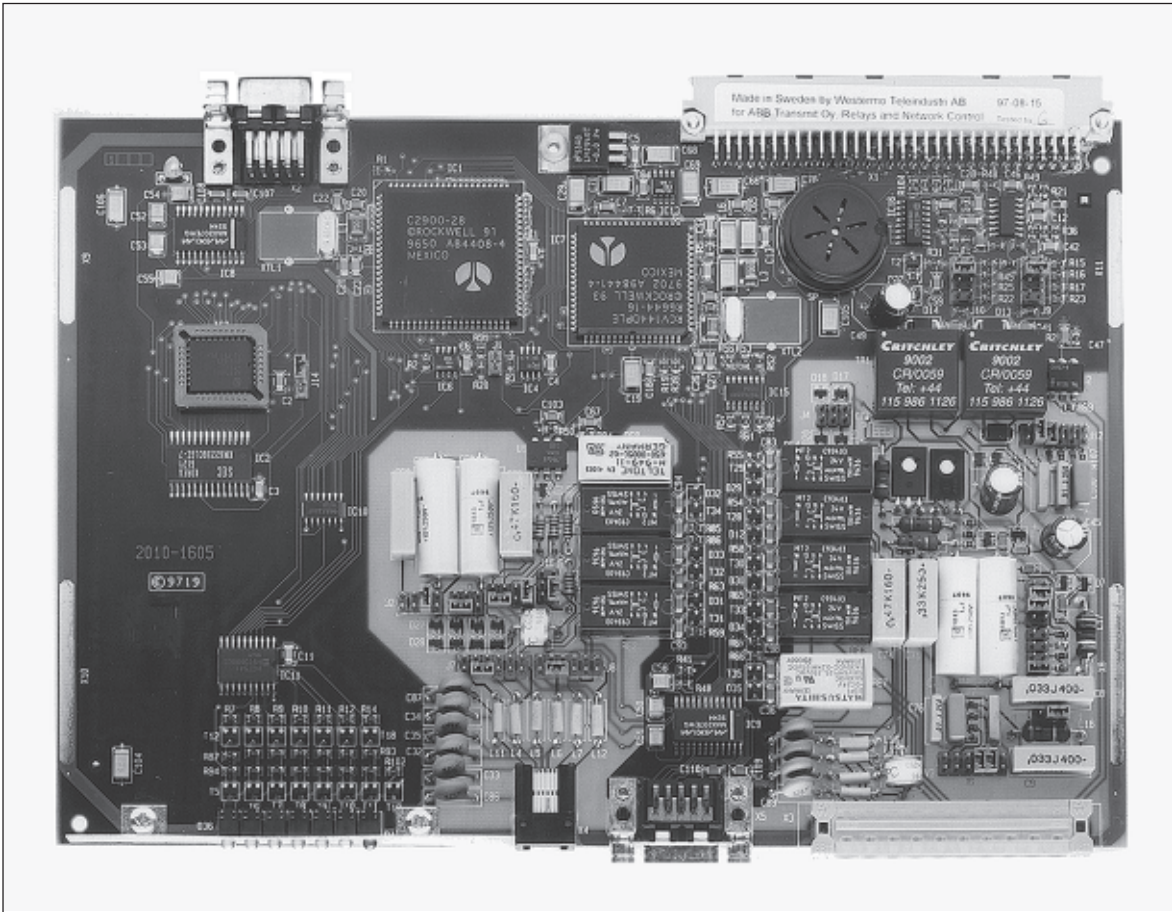


# 1MRS119000 Plug-in Modem

Engineering manual



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# 1.0

## General

### 1.1

#### Introduction

The 1MRS119000 modem board is a multifunctional plug-in modem board which can be used together with several distribution automation products of ABB Transmit Oy. Via the local public telephone network or leased lines the modem provides data communication at up to 14400 bps. Furthermore, the modem can be connected to several types of radios for communication via a radio-operated network.

This optional modem board is used for communication between a remotely controlled unit or a protection relay and a host computer. It is only delivered as part of such systems. The modem board takes care of the data communication from station-level equipment to the host computer via a public telephone network, leased lines or a conventional radio network.

The modem is designed according to the following international ITU-T recommendations for data signalling rates up to 14400 bps:

ITU-T V.21	300 bps
ITU-T V.22	1200 bps
ITU-T V.22bis	2400 bps
ITU-T V.23	1200/75 bps
ITU-T V.32	4800/9600 bps
ITU-T V.32bis	14400 bps

The line interface fulfils the NET 4 (ETS 300 001, second edition, April 1994) specification for the agreed countries: "Attachments to Public Switched Telephone Network (PSTN); General technical requirements for equipment connected to an analog subscriber interface in the PSTN".

The AT command set is used for configuration of both the telephone modem and the radio modem. Configuration is done via the RS 232 serial interface with help of a PC/ Terminal (DTE).

The remote configuration of the modem offers users network management capabilities. The user can configure the modem at remote sites from local modems, without having to visit the local stations or rely on the service personnel to follow instructions.

**1.2**

**Type marking**

The type marking of the modem consists of a type number, a temperature range code and a country code. The type number is 1MRS119000-\_\_\_. The one-letter temperature range code and the two-letter country code specify the service temperature range and the destination country where the modem is to be installed. The country code is needed to make sure that the public line part of the modem has been approved for use in the destination country. The status of approval per country can be inquired from ABB Transmit Oy or ABB's local customer centre.

Example of the type marking:

1MRS119000 -AFI

			Country code      FI = Finland
			Temperature range    A = +5...+50°C
			B = -20...+60°C

Type number

Country codes are:

- |                     |                  |                  |                    |
|---------------------|------------------|------------------|--------------------|
| AR = Argentina      | AT = Austria     | AU = Australia   | BE = Belgium       |
| BR = Brazil         | CA = Canada      | CH = Switzerland | CO = Colombia      |
| CZ = Czech republic | DE = Germany     | DK = Denmark     | EE = Estonia       |
| EG = Egypt          | ES = Spain       | FI = Finland     | GB = Great Britain |
| GR = Greece         | HK = Hong Kong   | HU = Hungary     | ID = Indonesia     |
| IE = Ireland        | IL = Israel      | ID = Indonesia   | IT = Italy         |
| MX = Mexico         | MY = Malaysia    | NL = Netherlands | NO = Norway        |
| NZ = New Zealand    | PH = Philippines | PL = Poland      | PT = Portugal      |
| SA = Saudi Arabia   | SE = Sweden      | SG = Singapore   | SI = Slovenia      |
| TR = Turkey         | TW = Taiwan      | RU = Russia      | VE = Venezuela     |
| ZA = South Africa   |                  |                  |                    |

**1.3**

**Features**

DTE Interface: an RS232 serial interface with hardware handshaking, connected to two 9-pin female D-connectors.

Line interface: a transformer-coupled telephone line interface with tone and pulse dialling. The line interface can be used in both 2-wire and 4-wire dial-up and leased line connections.

Radio interface: a combined interface for connecting either a leased line, or a radio transceiver.

Both the Line interface and Radio interface can be used for communication over leased lines.

Indication LEDs: The seven LEDs show the operation status of the modem.

Designed for operation in distribution automation environment.

## 1.4 Technical specifications

### 1.4.1 LED indicator functions

Total 7 LEDs:

LIN	Modem connected to line (off hook), connected to line relay control signals	Green
RNG	Indicates a true ringing signal	Green
TXD	Transmitted data. Connected to the modem TxD signal	Green
RXD	Received data. Connected to the modem RxD signal.	Green
CD	Carrier detect.	Green
RTS	Request to send.	Green
IRF	Internal Fault detected by the watchdog. Normally off.	Red

### 1.4.2 Interface connectors

Connector	Type	Function
X1	64-pin Euro	power supply
X2	9-pin D-connector	RS 232 serial interface
Xn.1	RJ12	public telephone network
Xn.2	9-pin D-connector	RS 232 serial interface
Xn.3	10-pin	leased line / radio

Loudspeaker on-board, adjustable sound volume

### 1.4.3 Telephone line interface

Modes Dial up, 2-or 4- wire leased or fixed line, Xn.1/1-6

ITU-T recommendations:

ITU-T V.21	300 bps
ITU-T V.22	1200 bps
ITU-T V.22bis	2400 bps
ITU-T V.23	1200/75 bps
ITU-T V.32	4800/9600 bps
ITU-T V.32bis	14400 bps

### 1.4.4 Private line

Input sensitivity	-43 to dBm, Xn.3/1-2 or 3-4.
Output level	software adjustable, -2 to -17 dBm, Xn.3/1-2.
Modem configuration	AT commands and S registers, Jumper settings

<b>1.4.5</b>	<b>Radio interface</b>	
	Modes	Radio, 2- or 4-wire private line
	Input sensitivity	-43 dBm, Xn.3/1-2 or 3-4.
	Output level	software/automatic adjustable, -2 dBm ... -17 dBm, Xn.3/1-2.
	Subcarrier detector	12 - 60 V forward voltage, 0.3 - 1.8 mA. 6 V maximum backward voltage. Xn.3/9-10.
	TX/RX switch (PTT)	relay operated (5 A, 30 Vdc, 250 Vac), Xn.3/6-8.
	TX/RX delay	adjustable between 30 and 2000 ms
	Modem configuration	AT commands and S registers

<b>1.4.6</b>	<b>DTE</b>	
	Interface	2 x RS232 in parallel, X2 and Xn.2.
	Data speed	Auto detection between 300 - 38 400 bit/s
	Data format	Auto detection between: 7 or 8 data bits odd, even or no parity 1 stop bit

<b>1.4.7</b>	<b>Power consumption</b>	
	5 V	typical 165 mA, max 250 mA
	24 V	passive typical 26 mA, active typical 45 mA, max. 60 mA

<b>1.4.8</b>	<b>Environmental conditions</b>	
	Ambient temperature range	
	- normal	+5...+50°C
	- extended	-20...+60°C
	Storage temperature range	-40...+125°C
	Relative humidity	15...90%, non-condensing

<b>1.4.9</b>	<b>Mechanical dimension</b>	
	Size	160 x 233.4 mm (E2), component high max 16 mm.

The modem is approved and manufactured by Westermo Teleindustri AB, 640 40 Stora Sundby, Sweden.

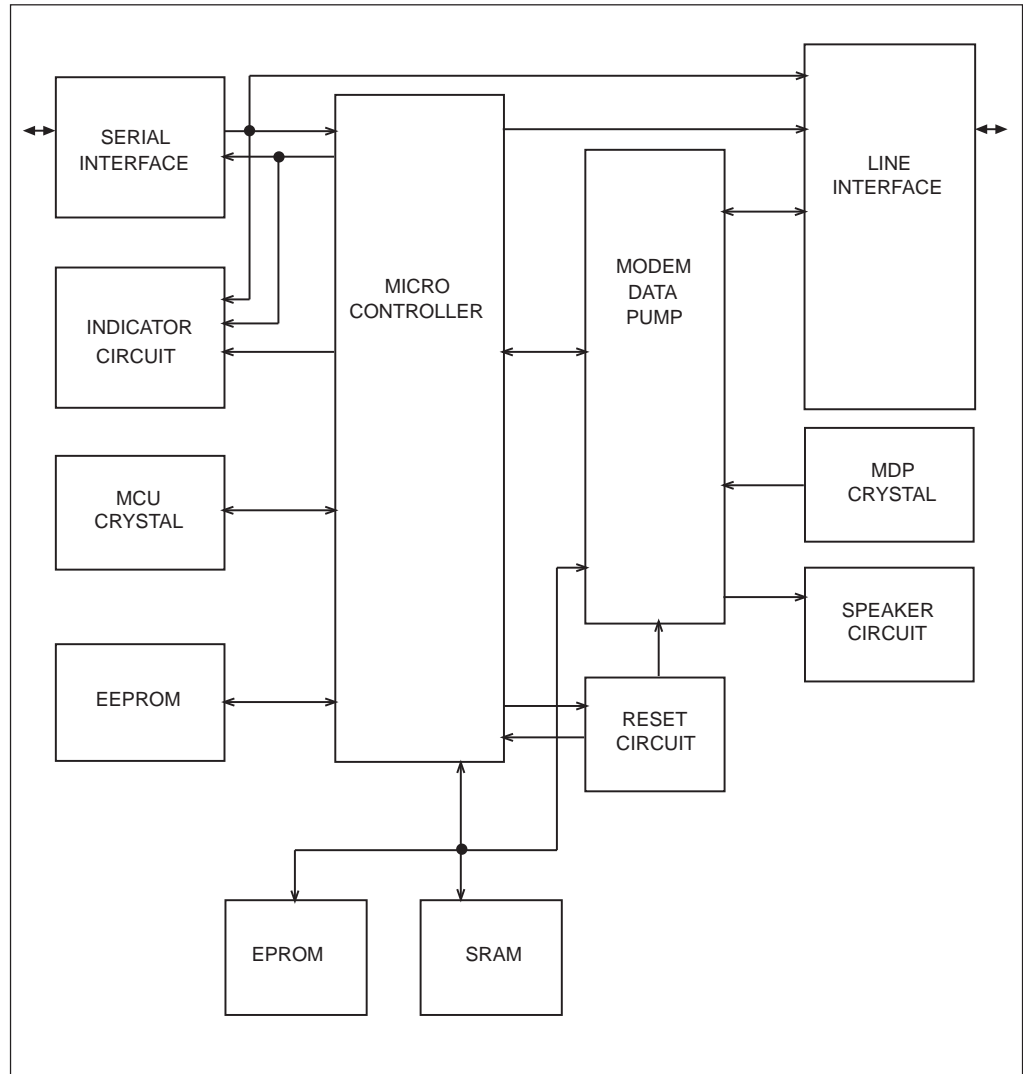


Fig. 1. Block diagram



## 1.6 Power supply and booting

The plug-in modem board is an optional unit for ABB Transmit Oy protection and control products. The modem is powered by the equipment it is used in and does not need a separate external power supply.

Modem settings are stored in non-volatile memory on the modem board and read after powering up. For certain settings, the microcontroller to which the modem is connected, sends initialisation strings after power-up of the unit.

The supply voltages are: +5Vdc  $\pm$ 2% / 165 mA for the electronics  
+24Vdc  $\pm$ 10% / 45 mA for the relays and LEDs

## 1.7 LED indicators

Communication to and from the modem, as well as the modem operation status can be checked with help of seven diagnostic LED indicators.

The LED indicators are:

LIN	Modem connected to line (off hook), connected to the line relay control signals	Green
RNG	Indicates a true ringing signal.	Green
TXD	Transmitted data. Connected to the modem TxD signal	Green
RXD	Received data. Connected to the modem RxD signal.	Green
CD	Carrier detect.	Green
RTS	Request to send.	Green
IRF	Internal Fault detected by the watchdog. Normally this LED is off.	Red

## 1.8 On-board controls

The 1MRS119000 is designed on a single printed circuit board (PCB). The board contains 11 series of jumpers for country-specific settings. The jumpers can only be reached after removing the PC board from the rack it normally is mounted in. The exact function of each jumper is described in the chapter 'Jumper settings'.

## 1.9 Loudspeaker

An on-board piezoelectric loudspeaker is provided, mainly for testing purposes. For normal, silent operation, the loudspeaker can be switched off, or set to a low volume by altering certain settings. Refer to the chapter 'Command Overview'.

## 2.0

# Installation and connection

### 2.1

## Introduction

The installation of the 1MRS119000 consists mainly of making the physical connections between the modem and the telephone network, leased line, fixed lines or radio equipment. The power supply connection and the connection for data transfer to and from the microcontroller (protective relay, I/O unit) are made after the modem board has been properly inserted. Mounting of the modem board is described in the manual of the equipment it is part of. A separate connector is provided to connect the modem to a PC using a standard RS232 cable. This connector is only used for setting up the modem and for service. Setting up the modem can also be done remotely.

Installation procedure:

1. Check the position of the on-board jumpers. The jumpers have been set to the default positions by the factory. Refer to chapter 'Jumper settings' for setting the jumpers according to local needs.
2. Insert the PC board properly into the rack. As the modem board normally is ordered as part of other distribution automation equipment, this is done by the factory.
3. Connect the modem to the dial-up lines, leased line or radio equipment. For setting up the modem, connect a PC temporarily to the modem board.
4. Attach the auxiliary supply and check the operation of the modem with help of the LED indicators.
5. Verify that the modem settings are in conformance with the network configuration and match with the settings of the modem used at the host computer. Check for error correction, baud rate, data compression, etc. See the chapter 'Command overview' for a detailed description on the available modem commands.
6. Verify self-test results. See chapter 'Self-test'.
7. Check the modems operation in the network.

## Connectors

All connectors are directly mounted on the modem board. Refer to the technical specifications for the modem-board layout and the position of connectors and jumpers. The connector name, type of connectors and their functions are as follows:

Connector	Type	Function
X1	64-pin Euro	power supply
X2	9-pin D-connector	RS 232 serial interface
Xn.1	RJ12	public telephone network
Xn.2	9-pin D-connector	RS 232 serial interface
Xn.3	10-pin	leased line / radio

n is the card slot number for the modem board.

Connectors X2 and Xn.3 are connected in parallel. For a description of the pin configuration of each connector, refer to chapter 'Technical Specifications'.

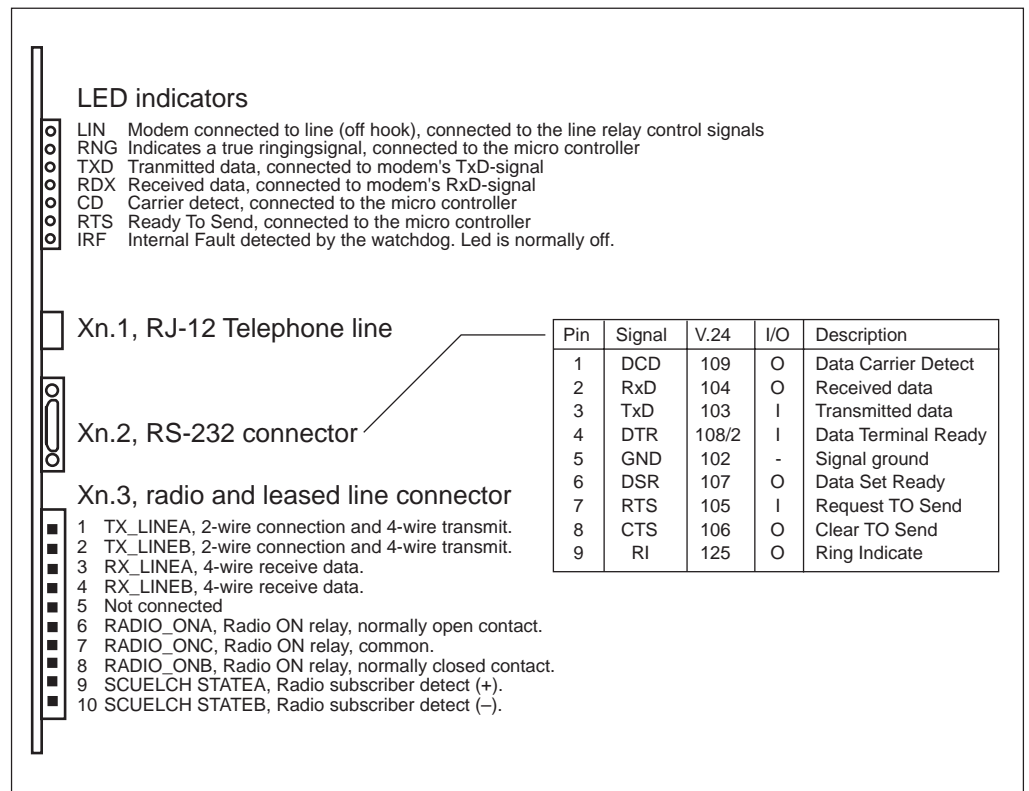


Fig. 2. Connection view

As the cables to be used for connecting the modem to the telephone network, leased lines and radio system depend on local conditions, these are not provided. For connecting a PC to the modem, use a standard RS232.

## 2.3 Jumpers

The jumper settings are for country-specific parameters. They should normally not be changed after delivery of the modem. See the chapter 'Jumper settings' for a detailed description on the jumper functions.

## 2.4 Phone line connections

The 1MRS119000 modem is designed for communications over a Public Switched Network Telephone line.

Connection to the phone system is made via an RJ12 type jack (connector Xn.1). Depending on the function of the line, the modem will be connected through one or several line relays. It can be connected to a switched or leased line network, 2-wire or 4-wire transformer coupled line interface and a ring detector opto. Depending on country, the jumper positions have to be altered. See the chapter 'Jumper settings' for a detailed description on the jumper functions.

Cables for connecting the modem board to the dial-up lines or leased lines are not provided as the type of cable and attached connector depend on the application. Refer to the technical specifications and pin configurations for attaching the 1MRS119000 modem board to the available lines.

## 2.5 Radio connections

The interface connector Xn.3 is used for connecting the 1MRS119000 modem board to either a leased line or a suitable radio transceiver. For the use of radio equipment extra I/O signals are provided: output relay contacts for switching between send and receive and a receiver subcarrier detection input.

The connection to a radio transceiver strongly depends on the type of radio used. It should be noted that only certain types of radio transceivers are suitable for the transmission of high speed digital data. For attaching the radio transceiver to the modem board, refer to the documentation provided with the radio equipment and refer to the pin configuration of connector Xn.3 given in chapter 'Technical Specifications'.

Cables for connecting the modem-board to the radio equipment are not provided as the type of cable and attached connectors depend on the application and the type of radio used.

Always refer to the technical specifications and pin configurations for attaching the 1MRS119000 modem board to external devices.

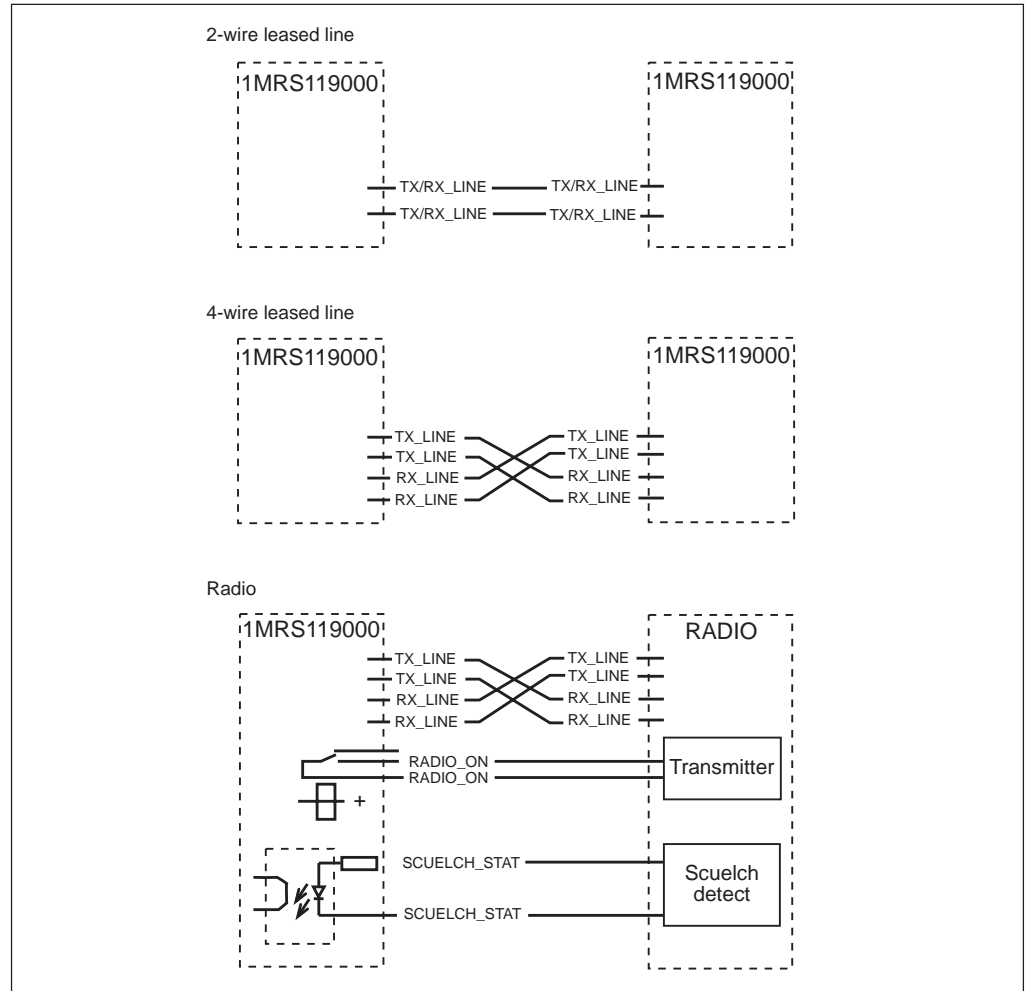
## 2.6 Leased and fixed Line connections

Both the phone line and the radio interface can be used for attaching a leased line. In many applications in distribution automation, leased lines, also called dedicated or private lines, are used. The 1MRS119000 modem is designed for use over a 2-wire or 4-wire leased line. No special line conditions are needed and the operation is full-duplex. The leased lines can be connected to the phone line interface connector (Xn.1, see previous section) or to the radio interface connector Xn.3.

Cables for connecting the modem board to leased lines are not provided as the type of cable and attached connectors depend on the application.

Always refer to the technical specifications and pin configurations for attaching the 1MRS119000 modem board to external devices.

Connection examples



Common configuration strings

Mode	Connector	Initialisation string originate	Answer
Dial up:	Xn.1	AT&FDnnnn	AT&FS0=1
2-wire fixed line	Xn.1	AT&F&L1D	AT&F&L1A
2-wire fixed line	Xn.3	AT&F&L1&J1D	AT&F&L1&J1A
4-wire fixed line	Xn.1	AT&F&L1&H1D	AT&F&L1&H1A
4-wire fixed line	Xn.3	AT&F&L1&J1&H1D	AT&F&L1&J1&H1A
4-wire radio V.23 HDX	Xn.3	AT&F&E1%F3&L1&J1&H1D	AT&F&E1%F3&L1&J1&H1A

AT	&F	Set factory default,
	Dnnnn	Dial number nnnn
	S0=1	Auto answer after 1 ring signal
	&L1	Fixed line synchronisation enabled
	&L0	Normal dial-up connection
	D	Set modem as originate
	A	Set modem as answering
	&J1	Set line to radio screw connector
	&J0	Set line to telephone connector
	&H1	4-wire line
	&H0	2-wire line
	&E1	Radio subcarrier control enabled
	&E0	Radio subcarrier control disabled
	%F3	Set V23 half duplex 1200/1200

Key in the telephone number instead of nnnn

## 2.9

### DTE connection

During commissioning, all settings to the modem board 1MRS119000 are made using a DTE (terminal or Personal Computer running e.g. a terminal emulation program). The DTE is to be connected to the 9-pin female connector Xn.2 via a standard RS 232 cable. If you use your own cable, always check that the cable matches the pin configuration of the modem board and DTE. Refer to the technical specifications for further details.

Connector Xn.2 has the same functionality as connector X2 on the rear side of the modem board. Connector X2 is used for the data communication between the modem and the microcontroller of the distribution automation equipment in which the modem is used. The two serial interface connectors can only be used one at the time. The modem board has a built-in serial interface using the data formats from: 1 start bit, 7 data bits, no parity and 1 stop bit, up to: 1 start bit, 8 data bits, 1 parity and 1 stop bit.

The modem recognises the DTE data format (baud rate, number of data bits, etc.) automatically after typing AT followed by a <CR> (carriage return), as long as the DTE data formats are within the above mentioned range. Preferably, the DTE data formats should be the same as the communication settings of the secondary substation equipment in which the modem is used. The communication between the modem and the DTE is always half duplex.

## 2.10

### Mounting

The modem board is only delivered as part of ABB Transmit Oy's secondary substation equipment and is therefore mounted by the factory. For altering jumper settings and for service reasons, the modem board might have to be removed from the rack in which it is normally mounted. The position of the modem board in the rack is described in the manuals of the concerned secondary substation equipment.

Remove or place the modem board only when the auxiliary supply voltage is turned off and the telephone line is disconnected. Connect the telephone line after the board is installed in the cabinet.

As the modem and the equipment in which the modem is placed contain ESD sensitive components, always take the necessary precautions to avoid electrostatic discharges before removing or placing any of the printed circuit boards. Disregarding these precautions can cause damage to internal electronics even in the long run.

## 2.11

### Powering-up

Before applying the auxiliary voltage, check that the modem board is correctly mounted. Refer to the previous section 'Mounting'.

The modem board is powered through the equipment it is placed in and does not need a separate power supply.

As soon as the auxiliary voltage is applied, the modem performs a self-test, after which it is initialized.

## **3.0 Command overview**

### **3.1 Introduction**

AT commands are the means by which the modem is configured. The available commands enable reading and modifying of the modem parameters. This chapter describes the AT commands recognized by the 1MRS119000 modem board. The sections of this chapter describe the command syntax and give a detailed description of the available AT commands and S registers. For a brief description of the commands refer to appendices.

### **3.2 Command syntax**

#### **3.2.1 DTE Commands**

The ISO 646 character set (CCITT T.50 International Alphabet 5, American Standard Code for Information Interchange) is used for issuing commands and responses. Only the low-order 7 bits of each character are used for commands or parameters; the high-order bit is ignored. Upper-case characters are equivalent to lower-case characters.

#### **3.2.2 AT command guidelines**

Modem operation is controlled by generic AT commands. These AT commands may be basic AT (i.e., commands preceded by AT, AT&, AT%, AT\*, AT\, AT), AT, or AT#), S register (e.g., S6=n), commands. The command syntax and operation guidelines governing each of these command categories are described in the subsequent sections.

#### **3.2.3 Basic command syntax**

Characters within the command line are parsed as commands with associated parameter values. The basic commands consist of single ASCII characters, or single characters preceded by a prefix character, followed by a decimal parameter (e.g., '&D1'). Missing decimal parameters are evaluated as 0.

### **3.3 AT command**

#### **3.3.1 AT command guidelines**

The basic AT commands used to control modem operation are defined in this section. These commands are summarised in Appendix A. All these commands may not be available in a specific product depending upon supported data rates and modes. The default values are typical of a fully configured modem supporting all data rates and options. The actual default value is dependent upon modem firmware as defined by the firmware release notes.

#### **3.3.2 AT Commands, DTE Adaptation**

Under AT operation, the serial interfaced modem performs an autobaud/autoparity/autolength function on each AT header entered. The autolength/autoparity facility can detect 7- or 8-bit characters of even, odd, or no parity with one stop bit.

### 3.3.3

## AT Command Format

A command line is a string of characters sent from a DTE to the modem (DCE) while the modem is in a command state. A command line has a prefix, a body, and a terminator. Each command line (with the exception of the A/ command) must begin with the character sequence AT and must be terminated by a carriage return. Commands entered in upper case or lower case are accepted, but both the A and T must be of the same case, i.e., "AT" = ASCII 065, 084 or `at` = ASCII 097, 116. The body is a string of commands restricted to printable ASCII characters (032 - 126). Space characters (ASCII 032) and control characters other than CR (ASCII 013) and BS (ASCII 010) in the command string are ignored. The default terminator is the ASCII <CR> character. Characters that precede the AT prefix are ignored. The command line interpretation begins upon receipt of the carriage return character.

Characters within the command line are parsed as commands with associated parameter values. The basic commands consist of single ASCII characters, or single characters preceded by a prefix character (e.g., `&"), followed by a decimal parameter. Missing decimal parameters are evaluated as 0.

The modem supports the editing of command lines by recognizing a backspace character. When modem echo is enabled, the modem responds to the receipt of a backspace or delete by echoing a backspace character, a space character, and another backspace. The hex value to be used for the backspace character is programmable through register S5. Values equal to 0 or greater than 127, or the value which corresponds to the carriage return character, cannot be used for the backspace character. This editing is not applicable to the AT header of a command. A command line may be aborted at any time by entering <cntrl-x > (18h).

The AT sequence may be followed by any number of commands in sequence, except for commands such as Z, D, or A. Commands following commands Z, D, or A on the same command line will be ignored. The maximum number of characters on any command line is 39 (including "A" and "T"). If a syntax error is found anywhere in a command line command, the remainder of the line will be ignored and the ERROR result code will be returned.

Most of the commands entered with parameters out of range will be rejected and the ERROR response will be returned to the DTE.

Commands will be accepted by the modem once the previous command has been fully executed. This is normally indicated by the return of an appropriate result code. Execution of commands D and A, either as a result of a direct command or a re-execute command, will be aborted if another character is entered before completion of the handshake.

### 3.3.4

## Escape Code Sequence

When the modem has established a connection and has entered on-line data mode, it is possible to break into the data transmission in order to issue further commands to the modem in an on-line command mode. This is achieved by the DTE sending to the modem a sequence of three ASCII characters specified by register S2. The default character is '+'. The timing of the three characters must comply with specific time constraints. There is a guard time before the first character (the pre-sequence time), a guard time following the third character (the post-sequence time), and a guard time-out between the first and second characters and between the second and third characters (the inter-character time). These times are controlled by the value recorded in register S12.



## AT Commands

The modem will respond to the commands detailed below. Parameters applicable to each command are listed with the command description. The defaults shown for each configuration command are those used in the Rockwell factory profile.

### A/ - Re-execute Command

The modem behaves as though the last command line had been re-sent by the DTE. "A/" will repeat all the commands in the command buffer.

The principal application of this command is to place another call (using the Dial command) that failed to connect due to a busy line, no answer, or a wrong number. This command must appear alone on a command line. This command should not be terminated by a carriage return.

### AT=x - Write to Selected S register

This command writes the value x to the currently selected S register. An S register can be selected by using the ATSn command. All of the S registers will return the OK response if x is a number. Some registers may not be written due to country-specific PTT limitations.

Result Codes:

OK For all arguments.

### AT? - Read Selected S register

This command reads and displays the selected S register. An S register can be selected by using the ATSn command.

Result Codes:

OK For all arguments.

### A - Answer

The modem will go off-hook and attempt to answer an incoming call if correct conditions are met. Upon successful completion of answer handshake, the modem will go on-line in answer mode. This command may be affected by the state of Line Current Sense, if enabled. (Most countries do not require Line Current Sense.) The operation is also dependent upon country-specific requirements.

### Bn - CCITT or Bell

When the modem is configured to allow either option, the modem will select Bell or CCITT modulation for a line speed connection of 300 or 1200 bps according to the parameter supplied. Any other line speed will use a CCITT modulation standard. The parameter value, if valid, is written to S27 bit 6. (Also, see ATFn command.)

B0 Selects CCITT operation at 300 or 1200 bps during Call Establishment and a subsequent connection. (Default.)

B1 Selects BELL operation at 300 or 1200 bps during Call Establishment and a subsequent connection.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

## Cn - Carrier Control

This command is included for compatibility only, and has no effect other than returning a result code. The only valid parameter is 1.

Result Codes:

OK n = 1.

ERROR Otherwise.

## Dn - Dial

This command directs the modem to go on-line, dial according to the string entered and attempt to establish a connection. If no dial string is supplied, the modem will go on-line and attempt the handshake in originate mode. In W-class models, the action of going off-hook is affected by the status of the Line Current Sense input, if line current sensing is enabled, and by the blacklist and delayed list.

*NOTE: If the ATD command is issued before the S1 register has cleared, the modem will respond with the NO CARRIER result code. Accordingly, with some country-specific regulations, the modem will answer DELAYED when you are making repeated call attempts, without getting any connection and BLACKLIST will be the answer if you are dialling a forbidden number.*

Dial Modifiers. The valid dial string parameters are described below. Punctuation characters may be used for clarity, with parentheses, hyphen, and spaces being ignored.

- 0-9 DTMF digits 0 to 9.
- \* The 'star' digit (tone dialling only).
- # The 'gate' digit (tone dialling only).
- A-D DTMF digits A, B, C, and D. Some countries may prohibit sending of these digits during dialling.
- L Re-dial last number: the modem will re-dial the last valid telephone number. The L must be immediately after the D with all the following characters ignored).
- P Select pulse dialling: pulse dial the numbers that follow until a "T" is encountered. Affects current and subsequent dialling. Some countries prevent changing of dialling modes after the first digit is dialled.
- T Select tone dialling: tone dial the numbers that follow until a "P" is encountered. Affects current and subsequent dialling. Some countries prevent changing of dialling modes after the first digit is dialled.
- R This command will be accepted, but not acted on.
- S=n Dial the number stored in the directory (n = 0 to 3 or 0 to 19 depending on the modem model). (See &Z.)
- ! Flash: the modem will go on-hook for a time defined by the value of S29. Country requirements may limit the time imposed.
- W Wait for dial tone: the modem will wait for dial tone before dialling the digits following "W". If dial tone is not detected within the time specified by S6 the modem will abort the rest of the sequence, return on-hook, and generate an error message.
- @ Wait for silence: the modem will wait for at least 5 seconds of silence in the call progress frequency band before continuing with the next dial string parameter. If the modem does not detect these 5 seconds of silence before the expiration of the call abort timer (S7), the modem will terminate the call attempt with a NO ANSWER message. If busy detection is enabled, the modem may terminate the call with the BUSY result code. If answer tone arrives during execution of this parameter, the modem handshakes.

- & Wait for credit card dialling tone before continuing with the dial string. If bong is not detected within the time specified by S6, the modem will abort the rest of the sequence, return on-hook, and generate an error message.
- , Dial pause: the modem will pause for a time specified by S8 before dialling the digits following ",".
- ; Return to command state. Added to the end of a dial string, this causes the modem to return to the command state after it processes the portion of the dial string preceding the ";". This allows the user to issue additional AT commands while remaining off-hook. The additional AT commands may be placed in the original command line following the ";" and/or may be entered on subsequent command lines. The modem will not enter call progress until an additional dial command is issued without the ";" terminator. Use "H" to abort the dial in progress, and go back on-hook.
- ^ Toggles calling tone enable/disable: applicable to current dial attempt only.
- () Ignored: may be used to format the dial string.
- Ignored: may be used to format the dial string.
- <space> Ignored: may be used to format the dial string.
- <i> Invalid character: will be ignored.
- > If enabled by country-specific parameter, the modem will generate a grounding pulse on the EARTH relay output.

## En - Command Echo

The modem enables or disables the echo of characters to the DTE according to the parameter supplied. The parameter value, if valid, is written to S14 bit 1.

E0 Disables command echo. (Default.)

E1 Enables command echo.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

## **Fn - Select Line Modulation**

This command selects the line modulation according to the parameter supplied. The line modulation is fixed unless Automode is selected. This command interacts with the S37 and the N command. The parameter value, if valid, is written to S37 bits 0-4. To select line modulation, it is recommended that either the F command, or a combination of the S37 and the N command, be used, but not both.

- F0 Selects auto-detect mode. Sets N1 and sets S31 bit 1. In this mode, the modem configures for Automode operation. All connect speeds supported by the modem are possible according to the remote modem's preference. The contents of S37 are ignored as is the sensed DTE speed.
- F1 Selects V.21 or Bell 103 according to the B setting as the only acceptable line speed resulting in a subsequent connection. Sets N0, sets S37 to 1, and clears S31 bit 1. This command is equivalent to the command string: ATN0S37=1.
- F2 Not supported.
- F3 Selects V.23 as the only acceptable line modulation for a subsequent connection. Originator is at 75 bps and answer is at 1200 bps. Sets N0, sets S37 to 7, and clears S31 bit 1. This command is equivalent to the command string: ATN0S37=7.
- F4 Selects V.22 1200 or Bell 212A according to the B command setting as the only acceptable line speed for a subsequent connection. Sets N0, sets S37 to 5, and clears S31 bit 1. This command is equivalent to the command string: ATN0S37=5.
- F5 Selects V.22 bis as the only acceptable line modulation for a subsequent connection. Sets N0, sets S37 to 6, and clears S31 bit 1. This command is equivalent to the command string: ATN0S37=6.
- F6 Select V.32 bis 4800 or V.32 4800 as the only acceptable line modulation for a subsequent connection. Sets N0, sets S37 to 8, and clears S31 bit 1. This command is equivalent to the command string: ATN0S37=8.
- F7 Selects V.32 bis 7200 as the only acceptable line modulation for a subsequent connection. Sets N0, sets S37 to 12, and clears S31 bit 1. This command is equivalent to the command string: ATN0S37=12.  

This setting also allows connection at the Rockwell proprietary 7200 V.32 speed, e.g., with an RC9696/12-based modem.
- F8 Selects V.32 bis 9600 or V.32 9600 as the only acceptable line modulations for a subsequent connection. Sets N0, sets S37 to 9, and clears S31 bit 1. This command is equivalent to the command string: ATN0S37=9.
- F9 Selects V.32 bis 12000 as the only acceptable line modulation for a subsequent connection. Sets N0, sets S37 to 10, and clears S31 bit 1. This command is equivalent to the command string: ATN0S37=10.  

This setting also allows connection at the Rockwell proprietary 12000 V.32 speed, e.g., with an RC9696/12-based modem.
- F10 Selects V.32 bis 14400 as the only acceptable line modulation for a subsequent connection. Sets N0, sets S37 to 11, and clears S31 bit 1. This command is equivalent to the command string: ATN0S37=11.

## **Hn - Disconnect (Hang-Up)**

This command initiates a hang up sequence.

This command may not be available for some countries due to PTT restrictions.

H0 The modem will release the line if the modem is currently on-line, and will terminate any test (AT&T) that is in progress. Country-specific, modulation specific, and error correction protocol specific (S38) processing is handled outside of the H0 command.

H1 If on-hook, the modem will go off-hook and enter command mode. The modem will return on-hook after a period of time determined by S7.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

## **In - Identification**

The modem reports to the DTE the requested result according to the command parameter.

I0 Reports product code (e.g., "1MRSxxxxxx").

I1 Reports a precomputed checksum .

I2 Reports program compilation date.

I3 Reports firmware revision.

I4 Reports copyright notice.

I5 Reports Country Code parameter .

I6 Reports modem data pump model and internal code revision.

Result Codes:

OK n = 0 to 6.

ERROR Otherwise.

## **Ln - Speaker Volume**

The modem sets the speaker volume control according to the parameter supplied. The parameter value, if valid, is written to S22 bits 0 and 1.

L0 Low volume.

L1 Low volume. (Default.)

L2 Medium volume.

L3 High volume.

Result Codes:

OK n = 0 to 3.

ERROR Otherwise.

## **Mn - Speaker Control**

This command selects when the speaker will be on or off. The parameter value, if valid, is written to S22 bits 2 and 3.

M0 Speaker is always off.

M1 Speaker is on during call establishment, but off when receiving carrier. (Default.)

M2 Speaker is always on.

M3 Speaker is off when receiving carrier and during dialling, but on during answering.

Result Codes:

OK n = 0 to 3.

ERROR Otherwise.

## **Nn - Automode Enable**

This command enables or disables Automode detection. The parameter value, if valid, is written to S31 bit 1.

- N0 Automode detection is disabled. A subsequent handshake will be conducted according to the contents of S37 or, if S37 is zero, according to the most recently sensed DTE speed.
- N1 Automode detection is enabled. A subsequent handshake will be conducted according to the Automode algorithm supported by the modem. This command is equivalent to F0. (Default.)

Result Codes:

- OK n = 0 or 1.
- ERROR Otherwise.

## **On - Return to On-Line Data Mode**

This command determines how the modem will enter the on-line data mode. If the modem is in the on-line command mode, the modem enters the on-line data mode with or without a retrain. If the modem is in the off-line command mode (no connection), ERROR is reported.

- O0 Enters on-line data mode without a retrain. Handling is determined by the Call Establishment task. Generally, if a connection exists, this command connects the DTE back to the remote modem after an escape (+++).
- O1 Enters on-line data mode with a retrain before returning to on-line data mode.

Result Codes:

- OK n = 0 or 1 and a connection exists.
- ERROR Otherwise or if not connected.

## **P - Set Pulse Dial Default**

This command forces pulse dialling until the next T dial modifier or T command is received. Sets S14 bit 5.

As soon as a dial command is executed which explicitly specifies the dialling mode for that particular call (e.g., ATDT...), this command is overridden so that all future dialling will be tone dialled. (See T command.)

This command may not be permitted in some countries.

Result Code:

OK

## **Qn - Quiet Results Codes Control**

The command enables or disables the sending of result codes to the DTE according to the parameter supplied. The parameter value, if valid, is written to S14 bit 2.

- Q0 Enables result codes to the DTE. (Default.)
- Q1 Disables result codes to the DTE.

Result Codes:

- OK n = 0 or 1.
- ERROR Otherwise.

## **Sn - Read/Write S register**

The modem selects an S register, performs an S register read or write function, or reports the value of an S register.

- n Establishes S register n as the last register accessed.
- n=v Sets S register n to the value v.
- n? Reports the value of S register n.

The parameter n can be omitted, in which case the last S register accessed will be assumed. The S can be omitted for AT= and AT?, in which case the last S register accessed will be assumed.

For example:

ATS7 establishes S7 as the last accessed register.

AT = 40 sets the contents of the last register accessed to 40.

ATS = 20 sets the contents of the last register accessed to 20.

If the number "n" is beyond the range of the S registers available, the modem will return the ERROR message. If the result is outside the range permitted for a given S register the values will still be stored, but functionally the lower and higher limits will be observed. Input and output are always in decimal format. Note that some S registers are read-only. In some cases, writing to the S register will appear to be accepted but the value will not actually be written.

Due to country restrictions, some commands will be accepted, but the value may be limited and replaced by a maximum or minimum value.

Minimum, maximum, and default values for S registers may be altered.

## **T - Set Tone Dial Default**

This command forces DTMF dialling until the next P dial modifier or P command is received. The modem will set an S register bit to indicate that all subsequent dialling should be conducted in tone mode. Note that the DP command will override this command. Clears S14 bit 5.

This command may not be permitted in some countries. (See P.)

Result Code:

OK

## **Vn - Result Code Form**

This command selects the sending of short-form or long-form result codes to the DTE. The parameter, if valid, is written to S14 bit 3.

V0 Enables short-form (terse) result codes. Line feed is not issued before a short-form result code. (Default.)

V1 Enables long-form (verbose) result codes.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

## Wn - Connect Message Control

This command controls the format of CONNECT messages. The parameter value, if valid, is written to S31 bits 2 and 3. Note that the Wn command can be overridden by register S95 bits (see S95 description).

- W0 Upon connection, the modem reports only the DTE speed (e.g., CONNECT 19200). Subsequent responses are disabled. (Default.)
- W1 Upon connection, the modem reports the line speed, the error correction protocol, and the DTE speed, respectively. Subsequent responses are disabled.
- W2 Upon connection, the modem reports the DCE speed (e.g., CONNECT 14400). Subsequent responses are disabled.

Result Codes:

- OK n = 0, 1, or 2.
- ERROR Otherwise.

## Xn - Extended Result Codes:

This command selects which subset of the result messages will be used by the modem to inform the DTE of the results of commands.

Blind dialling is enabled or disabled by country parameters. If the user wishes to enforce dial tone detection, a "W" can be placed in the dial string (see D command). Note that the information below is based upon the default implementation of the X results table. Table 3-1 indicates the messages which are enabled for each X value.

- X0 Disables monitoring of busy tones unless forced otherwise by country requirements; send only OK, CONNECT, RING, NO CARRIER, ERROR, and NO ANSWER result codes. Blind dialling is enabled/disabled by country parameters. If busy tone detection is enforced and busy tone is detected, NO CARRIER will be reported. If dial tone detection is enforced or selected and dial tone is not detected, NO CARRIER will be reported instead of NO DIAL TONE. The value 000b is written to S22 bits 6, 5, and 4, respectively.
- X1 Disables monitoring of busy tones unless forced otherwise by country requirements; send only OK, CONNECT, RING, NO CARRIER, ERROR, NO ANSWER, and CONNECT XXXX (XXXX = rate). Blind dialling enabled/disabled by country parameters. If busy tone detection is enforced and busy tone is detected, NO CARRIER will be reported instead of BUSY. If dial tone detection is enforced or selected and dial tone is not detected, NO CARRIER will be reported instead of NO DIAL TONE. The value 100b is written to S22 bits 6, 5, and 4, respectively.
- X2 Disables monitoring of busy tones unless forced otherwise by country requirements; send only OK, CONNECT, RING, NO CARRIER, ERROR, NO DIAL TONE, NO ANSWER, and CONNECT XXXX. If busy tone detection is enforced and busy tone is detected, NO CARRIER will be reported instead of BUSY. If dial tone detection is enforced or selected and dial tone is not detected, NO DIAL TONE will be reported instead of NO CARRIER. The value 101b is written to S22 bits 6, 5, and 4, respectively.
- X3 Enables monitoring of busy tones; sends only OK, CONNECT, RING, NO CARRIER, ERROR, NO ANSWER, and CONNECT XXXX. Blind dialling is enabled/disabled by country parameters. If dial tone detection is enforced and dial tone is not detected, NO CARRIER will be reported. The value 110b is written to S22 bits 6, 5, and 4, respectively.
- X4 Enables monitoring of busy tones; sends all messages. The value 111b is written to S22 bits 6, 5, and 4, respectively. (Default.)

Result Codes:

- OK n = 0 to 4.
- ERROR Otherwise.



**Table 3-1. Result Codes**

Short Form	Long Form	n Value in ATXn Command				
		0	1	2	3	4
0	OK	x	x	x	x	x
1	CONNECT	x	x	x	x	x
2	RING	x	x	x	x	x
3	NO CARRIER	x	x	x	x	x
4	ERROR	x	x	x	x	x
5	CONNECT 1200	1	x	x	x	x
6	NO DIALTONE	3	3	x	x	x
7	BUSY	3	3	3	x	x
8	NO ANSWER	x	x	x	x	x
9	CONNECT 0600	1	x	x	x	x
10	CONNECT 2400	1	x	x	x	x
11	CONNECT 4800	1	x	x	x	x
12	CONNECT 9600	1	x	x	x	x
13	CONNECT 7200	1	x	x	x	x
14	CONNECT 12000	1	x	x	x	x
15	CONNECT 14400	1	x	x	x	x
16	CONNECT 19200	1	x	x	x	x
17	CONNECT 38400	1	x	x	x	x
18	CONNECT 57600	1	x	x	x	x
22	CONNECT 75TX/1200RX	1	x	x	x	x
23	CONNECT 1200TX/75RX	1	x	x	x	x
24	DELAYED	4	4	4	4	x
32	BLACKLISTED	4	4	4	4	x
40	CARRIER 300	x	x	x	x	x
44	CARRIER 1200/75	x	x	x	x	x
45	CARRIER 75/1200	x	x	x	x	x
46	CARRIER 1200	x	x	x	x	x
47	CARRIER 2400	x	x	x	x	x
48	CARRIER 4800	x	x	x	x	x
49	CARRIER 7200	x	x	x	x	x
50	CARRIER 9600	x	x	x	x	x
51	CARRIER 12000	x	x	x	x	x
52	CARRIER 14400	x	x	x	x	x
66	COMPRESSION: CLASS 5	x	x	x	x	x
67	COMPRESSION: V.42 bis	x	x	x	x	x
69	COMPRESSION: NONE	x	x	x	x	x
76	PROTOCOL: NONE	x	x	x	x	x
77	PROTOCOL: LAPM	x	x	x	x	x
80	PROTOCOL: ALT	x	x	x	x	x

*Note: An 'x' in a column indicates that the message (either the long form if verbose, or the value only for short form) will be generated when that particular value of 'n' (shown at the top of the column) has been selected by the use of ATXn. If the column is blank, then no message will be generated for that X option. A numeral indicates which less explicit message (verbose or short form) will be output for that X option. (Also, see Section 3.3).*

## Yn - Long Space Disconnect

This command enables/disables the generation and response to long space disconnect. The parameter value, if valid, is written to S21 bit 7.

Y0 Disables long space disconnect. (default.)

Y1 Enables long space disconnect. In non-error correction mode, the modem will send a long space of four seconds prior to going on-hook. In error correction mode, the modem will respond to the receipt of a long space (i.e., a break signal greater than 1.6 seconds) by going on-hook.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

## Zn - Soft Reset and Restore Profile

The modem performs a soft reset and restores (recalls) the configuration profile according to the parameter supplied. If no parameter is specified, zero is assumed.

Z0 Soft reset and restore stored profile 0.

Z1 Soft reset and restore stored profile 1.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

### 3.4.1

## AT& Commands

### &An - Dial Abort Option

The modem normally aborts the connection negotiation if a character is received from DTE during the connection phase. This command gives the user the option to let the modem ignore incoming characters. The parameter value, if valid, is written to S22 bit 7.

&A0 Enable abort. (Default.)

&A1 Disable abort.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

### &Bn - DTR Dial Option

This command interprets the OFF to ON transition of the DTR signal from the DTE to enable the modem to dial the telephone number stored with AT&Z0=..... The parameter value, if valid, is written to S27 bits 7.

&B0 No action. (Default.)

&B1 Dial on OFF to ON transition of the DTR signal.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

### &Cn - DCD Option

The modem controls the DCD output in accordance with the parameter supplied. The parameter value, if valid, is written to S21 bit 5.

&C0 DCD remains ON at all times. (Default.)

&C1 DCD follows the state of the carrier.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

## **&Dn - DTR Option**

This command interprets the ON to OFF transition of the DTR signal from the DTE in accordance with the parameter supplied. The parameter value, if valid, is written to S21 bits 3 and 4.

&D0 - DTR drop is interpreted according to the current &Q setting as follows: (Default.)  
&Q0, &Q5, &Q6 DTR is ignored (assumed ON). Allows operation with DTEs which do not provide DTR.

&Q4 DTR drop causes the modem to hang up. Auto-answer is not affected.

&D1 DTR drop is interpreted by the modem as if the asynchronous escape sequence had been entered. The modem returns to command state without disconnecting

&D2 DTR drop causes the modem to hang up. Auto-answer is inhibited.

&D3 DTR drop causes the modem to perform a soft reset as if the Z command were received. The &Y setting determines which profile is loaded.

## **&En - Radio Subcarrier Option**

When this command is activated. The parameter value, if valid, is written to S16 bits 7.

&E0 No action. (Default.)

&E1 Transmission is not granted if radio subcarrier is active. Transmitter relay active

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

## **&Fn - Restore Factory Configuration (Profile)**

The modem loads the factory default configuration (profile). The factory defaults are identified for each command and in the S register descriptions. A configuration (profile) consists of a subset of S registers.

&F0 Restore factory configuration 0.

&F1 Restore factory configuration 1.

Result Codes:

OK

ERROR If the modem is connected.

## **&Gn - Select Guard Tone**

The modem generates the guard tone selected by this command according to the parameter supplied (DPSK modulation modes only). The parameter value, if valid, is written to S23 bits 6 and 7.

&G0 Disables guard tone. (Default.)

&G1 Disables guard tone.

&G2 Selects 1800 Hz guard tone.

This command may not be permitted in some countries.

Result Codes:

OK n = 0 to 2.

ERROR Otherwise.

## **&Hn - 2-Wire / 4-Wire Control**

This command selects 2 or 4-wire line connection. The parameter value, if valid, is written to S14 bit 6.

&H0 2-wire. (Default.)

&H1 4-wire.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

## **&Jn - Telephone Jack Control**

This command selects telephone jack or screw connector as the active line connection. The parameter value, if valid, is written to S21 bit 1.

&J0 Telephone jack. (Default.)

&J1 Screw connector.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

## **&Kn - Flow Control**

This command defines the DTE/DCE (terminal/modem) flow control mechanism. The parameter value, if valid, is written to S39 bits 0, 1, and 2.

&K0 Disables flow control.

&K3 Enables RTS/CTS flow control. (Default for data modem modes.)

&K4 Enables XON/XOFF flow control.

&K5 Enables transparent XON/XOFF flow control.

&K6 Enables both RTS/CTS and XON/XOFF flow control.

Result Codes:

OK n = 0, 3, 4, 5, or 6.

ERROR Otherwise.

## **&Pn - Select Pulse Dial Make/Break Ratio**

This command determines the make/break ratio used during pulse dialling. It will override the make/break ratios in the OEM parameters. The default is country-dependent. The parameter value, if valid, is written to S28 bits 3 and 4.

&P0 Selects 39%-61% make/break ratio at 10 pulses per second. (Default.)

&P1 Selects 33%-67% make/break ratio at 10 pulses per second.

&P2 Selects 39%-61% make/break ratio at 20 pulses per second.

&P3 Selects 33%-67% make/break ratio at 20 pulses per second.

Result Codes:

OK n = 0 to 3.

ERROR Otherwise.

## &Qn - Async Mode

This command is used to control the connection modes permitted. It is used in conjunction with S36 and S48. (Also, see \N.)

*NOTE: When the &Q0 to &Q4 command is issued to select the mode, the subsequent connect message will report the DCE speed regardless of the W command and S95 settings.*

**&Q0** Selects direct asynchronous operation. The value 000b is written to S27 bits 3, 1, and 0, respectively.

**&Q4** Selects AutoSync operation. The value 100b is written to S27 bits 3, 1, and 0, respectively.

AutoSync operation, when used in conjunction with the Hayes Synchronous Interface (HSI) capability in the DTE, provides synchronous communication capability from an asynchronous terminal.

Starting AutoSync. Set registers S19, S20, and S25 to the desired values before selecting AutoSync operation with &Q4. After the CONNECT message is issued, the modem waits the period of time specified by S25 before examining DTR. If DTR is on, the modem enters the synchronous operating state; if DTR is off, the modem terminates the line connection and returns to the command state.

Stopping AutoSync. AutoSync operation is stopped upon loss of carrier or the on-to-off transition of DTR. Loss of carrier will cause the modem to return to the command state. An on-to-off transition of DTR will cause the modem to return to the command state and either not terminate the line connection (&D1 active) or terminate the line connection (any other &Dn command active).

**&Q5** The modem will try to negotiate an error-corrected link. The modem can be configured using S36 to determine whether a failure will result in the modem returning on-hook or will result in fallback to an connection. The value 101b is written to S27 bits 3, 1, and 0, respectively. (Default.)

**&Q6** Selects asynchronous operation in normal mode (speed buffering). The value 110b is written to S27 bits 3, 1, and 0, respectively.

Result Codes:

OK n = 0, 4 to 6.

ERROR Otherwise.

## &Rn - RTS/CTS Option

This selects how the modem controls CTS. CTS operation is modified if hardware flow control is selected (see &K command). The parameter value, if valid, is written to S21 bit 2.

**&R0** CTS acts according to V.25 bis handshake.

**&R1** CTS will only drop if required by flow control. (Default.)

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

## &Sn - DSR Override

This command selects how the modem will control DSR. The parameter value, if valid, is written to S21 bit 6.

**&S0** DSR will remain ON at all times. (Default.)

**&S1** DSR will become active after answer tone has been detected and inactive after the carrier has been lost.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

## &Tn - Test and Diagnostics

The modem will perform selected test and diagnostic functions according to the parameter supplied. A test can be run only when in an asynchronous operation in non-error-correction mode (normal or direct mode). To terminate a test in progress, the escape sequence must be entered first, except for parameters 7 and 8 (see Section 3.1.3). If S18 is non-zero, a test will terminate automatically after the time specified by S18 and display the OK message.

- &T0 Terminates test in progress. Clears S16.
- &T1 Initiates local analog loopback, V.54 Loop 3. Sets S16 bit 0. If a connection exists when this command is issued, the modem hangs up. The CONNECT XXXX message is displayed upon the start of the test.
- &T2 Returns ERROR.
- &T3 Initiates local digital loopback, V.54 Loop 2. Sets S16 bit 2. If no connection exists, ERROR is returned. Sets S16 bit 4 when the test is in progress.
- &T4 Enables digital loopback acknowledgement for remote request, i.e., an RDL request from a remote modem is allowed. Sets S23 bit 0. (Default.)
- &T5 Disables digital loopback acknowledgement for remote request, i.e., an RDL request from a remote modem is denied. Clears S23 bit 0.
- &T6 Requests a remote digital loopback (RDL), V.54 Loop 2, without self-test. If no connection exists, ERROR is returned. Sets S16 bit 4 when the test is in progress. The CONNECT XXXX message is displayed upon the start of the test.
- &T7 Requests a remote digital loopback (RDL), V.54 Loop 2, with self-test. (In self-test, a test pattern is looped back and checked by the modem.) If no connection exists, ERROR is returned. When the test is terminated either via expiration of S18, or via the &T0 or H command, the number of detected errors is reported to the DTE. Sets S16 bit 5 when the test is in progress.
- &T8 Initiates local analog loopback, V.54 Loop 3, with self-test. (In self-test, a test pattern is looped back and checked by the modem.) If a connection exists, the modem hangs up before the test is initiated. When the test is terminated either via expiration of S18, or via the &T0 or H command, the number of detected errors is reported to the DTE. Sets S16 bit 6 when the test is in progress. This command may not be available in some countries due to PTT restrictions.

## **&V - Display Current Configuration and Stored Profiles**

Reports the current (active) configuration, the stored (user) profiles, and the first four stored telephone numbers. The stored profiles and telephone numbers are not displayed if the NVRAM is not installed or is not operational as detected by the NVRAM test during reset processing.

Result Code:

OK

Example:

AT&V

ACTIVE PROFILE:

B0 E1 L1 M1 N1 QO T V1 W0 X4 Y0 &C0 &D0 &G2 &J0 &K3 &Q5 &R1 &S0 &T4  
&X0 &Y0

S00:002 S01:000 S02:043 S03:013 S04:010 S05:008 S06:002 S07:030 S08:002 S09:006  
S10:014 S11:255 S12:050 S18:000 S25:005 S26:001 S36:007 S37:000 S38:020 S46:138  
S48:007 S95:000

STORED PROFILE 0:

B0 E1 L1 M1 N1 QO T V1 W0 X4 Y0 &C0 &D0 &G2 &J0 &K3 &Q5 &R1 &S0 &T4  
&X0

S00:002 S02:043 S06:002 S07:030 S08:002 S09:006 S10:014 S11:095 S12:050 S18:000  
S36:007 S37:000 S40:105 S41:003 S46:138 S95:000

STORED PROFILE 1:

B0 E1 L1 M1 N1 QO T V1 W0 X4 Y0 &C0 &D0 &G2 &J0 &K3 &Q5 &R1 &S0 &T4  
&X0

S00:002 S02:043 S06:002 S07:030 S08:002 S09:006 S10:014 S11:095 S12:050 S18:000  
S36:007 S37:000 S40:105 S41:003 S46:138 S95:000

TELEPHONE NUMBERS:

0 = 1 =

2 = 3 =

OK

If the NVRAM is not installed or is not operational as detected by the NVRAM test, the following message is displayed:

NVRAM FAILED OR NOT INSTALLED

## **&Wn - Store Current Configuration**

Saves the current (active) configuration (profile), including S registers, in one of the two user profiles in NVRAM as denoted by the parameter value. This command will yield an ERROR message if the NVRAM is not installed or is not operational as detected by the NVRAM test.

The current configuration is comprised of a list of storable parameters illustrated in the &V command. These settings are restored to the active configuration upon receiving an Zn command or at power up (see &Yn command).

&W0 Store the current configuration as profile 0.

&W1 Store the current configuration as profile 1.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

## **&Yn - Designate a Default Reset Profile**

Selects which user profile will be used after a hard reset.

&Y0 The modem will use profile 0.

&Y1 The modem will use profile 1.

Result Codes:

n = 0 to 1.

ERROR If n > 1, or if NVRAM is not installed or is not operational.

## **&Zn=x - Store Telephone Number**

The modem can store up to 4 or 20 (model dependent) telephone numbers and each telephone number dial string can contain up to 35 digits.

&Zn=x n = 0 to 3 (modem dependent) and x = dial string. (Requires 256-byte NVRAM.)

&Zn=x n = 0 to 19 (modem dependent) and x = dial string. (Requires 2048-byte NVRAM.)

Result Codes:

OK For n + 3 or + 19 (model dependent), and x + 35 digits.

ERROR If n > 3 or > 19 (model dependent), or x > 35 digits, or if NVRAM is not installed or is not operational.

### **3.4.2**

## **AT% Commands**

### **%En - Enable/Disable Line Quality Monitor and Auto-Retrain or Fallback/Fall Forward**

Controls whether or not the modem will automatically monitor the line quality and request a retrain (%E1) or fall back when line quality is insufficient or fall forward when line quality is sufficient (%E2). The parameter value, if valid, is written to S41 bits 2 and 6.

If enabled, the modem attempts to retrain for a maximum of 30 seconds.

%E0 Disable line quality monitor and auto-retrain.

%E1 Enable line quality monitor and auto-retrain.

%E2 Enable line quality monitor and fallback/fall forward. (Default.)

Result Codes:

OK n = 0, 1, or 2.

ERROR Otherwise.

Fallback/Fall Forward. When %E2 is active, the modem monitors the line quality (EQM). When line quality is insufficient, the modem will initiate a rate renegotiation to a lower speed within the V.32 bis/V.32 modulation speeds. The modem will keep falling back if necessary until the speed reaches 4800 bps. Below this rate, the modem will only do re-trains if EQM thresholds are exceeded. If the EQM is sufficient for at least one minute, the modem will initiate a rate renegotiation to a higher speed within the V.32/V.32 bis modulation speeds. The rate renegotiations will be done without a retrain if a V.32 bis connection is established.

Speeds attempted during fallback/fall forward are those shown to be available in the rate sequences exchanged during the initial connection. Fallback/fall forward is available in error correction and normal modes.



## **%F - V.23 operation mode**

This command sets V.23 operation mode .

%F1 75tx/1200rx.

%F2 1200tx/75rx. (Default.)

%F3 1200tx/1200rx half duplex. The carrier is controlled by the lt.)

Result Codes:

OK n = 0, 1, or 2.

ERROR Otherwise.

## **%L - Line Signal Level**

Returns a value which indicates the received signal level. The value returned is a direct indication (DAA dependent) of the receive level at the MDP, **not** at the telephone line connector. For example, 009 = -9 dBm, 043 = -43 dBm, and so on.

Result Codes:

OK

## **%Q - Line Signal Quality**

Reports the line signal quality (DAA dependent). Returns the higher order byte of the EQM value. Based on the EQM value, retrain or fallback/fall forward may be initiated if enabled by %E1 or %E2. A low value is good.

Example:

```
AT%Q
```

```
015
```

Result Codes:

OK If connected.

ERROR If not connected, or connected in 300 bps or V.23 modes.

## %T - PTT Testing Utilities

Facilitates PTT testing of signal levels by providing continuous signals regardless of whether the modem is connected or not. The signal transmitted is in accordance with the parameter provided.

This is a range of commands that allow the user to initiate a series of signals that are necessary for PTT approval. The signals emitted include answer tone, modulation, carriers, and other pertinent signals. A test is initiated upon receipt of a %TTn (the second T is a password and n is a test number), and the test is aborted when any keyboard character is entered. The modem will continuously transmit the tone or carrier according to the parameter supplied.

%TT00-%TT09	DTMF tone dial digits 0 to 9.
%TT0A	DTMF digit *.
%TT0B	DTMF digit #.
%TT0C	DTMF digit A.
%TT0D	DTMF digit B.
%TT0E	DTMF digit C.
%TT0F	DTMF digit D.
%TT10	V.21 channel 1 mark (originate) symbol.
%TT11	V.21 channel 2 mark symbol.
%TT12	V.23 backward channel mark symbol.
%TT13	V.23 forward channel mark symbol.
%TT15	V.22 originate (call mark) signalling at 1200 bps.
%TT16	V.22 bis originate (call mark) signalling at 2400 bps.
%TT17	V.22 answer signalling (guard tone if PTT required).
%TT18	V.22 bis answer signalling (guard tone if required).
%TT19	V.21 channel 1 space symbol.
%TT1A	V.21 channel 2 space symbol.
%TT1B	V.23 backward channel space symbol.
%TT1C	V.23 forward channel space symbol.
%TT20	V.32 9600 bps.
%TT21	V.32 bis 14400 bps.
%TT30	Silence (on-line), i.e., go off-hook.
%TT31	V.25 answer tone.
%TT32	1800 Hz guard tone.
%TT33	V.25 calling tone (1300 Hz).
%TT34	Fax calling tone (1100 Hz).
%TT40	V.21 channel 2
%TT41	V.27 ter 2400 bps
%TT42	V.27 ter 4800 bps
%TT43	V.29 7200 bps
%TT44	V.29 9600 bps
%TT45	V.17 7200 bps long train
%TT46	V.17 7200 bps short train
%TT47	V.17 9600 bps long train
%TT48	V.17 9600 bps short train
%TT49	V.17 12000 bps long train
%TT4A	V.17 12000 bps short train
%TT4B	V.17 14400 bps long train
%TT4C	V.17 14400 bps short train

**AT\ Commands****\Gn - Modem-to-Modem Flow Control (XON/XOFF)**

In non-error correction mode, the modem enables or disables the generation or recognition of modem-to-modem XON/XOFF flow control according to the parameter supplied. The parameter value, if valid, is written to S41 bit 3.

In error correction mode, the setting of modem-to-modem XON/XOFF flow control is ignored. However, the serial port flow control settings (AT&K) remain active during a reliable link.

Due to the buffering system used in the modem, modem-to-modem flow control is normally disabled.

\G0 Disables modem-to-modem XON/XOFF flow control. (Default.)

\G1 Enables modem-to-modem XON/XOFF flow control.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

**\Kn - Break Control**

Controls the response of the modem to a break received from the DTE or the remote modem or the \B command according to the parameter supplied. The parameter value, if valid, is written to S40 bits 3, 4, and 5.

The response is different in three separate states.

The first state is where the modem receives a break from the DTE when the modem is operating in data transfer mode:

\K0 Enter on-line command mode, no break sent to the remote modem.

\K1 Clear data buffers and send break to remote modem.

\K2 Same as 0.

\K3 Send break to remote modem immediately.

\K4 Same as 0.

\K5 Send break to remote modem in sequence with transmitted data. (Default.)

The second case is where the modem is in the on-line command state (waiting for AT commands) during a data connection, and the \B is received in order to send a break to the remote modem:

\K0 Clear data buffers and send break to remote modem.

\K1 Clear data buffers and send break to remote modem. (Same as 0.)

\K2 Send break to remote modem immediately.

\K3 Send break to remote modem immediately. (Same as 2.)

\K4 Send break to remote modem in sequence with data.

\K5 Send break to remote modem in sequence with data. (Same as 4.) (Default.)

The third case is where a break is received from a remote modem during a non-error corrected connection:

\K0 Clears data buffers and sends break to the DTE.

\K1 Clears data buffers and sends break to the DTE. (Same as 0.)

\K2 Send a break immediately to DTE.

\K3 Send a break immediately to DTE. (Same as 2.)

\K4 Send a break in sequence with received data to DTE.

\K5 Send a break in sequence with received data to DTE. (Same as 4.) (Default.)

Result Codes:

OK n = 0 to 5.

ERROR Otherwise.

## **\Nn - Operating Mode**

This command controls the preferred error correcting mode to be negotiated in a subsequent data connection. This command is affected by the OEM firmware configuration.

- \N0 Selects normal speed buffered mode (disables error-correction mode). (Forces &Q6.)
- \N1 Serial interface selected - Selects direct mode and is equivalent to &Q0 mode of operation. (Forces &Q0.)  
Parallel interface selected - Same as \N0.
- \N2 Selects reliable (error-correction) mode. The modem will first attempt an LAPM connection and then an MNP connection. Failure to make a reliable connection results in the modem hanging up. (Forces &Q5, S36=4, and S48=7.)
- \N3 Selects auto reliable mode. This operates in the same way as \N2 except the failure to make a reliable connection results in the modem falling back to the speed buffered normal mode. (Forces &Q5, S36=7, and S48=7.)
- \N4 Selects LAPM error-correction mode. Failure to make an LAPM error-correction connection results in the modem hanging up. (Forces &Q5 and S48=0.) Note: The -K1 command can override the \N4 command.
- \N5 Selects MNP error-correction mode. Failure to make an MNP error-correction connection results in the modem hanging up. (Forces &Q5, S36=4, and S48=128.)

Result Codes:

OK n = 0 to 5.

ERROR Otherwise.

## **\S - Display Current Configuration**

Reports a part of the current (active) configuration in a user-friendly manner

Result Code:

OK

## 3.5

## Error detection and data compression commands

### 3.5.1

### AT% Commands

#### %C - Enable/Disable Data Compression

Enables or disables data compression negotiation. The modem can only perform data compression on an error-corrected link. The parameter value, if valid, is written to S41 bits 0 and 1.

%C0 Disables data compression. Resets S46 bit 1.

%C1 Enables MNP 5 data compression negotiation. Resets S46 bit 1.

%C2 Enables V.42 bis data compression. Sets S46 bit 1.

%C3 Enables both V.42 bis and MNP 5 data compression. Sets S46 bit 1. (Default.)

Result Codes:

OK n = 0, 1, 2, or 3.

ERROR Otherwise.

### 3.5.2

### AT\ Commands

#### \An - Select Maximum MNP Block Size

The modem will operate an MNP error-corrected link using a maximum block size controlled by the parameter supplied. The parameter value, if valid, is written to S40 bits 6 and 7.

\A0 64 characters.

\A1 128 characters. (Default.)

\A2 192 characters.

\A3 256 characters.

Result Codes:

OK n = 0 to 3.

ERROR Otherwise.

#### \Bn - Transmit Break to Remote

In non-error correction mode, the modem will transmit a break signal to the remote modem with a length in multiples of 100 ms according to the parameter specified. If a number in excess of 9 is entered, 9 is used. The command works in conjunction with the \K command.

In error correction mode, the modem will signal a break through the active error-correction protocol, giving no indication of the length.

\B1-\B9 Break length in 100 ms units. (Default = 3.) (Non-error corrected mode only.)

Result Codes:

OK If connected in data modem mode.

NO CARRIER If not connected.

*Note: When the modem receives a break from the remote modem, the break is passed to the DTE as follows: In non-error correction mode direct, the break length is passed; in non-error correction mode normal and in error correction mode, a 300 ms break is passed.*

## 3.6

## W-CLASS Commands

### 3.6.1

### AT\* Commands

#### \*B - Display Blacklisted Numbers

This command requests the modem to return a list of blacklisted numbers to the DTE. The format of the response is shown by the example below. Permanently forbidden numbers as defined by country requirements will not appear on this list. If no numbers are blacklisted, only the OK result code is issued.

Example:

NO. - PHONE NUMBER -

```
1; 4175537660
2; 8288924961
3; 3887278862
4; 3124839442
5; 6284664
```

OK

#### \*D - Display Delayed Numbers

This command causes the modem to send a list of the delayed numbers together with the delay associated with each. The modem will return a list of delayed telephone numbers as defined in the \*B command. The format of the response is shown by the example below (delay times are shown as hours:minutes:seconds). If no numbers are delayed, only the OK result code is issued.

Example:

NO. - PHONE NUMBER -DELAY

```
1; 8264734660 2:00:00
2; 7532634661 2:00:00
3; 2587334662 0:02:00
4; 7532651663 0:03:25
5; 7459931664 0:01:45
```

OK

## \*NCnn - Country Select

Up to 20 sets of country parameters may be stored in the EPROM. This command checks to see if the entered number matches the country code of one of the countries stored in the EPROM. If found, the modem stores the location of that country in NVRAM. Upon power up or a soft reset (Z command), the modem uses this location to load the parameters for the corresponding country. The default value of zero is used if no NVRAM is installed or the NVRAM failed the self-test during reset.

\*NCnn Select country parameters corresponding to entered country code (nn).

The country codes are:

Country	Code (nn)
Australia	40
Austria	1
Belgium	2
Bulgaria	27
Canada	20
Czech Republic	19
Denmark	3
Finland	4
France	5
Germany	6
Greece	17
Hungary	23
Ireland	7
Israel	18
Italy	8
Japan	43
Luxembourg	9
Mexico	21
Netherlands	10
New Zealand	48
Norway	11
Poland	24
Portugal	12
Russia	25
Singapore	47
Slovak Republic	26
Spain	13
Sweden	14
Switzerland	15
United Kingdom	16
United States	22

Result Codes:

OK If parameters corresponding to entered country code are present in EPROM.

ERROR Otherwise.

## Special commands

### &Cn - DCD Option

The modem controls the DCD output in accordance with the parameter supplied. The parameter value, if valid, is written to S21 bit 5.

&C0 DCD remains ON at all times. (Default.)

&C1 DCD follows the state of the carrier.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

### &En - Radio Subcarrier Option

When this command is activated, the parameter value, if valid, is written to S16 bits 7.

&E0 No action. (Default.)

&E1 Transmission is not granted if radio subcarrier is active.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

### &Hn - 2-Wire / 4-Wire Control

This command selects 2 or 4-wire line connection. The parameter value, if valid, is written to S21 bit 1.

&H0 2-wire. (Default.)

&H1 4-wire.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.

### &Jn - Telephone Jack Control

This command selects telephone jack or screw connector as the active line connection. The parameter value, if valid, is written S21 bit 1.

&J0 Telephone jack. (Default.)

&J1 Screw connector.

Result Codes:

OK n = 0 or 1.

ERROR Otherwise.



## AT Command Result Codes

The modem responds to commands from the DTE and to activity on the line by signalling to the DTE in the form of result codes. The result codes that the modem can send are described below.

Two forms of each result code are available: long-form, an English-like "verbose" response, and short-form, a data-like numeric response (included in parentheses following the long-form). The long-form code is preceded and terminated by the sequence < CR> < LF>. The short-form is terminated by < CR>, only with no preceding sequence.

If result messages are suppressed, nothing is returned to the DTE.

### 0- OK

The OK code is returned by the modem to acknowledge execution of a command line.

### 1- CONNECT

The modem will send this result code upon connecting when:

1. The line speed is 300 bps and the modem has been instructed to report the line speed to the DTE upon connecting, or
2. The DTE speed is 300 bps and the modem has been instructed to report the DTE speed to the DTE upon connecting, or
3. The range of result code responses is restricted by the X command in such a way that no speed reporting is allowed.

### 2- RING

The modem sends this result code when incoming ringing is detected on the line. What qualifies as a ring signal is determined by country-dependent parameters.

### 3- NO CARRIER

The modem sends this result code when attempting to establish a call if:

1. Ringback is detected and later ceases but no carrier is detected within the period of time determined by register S7, or
2. No ringback is detected within the period of time determined by register S7.

This result code is also used when the modem auto-disconnects due to loss of carrier.

Under X0, if busy tone detection is enforced, this result code is used as a response to the detection of busy or circuit busy. Under X0, if dial tone detection is enforced or selected, this result code is used to indicate that dial tone has not been detected.

### 4- ERROR

The modem returns this result code if the command line contains a syntax error or it is unable to execute a command contained in the command line. It is issued if a command does not exist or if the parameter supplied is outside the permitted range.

Under X0, X1, X2, and X3, this result code is used instead of DELAYED and BLACKLISTED.

### 5- CONNECT 1200

For X1, X2, XN.1, and X4, the modem sends this result code when:

1. The line speed is 1200 bps and the modem has been instructed to report the line speed to the DTE upon connecting, or
2. The DTE speed is 1200 bps and the modem has been instructed to report the DTE speed to the DTE upon connecting.

(Also, see the W command.)

## **6- NO DIALTONE**

For X2 and X4, the modem sends this result code if it has been instructed to wait for dial tone during dialling but none is received.

## **7- BUSY**

For X3 and X4, if busy tone detection is enforced, the modem sends this result code when attempting to originate a call if the busy (engaged) signal is detected on the line.

## **8- NO ANSWER**

The modem sends this result code when attempting to originate a call if a continuous ringback signal is detected on the line, until the expiration of the timer S7.

## **9- CONNECT 0600**

For X1, X2, X3, and X4, the modem sends this result code when:

1. The line speed is 600 bps and the modem has been instructed to report the line speed to the DTE upon connecting, or
2. The DTE speed is 600 bps and the modem has been instructed to report the DTE speed to the DTE upon connecting.

## **10- CONNECT 2400**

For X1, X2, X3, and X4, the modem sends this result code when:

1. The line speed is 2400 bps and the modem has been instructed to report the line speed to the DTE upon connecting, or
2. The DTE speed is 2400 bps and the modem has been instructed to report the DTE speed to the DTE upon connecting.

## **11- CONNECT 4800**

For X1, X2, X3, and X4, the modem sends this result code when:

1. The line speed is 4800 bps and the modem has been instructed to report the line speed to the DTE upon connecting, or
2. The DTE speed is 4800 bps and the modem has been instructed to report the DTE speed to the DTE upon connecting.

## **12- CONNECT 9600**

For X1, X2, X3, and X4, the modem sends this result code when:

1. The line speed is 9600 bps and the modem has been instructed to report the line speed to the DTE upon connecting, or
2. The DTE speed is 9600 bps and the modem has been instructed to report the DTE speed to the DTE upon connecting.

## **13- CONNECT 7200**

For X1, X2, X3, and X4, the modem sends this result code when:

1. The line speed is 7200 bps and the modem has been instructed to report the line speed to the DTE upon connecting, or
2. The DTE speed is 7200 bps and the modem has been instructed to report the DTE speed to the DTE upon connecting.

## **14- CONNECT 12000**

For X1, X2, X3, and X4, the modem sends this result code when:

1. The line speed is 12000 bps and the modem has been instructed to report the line speed to the DTE upon connecting, or
2. The DTE speed is 12000 bps and the modem has been instructed to report the DTE speed to the DTE upon connecting.

## **15- CONNECT 14400**

For X1, X2, X3, and X4, the modem sends this result code when:

1. The line speed is 14400 bps and the modem has been instructed to report the line speed to the DTE upon connecting, or
2. The DTE speed is 14400 bps and the modem has been instructed to report the DTE speed to the DTE upon connecting.

## **16- CONNECT 19200**

For X1, X2, X3, and X4, the modem returns this result code upon connecting when the DTE speed is 19200 bps and the modem has been instructed to report the DTE speed upon connecting.

## **17- CONNECT 38400**

For X1, X2, X3, and X4, the modem sends this result code upon connecting when the DTE speed is 38400 bps and the modem has been instructed to report the DTE speed to the DTE upon connecting.

## **18- CONNECT 57600**

For X1, X2, X3, and X4, the modem sends this result code upon connecting when the DTE speed is 57600 bps and the modem has been instructed to report the DTE speed to the DTE upon connecting.

## **19- CONNECT 115200**

For X1, X2, X3, and X4, the modem sends this result code upon connecting when the DTE speed is 115200 bps and the modem has been instructed to report the DTE speed to the DTE upon connecting.

## **22- CONNECT 75TX/1200RX**

For X1, X2, X3, and X4, the modem returns this result code upon establishing a V.23 originate connection when the modem has been instructed to report the DCE speed upon connection.

## **23- CONNECT 1200TX/75RX**

For X1, X2, X3, and X4, the modem returns this result code upon establishing a V.23 answer connection when the modem has been instructed to report the DCE speed upon connection.

## **24- DELAYED**

For X4, the modem returns this result code when a call fails to connect and the number dialled is considered 'delayed' due to country blacklisting requirements.

### **32- BLACKLISTED**

For X4, the modem returns this result code when a call fails to connect and the number dialled is considered 'blacklisted'.

### **40- CARRIER 300**

The modem returns this result code when a 0-300 bps data rate has been detected on the line and carrier reporting has been enabled. (See S95 and Xn.)

### **44- CARRIER 1200/75**

The modem sends this result code when the V.23 backward channel carrier has been detected on the line and carrier reporting has been enabled. (See S95 and Xn.)

### **45- CARRIER 75/1200**

The modem sends this result code when the V.23 forward channel carrier has been detected on the line and carrier reporting has been enabled. (See S95 and Xn.)

### **46- CARRIER 1200**

The modem sends this result code when a 1200 bps data rate has been detected on the line and carrier reporting has been enabled. (See S95 and Xn.)

### **47- CARRIER 2400**

The modem sends this result code when a 2400 bps data rate has been detected on the line and carrier reporting has been enabled. (See S95 and Xn.)

### **48- CARRIER 4800**

The modem sends this result code when a 4800 bps data rate has been detected on the line and carrier reporting has been enabled. (See S95 and Xn.)

### **49- CARRIER 7200**

The modem sends this result code when a 7200 bps data rate has been detected on the line and carrier reporting has been enabled. (See S95 and Xn.)

### **50- CARRIER 9600**

The modem sends this result code when a 9600 bps data rate has been detected on the line and carrier reporting has been enabled. (See S95 and Xn.)

### **51- CARRIER 12000**

The modem sends this result code when a 12000 bps data rate has been detected on the line and carrier reporting has been enabled. (See S95 and Xn.)

### **52- CARRIER 14400**

The modem sends this result code when a 14400 bps data rate has been detected on the line and carrier reporting has been enabled. (See S95 and Xn.)

**66- COMPRESSION: CLASS 5**

This message is sent to the DTE when the modem has connected in MNP Class 5 and COMPRESSION message reporting has been enabled. (See S95 and Xn.)

**67- COMPRESSION: V.42 bis**

This message is sent to the DTE when the modem has connected in V.42 bis and COMPRESSION message reporting has been enabled. (See S95 and Xn.)

**69- COMPRESSION: NONE**

This message is sent to the DTE when the modem has connected without data compression and COMPRESSION message reporting has been enabled. (See S95 and Xn.)

**70- PROTOCOL: NONE**

This message is sent to the DTE when the modem has connected without any form of error correction, and PROTOCOL message reporting has been enabled. (See S95 and Xn.)

**77- PROTOCOL: LAPM**

This message is sent to the DTE when the modem has connected in the V.42 LAPM mode of error correction, and PROTOCOL message reporting has been enabled. (See S95 and Xn.)

**80- PROTOCOL: ALT**

This message is sent to the DTE when the modem has connected in the MNP mode of error correction, and PROTOCOL message reporting has been enabled. (See S95 and Xn.)

## 3.9

### S Register

The S registers are summarised in Table 4-1 along with their default values. Registers denoted with an '\*' in Table 4-1 may be stored in one of the two user profiles by entering the &Wn command. One of these profiles may be loaded at any time by using the Zn command. Registers or register fields quoted as `reserved` are reserved for current or future use by the firmware, or are permanently overridden by PTT limitations. Call Progress and Blacklisting options.

All bit-mapped registers are read-only. The appropriate AT command which controls the relevant bits in the S register should be used to change the value.

#### 3.9.1

### Factory defaults

The factory default values are stored in ROM and are loaded into the active configuration at power up or by the ATZn command. In addition, the designated default profile is subsequently loaded, and may change some of the factory default values. The designated default profile can be changed by entering the &Yn command where n is one of the two possible user profiles.

The defaults shown are those used by Rockwell in factory profiles zero and one. These may be overwritten by the OEM prior to placing the firmware in PROM. Minimum and maximum values may also be imposed in response to country PTT requirements.

The default values shown in Table 4-1 may vary by modem firmware configuration. Consult the MCU firmware release notes for exact configuration.

The factory default values may be loaded at any time by entering the &Fn command.

**Table 4-1. S register Summary**

Register	Function	Range	Units	Type*	Default
S0	Rings to Auto-Answer	0-255	rings	S	2
S1	Ring Counter	0-255	rings	R	0
S2	Escape Character	0-255	ASCII	S	43
S3	Carriage Return Character	0-127	ASCII		13
S4	Line Feed Character	0-127	ASCII		10
S5	Backspace Character	0-255	ASCII		8
S6	Wait Time for Dial Tone	2-255	s	S	2
S7	Wait Time for Carrier	1-255	s	S	50
S8	Pause Time for Dial Delay Modifier	0-255	s	S	2
S9	Carrier Detect Response Time	1-255	0.1 s	S	6
S10	Carrier Loss Disconnect Time	1-255	0.1 s	S	14
S12	Escape Prompt Delay	0-255	0.02 s	S	50
S13	Reserved	-	-	R	-
S14	General Bit Mapped Options Status	-	-	SR	128 (80h)
S15	Reserved	-	-	R	-
S16	Test Mode Bit Mapped Options Status (&T)	-	-	R	0
S17	Reserved	-	-	R	-
S18	Test Timer	0-255	s	S	0

Register	Function	Range	Units	Type*	Default
S19	AutoSync Options	-	-		0
S20	AutoSync HDLC Address or BSC Sync Character	0-255	-	S	0
S21	V.24/General Bit Mapped Options Status	-	-	SR	4 (04h)
S22	Speaker/Results Bit Mapped Options Status	-	-	SR	117 (75h) 58 (3ah)
S23	General Bit Mapped Options Status		-	SR	
S24	Sleep Inactivity Timer	0-255	s	S	0
S25	Delay to DTR Off	0-255	s or 0.01 s		5
S26	RTS to CTS delay	0-255	10 ms		1
S27	General Bit Mapped Options Status	-	-	SR	9(09h)
S28	General Bit-Mapped Options Status	-	-	S	0
S29	Flash Dial Modifier Time	0-255	10 ms		0
S30	Disconnect Inactivity Timer	0-255	10 s		0
S31	General Bit-Mapped Options Status	-	-	SR	2
S32	XON Character	0-255	ASCII		17 (11h)
S33	XOFF Character	0-255	ASCII		19 (13h)
S34-S35	Reserved	-	-		-
S36	LAPM Failure Control	-	-	S	7
S37	Line Connection Speed	-	-	S	0
S38	Delay Before Forced Hangup	0-255	s		20
S39	Flow Control Bit Mapped Options Status	-	-	SR	3
S40	General Bit-Mapped Options Status	-	-	SR	105 (69h)
S41	General Bit-Mapped Options Status	-	-	SR	3
S42-S45	Reserved	-	-		-
S46	Data Compression Control	-	-	S	138
S48	V.42 Negotiation Control	-	-	S	7
S82	LAPM Break Control	-	-		128(40h)
S86	Call Failure Reason Code	0-255	-	R	-
S91	PSTN Transmit Attenuation Level	0-15	dBm		13 (Country dependent)
S95	Result Code Messages Control	-	-	S	0

\* S - Register value may be stored in one of two user profiles with the &W command.  
R - Read only register.

## S Register definitions

### S0 - Number of Rings to Auto-Answer

Sets the number of the rings required before the modem automatically answers a call. Setting this register to zero disables auto-answer mode.

Range: 0-255 rings

Default: 2

### S1 - Ring Counter

S1 is incremented each time the modem detects a ring signal on the telephone line. S1 is cleared if no rings occur over an eight second interval.

Range: 0-255 rings

Default: 0

### S2 - Escape Character

S2 holds the decimal value of the ASCII character used as the escape character. The default value corresponds to an ASCII '+'. A value over 127 disables the escape process, i.e., no escape character will be recognised.

Range: 0-255, ASCII decimal

Default: 43 (+)

### S3 - Carriage Return Character

Sets the command line and result code terminator character.

Range: 0-127, ASCII decimal

Default: 13 (Carriage Return)

### S4 - Line Feed Character

Sets the character recognised as a line feed. The Line Feed control character is output after the Carriage Return control character if verbose result codes are used

Range: 0-127, ASCII decimal

Default: 10 (Line Feed)

### S5 - Backspace Character

Sets the character recognised as a backspace. The modem will not recognise the Backspace character if it is set to a value that is greater than 32 ASCII. This character can be used to edit a command line. When the echo command is enabled, the modem echoes back to the local DTE the Backspace character, an ASCII space character and a second Backspace character; this means a total of three characters are transmitted each time the modem processes the Backspace character.

Range: 0-32, ASCII decimal

Default: 8 (Backspace)



## **S6 - Wait Time for Dial Tone Before Blind Dialling, or After `W` Dial Modifier**

1. Sets the length of time, in seconds, that the modem will wait before starting to dial after going off-hook when blind dialling. This operation, however, may be affected by some ATX options according to country restrictions. The `Wait for Dial Tone` call progress feature (W dial modifier in the dial string) will override the value in register S6.
2. S6 sets the length of time, in seconds, that the modem will wait for dial tone when encountering a `W` dial modifier before returning NO DIAL TONE result code.

The modem always pauses for a minimum of 2 seconds, even if the value of S6 is less than 2 seconds.

Range: 2-255 seconds

Default: 2

## **S7 - Wait Time For Carrier After Dial, For Silence**

1. Sets the length of time, in seconds, that the modem will wait for carrier before hanging up. The timer is started when the modem finishes dialling (originate), or 2 seconds after going off-hook (answer). In originate mode, the timer is reset upon detection of answer tone if allowed by country restrictions.
2. Sets the length of time, in seconds, that modem will wait for silence when encountering the @ dial modifier before continuing with the next dial string parameter.

Range: 1-255 seconds

Default: 50

## **S8 - Pause Time For Dial Delay**

Sets the time, in seconds, that the modem must pause when the `,` dial modifier is encountered in the dial string.

Range: 0-255 seconds

Default: 2

## **S9 - Carrier Detect Response Time**

Sets the time, in tenths of a second, that the carrier must be present before the modem considers it valid and turns on DCD. As this time is increased, there is less chance to detect a false carrier due to noise from the telephone line.

Range: 1-255 tenths of a second

Default: 6 (0.6 second)

## **S10 - Lost Carrier To Hang Up Delay**

Sets the length of time, in tenths of a second, that the modem waits before hanging up after a loss of carrier. This allows a temporary carrier loss without causing the local modem to disconnect. When register S10 is set to 255, the modem functions as if a carrier is always present.

The actual interval the modem waits before disconnecting is the value in register S10 minus the value in register S9. Therefore, the S10 value must be greater than the S9 value or else the modem disconnects before it recognises the carrier.

Range: 1-255 tenths of a second

Default: 14 (1.4 seconds)

## S12 - Escape Prompt Delay (EPD)

Defines the maximum period, in fiftieths of a second, allowed between receipt of the last character of the three-escape-character sequence from the DTE and sending of the OK result code to the DTE. If any characters are detected during this time, the OK will not be sent. Note that sending of the OK result code does not affect entry into command mode. (See 3.1.3.)

Range: 0-255 1/50 of a second

Default: 50 (1 second)

## S13 - Reserved

## S14 - General Bit Mapped Options Status

Indicates the status of command options.

Default: 138 (80h) (10000000b)

- Bit 0 — This bit is ignored.
- Bit 1 — Command echo (En)
  - 0 = Disabled (E0) (Default.)
  - 1 = Enabled (E1)
- Bit 2 — Quiet mode (Qn)
  - 0 = Send result codes (Q0) (Default.)
  - 1 = Do not send result codes (Q1)
- Bit 3 — Result codes (Vn)
  - 0 = Numeric (V0) (Default.)
  - 1 = Verbose (V1)
- Bit 4 — Reserved
- Bit 5 — Tone (T)/Pulse (P)
  - 0 = Tone (T) (Default.)
  - 1 = Pulse (P)
- Bit 6 — 2/4-wire line interface (AT&H)
  - 0 = 2-wire (&H0) (Default.)
  - 1 = 4-wire (&H1)
- Bit 7 — Originate/Answer
  - 0 = Answer
  - 1 = Originate (Default.)

## S15 - Reserved

## S16 - General Bit Mapped Test Options Status

Indicates the test in progress status.

Default: 0

- Bit 0 — Local analog loopback
  - 0 = Disabled (Default.)
  - 1 = Enabled (&T1)
- Bit 1 — Not used
- Bit 2 — Local digital loopback
  - 0 = Disabled (Default.)
  - 1 = Enabled (&T3)
- Bit 3 — Remote digital loopback (RDL) status
  - 0 = Modem not in RDL (Default.)
  - 1 = RDL in progress
- Bit 4 — RDL requested (AT&T6)
  - 0 = RDL not requested (Default.)
  - 1 = RDL requested (&T6)
- Bit 5 — RDL with self-test
  - 0 = Disabled (Default.)
  - 1 = Enabled (&T7)
- Bit 6 — Local analog loopback (LAL) with self-test
  - 0 = Disabled (Default.)
  - 1 = Enabled (&T8)
- Bit 7 — Radio subcarrier option (AT&E)
  - 0 = Disabled (&E0) (Default.)
  - 1 = Enabled (&E1)

## S17 - Reserved

## S18 - Test Timer

Sets the length of time, in seconds, that the modem conducts a test (commanded by &Tn) before returning to the command mode. If this register value is zero, the test will not automatically terminate; the test must be terminated from the command mode by issuing an &T0 or H command. When S18 is non-zero, the modem returns the OK message upon test termination.

Range: 0-255 seconds

Default: 0

## S19 - AutoSync Bit Mapped Options

Defines the options for AutoSync operation (see &Q4 command). S19 must be set to the desired value before &Q4 is issued.

Default: 0

- Bit 0 — Reserved
- Bit 1 — BSC/HDLC format select
  - 0 = BSC selected (Default.)
  - 1 = HDLC selected
- Bit 2 — Address detection enable/disable
  - 0 = Disabled (Default.)
  - 1 = Enabled
- Bit 3 — NRZI/NZI coding select
  - 0 = NRZI (Default.)
  - 1 = NZI
- Bit 4 — Idle indicator select
  - 0 = Mark idle (Default.)
  - 1 = Flag or sync idle
- Bits 5 - 7 — Reserved

## S20 - AutoSync HDLC Address or BSC Sync Character

Defines the HDLC address (S19 bit 1 = 1) or BSC Sync Character (S19 bit 1 = 0) for AutoSync operation (see &Q4 command). S20 must be set to the desired value before &Q4 is issued.

Range: 0-255

Default: 0

## S21 - V.24/General Bit Mapped Options Status

Indicates the status of command options.

Default: 4 (00000100b)

- Bit 0 — Set by &Jn command but ignored otherwise.
  - 0 = &J0 (Default.)
  - 1 = &J1
- Bit 1 — Radio subcarrier (&En)
  - 0 = &E0 normal (Default.)
  - 1 = &E1 active
- Bit 2 — CTS behaviour (&Rn)
  - 0 = CTS tracks RTS (&R0)
  - 1 = CTS always on (&R1) (Default.)
- Bits 3-4 — DTR behaviour (&Dn)
  - 0 = &D0 selected (Default.)
  - 1 = &D1 selected
  - 2 = &D2 selected
  - 3 = &D3 selected
- Bit 5 — RLSD (DCD) behaviour (&Cn)
  - 0 = &C0 selected (Default.)
  - 1 = &C1 selected
- Bit 6 — DSR behaviour (&Sn)
  - 0 = &S0 selected (Default.)
  - 1 = &S1 selected
- Bit 7 — Long space disconnect (Yn)
  - 0 = Y0 (Default.)
  - 1 = Y1

## S22 - Speaker/Results Bit Mapped Options Status

Indicates the status of command options.

Default: 117 (75h) (01110101b)

Bits 0-1 — Speaker volume (Ln)

- 0 = Off (L0)
- 1 = Low (L1) (Default.)
- 2 = Medium (L2)
- 3 = High (L3)

Bits 2-3 — Speaker control (Mn)

- 0 = Disabled (M0)
- 1 = Off on carrier (M1) (Default.)
- 2 = Always on (M2)
- 3 = On during handshake (M3)

Bits 4-6 — Limit result codes (Xn)

- 0 = X0
- 4 = X1
- 5 = X2
- 6 = X3
- 7 = X4 (Default.)

Bit 7 — Dial abort option (AT&a)

- 0 = Do abort (&A0) (Default.)
- 1 = No abort (&A1)

## S23 - General Bit Mapped Options Status

Indicates the status of command options.

Default: 54 (36h) (00110110b)

Bit 0 — Grant RDL

- 0 = RDL not allowed (&T5) (Default.)
- 1 = RDL allowed (&T4)

Bits 1-3 — DTE Rate

- 0 = 0 - 300 bps
- 1 = 600 bps
- 2 = 1200 bps
- 3 = 2400 bps
- 4 = 4800 bps
- 5 = 9600 bps (Default.)
- 6 = 19200 bps
- 7 = 38400 bps or higher

Bits 4-5 — Assumed DTE parity

- 0 = even
- 1 = not used
- 2 = odd
- 3 = none (Default.)

Bits 6-7 — Guard tone (&Gn)

- 0 = None (&G0) (Default.)
- 1 = None (&G1)
- 2 = 1800 Hz (&G2)

## S24 - Sleep Inactivity Timer

Sets the length of time, in seconds, that the modem will operate in normal mode with no detected telephone line or DTE line activity before entering low-power sleep mode. The timer is reset upon any DTE line or telephone line activity. If the S24 value is zero, neither DTE line nor telephone inactivity will cause the modem to enter the sleep mode.

Range: 0-255 seconds

Default: 0

## S25 - Delay To DTR

Sets the length of time that the modem will ignore DTR before taking the action specified by &Dn. Its units are one hundredths of a second.

Range: 0-255 (0.01 second)

Default: 5

## S26 - Delay RTS To CTS

Sets the length of time that the modem will wait from RTS is active until CTS becomes active in V.23 half-duplex mode. The lowest value is 60 ms. 1-6 is 60 ms, 7 is 70 ms, 8 is 80 ms...

Range: 4-255 (0.01 second)

Default: 1

## S27 - Bit Mapped Options Status

Indicates the status of command options.

Default: 9 (09h) (00001001b)

Bits 0,1,3 — Asynchronous selection (&Qn)

3 1 0

0 0 0 = &Q0

1 0 0 = &Q4

1 0 1 = &Q5 (Default for ECC models.)

1 1 0 = &Q6 (Default for non-ECC models.)

Bit 2 — Leased line control (&Ln)

0 = Dial-up line (&L0) (Default.)

1 = Leased line (&L1)

Bits 4-5 — Internal clock select (&Xn)

0 = Internal clock (&X0) (Default.)

1 = External clock (&X1)

2 = Slave clock (&X2)

Bit 6 — CCITT/Bell mode select (Bn)

0 = CCITT mode (B0) (Default.)

1 = Bell mode (B1)

Bit 7 — DTR dial option (AT&B)

0 = No DTR dial (&B0) (Default.)

1 = Dial on DTR low to high transition (&B1)

## S28 - Bit Mapped Options Status

Default: 0

Bits 0-1 — Reserved

Bit 2 — Reserved (always 0).

Bits 3-4 — Pulse dialling (&Pn)

0 = 39%-61% make/break ratio at 10 pulses per second (&P0) (Default.)

1 = 33%-67% make/break ratio at 10 pulses per second (&P1)

2 = 39%-61% make/break ratio at 20 pulses per second (&P2)

3 = 33%-67% make/break ratio at 20 pulses per second (&P3)

Bit 5 — Reserved

Bits 6-7 — MNP Link Negotiation Speed (\*Hn)

0 = Link negotiation at highest speed (\*H0) (Default.)

1 = Link negotiation at 1200 bps (\*H1)

2 = Link negotiation at 4800 bps (\*H2)

## S29 - Flash Dial Modifier Time

Sets the length of time, in units of 10 ms, that the modem will go on-hook when it encounters the flash (!) dial modifier in the dial string. The time can be limited as it is a country-dependent parameter.

Range: 0-255 10 ms intervals

Default: 0 (disabled)

## S30 - Disconnect Inactivity Timer

Sets the length of time, in tens of seconds, that the modem will stay on-line before disconnecting when no data is sent or received. In error-correction mode, any data transmitted or received will reset the timer. In other modes, any data transmitted will reset the timer.

Range: 0-255 tens of seconds (0-2550 seconds)

Default: 0 (disabled)

## S31 - Bit Mapped Options Status

Default: 2 (00000010b)

Bit 0 — Reserved

Bit 1 — Controls auto line speed detection (Nn)

0 = Disabled (N0)

1 = Enabled (N1) (Default.)

Bits 2-3 — Controls error correction progress messages (Wn)

0 = DTE speed only (W0) (Default.)

1 = Full reporting (W1)

2 = DCE speed only (W2)

Bit 3 — Reserved

Bits 4-7 — Reserved

## S32 - XON Character

Sets the value of the XON character.

Range: 0-255, ASCII decimal

Default: 17 (11h)

## S33 - XOFF Character

Sets the value of the XOFF character.

Range: 0-255, ASCII decimal

Default: 19 (13h)

## S34-S35 - Reserved

## S36 - LAPM Failure Control

Default: 7 (00000111b)

Bit 0-2 — This value indicates what should happen upon a LAPM failure. These fallback options are initiated immediately upon connection if S48=128. If an invalid number is entered, the number is accepted into the register, but S36 will act as if the default value has been entered.

0 = Modem disconnects.

1 = Modem stays on-line and a Direct mode connection is established.

2 = Reserved.

3 = Modem stays on-line and a Normal mode connection is established.

4 = An MNP connection is attempted and if it fails, the modem disconnects.

5 = An MNP connection is attempted and if it fails, a Direct mode connection is established.

6 = Reserved.

7 = An MNP connection is attempted and if it fails, a Normal mode connection is established. (Default.)

Bit 3-7 — Reserved

## S37 - Desired Line Connection Speed

Default: 0

Bits 0-3 — Desired line connection speed. This is interlinked with the Fn command. If an invalid number is entered, the number is accepted into the register, but S37 will act as if the default value has been entered.

0 = Attempt auto mode connection (F0). (Default)

1-3 = Attempt to connect at 300 bps (F1).

4 = Reserved.

5 = Attempt to connect at V.22 1200 bps (F4).

6 = Attempt to connect at V.22 bis 2400 bps (F5).

7 = Attempt to connect at V.23 (F3).

8 = Attempt to connect at V.32 bis/V.32 4800 bps (F6).

9 = Attempt to connect at V.32 bis/V.32 9600 bps (F8).

10 = Attempt to connect at V.32 bis 12000 bps (F9).

11 = Attempt to connect at V.32 bis 14400 bps (F10).

12 = Attempt to connect at V.32 bis 7200 bps (F7).

Bits 4-7 — Reserved

## S38 - Delay Before Forced Hang Up

This register specifies the delay between the modem's receipt of the H command to disconnect (or ON-to-OFF transition of DTR if the modem is programmed to follow the signal), and the disconnect operation. Applicable to error-correction connection only. This register can be used to ensure that data in the modem buffer is sent before the modem disconnects.

1. If S38 is set to a value between 0 and 254, the modem will wait that number of seconds for the remote modem to acknowledge all data in the modem buffer before disconnecting. If time expires before all data is sent, the NO CARRIER result code will be issued to indicate that data has been lost. If all data is transmitted prior to time-out, the response to the H0 command will be OK.

2. If S38 is set to 255, the modem does not time-out and continues to attempt to deliver data in the buffer until the connection is lost or the data is delivered.

Range: 0-255 seconds

Default: 20



## S39 - Flow Control Bit Mapped Options Status

Default: 3 (00000011b)

Bits 0-2 — Status of command options

- 0 = No flow control
- 3 = RTS/CTS (&K3) (Default.)
- 4 = XON/XOFF (&K4)
- 5 = Transparent XON (&K5)
- 6 = Both methods (&K6)

Bits 3-7 — Reserved

## S40 - General Bit Mapped Options Status

Indicates the status of command options.

Default: 105 (69h) (01101001b)

Bit 0 - 1 — MNP Extended Services (-Kn)

- 0 = Disable extended services (-K0) (Default for non-MNP 10 models.)
- 1 = Enable extended services (-K1) (Default for MNP 10 models.)
- 2 = Enable extended services (-K2)

Bit 2 — Reserved.

Bits 3-5 — Break Handling (\Kn)

- 0 = \K0
- 1 = \K1
- 2 = \K2
- 3 = \K3
- 4 = \K4
- 5 = \K5 (Default.)

Bits 6-7 — MNP block size (\An)

- 0 = 64 chars (\A0)
- 1 = 128 chars (\A1) (Default.)
- 2 = 192 chars (\A2)
- 3 = 256 chars (\A3)

## S41 - General Bit Mapped Options Status

Indicates the status of command options.

Default: 131 (10000011b)

Bits 0 -1 — Compression selection (%Cn)

- 0 = Disabled (%C0)
- 1 = MNP 5 (%C1)
- 2 = V.42 bis (%C2)
- 3 = MNP 5 and V.42 bis (%C3) (Default.)

Bit 2, 6 — Auto retrain and fallback/fall forward (%En)

Bit 6 Bit 2

- 0 0 = Retrain and fallback/fall forward disabled (%E0) (Default.)
- 0 1 = Retrain enabled (%E1)
- 1 0 = Fallback/fall forward enabled (%E2)

Bit 3 — Modem-to-modem flow control

- 0 = Disabled (\G0) (Default.)
- 1 = Enabled (\G1)

Bits 4-5 — Reserved

Bit 7 — Enable fallback to V.22 bis/V.22 (-Qn)

- 0 = Disabled (-Q0)
- 1 = Enabled (-Q1) (Default.)

## S46 - Data Compression Control

Controls selection of compression. The following actions are executed for the given values:

Range: 136 or 138

Default: 138

S46=136 Execute error correction protocol with no compression.

S46=138 Execute error correction protocol with compression. (Default.)

## S48 - V.42 Negotiation Action

The V.42 negotiation process determines the capabilities of the remote modem. However, when the capabilities of the remote modem are known and negotiation is unnecessary, this process can be bypassed if so desired.

Range: 0, 7, or 128 If an invalid number is entered, it is accepted into the S register, but S48 will act as if 128 has been entered.

Default: 7

S48=0 Disable negotiation; bypass the detection and negotiation phases; and proceed with LAPM.

S48=7 Enable negotiation. (Default.)

S48=128 Disable negotiation; bypass the detection and negotiation phases; and proceed at once with the fallback action specified in S36. Can be used to force MNP.

## S82 - Break Handling Options

S82 is for compatibility purposes only, changing this register will not have any affect.

## S86 - Call Failure Reason Code

When the modem issues a NO CARRIER result code, a value is written to this S register to help determine the reason for the failed connection. S86 records the first event that contributes to a NO CARRIER message. The cause codes are:

Range: 0, 4, 5, 9, 12, 13, or 14

Default: -

S86=0 Normal disconnect, no error occurred.

S86=4 Loss of carrier.

S86=5 V.42 negotiation failed to detect an error-correction modem at the other end.

S86=9 The modems could not find a common protocol.

S86=12 Normal disconnect initiated by the remote modem.

S86=13 Remote modem does not respond after 10 re-transmissions of the same message.

S86=14 Protocol violation.

## S91 - PSTN Transmit Attenuation Level

Sets the transmit attenuation level from 0 to 15 dBm for the PSTN mode, resulting in a transmit level from 0 to -15 dBm, In some countries, the transmit level may not be changed and there are checks to prevent transmit attenuation level change.

Range: 0 to 15 dBm (Corresponding to 0 to -15 dBm transmit level.)

Default: 10 (-10 dBm transmit level.)

## S95 - Extended Result Codes

The bits in this register can be set to override some of the Wn command options. A bit set to a 1 in this register will enable the corresponding result code regardless of the Wn setting. Also, refer to Table 3-1.

Default: 0

- Bit 0 — CONNECT result code indicates DCE speed instead of DTE speed.
- Bit 1 — Append/ARQ to CONNECT XXXX result code in error-correction mode (XXXX = rate; see Table 3-1).
- Bit 2 — Enable CARRIER XXXX result code (XXXX = rate; see Table 3-1).
- Bit 3 — Enable PROTOCOL XXXX result code (XXXX = protocol identifier; see Table 3-1).
- Bit 4 — Reserved.
- Bit 5 — Enable COMPRESSION result code (XXXX = compression type; see Table 3-1).
- Bit 6 — Reserved.
- Bit 7 — Reserved.

## 4.0

### AT command set summary

A/	Re-execute command.
A	Go off-hook and attempt to answer a call.
B0	Select V.22 connection at 1200 bps.
B1	Select Bell 212A connection at 1200 bps.
C1	Return OK message.
Dn	Dial modifier.
E0	Turn off command echo.
E1	Turn on command echo.
F0	Select auto-detect mode (equivalent to N1).
F1	Select V.21 or Bell 103.
F3	Select V.23 line modulation.
F4	Select V.22 or Bell 212A 1200 bps line speed.
F5	Select V.22 bis line modulation.
F6	Select V.32 bis or V.32 4800 line modulation.
F7	Select V.32 bis 7200 line modulation.
F8	Select V.32 bis or V.32 9600 line modulation.
F9	Select V.32 bis 12000 line modulation.
F10	Select V.32 bis 14400 line modulation.
H0	Initiate a hang-up sequence.
H1	If on-hook, go off-hook and enter command mode.
I0	Report product code.
I1	Report pre-computed checksum.
I2	Report OK.
I3	Report firmware revision, model, and interface type.
I4	Report response programmed by an OEM.
I5	Report the country code parameter.
I6	Report modem data pump model and code revision.
Ln	Set speaker volume n= 0, 1, 2, 3 (low, low, medium, high).
M0	Turn speaker off.
M1	Turn speaker on during handshaking and turn speaker off while receiving carrier.
M2	Turn speaker on during handshaking and while receiving carrier.
M3	Turn speaker off during dialling and receiving carrier and on during answering.
N0	Turn off automode detection.
N1	Turn on automode detection.
O0	Go on-line.
O1	Go on-line and initiate a retrain sequence.
P	Force pulse dialling.
Q0	Allow result codes to DTE.
Q1	Inhibit result codes to DTE.
Sn	Select S register as default.
Sn?	Return the value of S register n.
=v	Set default S register to value v.
?	Return the value of default S register.
T	Force DTMF dialling.

V0	Report short form (terse) result codes.
V1	Report long form (verbose) result codes.
W0	Report DTE speed in EC mode.
W1	Report line speed, EC protocol and DTE speed.
W2	Report DCE speed in EC mode.
X0	Report basic call progress result codes, i.e., OK, CONNECT, RING, NO CARRIER also, for busy, if enabled, and dial tone not detected), NO ANSWER and ERROR.
X1	Report basic call progress result codes and connections speeds (OK, CONNECT, RING, NO CARRIER (also, for busy, if enabled, and dial tone not detected), NO ANSWER, CONNECT XXXX, and ERROR.
X2	Report basic call progress result codes and connections speeds, i.e., OK, CONNECT, RING, NO CARRIER (also, for busy, if enabled, and dial tone not detected), NO ANSWER, CONNECT XXXX, and ERROR.
X3	Report basic call progress result codes and connection rate, i.e., OK, CONNECT, RING, NO CARRIER, NO ANSWER, CONNECT XXXX, BUSY, and ERROR.
X4	Report all call progress result codes and connection rate, i.e., OK, CONNECT, RING, NO CARRIER, NO ANSWER, CONNECT XXXX, BUSY, NO DIAL TONE and ERROR.
Y0	Disable long space disconnect before on-hook.
Y1	Enable long space disconnect before on-hook.
Z0	Restore stored profile 0 after warm reset.
Z1	Restore stored profile 1 after warm reset.
&A0	Connection attempt aborted if a character is received from DET.
&A1	Connection attempt not aborted if a character is received from DET.
&B0	Ignore DTR auto dial.
&B1	Dial a stored number with DTR transition.
&C0	Force DCD active regardless of the carrier state.
&C1	Allow DCD to follow the carrier state.
&D0	Interpret DTR ON-to-OFF transition per &Qn: &Q0, &Q5-6, e modem ignores DTR. &Q4, The modem hangs up.
&D1	Interpret DTR ON-to-OFF transition per &Qn: &Q0, &Q4-6, synchronous escape.
&D2	Interpret DTR ON-to-OFF transition per &Qn: &Q0, &Q4-6, The modem hangs up., Autodial turns off.
&D2	Interpret DTR ON-to-OFF transition per &Qn: &Q0, &Q4-6, The modem performs soft reset.
&F0	Restore factory configuration 0.
&F1	Restore factory configuration 1.
&G0	Disable guard tone.
&G1	Disable guard tone.
&G2	Enable 1800 Hz guard tone.
&H0	2-wire connection.
&H1	4-wire connection.
&J0	Selects telephone jacket for line connection.

&J1 Selects screw connector for line connection.  
 &K0 Disable DTE/DCE flow control.  
 &K3 Enable RTS/CTS DTE/DCE flow control.  
 &K4 Enable XON/XOFF DTE/DCE flow control.  
 &K5 Enable transparent XON/XOFF flow control.  
 &K6 Enable both RTS/CTS and XON/XOFF flow control.  
 &P0 Set 10 pps pulse dial with 39%/61% make/break.  
 &P1 Set 10 pps pulse dial with 33%/67% make/break.  
 &P2 Set 20 pps pulse dial with 39%/61% make/break.  
 &P3 Set 20 pps pulse dial with 33%/67% make/break.  
 &Q0 Select direct asynchronous mode.  
 &Q4 Select Hayes AutoSync mode.  
 &Q5 Modem negotiates an error corrected link.  
 &Q6 Select asynchronous operation in normal mode.  
 &R0 CTS tracks RTS.  
 &R1 CTS is always active.  
 &S0 DSR is always active.  
 &S1 DSR acts per V.25.  
 &T0 Terminate any test in progress.  
 &T1 Initiate local analog loopback.  
 &T2 Returns ERROR result code.  
 &T3 Initiate local digital loopback.  
 &T4 Allow remote digital loopback.  
 &T5 Disallow remote digital loopback request.  
 &T8 Initiate local analog loop with self-test.  
 &V Display current configurations.  
 &W0 Store the active profile in NVRAM profile 0.  
 &W1 Store the active profile in NVRAM profile 1.  
 &X0 Select internal timing for the transmit clock.  
 &X1 Select external timing for the transmit clock.  
 &X2 Select slave receive timing for the transmit clock.  
 &Y0 Recall stored profile 0 upon power up.  
 &Y1 Recall stored profile 1 upon power up.  
 &Z<sub>n=x</sub> Store dial string x (to 35) to location n (0 to 3 depending upon modem model).  
 %C0 Disable data compression.  
 %C1 Enable MNP 5 data compression.  
 %C2 Enable V.42 bis data compression.  
 %C3 Enable both V.42 bis and MNP 5 compression.  
 %E0 Disable line quality monitor and auto retrain.  
 %E1 Enable line quality monitor and auto retrain.  
 %E2 Enable line quality monitor and fallback/fall forward.  
 %F1 V.23 operation mode 75tx/1200rx.  
 %F2 V.23 operation mode 1200tx/75rx.  
 %F3 V.23 operation mode 1200/1200 hdx.

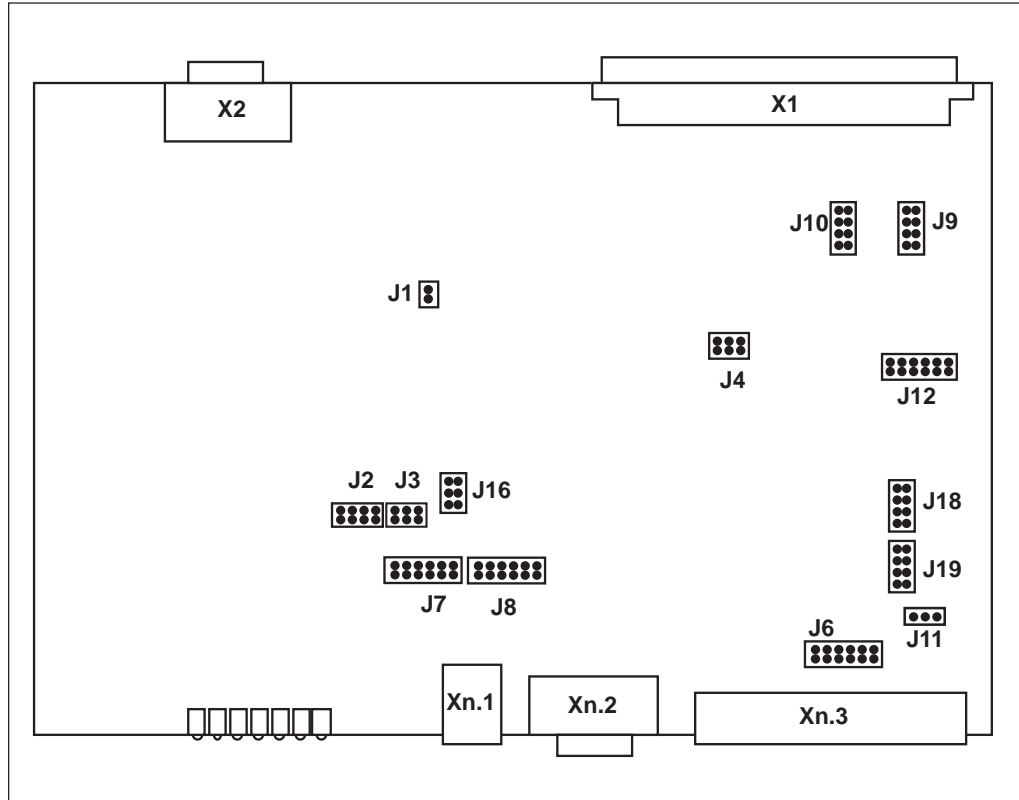
%L Return received line signal level.  
 %Q Report the line signal quality.  
 %TTn PTT certification test signals.  
 \An Set maximum block size in MNP to n=0, 1, 2, 3 ( block 64, 128, 192, 256).  
 \Bn Send break of n x 100 ms.  
 \G0 Disable modem to modem flow control.  
 \G1 Enable modem to modem flow control.  
 \Kn Controls break handling during three states:  
 When modem receives a break from the DTE:  
 \K0,2,4 Enter on-line command mode, no break sent to the remote modem.  
 \K1 Clear buffers and send break to remote modem.  
 \K3 Send break to remote modem immediately.  
 \K5 Send break to remote modem in sequence with transmitted data.  
 When modem receives \B in on-line command state:  
 \K0,1 Clear buffers and send break to remote modem.  
 \K2,3 Send break to remote modem immediately.  
 \K4,5 Send break to remote modem in sequence with transmitted data.  
 When modem receives break from the remote modem:  
 \K0,1 Clear data buffers and send break to DTE.  
 \K2,3 Send a break immediately to DTE.  
 \K4,5 Send a break with received data to the DTE.  
 \N0 Select normal speed buffered mode.  
 \N1 Select direct mode.  
 \N2 Select reliable link mode.  
 \N3 Select auto reliable mode.  
 \N4 Force LAPM mode.  
 \N5 Force MNP mode.  
 \S Display Current Configuration  
 \*B Display list of permanently blacklisted numbers.  
 \*D Display list of delayed numbers.  
 \*NCnn Change country to one of eight in NVRAM.

## 5.0



# Jumper settings






Jumpers are used to alter the hardware configuration of the 1MRS119000 modem board. In order to change the jumper positions, the modem-board is to be removed from the equipment it is mounted in. Refer to the chapter 'Installation and connection', section 'Mounting'.





Most of the jumpers are country-dependent. For re-exportation of the modem board carefully check the jumper positions.



*Note! This section is preliminary, Most PTT specifications in Europe are in a state of change.*

**J1:** PTT-test mode in Germany.  
 PTT-test mode in Germany, not mounted in normal usage.  
 Normally.

**J2:** Ring signal detector capacitor selection.  
 470nF: Normal position  
 1mF: Austria, UK,  
 2mF: (Belgium ?)  
 1.69mF: Ireland  
 330nF: Norway, Italy, Spain

**J3:** Ring signal detector voltage selection.  
 7V:  
 12V: Normal position  
 24V: Denmark, Greece, Italy, Norway, Portugal  
 38V:



**J4:** Ring signal detector resistance selection.



47kΩ:

100kΩ: Normal position

150kΩ: Denmark, Greece, Italy, Norway, Portugal

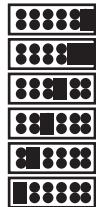
330kΩ:

**J5:** Line current limit selection.



Normal position

**J6,J12:** Line impedance selection.



Sweden, Norway, Finland

Netherlands, Italy

Denmark, UK

Spain

Austria, Germany, Switzerland, France

Belgium

**J7,J8:** Line connector selection.



"Normal" 4-wire PTT: Finland-OLD, (Denmark?) Germany, Island

"Normal" 2-wire PTT : NORMAL POSITION

Norway 4-wire PTT leased line

UK

**J9,J10:** Line impedance selection.



Austria, Belgium, Sweden, Norway, Finland, Germany, Spain

Denmark, UK,

France

Italy, Netherlands,

**J11:** Taxation pulse filter.



Normal position.



German filter.

**J18:** Pulse dialling spark quenching capacitor selection.



Sweden Austria,

Belgium, Greece

Denmark

**J19:** Pulse dialling spark quenching resistor selection.



Austria, Belgium,

Denmark, Sweden

Greece

## 6.0

### Service

During normal operation within the limits stated under technical specifications the 1MRS119000 modem board is maintenance-free.

## 7.0

### Trouble-Shooting

The LED indicators on the modem can be used to find errors in the modem. The LED indicators are:

LIN	Modem connected to line (off hook), connected to the line relay control signals.	Green
RNG	Indicates a true incoming ringing signal.	Green
TXD	Transmitted data. Connected to the modem TxD signal.	Green
RXD	Received data. Connected to the modem RxD signal.	Green
CD	Carrier detect.	Green
RTS	Request to send.	Green
IRF	Internal Fault detected by the watchdog. Normally this LED is off.	Red

LEDs under normal operation, not connected to another modem:

All LED:s OFF, except for the RTS LED which follows the status of the unit, connected to the RS-232 port.

LEDs under normal operation, connected to another modem:

LIN and CD LEDs are ON, the RTS LED follows the status of the unit that is connected to the RS-232 port. TXD and RXD indicates data transmitted to and from the modem on the RS-232 interface.

If the LED status differs from this please check the connections.

Disturbance	Possible reason	Corrective action
IRF LED lit	Internal fault	Switch OFF and ON the auxiliary supply. Check if the fault disappears. If not, contact the local ABB service for repair.
The RXD LED not lit even if the remote station asks for contact.	Connection between modem and network. Modem setup.	Check connection wires. If radio unit is present, check connection of antenna and the radio device. Check modem software setup with current type of connection.
RXD is flashing but not TXD.	Modem setup. Connection not compatible. Wrong address	Check modem software setup with current type of connection. Check data transfer rate and format for all units involved in the communication. Check the unit address
RXD and TXD is flashing but the master station does not receive the message.	Connection between modem and network. Delay time from transmitter ON to data too short.	Check connection wires. If radio unit is present, check connection of antenna and the radio device. Increase delay in modem.

Testing the modem with a terminal or a PC with a terminal program.:

Connect the terminal to the 9-pole RS-232 connection. Use normal Hayes commands to test the modem.

Example:

- Make a normal connection to another modem.
- Make a manual setup of the modem.
- Read the status of the modem with Hayes command AT\S. Compare the result with the expected configuration.
- Set the modem back to factory configuration



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