K 384
Network Simulator
Terminal Adaptor
Protocol Analyser

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Introduction

The K-384 is an invaluable tool which is useful in many situations.

It is important that the user sets up the equipment properly before plugging in any terminal equipment or plugging the K-384 into the telephone network.

As a network simulator the K-384 provides three ISDN interface ports into which ISDN terminal equipment (terminal adaptors, ISDN telephones etc.) can be plugged. The K-384 supports both the S/T interface (i.e. So interface) and the U interface (i.e. ANSI T1.601) by using plug in modules for each interface. Any mix of interfaces is possible. A call on any bearer channel on any interface can be connected to any other bearer channel on any interface. Virtually any type of call can be connected as the K-384 supports unrestricted digital, voice, 3.1kHz audio, V.110 and V.120 bearer capabilities. In simulator (NT/LT) mode the K-384 can also provide a 40V, 1W power supply on each ISDN interface port, operating in both normal and restricted modes. Internal tones (A law and μ law) are provided for voice/3.1 kHz Audio terminals.

As a terminal adaptor the K-384 will provide up to six X.21 data channels at 64kbps or 56kbps. Calls are set-up and cleared down using simple commands on the terminal attached to the control port.

Also available as a software option is a protocol analyser. When activated it will report to the user what is happening at each of the three ISDN interface ports. Decoding can be enabled or disabled at any of the three layers defined in the ISDN model. If layer 1 decoding is enabled the analyser will report the state of the physical connection. At layers 2 and 3 the user can select one of four possible modes of operation: (a) no reporting, (b) display message contents as hex bytes, (c) display message contents in brief text messages or (d) display message contents in detail, decoding all the information elements at layer 3. The originator, the interface port number, and the time are clearly identified in each message.

The K-384 can also be set to transparent mode allowing a terminal to be plugged into one port and the network into another. The protocol analyser will now decode the messages being exchanged between the K-384 and the network. Local power feeding for the terminal can also be supported.

In addition data passing between ISDN interface 1 and 2 can be delayed by up to 750ms thus simulating the effects of satellite delays.

This manual outlines how the K-384 should be set-up and how the terminal equipment is connected in simulator mode or how the equipment is connected to the ISDN lines in terminal equipment mode.

Quick Reference Guide

This section allows you to set up and use the K-384 to simulate an ISDN network with minimum effort. If you follow this guide and the terminal equipment still does not function you will have to read the complete manual.

The steps are as follows :

1. Unpack the K-384. There should be a Terminal Cable (DB9-DB9), three ISDN Cables (RJ45-RJ45) and a Mains Power Cable.

2. Plug the power cable into the rear of the unit and switch on (K-384 will work on 110V or 240V without adjustment).

3. Plug terminals into inteface 1,2 or 3.

4. Make a call from one terminal to the other. (The default telephone numbers and other parameters are shown in Table 1.)

5. If the call did not work and no led's came on on the front panel then the terminals probably require 40 V power feeding. Turn it on by folowing the instructions in Chapter 2 section 2.1 Hardware Setup.

6. If the P led comes on but no D led then there is a problem with Layer 2. Try making the call again - this should fix the problem.

Parameter	Default Setting
Baud Rate	19,200
Parity	None
Stop Bits	2
Data Bits	8
40 V Power	OFF
NT/TE Mode	NT Mode
100 Ω Terminators	In
NT Clock	Local
Datalinks/Channel	1
Use SPIDS	No
Numbering Option	Normal
CLIP	OFF
Interface 1 B1	384000
B2	384010
Interface 2 B1	384020
B2	384030
Interface 3 B1	384040
B2	384050

Table 1 K-384 Default Options

Product Specification

ISDN Connection

(a) Network Simulator Mode

The K-384 provides any mix of three ISDN S/T or U interface ports operating in NT mode. The ports can optionally provide 40V, 1W supply to power terminal equipment.

(b) Terminal Equipment Mode

The K-384 provides any mix of three ISDN S/T or U interface ports operating in TE mode. The S/T bus 100 ohm termination resistors can be isolated under software control allowing other equipment to be connected to the line.

In both these modes of operation four leds indicate the operating level of each port. (1) physical layer activated, (2) data link layer activated, (3) B1 and/or B2 channel connected.

(c) Transparent Mode

A terminal is connected to the K-384 and the K-384 is then connected to the network. All terminal/network messages pass through the K-384 unaltered. The protocol analyser can decode these messages and terminal power can be provided locally. In this mode of operation the leds do not function.

Data Ports

Six X.21 compatible data ports are available at the rear of the K-384. These provide connection to the ISDN network in TE mode and also allow external test equipment to have access to the B cahnnels while in NT mode.

Terminal Port

A V.24 control port is provided at the rear of the unit allowing the connection of an ANSI compatible terminal for setting up the unit.

Auxilary Port

The auxilary port receives or transmits clock and frame information which allows 2 K-384's to be locked to a single reference clock. This can be used to facilitate 6 simultaneous calls on a back to back configuration.

Memory Card Slot

The K-384 can be made to simulate country specific networks (e.g. 1TR6, BT, EuroISDN etc.) by plugging a preprogrammed PCMCIA memory card into the memory card slot on the front of the unit.

Chapter 1

Hardware Installation

First unpack the K-384 and check for signs of damage in transit. If the unit or packaging is damaged this should be reported immediately to Digital Engineering.

Assuming there is no damage, take an inventory of the parts supplied. Check that the items ordered were actually received. The list below should be of help in identifying each part.

To check which options have been installed inside the main unit check the option label on the bottom of the unit.

K-384 Network Simulator
Cables for ISDN - RJ45-RJ45 (3 off)
Power Supply Cable
Terminal Cable DB9-DB9 (1 off)
K-384 Protocol Analyser (Software Option)
This manual

Figure 1 shows the front panel.

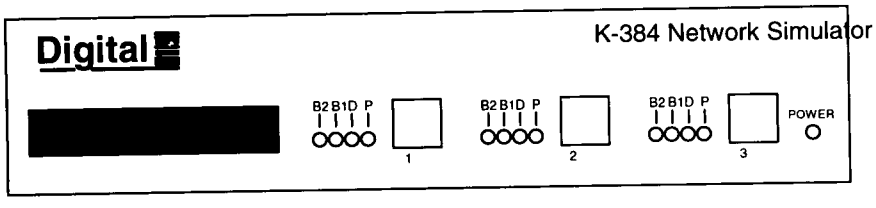

Fig 1 K-384 Front Panel

Each RJ45 connector provides an S/T or U interface port into the unit. It is important that nothing is connected into these ports until the unit is set-up properly. Connecting the K-384 when in simulator mode, with the power supply active, to the telephone network is liable to damage the network or the K-384.

Note that on power up while undergoing the internal self test the unit will default to TE mode with no interface power applied. When the unit is first switched on all the leds will illuminate. They will then extinguish and the four channel 1 leds will indicate, for 1 second, the configuration being used. The K-384 will then switch to the mode defined by the internal configuration (usually NT mode).

Also during this period the terminal port will default to 19200 baud, no parity, 8 data bits and 2 stop bits and will search for a <ctrl-c> being transmitted to the K-384. If this occurs the K-384 will restore all the factory defaults. This is useful if a setting has been changed (i.e. switch to remote clock when there is no remote clock source plugged in) and the K-384 ceases to operate. Powering up the K-384 and immediatly typing <ctrl-c> will restore a working configuration to the K-384.

Table 2 below lists the signals displayed.

Led Name	Description
P	ON = **NT Mode** OFF = **TE Mode**
D	ON = **40V Power Active** OFF = **40V Power Inactive**
B1	ON = **100 ohm Term In** OFF = **100 ohm Term Out**
B2	ON = **Local Clock** OFF = **Remote Clock**

Table 2 Power On Signals

Figure 2 Signals present in the ISDN connector.

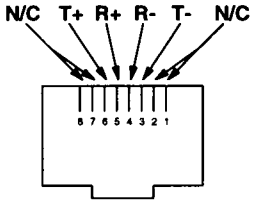

Fig 2a RJ45 Signals S/T
Terminal Adapter Mode

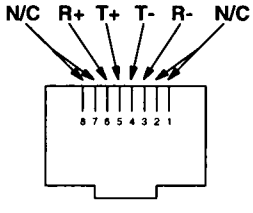

Fig 2b RJ45 Signals S/T
Network Simulator Mode

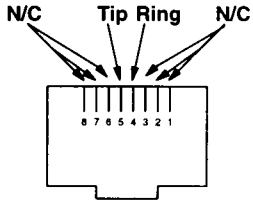

Fig 2c RJ45 Signals U
Terminal Adaptor/Network Simulator

Fig 2 ISDN Signals

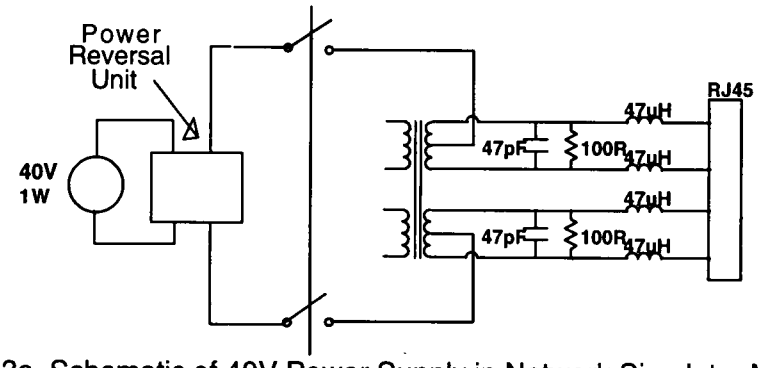

Fig 3a Schematic of 40V Power Supply in Network Simulator Mode (S I/F)

Figure 3a is a Schematic of how the power is generated at the ISDN S/T interface port, while Figure 3b is a schematic of U interface power feeding

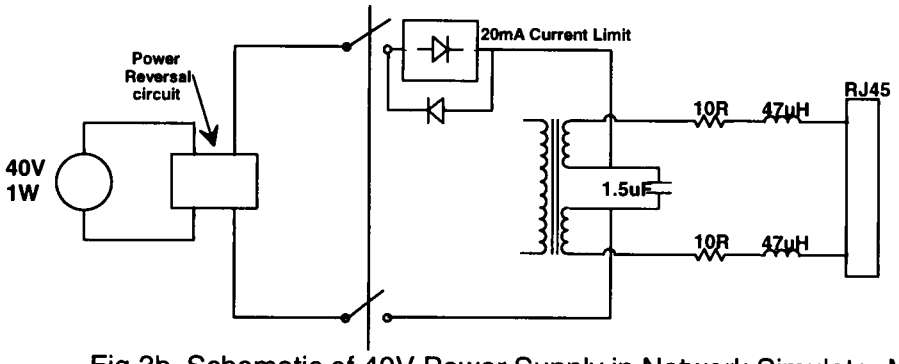

Fig 3b Schematic of 40V Power Supply in Network Simulator Mode (U I/F)

When using the K-384 in Network Simulator mode the ISDN cables of the terminal equipment are plugged into the sockets provided. When using the K-384 in Terminal Adaptor mode the ISDN cables provided are plugged into the sockets on the K-384 and into the Network Termination equipment provided by the local telephone company. The order in which cables are connected is not important. In Transparent Mode the terminal equipment is plugged into port 1 of the K-384 and port 2 is connected to the Network Termination equipment.

Beside each ISDN interface port is a group of 4 LEDs. These LEDs indicate the state of the ISDN port beside them. The P LED lights whenever the ISDN line has activated. The D LED lights whenever the Data Link layer for that port is active (Multi-Frame established). The corresponding B channel LED (B1/B2) lights whenever that bearer channel is connected. The LEDs perform no function in Transparent Mode.

Beside the three RJ45 connectors is the memory slot. The K-384 can be made to simulate specific networks (e.g. 1TR6) by plugging in a preprogrammed memory card into this slot.

Figure 4 shows the back panel.

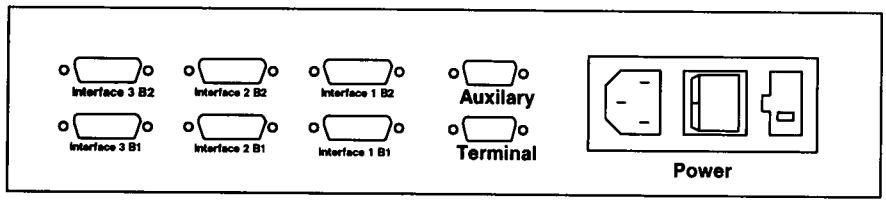

Fig 4 K-384 Back Panel

The K-384 has six X.21 data ports on the back panel. The connectors are grouped as three groups, each group corresponding to a particular ISDN interface port.

Figure 5 shows the pinout of each X.21 connector.

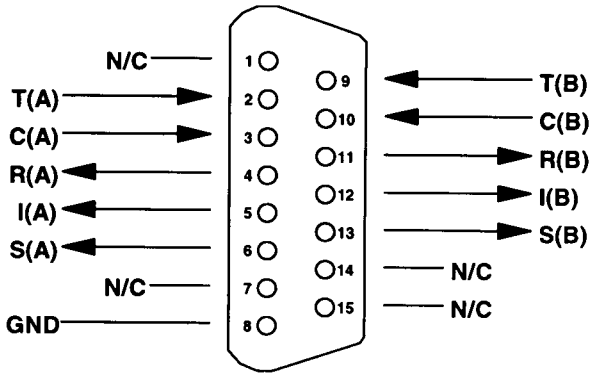

Fig 5 X.21 Pinout

Table 3 lists the X.21 signals and describes each one.

Pin Number	Function	Description
4,11	Receive Data	Output Data from K-384
2,9	Transmit Data	Input Data to K-384
3,10	Control	Input to K-384 indicating data valid
5,12	Indicate	Output from K-384 indicating connection made and data valid
6,13	Clock	Output from K-384 network dependant 64/56 kbps clock
8	Ground	Signal Ground

Table 3 Description of X.21 Signals

The K-384 has one V.24 compatible control port to which a PC or VT100 compatible terminal can be connected. The pinout of the port is shown in figure 6.

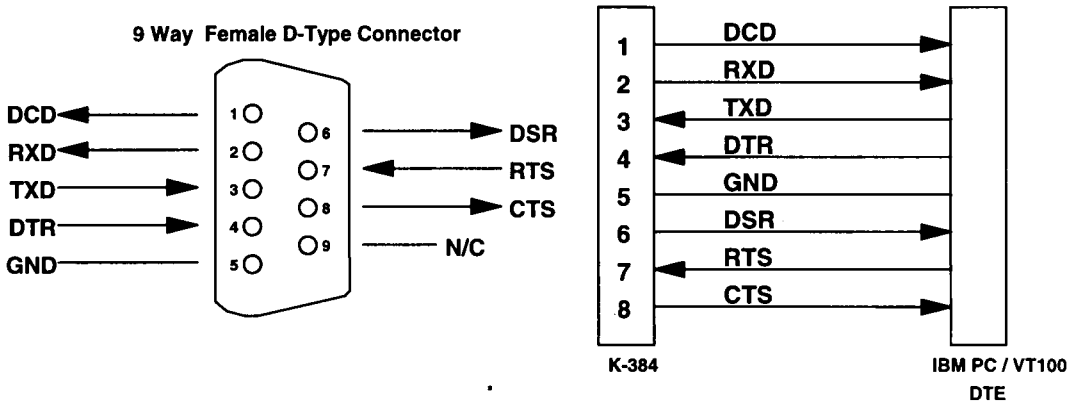

Fig 6 V.24 Terminal Port

Table 4 lists the operation of each pin.

Pin Number	Function	Description
1	DCD	Output-Active
2	RXD	Output- Received Data
3	TXD	Input- Transmitted Data
4	DTR	Input- Ignored
5	GND	Ground
6	DSR	Output- Active
7	RTS	Input- Ignored
8	CTS	Active when K-384 can receive data (handshake line)

Tabel 4 V.24 Signal Definition

When the K-384 is powered up it transmits an opening message. Once the K-384 has been set-up properly then it is not necessary to connect a terminal. To set-up the K-384 the user presses any key and the set-up screen is presented to the user. Chapter 2 covers setting up the K-384.

The factory default settings for the K-384 are 19200 baud, 8 data bits, 2 stop bits, no parity, although these settings can be changed by the user. If the K-384's setting in memory become corrupt it may not be possible to operate the terminal as the baud rate may be wrong. The K-384 will always power up with the terminal port operating at 19200 baud, 8 data bits, 1 stop bit, no parity and will maintain this setting during the time when the power up LEDs are on. Typing <ctrl-c> during this time will reload the factory defaults and the terminal should start to function normally again.

The auxilary port is currently used only to allow the K-384 to be clocked from another K-384. This forces the two K-384's to align the ISDN and X.21 data to each other allowing the X.21 ports to be connected between units. This can be used to connect two K-384's back to back and make 6 calls giving a total bandwidth of 384 kbps.

Figure 7 shows the pinout of the Auxilary connector.

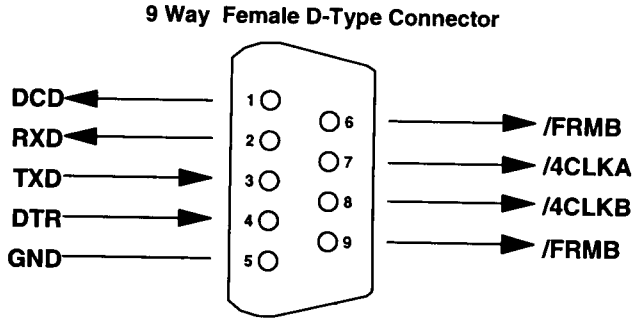

Fig 7 V.24 Auxilary Port

Figure 4 describes the function of each pin.

Pin Number	Function	Description
1	DCD	Output-Active
2	RXD	Output- Received Data
3	TXD	Input- Transmitted Data
4	DTR	Input- Ignored
5	GND	Ground
6	/FRMB	External Frame Signal (B)
7	/4CLKA	External Clock Signal (A)
8	/4CLKB	External Clock Signal (B)
9	/FRMA	External Frame Signal (A)

Table 5 Auxilary Port Pin Definitions

The K-384 power connector will accept an IEEE mains lead (supplied). The K-384 has a universal input suitable for 90V-250Vac/50-60Hz. Connection to any other source may result in the unit failing to comply with safety requirements.

The power supply must have a protective ground (earth). If not the mains filter will force the metal case to a voltage equal to half the mains supply voltage.

There are no user serviceable parts inside the K-384. It should only be opened by approved maintenance staff, otherwise the warranty will be invalidated.

Once the terminal has been connected to the control port, power can be applied. All twelve leds will light and immediatly extinguish except for the interface 1 leds which will then extinguish once the power on self-test is completed. The terminal should now display the opening message and be set-up as described in the next chapter.

Chapter 2

User Operation

This chapter outlines the user interface of the K-384 and how the various functions of the K-384 are set up and used.

Assuming that the hardware has been set up as described in chapter one, when power is applied the following message should be displayed on the user terminal.

```
Copyright Digital Engineering Ltd 1993
NT Simulator Vx.x  dd mmm yyyy S/N 12345678
Configuration I/F 1=x Mod I/F 2=x Mod I/F 3=x Mod
```

The default data format is 19200 baud, 8 data bits, 2 stop bits, no parity. If no message appears then there is probably something wrong with the control cable. If some characters are displayed but the format is strange then the terminal parameters are incorrect. Try adjusting the terminal parameters so that they match the K-384.

Nothing further will happen until the user presses a key. Note that once the unit has been set up it is not necessary to set it up each time it is powered on, and consequently the terminal need not be connected thereafter.

The K-384 now displays the main set up screen, shown in figure 8.

```
Hardware Setup
Software Setup
Terminal Setup
Telephone Number Setup
Analyser Setup
AT Command Processor
```

Fig 8 Main System Menu

The setup of the K-384 is structured rather like a tree with the menu of figure 8 at the top. The user moves to a more detailed lower function by using the <up-arrow> and <down-arrow> keys to select the desired function and presses <enter> on the keyboard. The user moves to the next higher function by pressing <esc> on the keyboard. Note that <u> and <d> perform the same function as <up-arrow> and <down-arrow>.

Once the user has located the item he wishes to change <space> is used to cycle through the various options permitted.

Some information must be entered by typing it in rather than using <space>, eg. telephone numbers. The user will be prompted for this information.

The functions listed in figure 8 are as follows.

(a) Hardware Setup

This function sets up the communications ports, and various other hardware functions of the K-384.

(b) Software Setup (NT mode)

This function allows the user to change the operation of the K-384 by switching on and off information elements in the call control messages or by changing the way in which the layer 2 and layer 3 software operates. This function can be used to enable facilities such as Multiple Subscriber Numbering and Sub-Addressing.

Software Setup (TE mode)

This function is identical to NT mode except that no control over network facilities is allowed.

(c) Terminal Setup

This function allows the user to change the setup terminal type or edit the control messages for special terminals.

(d) Telephone Number Setup

This function allows the user to change the default telephone numbers for each B channel and the special purpose telephone numbers.

(e) Analyser Setup

This function allows the user to change the setup functions on the analyser and to enable or disable the analyser.

(f) AT Command Processor (TE mode only)

This function, available only in TE mode, allows the user to control the K-384 as a three channel terminal adaptor using a subset of the ubiquitous 'AT' command set. The commands available are outlined in chapter 3.

2.1 Hardware Setup

On selecting this option the user is presented with the screen of figure 9.

```
Hardware Setup

Coms Port Baud Rate              xxxx
Coms Port Parity                 xxxx
Coms Port Stop Bits              xxxx
Coms Port Data Bits              xxxx
NT(LT)/TE/Tran Mode              xxxx
100 ohm Terminators              xxxx
40V Power                        xxxx
Power Operation                  xxxx
NT Mode Clock                    xxxx
S Bus Timing                     xxxx
Selected Tone                    xxxx
Ch1/B1 Delay                     xxxx
Ch1/B2 Delay                     xxxx
Data Port 0 Mode                 Outgoing 64k Incoming Auto
Data Port 1 Mode                 Outgoing 64k Incoming Auto
Data Port 2 Mode                 Outgoing 64k Incoming Auto
Data Port 3 Mode                 Outgoing 64k Incoming Auto
Data Port 4 Mode                 Outgoing 64k Incoming Auto
Data Port 5 Mode                 Outgoing 64k Incoming Auto
```

Fig 9 Hardware Setup Menu

All of the fields in figure 9 are changed by highlighting the required field and cycling through the options using <space>. The fields are listed below.

(a) Coms Port Parameters

These are the parameters for the control terminal. Note that changing these parameters will mean that the user will have to change the terminal setup also.

(b) NT(LT)/TE/Tran Mode

This field selects between Network Terminator (NT), (or Line Terminator (LT) on a U interface), Terminal Equipment (TE) and Transparent mode. In TE mode the equipment can be plugged into the public basic rate ISDN service and used to make calls to other ISDN terminal equipment. In NT mode the K-384 will simulate an ISDN network, allowing up to six terminals to be plugged in and to call each other (i.e. two terminals per BRI). In Transparent mode the terminal is plugged into port 1 while port 2 is connected to the ISDN network. Calls can be made on the public network through the K-384 which passes all messages transparently.

(c) 100 ohm Terminators

This field refers to the 100 ohm terminating resistors on the ISDN S-interface. (Note - changing this option has no effect on U interface module). If the K-384 is in TE mode and

plugged into an ISDN S interface connection in parallel with another terminal adaptor which contains terminating resistors then this field should be set to OUT, otherwise set this field to IN. Note in NT(LT) mode the field will automatically be set to IN.

(d) 40V Power

This field allows the user to provide a nominal 40V 1W d.c. supply to the ISDN S-interface or U-interface if any terminal adaptors or ISDN telephones require it. This should normally be turned ON in NT (LT) mode and Transparent Mode. Note that in TE mode this field will automatically be set to OFF. (See note for U interface operation under Power Operation)

(e) Power Operation

This field allows the user to switch the power from normal mode to restricted mode, ie. the power provided at the ISDN interface will switch polarity. This field should be set to normal operation unless the user wishes to test the terminal adaptor operation in restricted power mode. Note that the U interface module is fitted with a current limit circuit which restricts the total current to 20mA in normal mode. Switching to restricted mode power will disable the current limiter and the U interface will be supplied with the full 40V 1W. This will be necessary for testing NT1's and other line powered devices.

(f) NT Mode Clock

This field allows the clocks used to generate the timing for the ISDN S bus interfaces in NT(LT) mode to be driven from another K-384. Both K-384's interface modules are thus synchronised. This field must be set to "Local" if only one K-384 is being used and to "Remote" to receive clocking signals from another K-384.

(g) S Bus Timing

In NT mode using an S interface this field will switch between adaptive timing or fixed timing on the S interface. Use adaptive timing if the S interfaces have a long cable attached.

(h) Selected Tone

The K-384 can generate a tone on a B channel whenever a terminal dials a particular telephone number (see section 2.4 Telephone Number Setup). This field is used to select the tone frequency and power level. It is also possible to select dialtone, ring tone, error tone and busy tone using this field. Note that the '+' and '-' keys can be used to skip frequencies while <space> will skip to the next suported power level.

(i) B Channel Delay

The K-384 can be programmed to insert a time delay in the interface 1 B channels. B1 and B2 can be programmed for different delay values.

(j) Data Port Mode

These fields select the operating mode of the X.21 ports. Outgoing calls can be either 64kbps unrestricted digital or V.110 56kbps. Changing the outgoing mode changes the bearer capability information element included in the SETUP message. Incoming calls are accepted only if they conform to the incoming call operating mode as follows (a) 64k only - only 64k unrestricted digital accepted (b) 56k only - only V.110 56k calls accepted (c) Auto - both 64k and 56k calls accepted (d) Any - the incoming call will be accepted irrespective of the bearer capability.

2.2 Software Setup

On selecting this option the screen of figure 10 is displayed.

```
Software Setup

Drop Layer 2 if No Call Active          xxxx
Drop Layer 1 if Layer 2 Inactive        xxxx
Drop TEI if Layer 1 Inactive            xxxx
Number of Datalinks per Channel         n
Use Service Profile IDs (SPIDs)         xxxx
Allow Overlap Sending/Receiving         xxxx
Numbering System Option                 xxxx
Called Party Number                     xxxx
Calling Party Number                    xxxx
Called Party Subaddressing              xxxx
Calling Party Subaddressing             xxxx
Higher Level Compatibility              xxxx
Lower Level Compatibility               xxxx
```

Fig 10 NT Mode Software Setup Menu

The user turns these features on or off by selecting the relevant field and pressing <space>.

The first five options are universal options and can be set for any supported network in either NT or TE mode. These options operate as follows:-

(a) Drop Layer 2 if No Call Active

If activated the K-384 will disconnect layer 2 after a predetermined time if there are no active calls . This time can be set up by pressing <enter> on this field if it is activated. The screen of figure 11 is presented.

```
L2 Drop Timeout Setup

Timeout until L2 Dropped (secs) nn
```

Fig 11 L2 Drop Timeout Menu

Pressing <esc> will leave the value unchanged and <enter> will allow the user to change the default value.

(b) Drop Layer 1 if Layer 2 Inactive

If enabled the K-384 will deactivate layer 1 immediatly layer 2 becomes inactive.

(c) Drop TEI if Layer 1 Inactive

If activated the K-384 will remove its TEI value(s) once the layer 1 is deactiavted. The terminals will then have to send an ID Request once they become active again.

(d) Number of Data Links per Channel

The user can choose either 1 or 2 data links per channel in TE mode. The K-384 will set up the required number of datalinks. When more than one datalink is requested a call on B1 will be set up on the first datalink and a call on B2 will be set up on the second datalink. Otherwise both calls will be set up on the single datalink. In NT mode two datalinks may always be used.

If the number of datalinks is set to 1 then pressing <enter> will display the screen of figure 12.

```
Point to Point/Multipoint Setup

Basic Rate Interface 1      xxxx
Basic Rate Interface 2      xxxx
Basic Rate Interface 3      xxxx
```

Fig 12 Point to Point Setup

Each interface can be set to point to point mode (i.e. no broadcast TEI in use for SETUP messages) or in point to multipoint mode (i.e. broadcast TEI used).

(e) Use Service Profile IDs (SPIDs)

If activated and in NT mode the K-384 will accept a Service Profile Identifier from the terminal and assign a Terminal Endpoint Identifier (note that this is not the same as the TEI at layer 2) to it. In TE mode the K-384 will send a SPID to the network once a datalink becomes active. If activated the user can press <enter> to set up the SPIDs and the screen of figure 13 is presented.

```
Service Profile Identifier Setup

Ch #1 Spid #1                    ssssss
Ch #1 Spid #2                    ssssss
Ch #2 Spid #1                    ssssss
Ch #2 Spid #2                    ssssss
Ch #3 Spid #1                    ssssss
Ch #3 Spid #2                    ssssss
```

Fig 13 Service Profile ID Setup Menu

The user can change any of the SPIDs by moving to the relevant SPID and pressing <enter>. The user is then prompted for a new SPID value.

The remaining options affect the contents of the SETUP message sent from the K-384 to the called terminal as follows:-

(f) Allow Overlap Sending/Receiving

If activated the K-384 will allow Overlap Receiving on certain enbloc dialled calls. If deactivated Overlap Receiving is not allowed on enbloc dialled calls. For a further explanation of how Overlap Receiving works consult section 5.9.

(g) Numbering System Option

A Normal numbering system uses the numbers assigned to each B channel in the Telephone Number Setup Menu. Multiple Subscriber Numbering (MSN) is also available. If this feature is enabled and a number is called the last digit is treated as a wildcard i.e. dialling 384001 will connect to the channel whose number is set up as 384000. In addition to this the last digit of the dialled number is provided to the destination terminal in the Called Party Number information element (assuming that the Called Party Number information element is enabled). The third option is Auxiliary Working. Enabling this feature sets both B channels to the same telephone number. Lastly Direct Dialling In (DDI) is provided. This works in the same way as MSN but the complete Called Party Number is sent to the destination terminal if the Called Party Number option is enabled (see also section 5.9). Overlap Receiving works independantly of the numbering option.

(h) Called Party Number

If this feature is activated a Called Party Number information element is included in the SETUP message sent to the destination terminal. This is the network generated directory number if the calling terminal did not send a Called Party Number information element in its transmitted SETUP message or simply a copy of the terminal supplied number if it did include a Called Party Number information element in its transmitted SETUP message.

If enabled pressing <enter> when on this field displays the screen of figure 14.

```
Called Party Number Setup


Type                    tttttttt
Plan                    ppppppppp
```

Fig 14 Called Party Number IE Setup

This screen allows the user to reconfigure the Called Party Number information element before it is sent to the called party. If type or plan are set to automatic then the Called Party Number will be passed through the K-384 unaltered. The Type field can be forced to a different setting by pressing <space> while on the Type field. Available settings are :-

Unknown, International, National, Network, Subscriber, Abbreviated.

Similarly the Plan field can be forced to a fixed value. Available plans are:-

Unknown, ISDN/Telephony, Data, Telex, National, Private.

(i) Calling Party Number

If this feature is activated a Calling Party Number information element is included in the SETUP message sent to the destination terminal. This is the network generated directory

number if the calling terminal did not send a Calling Party Number information element in its transmitted SETUP message or simply a copy of the terminal supplied number if it did include a Calling Party Number information element in its transmitted SETUP message.

If enabled pressing <enter> when on this field displays the screen of figure 15.

```
Calling Party Number Setup


Type                    tttttttt
Plan                    ppppppppp
Screening               sssssssss
Presentation            ppppppppppp
```

Fig 15 Calling Party Number IE Setup

This screen allows the user to reconfigure the Calling Party Number information element before it is sent to the called party. If type, plan, screening or presentation are set to automatic then the Called Party Number will be passed through the K-384 unaltered. The Type field can be forced to a different setting by pressing <space> while on the Type field. Available settings are :-

Unknown, International, National, Network, Subscriber, Abbreviated.

Similarly the Plan field can be forced to a fixed value. Available plans are:-

Unknown, ISDN/Telephony, Data, Telex, National, Private.

The Screening field can be forced to a fixed value. Available screening indicators are :-

User Provided Not Screened, User Provided Verified and Passed, User Provided Verified and Failed, Network Provided.

The Presentation field can be forced to a fixed value. Available presentation indicators are :-

Presentation Allowed, Presentation Restricted, Number Not Available.

(j) Called Party Subaddress

If this feature is enabled a Called Party Subaddress information element is included in the SETUP message sent to the destination terminal, but only if the calling terminal sent a Called Party Subaddress information element in its transmitted SETUP message. The CCITT and BT software allows the generation of a Called Party Sub-Address by dialling an enbloc number and the Called Party Sub-Address seperated by a # (e.g. 384000#123).

(k) Calling Party Subaddress

If this feature is enabled a Calling Party Subaddress information element is included in the SETUP message sent to the destination terminal, but only if the calling terminal sent a Calling Party Subaddress information element in its transmitted setup message.

(l) Higher Level Compatibility

If this feature is activated a Higher Level Compatibility information element is included in the SETUP message sent to the destination terminal. If this information element is supplied by the calling terminal then a copy is simply passed to the destination terminal, otherwise the K-384 generates this information element as follows:-

If activated pressing <enter> when on this field allows the user to map the "information transfer capability" field of the Bearer Capability information element to the "high layer characteristics identification" of the High Layer Compatibility information element (See Q.931). To allow the user to set up this mapping the screen of figure 16 is displayed . The table is edited in the normal fashion - move to the element to be changed and use <space> to cycle through the available options until the desired option is selected.

The available options are :-

Telephone, Fax Group 2/3, Slow Scan Video, Fax Group 4, Teletex - Basic Mixed and Fax, Teletex - Basic and Processible, Teletex - Basic, International Videotex, Telex, Message Handling, OSI Application, Maintenance, Management.

One of these options is then chosen for each of the displayed fields to define the mapping required. For example, 'Speech' in the low layer compatibility information element might be mapped to 'Telephony' in the high layer compatibility information element.

```
Higher Layer Compatibility Setup

Speech translates as                    xxxxxxxxxx
Unrestricted Digital translates as      xxxxxxxxxx
Restricted Digital translates as        xxxxxxxxxx
3.1 kHz Audio translates as             xxxxxxxxxx
7 kHz Audio translates as               xxxxxxxxxx
Video translates as                     xxxxxxxxxx
```

Fig 16 Translation from Bearer Capabilities to HLC

(m) Lower Level Compatibility

If this feature is activated a Lower Level Compatibility information element is included in the SETUP message sent to the destination terminal. If this information element is supplied by the calling terminal then a copy is simply passed to the destination terminal, otherwise the K-384 generates this information element from the Bearer Capability information element.

2.3 Terminal Setup

On selecting this option the user is presented with the screen of figure 17.

```
Terminal Setup

Terminal Type              ttttt
```

Fig 17 Terminal Type Setup Menu

The user can select a terminal type by typing <space>. Supported terminals are ANSI, ANSI-Colour and Wyse-50.

2.4 Telephone Number Setup

On selecting this option the screen of figure 18 is displayed.

```
Telephone Number Setup

Port 1 B1 Number                xxxx
Port 1 B2 Number                xxxx
Port 2 B1 Number                xxxx
Port 2 B2 Number                xxxx
Port 3 B1 Number                xxxx
Port 3 B2 Number                xxxx
Busy Number                     xxxx
Unallocated Number              xxxx
No User Responded Number        xxxx
Call Rejected Number            xxxx
Out of Order Number             xxxx
Temporary Failure Number        xxxx
No Answer Number                xxxx
Test Tone Number                xxxx
Data Port B1 Number             xxxx
Data Port B2 Number             xxxx
```

Fig 18 Telephone Number Setup Menu

The fields of figure 18 are modified by selecting the relevant telephone number using the <up> arrow and <down> arrow keys and pressing <enter>. A prompt to enter a new telephone number appears at the bottom of the screen.

The telephone numbers are used as follows:-

Whenever the user wishes to make a call he simply dials the telephone number of the relevant interface and B channel. Whenever Multiple Subscriber Numbering (MSN) is enabled (see section 2.2) the last digit in the telephone number is treated as a wildcard i.e. if Port 1 B1 Number is set to 384010 and the user dials 384016 a connection will be made to Port 1 B1. If Auxiliary Working is enabled both B channels use the same telephone number but only one number is allowed. Direct Dialling In (DDI) works in exactly the same way as MSN except that the complete dialled number is sent to the called party (but only if the Called Party Number option is enabled in the software setup menu) wheras with MSN only the last digit dialled is forwarded. This is true only if the Called Party Number information element is enabled.

The data port numbers are used to connect calls to the X.21 data ports at the rear of the K-384. Each of the three RJ45 ports on the front of the unit has two associated data ports. Two numbers are allocated, one to each data port. If a call is made using the first RJ45 port then either data port one or data port two may be called, depending on which of the two allocated numbers is used. If another call is made from the second RJ45 port then using the same two numbers it may connect to either data port three or four. Likewise the third RJ45 port may connect to either of data ports five or six. Once a call is connected to the X.21 interface the B channel data is available and can be looped back or fed into other test equipment.

A series of failure numbers are also defined. If the user dials any of these numbers the call is rejected with a cause value defined by the failure mode, i.e. calling the User Busy number will cause the call to be rejected with cause value 17 (user busy).

A number is defined for test tones. Dialling this number will force the K-384 to send a PCM tone (A law or μ law) on the B channel. The tone frequency and power level are adjusted in the Hardware Setup Menu. Note that silence, dial tone, busy tone, and error tone can also be sent.

2.5 Analyser Setup

On selecting this option the screen of figure 19 is displayed.

```
Analyser Setup

Analyser Time            nn:nn:nn
Layer 1 Hardware         xxxx
Layer 2 Data Link        xxxx
Layer 3 Call Control     xxxx
Channel Filter           xxxx
Call Reference Filter    xxxx
Analyser Specification   xxxx
Activate Analyser        xxxx
```

Fig 19 Analyser Setup Menu

This screen defines how the protocol analyser option operates.

The time stamp on the analyser display can be changed to the current time rather than the elapsed time since power up.

The analyser will report activity at layers 1, 2 and 3. The user selects the reporting level required at each layer by moving to the particular option and pressing <space>. The reporting levels available are (a) Inactive - no reporting of any activity (b) Hex Display - Messages are displayed as hex digits (c) Ascii Short Display - messages are displayed in a shortened text form (d) Ascii Long Display - messages are displayed in text form and all the information elements are decoded and displayed.

The user can set up a channel filter. If selected, reporting will only take place on the channel or channels selected using this option. Any combination of the three channels is possible.

A call reference filter can also be set up. To use this facility the user moves to the Call Reference Filter field and presses <enter>. The user is now prompted to enter a call reference value. Once entered only calls having this call reference will be reported at layer 3, layers 1 and 2 being unaffected.

The user may also select the decoding of messages which are defined for a particular ISDN network. The networks currently supported are CCITT (general purpose), BTNR191 (UK), AT&T 5ESS (USA), NT DMS100 (USA), National ISDN 1 (USA), 1TR6 (Germany) and VN2/3 (France), ETSI (Europe).

The user enters analyser mode by setting Activate Analyser to YES and pressing <enter>. To exit analyser mode press <esc>.

2.6 AT Commands (TE Mode Only)

In TE mode the user can operate the K-384 using industry standard AT commands. Chapter 3 outlines the commands which can be used and their function. To activate this feature the user moves to this field and presses <enter>. The user can now enter commands e.g. AT <RETURN>. To exit the AT command interpreter enter AT/M <RETURN>.

Chapter 3

AT Command Interpreter

The K-384 while configured in TE mode can be operated by means of an AT command set. Extensions are provided to control the ISDN functions, such as B-channel selection.

Under the AT command set, each string of commands must begin with an AT and be terminated by carriage return. Commands are not interpreted until the carriage return is received. Commands may be entered in either upper or lower case.

The AT may be followed by any number of setting commands, in any sequence. Commands are interpreted sequentially until an action command or a syntax error is signalled. All commands after an action command or syntax error are ignored. Examples of action commands are Dial (D), Answer (A) and Hangup (H).

Editing is allowed by means of backspacing. A line may be aborted by <ctrl x>.
Note that commands which need a parameter will be given a default value if the given parameter in the command string is out of range or not given at all.

Note that the command interpreter operates only in command mode. Calls are connected using the ATCnD command but the user always remains in command mode. Successful calls connect directly to the X.21 data ports and operate only in synchronous 64 kbps or 56 kbps.

The AT Command Set

A - **Answer**
The K384 will answer an incoming call on the relevant data port if one is present

A/ - **Re-execute the last command line**

C - **ISDN Channel Select**
Selects the channel to be used for following commands.
Parameters
0 -Port 1 B Channel 1.
1 -Port 1 B Channel 2.
2 -Port 2 B Channel 1.
3 -Port 2 B Channel 2.
4 -Port 3 B Channel 1.
5 -Port 3 B Channel 2.

&C - **X.21 INDICATE Option**
The K-384 will operate the relevant X.21 Indicate signal in accordance with the parameter supplied.
Parameters
0 -Indicate shall remain on at all times.
1 -Indicate shall remain off at all times.
2 -Indicate shall be on only if there is an active call.

D - **Dial**
This command directs the K-384 to attempt to establish a connection on the relevant port. No command following the dial command will be interpreted.
Parameters :
[0-9] digits 0 - 9.
S :The stored Telephone Number.
L :Last number redial.

&D - **CONTROL Option**
This command controls how the K-384 responds to the X.21 Control signal according to supplied parameter.
Parameters :
0 -K-384 will ignore the state of the Control signal.
1 -K-384 will drop an active call if Control is in an inactive state
2 -K-384 will attempt to establish a call using the stored telephone number if Control is active

E - **Command echo**
Enables and disables echo of the command string to the terminal
Parameters :
0 -Echo off.

1 -Echo on. (default)

F - **Select X.21 Profile**

Selects the profile for outgoing and incoming calls according to the supplied parameter.

Parameters :

0 -Outgoing 64 kbps calls. Accept incoming 64 kbps calls
1 -Outgoing 64 kbps calls. Accept incoming 56 kbps calls
2 -Outgoing 64 kbps calls. Accept either 64 kbps or 56 kbps incoming calls
3 -Outgoing 64 kbps calls. Accept any incoming call
4 -Outgoing 56 kbps calls. Accept incoming 64 kbps calls
5 -Outgoing 56 kbps calls. Accept incoming 56 kbps calls
6 -Outgoing 56 kbps calls. Accept either 64 kbps or 56 kbps incoming calls
7 -Outgoing 56 kbps calls. Accept any incoming call

Note that these settings are also displayed on the Hardware Setup Screen.

&F - **Restore factory configuration**

Reload the specified factory default configuration.

H - **Hangup**

This command disconnects the call connected to the selected port

&H - **Toggles Command Commentary**

Deciphering or debugging an AT command string can often be quite time consuming. The Command commentary displays a description of each command as it happens.

I - **Identification**

Causes the K-384 to return product identity and version information.

Parameters :

0 -returns the product code i.e. contents of S38. (default)
1 -returns version number and release date of system software.
2 -returns copyright notice.

&O - **S-Register format**

Allows the input and output of S-Registers in either hexadecimal or decimal format.

Parameters :

0 -Decimal format (default)
1 -Hexadecimal format

Q - **Quiet control**

This command enables or disables the sending of result codes according to the parameter supplied.

Parameters :

0 -Disable result codes.

1 -Enable result codes.

%R - **Prints the contents of the S-registers.**

S - **Read /Write S-registers**
To read an S-Register :
ATSn?
To write an S-Register :
ATSn=v
where n is the number of the register, and v is the value to be written.
After the first use of ATS, a default S-Register is set. Any subsequent changes to the specified S-Register, do not need to identify it. For example,
ATS2=0 will set S2 as default.
ATS? will print the contents of the default register (S2)

&V - **Display directory**
Displays the contents of the phone number written to with the AT&Z command

V - **Result code form**
This command is used to select short-form or long-form result codes as responses to commands.
Parameters
0 -enables short-form (numeric) result codes.
1 -enables long-form result codes. (default)

&W - **Store configuration**
Stores the current configuration in the specified profile

Z - **Reset**
This will force the K-384 to do a soft reset and recover the stored configuration

&Z - **Store telephone number**
Stores a number which can be retrieved by ATDS

AT Commands by Function

Action Commands

A - Answer
A/ - Re-execute the last command line
D - Dial
H - Hangup
&H - Toggles Command Commentary
I - Identification
%R - Prints the contents of the S-registers.
S - Read /Write S-registers
Z - Reset

General Setup

C - ISDN Channel Select
E - Command echo
F - Select Port Profile
&F - Restore factory configuration
&I - Short verbose result codes
&O - S-Register format
Q - Quiet control
V - Short-form or long-form result codes
&V - Display directory
&W - Store configuration
&Z - Store telephone number

Results and Responses

The K-384 responds to commands and to activity on the line by issueing the following messages :-

OK

The OK result acknowledges successful execution of an AT command line.

CONNECT xxxxx

This result means that the attempted call has successfully established a connection. The number following the connect message indicates the transmission speed of the link.

RING

The K-384 sends this message when an incoming call is detected.

ALERTING

The K-384 sends this message when an outgoing call is made and the far end is ringing.

REMOTE DISC

The K-384 sends this message when an outgoing call is cleared by the far end.

NO CARRIER

This result is returned in two situations. Firstly, when an outgoing call fails to connect within the period specified by S7. The second type of occurrence is the case of an established call being auto-disconnected.

ERROR

The K-384 will return the ERROR message if any part of the AT command sequence contains a syntax error, or if it is unable to execute any part of the command sequence.

BUSY

This result is returned if an engaged signal is detected, when attempting to originate a call.

NO ANSWER

This result is returned if a continuous ringback signal is detected on the line, when attempting to originate a call.

The S-Registers

The S-Registers may be thought of as a series of 255 variables which the AT command set uses for various purposes. Although all are available to the user, not all should be changed. The following list details which can and can not be modified.

S0 - Rings to auto-answer
Range 0-255
Default0
Units rings
Description
Allow you to choose how many rings should be detected before the K-384 answers. A value of zero disables auto-answer, but any other value will cause immediate answer of an incoming call.

S3 - Carriage Return Character
Range 0-255
Default13
Units ASCII Decimal
Description
S3 records your choice of character to be recognized as a carriage return in the command line and to be used in result code responses.

S4 - Linefeed Character
Range 0-255
Default10
Units ASCII Decimal
Description
S4 records your choice of character to be used in result code responses.

S5 - Backspace Character
Range 0-255
Default8
Units ASCII Decimal
Description
S5 records your choice of character to be recognized as a backspace.

S7 - Wait for carrier time
Range 1 - 255
Default40
Units seconds
Description
S7 records the time that the K-384 will wait for a connection from the remote end.

S14 - General bit mapped options
0 - reserved
1 - command mode echo enable (ATE)

- 0:disabled
- 1:enabled

2 - result code transmission enable (ATQ)
- 0:enabled
- 1:disabled

3 - verbose result code enable (ATV)
- 0:enabled
- 1:disabled

7,6,5,4 - reserved

S27 - General bit mapped options

2,1,0 - reserved

3 - S-register input/output format (AT&O)
- 0:decimal (default)
- 1:hex

7,6,5,4 - reserved

S40 - General bit mapped options for channel 0

1,0 - indicate option (AT&C)
- 0:Indicate ON always
- 1:Indicate OFF always
- 2:Indicate ON only if call connected

3,2 - control option (AT&D)
- 0:Control state ignored
- 1:Control inactive will cause call to be dropped
- 2:Control active will force pre-stored number to be called

6,5,4 - port profile (ATF)
- 0:64 kbps out 64 kbps in
- 1:64 kbps out 56 kbps in
- 2:64 kbps out 64/56 kbps auto in
- 3:64 kbps out any in
- 4:56 kbps out 64 kbps in
- 5:56 kbps out 56 kbps in
- 6:56 kbps out 64/56 kbps auto in
- 7:56 kbps out any in7
- reserved

S41 - General bit mapped options for channel 1

Format same as S40

S42 - General bit mapped options for channel 2

Format same as S40

S43 - General bit mapped options for channel 3

Format same as S40

S44 - General bit mapped options for channel 4

Format same as S40

S45 - General bit mapped options for channel 5
Format same as S40

Chapter 4
Analyser Operation

Before the analyser can be used it must be configured as explained in chapter 2. The information is repeated here for convenience.

On selecting the analyser setup option from the main menu the screen of figure 20 is displayed.

```
Analyser Setup

Analyser Time          nn:nn:nn
Layer 1 Hardware          xxxx
Layer 2 Data Link         xxxx
Layer 3 Call Control      xxxx
Channel Filter            xxxx
Call Refrence Filter      xxxx
Analyser Specification    xxxx
Activate Analyser         xxxx
```

Fig 20 Analyser Setup Menu

This screen defines how the protocol analyser option operates.

The time stamp on the analyser display can be changed to the current time rather than the elapsed time since power up. The time is changed by moving to this field and pressing <enter>. A prompt apears at the bottom of the screen requesting a new time. This time is entered using the format hh:mm:ss. Note that this time is also used in the CONNECT message Time/Date information element.

The analyser will report activity at layers 1, 2 and 3. The user selects the reporting level required at each layer by moving to the particular option and pressing <space>. The reporting levels available are (a) Inactive - no reporting of any activity (b) Hex Display - Messages are displayed as hex digits (c) Ascii Short Display - messages are displayed in a shortened text form (d) Ascii Long Display - messages are displayed in text form and all the information elements are decoded and displayed.

The user can set up a channel filter. If selected, reporting will only take place on the channels selected using this option. Any combination of the three channels is possible. The channels are selected by moving to the field and pressing <space> until the required channel combination is selected.

A call reference filter can also be set up. To use this facility the user moves to the Call Reference field and presses <enter>. The user is now prompted to enter a call reference value. Once entered only calls having this call reference will be reported at layer 3, layers 1 and 2 being unaffected.

The user may also select the decoding of messages which are defined on for a particular ISDN network The networks currently supported are CCITT (general purpose), BTNR191

(UK), AT&T 5ESS (USA), NT DMS100 (USA), National ISDN 1 (USA), 1TR6 (Germany) and VN2/3 (France), ETSI (Europe).

The user enters analyser mode by setting Activate Analyser to YES and pressing <enter>. To exit analyser mode press <esc>.

4.1 Information Provided at Layer 1

A typical display of a layer 1 message is shown below.

```
23:  Ch 1 L1 STATE= Activated                    00:01:75:30.271
```

The information presented is outlined below.

(a) Sequence Number

Each message has a unique sequence number so that old messages can be easily located.

(b) Channel Number

The channel number (1-3) on which the event occured.

(c) Layer Number

The layer on which the event is being reported.

(d) State

The new state of the physical layer e.g. Activated.

(e) Timestamp

The time that the message was recorded. The timestamp has the form dd:hh:mm:ss.nnn where dd represents days, hh hours, mm minutes, ss seconds and nnn milliseconds.

Note that layer 1 messages only occur at layer 1 and only report a change in the state of the physical link.

4.2 Information Provided at Layer 2

A typical display of a short ASCII layer 2 message is shown below.

```
23: TE Ch 2 L2                                        00:01:75:30.271
      SAPI= 0, TEI= 40, C/R= 0, P/F=1, TYPE= SABME
```

The information presented is outlined below.

(a) Sequence Number

Each message has a unique number so that old messages can be easily located.

(b) Originator

This field reports which side generated the message, TE for terminal generated and NT for network generated.

(c) Channel Number

The channel number (1-3) on which the event occured.

(d) Layer Number

The layer on which the event is being reported.

(e) Timestamp

The time that the message was generated (NT message) or received (TE message). The timestamp has the form dd:hh:mm:ss.nnn where dd represents days, hh hours, mm minutes, ss seconds and nnn milliseconds.

(f) Service Access Point Identifier*

(g) Terminal Endpoint Identifier*

(h) Command/Response Bit*

(i) Poll/Final Bit*

(j) Type*

The message type, being one off I, RR, RNR, REJ, SABME, DM, UI, DISC, UA, FRMR, XID.

A typical display of a long ASCII layer 2 message is shown below.

```
23: TE Ch 2 L2                                          00:01:75:30.271
      SAPI= 0, TEI= 40, C/R= 0, P/F=1, TYPE= INFO
N(r)= 1, N(s)= 1
```

The following information has been added:-

(k) Send Sequence Number N(s)*

(l) Receive Sequence Number N(r)*

Layer 2 management transactions are also decoded in long form messages. A typical decode follows.

```
23: TE Ch 2 L2                                          00:01:75:30.271
      SAPI= 0, TEI= 40, C/R= 0, P/F=1, TYPE= UI
MEI= 15, Ri= 7FCD, MSG TYPE= ID Request, Ai= 0
```

The following information has been added:-

(m) Management Entity Identifier*

(n) Reference Number (Ri)*

(o) Management Message Type*

One of ID Request, ID Assigned, ID Denied, ID Check Request, ID Check Response, ID Remove, ID Verify.

(p) Action Indicator*

Only Information and certain Unnumbered Information messages at layer 2 form layer 3 messages.

Fields marked with * are explained further in CCITT Q.921 Digital Subscriber Signalling System No 1, Data Link Layer.

A typical display of a hex layer 2 message is shown below.

```
23: TE Ch 2 L2                                          00:01:75:30.271
      02 81 00 02 41 01 81 0D 18 01 89
```

The information contained in the message is not decoded but simply displayed as hex octets.

4.3 Information Provided at Layer 3

A typical display of a short ASCII layer 3 message is shown below.

```
23: TE Ch 1 L3                                          00:01:75:30.271
      PD= 65, LEN= 1, FLAG= Orig, CALL REF= 3, TYPE= SETUP
```

The information presented is outlined below.

(a) Sequence Number

Each message has a unique sequence number so that old messages can be easily located.

(b) Originator

This field reports which side generated the message, TE for terminal generated and NT for network generated.

(c) Channel Number

The channel number (1-3) on which the event occured.

(d) Layer Number

The layer on which the event is being reported.

(e) Timestamp

The time that the message was generated (NT message) or received (TE message). The timestamp has the form dd:hh:mm:ss.nnn where dd represents days, hh hours, mm minutes, ss seconds and nnn milliseconds.

(f) Protocol Discriminator*

(g) Call Reference*

The call reference consists of three parts, the Length of the call reference, the Value of the call reference and the Originator of the call reference.

(h) Message Type*

One of the Q.931 supported messages, or network specific message.

A typical display of a long ASCII layer 3 message is shown below.

```
23: TE Ch 1 L3                                          00:01:75:30.271
      PD= 65, LEN= 1, FLAG= Orig, CALL REF= 3, TYPE= SETUP

      CALLING PARTY NUMBER:0 LENGTH= 7
      TYPE= Unknown PLAN= ISDN/Telephony NUMBER= '234231'
```

```
CALLED PARTY NUMBER:0 LENGTH= 7
TYPE= Unknown PLAN= ISDN/Telephony NUMBER= '384020'
```

In the long ASCII message decode all the information elements contained in the messgae are decoded. Information elements are separated by a blank line, the information element name together with relevant codeset and length apears as a heading above each information element decode and the decoded information is indented by 1 space.

For more information on * marked fields, messages and information elements refer to CCITT Q.931 Digital Subscriber Signalling System No 1, Network Layer.

A typical display of a hex layer 3 message is shown below.

```
23: TE Ch 2 L2                                          00:01:75:30.271
      41 01 81 0D 18 01 89
```

The information contained in the message is not decoded but simply displayed as hex octets.

4.4 Analyser Commands

As soon as the user enters analyser mode stored messages (if there are any) are displayed in accordance with the analyser options selected. The user can now use a series of commands to make decoding of the information displayed easier. The user may enter <esc> to exit analyser mode, change the decode options and enter analyser mode again without losing any messages. The options available are:-

(a) <m> - Manual Mode

The analyser enters manual mode. Automatic display of incoming messages is stopped and the user can review the messages in the message buffer. Pressing M again will leave manual mode.

(b) <home> or <b> - Go to First Message

Will display messages starting at the oldest message in the buffer. This command works in manual and automatic modes.

(c) <end> or <e> - Go to Last Message

Will go to the last message in the buffer and display any new messages which arrive. This command works in manual and automatic modes.

(d) <up> or <u> - Review Previous Message

Will display the message which arrived just before the last message displayed. This command works only in manual mode.

(e) <down> or <d> - Go to Next Message

Will display the message which arrived just after the last message displayed. This command works only in manual mode.

(f) <c> - Clear Buffer

Will remove all messages from the buffer. This command works in manual and automatic modes.

(g) <h> - Pause Display

Will stop the display scrooling. Pressing <h> again will restart the display.

Note that whenever an attempt is made to move to a message beyond the start or end of the message buffer a beep will be sent to the terminal.

4.5 Analyser in Transparent Mode

In transparent mode the normal analyser display is slightly different. The message originator is redefined as being TE for messages being sent from the terminal plugged into channel 1 and NT for messages being sent from the network plugged into channel 2. The channel number display is no longer used. Other than this the protocol analyser functions identically to NT and TE modes.

Chapter 5
Fault Finding

This section seeks to provide some guidance on solving common problems encountered in using the K-384.

5.1 Changing a parameter on the K-384 forced it to stop operating.

Changing parameters on the K-384 may cause the unit to change operating modes and appear to stop functioning. In particular switching NT Clock from "Local" to "Remote" will cause the K-384 to stop running unless an external clock is provided.

To recover from this condition reload the factory defaults. When the K-384 powers up the configuration leds will light for about 1 second. During this period if the K-384 receives a <ctrl-c> character it will reload the defaults. The K-384 defaults are 19200 baud, 2 stop bits, 8 data bits and no parity.

5.2 Terminal will not activate at layer 1 (i.e. P led does not illuminate)

If the P led does not illuminate then the physical connection between the terminal, or the network, and the K-384 is not functioning

If the K-384 is being used in TE mode make sure that it is switched to the correct mode in the Hardware Setup Menu. It may be that the link is simply deactivated so making a call (See Chapter 3 AT Command Set Interpreter) will activate it again. If this does not work check if something else in plugged into the ISDN line along with the K-384. If so remove it. Also check that the 100 ohm termination resistors are switched to "In" when using the Hardware Setup Menu.

If the K-384 is being used in NT(LT) mode make sure that the K-384 is switched to the correct mode in the Hardware Setup Menu. Switch on the 40V power supply. If this does not help switch power operation between normal and restricted.

If the K-384 is being used in transparent mode the leds do not function and will normally remain off.

5.3 Terminal will not answer a call.

Check first that the call is actually being routed to the called teminal as expected. To do this dial the number of the called terminal and check that one of the B channel leds illuminate. If the terminal responds by activating the ISDN line (P led illuminates) and by starting up layer 2 (D led illuminates) then the terminal has received the call and is not answering for a specific reason. If neither P or D led illuminate then the terminal may be faulty or else refer to the guidance notes for section 5.2.

If the protocol analyser option is available set it to display the layer 3 lessages. The called terminal may send DISCONNECT, RELEASE or RELEASE COMPLETE with a cause value indicating the problem.

A potiential problem may be that called terminal and calling terminal do not support the same bearer capability in which case the called terminal will send RELEASE COMPLETE with a cause "Imcompatible Destination". Another possibility is that the called terminal is expecting a Called Party Number or Calling Party Number information element in the SETUP message. Turn on these options in the Software Setup Menu and ensure that the called terminal is programmed accordingly. It is also necessary that both terminals are running the same protocols. Most protocols (not 1TR6) will work with the basic Q.931 network supplied on the K-384 but may have reduced functionality.

5.4 Terminal can dial only one number to set up two calls.

If the calling terminal can be programmed with one telephone number to dial two calls then the K-384 must be switched out of Normal for the Numbering System option in the Software Setup Menu. In Normal operation each B channel has a seperate telephone number. To call B1 on interface 2 dial 384020 and to dial B2 on interface 2 dial 384030 (if using the default numbering system).

The other possibilities are :-

(a) Auxilary Working

One number is assigned per interface. Dialling this number can route a call to B1 on the called interface. Dialling this number again will route a call to B2 on the called interface. No other numbers will be accepted.

(b) Multiple Subscriber Numbering (MSN)

A base number is assigned to an interface. An interface can be called by dialling any of ten numbers refrenced to the base by changing the last digit. For example using MSN and the default numbering system interface 1 will respond to all numbers in the range 384000-384009. The last digit only is sent as a called party number information element to the called terminal.

(c) Direct Dialling In (DDI)

This works in exactly the same way as MSN except that the complete called party number is sent to the called terminal if the Called Party Number option is enabled in the sofware setup menu.

5.5 Windows Terminal Emulation will not move up and down menus.

If using the Windows terminal emulation program in its default configuration the <up> and <down> arrow keys will not function with the menus. This is because Windows uses these keys and does not pass any characters to the K-384. In most cases <up> can be replaced with the 'u' or 'U' key and <down> by the 'd' or 'D' key.

Aletrnatively change the operation of Windows by clicking on the Settings and Terminal Preferences options and then disable the "Use Function, Arrow and Ctrl Keys for Windows" option .

5.6 No comunication with terminal port.

Communication failure can occur for several reasons. Firstly check that the K-384 is powering up properly. The power led (if provided) should illuminate and the correct power up sequence should be observed (see chapter 1). In particular the internal relays should switch on power up and this should be audible.

Next check the cable. The K-384 provides a DCE connection so a cable with a 9 way D male to 9 way D female connected pin for pin will connect the K-384 to a PC.

If the cable is working then check the communication parameters The default is 19200 baud, no parity, 1 stop bit and 8 data bits. If the parameters have changed then during the power up sequence type <ctrl-c> at the keyboard of the terminal (terminal set for default communications parameters) and all the factory defaults should be restored (see chapter 1). Another possibility is that the K-384 is not powering up properly because the network support card installed in the K-384 will not start up and the leds on the front panel may flash. In this case see ssection 5.11.

5.7 Parameters are not being saved on power down.

If parameters are not being saved on power down this can be due to two factors

(a) Software Version Differences

If you are using a Network Emulation Card which has a different software version than the onboard EPROMS then on power up the EPROM software check on the parameter table will fail because the parameter table may be of a different length in the Network Emulation Card software. The EPROM software will reload the default values. Once the Emulation Card Software starts it will go through the same sequence. The only solution to this problem is to upgrade the EPROMS in the K-384 to the same version number as the Network Support Card. This should not be a problem with software version 1.2l or later. Mk1 version of the K-384 require a hardware modification to enable them to use version 1.2l software.

(b) Battery Failure

The default values are maintained by battery backed RAM. If the battery becomes discharged then power up the K-384 for about 12 hours which should recharge the battery.

If this does not rectify the problem then the K-384 should be returned to base for repair.

5.8 K-384 will not work in Transparent Mode.

To enter transparent mode use the NT(LT)/TE/Trans Mode option in the hardware setup screen and set to "Transparent". Now press the <esc> key to return to the power up screen i.e. the copyright screen. This will restart the software.

Check that the network is plugged into interface 2 and the terminal into interface 1.

Check that the K-384 is the only terminal connected to the ISDN line. If it is necessary to connect more than one terminal plug them all into the K-384.

Finally check the power feeding on the S interface. This may need to be switched on.

5.9 Overlap receiving will not work.

Overlap Sending/Receiving is avilable on the K-384 and operates as follows.

(a) Overlap Sending used to dial the call.

Here the calling terminal sends a SETUP message to the K-384 without any Called Party Number information. The K-384 will respond with SETUP ACK and the calling terminal can now dial the call by sending the Called Party Number as digits in INFO messages. Once the K-384 has received enough digits to route the call the K-384 will send SETUP to the called terminal but will not include the Sending Complete information element. If the called terminal responds with CALL PROCEEDING, ALERTING or CONNECT then the K-384 will send CALL PROCEEDING to the calling terminal followed by ALERTING or CONNECT as appropriate. The called terminal does not support overlap receiving in this case. However if the called terminal sends SETUP ACKNOWLEDGE then the K-384 will continue to accept digits in INFO messages from the calling terminal and will pass these to the called terminal. Once the called terminal has received enough digits to route the call internally it will send CALL PROCEEDING, ALERTING or CONNECT to the K-384 and the K-384 will send CALL PROCEEDING to the calling terminal followed by ALERTING or CONNECT as appropriate.

(b) Enbloc dialling used to dial the call

Here the calling terminal sends a SETUP containing the Called Party Number information required to route the call. If the Called Party Number option is enabled in the Software Setup screen then all of the enbloc digits are forwarded to the called terminal. Otherwise only the overlap extension digits (i.e. the full dialled number less the digits used to route the call e.g. 384000 for interface 1) are sent in the Called Party Number information element.

(c) Enbloc Dialling used to dial the call with an incomplete number.

This is a combination of (a) and (b) above. The SETUP message contains some of the Called Party Number information to the K-384. If the Called Party Number option is enabled in the Software Setup screen then all of the enbloc digits are forwarded. If not only the overlap extension digits are forwarded. The terminal responds with SETUP ACKNOWLEDGE. The calling terminal supplies the remaining digits in INFO messages until enough digits are sent to start routing. Operation at the called terminal is the same as before.

However dialling a Called Party Number (i.e base number plus overlap extension digits) ending in '0' will disable overlap receiving at the called terminal and the SETUP message sent by the K-384 to the called terminal will include a Sending Complete information element. The called terminal must respond with CALL PROCEEDING, ALERTING or CONNECT without waiting for more digits from the K-384.

If overlap receiving does not work check the called party number does not end in '0'. To change this reprogram the base number using the Telephone Number Setup Menu or enable DDI/MSN which will provide a range of 10 numbers with the last digit being 'don't care'.

It is also possible to completly disable Overlap Receiving for all numbers by setting the Enable Overlap Sending/Receiving option in the software setup screen to "No". All SETUP messages sent to the called terminal will now have the Sending Complete information element included.

It is worth checking if the terminal (say PABX) requires point-point operation at the K-384 to function in overlap receiving. If so the interface into which the terminal has been plugged requires setting to point-point mode (see 2.2 (d)).

5.10 Changing parameters had no effect on operation of K-384.

Some parameters once changed will not effect the operation of the unit immediatly. If the K-384 does not seem to be operating properly use the <esc> key to go back to the main power up screen i.e. the copyright screen. If this does not work then switch the K-384 off and on again. Please inform Digital Engineering.

5.11 Protocol Analyser will not run.

Firstly check that you have purchased this option. If not you will be able to enter the protocol analyser but no messages will be decoded.

To enter the protocol analyser move to the Activate Analyser field and switch it to Yes. Then press <enter> to start the analyser.

If this does not work then check the analyser option i.e. at least one level of decode must be enabled and the interface to which the terminal is connected must be enabled. If you are not sure set decode for layers 1, 2 and 3 on all interface ports.

5.12 Network support card will not work.

The most likely cause of the network support card not functioning is that the serial number programmed into the card does not match the K-384 on which it is running. Note that the network support cards will run only on the K-384 for which they were purchased.

If the network support card has just been reprogrammed then it is possible that it was not reprogrammed correctly. Try programming the card again.

Chapter 6
ETSI Support Card

This section outlines the differences in operation of the K-384 between the CCITT emulation provided on the standard K-384 and the ETSI support card.

Figure 21 shows the Software Setup Menu when simulating an ETSI network.

```
Software Setup

Drop Layer 2 if No Call Active          xxxx
Drop Layer 1 if Layer 2 Inactive        xxxx
Drop TEI if Layer 1 Inactive            xxxx
Number of Datalinks per Channel         n
Use Service Profile IDs (SPIDs)         xxxx
Allow Overlap Sending/Receiving         xxxx
Numbering System Option                 xxxx
Called Party Number (DDI/MSN)           xxxx
Calling Party Number (CLIP)             xxxx
Connected Party Number (COLP)           xxxx
Called Party Subaddressing (SUB)        xxxx
Calling Party Subaddressing (SUB)       xxxx
Higher Level Compatibility              xxxx
Lower Level Compatibility               xxxx
Advice of Charge (AOC)                  xxxx
```

Fig 21 ETSI Software Setup Menu

Advice of Charge has been added to the menu. The options available are CEPT-incremental, CEPT-total (in codeset 5 and 6) and ETSI AOC-E/AOC-D with units and currency options.

The main differences are:-

The CONNECT message includes the CEPT Advice of Charge information element (if enabled) and the Date/Time information element.

Advice of Charge (ETSI or CEPT option) is supplied in INFO or FACILITY messages during the call.

Date/Time information element does not include seconds.

A subset of the CCITT Bearer Capability information element is allowed in the SETUP message sent to the network. The most notable restrictions are

- u law encoding is not a valid layer 1 protocol
- V.120 rate adaption is not a valid layer 1 protocol

Keypad information element is not supported for sending the called party number.

Chapter 7

BT Support Card

This section outlines the differences in operation of the K-384 between the CCITT emulation provided on the standard K-384 and the ETSI support card.

Figure 22 showa the Software Setup Menu when simulating a BT network.

```
Software Setup

Drop Layer 2 if No Call Active          xxxx
Drop Layer 1 if Layer 2 Inactive        xxxx
Drop TEI if Layer 1 Inactive            xxxx
Number of Datalinks per Channel         n
Use Service Profile IDs (SPIDs)         xxxx
Allow Overlap Sending/Receiving         xxxx
Numbering System Option                 xxxx
Called Party Number                     xxxx
Calling Party Number                    xxxx
Called Party Subaddressing              xxxx
Voice is End-to-End ISDN                xxxx
```

Fig 22 BT Software Setup Menu

Note that the BT network support defines a new parameter in the menu. Switching "Voice is End-to-End ISDN" to "On" changes some of the display messages used by the K-384.

The main differences are :-

In the RELEASE COMPLETE message a cause value of 21 has priority over other cause values wheras in CCITT a cause of 18 has priority.

There are many display messages on the BT network not found in the CCITT specification. The most commonly encountered messages are:-

*03*1#
*86*number string#
*AA*NUMBER UNOBTAINABLE# or *EC*00#
*AA*CLEARED# or *EC*30#
*AA*NETWORK BUSY# or *EC*07#
*AA*NUMBER BUSY# or *EC*08#
*AA*INCOMPATIBLE TERMINAL# or *EC*13#
*AA*ERROR# or *EC*15#
*AA*NO REPLY# or *EC*1f#
*AA*NOT SUITABLE FOR DATA#

A CALL PROCEEDING message in response to an outgoing SETUP message causes ALERTING to be sent to the calling party.

SETUP ACKNOWLEDGE is sent by the network in response to a SETUP message even if the SETUP message contained the complete called party number.

A subset of the CCITT Bearer Capability information element is allowed (see ETSI support card for more details).

The Calling Party Number information element has a maximum length of 15 digits.

Progress Indicator information element location field is always "network beyond interworking type".

Calling Party Number and Called Party Number information element type and plan field are always "unknown".

Chapter 8
VN2/3 Support Card

This section outlines the differences in operation of the K-384 between the CCITT emulation provided on the standard K-384 and the VN2/3 support card.

The main differences are:-

VN2/3 adds a new information element to the SETUP message "Mode de fonctionnement d'usager" in codeset 6. This is mandatory in the SETUP message in both user->network and network->user directions.

In the user->network SETUP message the Higher Layer Compatibility information element is mandatory.

The Sending Complete information element is not supported in VN3.

A subset of the CCITT Bearer Capability information element is allowed in the SETUP message sent to the network. The most notable restrictions are

Coding Standard is fixed at CCITT
Information Transfer Capability is Speech, 3.1 kHz Audio or Unrestricted Digital
Information Transfer Rate is 64k only
Layer 1 protocol is G.711 A law or H.221/H.242 (G.722/G.725)

A new information element "Facility d'usager a usager" in codeset 6 is defined. The K-384 analyser decodes this although the K-384 does not generate it.

Octet 3a (Recommendation) is not supported in the Cause information element.

Keypad information element is not supported.

Chapter 9

1TR6 Support Card

This section outlines the differences in operation of the K-384 between the CCITT emulation provided on the standard K-384 and the 1TR6 support card.

Figure 23 shows the Software Setup Menu when simulating a 1TR6 network.

```
Software Setup

Drop Layer 2 if No Call Active          xxxx
Drop Layer 1 if Layer 2 Inactive        xxxx
Drop TEI if Layer 1 Inactive            xxxx
Number of Datalinks per Channel         n
Use Service Profile IDs (SPIDs)         xxxx
Allow Overlap Sending/Receiving         xxxx
Numbering System Option                 xxxx
Call Waiting                            xxxx
Billing                                 xxxx
Additional Transmission Attributes      xxxx
Called User Status                      xxxx
Date/Time                               xxxx
```

Fig 23 1TR6 Software Setup Menu

The German 1TR6 network is very different to Q.931 based networks networks such as ETSI. To understand all of the differences then refer to the 1TR6 specification. The K-384 does not support all of the differences provided by 1TR6 but the following notes outline the main differences between the standard network and 1TR6.

1TR6 does not use the normal Q.931 protocol descriminator (i.e. =8) but defines two new ones N0 (=1) and N1 (=65). Some messages are valid only with N0 and some only with N1.

The following Q.931 messages are not supported:-

PROGRESS, RESTART, RESTART ACKNOWLEDGE

The following N0 messages are additional to Q.931:-

REGISTER INDICATION, CANCEL INDICATION, FACILITY STATUS, STATUS ACKNOWLEDGE, STATUS REJECT, FACILITY INFORMATION, INFORMATION ACKNOWLEDGE, INFORMATION REJECT, CLOSE, CLOSE ACKNOWLEDGE.

None of these messages are supported by the K-384

The following N1 messages are additional to Q.931

DETACH, CANCEL ACKNOWLEDGE, CANCEL REJECT, FACILITY ACKNOWLEDGE, FACILITY CANCEL, FACILITY REGISTER, FACILITY REJECT, REGISTER ACKNOWLEDGE,

REGISTER REJECT.

None of these messages are supported by the K-384.

The following messages (supported by the K-384) are common to 1TR6 and Q.931 but their numeric value is different.

INFORMATION (1TR6 =0x6d)
STATUS (1TR6 =0x63)

1TR6 also defines additional information elements not found in Q.931. These are mostly found in codeset 6:-

Service Indicator, Charging Information, Date, Facility Select, Status of Facilities, Status of Called User, Additional Transmission Attributes.

The only non-Q.931 message in codeset 0 is Connected Address.

The following Q.931 information elements are not supported in 1TR6:-

Segmented Message, Bearer Capability, Call State, Facility, Progress Indicator, Notification Indicator, Date/Time, Signal, Switchhook, Feature Activation, Feature Indication, Calling Party Subaddress, Called Party Subaddress, Transit Network Selection, Restart Indicator, Low Layer Compatibility, High Layer Compatibility.

Where information elements are supported by both Q.931 and 1TR6 they may have a defferent structure e.g. the Cause information element supports different cause values in 1TR6 and Q.931.

Because the Bearer Capability information element is not supported 1TR6 uses the Service Indicator information element in its place.

The 1TR6 Date information element is mandatory in the CONNECT, CONNECT ACKNOWLEDGE, DISCONNECT, and RELEASE messages from the K-384

The 1TR6 Called User Status information element is mandatory in the ALERT message from the K-384.

The following information elements are used by the K-384 and can be enabled in the Software Setup menu as shown in Figure 23:-

Charging Information
Additional Transmission Attributes
Called User Status
Date

The K-384 also allows the generation of a call waiting SETUP message.

Chapter 10

DMS100/NAT-1/5ESS Support Card

This section outlines the differences in operation of the K-384 between the CCITT emulation provided on the standard K-384 and the USA support card.

The USA support card covers three switch varaints found in the USA i.e. Bellcore NAT-1, Nortel DMS100 and AT&T 5ESS.

(a) National ISDN-1

National ISDN-1 (NAT-1) defines four new ISDN messages not found in Q.931. These are network specific messages (i.e. two octet) and are :-

KEY HOLD, KEY RELEASE, KEY SETUP, KEY SETUP ACKNOWLEDGE

These are not used in the K-384.

NAT-1 does not include the following Q.931 messages

USER INFORMATION, RESTART, RESTART ACKNOWLEDGE, SEGMENT, CONGESTION CONTROL, FACILITY

NAT-1 defines new information elements in codeset 0. These are:-

Information Request, Service Profile Identification, Endpoint Identifier, Information Rate, End to End Transit Delay, Transit Delay Selection and Identification, Packet Layer Binary Parameters, Packet Layer Window Size, Packet Size, Closed User Group, Reverse Charging Information, Redirection Number.

The K-384 supports Service Profile Identification and Endpoint Identifier information elements.

NAT-1 does not support the following Q.931 information elements:-

Segmented Message, Call Identity, Facility, Network Specific Faclities, Display, Date/Time, Switchhook, Restart Indicator, Sending Complete

NAT-1 offers the following information elements in codeset 5:-

Operator System Access, Display Text

NAT-1 offers the following information elements in codeset 6:-

Redirection Subaddress, Redirection Number, Call Apearance.

In NAT-1 the signal information element is mandatory in the following network->user messages:-

ALERTING, RELEASE, CONNECT ACKNOWLEDGE, RELEASE, RELEASE COMPLETE, CALL PROCEEDING, SETUP ACKNOWLEDGE, DISCONNECT, SETUP, CONNECT.

A subset of the CCITT Bearer Capability information element is allowed in the SETUP message sent to the network. The most notable restrictions are

information transfer capability is speech, unrestricted, 3.1kHz audio
transfer mode and rate is 64k, Packet mode
layer 1 protocol is rate adapted, u-law
rate is 56k
layer 2 protocol is LAPD, LAPB
layer 3 protocol is X.25

(b) Nortel DMS100
(c) AT&T 5ESS

Appendix 1

Application Notes

A.1 Using K-384s Back to Back