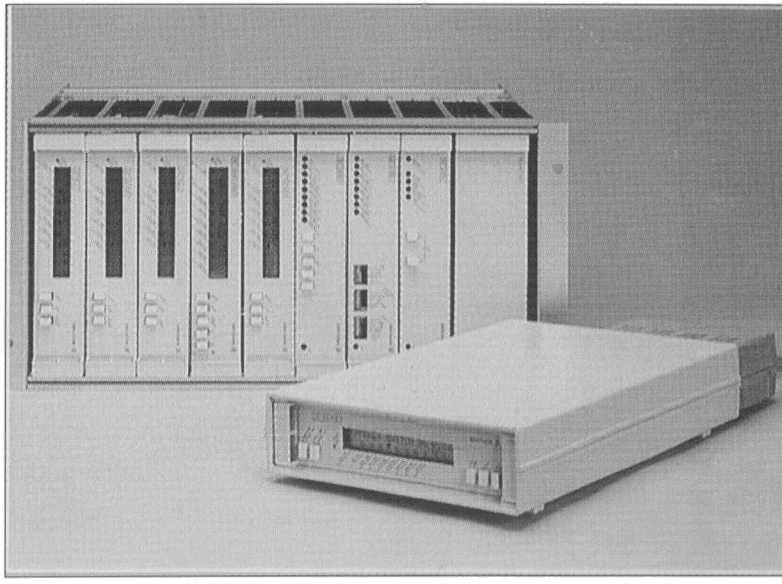
Modem ZAT 19.2/19.2-7
Modem ZAT 14.4/14.4-7

19 200 and 14 400 bits per second



Operation Manual

ERICSSON

User manual R. state	LZTR104006 R1.00
Date:	1994-09-01
Firmware version	R09.093

This is an operation manual for Zat 14.4/14-4-7 and Zat 19.2/19.2-7

All references to 19200 bit/s, 16800 bit/s or V.32 terbo are for 19.2/19.2-7 only.

It shall be kept in mind that the modems are subject to government regulations. Different regulations apply depending on where you purchased your modem and the country or countries where you will be using it.

Information about which country the modem is approved in shall normally be attached with the modem. For further information it is recommended to consult your dealer.

The default settings indicated in this manual must be considered as a guidance.

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1.1 The Modem

The modems support full duplex asynchronous and synchronous data transmission over switched or leased line connections.

Control and configuration of the modem can be carried out either by commands from DTE (AT or V.25 bis commands) or by menu guided front panel operation using a 24 character *2 lines LCD display and push-button control.

The modems can be used for data transmission according to the following recommendations:

Modem				
14.4/ 14.4-7	19.2/ 19.2-7	Standard	Speed	Comments
	*	ITU-T V.32 bis	19200 bit/s	Synchronous/asynchronous Full duplex with Trellis coded modulation.
*	*	ITU-T V.32 bis	14400 bit/s 9600 bit/s 7200 bit/s	Synchronous/asynchronous Full duplex with Trellis coded modulation.
*	*	ITU-T V.32	9600 bit/s	Synchronous/asynchronous Full duplex with Trellis coded modulation.
*	*	ITU-T V.32	9600 or 4800 bit/s	Synchronous/Asynchronous Full duplex
*	*	ITU-T V.22 bis	2400 or 1200 bit/s	Synchronous/Asynchronous Full duplex
*	*	ITU-T V.22	1200 or 600 bit/s	Synchronous/Asynchronous Full duplex
*	*	ITU-T V.21	0-300 bit/s	Asynchronous Full duplex
*	*	ITU-T V.23	75/1200 or 1200/75	Asynchronous Full duplex with backchannel
*	*	Bell 212A	1200 bit/s	Synchronous/Asynchronous Full duplex
*	*	Bell 103	0-300 bit/s	Asynchronous Full duplex
	*	V.32 terbo	16800 -19200 bit/s	Synchronous/Asynchronous Full duplex with Trellis Coded modulation

1.2 Feature

- Automatic operation from a data terminal (DTE) by means of US industry standard AT or ITU-T V.25 bis command sets.
- Automatic operation from a synchronous DTE using ITU-T V.25 bis command set.
- Emulation of Hayes standard AT and AT& commands, Microcom AT\ and AT% commands together with SEMAFOR AT+ commands.
- Loudspeaker for monitoring signals on telephone line.
- Communication with DTE according to V.24/V.28 (RS232C) with selectable speed and data format for full flexibility.
- Automatic speed detection towards remote modem ranging over all the standards V.21, V.23, V.22, V.22 bis, V.23, V.32, V.32 bis and V.32 turbo[1] and speeds 300, 75/1200, 1200, 2400, 4800, 7200, 9600, 12000 14400 and 19200
- Speed and format conversion with flexible flow control.
- Optimal detection /bypass of voice calls in autoanswer mode.
- Error free data transfer according to ITU-T V.42, and compatible with V.42 and MNP modems (MNP level 2, 3, 4).
- V.42 and MNP data compression according to ITU-T V.42 bis and MNP
- Auto detection between different protocols and compression schemes (See the \N command).
- V. 42 encryption using the DES CBC algorithm (may also run the V.42 bis data compression).
- Remote configuration by full AT command support over telephone line also error control mode. The function can be password protected/ disabled.
- Access security system based on password check /dialback.
- Full support for all ITU-T defined loops also with selftest.
- Continuous check of line quality by Eye Quality Monitor value readout.
- Rack mountable for 10 units with common power supply.

1.3 Organisation of this manual

1. Modem functions, exterior and connections.
2. An introduction to use of the modem.
3. Description of all AT-commands.
4. Description of all S-registers.
5. Manual use of the modem.
   - Dip switches and strapping.
   - Switches and indicators at the front fascia.
   - Manual asynchronous/synchronous configuration.
   - Manual mode, loading stored userprofile.
   - Set-up of manual auto-answer
   - Manual connection using the front switches.
   - Connect with 108.1 control
   - Manual set-up of leased line
   - Manual use of testloop.
6. Password and dialback function.
7. Encryption
8. Flow control and buffering.
9. Protocols and compression schemes.
10. Commands for configuration of synchronous operation.
11. Leased line
12. Advanced functions.
    - Bypass of voice calls in autoanswer
    - Automatic/manual connection
    - Connections from Inmarsat satellite terminal
    - Transfer of messages to person pagers
    - Remote commands
13. Fallback/fallforward and automatic retrain
14. Description of loop tests.
15. Technical description with V.24 cable connection and a technical survey of the modem standards in use.
16. Appendices

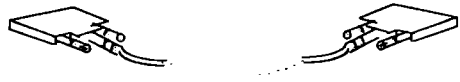
    Data Communication, AT-Commands and S-registers, Glossary, Character mapping and Set-up of line parameters

1.4 Connection to DTE and telephone line/set

The modem is connected to the telephone set and the line through a standard connector.

1.4.1 Connection to DTE

The computer/terminal is connected to the modem by a standard modem cable.
Recommendation V.24/V.28



1. Insert the 25-pin plug at the back of your modem. (Marked DTE V.24/V.25)
2. Tighten the mounting screw on each side of the connector shell so that it is securely attached to your modem.
3. The other end of the cable is connected to the serial port on the data terminal or the desired communication port on the computer.

If your equipment has more than one serial port, you must make the right selection.

1.4.2 Connecting the modem to telephone line

Lead 1.

Where one end, with the minicontact of the modular phone cable fits into the jack marked **LINE** in the modem, while the other end fits into the wall plug.

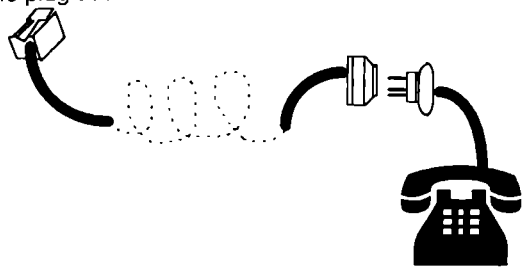
1.4.3 Connecting a telephone to your modem

Lead 2

With miniplug at either end is connected the tastaphone and the jack indicated **PHONE** on the modem.

1.4.4 Older type telephone

Use a transfer lead with miniplug at one end and a three pole telephone plug at the other.



The lead from the telephone apparatus is connected to the three-pole contact on the transfer lead. Set the minicontact in the jack, marked **PHONE** on the modem.

The modem is coupled to the telephone line with the aid of an apparatus lead designed for Tastaphone 1. Place the miniplug in the minicontact indicated **LINE** on the modem. The three-pole plug on the other end of this lead placed in the wall contact.

1.4.5 Powering your modem

An AC adapter is used to power the modem. The adapter connects to the modem in the jack marked 16V AC.

1.4.6 Unipax

Connection to Unipax products is made using a cable with a 6 pole plug/2 miniplugs marked T and L (T to the Telephone and L for the Line to the modem).

1.5 Checking that everything is OK

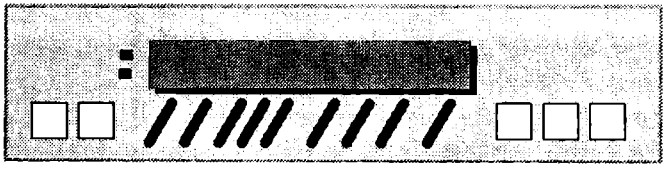
Check that you have all the required parts. See that cables are correctly connected and firmly in position.

The modem should NOT be placed near a stove or heater nor in direct sunlight. The electronic components may be damaged if exposed to extreme temperatures.

Thundery weather is particularly dangerous. Powerful surges can occur over the telephone network or through the power supply. The best protection is obtained by disconnecting the modem under such circumstances. An alternative is to connect the modem to an apparatus designed to hinder such surges in the telephone and modem cables as well as in the mains supply.

1.6 The Front Panel

The figure below shows the front panel of the modem with 2*24 character LCD display for status readout/ menu guide and switches for operation/configuration



☞*Read «Switches at front panel» chapter 5, for further description.*

1.7 Modem configuration

The modem has a wide range of operating modes selectable both by internal hardware jumpers (see chapter 5) and by commands (see chapter 3) and S-registers (see chapter 4).

2.1 Connecting the power supply

The modem is powered by an internal power supply. Connect the lead to a wall outlet and turn the unit on by setting the power switch, on the rear of the modem, to ON.

The following message will apear on the display

If everything is OK, this message will occur.

POWER UP MODE {MESSAGE}
COMMAND: SW 96 ASYNC □ □ □ □ □ □ □ □ MENU

2.2 Selection of operating mode

Setup and control of the modem can be carried out in three different ways:

- By commands from an asynchronous DTE connected to the V.24/V.28 interface
- By V.25 bis commands from a synchronous terminal/port using a standard V.24/V.28 interface.
- By remote commands entered over modem connection from remote modem/DTE
- From display/switches on the front.

Selection of method will depend on type of connected DTE and the habits of the operator.

Communication programs for mainframes, minis, workstations or PCs will normally base their operation of the modem on AT commands.

If synchronous data transfer shall be used, it will often be most practical to use front panel operation for configuration of the modem. Using an asynchronous terminal or PC with communication program, the modem can be configured from this and setup can be stored in the modem before connection to the synchronous equipment. For synchronous operation it is recommended to configure the modem for "DUMB" mode (modem will not accept any commands). Synchronous equipment will normally send data continuously and in some phases this may mislead the modem to try interpreting the synchronous data as commands. Chapter 5 and 10 is describing manual use and synchronous connection.

It is possible for your modem to receive synchronous (SDLC) V. 25 bis command in synchronous mode.

The modem is intended both for switched and leased line operation. Chapter 11 is describing leased line operation.

> *The modem is powered by power supply (16 V AC). Read more about power supply in chapter 5 strapping field 4, or chapter 14 «Technical data».*

2.3 Connection to an electronic bulletin board

As the final point in preparation and testing of the modem, we advise that you call an established bulletin board. In Norway, users may call Semaforum in Arendal/Norway. This is an electronic bulletin board located at the offices of the development team of the product, and is specially oriented to modem users. Here, you can obtain information concerning the modem, the latest news regarding modems and an opportunity to download various data programs. All users have entry to the data base. If you have any enquiries or comments (for example in connection with use of this modem), you may enter these into the database.

2.3.1 Connection can be carried out by three means:

1. **Manually**. Dial the telephone number in the normal manner and press the **CALL** menu selection switch to achieve contact.
2. **Semi-automatically**. This is done by entering the commands from the keyboard on your computer or terminal.
3. **Fully-automatically.** Controlled by your own data communications program, for example by selecting a telephone number from a list.

The procedure may appear a little complicated when carrying this out for the very first time. As soon as you set the modem to suit your equipment, the main task is done and the modem will be found simple to operate.

2.3.2 Setting the terminal

If you have a standard data terminal, this must be set up for data communication. The following settings must be made:

- speed 9600 bps (or 19200 bps)
- character format: 8 bits, no parity, one stop bit
- Output to the serial port to which the modem is connected
- full duplex
- Asynchronous communication

Some terminals contain the option of selecting various terminal types. It may be difficult to select that type which is best suited to Semaforum BBS. The best procedure is to set the terminal as a «standard ANSI terminal». Should this selection not be given on your equipment, you can set it to «TTY». This signifies that the terminal will function as a non-screen-based terminal (non-CRT).

2.3.3 Setting the communications program

If you use a communications program, this should be set as follows:

- Use the communications port normally used to connect the modem (normally COM 1)
- Transfer speed 9600 or 19200 bps
- Character format: 8 bits, no parity, one stop bit
- Full duplex
- Asynchronous communication

Most programs will contain a large range of alternative parameters and the terminology is not particularly standard. The next example therefore uses the semi-automatic method.

Finally, set the program in on-line status (in data phase with the modem).

2.3.4 Controlling the modem

The modem may be in either command status or modem status.

When the modem is in command status, this means that it is ready to receive commands from your keyboard. When it is in modem status, it is connected to the telephone line and all data from the terminal is transmitted over the telephone network to a remote modem.

When the power supply is switched on, the modem will always initially be in the command status. This should be the situation at the present moment.

Enter AT on the keyboard followed by <Return>. The characters «AT» should now appear on the screen. This is an «echo» from the modem, an acknowledgement that contact has been made. On the next line the modem will now give the message OK. This signifies that it is now ready to receive further commands.

☞ *If this does not occur, turn to the section «Trouble-shooting» and read the section «Modem dead». When you have found the problem - and solved it, return to this point.*

2.3.5 The Front panel - display and switches

The display and the five switches on the front of the modem are used for setting up and operating the modem as well as for monitoring the modem status at any time.

- The display contains various text messages and menus
- The lower line of the display will in idle mode and under data transfer indicate the following V.24 signals:

V.24 Signal	Description	FROM		TO
142 (TST)	Carrier detect	DCE	→	DTE
109 (CD)	Indicates test active	DCE	→	DTE
104 (RXD)	Received data	DCE	→	DTE
105 (RTS)	Request to send	DCE	→	DTE
106 (CTS)	Clear to send	DCE	→	DTE
103 (TxD)	Transmitted data	DCE	→	DTE
108 (DTR)	Terminal ready/ Connect to line	DCE	→	DTE
107 (DSR)	Dataset ready (Modem ready)	DCE	→	DTE
125(RI)	Ring indicator	DCE	→	DTE

2.3.6 Status messages

In the above example you received a status message form the modem. You entered AT, and the modem responded with ***OK*** on the screen. ***OK*** is a status message, also called a «Result Code».

In the event of calling Semaforum BBS, you will receive a message from the modem as soon as the connection is made. The message:

CONNECT 14400
signifies that the contact was made with a transmission rate of 14400 bps.
or
CONNECT 19200
signifies that the contact was made with a transmission rate of 19200 bps.

2.3.7 The loudspeaker

The modem has a loudspeaker which may be used to listen to what is happening when we call. The manufacturer's volume setting is «low».

Let us go through the stages of what happens when you make your first attempt, and which we are now prepared to do. (The following illustrates an example of a person in Norway calling Semaforum BBS. The procedure will be very similar in your own country).

When you dial Semaforum BBS, the first thing you hear is that the modem lifts the receiver. After a second or so you will hear the dialling tone. Thereafter you will hear the number being dialled, - irregular tones with tone signals or clicking with impulse connections.

The dialling tone ceases the moment the modem commences to send the number and you will now hear a new signal. This is a special call-up tone (1300 Hz) which is used to inform the modem at Semaforum that this will be a data transmission. In addition you may hear other background noises. These occur when the telephone line is being routed to the number you dialled.

When the line is connected, you will hear the telephone calling at the remote apparatus. Let us assume that you don't get the busy signal and that the modem at Semaforum BBS is connected up to the line. You will now hear a high-level peeping lasting about 3 seconds. This is the answer tone from the bulletin board modem. This is followed by a new tone, the remote modem's carrier wave.

Your modem will now sense its carrier wave . The connection will now be established. It sounds as though the transmission tone has been stifled. The status message ***CONNECT*** appears on the screen.

The modem is now in modem status. Everything now entered at the keyboard will be transmitted to Semaforum BBS.

This will be the situation, in a little while. But first, some small tasks are required to be carried out.

2.4 Getting started

The modem is operated from a data terminal (DTE) using one of the following command sets:

- AT (ATtention) command set.
- ITU-T V.25 bis command set.

2.4.1 AT- Modem init string

The modem initialisation string is sent to the modem every time you begin. The string may vary among different types of modems. The default, configured for Hayes compatible modem is AT, a command line prefix

2.4.2 ITU-T V.25 bis

A command standard set by the ITU-T (Comit, Consultatif International Télégraphique).The V.25 bis commands are only used in connection with the dialling procedure. The modem must be configured by means of AT commands.

2.5 Main Modes

The modem will always be in one of the two main states:

COMMAND MODE (ACCEPTS COMMANDS FROM DTE)	MODEM MODE (CONNECTED TO LINE)
• Modem ready to receive commands. • All data from DTE will be interpreted as commands.	• Modem connected to another modem, and all data from DTE is sent on the line to the remote modem.
Shift to DATA MODE: AT:	**Return to COMMAND MODE AT:**
ATDn[ENTER] Calls number n. **ATA**[ENTER] Modem answers. **ATO**[ENTER] Modem retrieves previous connection. • Autoanswer upon detection of ringing signal.	• By using escape-sequence (normally +++) • When DTE disconnects by turning DTR OFF. • Through loss of connection • Data inactivity.
ITU-T V.25 bis:	**ITU-T V.25 bis:**
CRNnL_F Calls number n **CIC** L_F Accept Incoming Call • Autoanswer upon detection of ringing signal.	• When DTR is turned OFF • Through loss of connection. • Data inactivity.

2.6 How to Dial a Number

2.6.1 AT

Use the D-command to dial a number.
The D-command has the format Dn, in which n is a character string of up to 80 characters (the length of the command buffer)

Examples using the AT command set:
When connected to a public exchange

ATDT4737011710 ENTER

D	«Dial number» command
T	Touch Tone Dial
4737011710:	Required number

Connected to a private exchange

ATDT0W4737011710 ENTER

D:	«Dial number» command
T:	Touch Tone Dial
W:	Wait for trunk line (second dial tone)
4737011710:	Required number

2.6.2 ITU-T V.25 bis

Use the CRN-command to dial a number.
The CRN-command has the format CRN n, in which n is the required number.

Examples using ITU-T V.25 bis command set:

CRN4737011710L_F

Dial number 4737011710

CRN0:4737011710L_F

0	is trunk prefix
	Wait for trunk line (second dial tone)
4737011710	Required number

2.7 Connection Established

The modem should now ring the required number. You will hear this in the loudspeaker. The remote receiver is now «lifted». You hear the peeping and that the modem connects. The status message ***CONNECT 9600*** or ***CONNECT 19200***[1] appears on the screen and you are now ready to commence dialogue with Semaforum BBS. The modems have a connection for data transmission at a speed of 9600 or 19200[1] bps

If the modem after receiving the D-command, A-command, O-command or after autoanswer, establishes a connection with a remote modem, a message is sent back to the DTE to confirm this.

Did you receive any alphabetic characters from the remote modem on your screen? Are you now ready to conduct a dialogue with Semaforum BBS?

In this case everything appears fine. You can read the next section and consider the test lesson satisfactorily concluded.

Should everything not be in order, then you may be able to solve the problem by consulting the section «Trouble-shooting».

2.8 Concluding the connection

Everything went well. You made connection with Semaforum BBS and now want to finish the communications session. The simplest way to do this is to press the **CALL** or **ANSW**-switch on the front of the modem.

2.9 Store Telephone Number

The number(s) can be stored by means of the AT or V.25 bis command set.

2.9.1 AT - examples

AT&ZT0W4737011710ENTER

or

AT&Zn=T0W4737011710ENTER

&Z: Stores telephone number in pos. 0
&Zn Stores telephone number in pos. **n**, where n=0-19
T: Tone dial
0: Trunk prefix
W: Wait for trunk line
4737011710: Required number

2.9.2 ITU-T V.25 bis - examples

Format: **PRNxx;yy..yy** **xx=1-20**

PRN12;4737011710L_F

Stores required number 4737011710 in position 12.

2.10 Dial Stored Number

2.10.1 AT - examples

Using **D**-command, followed by the dial modifier S, to dial stored number. (See **D**- command)

ATDSENTER

or:

ATDS=nENTER

DS Dial stored number in pos. 0.
or:
DS=n Dial stored number in pos. **n**, where n=0-19

2.10.2 ITU-T V.25 bis -examples

Using ITU-T V.25 bis command set CRSxx. xx, the modem dials the number stored in position xx .

CRS12L_F

The modem dials the number stored in position 12.

2.11 Troubleshooting

2.11.1 The modem is dead!

♦ **You entered AT[ENTER].**

It gives neither **AT** command nor **OK** on next line.

- Check that the leads and cables are correctly connected.
- Check the power supply (does the PWR (Test) indicator lights?)
- The modem has been used/tested by other persons and reset such it gives neither echo nor reply.
- When the modem was dispatched from the manufacturer, it was set such as to give both echo and reply in full text. The trick here is to reset the modem exactly as it was when you took delivery.

The modem should now reply OK. If not, repeat this command a couple of times just to be sure, before commencing with the following controls.

- The terminal/communication program may be incorrectly set and is not online with the modem. (For example, the modem may be connected to port 2, but you have defined port 1 in the program). Check this.

There are so many different types of terminals that it is impossible to give a comprehensive summary of all factors to be controlled in every single case. There remains just one thing to do: study the users guide carefully for advice on possible erroneous program settings.

☞ *You will discover that there is a setting designated «echo» (this is often referred to as «half duplex»). By setting this to the ON position, you obtain a «confirmation» of your AT commands on the screen. However, this is not an echo from the modem. When everything is in order and the apparatus is set to echo, the modem will reply with «AATT» followed by OK.*

- The equipment has an active communication port which conflicts with that of the modem (as for example for use with a mouse). This must be rectified.
- Some terminals require that the carrier wave is functioning prior to being able to communicate with the modem. If this is the occasion with your terminal, then this must be reset in order that the above tests can be carried out.
- There is a physical failure in a cable, the modem or the computer's communication port etc. (Assume that this is not the case until otherwise confirmed).

It can be something of a task to find out exactly what lies behind a physical or mechanical error in the system. The main rule is to attempt to eliminate possible sources of failure one by one, assuming you have the possibility to do this. For example:

- Substitute the cable with one you know to be in order. Alternatively try out the cable on a system you know to be in order. Then try again.
    - If this does not help, then replace the modem with one you know to be in order. Is this now functioning Ok, next step, and so on.

2.11.2 Modem replies with INV

♦ Modem replies with INV when you make a L_F after carriage return

The Modem is in ITU-T V.25 bis command status.

Enter SATL_F

to set the modem over to HAYES command status.

2.11.3 The modem replies ERROR

♦ The modem replies ERROR and awaits a further command

You entered a wrong command. Try again.

2.11.4 No dialling tone.

♦ The modem gives a *NO DIAL TONE* message, disconnects the line and awaits the next command.

You previously tested the connection between the modem and the telephone network by lifting the receiver and obtained the dialling tone. There is now clearly something wrong with the connection between the modem and the network. If you do not hear the dialling tone through the loudspeaker, there may be something wrong with the telephone network itself (overloaded possibly). It may be that the telephone lead on the rear of the modem has been reversed.

♦ You hear the dialling tone in the loudspeaker but the modem had not responded to this and gives the message NO DIALTONE.

This may occur with certain local switchboards.
⇒Give the command

ATX3[ENTER]

prior to calling, set commas «,» in the call command where a pause in the procedure is required.

This will result in the modem waiting for a specific number of seconds as specified in the S6 register before the first digit is dialled.

For example:

ATD0,,,4737011710[ENTER]

In this example (with X3) the modem will pause several seconds as determined by the S6 register (standard 2 seconds) before dialling the first digit. This is to say that the dialling tone is not registered by the modem but is assumed to be present. The manufacturers setting is 2 seconds per comma. (This may be increased by changing the contents of the S8 register. The maximum value is 255 seconds per comma).

Read more about the S-registers further on in this book if so required.

In this command, the modem lifts the receiver, waits 2 seconds and then dials 0 to obtain the town line. It then waits 6 seconds before commencing to dial the number to Semaforum BBS.

2.11.5 You obtain the dialling tone and the modem dials the number

♦ **The number is dialled but nothing happens.**

The switchboard is possibly not able to accept tone signals.

Try pulse signals.

If the modem does not pause long enough prior to commencing to dial, you may place commas in as required (see above). Repeat trying until you encounter the required number of commas to obtain the desired result.

♦ **The modem advises BUSY and the attempted connection is interrupted.**

The line is engaged.
Wait and try again later.

♦ **Somebody replies when the phone rings.**

You have probably forgotten to set the modem to X-impulse mode. This may be necessary in certain telephone districts (such as Oslo/Norway). Interrupt the contact, correct the modem status and retry.

♦ **The telephone continues to ring. The modem advises NO CARRIER and breaks off the connection.**

The remote modem is either faulty or disconnected. (We assume that you have dialled the correct number!!)

♦ **The remote modem reacts but nothing further happens.**

The modem does not respond to the 2100 Hz reply signal (a high frequency tone lasting 3 seconds). This is necessary in order that the remote modem may then commence to transmit on the carrier wave. Try again. Possibly the remote modem is not in order.

♦ **The remote modem responds and returns a tone, but disconnects before the connection is completed. The modem advises NO CARRIER, disconnects and awaits further commands.**

The modem waits up to 50 seconds on the carrier wave. If you consider this too short, you may adjust the modem setting to 60 seconds. This is done with the following command:

ATS7=60ENTER

If the modem is set to automatic transmission rate detection (manufacturers setting OFF), it is possible If the modem is set-up with automatic speed detection, you may come into contact with Semaforum at another rate than intended. Check that the automatic rate detection is OFF (In certain cases it can be appropriate to switch off the 1300 Hz connecting tone since some modems interpret this as the carrier wave in V.23 standard and reduce the rate to this level).

Semaforum's PC may of course be out of operation although the remote modem is functioning normally. You obtain the CONNECT message, but all further attempts to come into contact with the bulletin board are unsuccessful.

♦ **The calling up procedure is interrupted for no apparent reason**

The modem received a signal from the keyboard before the connection was completed. You may, for example, accidentally come into contact with a key while the calling up was in process.

The modem gives the OK or the NO CARRIER message, disconnects the line and awaits the next command.

☞ *You may deliberately use this procedure to interrupt the calling procedure. Just press any key and the operation will cease.*

2.11.6 Problems after the connection is made

♦ **You have hieroglyphics on the screen**

The modem has succeeded in the connection to Semaforum BBS, but you receive unreadable hieroglyphics on the screen.

Possible reasons:

- Poor line quality

You have certainly experienced this on the normal telephone. Another conversation barges in and interrupts your own conversation. If you are calling over a satellite connection, you may well experience echo and general interference.

If you have come in on a bad line, then break off and try again. The transmission route between yourself and the remote modem rarely follows the same route twice. A new attempt may well produce a better connection. Another alternative is to reduce the transmission speed, at which rate the modem is much less sensitive to interference on the line.

Sometimes it is just not possible to achieve such a satisfactory connection that data transfer is at all possible. Fortunately this is a rare occurrence within national boundaries.

♦ Communication standard

The modem/communication program assumes another standard than that which you have used. If the results obtained with 8 bits, and no parity are worthless, then try with 7 bits, parity and one stop bit.

Note that if you call at a transmission rate of 300 bps then the other modem must also be operating at the same rate. If you use ITU-T communication standards and the other modem uses Bell standard, then it will be impossible to obtain the ***CONNECT*** message. It can happen, however, that a successful connection between ITU-T and Bell may be achieved at the 1200 bps rate.

♦ Program

Occasionally the system at the remote modem uses special techniques for representation of sound and picture. IBM-compatible PCs frequently use, for example, ANSI Escape codes. If your machine is not set up to be able to receive these, the result will be gibberish on the screen.

2.11.7 Possible errors not attributable to the modem

If you wish to download programs or compressed data files from Semaforum BBS, you must have a communication program that makes this possible. Keywords in this case: Transmission protocols with names such as XMODEM or KERMIT.

The transfer is completely controlled by the program and failure to download is rarely, if ever, the fault of the modem.

2.11.8 Reporting failures in the modem

If your attempt to connect with Semaforum BBS have been entirely in vain - in spite of all our advice and assistance, then you should report the matter to your dealer. Please give a detailed and precise description of the problem, preferably written.

♦ **Which error arose**

Description

- The nature of the problem (error message on the screen, the transmission tone failed after x seconds, etc.)
- The telephone number you attempted to call
- The settings on the modem at the time (together with any changes in the straps, the active configuration employed, commands entered).
- The type of telephone apparatus you use. Do you go via a local switchboard, INMARSAT, etc.?
- The communication program you used.

2.11.9 Adjusting the modem to personal requirements

Certain communication programs are capable of sending the DTR OFF signal to the modem. This may be employed to simplify the closure of transmissions. The modem is not initially set to respond to this signal.

☞ *Further details are given under the section on &D commands.*

♦ **Initialisation string**

Users of communication programs will frequently encounter references to the initialisation string. This is a string of commands which are sent to the modem prior to the call being made.

The standard solution for users of the PROCOMM program is the following initialisation string:

ATE0S7=60S11=70S0=0V1X1 

For users of the modem this signifies:

E0
No echo to be made of the entered commands on the screen

S7=60
This instructs the modem to wait 60 seconds on the carrying wave. (The manufacturers setting is 50 seconds).

S11=70
The modem will use less time to call the number when tone signals are employed. The modem may however have a lower value than 70. Therefore always use S11=70. Note that certain switchboards are not able to accept signals sent at this rate. It is safer to use the manufacturers setting.

S0=0
The modem shall not reply when someone calls in. (This command is superfluous in that the modem has this as the default setting).

V1
This selects the full message code (as for example CONNECT 9600). This is also superfluous for the modem which has this as the manufacturers setting.

X1
The modem sends the messages CONNECT or CONNECT 9600. It will not detect the dialling tone or the busy signal. (The manufacturers setting is X4).
Read more about X4 under the section on AT «General commands».

2.11.10 Maintenance and repairs

The modem is maintenance free. However, you should keep the apparatus dust free.

Parts should only be changed by authorised dealers.

Notes:

3.1 What is a «Hayes? command»

«Hayes® Smartmodem» from Hayes® Microcomputer Products, Inc. in the USA was one of the first modems that could be controlled with the aid of simple commands from the terminal keyboard. These commands were simple in use and modems rapidly became popular.

Competitors adopted this principle and soon a new industrial standard was established. Today, all serious modem manufacturers offer modems employing «Hayes® standard».

Hayes® commands are characterised by the fact that they begin with the alphabetic characters AT, an abbreviation for the word «attention». These are followed by one or several codes which prompt the modem to give automatic reply, dial automatically, close the connection and much more.

Today's Hayes® standard comprises a few of the basic features of the early commands. These have been supplemented with a wide range of commands which are specific for a particular product and its technical complexity.

Commands in this book which are Hayes® standard commence with: **AT** or **AT&.**

Commands which are not Hayes® standard commence with: **AT**, **AT%**, **AT+**, **AT+&**, **AT+** or **AT+%**.

For all commands, except the A/ and +++ commands the "Cr" (Carriage Return) signifies the end of the command line.
"Cr" is marked [ENTER] in this book

Example:

Entering:	&F"Cr"
The modem answers:	"Cr""Lf"OK"Cr""Lf"

The Zat 14.4/14.4-7 and Zat 19.2/19.2-7 are compatible with the ANSI/TIA/EIA-602-1992 AT command standard.

3.2 AT Command Line Prefix (ATtention code)

Every command line must begin with **AT** or **at**. («At» or «aT» is not a legal command line prefix.)
The command line prefix (**AT**tention code) is a signal to the modem that one or several commands will follow.

The modem examines this command line prefix to determine the communication rate and parity settings of the local DTE.

As part of the description of each command the default value is indicated with an underscore. These default values are carefully selected in order to give the user a starting point from where it is easy to use the modem for most applications. However, there can be deviations from the standard default setting, due to national PTT requirements, or as a result of customer requests. If in doubt about this, the actual default values can be read out from the modem in the following way:

Load factory profile with command AT&F.
List all settings with command AT\S.

Speed (Bit/s)
300, 600, 1200, 2400, 4800, 7200, 9600,12000, 14400, 19200, 38400.

Character Format

7,N,1	8,N,1
7,N,2	8,E,1
7,E,1	8,O,1

7, O, 1
7= 7 bits, 8= 8 bits, n=none, e=even, o=odd
1=1 stop bit, 2=2 stop bit

The modem then automatically adjusts to this setting until another **AT** command is received or until the modem is turned off .

When a connection is established, speed towards the remote modem is determined by the last AT command, except when automatic detection of transmission rate is active (see +M-command), then the modem will automatically detect any of the modem standards.

- Several commands may be entered on the same command line, separated with space if desirable.
- A command line must end with Carriage Return <CR>.

- Use Backspace (ASCII 08hex) to correct typing errors.

ATA↵

ATS0=2B0&G2↵

ATDP0W4737011710↵

- A command line may contain up to 80 characters in addition to AT, Carriage Return and Space.
  If a command line contains more than 80 characters, the modem will ignore the command line, and report ERROR.
  If a command line is accepted the modem will give a OK response.
- The modem reports ***ERROR*** if the command string contains syntax error, illegal or unknown commands or parameters.
- A new command may be issued minimum 10 ms after the modem response for the previous command.

3.3 +++ Escape -Sequence

Command: +++

When connection is established with the remote modem, an AT command is ignored by the modem. +++ causes the modem returning to command state without going «on-hook».

+++	The modem returns to command state.

The modem responds with resultcode: ***OK***.

The +++ escape sequence is protected by guardtimes to inhibit return to command mode inadvertently. I.e. there must be no data too close in time before the first +, not too long time between the +, and no data too close after the last +. This time is set by the S12 register (see chapter 4).

3.4 Commands description

A/ Re-execute Last Command

Command: **A/**

When an AT command line is received, the command string is loaded into the command buffer before it is executed. Once executed, the command string remains in the buffer until the modem receives a new command

The principal application of A/ is to repeat a dial command that failed to connect.

This command is neither preceded by AT nor terminated with carriage return.

A/	Re executes last command string

A Go On-line in Answer Mode

Command: **A**

Causes the modem immediately go on-line in answer mode.

This command is used to answer an incoming call (Modem sends ***RING*** message to DTE and sets 125 on). It may also be used to start the modem on a voice connection established on the local phone set. (The remote part must issue D command).

ATA[ENTER]	Connecting up

\A Set maximum Protocol block size

Commands: **\A0, \A1, \A2, \A3**

This command will set maximum block size for MNP and LAPM stream link connection. The modem will send a block size up to the size specified with this command.

AT\A0[ENTER]	Set block size max. 64 characters
AT\A1[ENTER]	Set block size max. 128 characters
AT\A2[ENTER]	Set block size max. 192 characters
AT\A3[ENTER]	Set block size max. 256 characters

+A Auto answer Channel Select

Commands: **+AA**, **+AB**

The originating modem normally uses the A-channel. The default setting is to use the B channel in auto answer. This command allows for the reversed use of the channels.

AT+AAENTER	Selects channel A.
AT+ABENTER	Selects channel B.

+&A Auto answer control modification

Commands: **+&A0**, **+&A1**

AT+&A0ENTER	Disable autoanswer when V.24 ct108, DTR, is off in the following configurations: Asynchronous dialling (+E1, +ED1) Synchronous modes (&M1, &M2, &M3) DTR Disconnect (&D2)
AT+&A1ENTER	Enable autoanswer even when V.24 ct108, DTR, is off in the above mentioned configurations.

Some DTE's does not give commands to the modem and it will only be used as an answering unit. The modem link termination is controlled by DTR, consequently the &D2 is activated. Very often the DTR is controlled by «Data carrier detect» signal (109). This signal will not turn on before data mode is reached and +&A1 should be entered enabling auto answer.

B Selection of Bell or ITU-T standard

Commands: **B0**, **B1**

This command is used to select BELL/ITU-T recommendation. The modem can be used in the USA and other countries employing the Bell communication standard.

Note that if you ring at a transmission rate of 300 bps then the other modem must also be operating at the same rate.

If you use ITU-T communication standards and the other modem uses Bell standard, then it will be impossible to obtain the ***CONNECT*** message.

ATB0ENTER	Selects ITU-T standard.
ATB1ENTER	Selects Bell standard.

\B Send BREAK

Command: **\Bn** (n = length of break)

If the DTE is not capable of sending break signal, this command can be used to force the modem to send break to the remote modem. The \B command uses a parameter (1 to 9) which specifies the length of the break signal.

AT\B3 

The modem sends break for 0.3 sec.

\B is not activated in direct mode and synchronous modes.

%B Set-up of line speed

Command: **%Bn**

This command will set-up the line speed (writing into +S6 register will give the same result). The parameter n is bps rate 100.

Example:

AT%B12 

1200 bps

Automatic speed detection should be disabled, +M0. See also the %G command.

+B 1300 Hz test for bypass

Commands: **+B0**, **+B1**

Selects whether a call is to be bypassed, on the basis of a 1300 Hz Call tone.

AT+B0 

Bypass disabled

AT+B1 

After an automatic answer the modem will test if a 1300 Hz call tone is received from remote modem. This test will last for about 2,5 sec. If a 1300 Hz call is detected during the test, the modem will proceed with the handshake, else the modem sends a ring tone to the caller and at the same time indicates this call in the loudspeaker. The operator should then pick up the telephone set and disconnect the modem from line.

+&B Extended Bypass

Commands: **+&B0**, **+&B1**

AT+&B0[ENTER]	Extended bypass off
AT+&B1[ENTER]	Extended bypass on

When extended bypass is on, the number of RINGs defined by +S51 will be suppressed.

See chapter 13 (Advanced features) for more detailed information about this function.

&C Data Carrier Detection (DCD)

Commands: **&C0**, **&C1**.

DCD is a V.24 signal from the modem to the terminal. The modem can be configured to indicate presence of an actual received data carrier or always indicate presence of data carrier.

AT&C0[ENTER]	DCD (Data Carrier Detect) always on regardless of the state of the data carrier from remote modem.
AT&C1[ENTER]	DCD on indicates presence of data carrier.

\C Autoreliable buffer control

Commands: **\C0**, **\C1**,**\C2**.

This command is only active for answering modem in auto protocol mode (see \N command).

AT\C0[ENTER]	Doesn't buffer received data while attempting to establish a link in auto-reliable mode. Switches to normal mode if a SYN* character isn't detected within 3 seconds.
AT\C1[ENTER]	Buffers all characters on the answering modem. It switches to normal mode on receiving 200 non-SYN* characters and passes the data to DTE. If a SYN character is not received within 3 seconds it switches to normal mode and passes data to DTE
AT\C2[ENTER]	Doesn't buffer received data on the answering modem. Switches to normal mode on receiving fallback character defined by +S30. The fallback character is passed to DTE.

SYN* Character which synchronise start of link establishment.

%C Data compression

Commands: **%C0, %C1, %C2,%C3**

Compression is used to increase the effective transfer speed over the line. This commands selects whether to use data compression or not.

AT%C0[ENTER]	Compression off (MNP5 and V.42 bis).

When compression is disabled, the modem will be restricted to use:
MNP Level 4 or lower.
or LAPM.

AT%C1[ENTER]	Compression enabled.
AT%C2[ENTER]	Compression of transmitted data (V.42bis).
AT%C3[ENTER]	Compression of received data (V.42 bis).

If running MNP and transferring precompressed files there will be a degradation of the transfer speed when using the MNP5 compression scheme. V.42 bis will not have this degradation since it turns itself on/off dynamically depending on the compressibility of the transferred data.

When MNP is active, the commands %C2 and %C3 operate as %C1.

See chapter 9 for more information.

+C Speed-Conversion

Commands: **+C0, +C1**

Determines whether to allow speed differences between communication towards DTE and the line via the modem.

AT+C0[ENTER]	Speed must be equal.
AT+C1[ENTER]	Speed difference is allowed.

D Dial Telephone Number

ATDn[ENTER]	The modem dials number n

Example:

ATD4737011710[ENTER]	The modem dials number 4737011710

Which dial type should be used

The modem can dial numbers according to two different standards: Touch tone dial (modifier **T**) and Pulse dial (**P**).

When possible tone dial should be used. It is faster and it is an international standard.

Pulse dial may be used if tone dial is not accepted (Typical for old PABX equipment.)

Using neither of the two dial modifiers **T** nor **P**, the modem will use the most recently used modifier.

Blacklisting:

Blacklisting is a country dependent function and this text only applies for use in Norway.

1. There will always be a delay of 8 seconds between each repeated calls. The modem inserts this delay if necessary.
2. Maximum 7 retries to the same number are allowed within a period of 10 min. The number will be blacklisted for 30 min. if the maximum number of retries is exceeded. When a call to a blacklisted number is initiated the following result code will be given:

   ERROR (If +Q0 is active)
   BLACK LISTED NUMBER (If +Q3 is active)

3. All calls that fails with the resultcode NO CARRIER or BUSY will be stored for control of radialling. The total storage capacity for this storage is 200 characters. Each stored number consists of 7 characters in addition to the dialling sequence. The modem will deny calling any number when limit of 200 characters stored is reached and indicates this by result code:

   ERROR (If +Q0 is active)
   BLACK LIST TABLE IS FULL, RESET MODEM (If +Q3 is active)

The D command may be followed by one or more of the following Dial Modifiers:

T Touch tone Dial of subsequent telephone numbers containing digits **1-9** and/or symbols **A, B, C, D, #, ***.
Example:
ATDT4737011710 

P Pulse Dial of subsequent telephone number containing digits 1-9.

> *Note that use of Pulse Dialling can be restricted due to PPT regulations.*

R Reverse Mode (answer/originate). When the R modifier is used, the modem will connect as an answering modem. The remote modem must connect as originating (see +A command).

W Wait for Dial Tone before processing the next symbol in the dial string.

, Pauses register S8 seconds, before processing the next symbol in the dial string. Add more commas to insert a longer pause. If the modem has problems with detecting an off-standard dialtone, inserting one or several «,» can solve the problem.

; Return to command state after dialling, without disconnecting from the line. A semicolon enables the modem to send a telephone number of more than 80 characters.
Example:
ATDT123456789; 
The modem responds with resultcode *OK*
ATDT987654321 

S Dial stored number. The number has been stored by means of the **&Z** command in non-volatile memory. (The number is stored even after a power down).
The modem can store 20 numbers which can be dialled using the S modifier.

Example:
Requesting the modem to dial stored number located at entry 0.

ATDS 

or

ATDS=0 

Dial stored number at entry 12.

ATDS=12 

@ Wait for quiet answer before dialling (Person finders/Pager). Causes the modem to wait, for a period determined by register S7 + 20 sec., for one or more rings followed by 5 seconds of silence before processing the next symbol in the dial string.

% Checks acceptance tone from the paging service. If no acknowledgement is received, the modem reports ***NO ANSWER***, otherwise ***OK***

< Detection of dial tone from INMARSAT earth station.

Last digit in the transmitted information to the Pager system.
Example:

ATDT96608685@1234#% 

Sends the information «1234» to the person pager at the number 966 08685

K Sending number from the password table

ATDK=SEMAFORUM 

where SEMAFORUM is stored as
SEMAFORUM:T4737011710 in the password table.
Ex. **+P=SEMAFORUM:T4737011710**

Note that a specific telephone number only can be stored once in the password table (associated with only one password) if this number shall be dialled using ATDK=<password>

> When this modifier is used the modem will go on-line on the leased line connector (TX). This means that the modem can be connected to two switch lines which can be selected with command control.

It might be necessary to change the strapping field J16, using this function.

See the information about J16 in chapter 5.

&D Data Terminal Ready (DTR)

Commands: **&D0**, **&D1**, **&D2**, **&D3**

Used to determine function of the V.24 signal **DTR** (Data Terminal Ready)/108.2.

A typical application is to use DTR to disconnect the modem.

AT&D0 ENTER	The modem ignores DTR.
AT&D1 ENTER	The modem returns to command state when detecting an ON to OFF transition on DTR.
AT&D2 ENTER	The modem hangs up, returns to command state and disables autoanswer when detecting an ON to OFF transition on DTR. Autoanswer can be reenabled by turning DTR ON.
AT&D3 ENTER	The modem assumes initialisation state if it detects an ON to OFF transition on DTR.

The command is used in asynchronous mode only.

See also the +&A command.

+D 1300 Hz Call Tone

Commands: **+D0**, **+D1**

The Call Tone is a signal, defined in ITU-T V.25, which is used to inform the telephone network that the call was placed by an automatic dial unit.

If you know in advance that an originating modem sends a 1300 Hz call tone, you will obtain a quicker call detection by using the AT command +D. In some cases it may be necessary to turn it off, especially for modems including the V.23 standard.

As the 1300 Hz Call Tone is only a recommendation and not required for modems with auto dialler, you cannot expect to always receive it.

AT+D0 ENTER	Not active
AT+D1 ENTER	Active The modem sends a 1300 Hz call tone

Giving the command **+B1**, causes the answering modem to search for a 1300 Hz call tone to decide if this is an automatic modem call, or a voice (or a manual modem) call.

+&DA Dial backup on loss of carrier in leased line

Commands: **+&DA0**, **+&DA1**

AT+&DA0ENTER	Off
AT+&DA1ENTER	Dial backup on loss of DCD, provided that the modem is in A-channel (originator). The modem will use Call-list 2 when the dial backup sequence is started.

The modem will use Call-list 2 for the dial backup.

See chapter 11, "Leased line operation " for more information.

+&DB Dial backup if data inactivity for leased line

Commands: **+&DB0**, **+&DB1**

AT+&DB0ENTER	Off
AT+&DB1ENTER	On, provided that the modem is in A-channel (originator). This command must be combined with use of test of data inactivity, +&T. See also description of +S8.

The modem will use Call-list 3 for the dial backup.

See chapter 11, "Leased line operation " for more information.

E Echo on/off

Commands: **E0**, **E1**

Determines whether data received from DTE is echoed in command mode.

ATE0ENTER	Echo inhibited. Commands entered are not displayed on the screen
ATE1ENTER	Echo enabled. All commands entered are displayed

+E 108.1 Function

Commands: **+E0**, **+E1**

This command enables or disables 108.1 function.

AT+E0 ENTER	108.1 function disabled.
AT+E1 ENTER	108.1 function enabled.

If the 108.1 function is disabled, pin 20 on the V.24 connector will have the 108.2 function (DTR) and be controlled by the **&D**.

If the 108.1 function is enabled, pin 20 will have the 108.1 function. +S register 21 will select the different 108.1 functions. This function is often used in cases where the DTE is not capable of sending commands to the modem.

When the 108.1 signal is OFF the modem will always be disconnected. The action taken when 108 changes from OFF to ON, will be as described below:

In leased line (&L1):

⇒Connecting in answer or call mode depending on the +&LC-command.

AT+&LC0 ENTER	Use answer-mode when leased line.
AT+&LC1 ENTER	Use call-mode when leased line.

In switched line (&L0).

The channel selection may be automatically or fixed.

AT+&EC0 ENTER	Automatic channel choice

If RING signal has been detected when DTR (108) turns on, the modem will connect in answer mode (B-channel), otherwise the modem will connect in Call mode (A-channel).

AT+&EC1 ENTER	Channel is determined by +&FC-command, selecting answer or call.
AT+&FC0 ENTER	Fixed channel is B-channel (answer).
AT+&FC1 ENTER	Fixed channel is A-channel (call)

The modem may also dial a number when initiating a call.

AT+&ED0 ENTER	Start handshake immediately, do not dial.
AT+&ED1 ENTER	Use Call-list 1 and dial number(s).

+&EB Select transmit channel control with ct126

Commands: **+&EB0**, **+&EB1**

AT+&EB0 ENTER	Disabled
AT+&EB1 ENTER	Enabled

An ON value of ct126 will set-up modem for answer channel.
An OFF value of ct126 will set-up modem for originate channel

Ct 126 channel control applies to leased line or manual switched line control only.

+&EC Channel choice for 108.1 connections

Commands: **+&EC0**, **+&EC1**

This parameter is only used when operating in switched-line mode (**&L0**).

AT+&EC0 ENTER	Automatic channel choice. Automatic channel choice means that the modem will enter the answer handshake if RING is detected, else it will enter call establishment.
AT+&EC1 ENTER	Channel is determined by **+&FC**-command, selecting answer or call.

+&ED Call progress method for 108.1

Commands: **+&ED0**, **+&ED1**

This parameter applies to switched-line mode only (&L0).

AT+&ED0 ENTER	Start handshake immediately, do not dial.
AT+&ED1 ENTER	Use Call-List 1 and dial number(s). 108.1 will always use Call-list

Example of configuration for 108.1 dialling.

AT+E1 ENTER	108.1 function enabled.
AT+&EC0 ENTER	Use call-mode when leased line.
AT+&ED1 ENTER	Use Call-list 1 when dialling.
AT+S35=0 ENTER	Index to first number in the Call-list 1
AT+S36=1 ENTER	Index to last number in the Call-list 1
AT&Z0=T17000 ENTER	First number in Call-list (+S35=0)
AT&Z1=T17001 ENTER	Last number in Call-list (+S36=1)

When the DTR signal changes from OFF to ON the modem will dial the first. number in Call-list 1 (+S35=0):T17000. If the modem fails to connect it will dial the next number, i.e. T17001 and so on, until the Call-list is empty. In this case T17001.

Chapter 11 explains the use of Call-list.

&F Fetch Factory Configuration Profile

Command: **&F**

Fetches the factory configuration profile from permanent memory (ROM) and transfer it to the active memory (RAM)

+S5 and +S6 reg.: These are initiated to the speed and format the &F command was issued at.

Password functions: It is not possible to change or disable any function set-up by any +Pn command. (i.e. Password dialback, profile guarding or encryption).

\F Display stored telephone numbers

Command: \F

This command shows the content of all the 20 entries in the telephone list.

AT\F[ENTER]	The modem shows all the stored telephone numbers.

In this example the telephone list contains only 3 entries.

```
00-   T37011710
01-   T256348
02-   T545489
03
04


18
19
```

+&FB Automatic fallback

Commands: **+&FB0**, **+&FB1**

AT+&FB0[ENTER]	Automatic fallback disabled.
AT+&FB1[ENTER]	Automatic fallback enabled.

See the function in chapter 13, "Fallback"/"fallforward".

+&FC Fixed channel selection for 108.1 and Voice/Data

Commands: **+&FC0**, **+&FC1**

AT+&FC0[ENTER]	Fixed channel is B-channel (answer mode).
AT+&FC1[ENTER]	Fixed channel is A-channel (call mode).

See also +&EC

+&FF Automatic fallforward

Commands: **+&FF0**, **+&FF1**

AT+&FF0[ENTER]	Automatic fallforward disabled
AT+&FF1[ENTER]	Automatic fallforward enabled if fallback is enabled.

Remote request for fallforward to another modem standard will require the +&FF1 setting.
See the function in chapter 13, "Fallback"/"fallforward".

+&FH Fallback during V. 32/V.32 bis handshake

Commands: **+&FH0**, **+&FH1**

This command applies to fallback during a V.32/V.32 bis handshake only. The modem will decide if the line speed should be 4800, 7200, 9600, 12000 or 14400 bps. The command will not affect fallback in data mode. Automatic speed detection has to be enabled (See +M command).

AT+&FH0 ENTER	Fallback during handshake disabled
AT+&FH1 ENTER	Fallback during handshake enabled.

See the function in chapter 13, "Fallback"/"fallforward".

+&FR Automatic retrain

Commands: **+&FR0**, **+&FR1**

AT+&FR0 ENTER	Automatic retrain disabled.
AT+&FR1 ENTER	Automatic retrain enabled if fallback is disabled.

See the function in chapter 13, "Fallback"/"fallforward".

+&FV Enhanced fallback

Commands: **+&FV0**, **+&FV1**

AT+&FV0 ENTER	Fallback inside modem standard only. Assuming +&FB1 is on. From 14400 to 7200 bps (V.32 bis), 9600 to 4800 bps (V. 32) and from 2400 to 1200 bps (V. 22 bis). Assuming +&FB1 is on.
AT+&FV1 ENTER	Additional fallback between modem standards. (Assuming +&FB1 is on). This is only possible against a similar modem type.

See the function in chapter 13, "Fallback"/"fallforward".

&G Guard tone Selection

Commands: **&G0**, **&G1**, **&G2**

When the modem operates according to V.22 or V.22 bis-standard, it may happen that the carrier is interpreted as signalling in the telephone network. To prevent this, the modem can send a guard tone, as a signal to public exchanges indicating data transmission via modem is in progress.

AT&G0 ENTER	No guard tone.
AT&G1 ENTER	550 Hz guard tone
AT&G2 ENTER	1800 Hz guard tone

\G Line Flow Control

Commands: **\G0**, **\G1**, **\G2**

This command specifies the flow control used on data to/from the remote modem. This flow control can be set independent of the local flow control towards the DTE because data can be buffered in the modem. Line flow control uses XON/XOFF protocol and is only active in normal mode (\N0).

AT\G0 ENTER	No line flow control.
AT\G1 ENTER	Bi-directional line flow control.
AT\G2 ENTER	Unidirectional line flow control. The modem sends XON/XOFF, but ignores received XON/XOFF. (Treated as data).

Line flow control should not be used when there may be XON/XOFF characters in the data stream (ex. binary files).
*Other related commands: **\Q** and **\X**.*
Read more in chapter 8 «Flowcontrol and buffering»

%G Line speed locking

Commands: **%G0**, **%G1**

AT%G0 ENTER	The line speed (+S6) will be updated by command line prefix (AT).
AT%G1 ENTER	The line speed (+S6) will be updated by the %B command or by writing to the register +S6 only. This command may be used if the DTE speed is independent of the line speed (+C1), and the line speed should be changed.

+&G On line Data format

Commands: **+&G0**, **+&G1**

AT+&G0 ENTER	On line Data format enabled.

DTE (Data terminal)	DCE (Modem)	Comments
7E1	8N1	Parity as data bit
7O1	8N1	Parity as data bit
8N1	8N1	
8P1	+S6 format	

AT+&G1 ENTER	Line format is locked to +S6 format

As set-up in default configuration (+&G0), the modem is transparent to the data formats 7E1, 7O1 and 8N1. This means that you may change between these formats after connection to remote side (ex. If you use 8N1 during connection you may change to 7O1 at any time after connection).

However, if you want the modem to convert the data format used by your local DTE, you should give the command **+&G1**.

Example:
If local DTE uses the format 8N1 and remote DTE uses the 7E1, you should set-up register +S6 for 7E1 (See description of +S6)

H Switch-Hook Control

Commands: **H0**, **H1**

Switch-Hook Control in asynchronous operation only. This command causes the modem to go off line or on line.

ATH0 ENTER	Causes the modem to go off-line (hang up)
ATH1 ENTER	Modem connects to line (on-line)

\H HP -ENQ/ACK protocol Control

Commands: **\H0**, \H1, \H2

In the HP ENQ/ACK software protocol one part will be set-up as host, and the other as terminal. The protocol will prevent the host from sending data faster than the terminal is capable of receiving.

Host sends ENQ (05H) every 80th character to terminal. Transmission is stopped until ACK (06H) is received or until time-out (5s). Terminal sends ACK when ENQ is received if terminal is ready to receive. If buffers are full, ACK is sent when space is available.

AT\H0 ENTER	No ENQ/ACK (Default)
AT\H1 ENTER	ENQ/ACK Modem emulates terminal
AT\H2 ENTER	ENQ/ACK Modem emulates host

+H Full/half duplex

Commands: **+H0**, **+H1**, **+H2**, **+H3**

AT+H0 ENTER	Full duplex (V.22)
AT+H1 ENTER	V. 23 with back channel. The originator transmits at 75 bit/s and receives at 1200. The answering modem transmits at 1200 bit/s and receives at 75 bit/s.
AT+H2 ENTER	Not used. (Reserved)
AT+H3 ENTER	Full duplex on leased line 4-wire, V 23, 1200 or 600 bps.

☞ A setup for the +H3 command will be:
AT+M0%B12%G1+H3+W1&W

To use the standard 1200/75, the originator must issue the **AT+M1+H1** ENTER command at 1200 bps from DTE. The answering modem automatically detects V.23 mode. Connect messages in V.23 1200/75: ***CONNECT 1200***

+&HM Handshake according to V.25

Commands: **+&HM0**, **+&HM1**

AT+&HM0 ENTER	Handshake will start after detection of V.25 answer tone when manual connection.
AT+&HM1 ENTER	Handshake will start direct with no answer tone detection.

Applies to originate mode only. (ATD<CR>)

I Product Information

Commands: **I0, I1, I2**

ATI0 ENTER — The modem presents a three-digit number, representing its product.

The modem displays ***192***

ATI1 ENTER — The modem calculates the ROM checksum and shows the result.

The modem displays: ***xxx***

utilize

ATI2 ENTER — Performs and returns ROM checksum.

The modem displays: ***OK***

OK Correct checksum

or ***ERROR***

OK Invalid checksum

Use the +N command to get more extensive information.

+I X or Z impulsing

Commands: **+I0**, **+I1**

Select standard Z or X (Oslo) impulsing of telephone numbers.

AT+I0 ENTER	Z-impulsing (International)
AT+I1 ENTER	X-impulsing (Oslo, Norway).

This command is ignored by other countries.

+J Automatic leased line Dial Back-up.

Command: **+J0**, **+J1**, **+J2**

AT+J0	Disable the dial back-up function.
AT+J1	Enable the dial back-up function.
AT+J2	V.24 circuit 108.2 will enable or disable the dial back-up function. 108.2 On will enable dial back-up. 108.2 Off will disable dial back-up.

The criteria for dial back-up must be set-up by the +&DA and +&DB commands.

Note that the status S register bits for this function has been moved from +S23 bit 0, to +S24 bit 0 and 1.

See also description of the dial back-up function in chapter 11 (Leased line operation).

\K Break handling

Commands: **\K0, \K1,\K2 \K3,\K4, \K5**

This commands specifies how the modem shall handle a break signal. In protocol mode break is not sent as data, but as link information. It is the modem that sends a break signal that determines how the break should be interpreted at the remote modem.

The following table describes the break handling in data mode for different \K commands and normal/protocol mode:

	On line com. mode Send Break with \Bn		Data mode Break from			
			DTE			Line
Connect	Normal	MNP	Normal	MNP	Direct	Normal
\K0	Destructive Expedited	Destructive Expedited	Enter Command mode	Enter Command mode	Prioritised Enter Command mode	Destructive Expedited
\K1	Destructive Expedited	Destructive Expedited	Destructive Expedited	Destructive Expedited	Expedited	Destructive Expedited
\K2	Non-destructive Expedited	Non-destructive Expedited	Enter Command mode	Enter Command mode	Expedited Enter Command mode	Non-destructive Expedited
\K3	Non-destructive Expedited	Non-destructive Expedited	Non-destructive Expedited	Non-destructive Expedited	Expedited	Non-destructive Expedited
\K4	Non-destructive Expedited	Non-destructive Expedited	Enter Command mode	Enter Command mode	Expedited Enter Command mode	Non-destructive Expedited
\K5	Non-destructive Expedited	Non-destructive Buffered	Non-destructive Expedited	Non-destructive Buffered	Expedited	Non-destructive Expedited

Expedited:
The modem sends break immediately, even if other data is ready to be transmitted.

Destructive:
Break is sent immediately and any characters in the buffer is deleted.

Buffered:
The modem sends break in sequence with the data which is ready to be transmitted.

Local \Kn determines local break handling.

&L Switched or Leased line

Commands: **&L0**, **&L1**

AT&L0 ↵	Switched line operation.
AT&L1 ↵	Leased line operation.

Speed selection:

The +M command is ignored in leased line configuration. The modem will use the speed of the last AT-command issued or the speed selected in the SET-UP menu on the display. After a power up, the modem will use the speed information in the start up profile.

Channel selection (Answer/Call):

In leased line operation the modem will use the channel selected by register +S27, bit 7. This register may be modified with the +&L command. It may however be more convenient to use the SET-UP menu on the display to select the channel.

Connection:

The modems may be started on a leased line with the A and D commands. In most applications it is easier to configure and control the modem from the front switches and the display. The modem is either configured to "ALWAYS ON" or "108.1 CONTROL" in leased line. In the "ALWAYS ON" mode the modem will start a handshake immediately after the power up sequence has finished. If the modem is disconnected it will start a new connection after 60 seconds.

Modem handshake:

When the modem starts handshaking, it will transmit data carrier in the selected speed and wait for a received carrier from the remote modem. When received carrier is detected, the modem initiates a retrain sequence to synchronise the modems. The CONNECT message is sent to DTE and the DCD (109) signal is set to the ON state.

Disconnect:

If received data carrier is lost the modem will enter the handshake mode and try to establish a new connection. The modem can be forced from data mode to command mode by issuing the escape sequence (+++) and disconnect from line with **H** command. Disconnect controlled by the DTR (108.2) signal can be used if the modem has been configured with the **&D** or **+E1** commands. The ROLL/EXEC switch can always be used to disconnect.

Training sequence in V.22 bis or V.32/V.32 bis:

When the modems are connected at the V.22 bis or the V.32/V.32 bis standard, they may loose synchronisation due to line disturbances. The synchronisation may be retained by performing a retrain sequence. This is done manually by issuing the escape sequence (+++) and the **O1** command.

The modems may also do this automatically based upon the EQM values on the received signal samples. +S register 13 must be set to a low value (ex. 70). Read more about +S13 and +S14 in the S register chapter. During an automatic retrain CTS (106) will be off.

When the modem is used on a leased line it should be configured to start up with a userdefined profile in case of power downs. (**&W** and **&Y** commands).

When using the modem in a leased line configuration it is often more convenient to set the modem in manual leased line configuration.

Read more about this in chapter 5 "Manual operation".

+L Set LPDA2 option

Command: **+L1** , **+L2**

This command selects the LPDA2 mode of operation in synchronous mode. The command automatically sets the modem in synchronous SDLC mode and must therefore be the a part of the last command string given to the modem. Changing from LPDA2 mode to normal synchronous or asynchronous mode can only be done from the display menu.

AT+L1 ENTER	Set LDPA2 Primary mode
AT+L2 ENTER	Set LDPA2 Secondary mode

In order to utilise the full LPDA2 support, an address has to be specified in the +S48 register. (For more information see the LPDA2 section under synchronous operation.)

+&LB Lookback to leased line

Commands: **+&LB0, +&LB1, +&LB2, +&LB3**

This command will set-up the lookback to leased line during a dial backup.

AT+&LB0 ENTER	Lookback disabled.
AT+&LB1 ENTER	Continuously lookback
AT+&LB2 ENTER	Interval lookback (See +S32)
AT+&LB3 ENTER	Both continuously and interval lookback (See +S32)

Associated commands:+&DA, +&DB, +J

See chapter 11 for more information about leased line

+&LC Channel selection when leased line

Commands: **+&LC0, +&LC1**

AT+&LC0 ENTER	B-channel (answer mode)
AT+&LC1 ENTER	A-channel (call mode)

Affected register +S27, bit 7

+&LP Select service provider

Commands: **+&LP0, +&LP1**

AT+&LP0 ENTER	Modem is connected directly to the public network
AT+&LP1 ENTER	Modem is connected to an internal network (PABX)

This command is only applicable for modems strapped to France. When connected to the public network the modem automatically waits for a new dialtone when dialling internationally, i.e. when dialling numbers starting with 0, 00, 16 or 19 the modem waits for a new dialtone as specified by the French requirements. When connected to an internal network this may cause problems if there is any internal numbers starting with the above prefixes. In this case use AT+&LP1 to avoid this problem.

WARNING : When configured to AT+&LP1 the modem does not wait for new dialtone regardless of prefix. It is the users responsibility to insert a W to force detection of the secondary dialtone where appropriate.

+&LT Select test pattern used during selftest.

Commands: **+&LT0, +&LT1, +&LT2, +&LT3**

AT+&LT0 ENTER
AT+&LT1 ENTER
AT+&LT2 ENTER
AT+&LT3 ENTER

SPACE	Transmit data is forced to the SPACE condition
MARK	Transmit data is forced to the MARK condition
ALT	Transmit data is alternating between MARK and SPACE every bit.
511	Transmitted data conforms to the 511 pattern specified by ITU.-T recommendation O.153.

This command selects the test pattern used during selftest.

Note that both modems must use the same pattern during T+R tests. The default test pattern is compatible with the pattern used on older versions of Ericsson switched line modems, except for the early versions based on the AT&T datapump which uses the 511 pattern.

M Speaker on/off

Commands: **M0, M1, M2, M3**

ATM0 ENTER
ATM1 ENTER
ATM2 ENTER
ATM3 ENTER

Speaker always off
Speaker on until carrier detect.
Speaker always on.
Speaker on until carrier detect, but not while dialling.

&M Asynchronous/Synchronous Mode

Commands: **&M0**, **&M1, &M2, &M3**

AT&M0 ENTER	Selects asynchronous mode
AT&M1 ENTER	Selects **Synchronous mode 1** (synchronous/asynchronous) Call placement is performed by using asynchronous method. The modem will autoanswer if RING is detected (S1≥S0, S0>0). The modem hangs up and returns to asynchronous mode when it detects an ON to OFF transition on DTR, or loss of carrier.
AT&M2 ENTER	Selects **Synchronous mode 2** (Dial stored number) When an OFF to ON transition on DTR is detected, the modem dials the stored number. Semicolon can not be used in the stored number.
AT&M3 ENTER	Selects **Synchronous mode 3** (Manual Dial Mode) The operator manually places a call using a telephone handset. To connect the modem to line, turn DTR on and hang up the telephone.

The commands &M1, &M2, and &M3 set the modem to operate asynchronous in command mode and synchronous in data mode.
See chapter 10 "Synchronous operation".

+M Automatic speed detection

Commands: **+M0, +M1, +M2**

The modem will automatically try to adopt the speed of the remote modem and adjust to this rate. The modem tries to establish connection in this speed.

AT+M0 ENTER	Speed detection off.
AT+M1 ENTER	Speed detection in answer mode

AT+M2 ENTER	Speed detection in call and answer mode. (Same as for +M1, but the automatic speed detection is also active when the modem is operating as originator of a connection.)

If the remote modem is preset for dialling with automatic transfer rate detection, it may happen that the modems will be connected at another transfer speed than defined in the communications programs. To avoid this, it is advisable to set one of the modems to a fixed rate.

This speed detection applies to V.32 bis, V.32, V.22 bis, V.21 and V.23. The interworking between V.32 and V.22 bis is according to the recommendation of ITU.-T.

+&M Selects standard for 111 control

Commands: **+&M0** , **+&M1, +&M2, +&M3**

AT+&M0 ENTER	Selects V.32 standard, i.e. low rate is 4800 bps and high rate is 9600 bps
AT+&M1 ENTER	Selects V.22 bis standard, i.e. low rate is 1200 bps and high rate is 2400 bps
AT+&M2 ENTER	Selects V.22 standard, i.e. low rate is 600 bps and high rate is 1200 bps.
AT+&M3 ENTER	Selects V.32 bis standard, i.e. low rate is 7200 bps and high rate is 14400 bps

The +&M2 and the +&M3 commands should only be used for speed selection with V.24 ct111.

\N Set Operating Mode

Commands: **\N0, \N1,\N2, \N3, \N4, \N5, \N6, \N7**

The modem has a full duplex error correcting protocol implemented according to ITU-T V.42 (LAPM and MNP level 2 through 4). With block transmission and retransmission on receivers request. V.42 is only used for asynchronous DTE's.

AT\N0 ENTER	Normal mode

- Buffered mode with speed conversion capabilities
- Flow control (XON/XOFF) can be used (\Q-command).
- Password/Dialback can be used.
- Inactivity timer (+S8) can be used.
- No protocol support.

The commonly used mode is \N0 for non protocol applications. This is the default asynchronous mode on the modem.

AT\N1 	Direct mode

If this configuration is selected, the modem will not use internal data buffering. Data is transmitted as in a dumb modem. This gives the possibility to change the data format after a connection without any use of commands.

The modem has no active control on the transmitted data causing the password dialback function to be disabled in this mode. The commands **+PO1** and **+PO2** gives the error message ***ILLEGAL CONFIGURATION: PASSWORD*** as long as **\N1** command is active. The \N1 command will also give error message if **+PO1** or **+PO2** is active.

- No protocol support
- No data buffering.
- Data is sent directly to the modem hardware for transmission on the line.
- Error correction disabled.
- Split speed will be ignored.
- Flow control is ignored.

Fixed reliable mode:

AT\N2 	**Fixed protocol mode** will connect in LAPM towards modems with V.42 support, and MNP. If a non protocol modem tries to connect the connection will be disconnected after the protocol handshake attempts.
AT\N6 	**Fixed MNP mode**. As fixed protocol mode, but will not accept LAPM requests.
AT\N7 	**Fixed LAPM mode.** As fixed protocol mode but will not accept MNP requests.

Any connections without protocol will cause a disconnect. The difference between the modes is only which protocols that are allowed (LAPM and MNP, MNP only or LAPM only). All flowcontrol and buffering are as in normal mode.

After the handshake has finished, but prior to the ***CONNECT*** message, the modem tries to initiate the reliable link. During the link negotiation the modems agree on which reliable class to use. If the negotiation succeeds, the modem issues the ***CONNECT*** message and data transfer can proceed.

If the negotiation fails, the modem will disconnect and issue ***NO CARRIER*** message. This may occur if the line is too noisy or if the remote modem is a none MNP/LAPM modem.

- Flow control (XON/XOFF) is recommended.
- Escape code is detected (+++)
- Password/Dialback can be used.
- Inactivity timer (+S8) can be used.
- Any connections without protocol will cause a disconnect.

Password dialback function and inactivity timer (+S8) can be used with MNP/LAPM.

Auto reliable mode:

The commonly used mode is \N3 for protocol applications.

AT\N3 ENTER	**Auto protocol mode.** As fixed protocol mode but if a non V.42 modem tries to connect, the modem will fall back to normal data mode after the protocol handshake attempts.
AT\N4 ENTER	**Auto MNP mode**. As auto protocol mode but will not accept LAPM requests.
AT\N5 ENTER	**Auto LAPM mode**. As auto protocol mode but will not accept MNP requests.

These modes differ from the fixed modes only when trying to connect to a non V.42 modem. When this occurs the modem will fall back to normal mode.

The modem will try to establish a reliable link just like described above (see \N2, \N6, \N7) however if this link negotiation fails the modem will not disconnect but fallback to normal mode (see \N0).

See chapter 9, "Protocols and compression schemes"

+N National adaptations and Product information

Command: **+N**

This command displays which country and which transmit level the modem hardware is strapped to, and which firmware version the modem uses.

AT+NENTER

Typical response:	Zat 19.2/19.2-7	Zat 14.4/14.4-7
Product:	Zat 19.2/19.2-7	Zat 14.4/14.4-7
SW name:	RYSR 092000 S/X	RYSR 092000 S/X
Ver/Date	R09 093 27/06-93	09 093 27/06-94
Country:	NORWAY	NORWAY
Switched line Xmit level	-10dBm	-10dBm
Leased line Xmit level	-10dBm	-10dBm
PCB	3 1 *	3 1
Data Pump	AT&T HSM1900	AT&T HSM1900
DSP code revision	6 5	6.5

This information is subject for change.

** The first digit is the PCB revision. The last digit is the PBA.*

O Return to On-line State

Commands: **O0, O1, O2, O3**

The command is used if the modem has previously returned from on-line state to command state by issuing the escape sequence (+++) or by a DTR ON to OFF transition.

ATO0ENTER	Causes the modem to return to on-line state. **Also:** If no connection is made the modem will start a new handshake.
ATO1ENTER	Returns the modem to the on-line state and initiates a new training sequence. May be issued if the bit error rate is too high. The command applies to V.22 bis, V.32 and V.32 bis only.
ATO2ENTER	**Fallback.** The modem will start a training sequence with fallback within the current modem standard. This applies to V.32 and V.32 bis only. Speed conversion (+C1) should be enabled at both modems to maintain the DTE speed.
ATO3ENTER	**Fallforward.** The modem will start a training sequence with fallforward within the current modem standard. This applies to V.32 and V.32 bis only. Speed conversion (+C1) should be enabled at both modems to maintain the DTE speed.

+O Remote command access

Commands: **+O0**, **+O1, +O2, +O3**

AT+O0 ENTER	Remote command access disabled
AT+O1 ENTER	Remote command access enabled. No password is required.
AT+O2 ENTER	Remote commands enabled. The modem demands a password with level 1 or higher to give access.
AT+O3 ENTER	As for +O2, but will also enable remote unlocking of the modem. (+S18)

Read more about remote commands in chapter 12.

+PA Set Password Security level

Commands: **+PA0, +PA1, +PA2, +PA3**

AT+PA0 ENTER	No security on password commands.
AT+PA1 ENTER	Level 2 password required for password command access. Password commands may be accessed from both local and remote modem
AT+PA2 ENTER	Level 2 password required for password command access. No remote control of password commands enabled.
AT+PA3 ENTER	Local password commands must be confirmed by pressing the **ROLL/EXEC** switch. No remote control of password commands enabled.

Read more about password function in chapter 6.

+PC Encryption mode

Commands: +PC0, +PC1, +PC2, +PC3

AT+PC0	Encryption disabled.
AT+PC1	**Auto encryption mode.** Encryption in call mode, if the transmitting telephone number already exists in the password table and marked for encryption. Encryption in answer mode, if received passwords already exists in the password table and marked for encryption.
AT+PC2	**Encryption always on, using stored telephone numbers.** Only encryption mode is valid. Any attempt to establish a connection without encryption will be disregarded. The modems will disconnect and give ***ERROR*** result code.
AT+PC3	**Encryption always on, using a free telephone number.** The modem will always use the first stored password, when setting up an encrypted connection. This should have no phone number associated, have an encryption index and a user field.

Both **+PC1** and **+PC2** enable auto MNP mode (\N3).

The commands **+PC1** and **+PC2** demand a corresponding password, marked for encryption, in the password table. Key number 0 must be entered. If not, one of the following message is displayed:

CRYPT ENTRY NOT FOUND

or

KEY TABLE IS EMPTY.

The modem demands an existing user field, if the password is marked for encryption (K), with a corresponding telephone number. If user field is missing, the following message displays:

USER FIELD EMPTY

Read more about encryption function in chapter 7.

+PE The exception list

Commands: **+PE0**, **+PE1**, **+PE2**

AT+PE0 ENTER	Display contents of the exception list.
AT+PE1 ENTER	Add new command (s) to the exception list
AT+PE2 ENTER	Delete command (s) from the exception list.

+PG3 ... +PG8 uses the exception list. This list is stored in EEPROM. The maximal total size of the exception list is 100 bytes.

Add new commands, examples

AT+PE1=<XXX> [: <XXX> : <XXX> .....] ENTER

«XXX»

The command can be one of two types:

1. Only <Command name> or
2. <Command name> followed by <Parameter>.

- The command prefix AT is not a part of <Command name>.
- Any <XXX> might be a member of the exception list, even commands not recognised by the command interpreter in the predefined command set in ROM.
- Adding a command with a specific parameter means that the command will be protected for this specific parameter.
- Each command in the exception list is stored as entered from the command line plus a separator character.
- If the exception list is full the modem will respond with the result code *NO MORE SPACE AVAILABLE* when trying to add a new command.

«:» (ASCII 58 Dec.) is used as a separator character in the command line.

Example of adding a single command to the exception list:

AT+PE1=&D3[ENTER]

The command interpreter will check the command **&D3** according to the +PG setting.

Example of adding multiple commands to the exception list.

AT+PE1=&D1:&D2[ENTER]

If a command is to be protected for all its parameters then add this command to the exception list without a parameter.

AT+PE1=&D[ENTER]

The command interpreter will check the commands &D, &D0, &D2, and &D3 according to the +PG setting.

Delete command(s):

AT+PE2=<XXX> [: <XXX> : <XXX> ...][ENTER]

- The +PE2 command will report ERROR if an entry in the command line is not already in the exception list.
- There is no single command to delete all commands in the exception list.

Example of deleting one command.

AT+PE2=&D1[ENTER]

Delete command(s) from the exception list:

AT+PE2=&D2:D095[ENTER]

+PG Profile Guarding

Commands: **+PG0, +PG1, +PG2, +PG3, +PG4, +PG5, +PG6, +PG7, +PG8.**

Profile Guarding is intended for use in Network systems and when it is essential that the modem configuration is constant. When executing the +PG command the modem will read the parameter used for **&Y** command (profile to use after power up) and write the current S register set to the power up profile.

AT+PG0 ENTER	No Profile Guarding or Restriction in Commands. Note that +PG0 must be used to turn off profile guarding. The command to set factory configuration will not turn off profile guarding.
AT+PG1 ENTER	Disable the following commands: **&W**, **&Y**, **&Z** and give ***ERROR*** result code when these commands are executed. The **&W** command is protected only for the power up profile. The power up profile is reloaded during disconnect.
AT+PG2 ENTER	As +PG1, but OK result code when the commands, &W, &Y, &Z are executed. The power up profile is reloaded during disconnect.
AT+PG3 ENTER	Commands in the exception list are protected, ***ERROR*** result code is displayed for these commands.
AT+PG4 ENTER	As +PG3, but ***OK*** result code is displayed for the commands in the exception list.
AT+PG5 ENTER	Accept commands specified in the exception list only. ***ERROR*** result code is displayed for all other commands.
AT+PG6 ENTER	As for +PG5, but ***OK*** result code is displayed for illegal commands (those not in the exception list).
AT+PG7 ENTER	Commands in the exception list are free to use, all others are protected by the +PA command.
AT+PG8 ENTER	Commands in the exception list are protected by the +PA command. All the others are free to use.

Note 1: The commands &W, &Y0, &Y1 will be disabled for all +PG settings except +PG0. This means that these commands are handled separately, being a member of the exception list or not.

Note 2: The commands &F and Z will not overwrite the current settings defined by +PA, +PG and +PO.

Note 3: If a lock situation occurs (+PA, +PE or +PG is disabled) the modem can be brought to factory setting from the display menu.

+PIN PIN code control

Commands:	+PIN=<code>	Enter new PIN code
	+PIN=	Delete PIN code
	+PIN?	Display PIN code

The parameter <code> is a string from 1 to 8 characters in the range A-Z and 0-9.

There is no special protection of the +PIN command and to protect these the normal password access control should be used, +PA. Profile guarding, +PG, may also be used for protection.

There is no special command for enabling the PIN code. If configured with a PIN code the modem will require this code else the modem is unprotected.

When configured for protected mode i shall not be possible to access the modem after a power on reset (POR).

+PK Store encryption keys

Command: **+PKnn**

Syntax:

AT+PKnn=XXXXXXXXXXXXXXXX 

nn Key index from 00 to 99.

xx Key data. Consists of 16 hexadecimal values from 0 to F.

Keys are stored into a table located in «non volatile memory»* . If there is no more space left for new entries, the next key may be entered over an existing index or you may increase the size of the table. The modem displays:

NO MORE SPACE AVAILABLE

Read more about increasing the key table in the section about **+PL** command.

Default value for the key table is 5 keys. Increasing this size affects the password table. The maximum number of keys is dependent of the individual requirements.

+PL Enter/ display the total size of the key table

Command: **+PL?**

AT+PL? ↵	Displays the total number of possible keys.
AT+PL=xxx ↵	Enter the size of the key table to xxx. Range: 002-100.

When reducing the size of the key table, existing keys may be deleted.

+PN Command mode on/off

Commands: **+PN0**, **+PN1**

AT+PN0 ↵	Command mode on
AT+PN1 ↵	Command mode off.

To store a certain parameter in user profile, select «Command mode off». It is possible to recall this parameter after a power up.

Example:

AT+PN1&W ↵	+PN1 is stored in the userdefined memory.

Note! If the modem is setup in Dumb mode you will have to go into the SETUP menu at the front of the modem to get it back to command mode (AT or V.25 bis). Anyway, or you may also get it back to command mode from remote side by the command +PN0.

* Non volatile memory. The contents will remain after a power down

+PO Password/Dialback

Commands: **+PO0**, **+PO1**, **+PO2**

AT+PO0 ENTER	Password/Dialback function OFF (+PO may also be used)
AT+PO1 ENTER	Dialback enabled. Password required of all users.
AT+PO2 ENTER	Dialback enabled. Password control is optional

Read more about the "Password/Dialback" in chapter 6

+PS Local password

Commands: **+PS0**, **+PS1**

AT+PS0 ENTER	Password not necessary
AT+PS1 ENTER	Calling an existing telephone number, connected to a user logon in the password table, the modem demands a password

The following message is transmitted when the corresponding telephone number in the password table is detected:

ENTER PASSWORD FOR DIALLING PROTECTED TEL. NUMBER

⇒Enter the existing password, stored together with the telephone number.

This mode may be used if there is more than one modem operator, but not all are allowed to access the encryption mode.

+PZ Delete all keys

Command: **+PZ**

AT+PZ ENTER	Delete all keys stored in the key table

It is recommended to delete all keys, if a non authorised person is going to operate the modem. Confirm the following message :

DELETE ALL KEYS (Y/N)

If Y is entered all keys are deleted.

You may use the following command to delete a key, if there is no space left in the table.

AT+PZ=xx ENTER	The modem deletes one key from index "xx"

The following message displays if the corresponding key index xx doesn't exist in the table

KEY INDEX NOT FOUND

+P=, +P?, +PD, +PI
Other Password/Dialback commands

Formats:

AT+P= ENTER	Insert new password
AT+P? ENTER	List all passwords
AT+P?xx ENTER	List only those passwords which start with character(s) xx
AT+PD ENTER	Delete all passwords
AT+PD xx ENTER	Delete password xx
AT+PI0 ENTER	Password checksum control
AT+PI1 ENTER	Password checksum control

Syntax:

AT+P=<Password>:<Telephone number>:<Access level> :<K>:<USER>

Restrictions to password entries:

Minimum password length =	**4 characters**
Maximum password length =	**10 characters**
Maximum telephone number length =	**30 digits**
Memory available for password table =	**7 Kbyte**

Number of passwords which can be stored:

Minimum	**209 entries**
(Using maximum password and telephone length)	
Typical (Passw =5 chars Tel no.= 8 digits).	**328 entries**

Q Result Codes on/off

Commands: **Q0, Q1, Q2**

This command determines which result codes are sent to the DTE.

ATQ0↵	Result codes enabled
ATQ1↵	Result codes disabled.
ATQ2↵	Result codes disabled in answer mode

Result codes are messages given by the modem to inform the operator about transmission speed, missing dial tone, busy line.

Result codes described on page 3-56 may be displayed.

Associated S registers are S14, bit 2 (Q0 and Q1)
+S7, bit 3 (Q2)

\Q Local flow control

Commands: **\Q0, \Q1, \Q2, \Q3,\Q4**

This command specifies the local flow control between the modem and the DTE. This flow control may be set independent of the line flow control. Local flow control is disabled in direct mode (\N1).

AT\Q0↵	No local flow control
AT\Q1↵	Bi-directional local flow control using XON/XOFF
AT\Q2↵	Unidirectional local flow control using CTS
AT\Q3↵	Bi-directional local flow control using RTS/CTS
AT\Q4↵	Unidirectional local flow control using XON/XOFF

For further information read chapter 8

+Q Extra Result Codes

Commands: **+Q0**, **+Q1**,**+Q2**, **+Q3**

AT+Q0 ENTER	No extra result codes (Hayes compatible)
AT+Q1 ENTER	Extra ***CONNECT*** message enabled Ex. ***CONNECT 9600/REL (V.42 active)*** ***CONNECT 9600***
AT+Q2 ENTER	The ***CONNECT*** message will contain both line speed, DTE speed and REL if V.42 is active. Ex. ***CONNECT 9600/REL/19200***
AT+Q3 ENTER	As +Q2, and V.42 class if active. Ex. ***CONNECT 9600/REL/19200 V.42 bis***

Examples:

CONNECT 2400/REL/9600/MNP5
(MNP with compression)

CONNECT 2400/REL/9600/LAPM
(V.42 without compression)

CONNECT2400/REL/9600/V.42 BIS/DES
(V.42 with compression and encryption)

CONNECT 9600/REL/9600/V.42 BIS/DES/TCM
(V.42 with compression, with encryption and trellis coded modulation)

Result codes described on page 3-56.

&R RTS / CTS (Request To Send / Clear To Send)

Commands: **&R0**, **&R1**

The command is used in both synchronous and asynchronous mode. If hardware flow control is selected in asynchronous mode, CTS is used for flow control.

AT&R0 ENTER	CTS follows RTS in data mode. If RTS switch from ON to OFF. CTS will turn OFF immediately. If RTS switch from OFF to ON, CTS will turn ON after a delay determined by register S26
AT&R1 ENTER	In data mode CTS is on. Using this function, flowcontrol with CTS and RTS can't be used. Enter \Q0, \Q1 or \Q4

This command will be ignored when hardware flow control is enabled (\Q2 and \Q3).

+R List value of all registers

Commands: **+R0, +R1, +R2, +R3**

This command is used to obtain a listing of all registers and their current values.

AT+R0 ENTER	Display all active S-registers in decimal format.
AT+R1 ENTER	Display all S-register in decimal format, except Bit mapped S registers which will be display in hex format.
AT+R2 ENTER	Display all S-register in hex format.
AT+R3 ENTER	Display all S-registers in binary format.

S S-registers

The S registers are the active configuration memory in the modem. The S registers contain byte- or bit-mapped information controlling the operation of the modem. There are 28 S registers in the modem.

The user defined profiles contain the factory setting at delivery. The factory setting itself is stored in permanent memory (ROM) and cannot be deleted.

After a power up the modem moves one of the user defined profiles into the active S registers. The modem may be operated with this configuration or the user can change some of the values in the S registers to modify the configuration.

Example:
Register S0 is used to inform the modem how many ring signals it will accept before answering (automatic reply). The default setting is "0" ring signals. This means that the modem will not reply at all when someone rings. If the S0 register is set to 1 ring (numeric 1), then the modem will reply immediately.

ATSn=x

ATS0=1↵ | Assigns register 0 the value 1.

Sometimes it is more convenient to use hex or binary format:

ATSn=Hx Hexadecimal notation
ATSn=Bx Binary notation

ATS14=H8A↵ | Register 14 is set to the hex value 8A Hex.

ATS14=BI000I0I0↵ | The same command using binary notation.

ATSn? Show registers n on decimal notation
ATSnH? Use hexadecimal notation
ATSnB? Use binary notation

When assigning values below the minimum value or above the maximum value, the modem will use the nearest legal value.

Read more about the S registers in the next chapter

&S Set DSR/CTS Options

Commands: **&S0, &S1, &S2, &S3, &S4**

If your terminal equipment (DTE) is unable to operate with the default **&S** setting, this command may be used to change the DSR/CTS control from the modem.

AT&S0 ENTER

DSR/CTS always on.

	DSR	CTS
Command mode	Off	On
Dial, answer mode	Off	On
Answer tone on/detected	On	On
Data mode	On	On

AT&S1 ENTER

	DSR	CTS
Command mode	Off	On
Dial, answer mode	Off	Off
Answer tone on/detected	Off	Off
Data mode	On	On

AT&S2 ENTER

	DSR	CTS
Command mode	Off	Off
Dial, answer mode	Off	Off
Answer tone on/detected	Off	Off
Data mode	On	On

AT&S3 ENTER

	DSR	CTS
Command mode	On	On*
Dial, answer mode	On	On*
Answer tone on/detected	On	On*
Data mode	On	On*

AT&S4 ENTER

All the options indicates CTS on in data mode. In this mode CTS may turn off if flow control is active or if **&R0** is active.

In DUMB mode CTS will not turn on until carrier is detected regardless of selected option.

* CTS follows RTS CTS may be switched off by flow control

\S View modem configuration

Commands: **\S0, \S1**

AT\S0 ENTER	Displays all commands with text info.
AT\S1 ENTER	Displays all commands that is different from factory setting.

+S Extra S-Registers (Semafor Registers)

The modem has an extended set of S registers in addition to the AT standard registers. These registers are assigned or displayed with the following commands:

+Sn=x	Assign register n the value x (x on decimal notation)
+Sn=Hx	Assign register n the value x (x on hex notation)
+Sn=Bx	Assign register n the value x (x on binary notation)
+Sn?	Display the value of register n on decimal notation
+SnH?	Display the value of register n on hex notation
+SnB?	Display the value of register n on binary notation

+&S Controls 111/112 function

Commands : **+&S0, +&S1, +&S2, +&S3**

AT+&S0 ENTER	111 function is disabled
AT+&S1 ENTER	111 controls low/high rate within standard selected with **+&M**.
AT+&S2 ENTER	112 controls low/high rate within standard selected with **+&M**.
AT+&S3 ENTER	Combining +&S1 and +&S2, both 111/112 functions are active

The Jumper field J10 may need to be changed. Default setup of Jumper field J10 is 111 on pin. 23 and 112 on pin. 12.

See chapter 5 for more detailed information of jumper field J10

The V.24 ciruit 112 will not indicate the speed if the modem is setup for +&M2/V.22. The +&M2 command should only be used for speed selection (111).

&T Test Commands

Commands: **&T0, &T1, &T3, &T4, &T5, &T6, &T7, &T8**

If your modem is connected in LAPM/MNP mode, it is impossible to enter these commands.

AT&T0 ENTER	Terminates test in progress.
AT&T1 ENTER	Selects Local Analogue Loopback LOOP 3. Verifies integrity of the path which includes local modem and local DTE. LOOP 3 test is terminated with an escape code sequence. (+++).
AT&T3 ENTER	Selects Digital Loopback -LOOP 2. To loop the data stream received from the remote modem back to the remote modem
AT&T4 ENTER	Accepts remote digital loop request
AT&T5 ENTER	Denies remote digital loop request (Remote Loop 2)
AT&T6 ENTER	Initiate Remote digital loop
AT&T7 ENTER	Remote digital loop with selftest
AT&T8 ENTER	Local Analogue Loopback with selftest Verifies integrity of local modem transmit and receive circuit. LOOP 3 with selftest is terminated with the command &T0

If the commands &T4 or &T5 are given in online command mode, return to data mode (ATO) will activate the new setup.

Read more about «TESTS» in chapter 14

+T Trellis Coded Modulation

Commands : **+T0, +T1**

AT+T0 ENTER	Disable TCM.
AT+T1 ENTER	Enable TCM.

Applies to V.32 9600 bps operation only.

+&T Inactivity timer control

Commands : **+&T0**, **+&T1**, **+&T2**, **+&T3**

AT+&T0 ENTER	Inactivity timer disabled
AT+&T1 ENTER	Inactivity timer used on received data only
AT+&T2 ENTER	Inactivity timer used on transmitted data only
AT+&T3 ENTER	Inactivity timer used on both received and transmitted data.

Selects the operation of the inactivity timer (+S8).
Remember to assign this register with a value indicating the period of time with no data that is allowed before disconnect.

In **switched line** mode the modem will disconnect the line at inactivity timeout.
In **leased line** mode the modem will disconnect or initiate a dial backup on switched line if inactivity timeout occurs.

Associated command +&DB.

+U Data carrier detection - extended functions

Commands : **+U0**, **+U1**, **+U2**

Enhanced control of V.24 circuit 109 (DCD)

AT+U0 ENTER	DCD (109) OFF during tests where DTE is not active.
AT+U1 ENTER	DCD (109) ON during tests.
AT+U2 ENTER	DCD (109) always ON, except during disconnect.

V Result Code format

Commands: **V0**, **V1**

V-command causes the Result Codes to be displayed in short or verbal form.

ATV0[ENTER]	Enables (numeric) short-form result codes.
ATV1[ENTER]	Selects verbal result codes.

*A summary of the Result Codes is listed at the end of the AT-commands. The Result Codes may be displayed in verbal form. (**CONNECT 1200**) or in short form* **CONNECT 1200** *changes to 5.*

+V Select ITU-T V25 bis Command Mode

Command: **+V**

AT+V[ENTER]	Sets ITU-T V25 bis command mode. Only the ITU-T V25 bis commands are now accepted. Use SAT command to return to AT command set.

V.25 bis Commands are listed at the end of this chapter.

+&VC Channel choice when activating VOICE/DATA

Commands: **+&VC0**, **+&VC1**

This parameter is only used when operating in switched-line mode.

AT+&VC0[ENTER]	Automatic channel choice means that the modem will enter the answer handshake if "RING" is detected, else it will enter call establishment
AT+&VC1[ENTER]	Channel is determined by +&FC-command, selecting answer or call.

+&VD Call progress method by activating VOICE/DATA

Commands: **+&VD0**, **+&VD1**

This parameter is only used when operating in switched-line mode.

AT+&VD0 ENTER	No number dialing, start handshake immediately.
AT+&VD1 ENTER	Use Call list 1 and dial number(s). **VOICE/DATA** switch and 108.1 uses Call-list 1.

See chapter 11 "Call-lists".

Examples of dialling using Call switch.

AT+&VC1 ENTER	Automatic channel choice by activating Voice/Data
AT+&VD1 ENTER	Use Call-list 1 when dialling.
AT+S35=0 ENTER	Index to first number in the Call-list 1
AT+S36=1 ENTER	Index to last number in the Call-list 1
AT&Z0=T37017000 ENTER	First number in Call-list (+S35=0)
AT&Z1=T37017001 ENTER	Last number in Call-list (+S36=1)

When activating VOICE/DATA button the modem will dial the 1. number in Call list 1 (+S35=0):T37017000. If modem fails to connect it will dial the next number, i.e. T37017001 and so on, until the Call-list is empty. In this case T37017001.

+&VT Select test control with ct140/141

Commands: **+&VT0**, **+&VT1**

AT+&VT0 ENTER	Disable loop test control
AT+&VT1 ENTER	Enable loop test control

An OFF to ON transition of ct140 will start a remote Loop2 when +&VT1 is set.

An OFF to ON transition of ct141 will start a Loop3 when +&VT1 is set. Ct140 and ct141 will be ignored with the setting +&VT0.

&W Save Active Memory Configuration Profile

Commands: **&W0, &W1**

This command stores the active modem configuration in one of two userdefined memories. The active memory is lost if the power goes down, but the two userdefined memories are intact even during long periods without power.

Example:

AT&D2&W0 ENTER	**&D2** is stored in the userdefined memory (In some cases it may be necessary using &D2 and &D3 to go on hook.)

another example:

AT&F&W1 ENTER	The command reinstall the factory values into Active memory and store the configuration in userdefined memory 1

+W Select 2-wire or 4-wire configuration

Commands: **+W0, +W1**

Applies to leased line only.

AT+W0 ENTER	Select the 2 wire configuration
AT+W1 ENTER	Select the 4 wire configuration

X Dial tone/Busy detect - "Connect" messages

Commands: **X0, X1, X2, X3, X4**
"**Blind dial**" is not allowed in Sweden. therefor the commands X0, X1, and X3 are not allowed to use in Sweden.

Some local exchanges (PABX) uses a non-standard dial tone which the modem may not be able to detect. The X commands may disable dial tone detect in the modem to avoid this problem.

ATX0ENTER	The modem reports ***CONNECT*** once a satisfactory connection is established. The modem waits a number of seconds, determined by S6 register, and dials the number regardless of whether the dial tone is present or not. (Blind dial). Busy signals will not be recognised.
ATX1ENTER	The modem sends: ***CONNECT*** or ***CONNECT 0600*** or ***CONNECT 1200*** or ***CONNECT 2400*** or ***CONNECT4800*** or ***CONNECT 7200*** or ***CONNECT 9600*** or ***CONNECT 12000*** or ***CONNECT 14400*** or ***CONNECT 16800*** or ***CONNECT 19200*** The modem waits a number of seconds determined by S6 register, and dials the number without any dialtone detection. (Blind dial). After dialling, any busy signals will not be recognised.
ATX2ENTER	The modem sends ***CONNECT*** or ***CONNECT nnn***. (See command X1). Modem waits for dial tone before dialling and reports ***NO DIALTONE*** if dial tone is not detected within 20 seconds. (This parameter will depend on the selected country code). After dialling, any busy signals will not be recognised.
ATX3ENTER	The modem sends ***CONNECT or CONNECT nnn***. (See command X1). The modem blind dials (dials the number regardless whether the dial tone is present or not, but waits number of seconds determined by S6-register) and reports ***BUSY*** if busy signal is detected after dialling.
ATX4ENTER	The modem sends ***CONNECT*** or ***CONNECT nnn.*** Modem waits for dial tone, before dialling Reports ***NO DIALTONE*** if dialtone is not detected within 20 seconds. It reports BUSY if busy signal is detected after dialling.

Associated commands: **Q, +Q, V**.

&X Source Transmit Clock for Synchronous Mode

Commands: **&X0, &X1, &X2**

AT&X0 ENTER	The modem sources transmit clock V.24 circuit 114.
AT&X1 ENTER	The data terminal (DTE) sources transmit clock. V.24 circuit 113.
AT&X2 ENTER	The modem sources slave clock. Receive clock is used as transmit clock. V.24 circuit 115 will be both transmit and received clock.

\X Transparent XON/XOFF mode

Commands: **\X0, \X1**

If XON/XOFF local flow control on transmitted data to DTE (\Q1 or \Q4) is selected, this command selects whether an XON/XOFF character received from DTE should be sent to the remote modem.

AT\X0 ENTER	The modem will not transmit a received XON/XOFF character from DTE to the remote modem.
AT\X1 ENTER	A received XON/XOFF character received from DTE is sent to the remote modem.

\X1 should not be used in conjunction with the \G1 or \G2 commands because the remote modem will receive XON/XOFF from two sources: The modem (\G) and the DTE. This may lead to a conflict.

&Y Recall user Profile on power up

Commands: **&Y0, &Y1**

The modem will always recall its configuration from a userdefined profile after power up. This command selects which profile to use:

AT&Y0 ENTER	Recall userdefined profile 0 at power up. This profile is stored by &W0.
AT&Y1 ENTER	Recall userdefined profile 1 at power up. This profile is stored by &W1.

+Y Compromise Equaliser control

Commands: **+Y0**, **+Y1**, **+Y2**

This command selects which transmit compromise equaliser to use. The equaliser shall compensate the transmitted energy spectrum for the delay/gain shapes on the line between the modems. The default equaliser suits most applications and should not be changed unless special line types are used

AT+Y0 ENTER	Equaliser disabled. Improves modem performance on back to back or short cable connections.
AT+Y1 ENTER	Default equaliser. Should normally be used.
AT+Y2 ENTER	Selects an equaliser suited for long cable connections (Above 10 km).

Z Fetch Userdefined Configuration Profile

Commands: **Z0**, **Z1**

1. The modem has two userdefined profiles, 0 and 1. Each profile contains a complete modem configuration. The **Z** command fetches one of the profiles and loads it into the active memory.

ATZ1 ENTER	Fetches the content of userdefined profile 1, into active memory

2. Read more about how to insure that the modem keeps the active configuration after a power down in the **&Y** command and in chapter 5.
3. The modem disconnects when this command is given in on-line command mode.

&Z Store Telephone Number

The modem can store 20 telephone numbers in non volatile memory. References to a stored telephone number are based upon entry number in the list.

n Is the telephone number. The number may contain 35 characters, consisting of numbers and dial modifiers as described in the D command.

x Is the entry number in the telephone list. Legal values range from 0 to 19.

These numbers may be accessed in V.25bis command mode, but with numbers 1 to 20, where AT entry 0 equals V.25bis entry 1

&Zn Stores telephone number "n" at entry 0.
&Zx=n Stores telephone number "n" at entry "x".
&Z Deletes telephone number at entry 0.
&Zx= Deletes telephone number at entry "x".

A telephone number can be inserted or erased from the table with the &Z command. The total number of characters in the table is limited. The modem will send the message ***NO MORE SPACE AVAILABLE*** if a number is inserted and the table is full. Erasing an entry returns more free space.

The modem can dial a stored number when controlled by:
- The dial command DS. (Described in the D command.)
- The V.24 signal 108.1. The 108.1 function must be enabled (+E command) or &M2 command must be active. Read nire about this function in chapter 5.
- The front switch ROLL/EXEC and register +S21, bit 5 = 1.

Example of how to store a number in entry 0:

AT&ZT0W37011710 ENTER

T0W37011710 is now stored in non volatile memory.

The modem answers: ***OK***
The number string:
T: Tone Dial
0: Request for external dial tone
W: Wait for dial tone
37011710: subscribers number

Example of how to store a number in entry 12:

AT&Z12=T0W37011710 ENTER

The modem answers: ***OK***

How to erase the number at entry 0:

AT&Z ENTER

Erases the stored number at entry 0.

Modem : ***OK***
Example of how to erase the number at entry 12:

AT&Z12= ENTER

Erases the number at entry 12.

The modem answers ***OK***

+Z Test Mode

Command: **+Z** Sets the modem in test mode

The modem can be forced into a test mode which is used for functionality testing and measurements.

3.5 Result codes

As shown above the Result Codes may be displayed in short or verbal form. The result codes in verbal format may display ***CONNECT 1200***. In short form the result code ***CONNECT 1200*** changes to 5.

Result code	Short form	Description
OK	**0**	Execution of an approved command string.
CONNECT	**1**	A connection has been established at 0 - 300 bit/s, or the X0 command is active.
RING	**2**	Ring signal is detected.
NO CARRIER	**3**	Failure to connect or loss of carrier.
ERROR	**4**	Command not recognized. Too long command string. (More than 80 characters).
CONNECT 1200	**5**	A connection has been established at 1200 bps.
NO DIALTONE	**6**	The **W** command is issued,and dial tone is not detected within the period specified by S7. The **X2** or the **X4** command is issued, and the dial tone is not detected within 5 seconds after off-hook.
BUSY	**7**	Busy signal detected.
NO ANSWER	**8**	Calling the Paging System and no receipt tone detected after use of the **%** dial modifier. 5 seconds silence not detected after use of the **@** dial modifier.
CONNECT 0600	**9**	A connection has been established at 600 bps.
CONNECT 2400	**10**	A connection has been established at 2400 bps
CONNECT 4800	**11**	A connection has been established at 4800 bps.
CONNECT 9600	**12**	A connection has been established at 9600 bps.
CONNECT 7200	**13**	A connection has been established at 7200 bps.
CONNECT 12000	**14**	A connection has been established at 12000 bps.
CONNECT 14400	**15**	A connection has been established at 14400 bps.
CONNECT 16800	**16**	A connection has been established at 16800 bps.
CONNECT 19200	**17**	A connection has been established at 19200 bps.
CONNECT/REL	**20**	MNP/LAPM in 300 bps
CONNECT 0600/REL	**21**	MNP/LAPM in 600 bps
CONNECT 1200/REL	**22**	MNP/LAPM in 1200 bps
CONNECT 2400/REL	**23**	MNP/LAPM in 2400 bps. If Speed Conversion (+C1) and +Q1 are used simultaneously. The Result code ***CONNECT*** xxxx/REL/yyy displays (xxxx= baudrate towards the remote modem) (yyyy= baudrate towards the DTE.
CONNECT 4800/REL	**24**	MNP/LAPM in 4800 bps
CONNECT 9600/REL (CONNECT 9600/REL/9600/TCM)	**25**	MNP/LAPM in 9600 bps Using+Q2 or +Q3 (extra resultcodes) and TCM handshake.
CONNECT 7200/REL	**26**	MNP/LAPM in 7200 bps
CONNECT 12000/REL	**27**	MNP/LAPM in 12000 bps

Result code	Short form	Description
CONNEC14400/REL	**28**	MNP/LAPM in 14400 bps
CONNEC16800/REL	**29**	MNP/LAPM in 16800 bps
CONNEC19200/REL	**30**	MNP/LAPM in 19200 bps
PASSWORD EXISTS	**110**	Password exists. Attempt to store an existing password
PASSWORD TABLE IS EMPTY	**111**	No passwords has been entered. Requesting list of passwords, AT+P used.
PASSWORD NOT FOUND	**112**	Password does not exist. Attempt to delete a none existing password.
NO MORE SPACE AVAILABLE	**113**	No more space available to store passwords.
ENTER PASSWORD FOR +P ACCESS	**114**	The modem demands a password with access level 2 to give access to the password commands.
DELETE ALL PASSWORDS? (Y/N)	**115**	Safely question when deleting all passwords.
*PRESS **ROLL/EXEC** SWITCH TO CONFIRM*	**116**	The modem demands the **ROLL/EXEC** switch to be activated before the command is executed.
ILLEGAL CONFIGURATION	**117**	A command in conflict the the active configuration has been issued.
TEST	**120**	Modem is in testmode.
BLACK LIST TABLE IS FULL, RESET MODEM	**130**	Turn the modem on/off before calling.
BLACK LISTED NUMBER	**131**	The number will be blacklisted for 30 min.
DELAYED NUMBER	**132**	
THE MODEM IS BLOCKED, RESET MODEM	**133**	
HAND SET IS OFF-HOOK	**136**	
HAND SET IS ON-HOOK	**137**	
KEY TABLE EMPTY	**200**	No encryption keys found in the table.
CRYPT ENTRY NOT FOUND	**201**	No password with encryption key found in the table.
USER FIELD EMPTY	**202**	User field missing in password table.
DELETE ALL KEYS?	**203**	Confirm before deleting all keys. (+PZ)
REMOTE MODEM DIALS BACK	**204**	Message from remote modem. Will dial back.
KEY INDEX NOT FOUND	**205**	The key index received from remote modem is stored in the key table.

3.6 AT-Commands Ignored by the Modem

The following AT commands are ignored by this modem.

- **F** Half/full duplex
- **&J** Jack type selection
- **L** Loudspeaker volume control
- **&P** Select Pulse Dial
- **T** Set touch tone dial
- **P** Set pulse dial
- **W** Return line speed
- **Y** Long space disconnect
- **C** Transmitter ON/OFF

3.7 ITU-T V.25 bis commands

V. 25 bis mode provide with an alternate set of commands and responses to AT commands. The V.25 bis mode performs dialling functions in the asynchronous or synchronous mode according to the ITU-T.

The V.25 bis defines modem behaviour only while the modem is disconnected from the line, or while the modem is off-hook and is attempting to establish a connection. The modem is no longer in V.25 bis mode after the connection has been established.

In V.25 bis Synchronous mode, only the synchronous Data Link Control (SDLC), which is more common in use, is supported by the modem.

During automatic calling and answering procedure CD (109) follows the condition of CTS (106).

The selection of commands is restricted to those described in V.25 bis, except for the SAT command which is used to return to AT command mode. V.25 bis commands do not include any modem configuration commands . The modem must therefore be configured by means of AT commands or via display before entering V.25 bis mode. All relevant parameters set by AT commands are also valid for operating in the V.25 bis.

All commands are terminated with "Line Feed" (0AHex) and not "Carriage Return" (0DHex) as in AT command mode. (CR, LF is a legal terminating sequence).

To insure that the modem will start in V.25 bis mode after a power down you should give the following command sequence.

AT+V&W&Y

Sets ITU-T V.25 bis command mode.

In the V.25 bis mode, disconnecting the modem from the line is always done by turning DTR OFF.

To use the CCITT V25 bis commands, it is a precondition that the DTR-signal can be controlled.

To control the parameter "DTR Delay" see register S25.

Synchronous V.25 bis command mode:

Synchronous operation in V.25 bis command mode can be selected in any one of the following ways:

⇒Give AT&Mn+V in Hayes command mode (n=1, 2 or 3).
⇒Enter CHANGE GENERAL CONF. menu via display, select SYNC data format and V.25 bis command mode.

In order to utilise V.25 bis bit synchronous mode, a DTE that also supports this command mode is necessary. The commands from DTE and messages from the modem are sent in HDLC format.

	F	A	C	Message		F	

F 7EH
A FFH
C 13H
Message Information field of the frame
FCS Frame check sequence.

Clocking:

The modem provides clocking via pin 15 and 17 at DTE interface for communication with the local DTE. It is also possible to select DTE provided timing (circuit 113).

CRN yy...yy Dial Telephone Number

(command)
Dials telephone number yy...yy immediately

Example:

CRN4737011710 L_F The modem dials number: 4737011710.

The following dial modifiers may be used:

: Wait for new dial tone.

= The modem waits a period determined by S6 before transferring the next character of the telephone number.

PRN xx;yy...yy Storing of Telephone Number

Stores number yy...yy in position no. xx
Position number xx can be any number in the range 1--20

Example:

PRN12;4737011710 L_F The modem stores number: 4737011710 in position 12

CRS xx Dial Stored Number

The modem dials the number stored in position xx

Example:

CRS12 L_F The modem dials the number stored in position 12

RLN xx Request for Listing of Stored Number

The modem will display the number stored in position no. xx. (See indication LSNxx;yy..yy)

Example:

RLN12 L_F The modem displays the number stored in position no. 12

The RLN command by itself will list all entries from the list, even if they are empty.

DIC Disregard Incoming Call

Example:

DICL$_F$

This command is only accepted when an incoming call is detected, and will result in the call being ignored. When the call detection is cleared, the command state will also be cleared and the next incoming call will be handled normally again

CIC Accept Incoming Call

Example:

CICL$_F$

The modem will connect an incoming call.

SAT Set AT Command Mode

Example:

SATL$_F$

The modem now accepts only AT-commands.

Modem answers ***OK***

3.8 Result Codes in ITU-T V.25 bis:

LSN xx;yy..yy Listing of stored number

The modem indicates that number yy..yy is stored in position no. xx

Example:

LSN12;4737011710 L$_F$

The modem shows the number stored in position no. 12

Result Code	Explanation
CFINT	Failed during dial
CFIAB	Aborted call
CFICB	Local DCE busy, no Dial tone
CFIET	Engaged tone
INC	Incoming Call. The modem has received a call
VAL	Valid Command.
INV	Invalid Command.

4. Registers

4.1 What are S-registers

The S registers comprise the modem's active memory. These contain the information that controls the operation of the modem.

There are 4 different S register memories in the modem. Each memory contains 28 S registers (S0,S1,...,S27) and 56 +S registers (+S0,+S2,.. ..,+S55).

As part of the description of each command the default value is indicated with an underscore. These default values are carefully selected in order to give the user a starting point from where it is easy to use the modem for most applications. However, there can be deviations from the standard default setting, due to national PTT requirements, or as a result of customer requests. If in doubt about this, the actual default values can be read out from the modem in the following way:

Load factory profile with command

List all settings with command

4.1.1 Permanent memory:

This memory contains the factory configuration of the modem and is not erasable. (Located in EPROM).

4.1.2 Active memory:

This S register memory controls the operation of the modem. It is not permanent and will be destroyed in case of power down.

It is always the active memory that controls the operation of the modem. The content of this memory may be changed by commands.

4.1.3 Userdefined memory:

These are 2 memories in which the user may store userdefined configurations. The memories are permanent (EEPROM).

4.1.4 Examples

Example on how to store a value in a S register:

ATS6=6 

S register 6 is assigned the value 6.
The command makes the modem wait 6 seconds before dialling, instead of the default value 2.

The modem answers ***OK***

Example on how to display a S register:

ATS6? 

Show the current value of S register 6
The modem answers ***006***
OK

4.1.5 Bit mapped S registers:

In the description of the S registers you will notice that some of the S registers are bit mapped. This means that the operation is controlled bitwise.

Sometimes it may be desirable to change the bit values directly. This is done with the Sn= and +Sn= commands.

The content of a S register is displayed with the Sn? and +Sn? commands.

In the chapter on S-registers, the values of the binary coded registers are set to for example **0CCCAC0C** (S16) or **x0x0xxx0** (S14). This means:

C can only be changed by means of corresponding commands (not directly by means of Sn= and +Sn= commands).

A Automatically changed by the modem

X can be changed by means of corresponding commands and directly by means of Sn=and +Sn= commands.

0 (or 1) Cannot be changed.

Example:

S-register 14 - Default 8A hexadecimal or 138 decimal

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	0	0	0	1	0	1	0

If you require short form result codes instead of verbal ones, bit 3 must be changed to "0" according to the description.

The following commands will do this:

ATS14=162 

decimal form

or

ATS14=HA2  hexadecimal form

or

ATS14=B10100010  binary form

S-register 14

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	0	1	0	0	0	1	0

The above gives the binary figure 1000 0010, i.e. 82 hex or 130 decimal.

A conversion table between decimal, hexadecimal and binary notation is listed in the appendix.

S0 Auto answer on/off*

Default: **0**
Range: **0-5**

Example:

ATS0=0  Disable autoanswer function.

S0 determines how many ring signals the modem has to detect before answering a call.

Register S0 is used to inform the modem how many ringing tones it will accept before answering (automatic reply). "0" or when S0=0 means that the modem will not reply at all when someone rings. If the S0 register is set to 1, the modem will reply immediately.

S1 Ring counter

Range: **0-255**

Use:

ATS1?  Tells terminal numbers of ringing signal which is detected.

The S1 value increases by "1" for each ring signal detected on the telephone line and cleared if no rings occur within 8 seconds.

When S1 = S0, the modem will autoanswer (S0>0).

*Read more about country dependent parameters in appendix 5

S2 Escape Sequence Code (+++)

Default: **43**, which is the ASCII code for + .
Range: **0-255**

The Escape code is now **#**, which is ASCII code 23.
If you use the command **###**, causes the modem to return from data to command mode, without going on hook

The S2 value may be between 0 and 255. However, values greater than 127 will disable the "escape" - sequence, as it will not be registered by the modem. Return to command state can now only take place if the remote modem disconnects, causing the carrier to disappear.

If either of **&D1**, **&D2** or **&D3** commands is used, the modem will return to command state when detecting DTR ON/OFF.

S3 Carriage return

Default: **13**
(can be changed if the DTE is other than standard type.)
Range: **0-127 ASCII**

Used to end command strings

S4 Line feed

Default: **10**
Range: **0-127 ASCII**

Line feed is a check symbol following Carriage Return when verbal result codes are being used.

S5 Back space

Default: **8.**
Range: **0-127 ASCII**

The value must not represent an ASCII character greater than 33.

S6 Wait before blind dial*

Default: **2 seconds**.
Range: **2-10 sec.**

ATS6=8↵	This command causes the modem to wait eight seconds before blind dial (dialling the number)

The value in S6 is only used in the **X0**, **X1** and **X3** modes.

S7 Wait Time for Answer tone*

Default: **50 seconds**
Range: **0-60 sec**.

ATS7=60↵	S7 determines how long (0-60 seconds) the modem will wait for an answertone from a remote modem after having dialled the required telephone number.

If the answer tone is not detected within the specified time, or if carrier is not detected within 10 seconds after answer tone is detected, the modem will disconnect and send the ***NO CARRIER*** message.

S8 Pause time for comma: ","*

Default: **2 seconds.**
Range: **0-10 sec.**

ATS8=10↵	Causes the modem to wait 10 seconds for each comma.
ATD0,0165↵	The modem dials 0, then waits for 10 seconds before dialling 0165.

*Read more about country dependent parameters in appendix 5.

S9 Carrier detect Response time

Default: **6 x1/10 of a second**
Range: **1-255**

Determines the period a carrier must be present before the modem detects it and turns DCD (Data Carrier Detect) ON.

ATS9=100[ENTER]

This command causes the carrier detect to be present 100/10 seconds before the modem detects it and turns DCD (Data Carrier Detect) ON.

A time increase will reduce the risk of detecting a "false carrier" such as busy signal, voices etc.

S10 Lost carrier to hang-up delay.

Default: **1 x 1/10 second.**
Range: **1-255**

Determines the delay between lost carrier from the remote modem and disconnection of own modem.

ATS10=18[ENTER]

The modem waits 18/10 seconds between lost carrier from the remote modem and disconnection of own modem.

If S10 is set to 255 the modem will not disconnect if carrier is lost.

Associated register: **+S13**

S11DTMF Dialling speed*

Default: **100 x 1/1000 second.**
Range: **65-130**

Example:

ATS11=70[ENTER]

Waiting 70 msec between each number when dialling.

*Read more about country dependent parameters in appendix 5.

S12 Escape code guard time

Default: **50 x 1/50 seconds**
Range **0-255.**

Determines the time delay (Guard Time) required immediately before and after entering the escape sequence (+++).

Also sets the entering speed of the +++ sequence, as the time between each + must be less than Guard Time. (Does not apply when the S12 value is set to 0).

ATS12=100 

There must be a quiet time of 2 seconds before and after entering +++

S13 Not used

S14 Bit mapped options

Binary code: **x0x0 xxx0** Default: **138 (8A hex)**
x000 xxx0 (Sweden)

Bit 0	Not used	0		
Bit 1	Echo on/off (See **E**-command)	0 1	(**E0**) (**E1**)	Off On
Bit 2	Result codes on/off (See **Q**-command)	0 1	(**Q0**) (**Q1**)	On Off
Bit 3	Result code format (See **V**-command)	0 1	(**V0**) (**V1**)	Short form Verbal result code
Bit 4	Not used	0		
Bit 5	Impulsing (See **D**-commands, dial modifiers: **T**- and **P**)	0 1	(**T**) (**P**)	Tone dial Pulse dial
Bit 6	Not used	0		
Bit 7	Call/Answer mode (See **A**-, **D**- **R**-commands, and **S0**-register).	0 1	**(A)** **/(DR)** (**D**)	Answer Dial

S15 Not used

S16 Test mode status

Binary code: **0CCC AC0C** Default: **00 hex**

Bit 0	Local analogue loopback (See **&T1**-commands.)	0 1		Disabled Test in progress
Bit 1	Not used	0		
Bit 2	Digital loopback (See **&T3**)	0 1		Disabled Test in progress
Bit 3	Status bit-indicates that the modem has entered Remote Digital Loop (RDL) initiated by remote modem. (See **&T4**- and **&T5**)	0 1		Loopback off Test in progress
Bit 4	Indicates Remote Digital Loopback (RDL). (See **&T6**)	0 1		Inactive Test in progress
Bit 5	Indicates Remote Digital Loopback (RDL) with self test (See **&T7**.)	0 1		Disabled Test in progress
Bit 6	Indicates Local analogue loopback with self test (See **&T8**.)	0 1		Disabled Test in progress
Bit 7	Not used.	0		

&T0-command ends any test and sets S16 to zero.

S17 Not used

S18 Test timer

Default: **0** disables the test timer.
Range: **0 -255 (seconds)**

The duration of a test is determined by the content of S18 register. When a test has lasted for the time determined by the S18 value (in seconds), the test is ended and the modem returns to previous mode.

S19/S20 Not used

S21 Bit mapped options

Binary code: **00xx xx00** Default **20 hex**

Bit 0-1	Not used	0		
Bit 2	RTS/CTS function (Only in Synchronous mode.) (See **&R**-command.)	0	(**&R0**)	When the modem is on-hook, CTS is always ON. CTS goes off as soon as the modem goes off-hook and remains OFF until the handshake is completed. When the modem detects an OFF to ON transition on RTS, CTS will go ON after a delay determined by register S26. If the modem detects ON to OFF on RTS, CTS will go OFF immediately.
		1	(**&R1**)	When the modem is on-hook, CTS is always ON. CTS goes OFF as soon as the modem goes off-hook and remains OFF until the handshake is completed. Now CTS goes ON and stays ON until loss of carrier is detected.
Bit 4,3	Data Terminal Ready(DTR) (See **&D**-command.)	00	(**&D0**)	Modem ignores DTR.
		01	(**&D1**)	Modem is set to command state detecting DTR ON to OFF
		10	(**&D2**)	The modem hangs up if ON-to-OFF transition on DTR
		11	(**&D3**)	Modem goes to initialisation state if ON-to-OFF transition on DTR
Bit 5	Data Carrier Detect (DCD) (See **&C**-command.)	0	(**&C0**)	DCD always ON.
		1	(**&C1**)	DCD ON indicates carrier presence.
Bit 6-7	Not used	0		

S22 Bit mapped options*

Binary code: **0xxx xx00** Default: **74 hex**

Bit 1,0	Not used			
Bit 3,2	Speaker On/Off (See **M**-command)	00 01 10 11	(**M0**) (**M1**) (**M2**) (**M3**)	Speaker Off Speaker on until carrier detect Speaker always on Speaker on until carrier detect, Off during dial
Bit 6,5,4	Dial tone detect- "Connect" messages (See **X**-command)	000	(**X0**)	The modem reports once a satisfactory connection is established. The modem waits a number of seconds (S6 register), and dials the number regardless of whether the dial tone is present or not. Busy signals will not be recognised
		100	(**X1**)	The modem sends: ***CONNECT*** or ***CONNECT 1200*** or ***CONNECT 2400*** or ***CONNECT 4800*** or ***CONNECT 7200*** or ***CONNECT 9600*** or ***CONNECT 12000*** or ***CONNECT 14400*** or ***CONNECT 16800*** or ***CONNECT 19200*** or Waits a number of seconds (S6). Dials the number, regardless of any dialtone detection. After dialling, any busy signals will not be recognised.
		101	(**X2**)	Sends ***CONNECT*** or ***CONNECT nnn***. (See X1), waits for dialtone before dialling. Reports ***NO DIAL-TONE*** if dial tone is not detect-ed within 20 seconds. (Country dependent). After dialling, any busy signals will not be recognised.
		110	(**X3**)	Sends ***CONNECT*** or ***CONNECT nnn***. (Command X1), blind dials but waits number of seconds (S6) and reports BUSY if busy signal is detected after dialling.
		111	(**X4**)	Sends ***CONNECT*** or ***CONNECT nnn***, waits for dial tone, before dialling. Reports ***NO DIALTONE*** if dial tone is not detected within 20 seconds. Reports ***BUSY*** if busy signal is detected after dialling.
Bit 7	Not used	0 1	(**&P0**) (**&P1**)	39/61 Puls. 33/67 Imp.

* Read more about country dependent parameters in appendix 5.

S23 Bit mapped options*

Binary code: **xx00 000x** Default: **81 hex**

Bit 0	Accepts a request for Remote Digital Loopback. (See **&T4- / &T5** commands)	0 1	(**&T5**) (**&T4**)	Disabled Enabled
Bit 5-1	Not used	0		
Bit 7,6	Guard tone (See **&G**-command.)	00 01 10 11	(**&G0**) (**&G1**) (**&G2**)	No guard tone 550 Hz 1800 Hz Not used

S24 Not used

S25 DTR Delay

Default. : **5 seconds**
Value: **0-255**

Unit for S25 is:
seconds for Synchronous mode 1
1/100 seconds for asynchronous mode and synchronous mode 2 and 3

Synchronous mode 1

When connection is completed, the modem waits a number of seconds before accepting DTR. The time available for the operator to reconnect from asynchronous DTE to synchronous DTE (modem does not return to the command state) may be between 0 and 255

Asynchronous and Synchronous mode 2 and 3

A change of DTR (ON or OFF), lasting for a shorter period than determined by S25, will be ignored.

*Read more about country dependent parameters in appendix 5.

S26 RTS to CTS Delay

Default **1 (1/100 sec)**
Value **0-255**

Only used in synchronous mode.
When the modem detects an OFF to ON transition on RTS, CTS (Clear to Send) will go ON after a delay determined by register S26. **&R0** command must be active.

S27 Bit mapped options

Binary code: **0xxx 0xxx** Default: **00**

Bit 1,0	Transmission mode (See **&M**-command)	00	**(&M0)**	Asynchronous transmission
		01	**(&M1)**	Sync. mode 1
		10	**(&M2)**	Sync. mode 2
		11	**(&M3)**	Sync. mode 3
Bit 2	Leased or dialup line (See **&L**-command)	0	**(&L0)**	Switched line
		1	**(&L1)**	Leased line
Bit 3	Not used	0		
Bit 5,4	Source for synchronous transmit clock is (See **&X**-command)	00	**(&X0)**	Modem, (RS232c pin 15, circuit 114 - TCK)
		01	**(&X1)**	Data Terminal, (RS232c pin 24,circuit 113 - XCK)
		10	**(&X2)**	Slave clock
		11		Not used
Bit 6	Bell or ITU-T (See **B**-command.)	0	**(B0)**	ITU-T V.21/V.22
		1	**(B1)**	Bell 103, Bell 212A
Bit 7	Not used	0		

The modem has an extended set of S registers in addition to the S registers defined in the Hayes standard. These +S registers are operated with the commands:

+Sn=x Assign register n the value x (x in decimal notation)
+Sn=Hx Assign register n the value x (x in hex notation)
+Sn=Bx Assign register n the value x (x in binary notation)
+Sn? Display the value of register n in decimal notation
+SnH? Display the value of register n in hex notation
+SnB? Display the value of register n in binary notation

+S0 Bit mapped options*

Binary code: **CxxC x000** Default: 40 **hex**

Bit 0-2	Not used			
Bit 3	Bypass test of 1300 Hz (See **+B**-command)	0 1	(**+B0**) (**+B1**)	Disabled Enabled
Bit 4	Z or X (Oslo) impulsing (only used in Norway)	0 1	(**+I0**) (**+I1**)	Z-impulsing X-impulsing (Oslo)
Bit 5	Auto answer Channel Choice (See **+A**-command)	0 1	(**+AB**) (**+AA**)	Answers in channel B Answers in channel A.
Bit 6	Speed conversion (See **+C**-command)	0 1	(**+C0**) (**+C1**)	Inactive Enabled. When using dumb/manual mode with DIP7 on, +C0 is default.
Bit 7	Command mode (See **+V** and **SAT**) commands)	0 1	(**SAT**) (**+V**)	AT ITU-T V.25 bis

*Read more about country dependent parameters in appendix 5

+S1 Bit mapped options

Binary code: **Cx0C CCxx** Default: **40 hex**

Bit 1, 0	Extra result codes (See **+Q** command)	00 01 10 11	**(+Q0)** **(+Q1)** **(+Q2)** **(+Q3)**	Disabled Enabled Line and DTE speed MNP class/connect
Bit 3, 2	Remote control (See **+O**-command)	00 01 10 11	**(+O0)** **(+O1)** **(+O2)** **(+O3)**	Disabled Enable Enable. (Asks for password) Enable. As for +O2 but will also enable Remote Unlock of the modem
Bit 4	Password/Dialback (See **+PO**-command)	0 1	**(+PO0)**/ **(+PO1)** **(+PO2)**	Mode 1 Mode 2
Bit 5	Not used	0		
Bit 6	1300 Hz Call Tone (See **+D**-command)	0 1	**(+D0)** **(+D1)**	1300 Hz call tone OFF 1300 Hz call tone ON
Bit 7	Password/Dialback (See **+PO**-command)	0 1	**(+PO0)** **(+PO1)**/ **(+PO2)**	Off On

+S2 Dialback wait time

Default: **90 sec**
Range: **5-255 sec**

Defines the time the modem waits off-line before it initiates a dialback.

If the first connection failed, the modem will wait at least 60 seconds before a new dialback.

+S3 Wait time for password

Default: **60**
Range: **5-255**

The modem will wait a number of seconds, determined of the value in register +S3, to receive a password. The modem disconnects, if the correct password is not received within this period.

+S4 Number of dialback attempts

Default: **4 times**
Values: **1-4 times**

Number of dialback attempts to make a proper connection is set by value in register +S4

+S5 Bit mapped options (DTE configuration)

Binary code: **AAAA AAAA** Default: **8A hex**
Default DTE speed: **14400 bps**

This table is automatically updated by using AT commands or by using the SET-UP menu.

Bit 3-0	Speed	0000		Not used
		0001		Not used
		0010		300 bps
		0011		600 bps
		0100		1200 bps
		0101		2400 bps
		0110		4800 bps
		0111		7200 bps
		1000		9600 bps
		1001		12000 bps
		1010		14400 bps
		1011		16800 bps
		1100		19200 bps
		1101		38400 bps
Bit 4	Stop bit	0		1 stop bit
		1		2 stop bit
Bit 5	Parity	0		Disable
		1		Enable
Bit 6	Parity	0		Odd
		1		Even
Bit 7	Number of bit/character	0		7 bits/character
		1		8 bits/character

Speed detection by AT command is not available for this speed.

+S6 Bit mapped options (DCE Configuration)

Binary code: **xxxx xxxx** Default: **8A hex**
Default line speed: **14400 bps**

Defined as +S5. +S6 is set equal to +S5 whenever there is a change in speed or format on the AT command prefix received.

In off-line command mode all bits in +S6 may be changed. In on-line command mode only bit 7,6,5,4 may be changed.

This register lets the user specify the modem line speed and format independent of DTE speed and format. The autospeed detect function must be Inactive.(+M0 in answer, **+M0** or **+M1** in originate.)

Examples:
If you wish to establish a connection using a baudrate at 14400 bps and your terminal doesn't operate at this speed. You may use Speed Conversion .

Enter the following command for A-modem:

AT+M0+C1+S6=138 ENTER
ATDn ENTER

+S6=138
Character format= 8N1
DCE speed = 14400 bps

The B-modem must be configured as follows:

AT+M0+C1+S6=138 ENTER
ATS0=1 ENTER

Speed detection off (+M0 at answer/call and +M1 at call) the modem will try to handshake at a baudrate set in +S6 (+S5)

You may use **%G** and **%B** command to set the speed. This may be easier.

+S7 Bit mapped options*

Binary code: **xxx9 xxxx** Default: **03 hex**

Bit 1,0	Automatic Speed detection (See **+M** command)	00 01 10 11	**(+M0)** **(+M1)** **(+M3)** **(+M2)**	Speed detect off Speed detect only in Answer mode. Speed limit Speed detect in answer and call mode.
Bit 2	Service Provider	0 1		Public network Private network
Bit 3	Result codes in answer mode (See **Q** command)	0 1	**(Q0)/ (Q1)** **(Q2)**	Result codes defined by S14 bit 2 No result codes in answer mode.
Bit 4	On-line data format (See **+&G** command)	0 1	**(+&G0)** **(+&G1)**	Enabled Line format is locked to +S6
Bit 5	108.1 mode (See **+E** command)	0 1	**(+E0)** **(+E1)**	Inactive Active.
Bit 6,7	Half/full duplex (See **+H** command)	0 1 1 0 1 1	**(+H0)** **(+H1)** **(+H2)** **(+H3)**	Full duplex Full duplex with back-channel, V.23 Not used, reserved Full duplex 4-wire leased line, V.23

+S8 Inactivity timer

Default **30 (300 sec).** Unit : 10 sec.
Range: **1-255**

The modem will disconnect if no line activity is detected for a period set by +S8.

This function is available only in asynchronous on-line mode. Result Code ***NO CARRIER*** will be given when modem disconnects.

The inactivity function may be active on either receive or transmit data or both. (See **+&T** and **&DB** command).

*Read more about country dependent parameters in appendix 5.

+S9 Bit mapped options

Internal use only (This table is automatic updated by using AT commands.)

Binary code: **xxx0 CC00** Default: **AC hex**

Bit 1,0	Not used	0		
Bit 4,3,2	Operating mode bits (See \N-command)	000	(\N0)	Normal mode
		001	(\N1)	Direct mode
		010	(\N2)	LAPM/MNP
		011	(\N3)	LAPM/MNP/Normal auto detect
		100	(\N4)	MNP/Normal
		101	(\N5)	LAPM/Normal
		110	(\N6)	MNP
		111	(\N7)	LAPM
Bit 7,6,5	Break handling (See \K-command)	000	(\K0)	
		001	(\K1)	
	Destructive: All data buffers are cleared. Expedited: Break will be sent immediately **Non-Expedited:** Break is sent in sequence with data	011	(\K2)	
		011	(\K3)	
		110	(\K4)	
		101	(\K5)	

+S10/+S12 Not used

+S13 EQM Disconnect level

Default: **120**
Range: **0-255**

EQM (Eye Quality monitor) will monitor the quality of the received carrier if register+S13 is set to a value different from zero.

EQM =0 The signal level is very good for data transmission
EQM=255 The signal level of the carrier is far too low.

EQM monitor is active in the following configurations:

600 Baud	V.22
1200 Baud	V.22
2400 Baud	V.22 bis
4800 Baud	V.32
7200 Baud	V.32
9600 Baud	V.32
12000 Baud	V.32 bis
14400 Baud	V.32 bis
16800 Baud	V.32terbo
19200 Baud	V.32terbo

Setting +S13 to a high value (150 or higher) causes the modem to disconnect at a poor carrier. Setting +S13 to a lower value (10-50) may cause a disconnection at a relatively high line quality.

The value of the line quality is continuously calculated and stored in the register +S15.

The modem disconnects if the EQM monitored value (available in +S15) is larger than the EQM Disconnect level defined in +S13.

To set a correct value for the +S13

⇒Set +S13 to a high value (100-255)
⇒Establish a normal connection with the remote modem
⇒Send the escape code (+++), wait for result code OK.
⇒Enter the command:

AT+S15? ENTER

Repeating the command, the line quality may vary.

The register +S13 is normally set to a value higher than the response of "+S15?" with carrier present.

You may also test condition of loss of carrier when +S13 is entered. To avoid hang-up for the following test

⇒Enter the commands:

ATS10=255 

AT+S13=200 

⇒Disconnect the line plug of the modem

⇒Enter the command +S15? several times.

⇒Set the value +S13 below the average value of the +S15 (loss of carrier)

+S14 EQM Retrain level

Default: **120**
Range: **0-255**

EQM will start transmitting a training sequence when EQM monitor value (+S15) is larger than the constant stored in +S14.

+S15 EQM monitored value

Range: **0 - 255.**

The modem stores the EQM value of the carrier in this register continuously if +S13 is different from zero.

EQM monitor value:

0	means very good signal
255	means a very poor signal

Note that +S15 is an output value only and should not be set by the operator.

+S16 Remote Escape code character

Default : **45** in the ASCII table "-".
Range: **0-255**

Rules for accepting Remote Esc code is as for local Esc code (Enter +S16=42. The Remote Escape code is now *, which is the ASCII code 42). Values greater than 127 will disable «Remote control».

+S17 Remote Escape guard time

Default : **50** x1/50 second
Range: **0-255**

Determines the time delay (Guard Time) required immediately before and after entering the remote escape sequence (- - -)

Also sets the entering speed of the - - - sequence, as the time between each - must be less than the Guard Time.

ATS17=100 ENTER

There must be a quiet time of 2 seconds before and after sending remote escape code.

+S18 Password/Dialback locking function

Default : **255**
Range: **1-255**

129-255
+S18 will decremented by one (until the value 128 is reached) whenever the modem hangs up because a wrong password is entered. Locking will never occur.

128
+S18 will not be decremented when entering wrong password(s)

1-127
The register will be decremented by one (until the value zero is reached) whenever the modem hangs up because wrong password is entered.

0
Locking occurs. Access to host is no longer granted (This value can not be set directly by a command).

+S19 Bit mapped options

Binary code: **xxAx xx00** Default: **50 hex**

Bit 1,0	Not used	0		
Bit 2	Line speed locking (See **%G**-command)	0	(%G0)	Updated by command line prefix AT
		1	(%G1)	Updated by the %B command, or register +S6.
Bit 3	Select &D2 operation (See **+&A**-command)	0	(+&A0)	Normal &D2 operation
		1	(+&A1)	Autoanswer with &D2 and DTR off.
Bit 4	Trellis coded modulation (See **+T** -command)	0	(+T0)	Disabled
		1	(+T1)	Enabled
Bit 5	Command mode on/off (See **+PN**-command)	0	(+PN0)	Command mode on
		1	(+PN1)	Command mode off
Bit 7, 6	Extended DCD control (See **+U**-command)	00	(+U0)	CD (109) off during tests where DTE is not active.
		01	(+U1)	CD (109) on during test.
		10	(+U2)	CD (109) always on
		11		Not used

+S20 Bit mapped options

Binary code: **0000 0xxx** Default: **11 hex**

Bit 2-0	DSR, CTS control (See **&S**-command)	000	(&S0)	DSR and CTS always on
		001	(&S1)	DSR /CTS are controlled as in standard Hayes.
		010	(&S2)	DSR off and CTS on in command mode. DSR and CTS are turned on at same time as DCD.
		011	(&S3)	DSR off and CTS off in command mode. DSR and CTS are turned on at same time as DCD.
		100	(&S4)	DSR always on, CTS will never turn on if RTS is off, but may be switched off by flow control.
		101		Not used
		110		Not used
		111		Not used
Bit 5-3	Test pattern for selftest (See **+&LT**-command)	000	(+&LT0)	SPACE pattern
		001	(+&LT1)	MARK pattern
		010	(+&LT2)	Alternating pattern
		011	(+&LT3)	511 pattern
		1xx		Illegal
7-6	Not used			

+S21 Bit mapped options

Binary code: **00x0 00xx** Default: **00 hex**

Bit 0	Channel choice for 108.1 connections (See **+EC**-command)	0 1	**+&EC0** **+&EC1**	Automatic channel selection Channel selected by +S14 bit 7.
Bit 1	Call progress method for 108.1 (See **+ED**-command)	0 1	**+&ED0** **+&ED1**	Start handshake without dial Dial stored number defined Call list (See +S35, +S36)
Bit 4-2	Not used	0		
Bit 5	Call progress method by activating **VOICE/DATA** (See **+VD**-command)	0 1	**+&VD0** **+&VD1**	Starts handshake without dial Dial stored number defined by Call list (See +S35, +S36)
Bit 7,6	Not used			

+S22 Bit mapped options

Binary code:**00CC CCCC** Default: **07 hex**

Bit 1,0	MNP block size (See **\A**-command)	00 01 10 11	(**\A0**) (**\A1**) (**\A2**) (**\A3**)	Max. 64 bytes. Max. 128 bytes. Max. 192 bytes. Max. 256 bytes
Bit 3, 2	Data compression (See **%C**-command)	00 01 10 11	(**%C0**) (**%C1**) (**%C2**) (**%C3**)	Disabled. V.42 RX+TX V.42 TX V.42 RX
Bit 5,4	Auto-reliable Buffer Command (See **\C**-command)	00 01 10	(**\C0**) (**\C1**) (**\C2**)	Doesn't buffer received data Buffers all characters Doesn't buffer received data
Bit 6-7	Not used	0		

+S23 Bit mapped options

Binary code: **xxxx xxx0** Default: **0A hex**

Bit 0	Not used	0		
Bit 1	Dial backup if loss of Carrier in leased line level is set by +S13	0 1	**(+&DA0)** **(+&DA1)**	Disabled Enabled
Bit 2	Dial backup if data inactivity	0 1	**(+&DB0)** **(+&DB1)**	Disabled Enabled
Bit 4,3	Lookback to leased line (See **+&LB** command)	00 01 10 11	**(+&LB0)** **(+&LB1)** **(+&LB2)** **(+&LB3)**	Lookback disabled Continiously lookback Interval lookback Continously and interval
Bit 5	Leased line mode	0 1		Leased line always on 108.1 control
Bit 7,6	Inactivity timer selection (See **+&T** command)	00 01 10 11	**(+&T0)** **(+&T1)** **(+&T2)** **(+&T3)**	Disabled Received data active Transmitted data active Both directions active

+S24 Bit mapped options

Binary code: 0000 00xx Default: **00 hex**

Bit 1, 0	Automatic dial backup (See **+J** command)	00 01 10 11	**(+J0)** **(+J1)** **(+J2)**	Disabled Enabled Enabled, 108.2 contr. Not used
Bit 7-2	Not used			

+S25 Attempts for each telephone entry

Default: **1**
Range: **1-10**

This register defines the maximum number of attempts for each telephone entry from the call list in case of ***BUSY*** and ***NO CARRIER.***

+S26 Attempts for the telephone list

Default: **1**
Range: **1-10**

This register defines the maximum number of times the call list will be used before the modem cancels the dial sequence.

+S27 Bit mapped options

Binary code: **xxxx xxxx** Default: **00 hex**

Bit 0	2- or 4 wire leased line (See **+W** -command)	0	**(+W0)**	2 wire leased line
			(+W1)	4 wire leased line
Bit 1	V.24 circuits 140/141 test control	0	**(+&VT0)**	Disabled
		1	**(+&VT1)**	Enabled
Bit 2	V24 ct 126 channel select control	0	**(+&EB0)**	Disabled
		1	**(+&EB1)**	Enabled
Bit 3	V24 ct 111/112control	0		Disabled
		1		Enabled
Bit 4	111/112 select	0		111 control active
		1		112 indication active
Bit 6, 5	Select modem standard for 111 (See **+&M** command)	00	**(+&M0)**	V.32
		01	**(+&M1)**	V.22 bis
		10	**(+&M2)**	V.22 (111 only)
		11	**(+&M3)**	V.32 bis
Bit 7	Channel selection when leased line.	0	**(+&LC0)**	Answer (B channel)
		1	**(+&LC1)**	Originate (A channel)

+S28 Delay between leased line and dial backup

Default: **1 (10 sec)**
Range: **1-10**

This register defines the delay from leased line disconnection caused by loss of carrier or poor EQM to the modem initiates a dial backup procedure.

+S29 Bit mapped options

Binary code: **0xxx x0xx** Default: **10 hex**

Bit 1,0	Line flow control (See \G-command)	00 01 10	(\G0) (\G1) (\G2)	Disabled Bi-directional flow control Unidirectional flow control
Bit 2	Not used	0		
Bit 5, 4, 3	Local flow control (See \Q-command)	000 001 010 011 100	(\Q0) (\Q1) (\Q2) (\Q3) (\Q4)	Disabled Bi-directional XON/XOFF CTS control RTS/CTS control Unidirectional XON/XOFF
Bit 6	Transparent XON/XOFF (See \X-command)	0 1	(\X0) (\X1)	Disabled Enabled
Bit 7	Not used	0		

+S30 MNP fallback character

Default: **013 ASCII** Range: **0-127**

This register specifies the character which when received, causes a MNP fallback. This function is only enabled when the modem is configured to auto MNP mode (\N3) and is in answer mode. If the modem receives the MNP fallback character from the remote modem during the link negotiation, it will immediately switch to normal mode and pass the received character to DTE. This function reduces the connect time if the originating modem is in normal mode and the answering modem is in auto MNP mode.

+S30 = 0	Auto MNP fallback Inactive
+S30=1 to 127	Defines auto MNP fallback character, function active
+S30=128 to 255	Illegal value

Related command: \C

+S31 Bit mapped options

Binary code: **xxxx x0CC** Default: **08 Hex**

Bit 1,0	Password security level (See **+PA**-command)	00 01 10 11	(**+PA0**) (**+PA1**) (**+PA2**) (**+PA3**)	No security on password commands Security active Security active, remote control off. Highest security level
Bit 2	Not used	0		
Bit 4, 3	Transmit Compromise Equaliser (See **+Y**-command)	00 01 10 11	(**+Y0**) (**+Y1**) (**+Y2**)[1]	Disabled Standard equaliser Selects an equaliser suited for long cable connections (Above 10 km) Not used
Bit 6,5	HP-ENQ/ACK protocol (See **\H**-command)	00 01 10	(**\H0**) (**\H1**) (**\H2**)	Protocol disabled Modem emulates terminal Modem emulates host
Bit 7	Fixed channel selection for 108.1 and Voice/Data (See **+&FC**-command)	0 1	(**+&FC0**) (**+&FC1**)	Answer channel (B) Originate channel (B)

+S32 Delay between leased line attempts from switched line

Default: 1 Unit: 15 ms
Range: **1-255**

When the modem has performed a dial backup on switched line, it will periodically try to establish the leased line connection again. This register defines the time between each attempt. The periodic lookback function is setup by the +&LB command.

See also chapter 11 for further description

+S33 Disconnect time

Default: **150** Unit: 10ms
Range: **0-255**

This register defines the delay the modem uses during a disconnect. By changing this register the user can change the response time for the H command or the time 109 (DCD) drops during disconnect. (+U2).

+S34 Bit mapped options

Binary code: CCCC CCCC Default: **00 hex**

Bit 4-0	Profile Guarding (See **+PG**-command)	00000 00001 00011 10001 10011 10101 10111 11101 11001	**(+PG0)** **(+PG1)** **(+PG2)** **(+PG3)** **(+PG4)** **(+PG5)** **(+PG6)** **(+PG7)** **(+PG8)**	No Profile Guarding Disable the following commands &W, &Y, &Z and give ***ERROR*** result code As +PG1, and give ***OK*** result code Commands in Exception list are protected, and give ***ERROR*** result code. As +PG3, and give ***OK*** result code Commands in the Exception list only, ***ERROR*** result code for all other commands . As +PG5, and give ***OK*** result code Only commands in the Exception list, are free to use, all others are protected by the +PA. Commands in the Exception list are protected by the +PA. All others are free to use.
Bit 5	Local password control (See **+PS**-command)	0 1	**(+PS0)** **(+PS1)**	Password not necessary. Calling an existing telephone number, connected to a user logon in the password table, the modem demands a password.
Bit 7,6	Encryption mode (See **+PC**-command)	00 01 10 11	**(+PC0)** **(+PC1)** **(+PC2)** **(+PC3)**	Encryption Inactive. Auto encryption mode. Encryption always on, using stored numbers. Encryption always on, using free number

+S35 Index to first number in the Call-list

Default: **0** Range: **0-19**

Point to the start of Call-list 1. Is used if dialling by 108.1, the VOICE/DATA or the ROLL/EXEC switch with cursor at the CALL position.

+S36 Index to last number in the Call-list

Default: **0** Range: **0-19**

Point to the end of Call-list 1. Is used if dialling by 108.1, the VOICE/DATA or the ROLL/EXEC switch with cursor at the CALL position.

+S37 Index to first number in the Call-list 2

Default: **0** Range: **0-19**

Point to the start of Call-list 2. Is used if dial backup after loss of carrier in leased line

+S38 Index to last number in the Call-list 2

Default: **0** Range: **0-19**

Point to the end of Call-list 2. Is used if dial backup after loss of carrier in leased line

+S39 Index to first number in the Call-list 3

Default: **0** Range: **0-19**

Point to the start of Call-list 3. Is used if dial backupdata inactivity in leased line.

+S40 Index to last number in the Call-list 3

Default: **0** Range: **0-19**

Point to the end of Call-list 3. Is used if dial backupdata inactivity in leased line.

+S41 Bit mapped options

Binary code: **00xx x0x0** Default: **28 Hex**

Bit 0	Not used	0		
Bit 1	Automatic fallback (See **+&FB**-command)	0 1	**(+&FB0)** **(+&FB1)**	Inactive Enabled
Bit 2	Fallback during V.32/V.32 bis handshake (See **+&FH** command)	0 1	**(+&FH0)** **(+&FH1)**	Disabled Enabled
Bit 3	Automatic retrain (See **+&FR**-command)	0 1	**(+&FR0)** **(+&FR1)**	Disabled Enabled.
Bit 4	Enhanced fallback function (See **+&FV**-command)	0 1	**(+&FV0)** **(+&FV1)**	Fallback between modem standards Inactive. Fallback between modem standards enabled.
Bit 5	Auto fallforward (See **+&FF**-command)	0 1	**(+&FF0)** **(+&FF1)**	Disabled Enabled.
Bit 7, 6	Not used	0		

+S42 Line quality decision limit

Default: **80.**
Range: **0 - 255**. Unit: EQM
Defines the limit for decision of line quality. A high value makes the modem doing more retrains than fallbacks.

+S43 Line quality response time

Default: **5**. (3,2 seconds).
Range: **1 - 255** Unit:0.64

Specify how fast the modem will react when poor line quality is detected. (Response time for fallback or automatic retrain).

+S44 Line quality limit for fallback

Default: **110.**
Range: **0 - 255**. Unit: EQM

Defines the line quality limit for fallback. When setting this value higher the modem will accept poorer quality lines before doing a fallback.

+S45 Line quality limit during handshake[1]

Default: **70**
Range: **0 - 255** Unit: EQM

Defines the line quality limit for fallback during V.32/V.32 bis handshake. A higher value makes the modem more likely to handshake at the highest speed.

+S46 Line quality limit for fallforward

Default: **20.**
Range: **0 - 255.** Unit: EQM

Defines the line quality limit for fallforward. When setting this value higher the modem will accept poorer lines before doing a fallback.

+S47 Line quality response time for fallforward

Default: **92.** (59 seconds).
Range: **1 - 255.** Unit:0.64

Specifies the fallforward response time when experiencing better line quality.

+S48 LPDA2 Address

Default: **FF hex**

+S49 Bit mapped used by LPDA function

Default: **00 hex**

+S50 Bit mapped options

Binary code: **x000 000C**

Bit 0	Handshake according to V.25	0	**(+&HM0)**	Handshake will start after detection of V.25 answer tone when manual connection
		1	**(+&HM1)**	Handshake will start direct with no answer tone detection
Bit 1-6	Not used			
Bit 7	Select transmit clock tracking	0	**(+&W0)**	+/-100
		1	**(+&W1)**	+/-200

+S51 Number of RINGs to supress

In extended Bypass mode
Default: **3**
Range: **1-5**

+S52 Not used

+S53 Bit mapped options

Speeds valid for fallforward/fallback

Binary code: **xxxx 0000** Default: **D0hex**

Bit 3-0	Reserved, not used			
Bit 4	Fallback/fallforward speeds			1200bps
Bit 5	Fallback/fallforward speeds			2400bps
Bit 6	Fallback/fallforward speeds			4800bps
Bit 7	Fallback/fallforward speeds			7200bps

A «1» in a bit position means that the associated speed is valid for fallback/fallforward.

+S54 Bit mapped options

Speeds valid for fallforward/fallback

Binary code: **0001 1111** Default: **1F hex**

Bit 0	Fallback/fallforward speeds			9600bps
Bit 1	Fallback/fallforward speeds			12000bps
Bit 2	Fallback/fallforward speeds			14400bps
Bit 3	Fallback/fallforward			16800bps
Bit 4	Fallback/fallforward			19200bps
Bit 5-7	Fallback/fallforward			Not used

A «1» in a bit position means that the associated speed is valid for fallback/fallforward.

+S55 Number of times to attempt a retrain before disconnecting

Default:**1** Range **1-7**

5. Manual operation

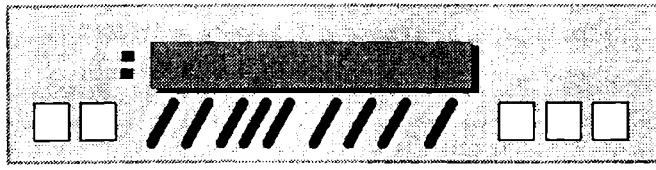
5.1 Introduction

Sometimes the modem may have to be used in a special configuration. It may be suitable for the user to operate this modem with switches at the front rather than using commands. Further, it may not be possible to give commands to the modem from the terminal equipment. (ex. a synchronous terminal). The switches and display make it possible to control as well as setup the modem from front panel.

5.2 Switches and indicators on the front fascia

5.2.1 Switches at front panel

The CURS and ROLL/EXEC switches make it possible to control and configure the modem using the display menu at the frontpanel.



The switches may be divided in two groups:

VOICE/DATA, MAN/AUTO and the LEA/SW switches which are "hot keys" for some often used functions.

VOICE/DATA (toggle):
Used to toggle between data mode and off line command mode i.e. If the modem is disconnected, pressing this switch will connect modem to line and start a handshake.

If the modem is connected this switch may be used to disconnect modem from line.

MAN/AUTO (Alternating):
In **AUTO** position the auto answer is enabled even if S-reg.0=0.

In **MANUAL** position automatic answer must be set in SETUP menu or by commands from DTE. Otherwise the auto answer function is disabled.

LEA/SW (Toggle):
Toggle between Switched line and Leased line i.e. pressing this switch will also change bit 2 in S-reg. 27.

The CURS switch and the ROLL/EXEC switch will make it possible to setup and control the modem through a menu on the display.

CURS (Toggle):
Pressing this switch will step display cursor to right, i.e. step between different choices in a menu.

ROLL/EXEC (Toggle):
Press this switch to confirm/execute what is selected by cursor position and roll/step to next menu.

V.24 signal	Description	From		To
142 (TST)	Test The modem will indicate that a loop test has been initiated.	DCE	→	DTE
109 (CD)	Carrier Detect	DCE	→	DTE
104 (RXD)	Received carrier	DCE	→	DTE
105 (RTS)	Request to send	DTE	→	DCE
106 (CTS)	Clear to send	DCE	→	DTE
103 (TXD)	Transmit data	DTE	→	DCE
108 (DTR)	Data terminal ready (108.2), or connect data set to line (108.1)	DTE	→	DCE
107 (DSR)	Data set ready	DCE	→	DTE
125 (RI)	Ring indicator	DCE	→	DTE

The notion DATA switch is used in this chapter. This means that you should press the DATA/VOICE switch or equivalent, in command mode move cursor to the position CALL or ANS and then press ROLL/EXEC, and in data mode move crusor to the position DISC and press ROLL/EXEC.

The next pages will explain how the menus is organized.

5.3 Front panel control and setup

The modem is equipped with a display (2 x 24 characters) and 5 switches (ROLL/EXEC, CURS, VOICE/DATA, MAN/AUTO, and LEA/SW). This will give a high degree of flexibility when it comes to modem setup.

- Most of the modem parameters may be changed from the menu. Normally it will not be necessary to setup the modem from an asynchronous terminal, save these parameters, and then move the modem back to the place where it shall operate.
- The display will give important real time information such as Handshake, Dialing,Line quality, Bit errors etc.

For setup and control of the modem you may choose the "full access display" or the "simplified access display". Which alternative to use is controlled by jumper field J5 position 4. The simplified version is chosen if you put a jumper at that position.

- The full access version will be the default choice and will give access to all setup-entries and tests.
- The simplified version will give access to Loop3 in command mode and to the Transmit+ Receive test in Data mode. No access to the setup will be possible.

When turning the power on the display will give the information expressed by the window below.

Power up {Firmware version} {message}

Where the message alternatives are:

MODE:	**AT COM SET**	AT Command set used.
MODE:	**V25bis**	V.25 bis Command set used.
MODE:	**DUMB COM SET**	The modem is setup in Dumb mode. Commands received from DTE are not executed or echoed.
ERROR:	**RAM FAILURE**	Error detected in internal RAM memory
ERROR:	**MODEM FAILURE**	Error detected in modulator/de?modulator.
ERROR:	**IN PROFILE**	Error in stored configuration.
ERROR:	**IN EEPROM**	Error in the nonvolatile memory (EEPROM)

If the power-up procedure fails, the ERROR message will remain, and you should call your modem dealer.

After updating of the modem software (changing the EPROM) or selecting a new country code (See strapping description later in this chapter), the message "ERROR: IN PROFILE" will always be shown when first power up.

Pin code menu :

After the power up self test the modem will check if the modem is setup with PIN code protection. When configured for protected operation with +PIN the modem will stop before entering operational mode and request the PIN from the display as follows:

```
ENTER PIN:
0123456789ABCDEFGH > CR
```

The operator have to enter the PIN code using CURS (CS) and ROLL/EXEC (ES) switches.

When pressing CS the cursor move from left to right starting from first column, if the cursor is on the last position (CR) the it will move to the first character on left again. I pressing ES on a alphanumeric character this is used for next character in PIN code. If pressing ES on the > sign the alpanumeric part will show the next sequence of characters if the following order:

0123456789ABCDEFGH
IJKLMNOPQRSTUVWXYZ

When pressing ES on the CR the modem will check the entered PIN against the configured PIN. If the PIN is correct the modem enters data state else it will clear the entered PIN and request PIN again.

See description of the +PIN command !

If the power-up succeed, the startmenu will appear at the display:

```
COMMAND: SWITCH 192  ASYNC
□ □ □ □ □      MENU
```

SWITCH
Switched line

192
Indicates the current speed between the DTE and modem. 19200.

ASYNC
means that the modem is setup for asynchronous communication.

Line 2 indicates status for some of the V.24 circuits.

The cursor will stay at the MENU position, and the window below is chosen by pressing the ROLL/EXEC switch.

The first line displays the possible choices.

Move the cursor (by pressing the CURS switch) to your choice, and press the ROLL/EXEC switch.

SETUP	Enter the setup/configuration menu.
CALL	Start a handshake in Call mode (A mode)
ANS	Start a handshake in Answer mode (B-mode)
TEST	Enter the loop test menu.
EXIT	Return to the top menu (See last page).

If simplified version has been chosen, the following window will appear at power-up.

The cursor will stay at the TEST position , and the test menu may be entered. Note that it is not possible to setup/configure the modem when simplified version is in use.

5.4 Setup of automatic answer

Automatic answer may be setup in the SETUP menu. See the description of the display map later in this chapter.

The automatic answer function may also be set by pressing the alternating switch MAN/AUTO. The modem will then answer after detection of one RING signal.

5.5 Manual connect using the front panel switches

A manual connection may be established both in originate and answer mode. Move the cursor to the CALL or ANS position by using the CURS switch and then press the ROLL/EXEC when the connection is to start. CALL will start a connection in originate mode. ANS will start a connection in answer mode. The active configuration will be used when these switches are used.

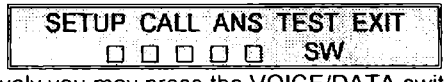
A manual connection may also be established by pressing the VOICE/DATA switch. Which channel to use must be setup in the SETUP menu or by the AT command +&VC and +&FC.

5.5.1 Example describing manual connection as answering modem:

The modem is setup to manual (DUMB) asynchronous mode, speed equal to 9600 bps., and 8N1 character format. First answer the call using the telephone set. The calling person wants to establish a modem connection.

⇒Press CURS to move the cursor to the ANS (Answer) position

⇒Press the ROLL/EXEC switch, the modem will take the telephone line and start a handshake towards remote modem. The figure below will describe the procedure just mentioned.



Alternatively you may press the VOICE/DATA switch. In this case the modem must be setup as answering modem.

When you have finished the communication and want to disconnect, then move the cursor to the **DISC** position and press the **ROLL/EXEC** switch. If the remote modem disconnects this will be detected and your modem will disconnect automatically. The modem will also disconnect if you press the **VOICE/DATA** switch.

5.5.2 Example describing manual connection as calling modem:

Assume that the modem is setup as in example above. You want to connect to a database (e.g. SEMAFORUM with phone no. Norway 37011710) Call this number and wait until you hear the answer tone (A high frequency tone with duration approximately 3 seconds.).

When you hear this tone press **ROLL/EXEC** with the cursor in the **CALL** position or press the **VOICE/DATA** switch with modem setup in calling(originate) mode.

The modem will now establish a connection, and you may communicate using your terminal. If you want to disconnect then select the disconnect menu at the database. The database modem will then disconnect and your modem will disconnect when loss of carrier is detected.

If you want the modem to dial a number when the switch is pressed, this can be setup in **SETUP** menu or by the AT command +&VD1.

5.6 Connect with 108.1 control

In addition to the switch control you may choose to control the modem with the V.24 108.1 circuit. 108.1 is a signal at the V.24 interface directed from DTE (Terminal) to DCE (modem). Notice that this signal is located at the same pin (at the V.24 connector) as the 108.2 signal.

If the modem is set-up for 108.1 control it will connect to line when the signal switches from off to on state. Before using this signal you should set-up which channel to use, or if the modem should dial a number when 108.1 turns from off to on. When 108.1 turns off after a connection is made, the modem will disconnect from line. Often the 108.1 control will be convenient when using synchronous data equipment where 108.1 control is possible.

The 108.1 control is disabled in default configuration. The command **+E1** will turn the 108.1 control on and the commands **+&EC** and **+&ED** will set-up this function.

108.1 control may be set-up both for switched and leased line. See description of SETUP menu for setup of this function.

5.6.1 Example:

Using data equipment with a synchronous port connected to the modem. The software in this equipment will turn 108.1 on and then wait a fixed time for the DCD (Carrier Detection) to turn on. If DCD doesn't turn on before time-out, the software will turn 108.1 off again before redialing.
If the RI (Ring indicator from modem) is detected the software will answer the call by turning 108.1 on.

The modem should be set-up in manual (DUMB) synchronous mode with 108.1 control using SETUP menu. The menus below will be of special interest for this etup. Also see the complete setup menu later in this chapter.

DATA FORMAT? ASYNC SYNC GOTO-END	Select synchronous format
COMMAND MODE? AT V.25 bis DUMB	Select dumb command mode.
CT 108 FUNCTION? 108.2 108.1	Select 108.1 control
108.1 DIALING? MANUAL STORED	We want the modem to dial a stored number before starting the handshake
CHANNEL SELECT ANSWER CALL AUTO	The channel shall be selected automatically.
CHANGE PHONE LIST? NO YES GOTO-END	YES if you want to change the phone list.
PROFILE TO USE AT? POWER UP? 0 1	Use profile 0 at power up.
STORE CONFIGURATION? NO PRO-0 PRO-1 GUARDED	Store the configuration in profile 0

Connect your modem to the synchronous port. After power-up the modem will include the S registers from user profile 0 in the active configuration.

When turning 108.1 on, the modem will dial the phone number stored in position 0, and then connect to remote modem.

If busy, the modem will disconnect after 3 busy signals.

If remote modem doesn't answer after the time setup by S register 7 (default 50 seconds) the modem will disconnect.

5.7 Front control of Loop tests

From front panel you may start and stop all the loop tests. The loop test can be entered under the TEST menu.

If the modem is in off line command mode the following TEST menu may be entered:

SELECT	LOCAL	TEST	MODE
L3	L3+(T+R)		EXIT

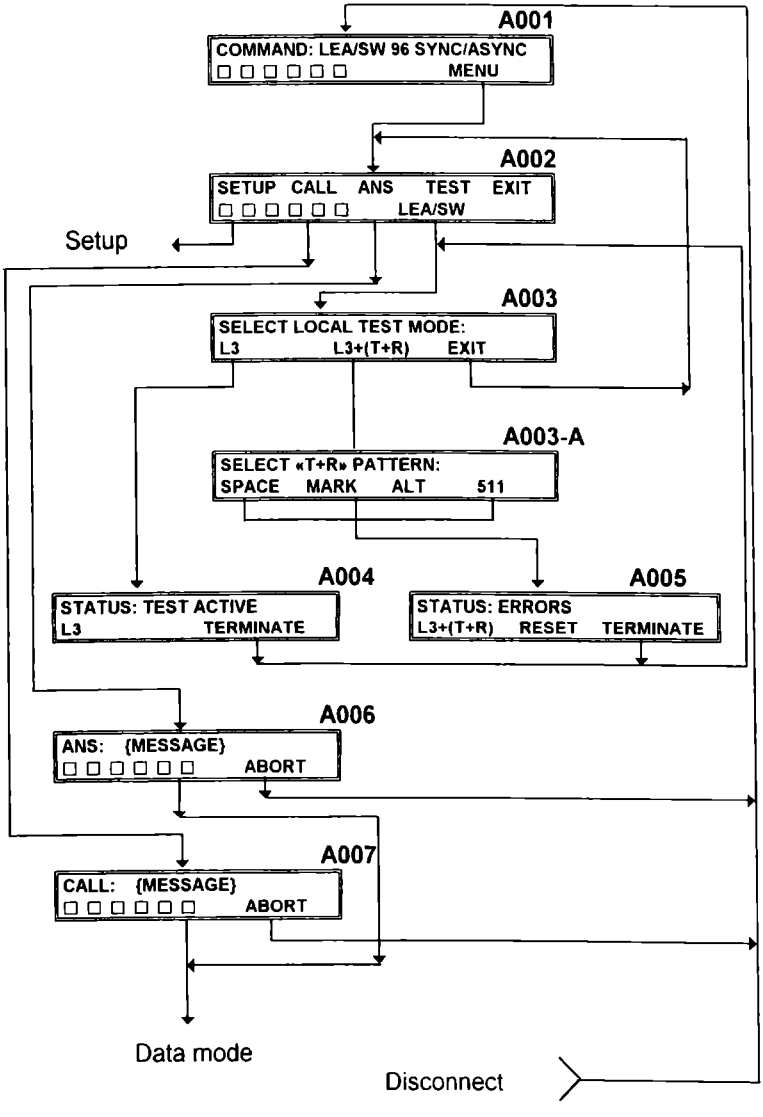
If the modem is in data mode the following test menu may be entered:

	SELECT TEST:		EXIT
L2	RL2	RL2+(T+R)	(T+R)

Test pattern means that an alternating 0/1 pattern is transmitted, and the receiver will indicate errors if a change from this pattern is detected. Note that "Test pattern only" only can be controlled from front panel.

Move the cursor to the test you want to execute, and press the ROLL/EXEC switch. The test can be terminated by another press on the ROLL/EXEC switch.

Display map full access version



A001	Command mode startmenu	
	1	Line will show if modem is setup to leased or switched to asynchonous mode and the speed between DTE (Terminal) and DCE (modem)
MENU	2	will give menu A002

A002	Command mode menu	
SETUP	For modem setup (Configuration)	
CALL	Connection in originate (CALL) channel	D
ANS	Connection in answer channel	A
TEST	Enter test menu	
EXIT	Return to menu A001	

A003	Loop tests in Command mode	
L3	Analogue loopback	&T1
L3+(T+R)	Analogue loopback with test pattern	&T8
EXIT	Exit test menu	

A004	Loop 3 active	
TERMINATE	Terminate the test	+++

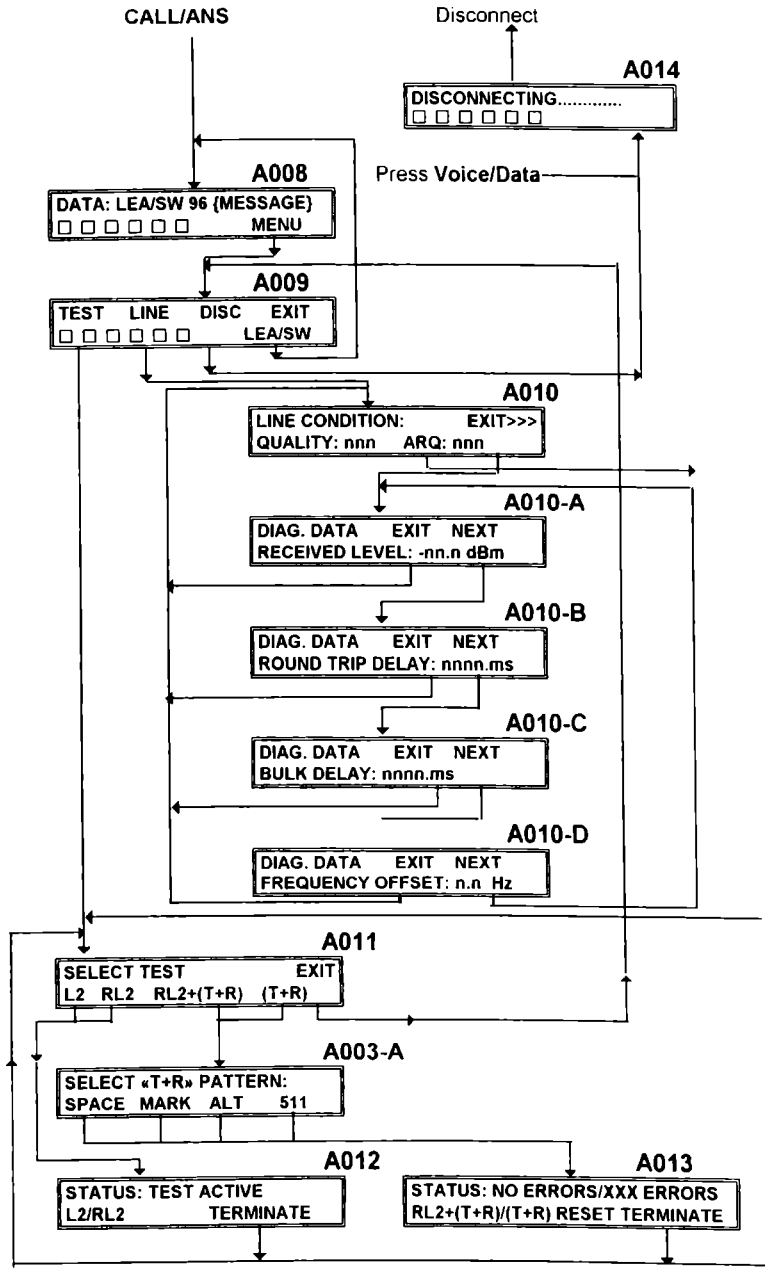
A005	Loop3 with test pattern active	
TERMINATE	Terminate the test	+++

A006	Connection/handshake in Answer mode	
ABORT	Abort handshake	

A007	Connection/Handshake in Originate (Call) mode	
ABORT	Abort handshake	

{Message}

WAIT FOR DIALTONE	*WAITING FOR ANSWER*
NO DIALTONE DISC	*NO ANSWER*
{Phone number}	*HANDSHAKE*
	NO HANDSHAKE


CALL/ANS
Disconnect
A014
DISCONNECTING.....
A008
Press Voice/Data
DATA: LEA/SW 96 (MESSAGE)
MENU
A009
TEST LINE DISC EXIT
LEA/SW
A010
LINE CONDITION: EXIT>>>
QUALITY: nnn ARQ: nnn
A010-A
DIAG. DATA EXIT NEXT
RECEIVED LEVEL: -nn.n dBm
A010-B
DIAG. DATA EXIT NEXT
ROUND TRIP DELAY: nnnn.ms
A010-C
DIAG. DATA EXIT NEXT
BULK DELAY: nnnn.ms
A010-D
DIAG. DATA EXIT NEXT
FREQUENCY OFFSET: n.n Hz
A011
SELECT TEST EXIT
L2 RL2 RL2+(T+R) (T+R)
A003-A
SELECT «T+R» PATTERN:
SPACE MARK ALT 511
A012
STATUS: TEST ACTIVE
L2/RL2 TERMINATE
A013
STATUS: NO ERRORS/XXX ERRORS
RL2+(T+R)/(T+R) RESET TERMINATE

A008	**Data mode startmenu**	
	Enter the A009 menu	
A009	**Data mode selection menu**	
TEST	Enter test menu in data mode.	
LINE	Go to line quality menu	**+S15**
DISC	Disconnection	**+++/ H**
EXIT	Return to start menu (A008)	
A010	**Line condition view.**	
QUALITY:	Indicates quality of received signal (0=good, 255 =very poor)	
ARQ:	Indicates number of retransmission in LAPM or MNP ARQ=Automatic Repeat Request)	
>>>	Go to submenues for diagnostic data	

Will indicate:

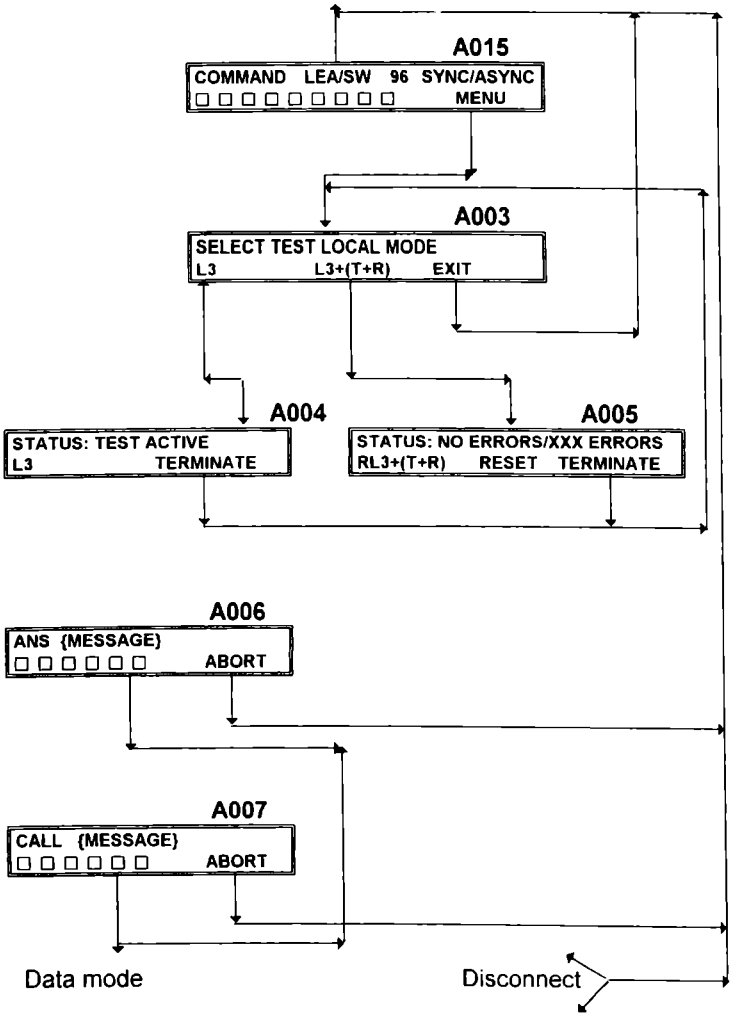
RECEIVE LEVEL	
ROUND TRIP DELAY	(V.32/V.32 bis/V.32 terbo)
BULK DELAY	(V.32/V.32 bis/V.32 terbo)
FREQUENCY OFFSET	(V.32/V.32 bis/V.32 terbo)

A011	**Loop tests menu in data mode**	
L2	Local digital loop2	**&T3**
RL2	Remote loop2	**&T6**
RL2+(T+R)	Remote loop2 with test pattern	**&T7**
(T+R)	Self test only	
EXIT	Exit test menu	
A012	**Loop2 or Remote loop2 active.**	
TERMINATE	Terminate active test	**&T0**
A013	**Remote loop2 with self test or test pattern only active.**	
RESET	Reset to 0 number of bit errors	
TERMINATE	Terminate active test	**&T0**
A014	**DISCONNECTING....**	
	The modem is disconnecting from line.	**+++/ H**

{Message} menu A008

ASYNC	*SYNC*
MNP2	*A-DES*
MNP4	
MNP5	
LAPM	
V 42 bis	

Display map Simplified version



A015	Command mode simplified version

A003	Loop tests in Command mode.	
L3	Analogue loopback	&T1
L3+(T+R)	Analogue loopback with test pattern.	&T8
EXIT	Exit the test menu.	

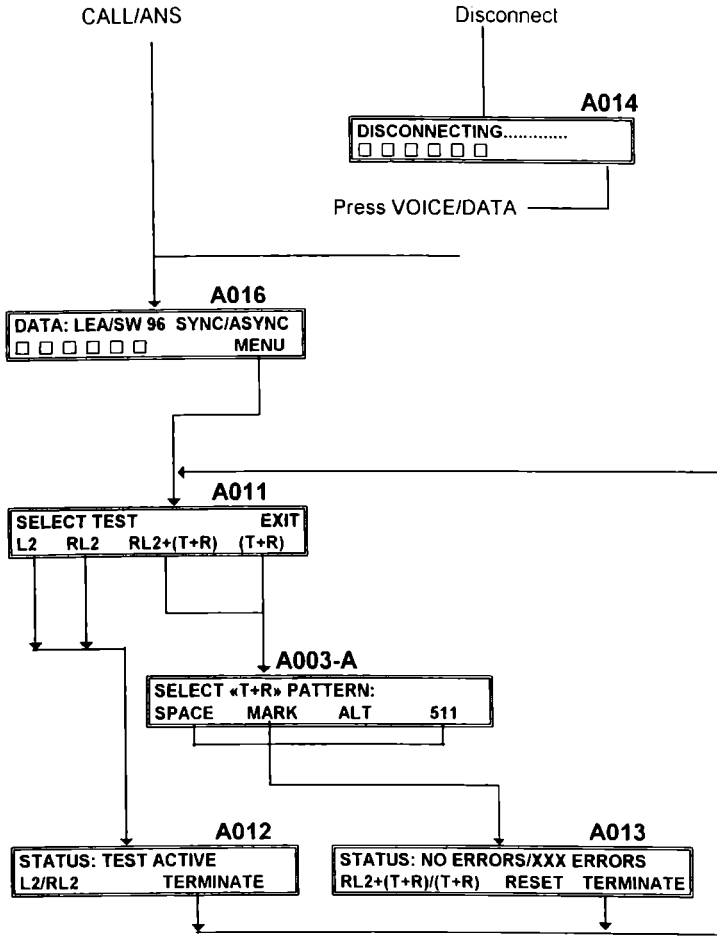
A004	Loop3 active.	
TERMINATE	Terminate the test.	+++

A005	Loop3 with test pattern active.	
TERMINATE	Terminate the test.	+++

A006	Connection/Handshake in Answer mode.	
ABORT	Abort handshake	

A007	Connection/Handshake in Originate(Call) mode.	
ABORT	Abort handshake	

{Message}	
WAIT FOR DIALTONE	*WAITING FOR ANSWER*
NO DIALTONE DISC	*NO ANSWER*
{Phone number}	*HANDSHAKE*
	NO HANDSHAKE


CALL/ANS
Disconnect
A014
DISCONNECTING.....
Press VOICE/DATA
A016
DATA: LEA/SW 96 SYNC/ASYNC
MENU
A011
SELECT TEST EXIT
L2 RL2 RL2+(T+R) (T+R)
A003-A
SELECT «T+R» PATTERN:
SPACE MARK ALT 511
A012
STATUS: TEST ACTIVE
L2/RL2 TERMINATE
A013
STATUS: NO ERRORS/XXX ERRORS
RL2+(T+R)/(T+R) RESET TERMINATE

A014	DISCONNECTING...	
	The modem is disconnecting from line	

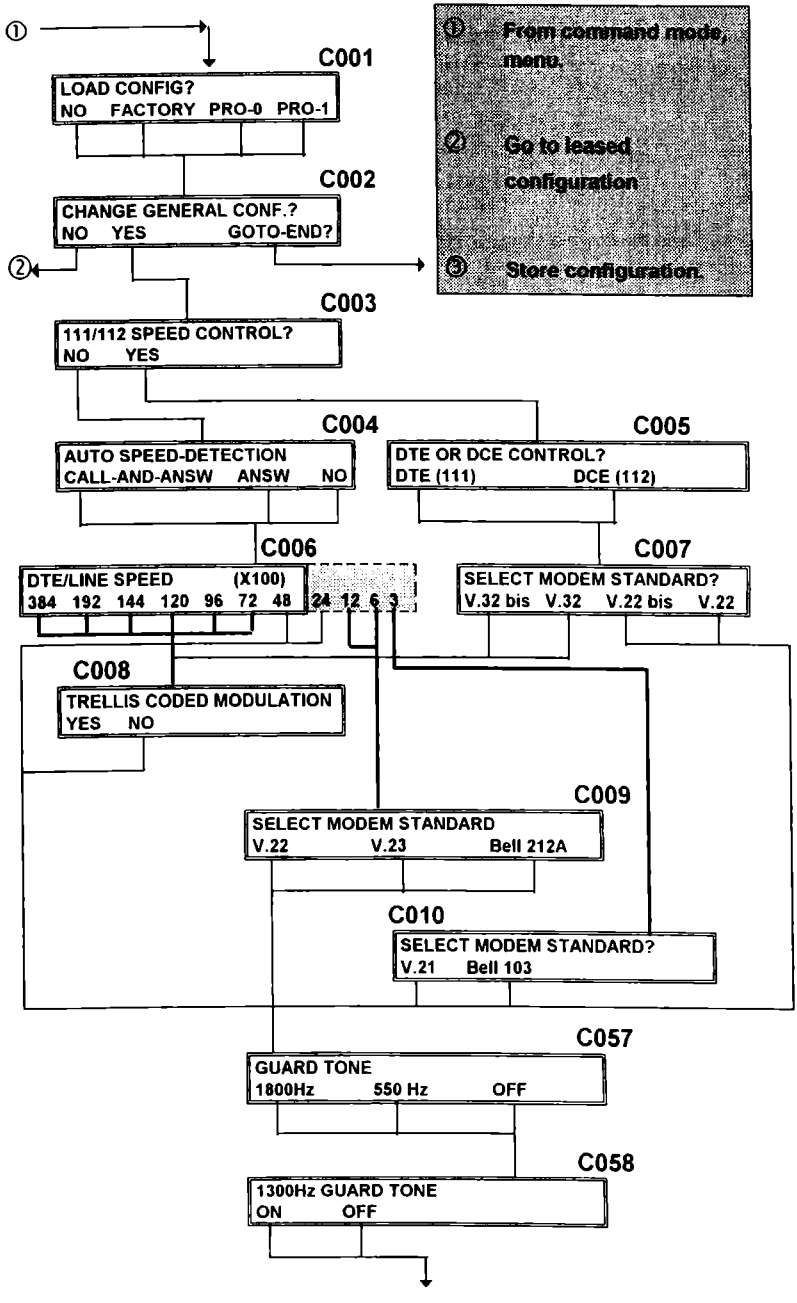
A016	Data mode simplified version

A011	Loop tests menu in data mode	
L2	Local digital loop2	&T3
RL2	Remote loop2	&T6
RL2+(T+R)	Remote loop2 with test pattern	&T7
(T+R)	Self test only	
EXIT	Exit test menu	

A012	Loop2 or Remote loop2 active	
TERMINATE	Terminate active test	&T0

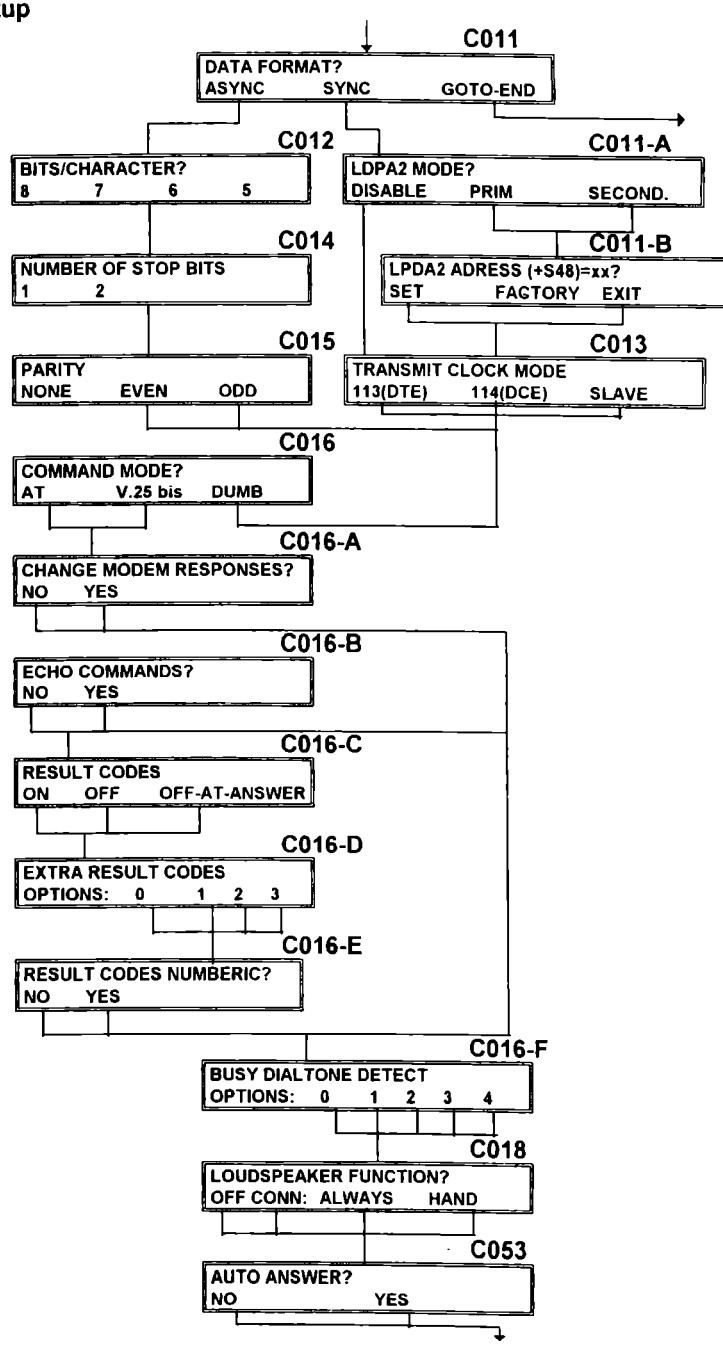
A013	Remote loop2 with self test or test pattern only active.	
RESET	Reset to 0 number of bit errors	
TERMINATE	Terminate active test	&T0

Setup menu


①
C001
LOAD CONFIG?
NO FACTORY PRO-0 PRO-1
C002
CHANGE GENERAL CONF.?
NO YES GOTO-END?
②
C003
111/112 SPEED CONTROL?
NO YES
C004
AUTO SPEED-DETECTION
CALL-AND-ANSW ANSW NO
C005
DTE OR DCE CONTROL?
DTE (111) DCE (112)
C006
DTE/LINE SPEED (X100)
384 192 144 120 96 72 48 24 12 6 3
C007
SELECT MODEM STANDARD?
V.32 bis V.32 V.22 bis V.22
C008
TRELLIS CODED MODULATION
YES NO
C009
SELECT MODEM STANDARD
V.22 V.23 Bell 212A
C010
SELECT MODEM STANDARD?
V.21 Bell 103
C057
GUARD TONE
1800Hz 550 Hz OFF
C058
1300Hz GUARD TONE
ON OFF
① From command mode, menu.
② Go to leased configuration
③ Store configuration.

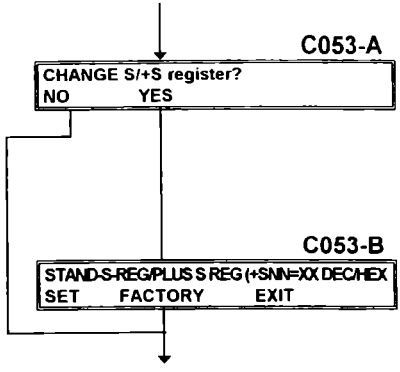
C001	Set starting point for your configuration	
NO	Use current active S registers	
FACTORY	Fetches factory configuration.	&F
PRO-1	Fetches userprofile 0.	Z0
PRO-1	Fetches userprofile 1.	Z1
C002	Should general parameters be changed?	
C003	Should 111/112 speed control/indication be used?	
NO	111/112 speed control/Indication	bit 3=0 +S27
YES	111/112 speed control enable	bit 3=0 +S27
C004	Select Automatic line speed detection?	
	This applies to switched line only. In leased line no speed detection is available	
CALL-AND-ANSW	Both in Call and Answer mode	+M2
ANSW	In Answer mode only	+M1
NO	No Automatic speed detection	+M0
C005	Should DTE or DCE control line speed?	
DTE (111)	DTE will control line speed through V.24 circuit 111.	bit 4=0 +S27
DCE (112)	DCE will control line speed, and indicate through V.24 circuit 112.	bit 4=1 +S27
C006	Select DTE and line speed.	
C007	Select modem standard in case of 111/112 control.	
C008	Enable/Disable Trellis coded modulation.	
YES	Enable Trellis coded modulation.	+T1
NO	Disable Trellis coded modulation	+T0
C009	Select standard in case of 1200/600 bit/sec.	
V.22	CCITT V.22	+H0B0
V.23	Select CCITT V.23	+H1B0
Bell 212A	Select Bell 212 A	B1
C010	Select modem standard in case of 300 bit/sec. operation.	
V.21	Select CCITT V.21	B0
Bell 103	Select Bell 103	B1
C057	Guard Tone	
1800Hz	1800Hz	&G2
550Hz	550Hz	&G1
OFF	No Guard tone	&G0
C058	1300Hz Call Tone	
ON	Active	+D1
OFF	Not active	+D0

Setup


C011
DATA FORMAT?
ASYNC SYNC GOTO-END
C012
BITS/CHARACTER?
8 7 6 5
C011-A
LDPA2 MODE?
DISABLE PRIM SECOND.
C014
NUMBER OF STOP BITS
1 2
C011-B
LPDA2 ADRESS (+S48)=xx?
SET FACTORY EXIT
C015
PARITY
NONE EVEN ODD
C013
TRANSMIT CLOCK MODE
113(DTE) 114(DCE) SLAVE
C016
COMMAND MODE?
AT V.25 bis DUMB
C016-A
CHANGE MODEM RESPONSES?
NO YES
C016-B
ECHO COMMANDS?
NO YES
C016-C
RESULT CODES
ON OFF OFF-AT-ANSWER
C016-D
EXTRA RESULT CODES
OPTIONS: 0 1 2 3
C016-E
RESULT CODES NUMBERIC?
NO YES
C016-F
BUSY DIALTONE DETECT
OPTIONS: 0 1 2 3 4
C018
LOUDSPEAKER FUNCTION?
OFF CONN: ALWAYS HAND
C053
AUTO ANSWER?
NO YES

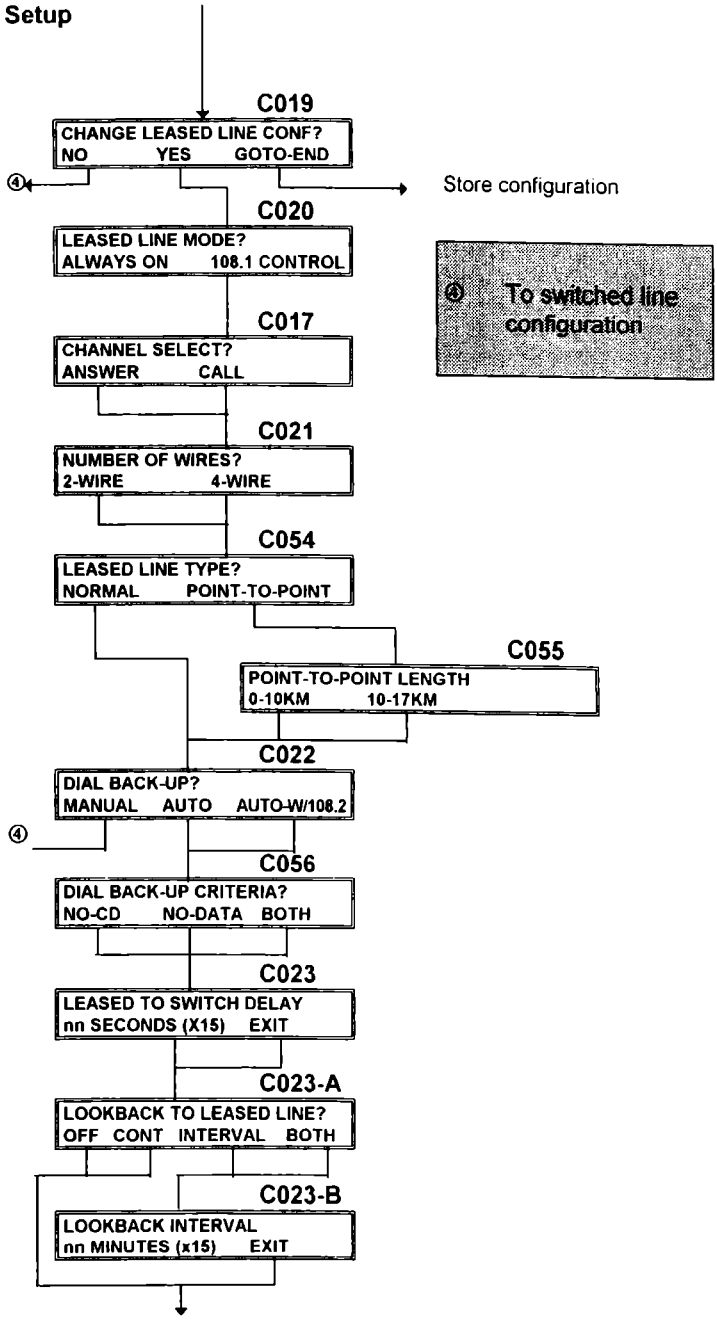
C011	Select data format	
ASYNC	Asynchronous data format in data mode	&M0
SYNC	Synchronous data format in data mode.	&M1
C011-A	LPDA2 command mode	
DISABLE	Disable LPDA2 mode	
PRIM	Select primary LDPA2 mode	+L1
SECOND	Select secondary LPDA2 mode	+L2
C011-B	Set LPDA2 Address	+S48
C012	Select number of data bits per character (Async)	Auto
C013	Select transmit clock mode (Sync.)	
113 (DTE)	DTE sources transmit clock	&X1
114 (DCE)	DCE sources transmit clock.	&X0
SLAVE	Slave clock mode.	&X2
C014	Select number of stop bits.	Auto
C015	Select parity	Auto
C016	Set command mode	Auto
AT	Set AT command mode	SAT
V.25bis	Set V.25 bis command set	+V
DUMB	Set dumb command mode (manual modem)	+PN1
C016B	Select Echo Commands	
NO	Commands entered are not displayed	E0
YES	Allcommands entered are displayed	E1
C016C	Select Result Codes	
ON	Result codes enabled	Q0
OFF	Result codes disabled	Q1
OFF-IN ANSWER	Result codes disabled in answer mode	Q2
C016D	Select Extra Result Codes	
OPTION 0	No extra result Codes	+Q0
OPTION 1	Extra Connect message enabled	+Q1
OPTION 2	Connect message contain both line speed, DTE and REL	+Q2
OPTION 3	As +Q2, and MNP Class if active	+Q3
C016E	Select Result Codes numeric	
NO	Select verbal result codes	V1
YES	Enables numeric form	V0
C016F	Busy/Dialtone detect *	
OPTION 0	Connect message.	X0
OPTION 1	Connect nnn.	X1
OPTION 2	Connect /Connect nnn. Reports No Dialtone.	X2
OPTION 3	Connect /Connect nnn. Reports Busy.	X3
OPTION 4	Reports No Dialton or Busy.	X4
C018	Select loudspeaker function	
OFF	Loudspeaker always off.	M0
CONN.	Loudspeaker on during connection.	M1
ALWAYS	Loudspeaker always on.	M2
HAND.	Loudspeaker on during handshake only.	M3
C053	Select auto answer	
NO	Disabled.	S0=0
YES	Enabled.	S0=1

Setup

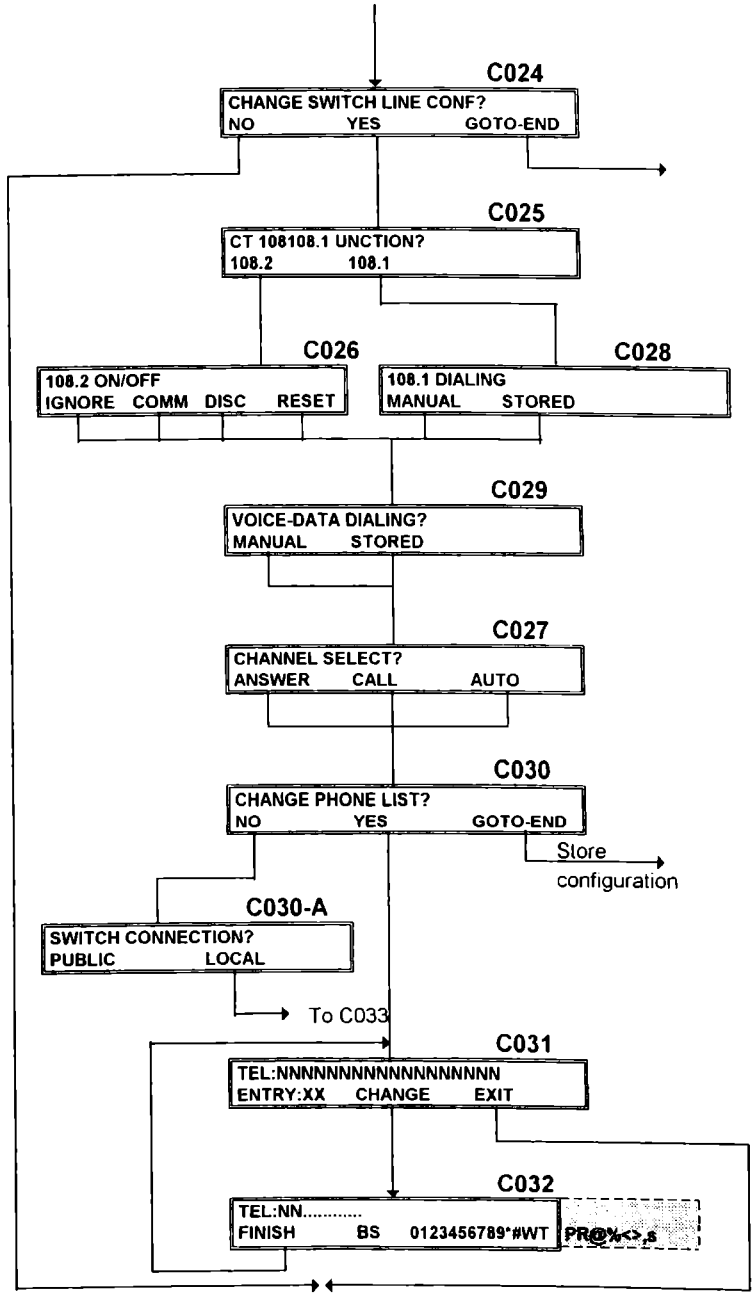

C053-A
CHANGE S/+S register?
NO YES
C053-B
STAND-S-REG/PLUS S REG (+SNN=XX DEC/HEX
SET FACTORY EXIT

053-A	Change S/+S register
	Should any S-registers be changed or displayed

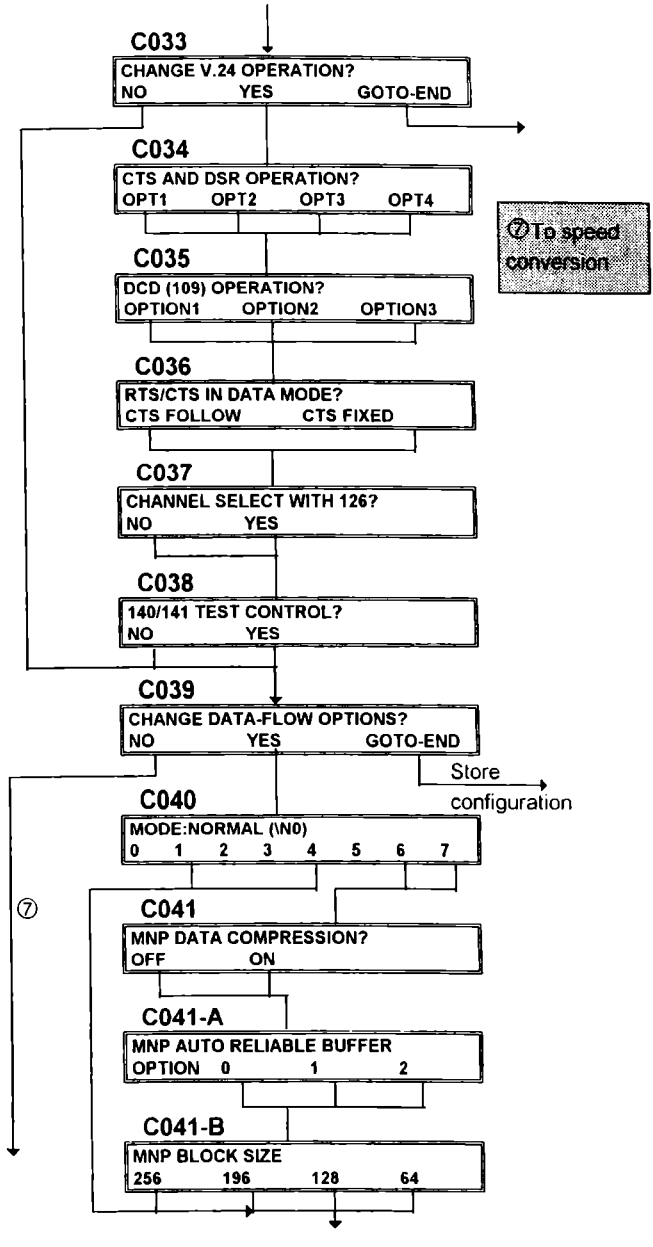
053-B	Stand-/Plus-S-register	+Snn=xxx
	You may edit upper display line as following: Move cursor to nn position to select register. (Use CURS switch). Then press the **ROLL/EXEC** switch to change The register number. The register will increment by one each time this switch is pressed, and the registered value (xxx will be displayed) To change the registered value move the cursor to xxx (following "=") and press the ROLL/EXEC switch for each digit which should be changed the new value will not be stored in the active S register position before SET Command has been executed. (Move the cursor to the SET position and then press the **ROLL/EXEC** switch.)	
STAND-S-REG/PLUS-S-Reg	Toggle between Standard Hayes S register and +S register. Move the cursor to this position and press the ROLL/EXEC switch.	
DEC/HEX	Toggle between decimal and hex presentation of register value.	
SET	Store the selected value (xxxx) in the active configuration. The S-Register will not take a new value until this command ha been executed.	
FACTORY	Restore the factory (default) value associated with the current (displayed) register. The value will not be stored in the active configuration. Until SET has been executed.	
EXIT	Exit this menu.	


Setup
C019
CHANGE LEASED LINE CONF?
NO YES GOTO-END
④
Store configuration
C020
LEASED LINE MODE?
ALWAYS ON 108.1 CONTROL
④ To switched line configuration
C017
CHANNEL SELECT?
ANSWER CALL
C021
NUMBER OF WIRES?
2-WIRE 4-WIRE
C054
LEASED LINE TYPE?
NORMAL POINT-TO-POINT
C055
POINT-TO-POINT LENGTH
0-10KM 10-17KM
C022
DIAL BACK-UP?
MANUAL AUTO AUTO-W/108.2
④
C056
DIAL BACK-UP CRITERIA?
NO-CD NO-DATA BOTH
C023
LEASED TO SWITCH DELAY
nn SECONDS (X15) EXIT
C023-A
LOOKBACK TO LEASED LINE?
OFF CONT INTERVAL BOTH
C023-B
LOOKBACK INTERVAL
nn MINUTES (x15) EXIT

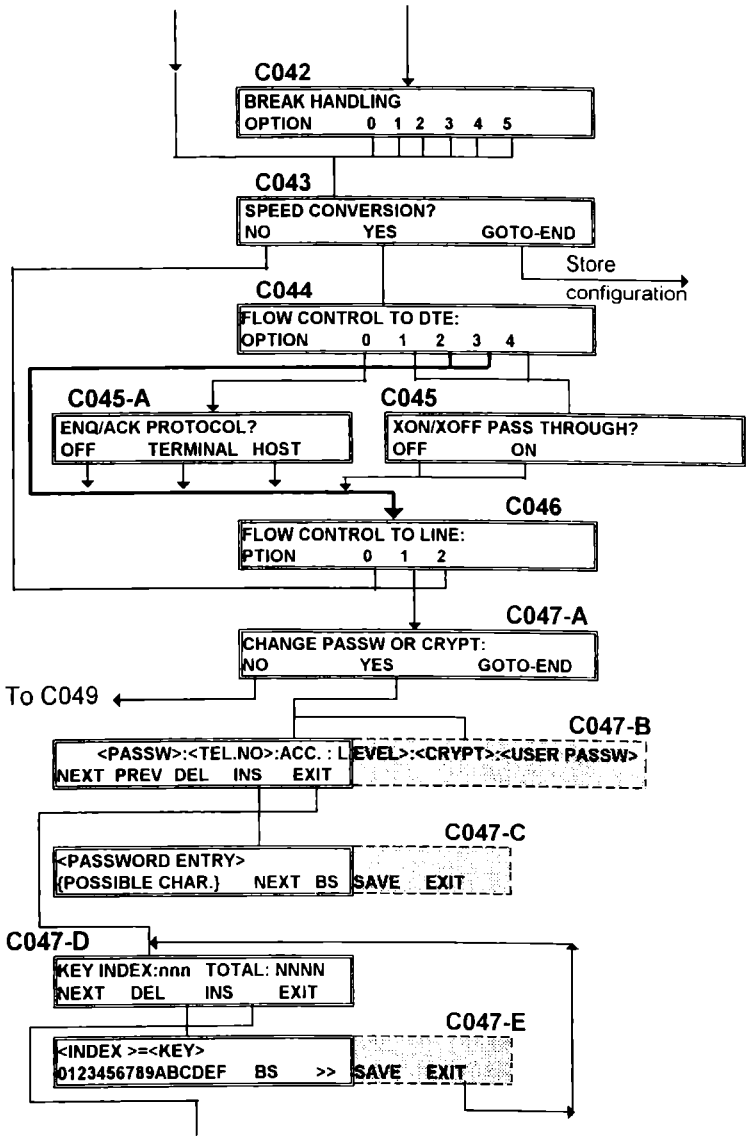
C019	**Should leased line parameters be changed?**	
C020	**Select leased line mode**	
ALWAYS ON	The modem carrier will always stay on. If you disconnect modem from line, it will go back after 1 min. timeout	**+S23 bit 5=0**
108.1	The modem will be controlled by the V.24 circuit 108	**+S23 bit 5=1**
C017	**Select channel in leased line and 108.1.**	
ANSWER	Select ANSWER mode in leased line	**+&LC0**
CALL	Select CALL mode in leased line	**+&LC1**
C021	**Number of wires in leased line.**	
2-WIRE	Select 2 wire configuration	**+W0**
4-WIRE	Select 4 wire configuration	**+W1**
C054	**Leased line type.**	
NORMAL	The transmit equalizer is adjusted for a "normal" line.	**+Y1**
POINT-TO-POINT	Select a point to point equalizer.	
C022	**Should automatic dial back-up be used?**	
MANUAL	Automatic dial back-up disabled. Turn to switched line by pressing LEA/SW and then establish the connection.	**+J0**
AUTO	Automatic dial back-up enabled. Originating (call) modem will automatically dial first number from phone list upon detection of a dial backup criteria.	**+J1**
AUTO-W/108.2	Automatic dial back-up enabled if 108.2 is ON, disabled if 108.2 is OFF. Will also disconnect a dial back-up if 108.2 is switched OFF.	**+J2**
C055	**Point to point length.**	
0-10 km	Select transmit equalizer for short cable connect.	**+Y0**
10-20km	Select transmit equalizer for long cable connect.	**+Y2**
C056	**Dial back-up criteria**	
NO-CD	Originate modem will dial back if loss of carrier **bit 1**	**+&DA**
NO-DATA	Originate modem will dial back if inactivity **bit 2**	**+&DB**
BOTH	Originate modem will dial back if NO-CD or NO DATA See +Sreg 8, +S reg 23 for more information.	**+&DA, +&DB**
C023	**Select delay from detection of a disconnection criteria/loss of sync. in leased line, to switch line connection.**	**+S28=**
C023A	**Lookback to leased line**	
OFF	No lookback to leased line	**+&LB0**
CONT	Continiously lookback	**+&LB1**
INTERVAL	Interval lookback (See +S32)	**+&LB2**
BOTH	Both continiously and interval	**+&LB3**
C023B	**Lookback interval (+S32=nnn)**	
nnn minutes	Select delay (Unit=15 minutes) between lookback to leased line when dial backup.	
EXIT	Exit this menu	


C024
CHANGE SWITCH LINE CONF?
NO YES GOTO-END
C025
CT 108108.1 UNCTION?
108.2 108.1
C026
108.2 ON/OFF
IGNORE COMM DISC RESET
C028
108.1 DIALING
MANUAL STORED
C029
VOICE-DATA DIALING?
MANUAL STORED
C027
CHANNEL SELECT?
ANSWER CALL AUTO
C030
CHANGE PHONE LIST?
NO YES GOTO-END
Store
configuration
C030-A
SWITCH CONNECTION?
PUBLIC LOCAL
To C033
C031
TEL:NNNNNNNNNNNNNNNNN
ENTRY:XX CHANGE EXIT
C032
TEL:NN.....
FINISH BS 0123456789*#WT
PR@%<>,$

C024	**Should switched line parameters be changed?**	
C025	**Select function for V.24 circuit 108.**	
108.2	Select Data Terminal Ready (DTR) function	**+E0**
108.1	Select Connect Data Set to line function.	**+E1**
C026	**108.2 ON/OFF response**	
Ignore	The modem will ignore the 108.2 ON to OFF transition in data mode.	**&D0**
Comm	The modem will return to command mode and stay on-line when 108.2 turns from ON to OFF	**&D1**
Disconnect	The modem disconnects from line and return to command mode when 108.2 turns from ON to OFF.	**&D2**
Reset	The modem disconnect from line and reset modem when 108.2 turns from ON to OFF.	**&D3**
C028	**How to connect when using 108.1.**	
MANUAL	Establish the connection by using the telephone handset. Then turn 108.1 ON and the handshake will start	**+&ED0**
STORED	The modem will dial from Call-list 1 when 108.1 turns ON	**+&ED1**
C029	**How to connect when using VOICE-DATA**	
MANUAL	Establish the connection by using the telephone handset. Press VOICE-DATA , handshake starts.	**+&VD0**
STORED	The modem will dial from Call-list 1, when VOICE DATA is pressed	**+&VD1**
C027	**Channel select for 108.1 and DATA switch.?**	
ANSWER	Handshake as answer modem.	**+&EC1** **+&VC1** **+&FC0**
CALL	Handshake as originate modem	**+&EC1** **+&VC1** **+&FC1**
AUTO	Modem will select channel automatically	**+&EC1** **+&VC1**
C030	**Should the phone list be changed?**	
C030-A	**Is the modem connected to a public or a local switch ?**	
PUBLIC	Modem is connected directely to the public network.	**+&LP0**
LOCAL	Modem is connected to an internal network (PABX).	**+&LP1**
C031	**Phone list view.**	
TEL: NNNNNN=	Phone number saved in entry xx.	
ENTRY: XX =	By moving the cursor to this position, it is possible to step through the phone list	
CHANGE	Select this for changing of current phone number	
EXIT	Exit phone list view	
C032	**Phone list editor.**	
TEL: NN	Will show the digits or dial modifiers selected. Second line contain selectable digits and dial modifiers	


C033
CHANGE V.24 OPERATION?
NO YES GOTO-END
C034
CTS AND DSR OPERATION?
OPT1 OPT2 OPT3 OPT4
⑦To speed conversion
C035
DCD (109) OPERATION?
OPTION1 OPTION2 OPTION3
C036
RTS/CTS IN DATA MODE?
CTS FOLLOW CTS FIXED
C037
CHANNEL SELECT WITH 126?
NO YES
C038
140/141 TEST CONTROL?
NO YES
C039
CHANGE DATA-FLOW OPTIONS?
NO YES GOTO-END
Store configuration
C040
MODE:NORMAL (\N0)
0 1 2 3 4 5 6 7
⑦
C041
MNP DATA COMPRESSION?
OFF ON
C041-A
MNP AUTO RELIABLE BUFFER
OPTION 0 1 2
C041-B
MNP BLOCK SIZE
256 196 128 64

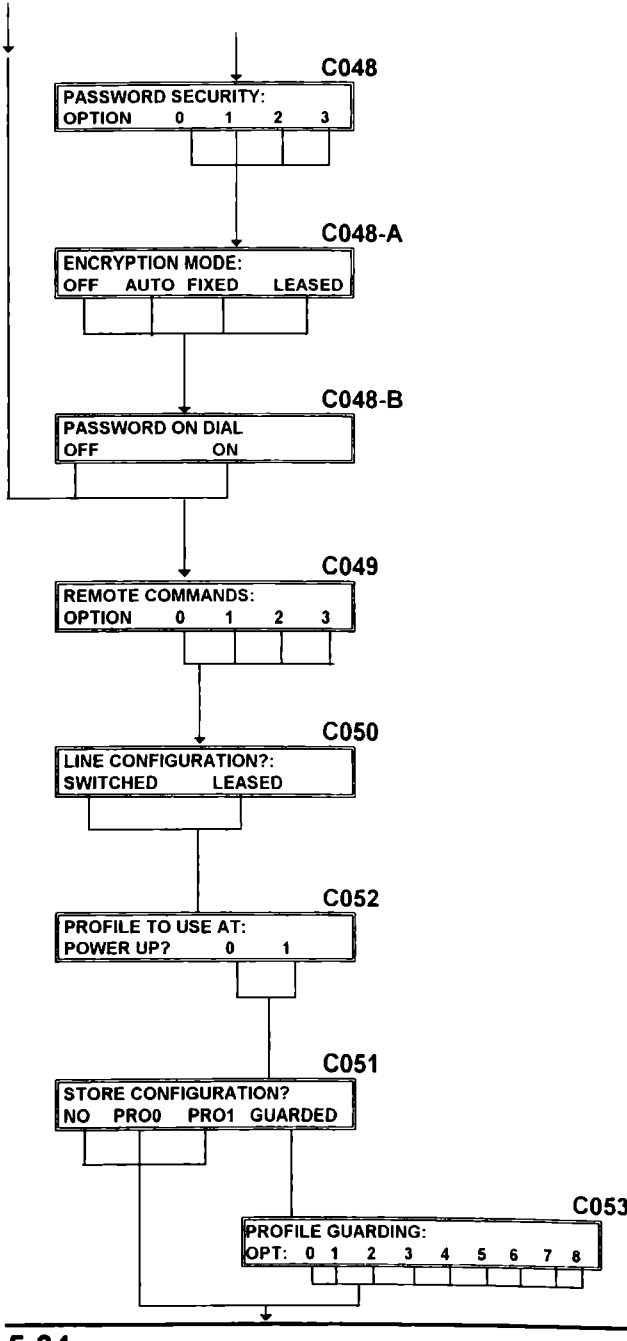
C033	**Should operation of V.24 signals be changed?**	
C034	**Operation of CTS and DSR during command mode and connection (Dial and/or handshake)**	
OPT1	DSR and CTS always on.	&S0
OPT2	DSR is turned ON according to CCITT. CTS always on.	&S1
OPT3	DSR is OFF in command mode, and will turn ON at the same time as modem carrier. CTS is on in command mode, will be OFF during connection, and turns ON at the same time as modem carrier.	&S2
OPT4	DSR and CTS are OFF until modem carrier is detected. *In DUMB mode CTS will not turn on until carrier is detected regardless of selected option.*	&S3
C035	**Operation of DCD**	
OPTION1	DCD (Data Carrier Detect) always ON regardless of the state of the carrier received.	&C0
OPTION2	DCD On indicates presence of data carrier.	&C1
OPTION3	CD (109) always on except during disconnect.	+U2
C036	**Operation of CTS in data mode.**	
CTS-FOLLOW	CTS will follow RTS, i.e. when RTS turns from OFF to ON CTS will turn ON after a delay determined by register S26. When RTS turns from On to Off, CTS will go off immediately	&R0
CTS-FIXED	CTS always on.	&R1
C037	**Select channel with V.24 circuit 126?**	
NO	126 channel control disable	+&EB0
YES	126 channel control enable. 126 will override +S27 bit 7 and +S31 bit 7	+&EB1
C038	**Enable /disable loop test control by V.24 circuits 140/141. V.24 circuits 140 and 141. (140 will control Remote loop2, and 141 will control Loop3)**	
NO	140/141 control disable.	+&VT0
YES	140/141 control enable.	+&VT1
C039	**Should anything concerning the dataflow be changed? (Asynchronous communication only)**	
C040	**Set operating mode**	
0	Normal	\N0
1	Direct	\N1
2	LAPM/MNP	\N2
3	LAPM/MNP/NORM	\N3
4	MNP/NORM	\N4
5	LAPM/NORM	\N5
6	MNP	\N6
7	LAPM	\N7
C041	**Should MNP level 5 (Data compression) be active.**	
OFF	MNP data compression disabled.	%C0
ON	MNP data compression enabled.	%C1
C041A	**Select MNP Auto Reliable Buffer**	
OPTION 0	Doesn't buffer received data	\C0
OPTION 1	Buffers all characters on the answering modem	\C1
OPTION 2	Does not buffer received data on the answering modem	\C2
C041B	**Select MNP block size.**	
64	Max 64 characters	\A0
196	Max 196 characters	\A2
128	Max 128 characters	\A1
256	Max 256 characters	\A3


C042
BREAK HANDLING
OPTION 0 1 2 3 4 5
C043
SPEED CONVERSION?
NO YES GOTO-END
Store
configuration
C044
FLOW CONTROL TO DTE:
OPTION 0 1 2 3 4
C045-A
ENQ/ACK PROTOCOL?
OFF TERMINAL HOST
C045
XON/XOFF PASS THROUGH?
OFF ON
C046
FLOW CONTROL TO LINE:
PTION 0 1 2
C047-A
CHANGE PASSW OR CRYPT:
NO YES GOTO-END
To C049
C047-B
<PASSW>:<TEL.NO>:ACC. : LEVEL>:<CRYPT>:<USER PASSW>
NEXT PREV DEL INS EXIT
C047-C
<PASSWORD ENTRY>
{POSSIBLE CHAR.} NEXT BS SAVE EXIT
C047-D
KEY INDEX:nnn TOTAL: NNNN
NEXT DEL INS EXIT
C047-E
<INDEX >=<KEY>
0123456789ABCDEF BS >> SAVE EXIT

C042	**Select Break handling options.**	
0 1 2 3 4 5	See table \K-command.	\K0-\K5
C043	**Select speed conversion?**	
NO	The speed between DTE and modem have adobt the same as on telephone line.	+C0
YES	The speed between DTE and modem is independent of line speed. This applies to NORMAL/MNP mode only	+C1
C044	**Select data flow protocol between DTE and DTC. This flow control is not active if direct operating mode is selected.**	
0	Data flow control disabled	\Q0
1	Enable bidirectional XON/XOFF flow control	\Q1
2	CTS flowcontrol on received data.	\Q2
3	RTS/CTS flowcontrol on transmitted/received data	\Q3
4	XON/XOFF flowcontrol on received data.	\Q4
C045A	**ENQACK protocol?**	
OFF	Disable HP - ENQ/ACK protocol	\H0
TERMINAL	ENQ/ACK. Modem emulates terminal	\H1
HOST	ENQ/ACK. Modem emulates host	\H2
C045	**Select transparent XON/XOFF mode?**	
OFF	The modem will not send XON/XOFF received from DTE to remote.	\X0
ON	The modem will send XON/XOFF received from DTE to remote *This should only be used with C044 Option 4.*	\X1
C046	**Select data flow protocol between local modem and remote modem. This flow control is active in NORMAL operating mode only**	
0	Data flow control disabled	\G0
1	Enable bidirectional XON/XOFF flow control	\G1
2	XON/XOFF flow control to remote modem	\G2
C047-A	**Change Passw. or Encryption?**	
NO	Don't change any password or encryption parameters	
YES	Change password or encryption parameters	
C047-B	**Password table handle**	
NEXT/PREV	List passw. entries	
DEL	Delete current password	
INS	Go to menu C047-C to insert passw. entry	
C047-C	**Insert password entries**	
{Possible char}	Possible password characters are listed below.	
NEXT		
BS		
SAVE		
EXIT		
C047-D	**Encryption key handler. Current key and total number of keys**	
NEXT	List key index in table	
DEL	Delete key index	
INS	Go below menu to insert key index	
EXIT	Exit encryption key handler menu	
C047-E	**Insert Encryption key**	

{Possible char. }:

ABCDEFGHIJKLM	0123456789* # -
NOPQRSTUVWXYZ	WTPR@<>,S= - %


C048
PASSWORD SECURITY:
OPTION 0 1 2 3
C048-A
ENCRYPTION MODE:
OFF AUTO FIXED LEASED
C048-B
PASSWORD ON DIAL
OFF ON
C049
REMOTE COMMANDS:
OPTION 0 1 2 3
C050
LINE CONFIGURATION?:
SWITCHED LEASED
C052
PROFILE TO USE AT:
POWER UP? 0 1
C051
STORE CONFIGURATION?
NO PRO0 PRO1 GUARDED
C053
PROFILE GUARDING:
OPT: 0 1 2 3 4 5 6 7 8

C048	Security for the password function.	
0	No security on password commands.	+PA0
1	Level 2 password required for password command access. Password commands may be accessed from both local and remote modem.	+PA1
2	Level 2 password required for password command access. No remote control of password commands enabled.	+PA2
3	Local password commands must be confirmed by pressing the ROLL/EXEC. No password remote control	+PA3
C048-A	Encryption mode	
OFF	Encryption disabled	+PC0
AUTO	Auto encryption mode.	+PC1
FIXED	Only encryption mode is valid. No connection without encryption will be established.	+PC2
LEASED	Only encryption mode, with no internal phone number	+PC3
C048-B	Password on dial	
OFF	No pasword required.	+PS0
ON	The user have to enter a password if the number exist in the passwordtable and a user password is associated with this number.	+PS1
C049	Enable/disable remote command function.	
0	Disable remote command function.	+O0
1	Enable remote command function, no password required.	+O1
2	Enable remote command function, password required.	+O2
3		+O3
C050	Should the modem use switch or leased line?	
SWITCHED	Switch line configuration	&L0
LEASED	Leased line configuration.	&L1
C052	Which profile to use at power up?	
0	Use profile 0 at power up	&Y0
1	Use profile 1 at power up.	&Y1
C051	Store configuration in any profile?	
NO	Don't store configuration.	
PRO 0	Store configuration in profile 0.	&W0
PRO 1	Store configuration in profile 1.	&W1
GUARDED	Go to Profile Guarding menu.	
C053	Profile Guarding	
0	Disabled	+PG0
1	ERROR result code for &W, &Y, &Z	+PG1
2	OK result code for &W, &Y, &Z	+PG2
3	ERROR for commands in the exception list	+PG3
4	OK for commands in the exception list	+PG4
5	Only commands in the exception list are accepted, ERROR message for others.	+PG5
6	Only commands in the exception list are accepted, OK message for others.	+PG6
7	Only commands in the exception list are accepted, other commands demand a password	+PG7
8	Commands in the exception list demand a password. Others are free	+PG8

5.8 Strapping:

5.8.1 Strapping and connectors

This section explains the functions and presents the set-up of each strapping field. Some of the **Jn** positions are used as connectors and not as strapping fields.

J2, J3 and J6 are used as connectors.
J10, J13 and J16 are country independent strapping fields.
J5, J12, J17, J18, J19 and J20 are country dependent strapping fields.

> *J1, J4, J7, J8, J9, J11, J14 and J15 do not exist on this hardware.*

STRAPPING:

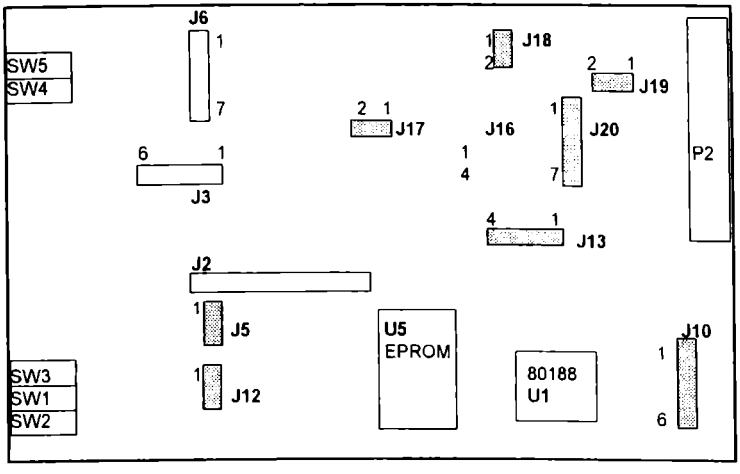


Fig 5-1 Location of jumpers

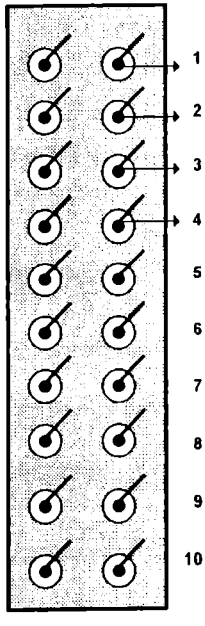
5.8.2 Connectors:

No jumper caps (shunts) should be placed on these connectors.
J2: 80188 connector for bus expansion. The address bus, data bus and some control signals are connected to this connector. This is for connecting the HW encryption board or a general expansion card.
J3: Connector for Serial Eye quality monitor (from data pump). Normally this connector is used during testing in laboratory only.
J6: Connector for the LCD display.

5.8.3 Strapping:

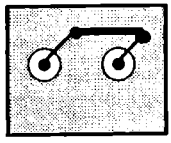
If you have to change any of the strapping fields comform to the following rules:

- Turn power off.
- Grip the brackets at the front, and pull the PCB card out.

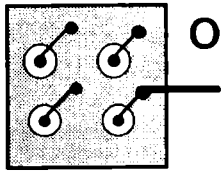


On the circuit board a bank of small pins is placed vertically.
On the top of some of these pins are attached small black plastic caps (frequently called "jumpers")
Each pair of pins has a number.
Strapping comprises moving the plastic caps in relation to the separate pairs.

Fig 5-2



Both pins are "capped"



Just one of the pins (or none) is "capped"

Fig 5-3

The possible settings are given in the following tables.

Replace the cover, connect the power supply, and the modem is ready for use again.

Strapping field J5: Set-up parameters for modem control. Transmit levels and software. When delivered, the hardware strapping fields are set up for correct country and the most commonly used functions. *(See also appendix 5)*

1	2	3	Transmit level (leased line only)
OFF	OFF	OFF	For regulatory use only
ON	OFF	OFF	
OFF	ON	OFF	
ON	ON	OFF	Do not change
OFF	OFF	ON	
ON	OFF	ON	
OFF	ON	ON	
ON	ON	ON	

4	Menu control
OFF	Full access display
ON	Simplified access display

5	6	Front/DTE control
OFF	OFF	Both front and DTE control
ON	OFF	DTE control only
OFF	ON	Front control only
ON	ON	Front control, status may be read by DTE

J5 pos 1-3 sets leased line transmit level only. Switched line transmit level is set automatically according to the selected country.

Strapping field J10: Select V.28 connection for 111, 112, 113 and 114.

1	2	3	113/114 V.28 pin select
OFF	OFF	OFF	Both disabled
ON	OFF	OFF	114 conn. to pin 15, 113 not connected
OFF	ON	OFF	113 conn. to pin 15, 114 not connected
ON	ON	OFF	Not valid
OFF	OFF	ON	113 conn. to pin 24, 114 not connected
ON	OFF	ON	113 conn. to pin 24, 114 to pin 15 (default)
OFF	ON	ON	Not valid
ON	ON	ON	Not valid

4	5	6	111/112 V.28 pin select
OFF	OFF	OFF	Both disabled
ON	OFF	OFF	111 conn. to pin 23, 112 not connected
OFF	ON	OFF	112 conn. to pin 23, 111 not connected
ON	ON	OFF	Not valid
OFF	OFF	ON	112 conn. to pin 12, 111 not connected
ON	OFF	ON	111 conn. to pin 23, 112 to pin 12 (default)
OFF	ON	ON	112 conn. to both pin 12 and pin 23
ON	ON	ON	Not valid

Strapping field J12: Country selection. Internal parameters will be adjusted by software (e.g. dialling method and other country dependent functions). *(See also appendix 5).*

1	2	3	4	5	6	Selected country
OFF	OFF	OFF	OFF	OFF	*	Norway
ON	OFF	OFF	OFF	OFF	*	Sweden
OFF	ON	OFF	OFF	OFF	*	Denmark
ON	ON	OFF	OFF	OFF	*	Finland
OFF	OFF	ON	OFF	OFF	*	Netherlands
ON	OFF	ON	OFF	OFF	*	Switzerland
OFF	ON	ON	OFF	OFF	*	Belgium
ON	ON	ON	OFF	OFF	*	Sweden/PTT
OFF	OFF	OFF	ON	OFF	*	Spain
ON	OFF	OFF	ON	OFF	*	Ireland
OFF	ON	OFF	ON	OFF	*	France
ON	ON	OFF	ON	OFF	*	Germany
OFF	OFF	ON	ON	OFF	*	Britain
ON	OFF	ON	ON	OFF	*	Poland
OFF	ON	ON	ON	OFF	*	Hungary
ON	ON	ON	ON	OFF	*	Slovakia
OFF	OFF	OFF	OFF	ON	*	Austria
ON	OFF	OFF	OFF	ON	*	Singapore
OFF	ON	OFF	OFF	ON	*	USA
ON	ON	OFF	OFF	ON	*	Canada
OFF	OFF	ON	OFF	ON	*	Not used
ON	OFF	ON	OFF	ON	*	Czech Republic
OFF	ON	ON	OFF	ON	*	
ON	ON	ON	OFF	ON	*	

* Reserved. Leave this cap unchanged.

Strapping field J13:

1	2	3	4	Selects BUSY functions
OFF			*	V.24 pin 9 BUSY function disabled
ON			*	V.24 pin 9 low sets BUSY state (on-line)
	OFF		*	Function disabled
	ON		*	Sets constant BUSY state
		OFF	*	Function disabled
		ON	*	System reset disconnects relays (off-line)

* Position is not used.

Strapping field J16: The Bell connector "LEASED", "LEA" or "TX" may be used for leased line (default), or as a second switch line. See dial modifier ">" (ATD command) and chapter 6 (Password dialback) for more information about the use of second switch line.

1	2	3	4	Selects BUSY functions
OFF	OFF	ON	ON	"LEA" used for leased line
ON	ON	OFF	OFF	"LEA" used as a second switch line

Note that other combinations are not valid.

Strapping fields J17, J18, J19 and J20: Line adjustment for various countries. The strapping fields control parameters concerning telephone network specifications in the country. The straps are put in correct position when delivered and should not be moved without consulting your dealer. *(See also appendix 5).*

Strapping field J17:

1	2	Adjust hybrid to complex line impedance
OFF	ON	Normal 600 Ohm line impedance
ON	OFF	Complex line impedance

Strapping field J18:

1	2	Adjust DC impedance
OFF	OFF	Normal impedance
ON	ON	Lower impedance

Strapping field J19:

1	2	Adjust ring detector impedance
OFF		Normal 220nF series capacitor
ON		1.22uF series capacitor
	OFF	Normal 215 kOhm parallell resistance
	ON	21k5 Ohm parallel resistance

Strapping field J20:

1	2	3	4	5	6	7	Pos 1-5: Impulsing circuitry
ON	ON	OFF	OFF	ON			619R in series with 2uF
*	*	*	*	*			Other combinations depending on country.
					ON		No 12kHz attenuation
					OFF		12kHz attenuation
						OFF	15R added in series to line signal
						ON	No extra resistance added.

6. Password/dialback

6.1 Introduction

The password table is a core, utilised by the different security and password functions in the modem.

The security functions are:

- Password/Dialback (Described in this chapter)
- Encryption (Described in chapter 7)
- Profile guarding (See +PG command)

Other functions related to the password table are:

- Remote command access
  (Described in chapter 12 "Remote control of the modem").
- Auto Login (Described in chapter 12)

In the first part of this chapter the password table is described.
In the last part of the chapter, the password/dialback is described.

6.1.1 Safety

A called modem demands a password to give access to, for example, a data base. Extra security is obtained if the called modem has an automatic dialback function to numbers that already have provided the proper password. This is obtained by selecting Mode 1.

6.1.2 Economy

The called modem dials back and thereby takes on the expenses for transfer of data. This function is available in Mode 1 and Mode 2.

6.2 Security Levels

The modem can be configured to different security levels by combining the following commands :

+POn Options for Password/Dialback

AT+PO0 ENTER	Password/Dialback Off
AT+PO1 ENTER	Dialback enabled. Password required of all users.
AT+PO2 ENTER	Dialback enabled. Password control is optional.

+PAn Options for extra security on all password commands :

AT+PA0 ENTER	No security on password commands.
AT+PA1 ENTER	Level 2 password required for password command access. Password commands may be accessed from both local and remote modem.
AT+PA2 ENTER	Level 2 password required for password command access. No remote control of password commands enabled.
AT+PA3 ENTER	Local password commands must be confirmed by pressing the **ROLL/EXEC** switch. No remote control of password commands enabled.

+O: Remote command access

AT+O0 ENTER	Remote command access disabled
AT+O1 ENTER	Remote command access enabled. No password is required.
AT+O2 ENTER	Remote commands enabled. The modem demands a password with level 1 or higher to give access.
AT+O3 ENTER	As for +O2, but will also enable remote unlocking of the modem. (+S18)

6.3 The Password Table

The modem can store 7 Kbytes in the password table. The maximum number of passwords that can be stored is dependent on the length of the individual password entries in the list. When a new password is entered and the storage space is to small for the new entry , the modem will respond :

NO MORE SPACE AVAILABLE

All passwords in the table have to be specific. If a new password is entered into the table and it already exists, the modem responds:

PASSWORD EXISTS

If the password table is empty and a request for a listing of passwords stored is entered , the modem will respond :

PASSWORD TABLE IS EMPTY

Trying to list out a specific password not stored will cause the following response :

PASSWORD NOT FOUND

6.4 Definitions

A password stored in the password table is defined as follows :

<password>:<telephonenumber>:<access-level>:<crypt(k) or auto login(a)>

6.4.1 Separators

: (ASCII 58 Dec) is used as a separator between the fields.

, may also be used as a separator between the password and the telephone number.

6.4.2 <password>

This record is mandatory in all entries and is used for access acceptance check and as a link to the telephone number to be used for dialback.

- Any characters with ASCII codes lower than 21H will be removed from the string.
- Lower case characters are converted to uppercase.
- The length of this entry is minimum 4, maximum 10 characters. Violating these rules when entering a password into the table will cause the modem to respond with the ***ERROR*** message.

6.4.3 <telephonenumber>

This record may be empty and is only entered into the table if dialback is to be performed when receiving <password>.

- The maximum length of this record is 30 characters (i.e numbers and dial modifiers).
- This record is left empty by entering two ":" between <password> and <access-level> or by entering only <password>, followed by a Carriage Return. In this case <access-level> will be assigned to zero.

6.4.4 <access-level>

This is a numeric value from the set : [0, 1 , 2] and is used to restrict the rights of the user of <password>.

0 Access to the modem only as an ordinary user for data transfer.
1 As value 0, but will also give access to the modem for remote command operation (if enabled), except for password commands (+P commands).
2 As value 1, but will also give access for operation of +P commands at local and from remote site.

6.4.5 <crypt(k) or auto login(a)>

This field may either start with K "encryption" or A "Auto login" to tell which of them should be used for this call.

Using encryption, the correct set-up is **:K:** in calling modem, **:K=n-m:** in answering modem. (Where n and m are two-digit key-indexes indicating start and stop of keys used for this call).

The answering modem will select which of the keys to be used in a random way. More information is given in chapter 7.

6.4.6 <user password>

This is your password which is transmitted to the remote side during either the key negotiation, or the Auto login.

If the modem is configured to demand a password or a switch toggle in order to execute +P commands, this will be done only at the first +P command entered. Further +P commands may be entered without any restrictions until resultcode ***ERROR*** is given, a non +P command is entered or an empty command line is entered.

6.4.7 Restrictions to password entries:

Minimum password length = 4 characters.
Maximum password length = 10 characters.
Maximum telephone number length = 30 digits.
Memory available for password table =7 Kbytes.
Number of password which can be stored:
Minimum: 209 entries (Using maximum passw. and tel. length).
Typical: 328 entries (Passw.=5 chars. Tel.no.= 8 digits).

6.5 Pitfalls

6.5.1 Deadlock

In configuration with **+PA1** or **+PA2** all +P commands are protected by a level 2 password, even the +PA command itself. This may result in a deadlock if the operator forgets this. Issue the command : +PA0. When the modem requests the password, enter only a Carriage Return. The modem will wait until the **ROLL/EXEC** switch is operated to confirm the command.

> *This means that obtaining full security of the password table only can be achieved by restricting the physical access to the modem.*

6.5.2 Profiles.

Always remember to store the configuration in both profiles after changing the setting of **+PO**,**+PA** and **+O**.

⇒Issue the commands:

AT&W0&W1 ENTER

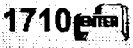
6.5.3 Resetting of +PO and +PA configurations:

Use of the command **&F** or **Z** will not affect the setting of **+PO**, **+PA**, **+PG** and **+PC**. Executing the ***LOAD FACTORY SETTING*** from the Display menu, will however reset the parameters to their default (off) setting.

6.6 Examples

6.6.1 Password protected system, Password table operated only at local site.

⇒Enter passwords for users all with access level 0

AT+P=SMITH:4737011710 

AT+P=0NLINE:37011555 

⇒Activate password protection :

AT+PO1 

⇒Set mode to only local operation of password commands protected by physical access to the modem (switch toggle)

AT+PA3 

⇒Set modem to auto answer the simulated RING sequence.

ATS0=2 

Remote commands can now be enabled (+O1,+O2,+O3) but password commands can not be executed from remote site.

Any attempt to use of +P commands from remote site will cause the ***ERROR*** resultcode to be given when +PA2 or +PA3 is used.

6.6.2 Remote maintenance of the password table

This example assumes that the previous example is already performed :

AT+P?[ENTER] Request a listing of all stored passwords.

The modem awaits the switch toggle.
⇒Press the ROLL/EXEC switch.

The modem displays the list :

SMITH: 37011710:0
ONLINE: 11555:0

⇒Enter passwords for users that may operate the modem from remote site (Access Level 1)

AT+P=REM0TE:37011555:1[ENTER]
AT+P=PETER:37025411:1[ENTER]

⇒Enter password(s) for users that may operate the password commands from a remote site :

AT+P=SYS0P:37029563:2[ENTER]

⇒Set the modem to accept remote commands at a Level 1 Password:

AT+O2[ENTER]

⇒Set the modem to demand a Level 2 password for operation of password commands at local and from remote site

AT+PA1[ENTER]

⇒Terminate the Password Access by entering an empty command line :

AT[ENTER]

The password table contains at this moment 2 users that may access the system attached to the modem, 2 users that have the additional rights of accessing the modem by remote commands and 1 user with the additional rights of changing the password table locally and from a remote site.

The following commands (and all +P commands) can also be entered from a remote site after requesting remote command access by sending remote escape code (---).

6.6.3 Request a partial list of the password table :

AT+P?O↵

The modem displays all passwords starting with "O"

The modem awaits password input before proceeding
ENTER PASSWORD FOR +P ACCESS.

⇒Enter your level 2 password
SYS0P↵
Modem responds :
ONLINE:37011555:0

6.7 Delete passwords

6.7.1 Deleting one password

AT+PD REM0TE↵

(The space is optional) The modem deletes the password "REMOTE" from the table.

6.7.2 Delete all passwords

AT+PD↵

Will cause the password table to become empty.

The modem awaits password input before proceeding
ENTER PASSWORD FOR +P ACCESS

⇒Enter your password.
Modem responds :
DELETE ALL PASSWORDS? (Y/N)

⇒Press **Y** to confirm or any other character to cancel the command. If you cancel the modem will respond with resultcode ***ERROR*** without deleting the table.

6.8 Checksum of the Password table

AT+PI0 

Show checksum of the Password table

143
056
OK

This command can effectively be used to check if any changes have been made in the table.

Validate the checksum of the password table:

AT+PI1 

The modem now calculates the checksum and compares the result by a checksum stored together with the table.

The response can be :

OK Indicates that the checksum calculated
OK equals the checksum stored together with the table.

or

ERROR Indicates invalid checksum. Can be caused
OK by EEPROM failure.

If this happens:

⇒Delete all passwords.

6.9 Functional description

6.9.1 Password/Dialback Mode 1 - Protected System

AT+PO0 

⇒Set the modem to demand a password when someone calls in:

AT+PO1 

Modem answers ***OK*** : Command is accepted.

If modem answers ***ERROR***: It is not possible to use this command if synchronous mode (&M command) or direct mode (\N1 command) is selected. Set asynchronous mode (&M0) and turn off direct mode (i.e. \N0,\N2 or \N3).

When this configuration is set it can only be reset by the +PO0 command. The &F or Z commands will not reset it. To activate the auto answer push the Auto-switch.

In normal mode (password OFF), the S0 register decides whether the auto answer function is active or not. If password function is active, the S0 register changes and you must push the MAN/AUTO switch to auto answer. The S0 value is only used simulating a step 3 call. The modem has now changed its operating mode for how to handle incoming calls. The procedure is divided into three main steps:

Step 1:

The purpose of this is that a connected system shall not be disturbed by any caller until the modem has made a proper connection.

The DTE is not supposed to know the background activity.

The modem will answer incoming calls ONLY if the **MAN/AUTO** switch is activated.

This call is "silent", i.e. RI/125, CD/109, DSR/107, and the resultcodes RING- and CONNECT will not be given

It is not possible to terminate an answer handshake by sending data to the modem.
As soon as a connection is made (successful handshake), the

modem will transmit the following message to the caller :
ENTER PASSWORD FOR REMOTE MODEM

The modem will now wait a number of seconds , determined of the value set in register +S3 , to receive a password. If a password is not received within this period, the following message will be sent:
TIMEOUT - REMOTE MODEM DISCONNECTS

and the modem hangs up.

A caller will have two attempts when entering the password. If the password in the first attempt is unknown for the modem the message
ENTER PASSWORD FOR REMOTE MODEM
will be sent once more and the caller may try again.

If the password entered in the second attempt also fails to be recognised the modem will send the following message :
UNAUTHORIZED ENTRY ATTEMPTED-REMOTE MODEM DISCONNECTS
and then hangs up.

When a password is received and approved , the modem finds out if the password entry has a corresponding tel. no.

If a tel. no. is not used in the password entry, STEP 3 will start. Otherwise STEP 2 starts:

Step 2

The modem sends the following message to the remote system :
DISCONNECT - REMOTE MODEM WILL DIAL BACK

The modem goes off-line and calls back after a number of seconds set by value in register +S2.

It is recommended to set up the modem with the **+M1** command when used with password/dialback.

The modem will answer incoming calls with the speed detect function on and dial back with the same speed setting used when the first (silent) connection in Step 1 was made.

When the modem calls back all result codes are suppressed. Number of attempts to make a connection is set by value in register +S4. It is not possible to terminate a dialback attempt when the modem goes on-line in call mode. However, the dialback procedure can be terminated by issuing a **D** or **+PO0** command while the modem is waiting to go on-line.

When a connection is made (successful handshake), the modem will suppress the ***CONNECT*** resultcode, CD/109 and DSR/109.

Step 3:

The modem goes on line and starts to simulate the presence of an incoming call. At the same time the following message will be sent to the remote modem:
PAGING HOST - WAIT

Resultcode ***RING*** will be given to the local DTE every 2 seconds and V24 circuit RI/125 will go ON for 200 ms for every RING. Register S1 will count the number of RINGs. The autoanswer function will handle the simulated ring sequence, i.e. if register S0 is set to a non-zero value. DTE must answer the (simulated) call by issuing the **A** command.

The position of the MAN/AUTO switch is ignored in the process of answering the simulated RING sequence.

When the modem enter data mode, the following message will be sent to the remote modem:
CONNECT TO REMOTE SYSTEM

Data mode must be entered within 30 sec. after the first RING indication is given. If this fails the following message is sent to the remote modem :
TIMEOUT - REMOTE MODEM DISCONNECTS
and the modem disconnects.

When password function is active, it is not possible to terminate an answer handshake or a dialback by sending data to the modem.

Other AT-commands and Escape sequence are ignored awaiting password.

6.9.2 Dialback with use of second switched line

The default value of +S register 2 is 90 seconds. This is to make sure that the switched line really is disconnected. (A public switch will normally disconnect the call within 90 seconds) after the message DISCONNECT - REMOTE MODEM WILL DIAL BACK is given. However, if you dialback on a second switched line, this is of course disconnected. You may dialback at once (minimum 5 sec.) without risking any «hacker» to keep the line and simulate an answer.

As a second switched line you may use the bell connector which normally is used for leased line (called «LEASED», «LEA» or «TX»).

To use the second switched line, you have to make sure jumper field J16 is set-up for this function (See chapter 5 «Strapping»). and the phone number should include the dial modifier **>**.

Example:
⇒Enter the following password:
AT+P=SYSOP:>T37011555

6.9.3 Password/Dialback Mode 2 - Open System

This function is activated by entering :
AT+PO2
Modem answers ***OK***

Command is accepted.

If modem answer ***ERROR***: It is not possible to use this command if synchronous mode (**&M** command) or direct mode (\N1 command) is selected. Set asynchronous mode (&M0) and turn off direct mode (i.e. \N0,\N2 or \N3).

When this configuration is set it can only be reset by the +PO0 command. The &F or Z commands will not reset it.

The command **+PO2** is based upon the password function. STEP 2 and STEP 3 are the same for both functions:

Step 1:

The purpose of this is that a connected system shall not be disturbed by any caller until the modem has made a proper connection. The data equipment connected, is not supposed to know the background activity. The modem will answer incoming calls ONLY if the **MAN/AUTO** switch is activated. This call is "silent", i.e. RI/125, CD/109, DSR/107, and the resultcodes RING- and ***CONNECT*** will not be given

It is not possible to terminate an answer handshake by sending data to the modem.

As soon as a connection is made (successful handshake), the modem will transmit the following message to the caller:
ENTER DIALBACK CODE FOR REMOTE MODEM
or
CARRIAGE RETURN FOR DIRECT CONNECTION

The modem will now wait a number of seconds, determined by value set in register +S3 , to receive a password (dialback code). If one of the 3 following conditions is met, STEP 3 will start.

- A password is not received within the period set by register +S3.
- The received password does not exist in the password table.
- The received password does not have a corresponding dialback number in the password table.

If none of these conditions is met, i.e. the received password does have a corresponding number defined, STEP 2 will start and continue into STEP 3, described under Password/Dialback Mode 1.

When dialback function is active, it is not possible to terminate an answer handshake or dialback by sending data to the modem. Other AT-commands and Escape sequence are ignored awaiting dialback code.

6.10 Hacker Protection/Locking function.

This function is related only to Password/Dialback-Mode 1, Protected System, and is controlled by register +S18.

Factory setting for +S18 is 255 and it can be set to any value in the range 1 - 255 by the command:

AT+S18=<number>

There are 4 ranges of +S18 , and the function operates different for each range :

129-255:

+S18 will be decremented by one (until the value 128 is reached) whenever the modem hangs up because a wrong password is entered. Locking will never occur.

128:

+S18 will not be decremented when entering wrong password(s).

1-127:

The register will be decremented by one (until the value zero is reached) whenever the modem hangs up because wrong password is entered.

0:

Locking occurs.
Access to host is no longer possible. (This value can not be set directly by a command.)

Setting +S18 in range **129** to **255**, means that the modem will only count interception attempts and never lock up.

Setting +S18 in range (3), **1** to **127**, means that the modem will count interception attempts and locking will occur when the value of zero is reached and access to host is then not available.

When +S18=0 and +PO1 is used a caller will receive the message:
ACCESS DENIED - REMOTE MODEM DISCONNECTS
and the modem will disconnect as follows :

+O0,+O1,+O2 :	Hang-up will follow after 3 Sec.
+O3 :	Hang-up will follow after 8 Sec.

The modem is now "Locked".

6.10.1 On site Unlock of Locked modem :

⇒Set +S18 to a non-zero value.

6.10.2 Remote Unlock of Locked modem :

When the modem is configured with remote access command +O3 there is a delay 8 Sec. after the message
ACCESS DENIED - REMOTE MODEM DISCONNECTS
before hang-up.

During this period the modem will detect Remote Access Esc Code and if detected the modem will present the message :
ENTER PASSWORD FOR REMOTE MODEM

If a Level 1 or Level 2 password is entered the Remote Access request is accepted and the modem responds :
REMOTE:OK
(The time limit of entering the password is stored in +S3.)

Now the remote operator will have full access to the remote modem for 8 Sec. only. If, during this period, +S18 is set to a non-zero value the remote access time limit of 8 Sec. is discarded and the system is open for Remote maintenance.

The modem is now Unlocked and ready for operation again. Disconnect by use of H0 command or enter the O command to start a simulated RING and proceed into data transfer mode.

7. Encryption

7.1 Introduction

The two most important aspects using encryption are:

- Prevent tapping of sensitive information.
- Restrict system access.

Encryption is in general based upon scrambling the transmitted data using an algorithm that provides sufficient security against descrambling. The algorithm used in the modems, is the well known DES standard. Only the key used to encrypt and decrypt data must be kept secret. The DES algorithm is today the most common and accepted encryption method.

Your modem always uses error correction in asynchronous DES mode. This function ensures error free data receiption before decryption. Data compression is active in DES mode, because data is compressed before they are encrypted. LAPM/V.42 bis is the preferred operation mode, MNP is only supported for backward compatibility.

When using encryption and character format 7E1 or 7O1 (7 data bit, odd parity and 1 stop-bit) between DTE and modem, the character format between the modems (on-line) should be set-up to 8N1 (8 data bit, no parity and 1 stop bit). This is set-up with the command +&G and writing to register +S6. See description of command and registers in this manual.

7.2 Security

To obtain maximum security, you should read the following user requirements:

- Encryption keys and possible copies of the keys must be stored unavailable to others.
- Keys should be upgraded at regular intervals. If anyone should know one of the keys, the access is only valid until a new one is distributed. Make sure the routine for distributing keys are safe enough.
- It is important that all keys have the same probability, the key should therefore be chosen at random.

Make your security precautions depending of the sensivity of the information to be transmitted. It may be sufficient to distribute the keys verbally or by mail and to keep the modems in a safe location.

7.3 Functional description

The modem connection should consist of two ERICSSON modems where both modems are installed with encryption. The correct configuration commands must also be entered. Each modem has a key and password table:

7.3.1 The key table

- This table is used for storing the keys together with an index reference for each key. When entering keys always enter key 0 first. Since this is the master key it must be placed first in the key list. If you have entered keys without entering key 0 first, the key 0 will overwrite the first key entered. The keys stored in this table can't be displayed from the modem, but you may however display the key indexes. Maximum 100 keys may be stored in this table. Legal index values: 0 to 99.
- Default memory allocation for keys is 5. To enter more keys, you have to increase the size of the table.
- When the size of the key table is increased, the size of the password table decreases automatically.

AT+PL=100  Maximum

7.3.2 The password table

- This is the same table used in password mode, the only difference is that more fields are used for each password.

7.3.3 Example, Call mode, password

SEMAFOR:T37011710:0:K:USER1 

SEMAFOR is the remote identity.
T37011710 is the corresponding telephone number.
0 is the access level. This is equal to the password table in the ordinary password mode.
K tells your modem to use encryption for this call.
USER1 is your password, which is transmitted to the remote modem during the key negotiation. The following key table shows stored keys, index 0,1,2. Each key consists of 16 hexadecimal characters, possible values 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F.

Key table:

0:7CB8D036A8925FA1
1:9AB573FC053ADFB8
2:825AC3BFE0935CB2

7.3.4 Example, Answering mode, password.

USER1::0:K=01-02

The key table.

0:7CB8D036A8925FA1
1:9AB573FC053ADFB8
2:825AC3BFE0935CB2

USER1 is the remote identity.
Neither telephone number nor dialback function exist.
The access level is **0**.
K=01-02 If USER1 should login, this field instructs the modem to use key index 1 or 2.

Key number 0 is only used during the key negotiation and is not used as a definite key. In encryption mode, the answering modem determines which of the keys to be used. If it is possible to choose among several keys, as in the example above, the answering modem will choose one of them at random. The call modem must have all the possible keys stored in its key table.

The key negotiation is further described in the section «Key negotiation diagram».

Seen from the users point of view the modem is operated as normal whether a connection is made in DES mode or not. From the originator site (your modem is already configured):

Dialling

ATDT37011710  The modem dials number 37011710 and connects.

Result code: ***CONNECT 14400***

As soon as a successful DES connection is made, the modem behaves just like having a normal V.42 bis connection. (Error free channel with data compression).

Asynchronous or synchronous/general requirements.
In synchronous communication with encryption an extra hardware module is required. The power-up menu will display CRYPT-OK if an encryption module is found. In addition the modem should have a software version 7.10 or higher. In asynchronous communication no extra hardware are required, however the encryption module will increase the throughput considerable for the higher speeds (9600 and above).

7.4 Configuration

In the examples following nothing is mentioned about synchronous or asynchronous communication, and the examples are valid in both modes, but there are some special requirements for synchronous encryption. See description of synchronous encryption later in this chapter.

7.4.1 Encryption always on.

The modems should be configured for encryption and the password tables should be protected. One of the modems is always the answer modem in this example. The keys are used.

Call modem:

⇒Enter encryption password

AT+P=MODEM2:T37024563:0:K:PASS0123 

⇒Enter Password for password table access

AT+P=SYSOP1::2 

⇒Enter 3 keys

AT+PK00=7CB8D036A8925FA1 

AT+PK01=9AB573FC053ADFB8 

AT+PK02=825AC3BFE0935CB2 

⇒Enter encryption always on

AT+PC2 

⇒Only local password access

AT+PA2 

⇒Extra result codes.

AT+Q3

Answering modem:

⇒Enter encryption password

AT+P=PASS0123::0:K=01-02

K=01-02 specifies legal key index

⇒Enter Password for password table access

AT+P=SYSOP2::2 

⇒Enter 3 keys identical for answering and calling mode

AT+PK00=7CB8D036A8925FA1

AT+PK01=9AB573FC053ADFB8

AT+PK02=825AC3BFE0935CB2

⇒Enter encryption always on

AT+PC2

⇒Activate password mode.

AT+PO1

⇒Auto answer

ATS0=1

⇒Only local password access

AT+PA2

⇒Extra result codes.

AT+Q3

Calling mode, examples:

⇒Dialling

ATDT37024563 Modem calls and connects.

CONNECT 2400/2400/V.42BIS/DES (LAPM protocol)

or:

CONNECT 2400/REL/2400/MNP 5/DES

7.4.2 One answering and many calling modems

All modems should be configured for encryption and the password tables should be protected.

Each user has their own individual key.

Set-up for two users are shown in the following example. Because of the auto-encrypting function, the calling modems may also be used for ordinary modem connections.

Extra security for the calling modem is obtained, by demanding local password before making a DES connection.

Calling modem 1.

⇒Enter encryption password

AT+P=HOST:T37024563:0:K:USER1

⇒Enter Password for password table access.

AT+P=SYSOP1::2 

⇒Common negotiation key

AT+PK00=123456789ABCDEF0 

⇒Individual key

AT+PK01=1122334455667788 

⇒Auto encryption

AT+PC1

⇒Demands password before encryption

AT+PS1 

⇒Only local password access.

AT+PA2

⇒Extra result codes

AT+Q3

Calling modem 2

⇒Enter encryption password

AT+P=HOST:T37024563:0:K:USER2ENTER

⇒Enter Password for password table access.

AT+P=SYSOP2::2ENTER

⇒Common negotiation key.

AT+PK00=123456789ABCDEF0ENTER

⇒Individual key.

AT+PK03=33445566778899AAENTER

⇒Enable auto encryption

AT+PC1ENTER

⇒Demand password before encryption

AT+PS1ENTER

⇒Only local password access

AT+PA2ENTER

⇒Extra result codes

AT+Q3ENTER

Answering modem:

⇒Reserve space for 20 keys

AT+PL=20ENTER

⇒Enter encryption password for USER1

AT+P=USER1::0:K=01-01ENTER

⇒Enter encryption password for USER2

AT+P=USER2::0:K=03-03ENTER

⇒Enter Password for password list access

AT+P=SYSOPB::2ENTER

⇒Common negotiation key.

AT+PK00=123456789ABCDEF0[ENTER]

⇒Individual key for User 1

AT+PK01=1122334455667788[ENTER]

⇒Individual key for User 2

AT+PK03=33445566778899AA[ENTER]

⇒Fixed encryption mode

AT+PC2[ENTER]

⇒Activate password mode

AT+PO1[ENTER]

⇒Auto answer

ATS0=1[ENTER]

⇒Only local password access

AT+PA2[ENTER]

Calling from USER1

⇒Dialling

ATDT37024563[ENTER]

The modem answers

ENTER PASSWORD FOR DIALLING PROTECTED TEL.NUMBER

⇒Enter the password

USER1[ENTER] Modem calls and connects.

Result code:

CONNECT 2400/REL/2400/V.42BIS/DES (w/LAPM protocol)

or:

CONNECT 2400/REL/2400/MNP 5/DES

7.4.3 Changing keys

Usually the system operator of the answering modem is distributing new keys. If USER1 in the example below are going to change keys, the following can be done:

⇒Deliver a new key with index number two to USER1 and set a deadline for entering the new key.

⇒Enter the key with index number two when deadline, in the answer modem and change the password, USER1 to

AT+P=USER1::0:K=02-02 

By doing this, it is not necessary for the two modems to change key at the same time.

It is necessary to keep an updated list of active keys for the system operator. You may write it down or file it, whatever you like. It is necessary to store it in a safe manner. You may also store the key on a script file, f ex. procomm.

Example:

```
;Common key
TRANSMIT "AT+PK00=123456789ABCDEF0^M"
WAITFOR "OK? M^J"
;Key for user1
TRANSMIT "AT+PK01=1122334455667788^M"
WAITFOR "OK^M^J"
;Key for user2
TRANSMIT "AT+PK03=33445566778899AA^M"
WAITFOR "OK^M^J"
```

7.4.4 Example, Answering modem, auto encryption. Calling modem using dialback

A modem is connected to a host where several users are logging on. Some may have access to data which should be encrypted, others don't need to do this. Some of them may use the dial back function.

⇒Call modem using dialback

AT+P=HOST:T37011710:0:K:USER4

⇒Host password after dialback.

AT+P=PASS1::0:K=03-03 

⇒negotiation key

AT+PK00=123456789ABCDEF0 

⇒Individual key

AT+PK03=33445566778899AA 

⇒Activate auto encryption..

AT+PC1

⇒Activate password mode.

AT+PO1

⇒Autoanswer.

ATS0=1

⇒Extra result code

AT+Q3

Answering mode, host:

⇒Allocate space for 20 keys
AT+PL=20

⇒USER 1 without encryption
AT+P=USER1

⇒USER 2 without encryption. dial back.
AT+P=USER2:T36476474

⇒USER 3 with encryption.
AT+P=USER3::0:K=01-01

⇒USER 4 with encryption and dialback.
AT+P=USER4:T121214:0:K:PASS1

⇒Enter Password for password table access
AT+P=SYSOPB::2

⇒Common negotiation key:
AT+PK00=123456789ABCDEF0

⇒Individual key no. 1
AT+PK01=1122334455667788

⇒Individual key no. 3
AT+PK03=33445566778899AA

AT+PC1	Auto encryption
AT+PO1	Activate password mode
ATS0=1	Auto answer
AT+PA1	Password security level.
AT+O2	Remote config with password control

Some common settings for a modem connected to a host:

AT+C1 ENTER	Speed conversion
AT&D2 ENTER	DTR disconnect
AT+&A1 ENTER	Autoanswer on, ignoring DTR
AT\N3 ENTER	Auto V.42
AT&Y0 ENTER	Recall user defined profile 0 at power up.
AT+PN1&W0 ENTER	Activate manual operation and store the profile.

Connect from the originator:

ATDT37011710 ENTER	Calling

When the password "USER 4" is transmitted, the answering modem disconnects and starts dial back the local modem sends the resultcode:
NO CARRIER - REMOTE MODEM DIALS BACK

Host modem has made a dialback.
RING

The modem connects in DES mode
CONNECT 2400/REL/2400/V.42BIS/DES (w/LAPM protocol)
or:
CONNECT 2400/REL/2400/MNP 5/DES

The host modem starts the answering procedure.
PAGING HOST - WAIT

Connection to the host is established in DES mode:
CONNECTED TO REMOTE SYSTEM

7.4.5 Leased line/external dialback encryption

In this mode encryption is always on, i.e. a connection without encryption is not permitted. This is the encryption mode used in leased line. There are no phone number associated with the password. The example below is valid for both leased line and switched line. In switched line the phone number is free. Using encrypted connection with dialback, it may be bothersome to manage the password table in the answering modem. If the incoming calls, are to be returned at different numbers with regular intervals, the dialback task may be given to host computer.

When set-up with the **+PC3** command, the modem will not search in password table for a telephone number. Instead the modem will use the information associated with the first stored password, i. e. the user password and the key index.

Example, Common set-up for both answering and calling modem:

⇒Common negotiation key:

AT+PK00=30303030303030304

⇒Individual key no 1:

AT+PK01=31313131313131314

⇒Individual key no 2:

AT+PK02=32323232323232324

⇒Delete all passwords:

AT+PD

⇒Insert a password in answering modem:

AT+P=REMOTE::0:K=01-02:HOST

⇒Insert a password in calling modem:

AT+P=HOST::0:K=01-02:REMOTE

AT+PC3

AT+PO1

AT+Q3

ATS0=1

Calling modem

ATDT22967666

CONNECT 2400/REL/2400/V.42 bis /DES

Answering modem:

RING

CONNECT 2400/REL/2400/V.42 bis /DES

7.5 Synchronous Configuration

This section assumes that you are familiar with the asynchronous encryption mode of operation.

> ☞ *Synchronous encryption modules must be installed in the modems before they are able to operate in synchronous encrypted mode.*

The power up menu will display *CRYPT OK* if an encryption module is found. In addition the modem should have a software version 7.10 or higher. The modem configuration for synchronous encryption mode is the same as for asynchronous encryption mode except that the modem is set to synchronous mode. (&M command or by display setting). Most synchronous applications use dumb mode as well.

Detection of escape code is not supported in synchronous mode with encryption.

7.5.1 Switched line (automatic dial):

Assuming the modems are configured from an asynchronous DTE at 9600 bps:

Originating modem:

⇒Enter password entry with encryption

AT+P=MODEM2:T37024563:0:K:PASS0123 

⇒Enter 2 secret and random keys

AT+PK00=7CB8D036A8925FA1 

AT+PK01=9AB573FC053ADFB8 

⇒Set fixed encryption

AT+PC2

⇒Store tel. number to remote

AT&Z0=T37024563

⇒Set Voice/Data dialling

AT+&VD1

⇒Set synchronous mode

AT&M1

⇒Make CT-106 go off during handshake

AT&S2

⇒Set dumb mode and store configuration

AT+PN1&W

Answering modem:

⇒Enter password entry for remote login

AT+P=PASS0123::0:K=01-01ENTER

K=01-01 specifies the key index.

⇒Enter 2 keys identical to remote keys.

AT+PK00=7CB8D036A8925FA1ENTER

AT+PK01=9AB573FC053ADFB8ENTER

⇒Set fixed encryption

AT+PC2ENTER

⇒Password mode on

AT+PO1ENTER

⇒Autoanswer

ATS0=1ENTER

⇒Set synchronous mode

AT&M1ENTER

⇒Make CT-106 go off during handshake

AT&S2ENTER

⇒Set dumb mode and store configuration

AT+PN1&WENTER

All of the above settings may also be set from the display menus.

7.5.2 Operation of the modems:

(Synchronous DTE's are connected).

⇒The user at the originating modem starts the session by pressing the VOICE/DATA switch on the front.

The modem will automatically start dialling the stored number.

When the handshake is completed the modem will execute an automatic login sequence using the password stored in the password table (PASS0123).

Then the synchronous encryption part of the modems will activate and both modems turn CT109 and CT106 on. This triggers the DTE which will start sending and receiving data.

The modem is disconnected by pressing the VOICE/DATA switch or by dropping CT 108.2.

7.5.3 Leased line with lookback function:

Assuming the modems are configured from an asynchronous DTE at 9600 bps:

Originating modem:

⇒Enter password entry with encryption.

AT+P=MODEM2:T37024563:0:K:PASS0123 

Tel. number is used by dialbackup function.

⇒Enter 2 secret and random keys

AT+PK00=7CB8D036A8925FA1 

AT+PK01=9AB573FC053ADFB8 

⇒Set leased line encryption

AT+PC3

⇒Store tel. number to remote

AT&Z0=T23704563 

Set originate channel

AT+&LC1 

⇒Set automatic dialbackup on

AT+J1 

⇒Set continuous lookback

AT+&LB1 

⇒Set synchronous mode

AT&M1 

⇒Make CT-106 go off during handshake

AT&S2 

⇒Set dumb mode, leased line and store configuration

AT+PN1&L1&W

Answering modem:

⇒Enter password entry for remote login,

AT+P=PASS0123::0:K=01-01ENTER

K=01-01 specifies the key index.

⇒Enter 2 keys identical to remote keys.

AT+PK00=7CB8D036A8925FA1ENTER

AT+PK01=9AB573FC053ADFB8ENTER

⇒Set leased line encryption

AT+PC3ENTER

⇒Password mode on

AT+PO1ENTER

⇒Autoanswer

ATS0=1ENTER

⇒Set answer channel

AT+&LC1ENTER

⇒Set synchronous mode

AT&M1ENTER

⇒Make CT-106 go off during handshake

AT&S2ENTER

⇒Set dumb mode, leased line and store configuration

AT+PN1&L1&WENTER

7.5.4 Operation of the modems:

(Synchronous DTE's are connected)

After the last configuration command, the modems will start trying to connect on the leased line.

When the remote modem is detected, the handshake, auto login and synchronous encryption procedure will be executed.

The modems turn CT109 and CT106 on.

At this time the DTE's have a transparent synchronous channel. The modems will stay in this mode as long as the leased line is good.

If the leased line connection is lost, both modems will turn CT 109 and CT 106 off and enter handshake mode trying to reconnect the leased line.

If the leased line stays down, the originating modem will detect a time-out and dial the remote modem on the switched line.

The answering modem will detect the ring signal and connect on switched line.

The complete login sequence is executed and the synchronous encrypted channel is re-established.

While staying on the dialbackup line the originating modem will continuously check the leased line.

When the leased line failure is corrected the modems will immediately go back to leased line and set up a synchronous encrypted channel.

7.5.5 Other combinations of configuration:

Password dialback:

The configuration example "Switched line synchronous encryption (automatic dial)" for switched line may be expanded with a dialback function. This added configuration may be found in the user manual describing asynchronous. encryption with dialback.

More keys:

The modems may be configured with more than one data key, thus increasing the security. More keys can be stored in both modems and the password table - encryption field in the answering modem should be changed to select indexes at random.
⇒Change "K=01-01" to "K=01-04" if 4 keys are used.

Manual dialbackup:

In the leased line example, the originating modem may be configured for manual as well as automatic dialbackup.

⇒Use the +&VD1 command.

When on-line in leased line, a manual dialbackup is performed by pressing the LEAS/SW switch on the front and then the VOICE/DIAL switch.

No dialbackup:

If no dialbackup switched line is used, the +J1 command should be changed to +J0.

Transmit clock:

The default transmit clock is CT 114. If CT 113 is used, the &X1 command must be issued.

> ☞ *Note that when 113 clock is used, the modem demands a stable clock during connection. If 113 clock is not present the connection will fail.*

7.5.6 Description of the data channel and encryption mode.

In encrypted synchronous data mode, the DTE will have a transparent full duplex data channel. The delay through both modems at 9600 bps with trellis coding is about 70ms. This delay will typically be 25ms in normal synchronous mode.

The connection sequence in synch. encryption mode is as follows:
First the modems are connected.

- Then the V.42/V.42 bis protocol is set up.
- Then the answering modem requests password in plain text.
- The originating modem sends this password in plain text.
- The answering modem decides which key index to use and sends this information to the remote encrypted with key 0.
- The originating modem decrypts the information and activates the correct local key.
- Then both modems starts a bit synching procedure. The synching of the receive and transmit channel is independent.
- When the bit synching process is nearly finished, the modem turns 106 on and starts reading data from DTE.
- When the bit synching process has finished, the modems set 109 on and enters data state.
- In data state, the modems receives bytes synchronously from both line and DTE. The bytes are stored in buffers. When the buffers has accumulated 8 bytes, these 8 bytes are encrypted or decrypted as a block. After encryption/decryption the block is put in transmit buffers waiting to be sent. The number of characters in the buffers are kept at a constant size because both receiver and transmitter is clocked from the same source.
- The encryption/decryption uses DES-Cipher Block Chaining (CBC) mode of operation with a random initial vector. (The same as in asynchronous encryption mode) This means that all encrypted sessions will send different bit patterns on the line, even if the plain text data is the same.
- The DES-CBC mode is self synchronising. This means that any bit errors in an encrypted block will produce bit errors in the decrypted block. But the next error free block will be decrypted into an error free block.
- If the modems loose synch. the CBC mode will not synchronise again. This case is prevented in the modem by automatically starting retrains or entering a new handshake when serious line distortions are detected.

7.6 Troubleshooting

If you meet problems of any kind using encryption, configure your modem to extended connect messages, +Q3 command.

7.6.1 Messages from call modem:

CRYPT ENTRY NOT FOUND

Your modem is unable to find the telephone number (given by the D command) in the password table, or the number is not marked for encryption (K).

ENCRYPTION ERROR: NO REMOTE V42/MNP

An error free link (V.42 bis or MNP) could not be established. Encryption is impossible.

ENCRYPTION ERROR: NO REMOTE LOGIN STRING

The password mode is not active in the remote modem. (Doesn't transmit the message "Enter password for remote modem")

ENCRYPTION ERROR: PASSWORD NOT ACCEPTED BY REMOTE

The password transmitted from the calling modem to the remote modem is not accepted. (The password stored in the userfield in the password table).

ENCRYPTION ERROR: NO REMOTE CRYPT RESPONSE

The key negotiation parameter is not transmitted from the remote modem. The remote modem is obviously set to ordinary password mode.

KEY INDEX NOT FOUND

Key index received from the remote modem is not stored in the key table.

CRYPT MODULE MISSING

The hardware module required for synchronous encryption is missing.

SYNC CRYPT HANDSHAKE FAILED

The encryption handshake with key negotiation failed.

7.6.2 Messages from the answer modem:

KEY INDEX NOT FOUND

Activated key index in the key negotiation is not stored in the key table. The content in the password list doesn't agree with the key table.

7.6.3 Data mode:

If transmitted data is received in unreadable hieroglyphics, most probably the keys in the two modems are not identical. (Another reason might be the communication speed and format).

7.7 DES algorithm.

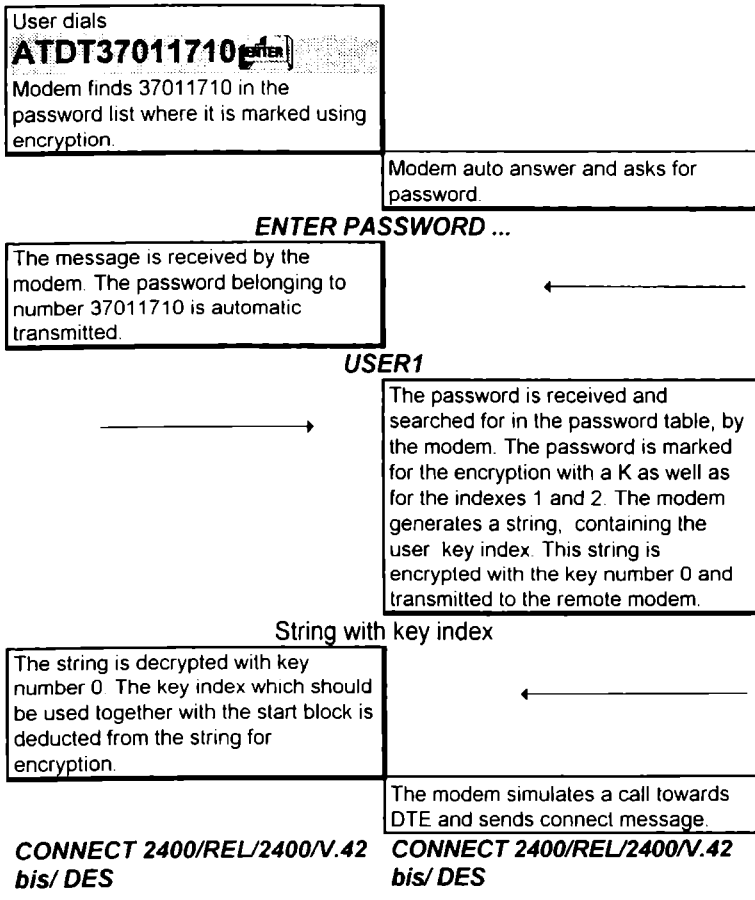
DES uses a 56 bit key. (8 bits of the 16 hexadecimal digits are used as parity bits.). If anyone should know parts of the plain text and try to decrypt this using different keys, at worst about 7.2×10^{16} attempts must be tried (72 million billion attempts).

The DES algorithm is used in the "Chipher Block Chaining" (CBC) mode. The encrypted block will depend on the previous block. The first block is dependent of one of the blocks exchanged in the key negotiation.

During this negotiation, before a user key has been agreed upon, data is encrypted using key no. 0. By using this key negotiation, identical messages transmitted several times, are not encrypted in the same way. (Only the message length will repeat itself).

7.8 Key negotiation diagram.

Both modems are configured using encryption and the key- as well as the password table is configured. The connect message is set to +Q3- mode.

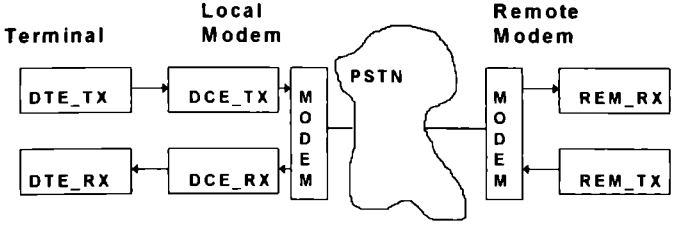


Notes:

8. Flowcontrol and buffering

8.1 Flowcontrol

Buffering is performed when the modem cannot transfer data over the line as fast as the DTE transfers data to the modem or when the line speed is higher than the DTE speed. Since this clearly causes a problem with buffer overflow there has to be a mechanism which controls the dataflow, i.e. flowcontrol. The following figure illustrates the different buffers which may need flowcontrol.



8.1.1 Terms

DTE_TX
This buffer contains data from the DTE which is to be sent on the V24 interface to the modem.
DCE_TX
Data from the DTE to be transmitted to the remote modem/DTE.
DCE_RX
Data from remote modem/DTE to be transmitted to the DTE.
DTE_RX
This buffer contains data which the DTE has received from the modem but not processed internally.

When data is placed in a buffer faster than it is removed, this buffer will of course overflow. This means loss of data and must be prevented. The following overflows are possible :
DTE_TX
Internal DTE problem.
DTE_RX
When the DTE is receiving data from the modem faster than it can process them it must stop the modem from sending more data. This is called **DTE to DCE flowcontrol** and utilises hardware (RTS) and/or software (XON/XOFF) signalling.
DCE_TX
When the DTE is transmitting data to the modem faster than the modem transmits data to the line, the modem must stop the DTE from sending more data. This is called **DCE to DTE flowcontrol** and utilises either hardware (CTS) and/or software (XON/XOFF) signalling.

DCE_RX
When the line speed is higher than the DTE speed or the DTE has stopped data flow with DTE to DCE flowcontrol the modem must stop the remote DCE or DTE from sending data. This is called **DCE to DCE flowcontrol** and uses only software (XON/XOFF) signalling.

The methods used for flowcontrol are hardware (CTS and/or RTS) and software (XON/XOFF) signalling. Below is an explanation of these terms

RTS
This is a hardware signal from the DTE to the modem which is used (if enabled) to tell the modem when the DTE is ready for more data.

CTS
This is a hardware signal from the modem to the DTE which is used (if enabled) to tell the DTE when the modem is ready for more data.

XON/XOFF
These are data bytes inserted into the data stream to tell the receiver (DTE/modem/remote) to stop (XOFF) or restart (XON) its transmitter. This means that you may not send these bytes as data in your data stream since they will be lost and cause unintentional starting/stopping of the transmitter. XON/XOFF bytes may be stripped from the data stream by the modem (normal) or passed on (transparent). If passed on, this means that when the DTE starts or stops the modem transmitter by sending XON or XOFF the XON/XOFF will also be sent to the remote DCE/DTE.

8.1.2 DTE to DCE flowcontrol: \Qn \Xn

\Q controls how the DTE signals to the modem and \X controls whether the modem is transparent or not. The following combinations are possible :

\Q0 ENTER \Xn ENTER	No flowcontrol.
\Q1 ENTER \X0 ENTER	XON/XOFF flowcontrol, XON/XOFF characters are stripped from the data stream to remote.
\Q1 ENTER \X1 ENTER	XON/XOFF flowcontrol, XON/XOFF characters are not stripped from the data stream to remote.
\Q2 ENTER \Xn ENTER	No flowcontrol.
\Q3 ENTER \Xn ENTER	RTS signal flowcontrol.
\Q4 ENTER \Xn ENTER	No flowcontrol.

8.1.3 DCE to DTE flowcontrol: \Qn (Local flow control)

\Q controls how the modem signals to the DTE. The following combinations are possible :

Q0 ENTER	No flowcontrol.
\Q1 ENTER	XON/XOFF flowcontrol.
\Q2 ENTER	CTS signal flowcontrol.
\Q3 ENTER	CTS signal flowcontrol.
\Q4 ENTER	XON/XOFF flowcontrol.

8.1.4 DCE to DCE flowcontrol: \Gn (Line Flow control)

\Q controls how the modem signals to the remote modem/DTE. The following combinations are possible :

\G0 ENTER	No flowcontrol.
\G1 ENTER	XON/XOFF flowcontrol both on received and transmitted data.
\G2 ENTER	XON/XOFF flowcontrol is used for received data but received XON/XOFF is ignored and passed directly to DTE as data.

8.1.5 When to use flowcontrol

Flowcontrol should be used when there is a mismatch between linespeed and DTE speed.

When using any of the internal modem protocols (see chapter 9), flowcontrol should be used even if the DTE is using the same speed as the line speed, because the protocol may slow down the line speed due to retransmissions caused by a noisy line.

The recommended DTE to DCE flowcontrol is RTS since this is data independent (XON/XOFF characters are ignored) and the recommended DCE to DTE flowcontrol is CTS for the same reason. Regarding DCE to DCE flowcontrol, this is only necessary in buffered mode since any protocol implies DCE to DCE flowcontrol. The DCE to DCE flowcontrol is normally not needed.

8.2 Buffering

Buffering occurs whenever data speeds into and out from a buffer differ. The following situations imply such a difference :

- The DTE transmits data faster than the line speed, DTE overspeed.
- The line speed is higher than the DTE speed, DTE underspeed.
- The modem transmits data faster than the DTE can process them, DTE inefficiency.
- Protocols causes line speed degradation due to noise, DTE overspeed.
- Difference in real speed as opposed to nominal speed, Rate inaccuracy.

In NORMAL mode DTE overspeed/underspeed is only affected by the +C command (except rate inaccuracy) as follows:

+C0	DTE speed follows line speed. No flowcontrol is necessary.
+C1	DTE speed is constant regardless of line speed. If DTE speed is equal or higher than maximum linespeed DCE to DTE flowcontrol is necessary to ensure data integrity. If DTE speed is below maximum line speed DCE to DCE flowcontrol is also necessary.

In protocol modes DTE overspeed/underspeed is affected by +C command (as above), line quality and compression schemes. Since the line speed may vary depending on nominal line speed, data retransmissions due to noise and compression efficiency, it is always recommended to use DCE to DTE flowcontrol.

When the DTE processes data at a lower speed than the line speed, you must use DTE to DCE flowcontrol to ensure data integrity.

When using normal mode with buffering, there is still a possibility for buffer overflow, since the speed generators have internal inaccuracies which cause them to transmit data at a slightly different speed than the nominal. If the DTE has maximum overspeed at 9600bit/s which is 1%, or 9696 bit/s, this will cause a buffer overflow in the modem (if the linespeed is perfect) after 213 seconds or approx. 200kB of data at maximum rate. Since this occurs very seldom this should not be a problem. In special applications where this causes a problem, flowcontrol should be applied.

9. Protocols and Compression schemes

9.1 Protocols

The internal protocols utilise both the flowcontrol and buffering m echanisms described in chapter 8 to ensure data integrity between the DTE and modem. In addition an error correcting protocol is used between the local and remote modem. If an error occurs when sending data, it is detected by the remote modem and it requests a retransmission from the other modem. This is repeated until the data is verified. On a very bad line this may cause a speed degradation but will insure data integrity from DTE to remote DTE. The internal protocols also reduce the need for protocols in the DTE's. In addition compression algorithms are available which may increase the effective line speed considerably.

The protocols only support asynchronous communication towards the DTE. When a protocol is marked as synchronous it is only the DCE to DCE communication which is synchronous; the DTE to DCE communication is still asynchronous. The reason for synchronous DCE to DCE communications is that the asynchronous start and stopbits are removed and this decreases data by 20%, and increases linespeed equally. This ensures that even with the protocol overhead the effective linespeed on good lines is higher than the nominal asynchronous line speed.

Below are a list and a description of the supported protocols :
All of the below protocols are specified in the CCITT V.42 specification and are referred to as V.42.

9.1.1 MNP2

Asynchronous protocol which may be used on V.21 connections. Lowers effective linespeed by introducing additional information for error correction over the line. Normally not used.

9.1.2 MNP3

Synchronous protocol used on older modems. Reduces protocol overhead by converting data from asynchronous to synchronous format. Gives an overspeed of approximately 13% compared to nominal line speed.

9.1.3 MNP4

Based on MNP 3 but adds support for longer packets and thus reduces protocol overhead. This increases the overspeed to approximately 15%.

9.1.4 LAPM

HDLC based protocol with approximately 15% overspeed compared to nominal speed.

9.1.5 Connection information

The modem will, depending on extended result code set-up, report the connection information after the handshake and protocol linkup as follows.

If the X0 command is given no additional information is presented.

If the X1, X2, X3 or X4 command is given, the +Q command controls whether extra information is presented to the user :

AT+Q0 ENTER	Line speed is indicated Ex. ***CONNECT 9600***
AT+Q1 ENTER	Protocol presence is indicated by appending /REL to the result message. Ex. ***CONNECT 9600/REL***
AT+Q2 ENTER	DTE speed is indicated by appending /dddd, where dddd is DTE speed, This will be appended both in protocol and non protocol modes. Ex. ***CONNECT 9600/REL/38400***
AT+Q3 ENTER	As +Q2 but with protocol specification when there is a protocol connection. Example: ***CONNECT 9600/REL/38400 LAPM.*** Legal protocol specifications are: LAPM, MNP2, MNP3, MNP4, MNP5 and V.42bis.

9.2 Compression

Compression is used to increase the effective transfer speed over the line. Since compression schemes are dependent on error free data transfer, they are always used in conjunction with a protocol. The modem supports two different compression schemes, MNP5 which uses run length and adaptive frequency encoding, and V.42bis which uses Lempel-Ziv encoding.

The %Cn command controls the use of compression (both MNP5 and V.42bis) as follows :

AT%C0 ENTER	Compression is disabled.
AT%C1 ENTER	Compression is enabled.
AT%C2 ENTER	Compression of transmitted data only (V.42bis).
AT%C3 ENTER	Compression of received data only (V.42bis).

The increase in speed using compression depends on several factors :

Scheme :
MNP5 gives a theoretical increase of 200% and V.42bis of 400%.
Data :
The compressibility of the transmitted data. Plain text files are normally most compressible and binary files least compressible. Pre-compressed files (ZIP, ARC and others) are not compressible at all.
Efficiency :
The efficiency of the data processing unit internally in the modem.

9.2.1 Preferred compression scheme

The preferred compression scheme is V.42bis. The reasons for this are increased compression, less dependency on transferred data and the auto compression ability.

9.2.2 Auto compression

When connected in V.42bis the modem continuously monitors the compression efficiency. When the compression starts to be inefficient it turns itself off. It will still monitor the compression efficiency and restart itself when the efficiency rises. This means that you don't have to disable compression to transfer pre-compressed files since the compression disables itself when necessary to allow the highest possible transfer speed.

9.3 Operating modes

Below is a description of each major operating mode (\Nx command):

9.3.1 Normal mode

AT\N0↵	**Normal mode.** No protocol support, buffered mode with speed conversion capabilities (see chapter 8).

This mode allows only connections without internal protocols but with buffering and flowcontrol. It also allows speed difference between the terminal and the modem (see +C command).

9.3.2 Direct mode:

AT\N1↵	**Direct mode**

This mode connects the terminal directly to the internal modem chip. This means that all internal buffers are bypassed and both speed conversion and local flowcontrol are disabled.

9.3.3 Fixed reliable mode :

AT\N2↵	**Fixed protocol mode** will connect in LAPM towards modems with V.42, and MNP support. If a non protocol modem tries to connect the connection will be disconnected after the protocol handshake attempts.
AT\N6↵	**Fixed MNP mode**. As fixed protocol mode, but will not accept LAPM requests.
AT\N7↵	**Fixed LAPM mode.** As fixed protocol mode but will not accept MNP requests.

These modes allow only protocol connections. Any connections without V.42 will cause a disconnect. The difference between the modes is only which protocols that are allowed (LAPM and MNP, MNP only or LAPM only). All flowcontrol and buffering are as in normal mode.

9.3.4 Auto reliable mode :

AT\N3 ENTER	**Auto protocol mode.** As fixed protocol mode but if a non V.42 modem tries to connect, the modem will fall back to normal data mode after the protocol handshake attempts.
AT\N4 ENTER	**Auto MNP mode.** As auto protocol mode but will not accept LAPM requests.
AT\N5 ENTER	**Auto LAPM mode.** As auto protocol mode but will not accept MNP requests.

These modes differ from the fixed modes only when trying to connect to a non V.42 modem. When this occurs the modem will fall back to normal mode.

The modem selects which protocol to use depending on the \N command and the capabilities of the remote modem.

Notes:

10. Synchronous operation

10.1 Introduction

The commands &M1, &M2 and &M3 tell the modem to operate in asynchronous command mode when off-line and synchronous mode when transmitting data.

Synchronous mode 1 (&M1) will be set if synchronous mode is selected from the display menu.

The following functions can not be used in synchronous mode:

Function	Comment	Operate as
Password/dialback	Not available	+PO0
LAPM/MNP reliable link	Not available	\N1
Speed buffering		+C0
Flow control	Not available	\Q0
Escape code detection	No detection	
Remote Command mode	No detection	+O0
DTR disconnect	&D setting ignored	Refer to &M

Operating in synchronous modes, the following parameters and commands are closely related:

RTS/CTS control:	&R command
Selecting transmit clock:	&X command
Register S26:	RTS/CTS delay

10.2 Synchronous Mode 1

Synchronous Mode 1 is set by the command :

AT&M1 ENTER

The command must be entered from an asynchronous DTE. The modem remains in asynchronous command state until a connection is established.

10.2.1 AT-command mode:

The modem ignores DTR OFF to ON transition and will disconnect on DTR ON to OFF transition if the OFF condition persists for a time set by S25 (in seconds).

10.2.2 Calling

A call is made in asynchronous mode by means of the **D** - command, as described under asynchronous mode. The modem gives resultcodes as in asynchronous mode, and changes to synchronous mode when a connection is established.

⇒Enter the dial command:

ATDnnnnnnnn ENTER

Wait until CTS (106) and DCD (109) is ON.

⇒Set DTE to synchronous operation or switch the V24 interface to a synchronous DTE.

⇒Set DTR ON.

Transmission may start.

10.2.3 Synchronous Autoanswer:

⇒Activate the MAN/AUTO switch or set register S0 to a non-zero value.

⇒Set DTR OFF.

Wait for RING indication (V24. circuit RI/125)

The modem will go off-hook when sufficient number of RING is received. (Ref. to S0)

Wait until CTS (106) and DCD (109) is ON.

⇒Set DTR ON.

⇒Set DTE to synchronous operation or switch V24 interface to a synchronous DTE.

Transmission may start. The autoanswer function is not dependent of a DTR on level.

10.2.4 Requirements on the Data Terminal:

A data terminal to be used in Synchronous Mode 1 must be able, in synchronous mode as well as in asynchronous mode, to communicate through the same physical V.24 port. It must also allow software controlled change-over between synchronous mode and asynchronous mode. If an available DTE does not fulfil these requirements, an asynchronous DTE can be used as long as the modem is in the command state (during connecting-up). When connection is completed, the V.24 cable between the DTE and the modem can be moved to a synchronous DTE. The time available for the operator to reconnect is set by the S25 register. The unit for S25 when operating in Synchronous mode 1 is seconds. In synchronous mode 2 and 3 the unit is 100ms.

10.2.5 Disconnecting.

The modem disconnects if carrier is lost for a longer period than set by register S10. Default 0,1 second. The modem may also be disconnected by turning DTR OFF or by the display menu.

10.2.6 Dumb mode

Dumb mode is intended to be used when the modem must ignore commands or the terminal is a dedicated synchronous DTE. Dumb synchronous mode must be selected using the Display menu. Refer to menu description C011 and C016.

10.2.7 DTR control

The modem can be programmed for 108.1 or 108.2 using the display menu.

10.2.8 108.1 control

Selecting 108.1 control will cause the modem to disconnect if DTR changes from ON to OFF and to disable autoanswer when DTR is OFF. A call or an answer procedure is initiated when DTR changes from OFF to ON when off-line. Refer to menu description C028, C029 and C027.

10.2.9 108.2 control

DTR off to on transition can not be used for initiating a call or answer procedure when using 108.2 control. This mode will only define how to handle DTR on to off. Refer to menu description C026. If DTR on to off response is set to DISCONNECT then autoanswer will be disabled when DTR is OFF. DTR OFF to ON transition is ignored.

10.3 Synchronous Mode 2 - Dial stored number

Synchronous Mode 2 is set by :

AT&M2 extra	The command must be entered from an asynchronous DTE. The modem remains in asynchronous command state until a connection is established.

10.3.1 Storing the telephone number

The telephone number must be stored or changed using an asynchronous DTE as described under the &Z command or by use of the display menu (refer to menu description C031). Remember that the modem will use the number stored in position 0.

10.3.2 Calling.

⇒Set DTE to synchronous operation or switch the V.24 interface to a synchronous DTE.

The modem will automatically dial the stored number at position 0 (See &Z command) when it senses DTR OFF to ON transition. If the modem fails to connect, it will return to asynchronous command state. When the connection is established, the modem changes to synchronous mode and transmission may start when CTS (106) and DCD (109) is ON.

10.3.3 Disconnecting

The modem disconnects if carrier is lost for a longer period than set by register S10. The modem may also be disconnected by turning DTR off or by the display menu.

10.3.4 Synchronous Autoanswer.

⇒Activate the MAN/AUTO switch or set register S0 to a non-zero value.
⇒Set DTE to synchronous operation or switch V.24 interface to a synchronous DTE.
⇒Set DTR OFF.
Wait for RING indication (V.25 circuit RI/125).
⇒Set DTR ON.
Wait until CTS (106) and DCD (109) is on.
Transmission may start.
Answer mode will be started immediately on a DTR OFF to ON transition, after RING detection.
A call can be rejected by keeping DTR off for at least 8 seconds after the last RING signal.

10.4 Synchronous Mode 3 - Manual call

Synchronous Mode 3 is set by :

AT&M3	The command must be entered from an asynchronous DTE. The modem remains in asynchronous command state until a connection is established.

A telephone set must be connected to the modem via the PHONE terminals as described in "Installation". The only difference between Synchronous Mode 2 and Synchronous Mode 3 is the call sequence:

10.4.1 Calling.

⇒Set DTE to synchronous operation or switch the V.24 interface to a synchronous DTE.
⇒Turn DTR OFF.
⇒Dial the required number using the telephone handset.
⇒Turn DTR ON when the number is dialled (and any conversation with the operator of the remote modem has been finished).

The modem starts the handshake.

⇒Replace the handset.
Wait until CTS (106) and DCD (109) is on.

Transmission may start.

10.4.2 Disconnecting.

Refer to description in Synchronous mode 2.

10.4.3 Synchronous Autoanswer.

Refer to description in Synchronous mode 2.

10.5 LPDA2 Command mode

LDPA2 (Link Problem Determination Aid) is a protocol defined by IBM. This protocol uses SDLC frames inserted into the data stream to give commands to the modem. In order to enable the modems to accept LDPA2 commands, both network function and LPDA2 address must be configured.

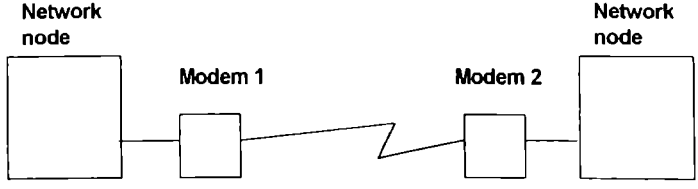
10.5.1 Network function:

Primary : The modem accepts LPDA2 commands from both the DTE side and the line side.
Secondary : The modem only accepts LPDA2 commands from the line side.

10.5.2 LDPA2 Address:

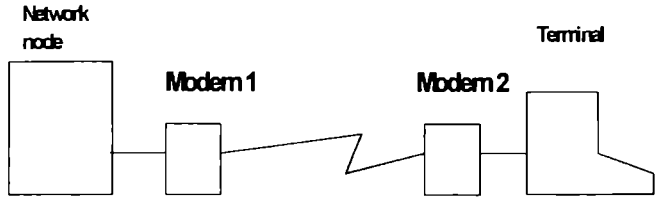
Consult your network equipment documentation in order to obtain the correct addresses. These may vary from one manufacturer to another. The addresses in the examples are often used in Eripax and IBM networks.

Example LPDA2 configurations:



Modem 1	Modem 2
LPDA2 Primary	LPDA2 Primary
LPDA2 Address = 03	LPDA2 Address = 01

Both nodes may give LDPA2 commands to the modems.



Modem 1	Modem 2
LPDA2 Primary	LPDA2 Secondary
LPDA2 Address = 01	LPDA2 Address = 03

The node may send commands to both modems. Modem 2 will not react to LDPA2 commands sent from the terminal.

10.5.3 Addresses used by ERIPAX:

The following table gives the local modem LPDA2 address used by various protocols:

Protocol		Modem address
SLP:	X25	01
	X25DTE	03
	X75A	03
	X75B	01
MLP:	X25	07
	X25DTE	15 (H'0F)
	X75A	15 (H'0F)
	X75B	07

10.5.4 Supported commands:

Modem and Line Status/Test
- Except: Power-off tone detect
  Failure tone detection
  Impulse hit detection

Line Analysis
- Except: Signal distortion ratios
  Phase jitter
  Frequency Shift
  Impulse hit count

Transmit / Receive Test
Call Out
Disconnect
Read Local Configuration
Write Local Configuration
Set Local Transmit Speed
Read Remote Configuration
Write Remote Configuration
Set Remote Transmit Speed

10.5.5 Supported configuration fields:

Leased / switched transmit level
Selected speed
Nominal / backup bit rate
Speed control mode
Primary / secondary mode
Transmit clock
Alarm tresholds
Autoanswer enable / disable
DTMF / Pulse dialing
Phone numbers

10.5.6 Compatibility

LPDA2 has the following limitations:

- It does not work together with encryption.
- Set Transmit Speed is not supported if the modem is configured for 2400 b/s or 4800 b/s. This is due to the fact that 2400 offers little or no improvement over 4800 on heavily impaired lines.
- If LDPA2 is enabled in synchronous mode, the modem will not accept AT commands.

LDPA2 does work with the following functions in the modem:

- V.25bis
- Automatic Fallback/Fallforward
- Automatic Dialbackup

11. Leased line

11.1 Introduction:

The modem may be configured for leased line operation either by use of the display menus or by issuing AT commands. Before starting a configuration the modem should be set to the default configuration.

11.1.1 Set-up from display menu:

⇒Enter the set-up menu and step down to menu C019.

⇒Should the modem always be connected to the leased line or should it be controlled by 108.1 signal? (Menu C020).

C019	**Change leased line conf?**	
	Yes	
C020	**Leased line mode?**	
	Always on	108.1 control

If ALWAYS ON is selected the modem will be connected to the leased line until it is manually disconnected from the front. If disconnected, the modem will start a 1 minute timer and go on-line after this time-out. During this period you may enter the set-up menu again if you want to change any parameters or you may turn leased line operation off (The modem will not go on-line as long as SET-UP menu is active)

If 108.1 CONTROL is selected, the modem will be on-line as long as the 108.1 signal from DTE is on.

⇒Select channel. The channel selection must not be the same as for the remote modem.

C017	**Channel select?**	
	Answer	Call

If leased line is set-up for Answer channel (by command +&LC0 or by using the set-up menu at the front panel) this selection will be restored after a connection which is forced into Call channel by pressing the ROLL/EXEC switch with cursor in CALL position.

⇒Select 2 or 4 wire leased line connection. This selection must be done according to the type of leased line connected to the modem.

C021	**Number of wires**	
	2- wire	+W0
	4-wire	+W1

⇒Select MANUAL or AUTO dial backup.

C021	**Dial backup**	
	Manual	+J0
	Auto	+J1

If AUTO is selected you must ensure that switched line also is connected to the modem for dial backup use.

⇒Set the criteria for the operation.

C056	**Dial backup criteria?**	+&DA/+&DB

⇒Select time-out for re-establishing the leased line connection.
⇒Set the modem to operate in leased line by selecting

C050	**Line configuration**	
	Leased	&L1

⇒Remember to store the configuration into a profile.

C051	**Store configuration?**	
	Profile-0	&W0
	Profile-1	&W1
C052	**Profile to use at Power up?**	
	0	&Y0
	1	&Y1

11.1.2 Set-up using AT commands :

⇒Select leased line with:

AT&L1ENTER

If 4 wire leased line is to be used:

AT+W1ENTER

Select channel to use:

AT+&LC0ENTER

Use answer mode when leased line
or

AT+&LC1ENTER

Use call-mode when leased line
⇒If 108.1 Control is to be used:

AT+E1ENTER

⇒Store the leased line configuration into a user profile:

AT&W&YENTER

11.2 Dial backup

When the modem is set to operate in leased line mode you normally expect to have the modem connection established all the time. It may however occur that these lines go down and the modems lose the carrier. It may also happen that the connected DTE malfunctions and as a result of this the data stream stops (data inactivity). The modem can be set up to be aware of such situations and to automatically call a modem connection on a switched line. This is possible because the modem has separate line terminals for switched and leased line connections.

A spare connection can be established manually or automatically:

AT+J0 ENTER	Use manual dial backup
AT+J1 ENTER	Use automatic dial backup.

11.2.1 Manual Dial backup. (+J0)

Use "Manual Dial backup" if an error has occurred on the leased connection. It is necessary to disconnect the leased connection before establishing a switched connection to another modem. You may do this by entering AT-commands to the modem, or use the front control facilities.

AT-command: (Connection established)

⇒Enter escape code to the modem and wait for resultcode OK.

+++

⇒Enter the following commands.

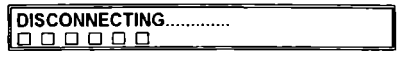
ATH ENTER	Disconnect the leased line connection.
AT&L0 ENTER	Enter switched line mode.
ATDnnnnn ENTER	The modem dials number n.

11.2.2 Front control:(Connection established)

⇒Enter the display menu by pressing ROLL/EXEC and enter the LINE menu.

⇒Move the cursor to DISC and press ROLL/EXEC.

The modem disconnects.



⇒Change mode to switched-line by use of menu C-50

⇒Dial the number to establish the backup connection manually.

⇒Command the modem into Call by using menu A002.

Alternatively:

⇒Press the LEA/SW switch. The modem will now disconnect the leased line connection and enter switched line mode.

Activate automatic dialling by pressing the VOICE/DATA switch. This can be done provided that the VOICE/DATA is already programmed for automatic dialling. Read more about the +&VD command in chapter 3.

11.2.3 Automatic Dial backup (+J1 or J2)

Automatic dial backup means that the modem will call up a backup connection when a condition for this occurs.

The originate modem is the master in dial backup, i.e. this modem will decide if a dial backup condition has occurred The answering part, will in case of carrier loss continuous try to re-establish a leased line connection and also auto answer an incoming call at the switched line connection.

Automatic dial back-up may be set-up either by the +J1 or by the +J2 command. If choosing +J1, the dial back-up function is enabled with no other requirements.

If choosing +J2, the V.24 circuit 108.2 has to turn on to enable dial back-up. This gives a very flexible control of the dial back-up function. If, during a leased line connection, a dial back-up event occurs, the modem will read the 108.2 circuit and start the dial back-up if 108.2 is ON. If 108.2 is OFF, the modem will stay on leased line, or try to re-establish the connection if it's broken. The dial back-up may be enabled any time by turning 108.2 ON.

If 108.2 turns OFF during a dial back-up, the modem will disconnect this connection and return to leased line.

Criteria for automatic dial backup.

Call -list is a vital part of the automatic dial backup .
Read more about this function in the Call-list section.
Automatic dial backup requires at least one specified criteria.

Carrier loss

AT+&DA0 ENTER	No dial backup on carrier loss
AT+&DA1 ENTER	Carrier loss criterion activated

If a carrier loss is detected the modem will try to re-establish the leased line connection, for a period set by register +S28. If no carrier is detected during this period, a dial backup sequence using Call-list 2 will start.

This will be the procedure:

1.	Call number 1 in Call-list 2.
	If connection established: stop.
2.	Try to connect on the leased line connection.
	If connection established: stop.
3.	Are there more numbers in list 2?
	If no. Go to 5.
4.	Call next entry in list 2.
	If no connection established: stop. If no connection: Go to 2.
5.	Try to connect at the leased line connection without stop.

11.2.4 Example of configuration . (AT Commands):

AT+&LC1 ENTER	Use A-channel for leased line
AT+J1 ENTER	Enable auto dial backup.
AT+&DA1 ENTER	Select dial backup criteria: carrier loss
AT+S28=2 ENTER	Drops in the leased line connection persisting for more than 20 sec. will activate the automatic dial backup.
AT+S37=10 ENTER	Index to first space connection for Call-list 2
AT+S38=12 ENTER	Index the last space connection for Call-list 2

Enter numbers into the telephone register for use by Call-list 2

AT&Z10=37011111 ENTER	Number to first spare connection. (+S37=10)
AT&Z11=37022222 ENTER	Number to second spare connection
AT&Z12=37033333 ENTER	Number to last spare connection. (+S38=12)
AT\F ENTER	Check that numbers are correctly entered.
AT+S25=1 ENTER	Each number is to be used only once.
AT+S26=1	Work through the Call-list only once
AT+S32=1 ENTER	The modem will try to re-establish the leased line connection from the spare connection every 15 min
AT&L1&W0&Y0 ENTER	Set the modem to operate in leased line mode and save this configuration in profile 0. We also select to use profile 0 at power up

11.2.5 Data inactivity (no data transmitted)

AT+&DB0 ENTER	No dial backup if data inactivity.
AT+&DB1 ENTER	Criteria Inactivity enabled for automatic dial backup.

If the modem detects inactivity in the data stream (see command +&T) in a period set by the +S8 register, a dial backup using Call-list 3 will be started. Note that the data inactivity test also will be active in the backup connection. If data inactivity is detected in the backup connection the modem will call next number in Call-list 3. When Call-list 3 is empty the modem will return to the leased line connection and disregards the inactivity test until data is received or transmitted.

1.	Call number 1 in Call-list 3.
	If connection established: go to 4.
2.	Are there more numbers in list 3?
	If no. Go to 5.
3.	Call next entry in list 3.
	If no connection: go to 2.
4.	Connection is established on switched line.
	Inactivity detected? If Yes. Disconnect. Go to 2. Go to 4.
5.	Try to connect at the leased line connection without stop.
6.	Connection established on the leased line.
	Disable the inactivity test until data is transmitted.

11.2.6 Example of configuration . (AT Commands):

AT+&LC1	Use A-channel for leased line
AT+J1	Enable auto dial backup.
AT+&DB1	Select dial backup criteria: data inactivity. The modem will always use Call-list 3 on data inactivity.
AT+S39=15	Index to first spare connection for Call-list 3.
AT+S40=17	Index to last spare connection for Call-list 3.

Enter numbers into the telephone register for use by Call-list 3

AT&Z15=37055555	Number to first spare connection. (+S39=15)
AT&Z16=37066666	Number to second spare connection.
AT&Z17=37077777	Number to last spare connection. (+S40=17)
AT\F	Check that numbers are correctly entered.
AT+&T3	Enable data inactivity test.
AT+S8=6	1 min without data will activate the dial backup using Call-list 3.
AT&L1&W0&Y0	Set the modem to operate in leased line mode and save this configuration in profile 0. We also select to use profile 0 at power up

11.2.7 Lookback to leased line:

If the leased line is "repaired" during a dial backup, then you normally wants to re-establish the leased line. This may be done manually or automatically.

Manually:

⇒Enter escape code to the modem and wait for resultcode OK.

+++

⇒Enter the following commands.

ATH[enter]	Disconnect the leased line connection.
AT&L1[enter]	Change mode to leased line.

Front control:

⇒Press the LEA/SW switch. The modem disconnects, changes operating mode to leased line and starts the handshake.

Automatically:

The modem can be configured to renter the leased line connection continuous during the dial backup or at fixed intervals. The +S32 register determines the delay between each attempt.

Which of these two method to use is determined by the configuration and the reason for dial backup.

Lookback may be set-up by AT commands or from SET-UP menu C023A

Function	AT command	Menu entry
Lookback disabled	+&LB0	OFF
Continuous lookback	+&LB1	CONT
Interval lookback	+&LB2	INTERVAL
Both cont. and interval lookback	+&LB3	BOTH

As described earlier in this chapter a dial backup may be set-up after loss of carrier or after detection of inactivity in data transmission (No data).

Selection of dial backup criteria is also important for the kind of lookback to use. *See more about this earlier in this chapter, and the commands +&DA and +&DB.*

If set-up for continuous lookback, a lookback will occur only after a backup initiated after loss of carrier. During the dial backup the modem will monitor the leased line continuous, and if this line is "back" (transparent to tone signalling), the modem will start a new handshake on leased line within about 2 seconds.

AT+&LB1  Continuous lookback

Note that the criteria for dial backup should be loss of carrier.

AT+&DA1 

If set-up for interval lookback only, a lookback will be initiated at fixed intervals depending on the value of +S32. This is independent of the event leading to the backup.

AT+&LB2  Interval lookback.

A continuous lookback will start if loss of carrier initiated the backup. An interval lookback will start if inactivity initiated the backup

AT+&LB3  Both interval and continuous

If the modem fails to connect at the leased line it will use Call-list 2 and try re-establishing a new switched line connection. If this also fails, it will continuous try to connect at the leased line.

11.3 Call-lists

The modem may store maximum 20 numbers in phone register by use of the command &Zn. n is the number in the register (0-19). The phone register is basis of the 3 Call-lists. A Call-list is a subset of telephone numbers from the phone register . A Call-list is used by the modem to dial one or more numbers until it reaches a connection to another modem.

Associated to each Call-list there are two important parameters.

1. Index to the first telephone number in the dictionary to be dialled . This parameter is stored in a S-register and can take values in the range 0 to 19. Each Call-list has a S-register for this purpose. If the modem fails to connect (BUSY, NO CARRIER) it will dial the next number in the dictionary until the Call-list is empty. S-register +S25 determines how many times each number shall be tried before the modem advances to next index in the dictionary.

2. Index to the last number to be dialled.
Each Call-list has a S-register for this purpose. The Call-list is empty when the modem fails to connect using this index.

The Call-lists will be used by separate functions:

List 1 is used when activating the VOICE/DATA switch and by calls originated by 108.1 (see +E1 command)
Call-list 1 uses +S35 (first)/+S36 (last) as index registers.

List 2 is used by automatic dial backup initiated by loss of carrier on leased line connections.
Call-list 2 uses +S37 (first)/+S38 (last) as index registers.

List 3 is used by automatic dial backup initiated by data inactivity.
Call-list 3 uses +S39 (first)/+S40 (last) as index registers.

The following example shows how the Call-lists may be organised. The figure illustrates the phone register.

00	T37011700	+S35=00
01	T37011701	Call-list 1 for use by VOICE/DATA and 108.1 (3 tel numbers)
02	T37011702	+S36=02
03		Not used. (Spare position to expand List 1.)
04	T37011704	+S37=04
05	T37011705	Call-list 2 for carrier loss on leased line (3 tel. numbers)
06	T37011706	+S38 =06
07		Not used. (Spare position to expand List 1.)
08		+S39=09
09	T37011704	
10	T37011705	
11	T37011706	Call-list 3 for use by dial backup caused by data inactivity (5 tel. numbers)
12	T37011707	
13	T37011708	+S40=13
19		

If desirable the Call-lists may overlap, so that some numbers are common for two or more phone registers.

The following figure sums up parameters relating to use of Call-lists:

Call list	Used when	Index to first number in the phone register	Index to last number in the phone register	Related commands and parameters
1	Activating a call by 108 1	+S35	+S36	+E1, +&EC0, +ED1
	Activating VOICE/DATA			+&VC0, +&VD1
2	Auto dial backup initiated by carrier loss.	+S37	+S38	+L1, +J1, +&DA1, +S28
3	Auto dial backup initiated by data inactivity	+S39	+S40	&L1, +J1, +&DB1, +&Tn, +S8

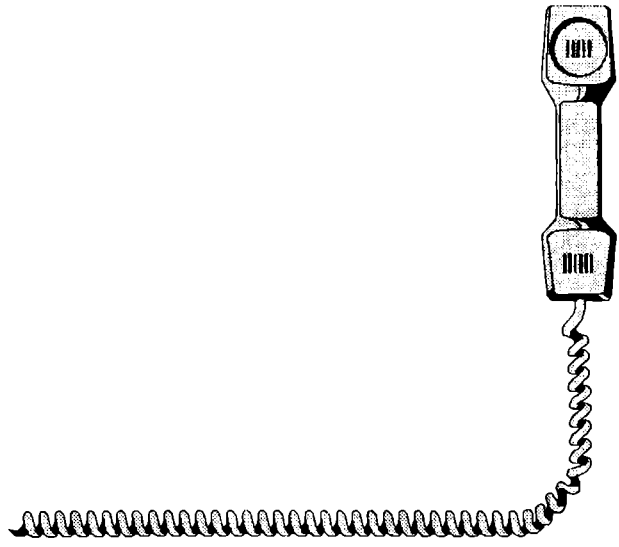
The Call-lists in addition to this have two common parameters:

+S25: This register determines how many times each number shall be tried before the call progress advances to the next number (in case of BUSY, NO CARRIER)

+S26: Determines how many times each Call-List shall be tried. The modem terminates the call establishment phase if it has dialled all the numbers in the list +S26 times.

Notes:

12.1 Voice or data connection



The modem has a function which enables it to decide whether the incoming call is a voice or data call. This function is controlled by the **+B** command, +B1 switches it on, while +B0 switches it off.

In order to use this facility, two requirements have to be met. First, auto answer must be enabled; second, the calling modem must use the 1300 Hz call tone, i.e. it has to be an auto dialling modem.

With the automatic detection on, the modem will, after it has connected to the telephone line, first check for the presence of the 1300 Hz call tone. If present, the modem will continue with the standard V.25 auto answer procedure.

If not present, the modem will indicate the incoming voice call by generating a tone in the loudspeaker, and at the same time transmit a ringing tone back to the calling end. In order to answer the call, first the handset has to be lifted off on the phone set connected to the modem; second, the modem must go on hook. This can be done either by a push on the **ROLL/EXEC** buttons, or by sending a character from the DTE. The voice connection is now established, and is terminated the normal way, simply by placing the handset on the cradle.

12.2 Manual connections

The user at the remote modem rings you in the normal manner. You must have agreed verbally that data transfer is to take place, also at what parity and transfer speed.

You will also have to agree upon who sets the modem in answer mode, and who sets it in call mode. The important issue here is that the modems are set up in different modes.

Messages may now be transmitted and you may commence with file transfer etc. (This can be a little confusing possibly in that the messages entered on the keyboard are not shown on the screen. This is completely normal however. With the exception of communications with an electronic bulletin board or large commercial databases, it is not normal that the remote computer sends echoes of its keyboard messages back to you).

If the remote modem is preset for ringing with automatic transfer rate detection, it may be that the modems will be connected at another transfer speed than that set in the communications programs. If you are not sure which speeds are required to be used, it is advisable to set the modem to a fixed rate.

12.3 Manual connections with AT commands

If you prefer to use a communications program for making the connection, set the modem in AT command mode and use the following procedure:

12.3.1 Connect as answer modem:

The modem connects to the line as the answering modem and starts transmitting the auto answer sequence.

12.3.2 Connect as call modem:

The modem is connected to the line, and tries to detecl the auto answer sequence from other modem

12.4 Setting up the auto-answering system

12.4.1 Automatic answer

The following command sets the modem in auto answer mode:

ATS0=1 enter

The modem is now ready for automatic answer. It will reply after a single ring.

The sender rings to the receiver's modem. When the response code (e.g. ***CONNECT 9600*** appears on the screen, the connection is complete and the dialogue may begin.

12.4.2 The host-mode at preset speed

Several modern communications programs can be preset to automatically receive incoming data messages.

Example:

Smith uses his PC at the office. Rather than continue to work here, he prefers to take his work home and finish it there. However, he forgets some important data on the office PC and rings there and "fetches" it. The office machine is equipped with a modem set to auto-answer and a host program.

Use of this procedure assumes predetermined settings. For example, it must not be possible for unauthorised persons to be able to access the office PC and the data stored there.

The majority of data programs use several sets of AT commands when they function in host-mode

1. When the machine is started up in host-mode, other parameters are necessary than those of the basic set-up.

> *Read the user instructions for your program regarding the necessary requirements.*

A typical basic set-up

A typical basic set-up may appear thus:

ATS0=1&D2&C1&W↵

S0=1

The modem answers after receiving one ring

&D2

When the data terminal sends a message to the modem that it is no longer in operation, the modem replaces the receiver and reverts to command mode (i.e. is now ready for the next incoming call).

Many host programs require that the caller key in a password. Following a number of failures to give the correct password, the program assumes that the caller does not have legal access. It subsequently sends "DTR OFF" to the modem. The &D2 ensures that the connection is broken off when this message is received.

&C1

Following this command the modem will give continuous messages to the terminal/computer on the state of the carrier wave. Should the connection with the remote modem suddenly be broken (something goes wrong or the caller breaks off the dialogue), the host program will detect this and return to the "awaiting new call" status.

&W

The commands are entered into a pre-assigned register set.

2. The first caller rings up. The modem lifts the receiver after one ring and sends a message to the terminal (e.g ***CONNECT 9600***). The host program is initiated and the dialogue can begin.

3. The conversation is complete and the caller
   - terminates the call, or
   - does something illegal which causes the host program to replace the receiver.

   The program sends the "DTR OFF" message to the modem and the connection is broken off.

4. Finally the system must be prepared for the next caller. Normally the program will have used several other AT commands in association with points 2 and 3 above.

ATZ0↵

The modem appends the contents of the pre-assigned storage (as defined under point 1) and is now clear for the next call.

12.4.3 The host mode at several speeds

The modem will automatically detect which speed the calling modem uses and adjust to this rate. This is shown by the message sent back to the terminal if this function is enabled. Note, several types of messages exists, dependent upon the +Q command currently in use.

Automatic transmission rates makes special demands on the communication program at the host machine. Different programs have different solutions.

> *When you set the modem to automatic detection of transmission rate, this should be done (from your own terminal) in accordance with the highest permissible rate which is accessible to the caller. (The host program will frequently be required to be adjusted to receive result codes from the modem at this speed).*

Only a very few computers/programs manage to detect rates automatically. They normally function as follows:

- 300, 1200, 2400, 4800, 9600, 12000 or 14400 bps are permissible. The caller uses a rate of 300 bps, the host program is preset to 9600 bps.

The modem sends the message CONNECT to the host program, at the speed which was in use when the last AT command was given.

- The Host mode program receives the ***CONNECT*** message and sets the communications port at a rate of 300 bps. The dialogue may now begin.

If the modem had sent the ***CONNECT*** message to the host program at another speed than expected, then the program would not be able to interpret the message. The result would be that the communications line would not be established.

12.4.4 Example:

An electronic bulletin board based on RBBS-PC, version 14-1y uses the following commands:
The modem first gives the command:

AT&F&W

in order to reset the manufacturer's preset status.

The command is resident in the pre-assigned storage.

AT&D3E0&T5&W

What is notable here is the use of &D3 command at the end of the conversation.

When the host mode program starts the following command is sent:

ATQ1S2=255S10=10E0S0=0

The modem is informed, among other things, that it is not to reply when it hears the ringing tone (S0=0).

When the RBBS-PC program detects that the telephone is ringing (perhaps it is not ready with the resetting procedure following the previous call, such that this may take a few seconds), the following command is sent:

ATS1?

When reading in the S1 register, the number of ringing tones is noted.

When the number of ringing signals are equivalent (or greater) than that set as a parameter in the program definition, the program sends the following command:

ATQ0X1V1A

The modem now connects with the remote modem

When the connection is concluded, the modem reverts to the status registered in the pre-assigned store.

Other bulletin board programs employ other procedures. The above example is used to illustrate how complex these may be.

12.5 Communication ship-shore via INMARSAT

Calling from ship to shore requires detection of an earth station dial tone before dialling the number of the subscriber. The dial tone must be acknowledged after 400 ms continuous detection, and further dialling must not continue until 600 ms after detection of the dial tone.

< is the dial modifier to be included to detect the dial tone of the earth station

Example:

ATD0W789<4737011710

0	Request for dial tone
W	Wait for dial tone
789	Earth station number
<	Detects earthstation dial tone
47	Country code (e.g. Norway)
37	National trunk Code
011710	Subscriber's number

12.6 Call via Paging System

Autocall to pagers is possible with the use of two dial modifiers:

@ Used to detect a voice
("Pre recorded voice from the paging system")
% Used to detect acceptance tone

Example of call:

ATD96612345@0123456#%

966	Request for paging
12345	Pager's five digit number
@	Detection of voice or similar.
012345678 #	Additional information and closing sign #
%	Detection of acceptance tone

If the modem disconnects before establishing a connection with the Paging System. You may then change S7 to 60 (sec)

Example:

ATS7=60

12.7 Remote control of the modem:

This is a powerful option, which serves many functions:

- Modems in unmanned installations can easily be controlled
- System operator in a network can perform remote diagnostics and control of all modems in the network
- Stored number for dialback can be altered from remote site.

When remote control is used, the modem must be in on-line asynchronous AT command mode.

When remote escape sequence (normally ---) is received and accepted by the remote modem, it will respond with the result code ***REMOTE: xxx. xxx*** is here the ordinary result code, for example ***REMOTE: OK***.

Numeric short form codes will not be modified in this mode.

All commands will now be available for the user.

The escape code for remote command mode is stored in the +S16 register. If the decimal value of the code is higher than 128, the modem will not recognise the remote escape code. The escape sequence guard time is stored in +S17.

The rules for use of the remote escape sequence are in all respects similar to the use of the ordinary escape sequence. The command **+O0** disables the remote control function.

12.7.1 Remote commands control - down line loading

This function has two important aspects:

- **Economy:**

Makes it easy to control unserved modem(s).

- **Support/testing:**

Makes it easier for your modem dealer to help with modem troubles. Your configuration may be read from remote side.

Enable/disable the function

The remote command function may be enabled/disabled by AT command (+O). The function may be enabled with (+O2) or without (+O1) password requirement.

To force the remote modem from modem-state to on-line command state an escape sequence is used. This escape sequence should be entered, but the ASCII value will usually be different. Register +S16 contains the ASCII value to be recognised as an remote escape code character. This register is factory set to 45, representing the minus character (-).

When this remote escape sequence is entered three things may happen.

1. You don't get any response from the remote modem. This means that the remote command function is probably not enabled in the remote modem.

2. If the Remote modem is enabled to function without a password requirement, the following result code is displayed: ***REMOTE:OK***

3. If the Remote modem is enabled to function with a password requirement, the password should be entered and you will get the result code: ***REMOTE:OK.*** if the password is accepted.

Otherwise you will get the resultcode
UNAUTHORISED ENTRY ATTEMPTED-REMOTE MODEM DISCONNECTS
or
TIMEOUT -REMOTE MODEM DISCONNECTS .

All commands available in local on-line command mode are now available to the remote operator.

12.7.2 Call-back in Remote command mode

In remote command mode it is possible to instruct the modem to call you back by giving the following command:

ATHDT4737011710↵

H

instructs the remote modem to hang up,

DTnnnnnn

instructs it to call you back on the telephone number nnnnnn.

12.7.3 Examples how to configure for remote control:

1. Remote control is accepted without password, and with a different remote escape code:

AT+S16=42↵	Sets the escape code to decimal value 42 (ASCII *)
AT+O1↵	Remote control is accepted without password
AT&W&Y↵	Store configuration in user profile 0, and use this profile at power up.

2. Remote control is accepted with password:

AT+O2↵	Remote control requires password
AT+P=J0HN: :1↵	Inserts a password "JOHN" with access level 1.
AT&W&Y↵	Store configuration in user profile 0, and use this profile at power up

How to unlock a locked modem.

Command:

AT+O3↵	The remote modem can be locked due to receptionof a large number of invalid passwords.

☞This command is explained more in detail under chapter 6.

12.8 Automatic logon procedure:

The password used for logon to a remote computer may be stored in the password table in your local modem. After connection with the remote modem this password is transmitted to the remote side automatically.

Enter password for auto logon, in the calling modem.

AT+P=AUTOLO:37011710::A:SECRET 

In the remote modem the password "SECRET" is saved:

AT+P=SECRET 

For a calling modem with password control, use the local password table as a reference.

ATDK=AUTOLO 

Calling modem dials tel. no. 37011710 and executes an auto logon procedure.

12.9 V.24 operation

12.9.1 108.1/108.2-functions???

Two 108 functions exists:

108/1 Connect Data set to line

In this mode the modem is controlled by 108.1, and the modem will connect to line and start a handshake or dial a number when 108.1 turns from OFF to ON. The modem will disconnect when 108.1 turns from ON to OFF.

In **Switched Line** this function can be set up by the +E1 command or from front under SETUP menu. Channel selection and if a phone number should be dialed may also be setup, either by writing to +S register 21 or from front under SETUP menu. Setting synchronous mode with the &M

In **Leased Line** this function can be set up by writing to +S register 23, bit 5 or from front under SETUP menu.

108/2 DTE ready (Data terminal ready)

In this mode 108 tells the modem that DTE is ready, and the modem may establish a connection. The connection starts by entering a command (AT, V25bis), answering an incoming call or by pressing a switch at the front panel.

In **Switched Line** this function can be set up by the +E0 command or from front under SETUP menu. The modem will not take any action until a command is given, an incoming call is detected or a switch is pressed at the front of modem.

In **Leased Line** the 108.2 function does not exist. (The modem may be set up to 108.1 or "Always on".)

Associated commands and registers:

AT+En ENTER	Selects 108/1 or 108/2 function in Switched line.
AT&Dn ENTER	Select 108/2 disconnect function.
S21 ENTER	Contain &D command state.
S25 ENTER	108 guard time.
+S7 ENTER	Contain +E command state.
+S21 ENTER	108.1 Options.
+S23 ENTER	108.1 in leased line.

The 105 (RTS=Request to send) Circuit

In command mode this circuit will have no consequence.

In Data mode this circuit may control the 106 (CTS) circuit. This function is set up by the &R0 command, or from front under the SETUP menu. The 106 circuit will follow the 105 circuit. When the modem detects an OFF to ON transition on 105, 106 will turn ON after a delay determined by register S26. The time base for this register is 10 msec. and it may be set up by AT command or from front under SETUP menu.

When modem detects an ON to OFF transition on 105, 106 will turn OFF.

Note. This function is not active during any loop tests.

The 106 (CTS) and 107 (DSR) circuits.

This is indication circuits from modem to DTE.
106 (CTS-Clear to send). Normally indicate that DTE may start sending data.
107 (DSR-Data Set Ready). Normally indicate that the modem has connected to line and started the handshake with remote modem.

106 and 107 operation in command mode and during connection

Use the following table when the central site computer requires 107 and 106 to be OFF at certain times. This table shows the &S settings and the equivalent setup from front/display.

Display menu	Command	Description
OPT1 (Option1)	AT&S0 ENTER	107 and 106 always ON
OPT2 (Option2)	AT&S1 ENTER	107 are turned ON according to CCITT. CTS always on
OPT3 (Option3)	AT&S2 ENTER	107 are OFF in command mode, and will turn ON at the same time as modem carrier. 106 is ON in command mode, will be OFF during connection, and turns ON at the same time as modem carrier.
OPT4(Option4)	AT&S3 ENTER	DSR and CTS are OFF until modem carrier is detected.

106 controlled by 107 in data mode:

106 may be controlled by 107 in data mode. This function is mostly used in synchronous half duplex communication (Simulated half duplex) The table below will show the set up which may be done with command or from display at front.

Display menu	Command	Description
CTS-FOLLOW	AT&R0 ENTER	When the modem detects an OFF to ON transition on RTS, CTS will go ON after a delay determined by register S26. If the modem detects ON to OFF on RTS, CTS will go OFF immediately
CTS-FIXED	AT&R1 ENTER	CTS is On in data mode.

CTS used in hardware flowcontrol:

This is an alternative to the XON/XOFF flowcontrol. When using the modem for transferring binary files, the XON/XOFF protocol can't be used, because XON/XOFF may be included in the data.

The table below will show the set up which may be done with command or from display at front.

Display menu	Command	Description
OPTION 2	AT\Q2 ENTER	Unidirectional local flowcontrol. The modem sets V.24 signal 106 (CTS) OFF when the receive buffer from DTE has accumulated 1400 bytes, defined in +S20. CTS is turned on when the number of buffered characters is reduced to 600, defined by +S20. There is no flowcontrol on data sent to DTE.
OPTION 3	AT\Q3 ENTER	Bidirectional local flowcontrol using RTS/CTS. Flowcontrol on received data from DTE is as for \Q2. Flowcontrol on transmitted data to DTE. DTE sets V.24 signal RTS Off if it is not capable of receiving any more characters from the modem. The modem will stop data transmission to DTE until RTS is turned On again. Data from line is buffered in a 1500 byte buffer.

Read more about flowcontrol in chapter 8 "Flowcontrol and buffering".

The 109/DCD circuit

Use the following table when the central site computer requires DCD be ON/OFF at certain times. This table shows the &C and +U settings and the equivalent setup from front/display:
OPT1 (Option1)

Display menu	Command	Description
OPT1 (Option1)	AT&C0 ENTER	DCD (Carrier detect) always ON regardless of the state of the carrier received
OPT2 (Option2)	AT&C1 ENTER	DCD ON indicates presence of data carrier.
OPT4 (Option4)	AT+U2 ENTER	DCD (109) always ON except during disconnect. This command will override the &C command

CTS, DSR and DCD operation during loop tests.

CTS: Will always be ON during Loop3 and Remote loop2 - local side. Will always be OFF during Loop3 with test pattern (L3+(T+R)), Remote loop2 - remote side, Remote loop2 with self test (RL2+(T+R)) and test pattern only (T+R).
DSR: Will always be ON during loop tests..
DCD: According to the table below (+U command).

Display menu	Command	Description
----------	AT+U0 ENTER	CD (109) OFF during tests where DTE is not active.
----------	AT+U1 ENTER	CD (109) ON during test

111 /112 circuit for speed control/indication

Pin 23 (AT V.24/V.28) is used for both 111 and 112.

111: The modem speed may be controlled from DTE by using the 111 circuit.
112: The modem may indicate the speed by using the 112 circuit.
ON state will give high speed, and OFF state will give low speed

> *Selection between the use of circuit 111 or 112 is dependent upon correct configuration on jumper field J10. See chapter 5.*

12.10 Extended bypass

Command to set: **+&B1** Register used: **+S51**

On recognising an incoming call, the circuit 125 remains OFF and the **RING** message to the DTE is suppressed, for a defined number "n" in +S51 (1 <= n <= 5). During this period the modem will ignore the auto answer option.

The modem will operate in one of the following ways, as according to the action taken by the operator.

12.10.1 No action or absent operator:

The normal operation of the modem is retained if no action is taken by the operator before exceeding +S51 ring bursts. The modem will begin to send ***RING*** message and change the state of circuit 125 on ring bursts.

The modem will start with the handshake on pressed down **AUTO** switch, enabled auto answer option or by A command.

12.10.2 ANSW switch pressed down after +S51 rings:

If the ANSW switch is pressed after +S51 ring bursts, the modem will immediately start with the handshake.

12.10.3 ANSW switch pressed down while attending the phone before +S51 rings:

On attending the phone and hearing the modem or facsimile call tone, the operator must press the ANSW switch to hand over the control to the modem.

The modem will then start to simulate an incoming call, i.e. send ring back signals to the line and RING message to the DTE. The circuit 125 is also toggled on each RING message. The modem will start with the handshake (modem or fax) on A command from the DTE, on enabled auto answer option or ANSW switch pressed again .

The modem will remain in this state for a time period of 30 seconds on missing A command or disabled auto answer option.

To use this function together with Trio DataFax, simply add **+&B1+S51=n** in the initializing string during modem set-up. The modem will ignore **n** ring bursts, i.e. no RING message will be sent to DataFax. This will give the opportunity to attend a call and take an appropriate action such as pressing ANSW switch to receive a facsimile document.

For Zat 14.4/14.4-7 modem, the DATA/VOICE switch is used to simulate rings when extended bypass is enabled.

Notes:

13. Fallback/fallforward and automatic retrain

13.1 Fallback

The modem may fallback from:

19.2/ 19.2-7	14.4/ 14.4-7	
*		19200 to 16800 bps
*		16800 to 14400 bps
*	*	14400 to 12000 bps
*	*	12000 to 9600 bps
*	*	9600 to 7200 bps
*	*	7200 to 4800 bps.

If the +&FV0 command is enabled the fallback may only take place inside the current modem standard, i.e. only from 14400 to 7200 in V.32 bis, from 9600 to 4800 bps in V.32 and from 2400 to 1200bps in V.22 bis. This kind of fallback has been standardised, and may be used with other modem types using the same standards. Fallback from 4800 to 1200 bps. (+&FV1) will only work when using modem of the same type.

13.1.1 Fallback during handshake (+&FH1):

This kind of fallback is only possible in V.32 and V.32bis.
If +&FH1 is enabled, the modem will during handshake decide if the line quality is good enough for 14400, 12000, 9600 or 7200 bps. This handshake is compatible with other types of V.32 and V.32bis modems.

13.1.2 Automatic retrain(+&FR1):

Automatic retrain applies to the speeds 14400, 12000, 9600, 7200, 4800 and 2400 bps only. If the modem receiver is out of synchronisation a retrain may help. A retrain implies no changes in speed.

The fallback function will operate in all operating modes (Asynchronous with or without protocol, and synchronous) on switched lines. This function will not be active on leased lines.

To be able to continue the communication after a fallback or fallforward, both the modem and DTE (terminal or host computer) should be capable of the new speed.

For a synchronous connection this means that 114 transmit clock should be used. The modem will then indicate the speed for both the transmitter and receiver.

In asynchronous mode the modem should be set-up to speed conversion (+C1) and speed detection (+M2). Then DTE does not need to adapt to the new speed.

When using fallback/forward or retrain together with a protocol (V.42/MNP) there will be continuity in data during this transition. No noise character will be introduced or any character lost. DTE will only see a pause in data stream.

The fallback function is based on a comparison between the quality of the received signal and a limit set by the user.
If the quality is below the specified limit during a time specified by the user (See +S reg.43) the following tasks will be started (depending on configuration):

13.1.3 Auto retrain on, Fallback off:

AT+&FR1	Auto retrain on
AT+&FB0	Fallback off

If line quality is worse than set-up in +S14 and the line-speed is 2400, 4800, 7200, 9600, 12000 or 14400 an automatic retrain will be initiated trying to improve theadaption to line. Automatic retrain is not activated when using lower speed because these standards will be selfsynchronising.

13.1.4 Fallback on:

AT+&FB1	Fallback on

While the fallback function is enabled, no retrain will be initiated. If the line quality is worse than set-up in register +S44, the modem will start a fallback. Note that a fallback will not be started if the line speed is 1200bps or if the line speed is 4800 bps and the modem is not set-up with the command +&FV1.

13.1.5 Fallback on, Fallforward on:

AT+&FB1	Fallback on
AT+&FF1	Fallforward on

Fallforward will only take place after a fallback, i.e. the modem will not fallforward to a speed higher than after first handshake. After a fallback the modem will compare the line quality with both the fallback limit and the fallforward limit. When the line quality become better than what is set-up in register +S46 the modem will calculate a time telling when to start a fallforward. This time will be the value in register +s47 multiplied by the number representing the line quality. Register +S47 is default equal 1 min. If the line quality is equal to 5, the modem will wait in 5 minutes before fallforward.

14. Tests

14.1 Introduction

This modem is equipped with three types of test functions according to the CCITT standard:

1. Local analogue loopback (CCITT loop 3)
   Local analogue loopback (CCITT loop 3) with test pattern.

2. Remote digital loopback (CCITT remote loop 2)
   Remote digital loopback (CCITT remote loop 2) with test pattern.
   (Not in CCITT V.21 mode)

3. Digital loopback (CCITT loop 2).

To execute the above test functions, the modem must be in the command state.

Before test functions 2 and 3 can be executed, a connection must be established with the remote modem. The modem must change from command mode to data mode.

To return to command mode in order to execute a test, enter **+ + +.**

> *Activating the remote digital loopback (with or without selftest) during the CCITT V.21 mode is not possible. PWR (Test) diodes on the modem flashes when test mode is active. Local analogue loopback is not supported for V.32 terbo.*

You may also use the **TEST** switch, see chapter 5.

14.2 Test timer

The duration of a test is determined by the content of S register S18. When a test has lasted for the time determined by the S18 value (in seconds), the test is ended and the modem returns to command state. The **S18=x** command sets the S18 value. The highest legal value is 255.

ATS18=0 ↵	Disconnects the test timer (factory setting)
ATS18=70 ↵	Sets the test timer to 70 seconds

14.3 End Test, Using the &T0 Command

It is possible to interrupt a test by means of the &T0 command.

Example 1

Interruption of Local analogue loopback or remote digital loopback.

+++	The modem returns to command state
AT&T0 ↵	The test will be interrupted.

Example 2

Interruption of Digital loopback

AT&T0 ↵	The test will be interrupted.

14.4 Accepts Request for Remote Digital Loopback.

Use the &T4 command to make the modem accept a request from a remote modem for remote digital loopback.

Example:

AT&T4 	The modem accepts a request for remote test.

14.5 Denies Request for Remote Digital Loopback.

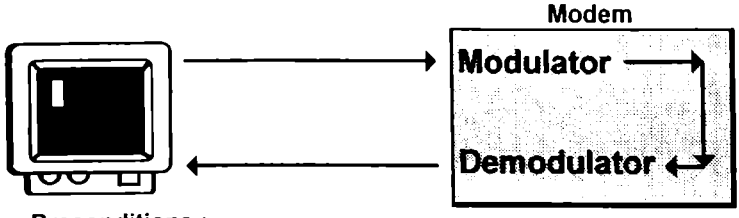
Use the &T5 command to make the modem deny a request for remote digital loopback.

Example :

AT&T5 	The modem will ignore any request for remote test.

14.6 Local analog loopback

The purpose of this test is to check your own modem (DCE), your own data terminal (DTE) and the connection between them. The modem is not on-line during this test.



Preconditions :
The modem must be in command state. (Use either **+++** or the **H0** command.)
Echo must be enabled (The E1 command).

Test Timer disabled. (example 1)

⇒Enter:

ATS18=0&T1↵

S18=0 disconnects the Test Timer.
&T1 Selects Local analogue loopback. The test indicator lights.

⇒Write for example:

This is a test

The same text will appear on the screen.

⇒Enter

+++

Escape sequence.
The modem returns to command state.

The modem answers ***OK***

If the modem returns the message to the screen exactly as it was written, the result is good.

The Test Timer is set to 40 (seconds) - example 2.

⇒Enter:

ATS18=40&T1 ↵

S18=40 Sets the test timer to 40 seconds **&T1** Selects Local analogue loopback. The test indicator lights.

⇒Write for example:

This is a test

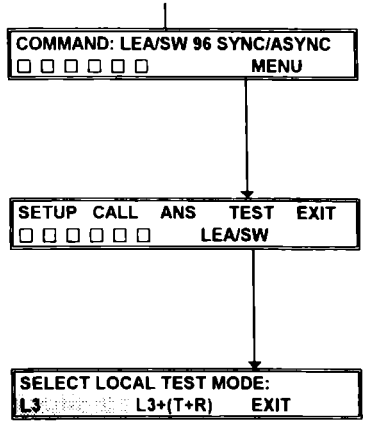
The same text will appear on the screen.

The modem answers ***OK***

The test has lasted for 40 seconds and the modem returns to command state.

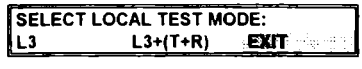
If the modem returns the test message to the screen exactly as it was written, the test is good.

⇒Move the cursor to L3 in Test menu, command mode:

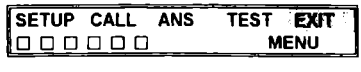


⇒Press the ROLL/EXEC switch to activate the testloop.

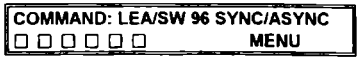
⇒TERMINATE the test.



⇒EXIT menu.

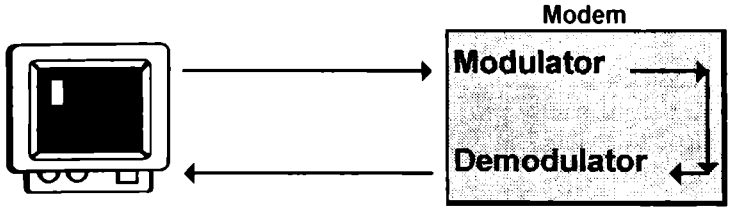


⇒EXIT menu.



14.7 Local analogue loopback with test pattern

The purpose of this test is to check the receive and transmit circuits in the local modem. The modem will generate a varying bit-pattern which will be modulated and demodulated. Numbers of errors will be counted and displayed on the screen when the test is ended.



Preconditions :
The modem must be in command state (Eventually use +++).
Echo must be enabled (The E1 command).

Test timer disabled - example 1 :
⇒Enter:

ATS18=0&T8↵	**S18=0** disconnects the Test Timer. **&T8** Selects Local analogue loopback with test pattern. The test indicator lights.
AT&T0↵	The test will be interrupted.

The modem answers ***000*** 0 fault detected
OK Test terminated

Alternative 2:

The modem answers ***007*** 7 faults detected
OK Test terminated

The test timer is set to 10 (seconds) - example 2

⇒Enter:

ATS18=10&T8↵

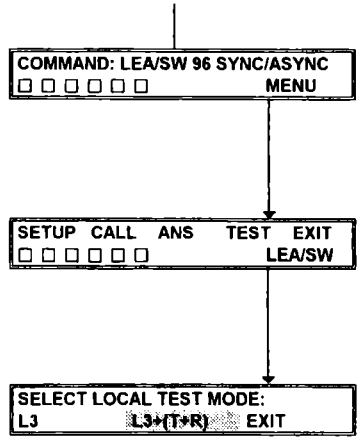
S18=10	sets the test timer to 10 seconds
&T8	selects Local analogue loopback with self test.

The modem answers ***000*** No fault detected
OK Test terminated

Alternative 2

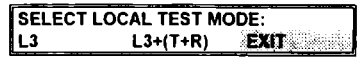
The modem answers ***007*** 7 faults detected
OK Test terminated

⇒Move cursor to L3+(T+R) in TEST menu, command mode.

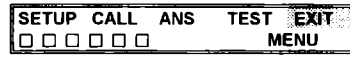


⇒Press tthe ROLL/EXEC switch to activate the test.

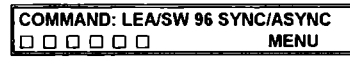
⇒RESET. Resets to 0 number of bit errors.
⇒TERMINATE active test.



⇒EXIT menu.

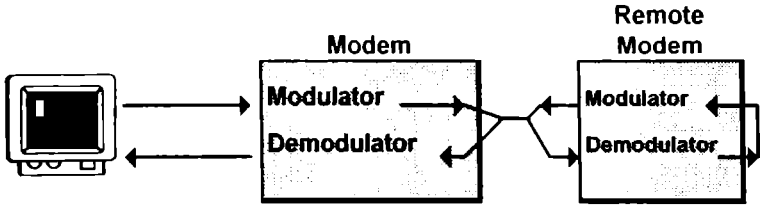


⇒EXIT menu.



14.8 Remote digital loopback

The purpose of this test is to check your own data terminal (DTE), your own modem (DCE),the remote modem and the telephone line. This test is initiated by your own DTE sending a test message to the remote modem. The remote modem loops this message back to the local modem, and the DTE will compare the transmitted data with the received.



Preconditions:
Your own modem must have established a connection with the remote modem (A-mode or B-mode). Echo must be enabled (**E1** command)
The remote modem must be set to accept request for a remote digital loopback (**&T4** command)

Test timer disabled - example 1

⇒Enter:
+++
The modem returns to command state.

The modem answers ***OK*** Ready to continue.

⇒Enter:
ATS18=0&T6 ENTER
S18=0 disconnects test timer.
&T6 selects remote digital loopback.
Test indicator lights.

⇒Write for example:
This is a test
The same text will appear on the screen

⇒Enter:
+++
Escape sequence
The modem returns to command state.

The modem answers ***OK***

⇒Enter:

AT&T0↵

&T0 terminates the test.

The modem answers ***OK*** Test terminated

If the modem echoes the test message to the screen exactly as written, the test is good.

Test timer set to 40 (seconds) - example 2

⇒Enter:

+++

The modem returns to command state.

The modem answers ***OK*** Ready to continue.

⇒Enter:

ATS18=40&T6↵

S18=40 sets the test timer to 40 seconds **&T6** selects remote digital loopback Test indicator lights.

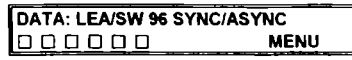
⇒Enter:

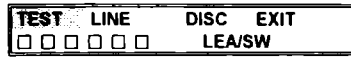
This is a test

The same text will appear on the screen.

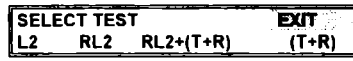
The modem answers ***OK*** Test terminated.

The test has lasted for 40 seconds and the modem returns to the command state.

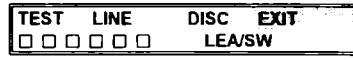




⇒Press the ROLL/EXEC switch to activate the test.



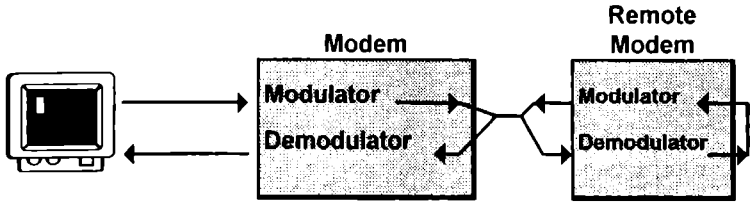
⇒EXIT menu



⇒EXIT menu

14.9 Remote digital loopback with test pattern

The purpose of this test is to check the remote modem and the telephone line. This is initiated by your own modem sending a standard test message to the remote modem.
The remote modem loops this test message back to the local modem, which compares transmitted data with received data and counts the number of faults



Preconditions:
Your own modem must have established a connection with the remote modem (A-mode or B-mode).
Echo must be enabled (E1 command) . The remote modem must be set to accept request for a Remote Digital Loopback (&T4 command) .

Test timer disconnected - example 1:

⇒Enter:

+++	The modem returns to command state.

⇒Enter:

ATS18=0&T7 ENTER	**S18=0** disables the test timer. **&T7** selects remote digital loopback with test pattern. Test indicator lights
AT&T0 ENTER	**&T0** terminates the test.

The modem answers ***000*** No faults detected
OK Test terminated

Alternative 2

The modem answers ***007*** 7 faults detected
OK Test terminated

Test timer set to 10 (seconds) - example 2

⇒Enter:

+++

The modem returns to command state.

⇒Enter:

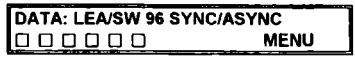
ATS18=10&T7↵

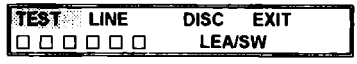
S18=10 sets the test timer to 10 seconds
&T7 selects remote digital loopback with self test.
Test indicator lights.

The modem answers ***000*** No faults detected
OK Test terminated

Alternative 2

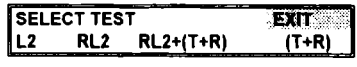
The modem answers ***007*** 7 faults detected
OK Test terminated



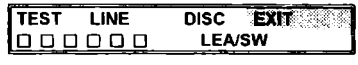


⇒Press the ROLL/EXEC switch to activate the test.

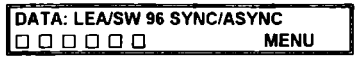
⇒RESET. Reset to 0 number of bit errors.
⇒TERMINATE test.



⇒EXIT menu

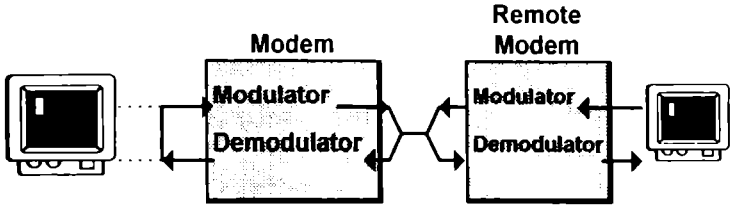


⇒EXIT menu



14.10 Digital loopback

The purpose of this test is to check local modem , the remote modem and the line between them. This is obtained by looping the data flow from the remote modem via the local modem back to the remote modem. The remote DTE then compares the transmitted data with the received data.



Preconditions:
Your own modem must have established a connection with the remote modem (A-mode or B-mode).

Test timer disabled - example 1:

⇒Enter:

+++

The modem returns to the command state

The modem answers *OK*

⇒Enter:

ATS18=0&T3↵

S18=0 disconnects test timer. &T3 Selects Digital loopback Test indicator light

The modem answers *OK* The test is in progress

When the remote operator informs (normally by phone) that the test is completed, the test loop can be disabled:

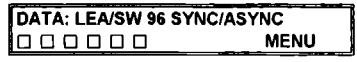
⇒Enter:

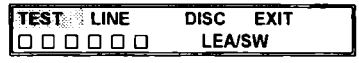
AT&T0↵

&T0 disables the test.

The modem answers *OK* Test is terminated

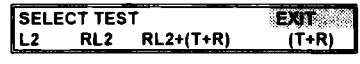
⇒Move cursor to L2 in TEST menu data mode



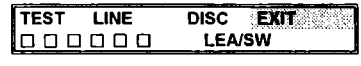


Press the ROLL/EXEC switch to activate the test.

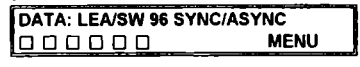
⇒TERMINATE test.



⇒EXIT menu



⇒EXIT menu

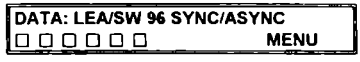


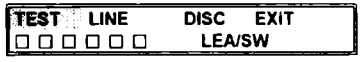
Remote and local loopback with test pattern.

This test is used to check the local/remote modem and the line between.

This test must be performed in data mode and only from the SETUP menu from both modems simultaneously.

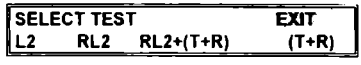
Example:
⇒Move cursor to (T+R) in TEST menu, data mode.



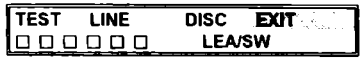


⇒Press the ROLL/EXEC switch to activate the test.

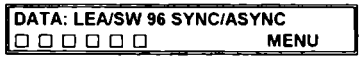
⇒RESET. Reset to 0 number of bit errors.
⇒TERMINATE test.



⇒EXIT menu



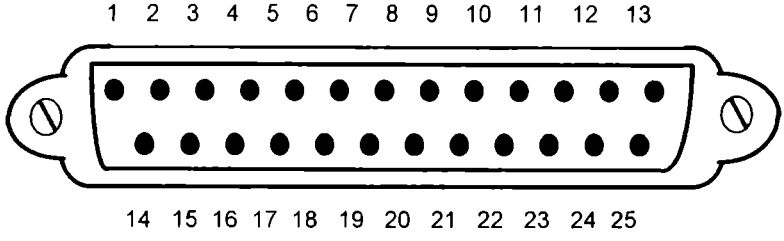
⇒EXIT menu



15. Technical data

15.1 The modem cable

The signals associated with each pin are described in the following section



Dataterminal (DTE)						Modem DCE
9 pin	25 pin	Symb.	Signal name	ITU-T	Direction	Pin #
5	7	GND	Signal Ground	102	↔	7
3	2	TXD	Transmitted data	103	→	2
2	3	RXD	Received data	104	←	3
7	4	RTS	Request to send	105	→	4
8	5	CTS	Ready for sending	106	←	5
6	6	DSR	Data Set Ready	107	←	6
4	20	CON	Connect Data set to Line	108.1	→	20
4	20	DTR	Data Terminal Ready	108.2	→	20
1	8	DCD	Data Carrier Detect	109	←	8
	23	DRS	Data Rate Select	111	→	23
	23	DRI	Data Rate Indicator	112	←	23
	24	XCK	Tx Signal Element Timing	113	→	24
	15	TCK	Tx Signal Element Timing	114	←	15
	17	RCK	Tx Signal Element Timing	115	←	17
9	22	RI	Calling Indicater	125	←	22
	11	STF	Select transmit channel	126	→	11
	21	RL	Remote Loop control	140	→	21
	18	LL	Local Loop control	141	→	18
	25	TI	Test indicator	142	←	25

Circuit 102 **Signal ground**

ITU-T name: **GND** RS232C name:**AB** Pin no.:**7**

Signal Ground is the reference for all Signal Voltages.

103 Transmitted data **DTE->DCE**

ITU-T name: **TXD** RS232C name:**BA** Pin no.:**2**

Data is transmitted from DTE on circuit 103 in serial binary form. Circuit 106 (CTS) indicates that DTE can send data.

104 Received data **DTE<-DCE**

ITU-T name: **RXD** RS232C name:**BB** Pin no.:**3**

DCE sends received data from the line on circuit 104 in serial binary form, providing that data carrier detect (109) is ON. If data is not transmitted, circuit 104 is logic "1"

105 Request to send **DTE->DCE**

ITU-T name: **RTS** RS232C name:**CA** Pin no.:**4**

State ON: Data may be sent, CTS is ON.
State OFF: The modem sends scrambled "1".
CTS is OFF.

106* Ready for sending **DTE<-DCE**

ITU-T name: **CTS** RS232C name:**CB** Pin no.:**5**

State ON:
Indicates that DCE is ready for data transmission.
State OFF:
Indicates that DCE cannot receive data from DTE.

107 Data set ready **DTE<-DCE**

ITU-T name: **DSR** RS232C name:**CC** Pin no.:**6**

State ON: The modem is connected to the line and ready for data transmission.
State OFF: The modem is not ready for data transmission.

108/1 Connect data set to line **DTE->DCE**

ITU-T name: **CON** RS232C name:**CD** Pin no.:**20**

State ON: Connects the modem to the telephone line.
State OFF: Connects the line to the telephone set.

* The common meaning of «ON» and «OFF» is described here. The actual way to use the circuits is setup by the commands **&S**, **&R** and **\Q**

Circuit 108/2 Data terminal ready **DTE->DCE**

ITU-T name: **DTR** RS232C name:**CD** Pin no.:**20**

State ON: DTE is ready for data transmission
State OFF: DTE cannot transfer data. The modem is prevented from connecting to the line, and existing connections will be broken.

109 Data carrier detect **DTE<-DCE**

ITU-T name: **DCD** RS232C name:**CF** Pin no.:**8**

State ON: The received signal level is not sufficient for data transmission.
State OFF: Data transmission is not possible. The modem does not receive any carrier, or the signal level of the carrier is too low.

111 Data Rate Select **DTE->DCE**

ITU-T name: **DRS** RS232C name:**CI** Pin. no.:**23**

State ON: High data rate is selected.
State OFF: Low data rate is selected.

112 Data Rate Indicator (Not supported) **DTE<-DCE**

ITU-T name: **DRS** RS232C name:**CH** Pin. no.:**12**

State ON: The modem operates with high data rate
State OFF: The modem operates with low data rate

113 Transmitter signal element timing **DTE->DCE**

ITU-T name: **XCK** RS232C name:**DA** Pin no.:**24**

During synchronous transmission, the transmission timing is either controlled bye DTE through circuit 113, or by DCE through circuit 114. When using external control (113), DTE has to generate timing signals in the form of a 50% duty cycle square wave signal with a frequency of 1200/600 Hz, 0.01% synchronised with transmitted data. OFF to ON transition will normally indicate the centre of each signal element on circuit 103 (TXD). See figure below, Circuit 115.

114 Transm. signal element timing **DTE<-DCE**

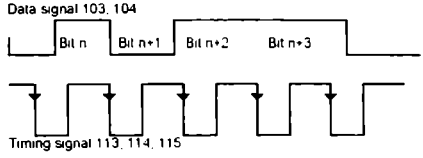
ITU-T name: **TCK** RS232C name:**DB** Pin no.:**15**

DCE will determine transmitter timing through circuit 114. OFF to ON transitions will normally indicate the centre of each signal element on circuit 103 (TXD). See figure below, Circuit 115.

Circuit 115 Receiver signal element timing DTE<-DCE

ITU-T name: **RCK** RS232C name:**DD** Pin no.:**17**

During synchronous transmission, the receive signal element timing is presented by the DCE on circuit 115. This square wave signal synchronises DTE with the data flow on circuit 104. The OFF to ON transition will normally indicate the centre of each signal element on circuit 104 (RXD). See figure!



125 Calling indicator DTE<-DCE

ITU-T name: **RIR** RS232C name:**CE** Pin no.:**22**

This circuit indicates that DCE has received a call.
State ON: Call received
State OFF: No call received.

126 Select transmit channel DTE- >DCE

ITU-T name:**STF** RS232C name: Pin no.:**11**

State ON: Modem uses answer channel.
State OFF: Modem uses originate channel.

140 Remote Loop control DTE->DCE

ITU-T name: **RL** RS232C name: Pin. no.:**21**

State ON Initiate remote loop 2 test condition.
State OFF: Release of remote loop 2 condition. Normal datatransmission can take place.

141 Local Loop Control DTE->DCE

ITU-T name: LL RS232C name: Pin. no.:18

State ON : The modem establishes local loop 3 test condition.
State OFF: Release of loop 3 condition.

142 Local Indicator Test DTE<-DCE

ITU-T name: TI RS232C name: Pin. no.:25

State ON : Indicates test condition in the modem
State OFF: Indicates normal condition.

15.2 Specifications

Dimensions (HxWxDx):

63mmx212x425 mm

Weight:

1700 g

DTE Interface:

Physical:	- 25-pin female (ISO standard 2110) V.24/V.28 (RS232 C)
Electric:	Circuits 102, 103, 104, 105, 106, 107, 108, 109, 111, 113, 114, 115, 125, 126, 140, 141, 142.

Line Interface:

Signal level:	0, to -14 dBm
2-wire switched, or 2/4 wire leased	2 wire leased can be used as secondary switched line.
Common mode reject:	>55dB 300-3400 Hz
DC resistance, idle	> 5Mohn
AC resistance, idle	>100 kOhm, 300-3400 Hz, U=+6 dBm
Line current load:	Electronic, type 30 mA/7V
Return loss	>20dB vs. 600 ohms, 300-3400 Hz
Transmit carrier level	0 to -14 dBm, adjustable in 2 dB steps
Receive carrier level	0 to -43 dBm

External power voltage:

Power supply current:	<500 mA max

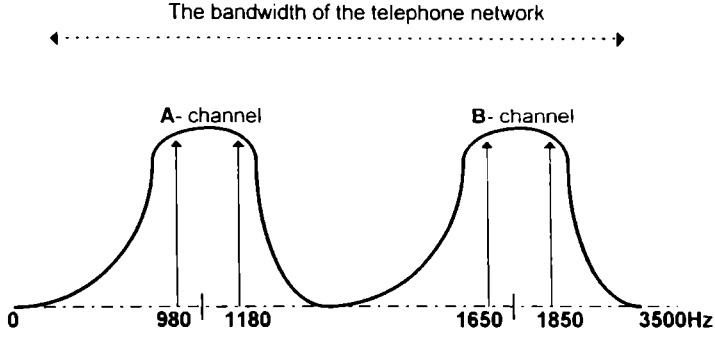
Modem characteristics

Bit rates available:	300, 600, 1200, 2400, 4800, 7200 TCM, 9600, 9600 TCM, 12000 TCM, 14400 TCM, 75/1200 and 75/600 bps
Compatibility:	V.21, V.22, V.22 bis, V.32, V.23, Bell 212/103
Near end echo canceler span	12 ms default
Far end echo canceler span:	41,3 ms default
Echo delay:	≤1.7 ms
Receive carrier offset	± 7% max
Environmental:	0 to +40 degrees Celsius 90% humidily, non condensing.

15.3 Bandwidth

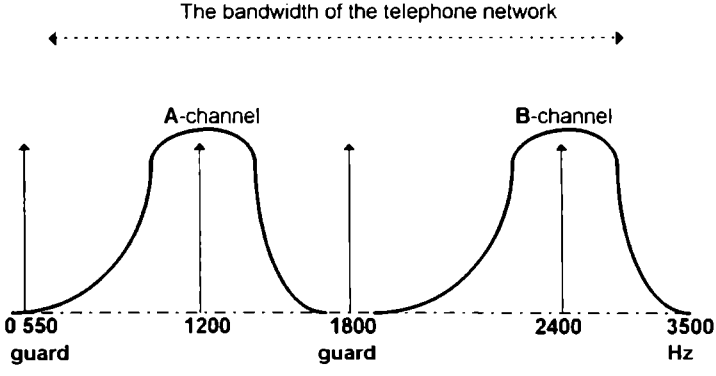
The modem uses the bandwidth of the telephone network according to sections 15.3.1 (ITU-T V.21) and 15.3.2 (ITU-T V.22)

ITU-T V.21



Frequency shift keying (FSK) around the frequencies 1080 HZ and 1750 Hz

ITU-T V.22

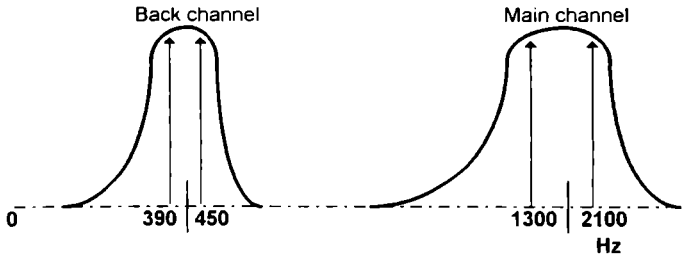


Phase shift keying (PSK) with 4 possible phase shifts in both channel

The originating modem normally sends in the lower channel (A channel), whereas the answering modem sends in the upper channel (B channel). However, it is possible to transmit in the opposite channel if desirable.

ITU-T V.23 (1200 bit/s)

Frequency shift keying (FSK) around the frequencies 1700 Hz and 420 Hz



15.4 Transmission standards and modulation

Standard	Transmission carrier: Originating modem	Transmission carrier: Answering modem	Modulation	Answer tone
ITU-T V.22 bis	1200Hz	2400 Hz	QAM	2100 Hz
ITU-T V.22/1200	1200Hz	2400 Hz	4DPSK	2100 Hz
Bell 212A	1200Hz	2400 Hz	4DPSK	2225 Hz
ITU-T V.22/600	1200Hz	2400 Hz	2DPSK	2100 Hz
ITU-T V.21	1080 ±100Hz	1750 ±100Hz	FSK	2100 Hz
ITU-T V.23	1700 ±400Hz	1700 ±400Hz	FSK	2100 Hz
ITU-T V.32 bis*	1800 Hz	1800 Hz	QAM	2100 Hz
V.32 terbo	1800 Hz	1800 Hz	QAM	2100 Hz
Bell 103	1170 ±100Hz	21250 ±100Hz	QPSKSK	2225 Hz

FSK Frequency Shift Keying
DPSK Differential Phase Shift Keying
QAM Quadrature Amplitude Modulation

* ITU-T V.32 bis uses echo canceling technique for channel separation, i.e. the originating and answering modem have the same carrier frequency, and uses the full bandwidth of the telephone network.

ITU-T V.21:

Specifies full duplex transmission at 300 bit/s. Modulation rate: 300 baud.

ITU-T V.22:

Alternative A specifies synchronous transmission at 1200 or 600 bit/s. Modulation rate: 600 baud.
Alternative B specifies asynchronous transmission at 1200 or 600 bit/s. Modulation rate 600 baud.

1200 bit/s data speed . Groups of 2 bits (dibit) are modulated simultaneously, according to the following table:

Dibit values	Phase shift by degrees
00	90°
01	0°
11	270°
10	180°

Fig 15-1

600 bit/s

Bit values	Phase shift by degrees
0	90°
01	270°

Fig 15-2

ITU-T V.22 bis

Specifies synchronous or asynchronous transmission at 2400 or 1200 bits bit/s. Modulation rate: 600 baud.

2400 bit/s data signaling rate: Groups of 4 bits (quadbit) are modulated simultaneously. First, a phase quadrant change is defined - relative to the first quadrant occupied by the previous signal element - using the first two bits of the group.
See fig15-3.

Then the last two bits of the group are used to define one of the four signal elements of the new phase quadrant (after phase quadrant change).
See fig 15-4.

First two bits in the quadbit	Phase quadr. change	Phase change
00	1 → 2 2 → 3 3 → 4 4 → 1	90°
01	1 → 1 2 → 2 3 → 3 4 → 4	0°
11	1 → 4 2 → 1 3 → 2 4 → 3	270°
10	1 → 3 2 → 4 3 → 1 4 → 2	180°

Fig 15-3

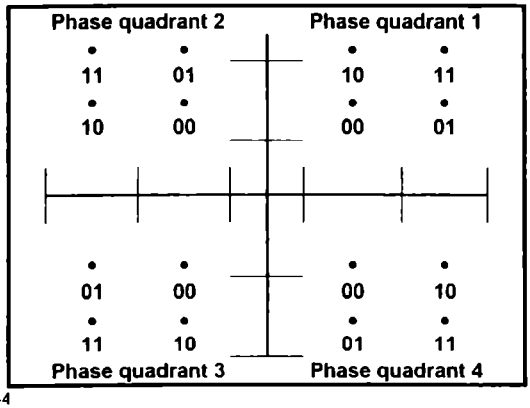


Fig 15-4

1200 bit/s data signaling rate: The data flow is divided into groups of two bits (dibits). Each group defines in turn a phase quadrant change, relative to the quadrant occupied by the previous signal element (see FIG 5). Regardless of which of the phase quadrants of FIG 6 you are in, the signal element 01 is sent. Thus V.22 bis at 1200 bit/s is compatible with V.22.

ITU-T V.23:
Specifies half duplex transmission at 1200 bits/s or split speed full duplex with 75 bits/s in one direction, 1200 bits/s in the opposite.

Connecting up in V.22/V.22 bis

In V.22 bis, the modems decide during the connecting sequence which transmission speed to use. The connecting sequence is compatible with V.22 and is always started in 1200 bit/s.
If the originating modem can transmit 2400 bit/s, it will send a short sequence in a special pattern. If the answering modem detects this and answers with a corresponding sequence, both modems will after a short time, start transmission at a rate of 2400 bit/s. If however, one of the modems does not send this sequence, the speed will remain 1200 bit/s.

ITU-T V.22 bis Handshake sequence at 2400 bit/s

Fig. 15-5 shows a connecting-up sequence where both modems can transmit 2400 bit/s.

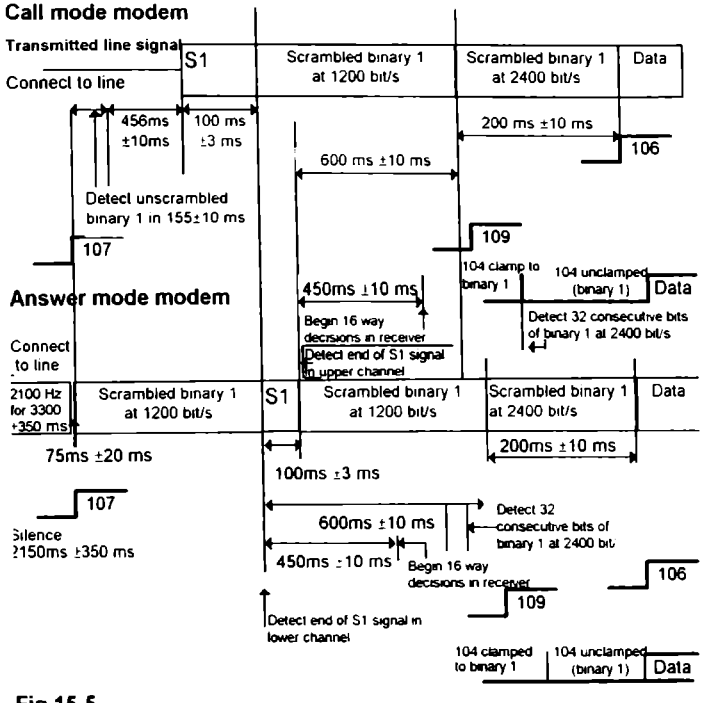


Fig 15-5

ITU-T V.22 bis Handshake sequence at 1200 bit

Fig15-6:shows a sequence where answering modem cannot transmit 2400 bit/s. This sequence is identical to V.22 connection, except for the S1 sequence.

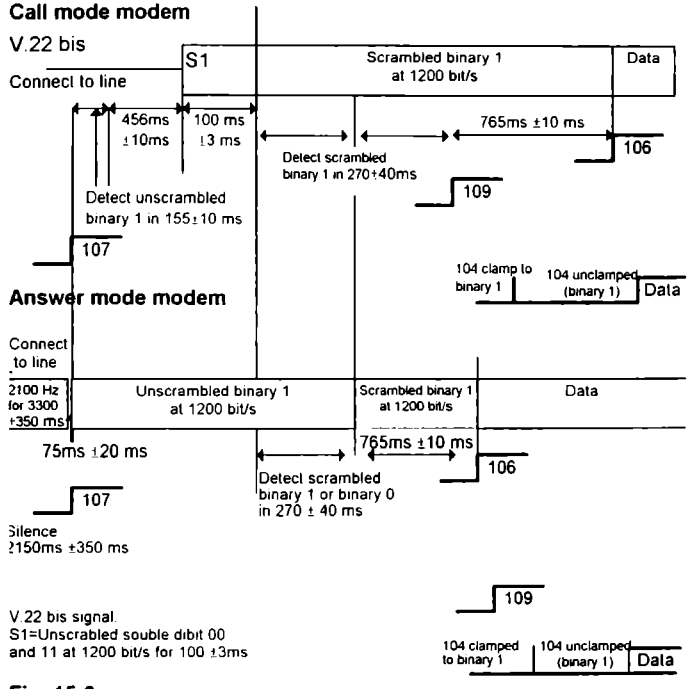


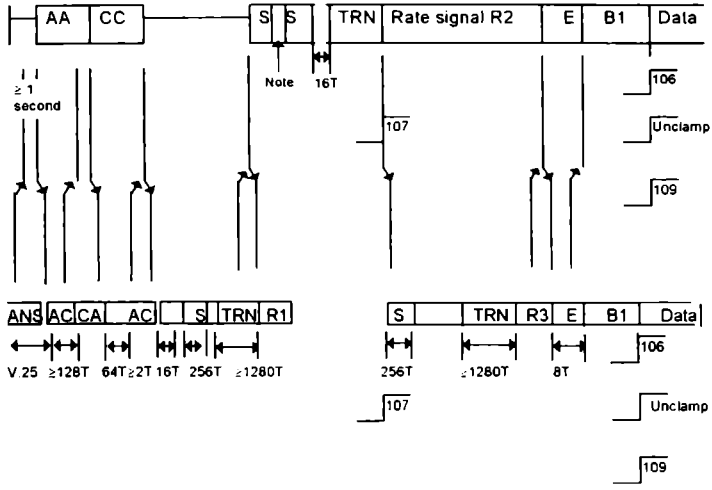
Fig. 15-6

Connecting up in V.32 bis

During a V.32 bis handshake sequence, both modems try to learn as much as possible about the current telephone channel, and also some negotiating between the modems take place. Below are listed up some of the key items.

- Determination of round trip delay, for the echo canceler.
- Training of the adaptive equalizer.
- Negotiate about the bit rate, and if TCM shall be used
- Synchronizing the receivers.
- The figure below show the handshake sequence.

Call mode modem



Answer mode modem

AC Signal states ACAC. AC for an even number of symbol intervals T; similarly with CA,AA and CC.

MT, NT Round-trip delays observed from answer and call modems respectively, including 64T±2T modem turn round delay.

S,S Signal states ABAB..AB, CDCD..CD

TRN Scrambled ones at 4800 bit/s with dibits encoded directly to states A,B,C and D

R1, R2, R3 Each a repeated 16-bit rate sequence at 4800 bit/s scrambled and different encoded as in Table 1/V 32

B1 Binary ones scrambled and encoded as for the subsequent transmission of data

The inclusion of a special echo canceler training sequence at this point is optional

16.1 Datacommunication and modem

Data communication means information in the form of binary digits transferred between for instance two CPU's or from a terminal to a CPU. Data can be transferred in parallel or in serial form, but only serial form will be considered in this chapter.

The simplest form of serial data transmission is a direct cable between the terminal and the CPU, where the binary digits are transferred one after another, represented as high or low voltage levels.

This is possible only for short distances. For longer distances, other solutions must be found.

The telephone network is able to transfer information all over the world in the form of human speech. It is therefore natural to consider it used for data transmission as well.
The challenge is then to convert the electrical data signals to analogue signals within the frequency band that will be passed through by the telephone network. This frequency band ranges from 300 Hz to app. 3400 Hz.

This problem is solved by a modem. The word modem is a contraction for Modulator and Demodulator.

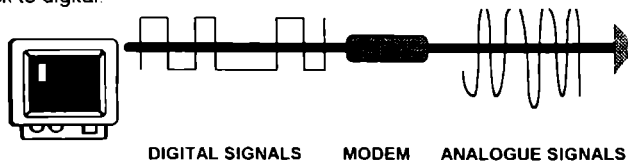
The modulator part converts the digital signals to analogue signals that can be transferred through the telephone network. The principle is mainly to modify a single tone called carrier, in such ways that these modifications can be recognised by the receiver.

The demodulator part interprets the modifications in the analogue signals, and convert them back to digital signals.

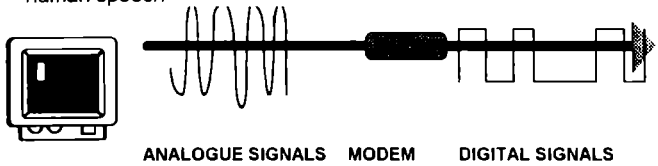
16.1.1 Data Communication System

Transmitting of data from a terminal:

- The terminal sends data in the form of digital signals to the modem
- The modem converts (modulates) the digital signals to analogue signals or tones.
- The receiving modem converts (demodulates) the analogue signals back to digital.



- The CPU receives the data as binary digits
- The tones are transmitted on the telephone line in similar manner as human speech



16.1.2 Symbols and bits

When people communicate with each other, they use different symbols, known as letters and numbers. Computers have only two symbols available. These symbols are represented by for instance, a certain voltage present, or no voltage at all, and are usually denoted binary "1" or binary "0".

Such symbol is called a binary digit, or a bit, and represents the smallest unit of information.

In order to obtain the variety of symbols needed to represent the known characters, it is necessary to combine a number of digits. Usually 7 or 8 bits are used in combination. A group consisting of 8 bits, is called a byte.

Example:

0	1	0	0	0	1	1	1

This is a group of eight bits, that represents the character "G".

16.1.3 Transmission speed

The transmission speed is measured in number of bits transferred per second (bps). At asynchronous communication, 10 or 11 bits per character. 7 or 8 represent the symbol itself, and in addition a startbit and one or two stop bits are transmitted. The real transmission speed at 2400 bps is then app. 240 characters per second.

Data can be transmitted in either asynchronous or synchronous format. The difference is explained below.

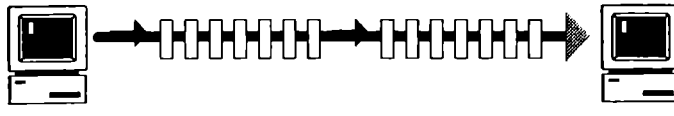
16.1.4 Asynchronous format

When asynchronous format is used, each character carries a start bit and at least one stop bit for synchronising purpose. Each character is then independent of the others.

16.1.5 Synchronous format

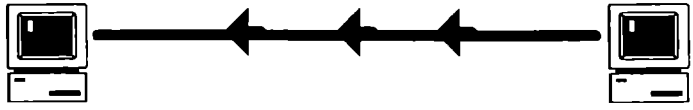
When synchronous format is used, are all bits sent after each other, with no extra start/stop bits. Each bit is accompanied by a clock signal to synchronise the receiver. In order to obtain character alignment, it is necessary to transmit synchronising characters prior to the information part.

Since start/stop bits are not needed for each character, synchronous transmission gives a higher throughput.



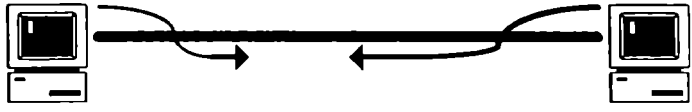
16.1.6 Simplex

Data can be transmitted in one direction only.



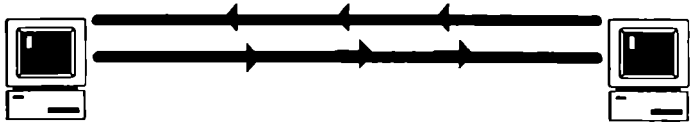
16.1.7 Half duplex

Data can be transmitted in both directions but only in one direction at a time. This demands a certain discipline from the data equipment on both sides.



16.1.8 Full duplex

Data can be transmitted in both directions at the same time. To obtain this, the modems either divide the available bandwidth of the telephone channel, and use one half in each direction, or they use echo cancellation, which gives virtually a complete telephone channel in each direction.



16.2 Summary S- registers

16.2.1 S- registers

No	Possible values	Code	Default	Description
S0	0-5	Ringsignals	00	Auto answer on/off
S1	0-255	Ringsignals	00	Ring counter
S2	0-255	ASCII	43	Escape Sequence Code (+++)
S3	0-127	ASCII	13	Carriage return
S4	0-127	ASCII	10	Line feed
S5	0-127	ASCII	08	Back space
S6	2-10	Seconds	02*	Wait time blind dial
S7	0-60	Seconds	50*	Wait time for Carrier
S8	0-10	Seconds	02*	Pause time for , (comma).
S9	1-255	1/10 second	06	Carrier detect Response time
S10	1-255	1/10 second	01	Lost carrier to hang-up delay
S11	70-130	milsec.	100*	DTMF Dialling speed
S12	0-255	1/50 second	50	Escape Sequence code guard time
S13				Not used
S14	x0x0 xxx0	Binary	8A hex*	Bit mapped options
S15				Not used
S16	0CCC AC0C	Binary	00	Test mode status
S17				Not used
S18	0-255	Seconds	00	Test timer
S19/ S20				Not used
S21	00xx xx00	Binary	20 hex	Bit mapped options
S22	0xxx xx00	Binary	74 hex*	Bit mapped options
S23	xx00 000x	Binary	81 hex*	Bit mapped options
S24				Not used
S25	0-255	1/100 second	05	DTR delay
S26	0-255	1/100 second	01	RTS to CTS delay
S27	0xxx 0xxx	Binary	00 hex	Bit mapped options

* See 16.5 for more information about the parameters for different countries.

16.2.2 +S- registers

No	Possible values	Code	Default	Description
+S0	CxxC x000	Binary	40 hex*	Bit mapped option
+S1	Cx0C CCxx	Binary	40 hex	Bit mapped option
+S2	5-255	Seconds	90	Dialback wait time
+S3	2-255	Seconds	60	Wait time for password
+S4	1-4		04	Number of dialback attempts
+S5	AAAA AAAA	Binary	8A hex	Bit mapped option
+S6	xxxx xxxx	Binary	8A hex	Bit mapped option
+S7	xxx0 x0xx	Binary	03 hex*	Bit mapped option
+S8	1-255	1/ 10 Seconds	30	Inactivity timer
+S9	xxxx xx00	Binary	AC hex	Bit mapped option
+S10 +S12	0			Not used
+S13	0-255		120	EQM Disconnect level
+S14	0-255		120	EQM Retrain level
+S15	0-127		0	EQM monitor value
+S16	0-255		45	Remote Escape code character
+S17	0-255	1/50 sec.	50	Remote Escape guard time
+S18	1-255		255	Password/Dialback locking funct.
+S19	xxAx xx00	Binary	50hex	Bit mapped option
+S20	0000 0xxx	Binary	01hex	Bit mapped option
+S21	00xx 00xx	Binary	00 hex	Bit mapped option
+S22	00xx x0xx	Binary	07 hex	Bit mapped option
+S23	xxx0 0xxx	Binary	00 hex	Bit mapped option
+S24	0-19		0	Last telephone entry for dial backup
+S25	1-10		1	Dial backup attempts for each entry
+S26	1-10		1	Dial backup attempts for telephone list
+S27	xxxx xxxx	Binary	00	Bit mapped option
+S28	0-65	1/10 seconds	10 sec	Delay between leased line and dial backup
+S29	0xxx x0xx	Binary	10 hex	Bit mapped option
+S30	0-127		013	MNP disconnect character
+S31	xxxx x0CC		08 hex	Bit mapped option

* See 16.5 for more information about the parameters for different countries.

No	Possible values	Code	Default	Description
+S32	1-255	15 min	0	Delay between leased line attempts from switched lined
+S33	0-255	10 ms	150	Disconnect wait time
+S34	CCCC CCCC	Binary	0	Bit mapped option
+S35	0-19	0	0	Index to first number in the Call-List 1
+S36	0-19		0	Index to last number in the Call-List 1
+S37	0-19	0	0	Index to first number in the Call-List 2
+S38	0-19	0	0	Index to last number in the Call-List 2
+S39	0-19	0	0	Index to first number in the Call-List 3
+S40	0-19	0	0	Index to last number in the Call-List 3
+S41	00xx x0x0	Binary	28hex	Bit mapped option
+S42	0-255	EQM	80	Line quality decision limit
+S43	1-255	0,64	5	Line quality response time
+S44	0-255	EQM	110	Line quality limit for fallback
+S45	0-255	EQM	70	Line quality limit during handshake
+S46	0-255	EQM	20	Line quality limit for fallforward
+S47	1-255	0,64	92	Line quality response time for fallforward
+S48			FFhex	LPDA2 Address
+S49		Binary	00hex	Bit mapped used by LPDA function
+S50	x000 000C	Binary		Bit mapped options
+S51	1-5	Number	3	Used by the extended bypass function
+S52			0	Not used
+S53	xxxx 0000	Binary	D0 hex	Bit mapped
+S54	0001 1111	Binary	1Fhex	Bit mapped
+S55	1-7	Number	1	Number of retrain attempts before discon.

16.3 Factory settings

16.3.1 Permanent memory

All factory settings for the S-Registers are permanently stored here. When power is connected for the first time, these values are automatically transferred to the active memory and to the userdefined memory where they remain although power is disconnected again. If the content of the active memory has been changed and you wish to reinstall the factory values, this can be done by means of the &F.

16.4 Users, Settings

16.4.1 Active memory

The content of the active memory is always the valid configuration profile when power is on and the modem is operative. When the modem is in command state, the content can be altered any time.

The content may be stored in the userdefined memory for later use by means of the &W command. It can be brought back by means of the Z command. Factory settings are retrieved by means of the Z command. Factory settings are retrieved by means of the &F command.

16.4.2 Userdefined memory

In this memory, the user may store his own configuration profile. It can be transferred to the active memory by means of the Z command, of be replaced by means of the &W command. This memory will keep it's content even if the power is turned off.

16.5 Glossary of selected terms

A

Analogue loopback

A local test that evaluates the internal operation of the modem. Data is modulated and demodulated before it is looped back to DTE.

Analogue transmission

Transmission of a continuously variable signal. The electric signal from a microphone as a result of human speech is an example of an analogue signal. The telephone network was designed to transmit voice in analogue form.

ASCII

American Standard Code for Information Interchange. The normal character set used for data entry and transmission.

Asynchronous

During asynchronous data transmission the time interval between the separate characters can vary. Start and stop bits are added for synchronisation.

AT Attention code.

This is used at the commencement of Hayes standard command strings.

B

Baud

Unit used for measure of modulation speed, i.e. the number of signal modulations per time-unit. (Not the same as bit per second).

Binary

A binary character, 0 or 1. Having a value of zero or one. All data stored in a computer is stored as a combination of ones and zeroes.

Bit

Contraction of binary digit. This is the smallest unit of information in a binary system. A bit represents a one or a zero condition.

Bit mapped

A register used to store information that controls the register modem. Each bit can represent an on or an off condition for a specified function, or more bits can be grouped if several options exist.

Byte

A group of 8 bits.

C

CCITT

Comitè Consultatif International Telegraphique et Telephonique. (The international consultative council for telephone and telegraph). This organization has changed name to ITU.

COM

COM1, COM2, COM3 etc. The communications ports found on PCs and other apparatus. The modem must be connected to the appropriate communications port before data transmission can take place

Command

The mode of the modem such that it accepts mode commands from the terminal/computer.

D

DCD

Carrier wave detection. The signal sent from the modem to the terminal with information on the received carrier wave.

Default

Preselected values or settings that have been chosen from the factory, and considered as a good base to start from.

Demodulation

A process that extracts information that has formerly been merged together with a carrier wave. See under modulation.

DTE

Date Terminal Equipment (Data terminal, PC or data apparatus)

DTMF

Dual-Tone Multi-frequency signalling. See Tone signalling

F

Full duplex

A communications channel capable of simultaneous transmission in both directions.

H

Half duplex

A communications channel capable of transmission in both directions, but only in one direction at time.

I

ITU-T

The International Telecommunication Union was formerly CCITT. ITU-T is in charge of modem standards

M

Main channel

The main channel in a data connection which transfers data at full transmission speed. (See Return Channel)

Modem

Contraction of modulator-demodulator. Equipment required to transfer data over the telephone network

Modem

The status of the modem when it is connected status to the telephone line and is used to transfer data from the terminal/computer to a remote modem.

Modulation

Modulation is when an analogue carrier wave, e.g. tone of a given frequency, is modified by a signal in such way that the modifying signal is "carried" by the carrier wave. Data signals can lead to such modification according to specifications given for such modulation.

P

Parity

An extra-bit code used to detect errors in transmission

R

RAM

Random Access Memory. A storage unit into which data may be both written and read during operations.

Return channel

The data channel used for transmission at reduced speed.

Remote modem

The modem to which the call is made.

RTS Request to Send.

The signal from the terminal/computer to the modem informing that the data is now clear for transmission.

S

Startbit

The bit marking the commencement of a character with asynchronous transmission.

Stopbit

The bit marking the end of a character with asynchronous transmission.

Synchronous

Data bits transmitted in synchronous format are transmitted one bit after another. No start/stop bits are transmitted but an additional clock signal serves to synchronise the receiver and the transmitter. Usually certain sync characters are needed to define the byte boundaries.

Tone signalling

A modern form of number transmission. A tastaphone (with keys instead of a dialling template) normally uses tone signalling. This also requires a contemporary telephone switch board

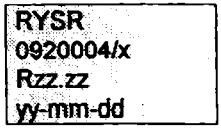
16.6 Codes and mapping

dec	binary	hex	ASCII	dec	binary	hex	ASCII	dec	binary	hex	ASCII
000	0000 0000	00	NUL	045	0010 1101	2D	-	090	0101 1010	5A	Z
001	0000 0001	01	SOH	046	0010 1110	2E		091	0101 1011	5B	[/Æ
002	0000 0010	02	STX	047	0010 1111	2F	/	092	0101 1100	5C	\ /Ø
003	0000 0011	03	ETX	048	0011 0000	30	0	093	0101 1101	5D	] / Å
004	0000 0100	04	EOT	049	0011 0001	31	1	094	0101 1110	5E	^ /ü
005	0000 0101	05	ENQ	050	0011 0010	32	2	095	0101 1111	5F	_
006	0000 0110	06	ACK	051	0011 0011	33	3	096	0110 0000	60	` / e
007	0000 0111	07	BEL	052	0011 0100	34	4	097	0110 0001	61	a
008	0000 1000	08	BS	053	0011 0101	35	5	098	0110 0010	62	b
009	0000 1001	09	HT	054	0011 0110	36	6	099	0110 0011	63	c
010	0000 1010	0A	LF	055	0011 0111	37	7	100	0110 0100	64	d
011	0000 1011	0B	VT	056	0011 1000	38	8	101	0110 0101	65	e
012	0000 1100	0C	FF	057	0011 1001	39	9	102	0110 0110	66	f
013	0000 1101	0D	CR	058	0011 1010	3A		103	0110 0111	67	g
014	0000 1110	0E	SO	059	0011 1011	3B	;	104	0110 1000	68	h
015	0000 1111	0F	SI	060	0011 1100	3C	<	105	0110 1001	69	i
016	0001 0000	10	DLE	061	0011 1101	3D	=	106	0110 1010	6A	j
017	0001 0001	11	DC1	062	0011 1110	3E	>	107	0110 1011	6B	k
018	0001 0010	12	DC2	063	0011 1111	3F	?	108	0110 1100	6C	l
019	0001 0011	13	DC3	064	0100 0000	40	@ / E	109	0110 1101	6D	m
020	0001 0100	14	DC4	065	0100 0001	41	A	110	0110 1110	6E	n
021	0001 0101	15	NAK	066	0100 0010	42	B	111	0110 1111	6F	o
022	0001 0110	16	SYN	067	0100 0011	43	C	112	0111 0000	70	p
023	0001 0111	17	ETB	068	0100 0100	44	D	113	0111 0001	71	q
024	0001 1000	18	CAN	069	0100 0101	45	E	114	0111 0010	72	r
025	0001 1001	19	EM	070	0100 0110	46	F	115	0111 0011	73	s
026	0001 1010	1A	SUB	071	0100 0111	47	G	116	0111 0100	74	t
027	0001 1011	1B	ESC	072	0100 1000	48	H	117	0111 0101	75	u
028	0001 1100	1C	FS	073	0100 1001	49	I	118	0111 0110	76	v
029	0001 1101	1D	GS	074	0100 1010	4A	J	119	0111 0111	77	w
030	0001 1110	1E	RS	075	0100 1011	4B	K	120	0111 1000	78	x
031	0001 1111	1F	US	076	0100 1100	4C	L	121	0111 1001	79	y
032	0010 0000	20	SP	077	0100 1101	4D	M	122	0111 1010	7A	z
033	0010 0001	21	!	078	0100 1110	4E	N	123	0111 1011	7B	{ / æ
034	0010 0010	22	"	079	0100 1111	4F	O	124	0111 1100	7C	| / ø
035	0010 0011	23	#	080	0101 0000	50	P	125	0111 1101	7D	å /}
036	0010 0100	24	$ / □	081	0101 0001	51	Q	126	0111 1110	7E	~ /?u
037	0010 0101	25	%	082	0101 0010	52	R	127	0111 1111	7F	DEL
038	0010 0110	26	&	083	0101 0011	53	S	128	1000 0000	80	
039	0010 0111	27	'	084	0101 0100	54	T	129	1000 0001	81	
040	0010 1000	28	(	085	0101 0101	55	U	130	1000 0010	82	
041	0010 1001	29	)	086	0101 0110	56	V	131	1000 0011	83	
042	0010 1010	2A	*	087	0101 0111	57	W	132	1000 0100	84	
043	0010 1011	2B	+	088	0101 1000	58	X	133	1000 0101	85	
044	0010 1100	2C	,	089	0101 1001	59	Y	134	1000 0110	86	

dec	binary	hex	ASCII	dec	binary	hex	ASCII	dec	binary	hex	ASCII
135	1000 0111	87		180	1011 0100	B4		225	1110 0001	E1	
136	1000 1000	88		181	1011 0101	B5		226	1110 0010	E2	
137	1000 1001	89		182	1011 0110	B6		227	1110 0011	E3	
138	1000 1010	8A		183	1011 0111	B7		228	1110 0100	E4	
139	1000 1011	8B		184	1011 1000	B8		229	1110 0101	E5	
140	1000 1100	8C		185	1011 1001	B9		230	1110 0110	E6	
141	1000 1101	8D		186	1011 1010	BA		231	1110 0111	E7	
142	1000 1110	8E		187	1011 1011	BB		232	1110 1000	E8	
143	1000 1111	8F		188	1011 1100	BC		233	1110 1001	E9	
144	1001 0000	90		189	1011 1101	BD		234	1110 1010	EA	
145	1001 0001	91		190	1011 1110	BE		235	1110 1011	EB	
146	1001 0010	92		191	1011 1111	BF		236	1110 1100	EC	
147	1001 0011	93		192	1100 0000	C0		237	1110 1101	ED	
148	1001 0100	94		193	1100 0001	C1		238	1110 1110	EE	
149	1001 0101	95		194	1100 0010	C2		239	1110 1111	EF	
150	1001 0110	96		195	1100 0011	C3		240	1111 0000	F0	
151	1001 0111	97		196	1100 0100	C4		241	1111 0001	F1	
152	1001 1000	98		197	1100 0101	C5		242	1111 0010	F2	
153	1001 1001	99		198	1100 0110	C6		243	1111 0011	F3	
154	1001 1010	9A		199	1100 0111	C7		244	1111 0100	F4	
155	1001 1011	9B		200	1100 1000	C8		245	1111 0101	F5	
156	1001 1100	9C		201	1100 1001	C9		246	1111 0110	F6	
157	1001 1101	9D		202	1100 1010	CA		247	1111 0111	F7	
158	1001 1110	9E		203	1100 1011	CB		248	1111 1000	F8	
159	1001 1111	9F		204	1100 1100	CC		249	1111 1001	F9	
160	1010 0000	A0		205	1100 1101	CD		250	1111 1010	FA	
161	1010 0001	A1		206	1100 1110	CE		251	1111 1011	FB	
162	1010 0010	A2		207	1100 1111	CF		252	1111 1100	FC	
163	1010 0011	A3		208	1101 0000	D0		253	1111 1101	FD	
164	1010 0100	A4		209	1101 0001	D1		254	1111 1110	FE	
165	1010 0101	A5		210	1101 0010	D2		255	1111 1111	FF	
166	1010 0110	A6		211	1101 0011	D3					
167	1010 0111	A7		212	1101 0100	D4					
168	1010 1000	A8		213	1101 0101	D5					
169	1010 1001	A9		214	1101 0110	D6					
170	1010 1010	AA		215	1101 0111	D7					
171	1010 1011	AB		216	1101 1000	D8					
172	1010 1100	AC		217	1101 1001	D9					
173	1010 1101	AD		218	1101 1010	DA					
174	1010 1110	AE		219	1101 1011	DB					
175	1010 1111	AF		220	1101 1100	DC					
176	1011 0000	B0		221	1101 1101	DD					
177	1011 0001	B1		222	1101 1110	DE					
178	1011 0010	B2		223	1101 1111	DF					
179	1011 0011	B3		224	1110 0000	E0					

16.7 Line parameters/connectors for different countries

The software which controls the modem is stored in a chip called EPROM (Erasable Programmable Read Only Memory). Each EPROM has a label of the type:



This is an example

RYSR 092 0004/x	is the complete firmware article number.
Rzz.zz	is the complete revision state
yy-mm-dd	is the firmware release date.

The set-up for a country is done with hardware strapping. An overview of the hardware strapping fields is given in chapter 5. Chapter 5 also describes how to treat the modem if you want to change one of the functions associated with the strapping fields. When delivered, the modem is set up for the correct country and with the most commonly used functions. Normally there is no need to change the strapping.
This chapter describes the modem set-up for selected countries, and how to use the modular jacks.

The figure below shows the factory strapping common to all countries.

16.7.1 S-registers

Some of the countries will have S register default values different from the standard S register default values mentioned in chapter 4.

Sweden:

S11	Default:	70	Range:	65-75

Netherlands:

S0	Default:	0	Range:	0-8

Switzerland:

S0	Default:	2	Range:	0-5
S7	Default:	90	Range:	83-97
S8	Default:	0	Range:	0-0
			(Pause time not allowed)	
S11	Default:	100	Range:	70-105

Belgium:

S22	F4h	Changeable bits: 7Ch

Sweden/PTT:

S0	Default:	1	Range:	0-255
S6	Default:	10	Range:	2-10
S7	Default:	60	Range:	1-60
S11	Default:	70	Range:	70-70
S14	Default:	AAh	Changeable bits: AEh	
S23	Default:	01h	Changeable bits: C1h	
+S0	Default:	40h	Changeable bits: 68h	
+S7	Default:	03h	Changeable bits: EBh	

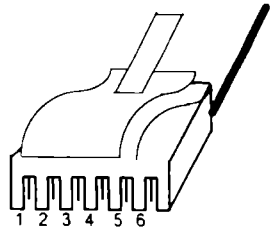
In addition the following commands are default (this has been changed compared to the standard default values which are underlined in the manuel):

%C0	Data compression off
+&FB1	Auto fallback enabled
+&FR0	Auto retrain disabled
+O1	Remote command access enabled
\Q3	Local flow control RTS/CTS.

All commands may be executed from remote. See chapter 4 for more description of the S-registers.

16.7.2 The modular jacks

The modular jacks may be with 4 or 6 positions. The figure below shows how this connector is numbered.



The figure below illustrates the modem seen from rear view. Line, connects to the wall jack and Phone, to the telephone set.

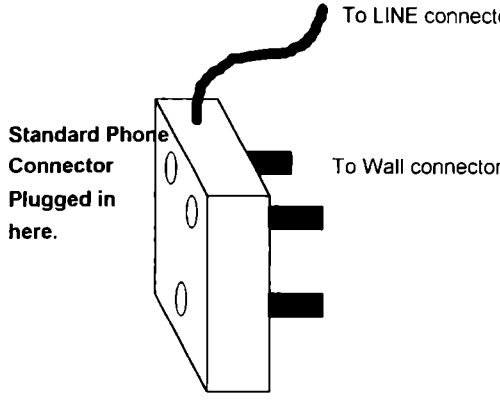
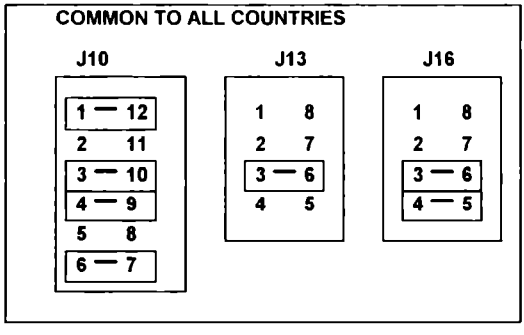


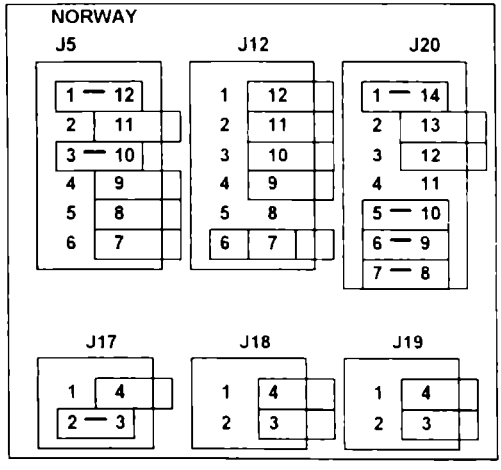
Fig.3



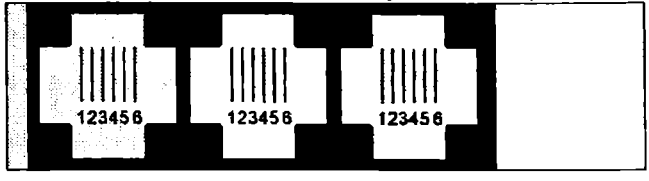
J12 pos 6 is set in both positions in the preceding figures. The reason is that J12 pos 6 can be mounted in both positions and shall remain in the position as delivered.

16.7.3 Norway:

The factory set-up for country dependent straps is shown below:

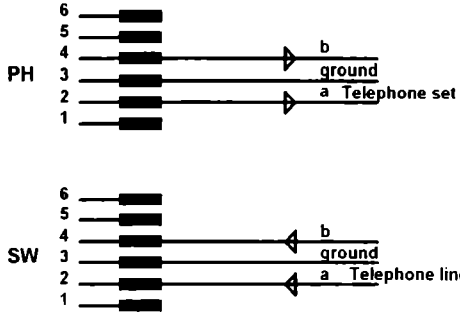


Connection to Line/Use of modular jacks at rear panel.

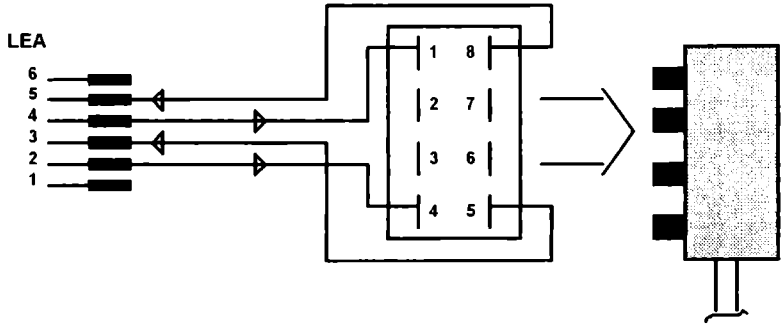


1. Setup of SW and PHONE connector.

Without intermediate connector. Standard telephone cord is used.

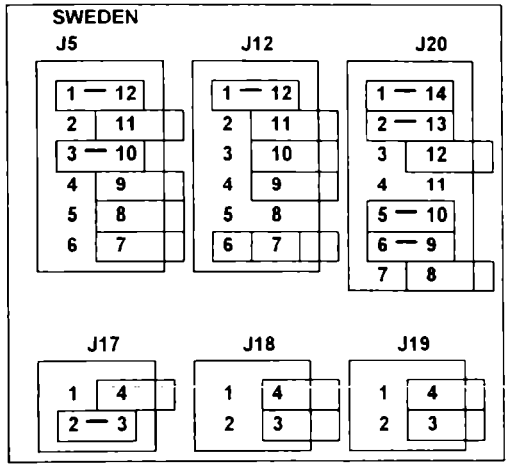


1. Setup of LEA connector.

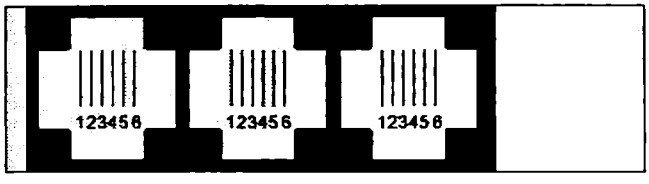


16.7.4 Sweden:

The factory set-up for country dependent straps is shown below:



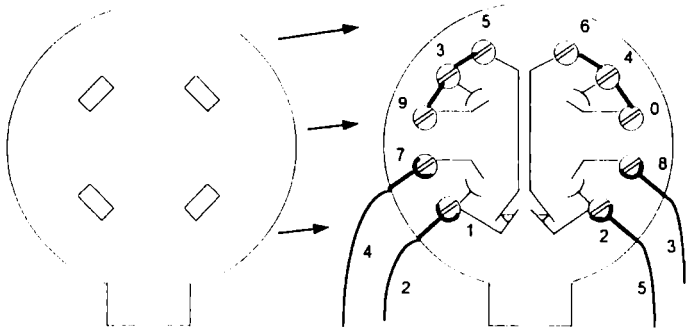
Connection to Line/Use of modular jacks at rear panel.

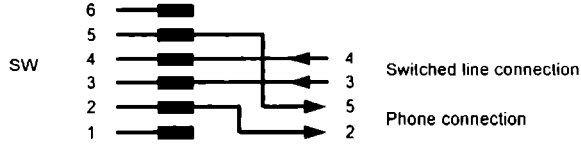


This rear panel is called the general version, and when delivered to countries outside Scandinavia, this is the one used.

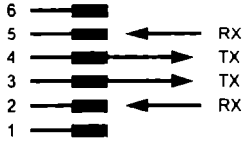
1. Setup of SW and phone connector.

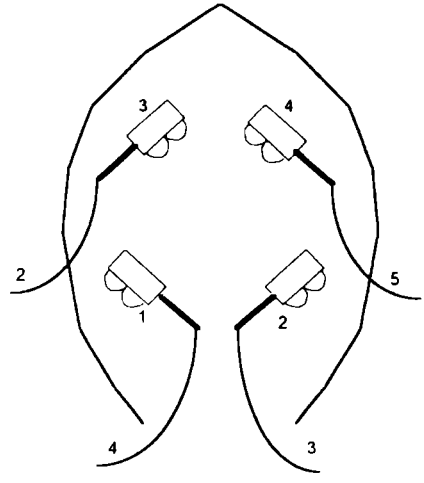
With intermediate connector.





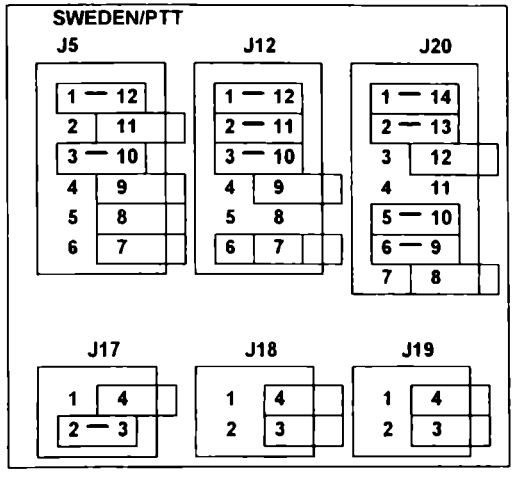
2. Setup of LEA connector





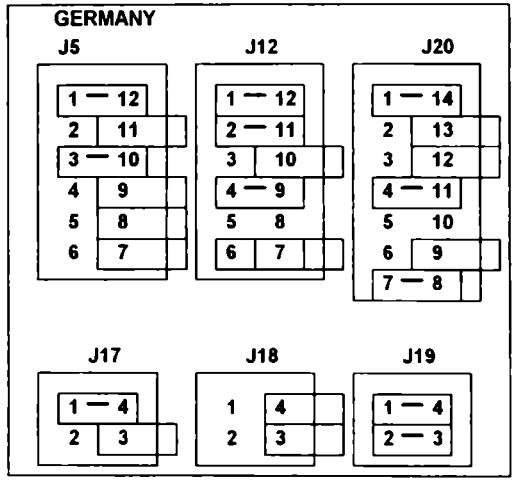
16.7.5 Sweden/PTT:

The factory set-up for country dependent straps is shown below:



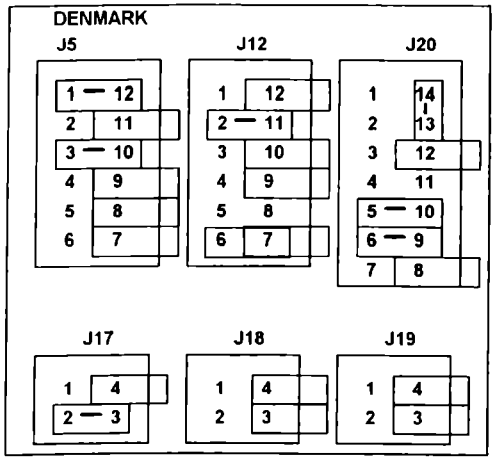
16.7.6 Germany:

The factory set-up for country dependent straps is shown below:



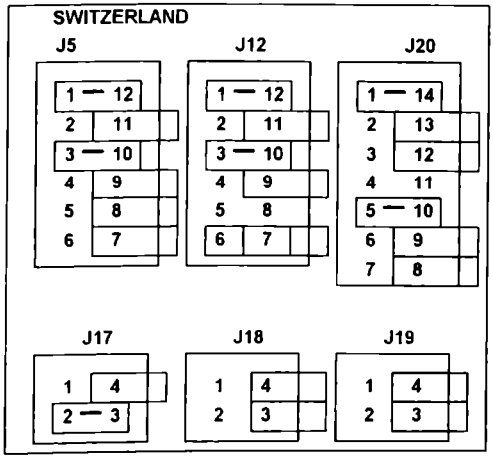
16.7.7 Denmark / International:

The factory set-up for country dependent straps is shown below:



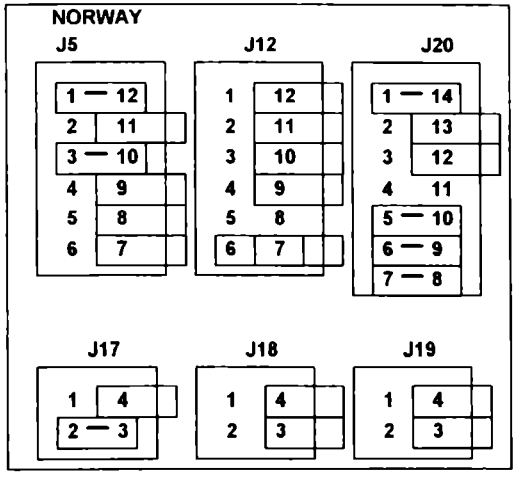
16.7.8 Switzerland:

The factory set-up for country dependent straps is shown below:



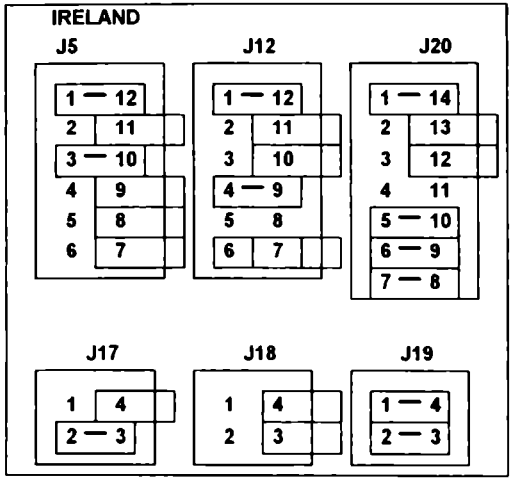
16.7.9Norway, PTT:

The factory set-up for country dependent straps is shown below:



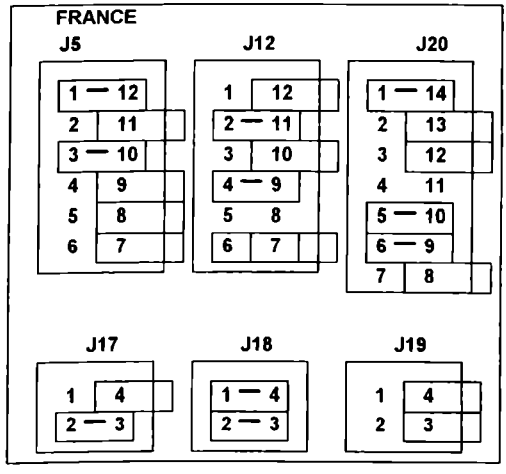
16.7.10 Ireland:

The factory set-up for country dependent straps is shown below:



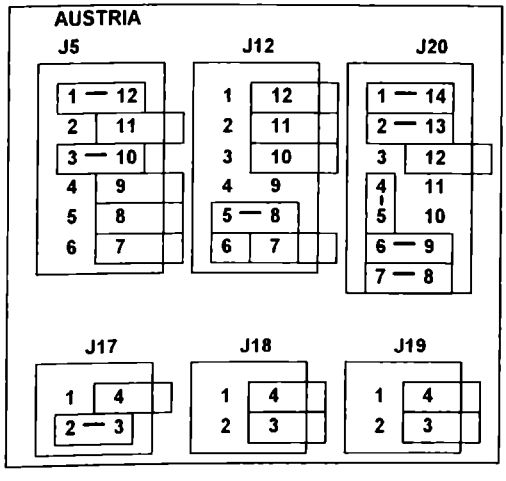
16.7.11 France:

The factory set-up for country dependent straps is shown below:



16.7.12 Austria:

The factory set-up for country dependent straps is shown below:



16.7.13 Netherlands:

The factory set-up for country dependent straps is shown below:

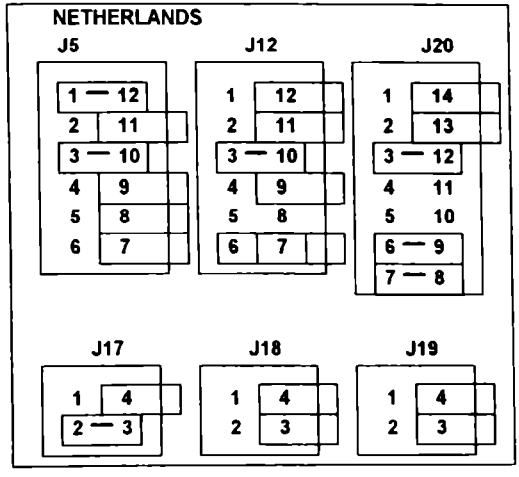


Fig 16-1

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