits, after the carrier has been lost, before disconnecting the line (see *T).

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.

S26 RTS to CTS Delay

Timer Range: 0-255 (seconds) Default: 10 (0.001seconds)

Transmitter/Receiver

Line Coding	SU32 (modified version of 3B2T, 3 binary, 2 ternary).
Operation	2-wire full-duplex synchronous or asynchronous.
Output level	10 dBm max. 0 dBm max at any single frequency. 140 ohm impedance.
Data Input	Serial binary. Complies with ITU-T V.28. Accepts levels +3 volts to +25 volts (space), and -3 volts to -25 volts (mark). Single wire ground return. 3000 to 7000 ohms load. Also option of V.11 receivers for use in X.21 interface. Balanced inputs between -10 and +10 volts.
Data Output	Serial binary. Complies with ITU-T V.28, +12 and -12 volts nominal. Output impedance 300 ohms. Also option of V.11 transmitters for use with X.21 interface. Balanced outputs, 0 and +5 volts nominal.
Test Functions	Local digital loop. Remote digital loop. Test pattern generator. Test functions selectable via front panel switches or AT commands.

Facilities

Command Sets	Extended AT. Commands can be entered asynchronously via the separate command port.
Memory	Non-volatile memory. 12 preset factory/user configurations.

Physical Description

Power	Standalone: 230 ± 10% VAC, 50 to 60 Hz, 0.1 A max. Optional 24 VDC to 48 VDC, 0.5A max. (DC source must be SELV.) Rackmount: +5 V, +12 V, -12 V, 0.1 A max. Typical power consumption 10 watts.
Environment	Temperature: operating: +5°C to +40°C storage: -25°C to +55°C Relative humidity 5% to 95% non-condensing. Altitude to 3000 metres.
Dimensions	Standalone : 45 mm high × 190 mm wide × 275 mm deep. Rackmount : Takes up one rack slot (19" × 4U).

Appendix B

Interfaces and Cables

The modem has two serial ports. The DTE port is used to pass user data. The command port is used to enter AT commands.

B.1 DTE Port

B.1.1 V.24 Operation

The connections are on a 25-way D-type female socket on the rear panel of the unit or rack. When the modem is configured for V.24 operation (see the Appendix entitled 'Technical Guide' and the `-Vn` command) the pin assignments are as shown in the following table:

PIN	MNEMONIC	FUNCTION	COMMENTS	ITU-T
1	(GRD)	Chassis Ground	Connect one end only	101
2	(TxD)	Transmit Data	Data from DTE	103
3	(RxD)	Receive Data	Data from DCE	104
4	(RTS)	Request To Send	Control from DTE	105
5	(CTS)	Clear To Send	Control from DCE	106
6	(DSR)	Data Set Ready	Control from DCE	107
7	(GND)	Signal Ground	Signal reference	102
8	(DCD)	Data Carrier Detect	Control from DCE	109
9	(+12)	12 volt test	Test	
10	(-12)	12 volt test	Test	
11	(+5)	volt test	Test	
14	(TxD)	Command Port	Parallel to comm port	
15	(TxCLK)	Transmit Clock	Tx data clock from DCE	114
16	(RxD)	Command Port	Parallel to comm port	
17	(RxCLK)	Receive Clock	Rx data clock from DCE	115
18	(LDL)	Local Digital Loop	Test	
20	(DTR)	Data Terminal Ready	Control from DTE	108
21	(RDL)	Remote Digital Loop	Control from DTE	
24	(TC)	External Tx Clock	Control from DTE	113
25	(TI)	Test Indicator	Control from DCE	

If the modem is to be connected directly to the DTE, the connecting cable should have straight-through pin-to-pin connections.

If the modem is to be connected to a multiplexer channel, the cable should have crossover connections.

Note: If unterminated DTE cables are connected to this modem, the TxD and RTS LED's may give inaccurate indications. In addition, if the modem is connected to another unit and they are synchronised, these indications may be reflected on the LED's of the remote modem.

B.1.2 X.21 Operation

X.21 has become the most popular method of interfacing to high speed digital networks. An X.21 interface uses a 15-pin connector.

To connect your modem to an X.21 service, set the modem's internal link option to X.21 (see Appendix entitled 'Technical Guide' and command -Vn), and use the adapter cable (part number X450-404511) specified below.

	2	(TxD) Transmit Data A	2	
	14	(TxD) Transmit Data B	9	
	3	(RxD) Receive Data A	4	
	16	(RxD) Receive Data B	11	
	17	(SET) Signal Timing Element A	6	
	13	(SET) Signal Timing Element B	13	
	24	(CON) Control A	3	
	12	(CON) Control B	10	
MODEM	22	(IND) Indication A	5	DTE
	23	(IND) Indication B	12	
	19	(TxCLK) External Transmit Clock A	7	
	15	(TxCLK) External Transmit Clock B	14	
	1	(GND) Signal Ground A	8	
	7	(GND) Signal Ground B	8	
	9	+12 Volt Test	—	
	10	+12 Volt Test	—	
	11	+5 Volt Test	—	
	25-way D-type plug		15-way D-type socket	

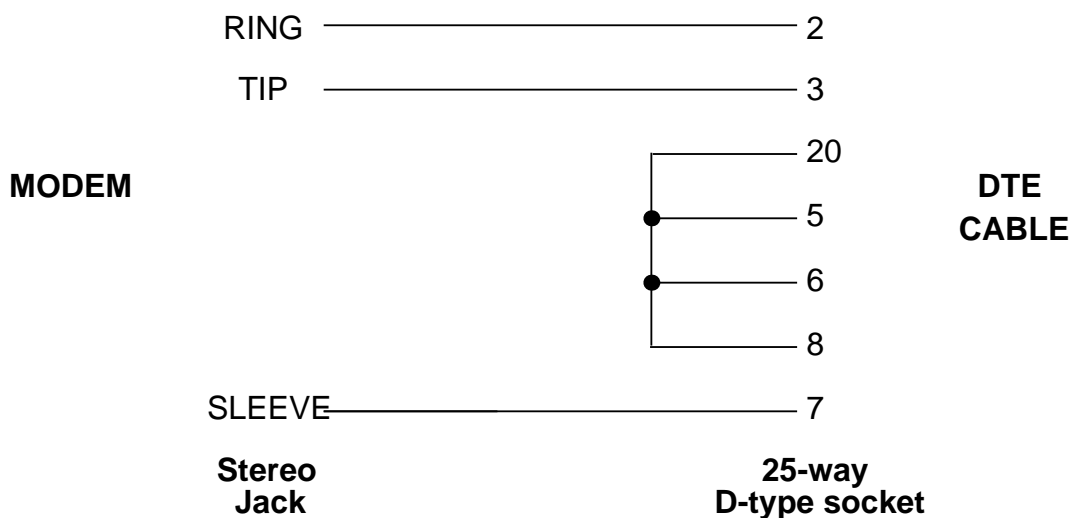
B.2 Command Port

B.2.1 Standalone Modem

The connections are on a 3.5 mm stereo socket, with the following pin assignments:

NAME	FUNCTION	DIRECTION
Ring	Transmit Data (TxD)	To modem
Tip	Receive Data (RxD)	From modem
Sleeve	Signal Ground (GND)	Common

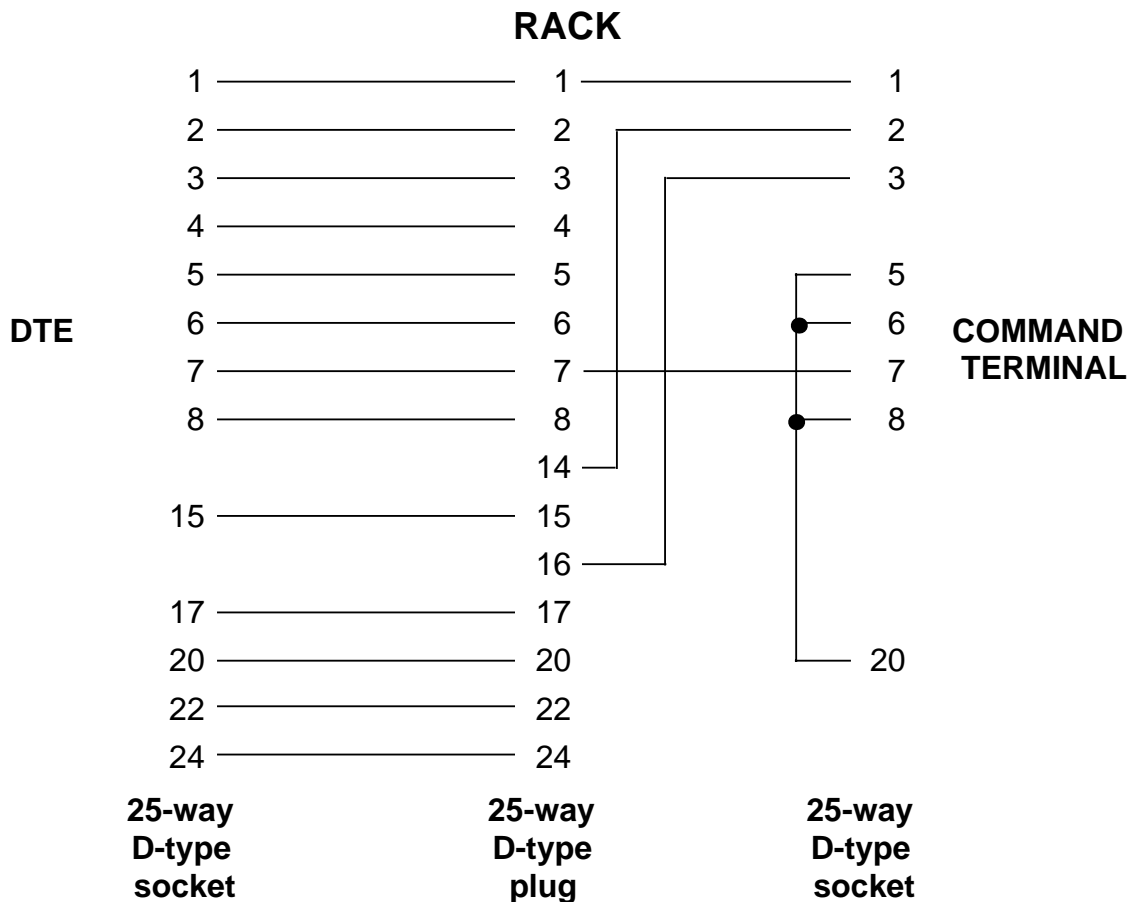
A command port adapter is provided with the modem, to enable a standard 25-way DTE plug to be connected to the command port:



B.2.2 Rackmount Modem

Connection to the command port is normally made through the controller module in Network 16, or can be made directly through the DTE interface on the rearplane of Network 16 if you are not using the controller module.

For connection to the command port through the DTE interface, use a 'Y' cable as below. If you are using a 'Y' cable, links 10 and 11 should be in position 1 (see the Appendix entitled 'Technical Guide').



C.1 Introduction

This appendix gives information which is specific to using the modem in the UK, so as to comply with the approvals regulations. For convenience, it is split into a number of sections, as shown below.

- C.2 Statutory Instructions for UK Users of the Standalone Modem
- C.3 Statutory Instructions for UK Users of the Rackmount Modem
- C.4 Installing the Standalone Modem

Postcard for Requesting Socket Installation

A postcard is supplied with this manual for requesting installation of British Telecom sockets for connection. It is not necessary to apply to British Telecom for installation of sockets where the wiring does not belong to British Telecom.

C.2 Statutory Instructions for UK Users of the Standalone Modem

Users of this modem in the UK should pay particular attention to the information contained in this section.

Approved for connection to telecommunications systems specified in the instructions for use, subject to the conditions set out in them.

General

- (a) Interconnection directly, or by way of other apparatus, of ports marked with 'Warning. Connect only apparatus complying with BS6301 to these ports' with ports not so marked may produce hazardous conditions on the BT network. Advice should be sought from a competent engineer before such a connection is made.
- (b) This modem contains a Lithium battery and should be returned to the manufacturer for replacement of this item or disposal of the modem. Incorrect replacement or disposal of this battery can cause risk of fire or explosion.
- (c) This modem does not require DC from the British Telecom Private Speech Band Circuit for correct operation.
- (d) This modem has been approved for connection to EPS8 leased line circuit.
- (e) This modem may be connected to a baseband circuit or a relevant branch system for baseband circuits.
- (f) If any other apparatus, including cabling and wiring, is to be connected between the modem and the point of connection to the baseband circuit, it must comply with:
 - (i) The overall characteristics of the additional apparatus shall be such as to introduce no material effect upon the electrical conditions presented to one another by the modem and the baseband circuit.
 - (ii) The additional apparatus shall comprise: apparatus approved for the purpose of connection between the modem and a baseband circuit; and cable or wiring complying with a code of practice for the installation of equipment covered by BS6328 part 2, or such other requirements as may be applicable.

- (g) The LINE socket on the rear panel of your modem complies to BS6312. The LINE cable is terminated with a standard plug that also complies to BS6312.

Equipment Faults

If any of your telephone apparatus is not operating properly, you should immediately remove it from the telephone line.

Protective Earthing

The protection of the user of this product relies on the connection of a protective earth. If this has not been hard-wired to the connection earth point of the modem users should ensure:

- (i) That the connection to the line is unplugged before the mains plug is removed.
- (ii) That the connection to the line is not hard-wired.

C.3 Statutory Instructions for UK Users of the Rackmount Modem

Users of this modem in the UK should pay particular attention to the information contained in this section.

Approved for connection to telecommunications systems specified in the instructions for use, subject to the conditions set out in them.

The modem is only approved for use in the Network 16 rack.

General

- (a) Interconnection directly, or by way of other apparatus, of ports marked with 'Warning. Connect only apparatus complying with BS6301 to these ports' with ports not so marked may produce hazardous conditions on the BT network. Advice should be sought from a competent engineer before such a connection is made.
- (b) This modem contains a Lithium battery and should be returned to the manufacturer for replacement of this item or disposal of the modem. Incorrect replacement or disposal of this battery can cause risk of fire or explosion.
- (c) This modem does not require DC from the British Telecom Private Speech Band Circuit for correct operation.
- (d) This modem has been approved for connection to EPS8 and EPS9 leased line circuits.
- (e) This modem may be connected to a baseband circuit or a relevant branch system for baseband circuits.
- (f) If any other apparatus, including cabling and wiring, is to be connected between the modem and the point of connection to the baseband circuit, it must comply with:
 - (i) The overall characteristics of the additional apparatus shall be such as to introduce no material effect upon the electrical conditions presented to one another by the modem and the baseband circuit.
 - (ii) The additional apparatus shall comprise: apparatus approved for the purpose of connection between the modem and a baseband circuit; and cable or wiring complying with a code of

practice for the installation of equipment covered by BS6328 part 2, or such other requirements as may be applicable.

Equipment Faults

If any of your telephone apparatus is not operating properly, you should immediately remove it from the telephone line.

Protective Earthing

The protection of the user of this product relies on the connection of a protective earth. If this has not been hard-wired to the connection earth point of the modem users should ensure:

- (i) That the connection to the line is unplugged before the mains plug is removed.
- (ii) That the connection to the line is not hard-wired.

C.4 Installing the Standalone Modem

This section supplements the information in Chapter 2. It includes details which are specific to the UK version of the product.

Mains Power Connection

The mains connector is a standard 13 amp plug, fitted with a 3 amp fuse.

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.

D.1 Introduction

This appendix provides detailed information on the physical configuration of the modem.

WARNINGS

The information contained in this appendix is for use only by suitably qualified and competent engineers.

In order to comply with national regulations it will be necessary to re-test the modem to ensure it meets the requirements of BAPT document 340 following any modifications. Failure to meet this condition will invalidate the approval.

This product contains static-sensitive devices. Normal anti-static precautions should be taken when handling the PCB.

D.2 Standalone Modem

D.2.1 Accessing the Modem Card

1. Disconnect all line connections.
2. Disconnect the computer or terminal from the DTE and command port connectors, then remove the mains plug from its supply.
3. The modem is secured to the chassis by three back-panel-mounted screws. Remove these screws.
4. Carefully slide the modem and back panel out from the chassis. Place the modem in front of you with the front panel on the left as in the diagram below.

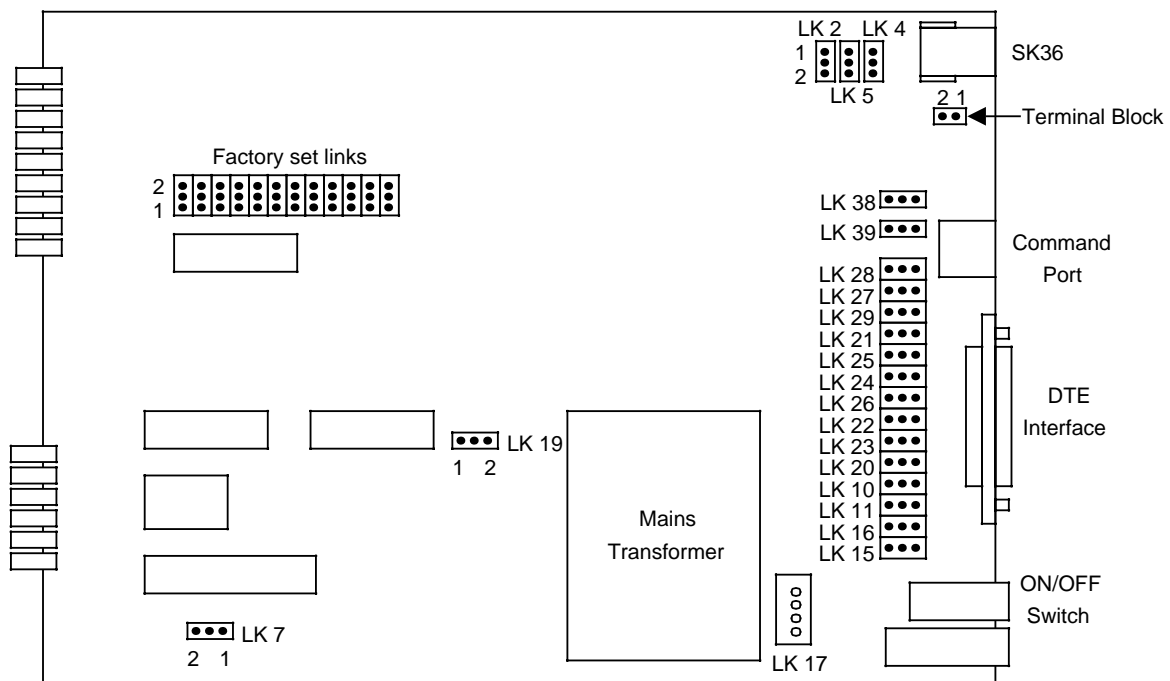


Figure D-1 Standalone Card Layout

D.2.2 Terminal Block Wiring

The terminal block can be used for your leased line, if preferred. The wiring configuration is shown in Figure D-2.

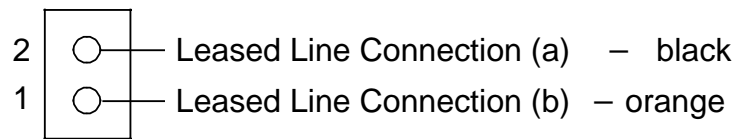
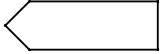


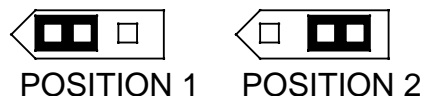
Figure D-2 Leased Line Terminal Block Connections

The red, white, green and blue wires must be cut back to the insulating sleeve.

D.2.3 Link Options

PCB links enable you to make the appropriate connections for your operating mode.

Link boxes are drawn on the PCB as  but the positions are not marked. The link positions are:



Links 1, 4, 6, 7, 8, 9, 12, 13, 14, 16, 19 and 30-37 are for factory use only and must not be changed.

DTE interface options:

Links 20-29:

position 1 = V.24 interface. Default.

position 2 = X.21 interface.

Links 38, 39 (only used with X.21 link positions):

position 1 = Transmit clock output on pins 15 and 19.

position 2 = External transmit clock input on pins 15 and 19.
Default.

Links 10, 11:

position 1 = Command port access on pins 14 and 16.

position 2 = No command port access on the DTE.

Note: When using X.21 interface, these links can only function in position 2.

Link 15:

position 1 = RDL on pin 21.
Factory default is link not fitted.
Position 2 is not to be used.

Link 18:

position 1 = DL on pin 18.
Factory default is link not fitted.
Position 2 is not to be used.

Long Cable Lengths:

If the modem is transmitting over a distance in excess of 5 km, and error rates are high or synchronisation is lost frequently, then the position of links 2 and 5 can be set to long cable lengths.

Links 2, 5:

position 1 = Default.
position 2 = Long cable lengths.

D.2.4 Connecting the 24 to 48 VDC Version

The 24 to 48 volt DC powered version of the standalone modem is designed to operate on an exchange/PABX battery. The supply requirements are 24-48 VDC, 0.5A max. DC source must be SELV.

The modem power connection is via a 2 metre cable, stripped and tinned ready for connection to a terminal block.

Ensure both the modem and the DC source are switched off. Connect the red wire to the ground terminal and the black wire to the –24 to –48 volts DC supply. Double check the connections before turning the modem on. If the connections are reversed, or the supply voltage is too high, the modem may be damaged. If the fuse is blown, ensure you replace it with a 500mA 250V (T) anti-surge fuse.

D.3 Rackmount Modem

D.3.1 The Modem Card

Before inserting the modem into the Network 16 rack, the switches and links should be in the correct positions for the application. The rackmount card layout is as shown below.

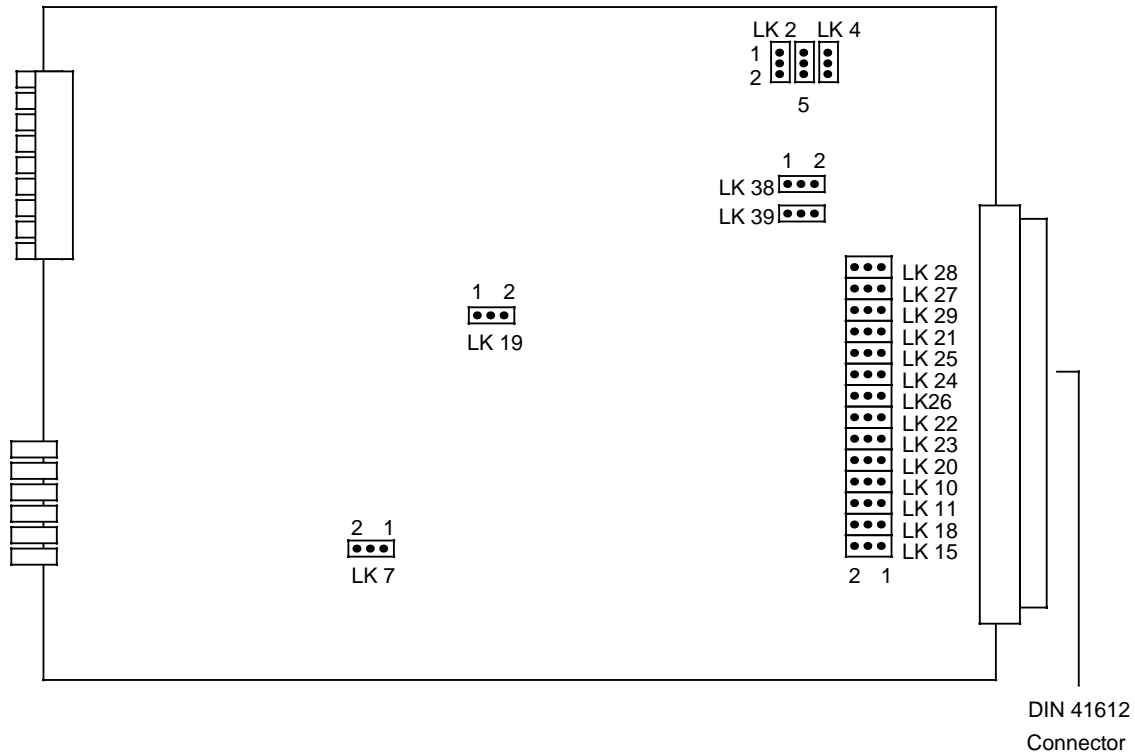
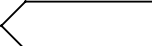
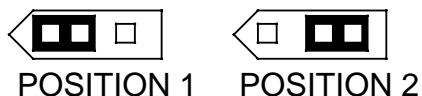


Figure D-3 Rackmount Card Layout

D.3.2 Link Options

PCB links enable you to make the appropriate connections for your operating mode.

Link boxes are drawn on the PCB as  but the positions are not marked. The link positions are:



Links not to be changed:

Links 1, 6, 7, 8, 9, 12, 13, 14, 16, 19 and 30-37 for factory use only.

DTE interface options:

Links 20-27, 29:

- position 1 = V.24 interface.
- position 2 = X.21 interface.

Link 28:

- position 1 = V.24 interface.
- position 2 = X.21 interface.

Links 38, 39 (only used with X.21 link positions):

- position 1 = Transmit clock output on pins 15 and 19.
- position 2 = External transmit clock input on pins 15 and 19.

Links 10, 11:

- position 1 = Command port access on pins 14 and 16.
- position 2 = No command port access on the DTE.

Note: When using X.21 interface, these links can only function in position 2.

Link 15:

- position 1 = RDL on pin 21.
- Factory default is link not fitted.
- Position 2 is not to be used.

Link 18:

- position 1 = DL on pin 18.
- Factory default is link not fitted.
- Position 2 is not to be used.

Long Cable Lengths:

If the modem is transmitting over a distance in excess of 5 km, and error rates are high or synchronisation is lost frequently, then the position of links 2, 4 (slave only) and 5 can be set to long cable lengths.

Links 2, 5:

- position 1 = Default.
- position 2 = Long cable lengths.

Link 4 (slave modem only):

- position 1 = Default.
- position 2 = Long cable lengths.

D.3.3 Line Connection

In addition to the modem you need a four-way (BT 4/502) or six-way (BT 6/502) line cord.

The modem is connected to the leased line using the terminals on the rear panel of the rack and a linecord. Connect the cord to the terminals before plugging the other end into the BT socket.