TD-35 HV/LV
RS-422/485

INSTALLATION MANUAL

**6613-2201**
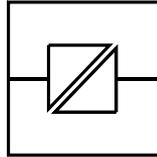
Galvanic
Isolation
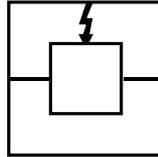
Transient
Protection
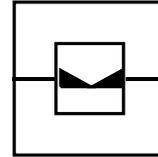
Balanced
Transmission

CE
Approved
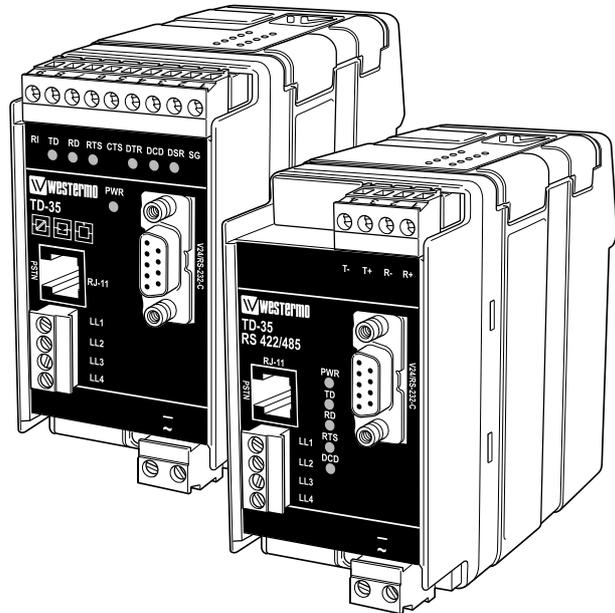
® **WESTERMO**

Tele modem
V.34

W Westermo®

www.westermo.com

Table of Contents

1. Introduction

The TD-35 is a high quality V.34 PSTN and leased line modem designed for use in harsh industrial environments. To make installation and maintenance easy all the connections are at the front and the modem is designed to snap easily onto a DIN rail. Fault diagnosis is made simple with the inclusion of a number of LED indicators. The TD-35 is suitable for many applications including remote connection to PLC's, energy meters or data loggers.

The TD-35 has a number of features not found in standard modems including complete tri-galvanic isolation, DIP switches for configuring popular AT commands and a watchdog function. The watchdog monitors internal hardware and software as well as the power supply. If any problems are detected the modem will be reset leaving the modem ready to receive the next call or to negotiate a new leased line connection. This feature makes the TD-35 ideal for use on unmanned sites.

The TD-35 has two variants, one which supports only RS-232 and one that can be used with RS-232 or RS-422/485. Both variants are available as either an LV (12–54 VDC, 12–48 VAC) or HV (95–240 VAC, 110–250 VDC).

1.1 Functional description
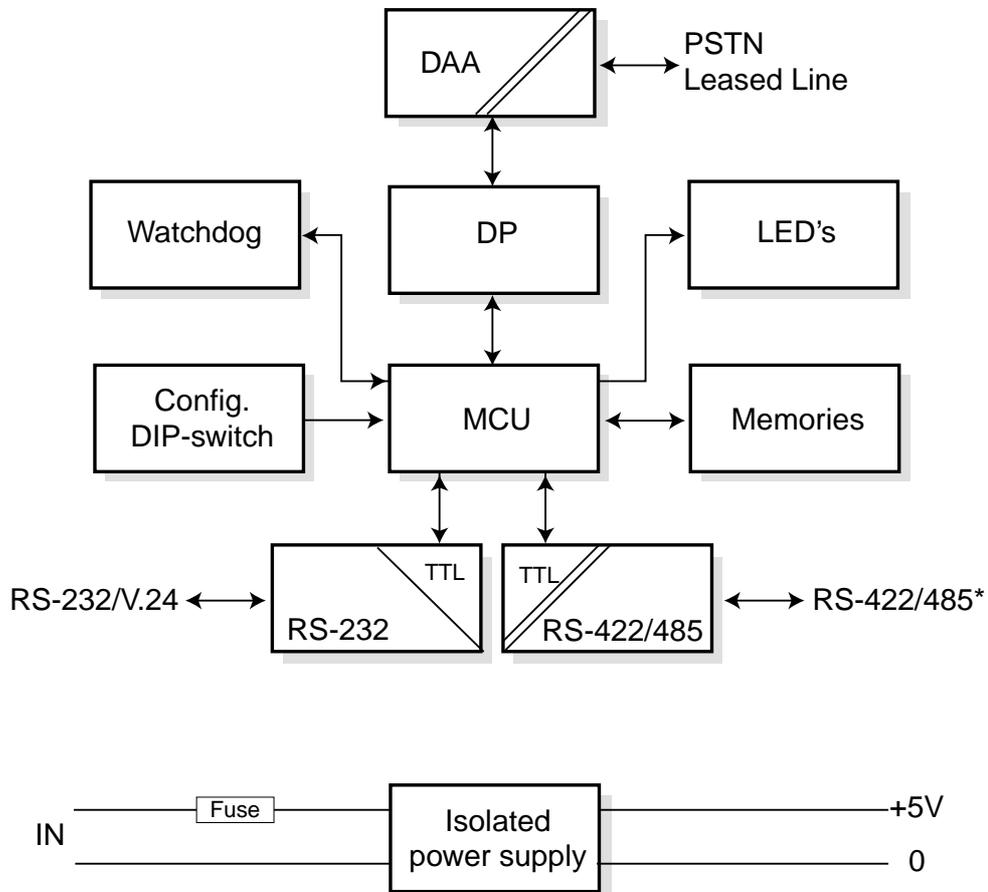
*) Only on TD-35 RS-422/485 LV and TD-35 RS-422/485 HV

2. Safety

⚠ **General:**
Before using this unit, read this manual completely and gather all information on the unit. Make sure that you understand it fully. Check that your application does not exceed the safe operating specifications for this unit.

⚠ **Before installation, maintenance or modification work:**
Prevent damage to internal electronics from electrostatic discharges (ESD) by discharging your body to a grounding point (e.g. use of wrist strap).

Prevent access to hazardous voltages by disconnecting the unit from AC/DC mains supply and all other electrical connections.

⚠ **Installation:**
This unit should only be installed by qualified personnel.

This unit should only be installed in a "restricted access area", for example a lockable cabinet where access is restricted to service personnel only.

This unit is intended for permanent connection to the AC/DC mains supply.

The power supply wiring must be sufficiently fused, and if necessary it must be possible to disconnect manually from the AC/DC mains supply. Ensure compliance to national installation regulations.

Unit with the rated voltage exceeding 42.4 V peak or 60 VDC, is defined as class I equipment with a protective earthing conductor terminal.

Unit with the rated voltage up to 42.4 V peak or 60 VDC, is defined as class III equipment and shall be separated from hazardous voltage by double or reinforced insulation.

This unit uses convection cooling. To avoid obstructing the air flow around the unit, follow the spacing recommendations (see under chapter Installation).

3. Approvals

See Declaration of Conformity

3.1 Declaration of conformity

Westermo Teleindustri AB

Declaration of conformity

The Westermo Teleindustri AB company declares that the listed products conforms to the Council Directive 89/336/EEC, related to Electro Magnetic Compability, 73/23/EEC Low Voltage Directive and 1999/5/EC R&TTE Directive.

Type of equipment: DIN-rail Industrial Telephone Modem

Model:

TD-35 LV	3613-0001	serial number	1000-
TD-35 HV	3613-0101	serial number	1000-
TD-35 RS422/485 LV	3613-0050	serial number	1000-
TD-35 RS422/485HV	3613-0150	serial number	1000-
TD-35 LV Aus	3613-0010	serial number	0-
TD-35 HV Aus	3613-0110	serial number	0-
TD-35 RS422/485 LV Aus	3613-0060	serial number	0-
TD-35 RS422/485 HV Aus	3613-0160	serial number	0-
TD-35 LV HDX	3613-0020	serial number	0-
TD-35 HV HDX	3613-0120	serial number	0-

Standards:

EMC: EN 55022 (1992): Class B
EN61000-6-2(1999):EN 61000-4-2
EN61000-6-2(1999):IEC61000-4-3
EN61000-6-2(1999):IEC61000-4-4
EN61000-6-2(1999):IEC61000-4-5
EN61000-6-2(1999):IEC 1000-4-6
EN61000-6-2(1999):IEC61000-4-11
EN61000-6-2(1999):IEC61000-4-8
EN55024(1998)

Safety: IEC 60950:1991+A1:1992+A2:1993+A3:1995:A4:1996
EN41003:1998

Reference: Installation manual TD-35, Art. nr. 6613-2201 and up (English).
Installation manual TD-35 HDX, Art. nr. 6613-2211 and up (English).

Hans Levin

Hans Levin
Technical Manager
27th of January 2004

4. Specifications

4.1 Connections

Power interface

	TD-35 LV	TD-35 HV
Rated voltage	12–48 VDC	95–240 VAC, 110–250 VDC
Rated current	250 mA	50 mA
Rated frequency	DC	DC / 48–62 Hz
Polarity	Independent	Independent
Connection	2-position screw terminal	3-position screw terminal
Fuse	To be externally fused	

Serial interface

Electrical specification	RS-232-C
Data rate	300–115 000 bit/s
Connection	9-position D-sub and 9-position screw terminal
Circuit type	shielding not required

Serial interface

Electrical specification	RS-422/485
Data rate	300–115 000 bit/s*
Connection	4-position screw terminal
Circuit type	TNV-1
Circuit type	shielding not required

PSTN interface

Electrical specification	PSTN
Data rate	300–33 600 bit/s
Connection	RJ-11C
Circuit type	TNV-3

Leased Line interface

Electrical specification	Leased Line
Data rate	300–33 600 bit/s
Connection	4-pos screw terminal
Circuit type	TNV-1

* Turning time approximately one byte.

4.2 Insulation between interfaces

Power TD-35 HV to all other	3.0 kV RMS @ 50 Hz and 60 s duration
Power TD-35 LV to all other	1.5 kV RMS @ 50 Hz and 60 s duration
PSTN to all other	1.5 kV RMS @ 50 Hz and 60 s duration
RS-422/485 to all other	1.5 kV RMS @ 50 Hz and 60 s duration
Leased Line to all other	1.5 kV RMS @ 50 Hz and 60 s duration

4.3 Climatic environment

Temperature, operating	5 to 50°C
Temperature, storage and transportation	−25 to +70°C
Relative humidity, operating	0 to 95 % (non-condensing)
Relative humidity, storage and transportation	0 to 95 % (condensation allowed outside packaging)

4.4 Mechanics

Dimension	55 x 100 x 128 mm (WxHxD)
Weight	0.3 kg
Mounting	Snap on mounting to 35 mm DIN-rail
Degree of protection	IP 20 (IEC 529)

5. Maintenance

No maintenance is required, as long as the unit is used as intended within the specified conditions.

6. Installation

⚠️ ## 6.1 Mounting /Removal

Before mounting or removing the unit:

Prevent damage to internal electronics from electrostatic discharges (ESD) by discharging your body to a grounding point (e.g. use of wrist strap).

Prevent access to hazardous voltages by disconnecting the unit from AC/DC mains supply and all other electrical connections.

Mounting

This unit should be mounted on 35 mm DIN-rail which is horizontally mounted on a wall or cabinet backplate.

This unit uses convection cooling. To avoid obstructing the air flow around the unit, use the following spacing rules. Minimum spacing 25 mm (1.0 inch) above/below and 10 mm (0.4 inches) left/right the unit.

Snap on mounting, see figure.
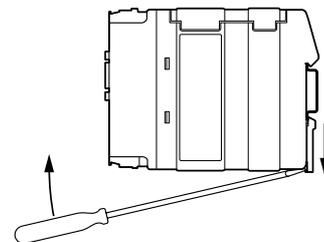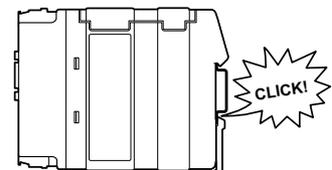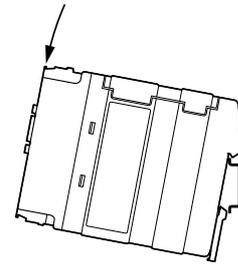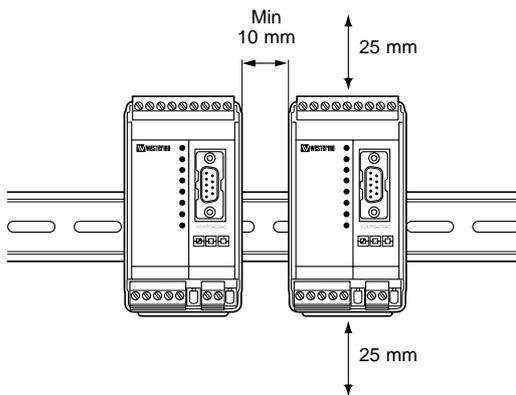
Removal

Press down the black support at the back of the unit using a screwdriver, see figure.
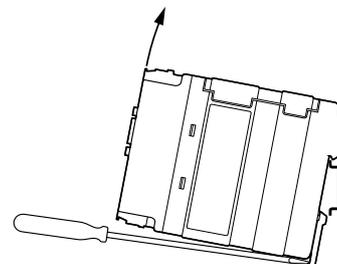
6.2 Connections

TD-35 LV and TD-35 HV

DIP switches

RS-232

PSTN

Leased Line

Power Input
TD-35LV
TD-35HV
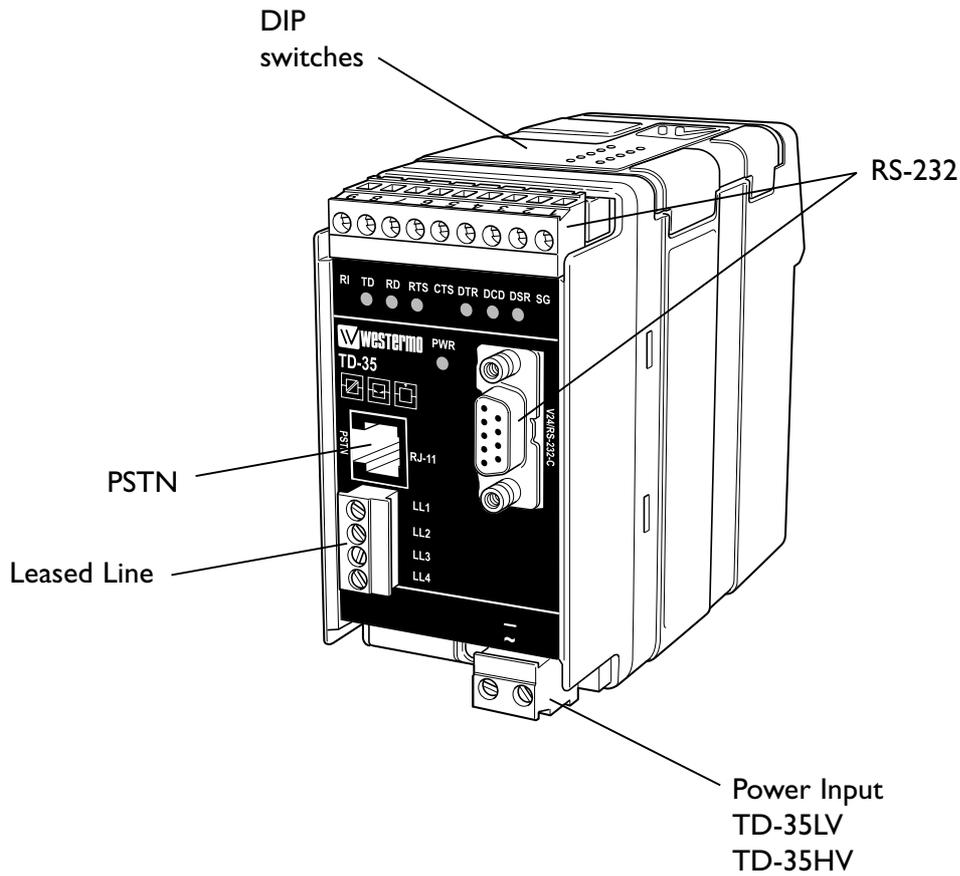
6.2.1 Power TD-35 HV
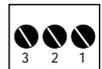
Connection	Description
3-pos screw block, L	Line
3-pos screw block, N	Neutral
3-pos screw block, PE	Protective Earth, Not Connected Internally

6.2.2 Power TD-35 LV

Connection	Description
2-pos screw block, 1	Line
2-pos screw block, 2	Line
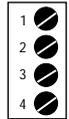
6.2.3 Leased Line

Connection	Direction	Description
4-pos screw block no. 1	**In/Out**	2-/4-wire Leased Line Receive/Transmit
4-pos screw block no. 2	**In/Out**	2-/4-wire Leased Line Receive/Transmit
4-pos screw block no. 3	**In**	4-wire Leased Line Receive
4-pos screw block no. 4	**In**	4-wire Leased Line Receive

6.2.4 PSTN

Connection	Direction	Description
6-pos RJ-11C no. 3	**In/Out**	PSTN Transmit/Receive
6-pos RJ-11C no. 4	**In/Out**	PSTN Transmit/Receive
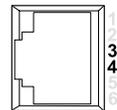
6.2.5 RS-232 (DCE)

Connection	Direction	Name	Description
9-pos D-sub no. 1	**Out**	DCD	Data Carrier Detect
9-pos D-sub no. 2	**Out**	RD	Receive Data
9-pos D-sub no. 3	**In**	TD	Transmit Data
9-pos D-sub no. 4	**In**	DTR	Data Terminal Ready
9-pos D-sub no. 5	**–**	SG	Signal Ground
9-pos D-sub no. 6	**Out**	DSR	Data Set Ready
9-pos D-sub no. 7	**In**	RTS	Request To Send
9-pos D-sub no. 8	**Out**	CTS	Clear To Send
9-pos D-sub no. 9	**Out**	RI	Ring Indicate
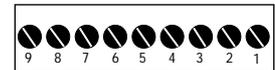
6.2.6 RS-232 (DCE) on TD-35 LV and TD-35 HV

Connection	Direction	Name	Description
9-pos screw block no. 1	**–**	SG	Signal Ground
9-pos screw block no. 2	**Out**	DSR	Data Set Ready
9-pos screw block no. 3	**In**	DTR	Data Terminal Ready
9-pos screw block no. 4	**Out**	DCD	Data Carrier Detect
9-pos screw block no. 5	**Out**	CTS	Clear To Send
9-pos screw block no. 6	**In**	RTS	Request To Send
9-pos screw block no. 7	**Out**	RD	Receive Data
9-pos screw block no. 8	**In**	TD	Transmit Data
9-pos screw block no. 9	**Out**	RI	Ring Indicate

TD-35 RS-422/485 LV and TD-35 RS-422/485 HV

Front DIP switch Lid
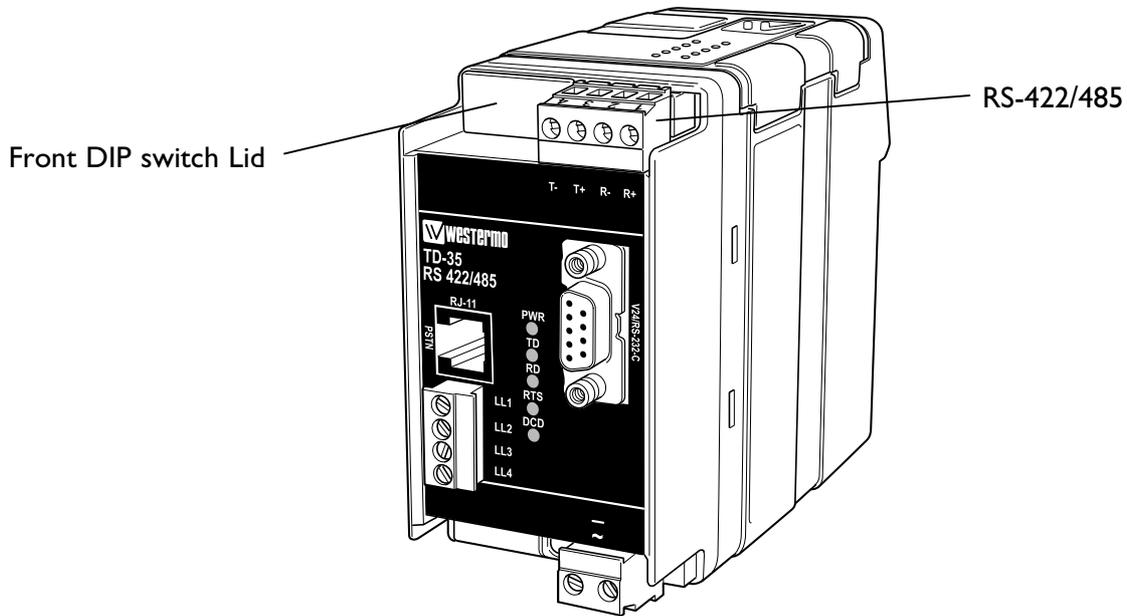
RS-422/485

6.2.7 RS-422/485 only TD-35 RS-422/485 LV and TD-35 RS-422/485 HV
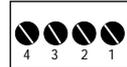
Connection	Direction	Description
4-pos screw block no. 1	**In**	RS-422 Receive R+
4-pos screw block no. 2	**In**	RS-422 Receive R–
4-pos screw block no. 3	**Out/In**	RS-485 / Transmit RS-422 T+
4-pos screw block no. 4	**Out/In**	RS-485 / Transmit RS-422 T–

6.3 LED Status Indicators

PWR	LED on LED off	Power On Power Off
TD	LED on LED off	Transmit Data Active Transmit Data Inactive
RD	LED on LED off	Receive Data Active Receive Data Inactive
RTS	LED on LED off	Request to Send Active Request to Send Inactive
DTR	LED on LED off	Data Terminal Ready Active Data Terminal Ready Inactive
DCD	LED on LED off	Data Carrier Detect Active Data Carrier Detect Inactive
DSR	LED on LED off	Data Set Ready Active Data Set Ready Inactive

6.4 Configuration

6.4.1 DIP-switch settings

DIP-switches are accessible under the lid on top of the unit. DIP-switches are used to configure the modem.

⚠ **Warning!**

Prevent damage to internal electronics from electrostatic discharges (ESD) by discharging your body to a grounding point (e.g. use of wrist strap), before the lid on top of the modem is removed.

⚠ **Warning! Do not open connected equipment.**

Prevent access to hazardous voltages by disconnecting the unit from AC/DC mains supply and all other electrical connections.

NOTE! The change of DIP-switch settings are valid only after a power on. If configured by any other method during normal operation, this new configuration override the DIP-switch settings. However, after a new power on the DIP-switch settings have precedence.
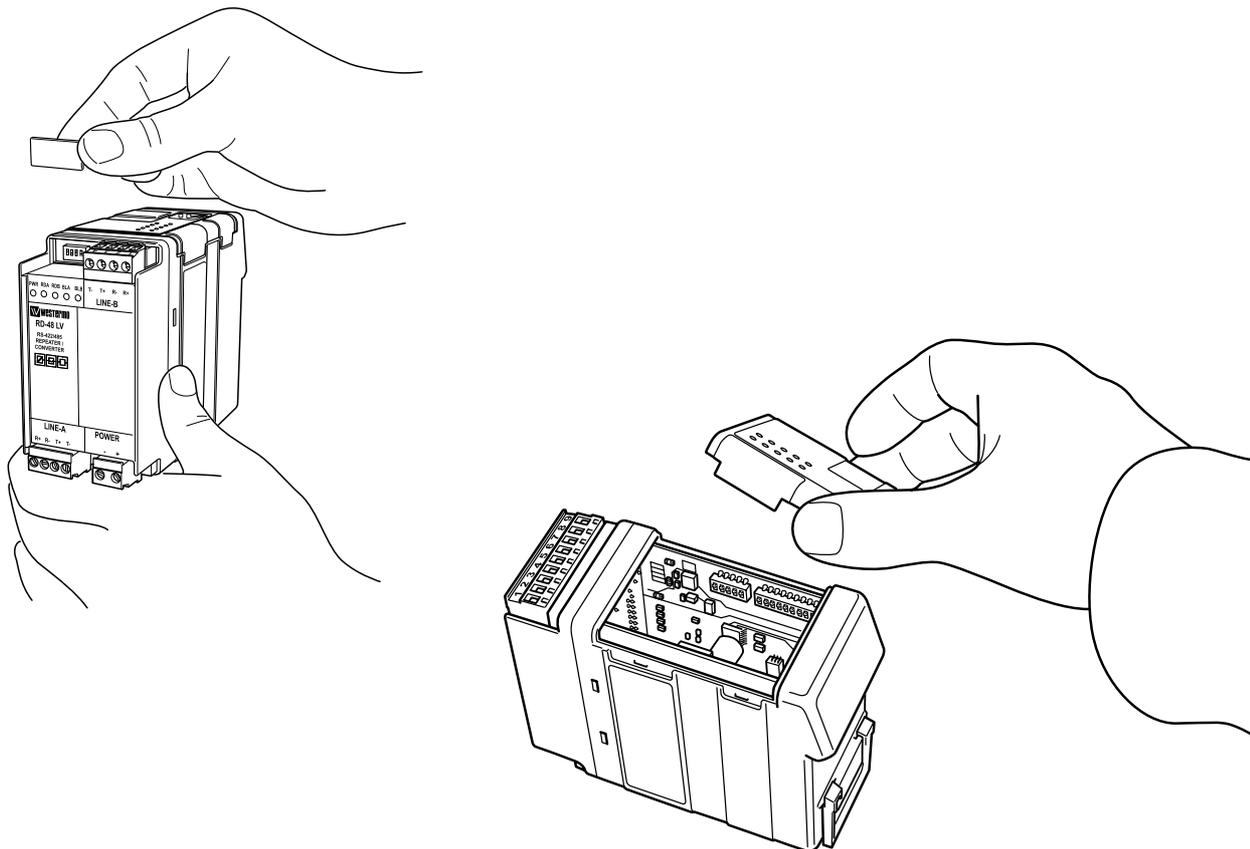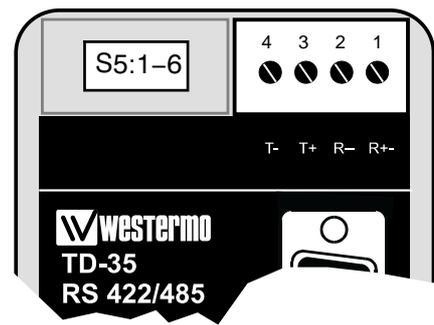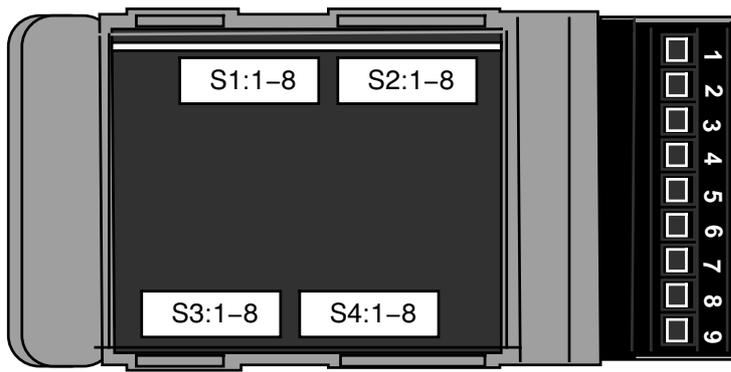
SW 1
General Settings
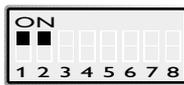
ON ▣▣ 1 2 3 4 5 6 7 8	Leased Line, Calling
ON ▣ 1 2 3 4 5 6 7 8	Leased Line, Answering
ON ▣ 1 2 3 4 5 6 7 8	AT&F *
ON ▣ 1 2 3 4 5 6 7 8	Disable Data Compression AT%C0
ON ▣ 1 2 3 4 5 6 7 8	Select reliable mode AT\N2
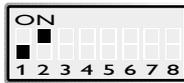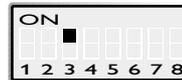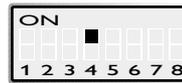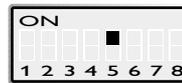
5–8 Not used. * If S1:3 is on no other switches (Sw 1 – SW 4) allows to be on at power up.

SW 2
Serial Format & Speed
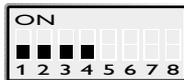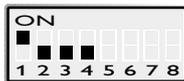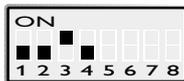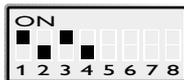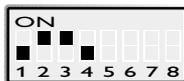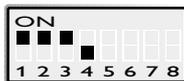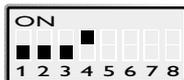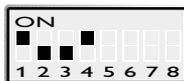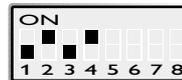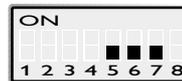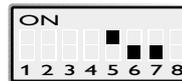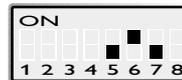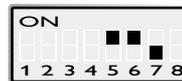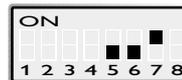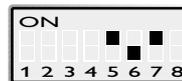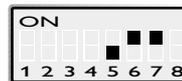
|			
ON 1 2 3 4 5 6 7 8	Autobaud	ON 1 2 3 4 5 6 7 8	115 200 bit/s
ON 1 2 3 4 5 6 7 8	300 bit/s	ON 1 2 3 4 5 6 7 8	7N, 2 stop bits
ON 1 2 3 4 5 6 7 8	600 bit/s	ON 1 2 3 4 5 6 7 8	7E
ON 1 2 3 4 5 6 7 8	1 200 bit/s	ON 1 2 3 4 5 6 7 8	7O
ON 1 2 3 4 5 6 7 8	2 400 bit/s	ON 1 2 3 4 5 6 7 8	8N
ON 1 2 3 4 5 6 7 8	4 800 bit/s	ON 1 2 3 4 5 6 7 8	8E
ON 1 2 3 4 5 6 7 8	9 600 bit/s	ON 1 2 3 4 5 6 7 8	8O
ON 1 2 3 4 5 6 7 8	19 200 bit/s	ON 1 2 3 4 5 6 7 8	Direct Mode 8E or 8O
ON 1 2 3 4 5 6 7 8	38 400 bit/s	ON 1 2 3 4 5 6 7 8	Direct Mode 7E, 7O or 8N
ON 1 2 3 4 5 6 7 8	57 600 bit/s	ON 1 2 3 4 5 6 7 8	2 stop bits

SW 3
Special AT services
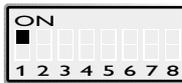
RTS/CTS
Flow Control Enable AT&K3
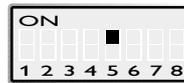
Line Monitor Disabled
and no retraining AT%E0
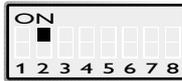
Reliable Mode Disable
AT\N0
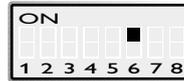
DTR/DSR disconnected
AT&S0&D0&C0
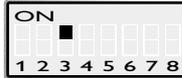
PLC settings
ATQ1E0&C1&K0&A1
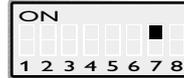
Escape sequence Disabled
ATE0Q1&C1

ATX3
(see description ATXn)
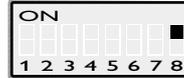
Abort disabled
AT&A1

SW 4
Line Modulation, Mode

Use saved parameters
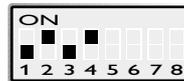
V32bis; 14 400 bit/s

V21; 300 bit/s
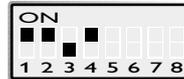
V34; 19 200 bit/s

V22; 1 200 bit/s
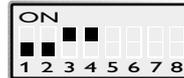
V34; 24 400 bit/s

V.22bis; 2 400 bit/s
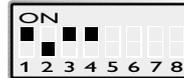
V34; 28 800 bit/s

V32bis; 4 800 bit/s
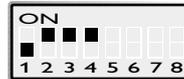
V34; 33 600 bit/s

V32bis; 7 200 bit/s
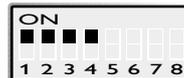
Automatic Line Speed

V32bis; 9 600 bit/s

4-wire Line Mode Enable
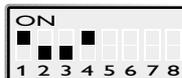
V32bis; 12 000 bit/s
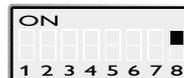
RS-422/485 Enable

5 and 6 not used

SW 5
Terminate RS-422/485
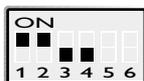
Terminate
RS-422

Terminate
RS-485

Enable
RS-485
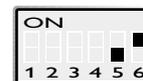
Enable
RS-422

Factory settings

S1

S2

S3

S4
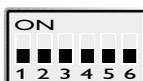
S5

7. AT Commands

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.

The modem will enter the connect state after exchanging carrier with the remote modem. If no carrier is detected within a period specified in register S7, the modem hangs up. Any character entered during the connect sequence will abort the connection attempt.

Please also refer to AT&An

&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.

&A0   Enables abort (**Default**)

&A1   Disables abort

Please also refer to AT&D

Bn – ITU-T 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.

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.

&Bn – DTR Dial Option

This command enables the modem to dial a number stored with &Zn=number when the DTR signal goes from inactive to active signal level.

&B0 No automatic call with DTR. (**Default**)

&B1 Call on DTR.

Please also refer to AT&Z, AT&D

\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 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.)

Cn – Carrier control

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

&Cn – RLSD (DCD) Option

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

&C0 RLSD remains ON at all times.
&C1 RLSD follows the state of the carrier. (**Default**)

%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**)

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.

NOTE:
If the ATD command is issued before the S1 register has cleared, the modem will respond with the NO CARRIER result code.

The modem will behave as a data modem and will attempt to connect to another data modem. The modem will have up to the period of time specified by register S6 to wait for carrier and complete the handshake. If this time expires before the modem can complete the handshake, the modem will go on-hook with the NO CARRIER response.This command will be aborted in progress upon receipt of any DTE character before completion of the handshake.

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

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 dialing only).
#	The 'gate' digit (tone dialing only).
A-D	DTMF digits A, B, C, and D. Some countries may prohibit sending of these digits during dialing.
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).

R	This command will be accepted, but not acted on.
S=n	Dial the number stored in the directory (n = 0 to 1). (See &Z.)
!	Flash: the modem will go on-hook for a time defined by the value of S29.
W	Wait for dial tone: the modem will wait for dial tone before dialing the digits following ”W“. If dial tone is not detected within the time specified by S6 or S7, 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 dialing tone before continuing with the dial string. If the tone is not detected within the time specified by S6 or S7, 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 dialing 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 enter call progress only after 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.

&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. Also, see S25.

&D0 DTR drop is interpreted according to the setting as follows: DTR is ignored (assumed ON). Allows operation with DTEs which do not provide DTR. (**Default**)

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

&D2 DTR drop is interpreted according to the setting as follows: DTR drop causes the modem to hang up. Auto-answer is inhibited.

&D3 DTR drop is interpreted according to the setting as follows: 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 – 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.

E1 Enables command echo. (**Default**)

%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**)

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.34/V.32 bis/V.32 (TD-33) modulation speeds. The modem will keep falling back within the current modulation if necessary until the speed reaches 2 400 bit/s (V.34) or 4 800 bit/s (V.32). Below this rate, the modem will only do retrains 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 current modulation speeds. The rate renegotiation 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, but not in direct mode.

Fn – Select Line Modulation

This command selects which type of modulation will be used on the phone line. If this parameter is set to something other than F0, the line speed will be fixed.
(See also the +MS command)

F0   Selects automatically line speed according to the preference of the remote modem. (**Default**)

F1   Selects 300 bit/s, V.21 (if B0 is set) or Bell 103 (if B1 is set).

F2   Not supported.

F4   Selects 1 200 bit/s, V.22 (if B0 is set) or Bell 212A (if B1 is set).

F5   Selects 2 400 bit/s, V.22bis.

F6   Selects V.32bis 4 800 bit/s or V.32 4 800 bit/s.

F7   Selects V.32bis 7 200 bit/s.
     This command also enables connection to Rockwell 7 200 V.32 speed,
     that is to a RC9696/12 based modem.

F8   Selects V.32bis 9 600 bit/s or V.32. 9 600 bit/s.

F9   Selects V.32bis 12 000 bit/s.
     This command also enables connection to Rockwell 12 000 bit/s V.32bis speed,
     that is to a RC9696/12 based modem.

F10 Selects V.32bis 14 400 bit/s.

&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.

&F Restore factory configuration.

*Gn – Password Enable/Disable

Controls whether or not the modem will handle Password and/or Callback functionality. Value is written to S14 bit 6.

*G0 Disables Password handling. (**Default**).
*G1 Enable Password handling.

See also *Pn and *L.

+GCI – Country Code

This selects the country code for the modem.

The command format is:

AT+GCI=<countrycode>

Where <countrycode> options are:

FD   Europe (**Default TD-35**)
09   Australia (**Default TD-35 AUS**)

For listing of the current configuration:

+GCI?

&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 1 800 Hz guard tone.

        This command may not be permitted in some countries.

Hn – Disconnect (Hang-Up)

This command initiates a hang up sequence.

    H0 The modem will release the line if the modem is currently on-line. 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.

\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**)

&K – Flow Control

Defines the DTE/DCE Flow Control. The parameter is written to S39 bits 0,1, and 2.

  &K0 Disables flow control. (**Default**)
  &K3 Enables RTS/CTS.
  &K4 Enables XON/XOFF.
  &K5 Enables transparent XON/XOFF.

-Kn – MNP Extended Services

Enables or disables conversion of a V.42 LAPM connection to an MNP 10 connection. The parameter value, if valid, is written to S40 bits 0 and 1.

  -K0 Disables V.42 LAPM to MNP 10 conversion. (**Default**)
  -K1 Enables V.42 LAPM to MNP 10 conversion.
  -K2 Enables V.42 LAPM to MNP 10 conversion; inhibits MNP Extended Services initiation during V.42 LAPM answer mode detection phase.

*L – Display Stored Passwords and Callback numbers

This commands displays stored Password and Callback numbers.

%L – Report Line Signal Level

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

L – Speaker Volume

Sets the speaker volume control. The parameter is written to S22 bits 0 and 1.

  L0 Low Volume
  L1 Low Volume
  L2 Medium Volume (**Default**)
  L3 High Volume.

M – Speaker Control

Speaker Control command. The parameter is written to S22 bits 2 and 3.

M0 Speaker is always off

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

M2 Speaker is always on.

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

+MS – Select Modulation

This extended-format command selects the modulation and, optionally, enables or disables automode, specifies the lowest and highest receive rates, and, specifies the highest transmit rate using one to six subparameters. The command format is:

+MS=<carrier>,<automode>,<min_tx_rate>,<max_tx_rate>,<min_rx_rate>,<max_rx_rate>
Where

<carrier> = A string which specifies the preferred modulation (automode enabled) or the modulation (automode disabled) to use in originating or answering a connection. The options are:

<carrier> Modulation Possible Rates (bit/s)

V21 V.21 300

V22 V.22 1 200

V22B V.22 bis 2 400 or 1 200

V23C V.23 1 200

V32 V.32 9 600 or 4 800

V32B V.32 bis 14 400, 12 000, 9 600, 7 200, or 4 800

V34 V.34 33 600, 31 200, 28 800, 26 400, 24 000, 21 600, 19 200, 16 800, 14 400, 12 000, 9 600, 7 200, 4 800, or 2 400

B103 Bell 103 300

B212 Bell 212 1 200

<automode>

0 disable

1 enable

<min_xx_rate>, <max_xx_rate>

Min and max data rates depending on modulation used (see below).

Reporting Supported Options

The modem can send a string of information to the DTE consisting of supported options using the following command:

+MS=?

or

For listing current configuration:

+MS?

\Nn – Operating Mode

This command controls the preferred error correcting mode to be negotiated in a subsequent data connection.

\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.)

\N2 Selects reliable (error-correction) mode. The modem will first attempt a 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 the same as \N2 except 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.) (**Default**)

\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.)

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, it 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.

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.

&Q – Async Mode

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

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

&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 asynchronous 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.

%Q – Report Line Signal Quality

Reports the line signal quality. 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.

*Pn – Store Password and Callback number

It is possible to store 2 different Passwords and Callback numbers in the modem.
This command works if command *G1 is used.
The command format is:
    *P0:Password#0:Callbacknumber#0
    *P1:Password#1:Callbacknumber#1
Password min. 6 characters max. 12 characters.
Callback number up to 18 characters.
If Password and Callback number is stored then the modem prompts the text "PASSWORD:" before releasing the connection and dialing back after a time given in S13.
If target is busy three retries will be executed.
If no Callback number is stored then the modem prompts the text "PASSWORD:" before switching into normal data transmission mode.
If no Password is stored then the modem prompts "CALLBACK NUMBER:" before releasing the connection and dialing back after a time given in S13.

&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.

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.
    V1 Enables long-form (verbose) result codes. (**Default**)

\Vn – Single Line Connect Message Enable

This command enables or disables the single line connect message format as follows:

\V0 Connect messages are controlled by the command settings X, W, and S95.
(Default)

\V1 Connect messages are displayed in the single line format described below subject to the command settings V (Verbose) and Q (Quiet). In Non-Verbose mode (V0), single line connect messages are disabled and a single numeric result code is generated for CONNECT DTE.

When single line connect messages are enabled, there are no CARRIER, PROTOCOL, or COMPRESSION messages apart from the fields described below.

The single line connect message format is:

CONNECT `<DTE Speed></Modulation></Protocol></Compression></Line`
`Speed>/<Voice and Data>`

Where:

<DTE Speed> = DTE speed, e.g., 57 600.

Modulation = "V34" for V.34 modulation.

        "V32" for V.32 or V.32bis modulation.

Note: Modulation is omitted for all other modulations.

Protocol = "NONE" for no protocol.

"ALT" for Microcom Network Protocol.

"LAPM" for LAP-M protocol.

Compression = "CLASS5" for Microcom MNP5 compression.

"V42BIS" for V.42bis compression.

Note: Compression is omitted if protocol is NONE.

Line Speed = Asymmetric rates are displayed as /rate:TX/rate:RX, e.g., /1 200 TX/75 RX.

Symmetric rates are displayed as a single DCE rate, e.g., 14 400.

Voice and Data = Blank for Data mode only.

LAPM-SREJ = Selective reject.

&V – Display Current Configuration and Stored Profiles

&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 operational as detected by the NVRAM test during reset processing.

Example:

AT&V

ACTIVE PROFILE:

B0 E1 L2 M1 N1 QO T V1 W0 X4 Y0 &C0 &D0 &G2 &K0 &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 L2 M1 N1 QO T V1 W0 X4 Y0 &C0 &D0 &G2 &K0 &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 L2 M1 N1 QO T V1 W0 X4 Y0 &C0 &D0 &G2 &K0 &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 =

&V1 – Display Last Connection Statistics

Displays the last connection statistics in the following format (shown with typical results):

```
TERMINATION REASON.......... LOCAL REQUEST
LAST TX rate................ 33 600 BIT/S
HIGHEST TX rate............. 33 600 BIT/S
LAST RX rate................ 33 600 BIT/S
HIGHEST RX rate............. 33 600 BIT/S
PROTOCOL.................... LAPM
COMPRESSION................. V42Bis
Line QUALITY................ 033
Rx LEVEL.................... 015
Highest Rx State............ 67
Highest TX State............ 67
EQM Sum..................... 00C2
RBS Pattern................. FF
Rate Drop................... FF
Digital Pad................. None
Local Rtrn Count............ 00
Remote Rtrn Count........... 00
Flex fail
```

RBS Pattern: Shows the number of least significant bits robbed per 6 bytes.

Digital Pad: Shows if a pad was encountered and if so, what was the digital loss.

Flex: Shows V.8bis information as follows:

First byte: Octet 13 (second byte of manufacturer id, 94 = K56flex)
Second byte: Octet 14 (Licensee code: 81 = Rockwell)
Third byte: Octet 15 (manufacturer's product capabilities)
Fourth byte: Octet 16 (K56flex version number)
Fifth byte: Octet 17 (Rockwell pump code version number)
Sixth byte: Octet 18 (x-law and controller version number)
Bit 4:0 Controller version

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.

W0 Upon connection, the modem reports only the DTE speed (e.g., CONNECT 19 200). 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 14 400). Subsequent responses are disabled.

&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 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 a 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.

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 dialing 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.

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 dialing 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 dialing 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 DIALTONE, 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; send only OK, CONNECT, RING, NO CARRIER, ERROR, NO ANSWER, and CONNECT XXXX. Blind dialing 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; send all messages. The value 111b is written to S22 bits 6, 5, and 4, respectively. (**Default**)

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 non-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.

&Yn – Designate a Default Reset Profile

This command selects which user profile will be used after a hard reset.

 &Y0 The modem will use profile 0. (**Default**)
 &Y1 The modem will use profile 1.

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.

&Zn=x – Store Telephone Number

The modem can store up to two telephone numbers and each telephone number dial string can contain up to 34 digits.

 &Zn=x n = 0 to 1 and x = dial string.

8. Result Codes

Short-form	Long-form
0	OK A command line has been executed.
1	CONNECT For X command values specifying no speed reporting, the modem has connected to the line and either the line speed is 300 bit/s and line speed is enabled, or the DTE speed is 300 bit/s and DTE speed reporting is enabled.
2	RING An incoming ring signal is detected on the line.
3	NO CARRIER Sent 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. Also sent when the modem auto-disconnects due to loss of carrier. For X0, sent for the following conditions: 1. If busy tone detection is enforced, busy or circuit busy has been detected. 2. If dial tone detection is enforced or selected, dial tone has not been detected.
4	ERROR Sent during an attempt to execute a command line if any of the following conditions occur: 1. The command line contains a syntax error. 2. The modem cannot execute a command contained in the command line, i.e., the command does not exist or is not supported. 3. A command parameter within the command line is outside the permitted range. For X0, X1, X2, and X3, this message is sent instead of DELAYED and BLACKLISTED.
5	CONNECT 1 200 The modem has connected to the line and either the line speed is 1 200 bit/s and DCE speed reporting is enabled, or the DTE speed is 1 200 bit/s and DTE speed reporting is enabled.
6	NO DIALTONE For X2 and X4, the modem has been instructed to wait for dial tone during dialing but none is received.
7	BUSY For X3 and X4, if busy tone detection is enforced, the busy (engaged) signal is detected on the line when the modem is attempting to originate a call.
8	NO ANSWER The modem is 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 The modem has connected to the line, the DTE speed is 600 bit/s, and DTE speed reporting is enabled.
10	CONNECT 2 400 The modem has connected to the line and either the line speed is 2 400 bit/s and DCE speed reporting is enabled, or the DTE speed is 2 400 bit/s and DTE speed reporting is enabled.
11	CONNECT 4 800 The modem has connected to the line and either the line speed is 4 800 bit/s and DCE speed reporting is enabled, or the DTE speed is 4 800 bit/s and DTE speed reporting is enabled.
12	CONNECT 9 600 The modem has connected to the line and either the line speed is 9 600 bit/s and DCE speed reporting is enabled, or the DTE speed is 9 600 bit/s and DTE speed reporting is enabled.
13	CONNECT 7 200 The modem has connected to the line at 7 200 bit/s and DCE speed reporting is enabled.
14	CONNECT 12 000 The modem has connected to the line at 12 000 bit/s and DCE speed reporting is enabled.
15	CONNECT 14 400 The modem has connected to the line at 14 400 bit/s and DCE speed reporting is enabled.
16	CONNECT 19 200 The modem has connected to the line and either the line speed is 19 200 bit/s and DCE speed reporting is enabled, or the DTE speed is 19 200 bit/s and DTE speed reporting is enabled.
17	CONNECT 38 400 The modem has connected to the line, the DTE speed is 38 400 bit/s, and DTE speed reporting is enabled.
18	CONNECT 57 600 The modem has connected to the line, the DTE speed is 57 600 bit/s, and DTE speed reporting is enabled.

Short-form	Long-form
19	CONNECT 115 200 The modem has connected to the line, the DTE speed is 115 200 bit/s, and DTE speed reporting is enabled.
22	CONNECT 75TX/1 200RX The modem has established a V.23 originate connection and line speed reporting is enabled.
23	CONNECT 1 200TX/75RX The modem has established a V.23 answer connection and line speed reporting is enabled.
24	DELAYED For X4, sent when a call fails to connect and the number dialled is considered 'delayed' due to country blacklisting requirements.
32	BLACKLISTED For X4, sent when a call fails to connect and the number dialled is considered 'blacklisted'.
40	CARRIER 300 The modem has connected to the line at 0–300 bit/s and carrier reporting is enabled. (See S95 and Xn.)
44	CARRIER 1 200/75 The V.23 backward channel carrier is detected and carrier reporting is enabled. (See S95 and Xn.)
45	CARRIER 75/1 200 The V.23 forward channel carrier is detected and carrier reporting is enabled. (See S95 and Xn.)
46	CARRIER 1 200 The modem has connected to the line at 1200 bit/s and carrier reporting is enabled. (See S95 and Xn.)
47	CARRIER 2 400 The modem has connected to the line at 2400 bit/s and carrier reporting is enabled. (See S95 and Xn.)
48	CARRIER 4 800 The modem has connected to the line at 4 800 bit/s and carrier reporting is enabled. (See S95 and Xn.)
49	CARRIER 7 200 The modem has connected to the line at 7 200 bit/s and carrier reporting is enabled. (See S95 and Xn.)
50	CARRIER 9 600 The modem has connected to the line at 9 600 bit/s and carrier reporting is enabled. (See S95 and Xn.)
51	CARRIER 12 000 The modem has connected to the line at 12 000 bit/s and carrier reporting is enabled. (See S95 and Xn.)
52	CARRIER 14 400 The modem has connected to the line at 14 400 bit/s and carrier reporting is enabled. (See S95 and Xn.)
53	CARRIER 16 800 The modem has connected to the line at 16 800 bit/s and carrier reporting is enabled. (See S95 and Xn.)
54	CARRIER 19 200 The modem has connected to the line at 19 200 bit/s and carrier reporting is enabled. (See S95 and Xn.)
55	CARRIER 21 600 The modem has connected to the line at 21 600 bit/s and carrier reporting is enabled. (See S95 and Xn.)
56	CARRIER 24 000 The modem has connected to the line at 24 000 bit/s and carrier reporting is enabled. (See S95 and Xn.)
57	CARRIER 26 400 The modem has connected to the line at 26 400 bit/s and carrier reporting is enabled. (See S95 and Xn.)
58	CARRIER 28 800 The modem has connected to the line at 28 800 bit/s and carrier reporting is enabled. (See S95 and Xn.)
59	CONNECT 16 800 The modem has connected to the line, the DTE speed is 16 800 bit/s and DTE speed reporting is enabled.
61	CONNECT 21 600 The modem has connected to the line, the DTE speed is 21 600 bit/s and DTE speed reporting is enabled.
62	CONNECT 24 000 The modem has connected to the line, the DTE speed is 24 000 bit/s and DTE speed reporting is enabled.
63	CONNECT 26 400 The modem has connected to the line, the DTE speed is 26 400 bit/s and DTE speed reporting is enabled.

Short-form	Long-form
64	CONNECT 28 800 The modem has connected to the line and either the line speed is 28 800 bit/s and DCE speed reporting is enabled, or the DTE speed is 28 800 bit/s and DTE speed reporting is enabled.
66	COMPRESSION: CLASS 5 The modem has connected to the line in MNP Class 5 and COMPRESSION message reporting is enabled. (See S95, Wn, and Xn.)
67	COMPRESSION: V.42 bis The modem has connected to the line in V.42 bis and COMPRESSION message reporting is enabled. (See S95, Wn, and Xn.)
69	COMPRESSION: NONE The modem has connected to the line without data compression and COMPRESSION message reporting is enabled. (See S95, Wn, and Xn.)
70	PROTOCOL: NONE The modem has connected to the line without any form of error correction and the PROTOCOL message reporting has been enabled. (See S95, Wn, and Xn.)
77	PROTOCOL: LAPM The modem has connected to the line in V.42 LAPM error correction mode and PROTOCOL message reporting has been enabled. (See S95, Wn, and Xn.)
78	CARRIER 31 200 The modem has connected to the line at 31 200 bit/s and carrier reporting is enabled. (See S95 and Xn.)
79	CARRIER 33 600 The modem has connected to the line at 33 600 bit/s and carrier reporting is enabled. (See S95 and Xn.)
80	PROTOCOL: ALT Sent when the modem has connected in the MNP mode of error correction, and PROTOCOL message reporting has been enabled. (See S95, Wn, and Xn.)
84	CONNECT 33 600 The modem has connected to the line, the DTE speed is 33 600 bit/s and the DTE speed reporting is enabled.
91	CONNECT 31 200 The modem has connected to the line DTE speed is 31 200 bit/s and the modem is to report the DTE speed upon connecting.

9. S-registers

S0 – Number of Rings to Auto-Answer
S0 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 (TD-35 AUS D.2)

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 recognized.
Range: 0–255, ASCII decimal
Default: 43 (+)

S3 – Carriage Return Character
S3 sets the command line and result code terminator character.
Range: 0–127, ASCII decimal
Default: 13 (Carriage Return)

S4 – Line Feed Character
S4 sets the character recognized 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
S5 sets the character recognized as a backspace. The modem will not recognize 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 before Blind Dialing or for Dial Tone

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: 2–60 seconds

Default: 3

S7 – Wait Time for Carrier, Silence, or Dial Tone

S7operation is country dependent.

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 dialing (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

S8 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

S9 is supported for backwards compatibility only. No value can be written. Responds with default value.

Range: 6 tenths of a second

Default: 6 (0.6 second)

S10 – Lost Carrier To Hang Up Delay

S10 sets the length of time, in tenths of a second, that the modem waits before hanging up after a loss of carrier. This allows for 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 recognizes the carrier.

Range: 1–255 tenths of a second

Default: 14 (1.4 seconds)

S11 – DTMF Tone Duration

S11 operation is country dependent.

Range: 50–255 milliseconds

Default: 95 (95 milliseconds) (TD-35 AUS **Default: 70**)

S12 – Escape Prompt Delay (EPD)
S12 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.
Range: 0–255 1/50 of a second
Default: 50 (1 second)

S13 – Callback delay time
S13 defines the time between that the modem releses connection and dials a stored call-back number.
Range: 0–255 seconds
Default: 10 (10 seconds)

S14 – General Bit Mapped Options Status
S14 indicates the status of command options.
Default: 138 (8Ah) (10001010b)
Bit 0 This bit is ignored.
Bit 1 Command echo (En)
   0 = Disabled (E0)
   1 = Enabled (E1) (**Default**)
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)
   1 = Verbose (V1) (**Default**)
Bit 4 Dial Abort Option (&An)
   0 = Enable (&A0) (**Default**)
   1 = Disable (&A1)
Bit 5 Tone (T)
   0 = Tone (T) (**Default**)
Bit 6 Password (*Gn)
   0 = Disabled (*G0) (**Default**)
   1 = Enabled (*G1)
Bit 7 Originate/Answer
   0 = Answer
   1 = Originate (**Default**)

S21 – V.24/General Bit Mapped Options Status
S21 indicates the status of command options.
Default: 36 (24h) (00100100b)
Bit 0 Reserved (0)
Bit 1 Reserved (0)
Bit 2 CTS behavior (&Rn)
   0 = CTS tracks RTS (&R0)
   1 = CTS always on (&R1) (**Default**)
Bits 3–4 DTR behavior (&Dn)
   0 = &D0 selected (**Default**)
   1 = &D1 selected
   2 = &D2 selected
   3 = &D3 selected
Bit 5 RLSD (DCD) behavior (&Cn)
   0 = &C0 selected
   1 = &C1 selected (**Default**)
Bit 6 DSR behavior (&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
S22 indicates the status of commands options.
Default: 118 (76h) (01110110b)
Bits 0–1 Speaker volume (Ln)
      0 = Off(L0)
      1 = Low(L1)
      2 = Medium(L2) (**Default**)
      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
Bits 4-6 Limit result codes (Xn)
      0 = X0
      4 = X1
      5 = X2
      6 = X3
      7 = X4 (**Default**)
Bit7   Reserved

S25 – Delay To DTR

S25 sets the length of time that the modem will ignore DTR for taking the action specified by &Dn. Its units are one hundredths of a second for other modes.
Range: 0–255 (0.01 seconds)
Default: 5 (0.05 seconds)

S29 – Flash Dial Modifier Time

S29 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 (0 ms) (TD-35 AUS **Default: 9**)

S30 – Disconnect Inactivity Timer

S30 sets the length of time, in tens of seconds, that the modem will stay online 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 (0–2 550 seconds)
Default: 0 (disabled)

S31 – Bit Mapped Options Status
Default: 192
S31 indicates bit mapped options status.
Bit 0 Single line connect message enable/disable (\Vn)
   0 = Messages controlled by S95, Wn and Vn (\V0) (**Default**)
   1 = Single line connect message (\V1)
Bit 1 Auto line speed detection (Nn)
   0 = Disabled (N0) (**Default**)
   1 = Enabled (N1)
Bits 2–3 Error correction progress messages (Wn)
   0 = DTE speed only (W0) (**Default**)
   1 = Full reporting (W1)
   2 = DCE (line) speed only (W2)
Bits 4–5 Not used
   0 = (**Default**)
Bits 6–7 Reserved (**Default** = 11b)

S36 – LAPM Failure Control
Default: 7 (00000111b)
Bits 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**)
Bits 3–7 Reserved

S38 – Delay Before Forced Hang Up
S38 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
Bits 0–2 Status of command options
    0 = No flow control (**Default**)
    3 = RTS/CTS
    4 = XON/XOFF
    5 = Transparent XON
Bits 3–7 Reserved

S40 – General Bit Mapped Options Status
S40 indicates the status of command options.
Default: 168 (A8h) (10101000b)
Bits 0–1 MNP Extended Services (-Kn)
   0 = Disable extended services (-K0) (**Default**)
   1 = Enable extended services (-K1)
   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 Reserved

S41 – General Bit Mapped Options Status
S41 indicates the status of command options.
Default: 195 (C3h) (11000011b)
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**)
Bits 2, 6 Auto retrain and fallback/fall forward (%En)
Bit 6 Bit 2
   0 0 = Retrain and fallback/fall forward disabled (%E0)
   0 1 = Retrain enabled (%E1)
   1 0 = Fallback/fall forward enabled (%E2) (**Default**)
Bit 3 Reserved
Bits 4–5 Reserved
Bit 7 Reserved

S46 – Data Compression Control
S46 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.

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. Range: 0–24, the cause codes are:

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

S91 sets the transmit attenuation level for the PSTN mode.

Range: 0 to 15

Default: 10

S95 – Extended Result Codes

A bit set to a 1 in this register will enable the corresponding result code regardless of the W setting.

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).

Bit 2 Enable +MCR: XXXX result code (XXXX = rate).

Bit 3 Enable +ER: XXXX result code (XXXX = protocol identifier).

Bit 4 Reserved.

Bit 5 Enable +DR: result code (XXXX = compression type).

Bit 6 Reserved.

Bit 7 Reserved.

10. Glossary

ASCII

A binary code system which defines 128 characters using different combinations of 1s and 0s. ASCII = American Standard Code for Information Interchange.

Asynchronous Data

Transmission where the characters are transmitted one at a time, starting with a start bit and ending with a stop bit. About 90–95% of all serial data communications are asynchronous.

Baud

The number of data symbols transmitted every second. Often baud = bit/s. Sometimes a few data symbols can represent several bits since different coding are used to compress data.

Buffer

A memory for storing data for a short time, e.g. until the receiver is ready.

Byte

A byte is a number of data bits (1s or 0s) which forms a character. Most often a character consists of 7 or 8 bits.

DCE

Describes which direction the signals in the RS-232/V.24 contact have. Modems are often DCE. DCE = Data Communication Equipment.

DIN rail

An installation rail which is used in apparatus cubicles to set up different equipment on a simple way. DIN = Deutsche Industri Norme.

DTE

Same as DCE but the signals are directed on opposite directions. Terminals, PC's and printers are most often DTE. DTE = Data Terminal Equipment.

Data Compression and Error Correction.

V.42	ITU-T's error correction protocol incorporating LAPM. If the V.42 connection fails then usually MNP will be tried.
LAPM	Link Access Procedure for Modems. An error correction method used in transmissions via PTT modems.
MNP	Microcom Networking Protocol. Several methods for error correction and data compression for PTT modems.

    MNP 1: Asynchronous Protocol, half duplex.

    MNP 2: Asynchronous Protocol, full duplex, Data is divided into blocks (slower data rate).

    MNP 3: Synchronous Protocol, full duplex. Data in blocks (higher speeds with no errors).

    MNP 4: Similar to 3, but with smaller data blocks allowing for faster data rates with no errors.

    MNP 5: Level 4 with data compression, gives about double the data rate.

    MNP 10: Development of MNP5 with dynamic line monitoring and block size adjustment, used on very bad lines (cellular phone connections).

ARQ	Automatic Repeat reQuest. When incorrect data is detected a request to retransmit the data is made to the remote modem.
V.42bis.	Data Compression technique used by modems rather than MNP5, because it offers better transmission on already compressed data.

Data Rate
In modems this is often different to the baud rate. For instance the Data Rate of V.32bis is 14 400bit/s and the baud rate is 2 400 symbols/second.

Direct Mode
The Data to be transmitted is sent directly to the data pump (the modem circuit). No compression, error correction or buffering occurs, allowing the data to be transmitted across the link unaltered by the modem.

Duplex
Means that the communication is bi-directional. In half duplex, the devices take turns sending and receiving. In full duplex, sending and receiving can take place simultaneously.

Hayes commands
A set of commands for controlling PTT modems. Often referred to as the AT command set, since all commands are started with AT. Most modems support these commands, but there are variations and commands that are specific for a certain modem.

ISP
Internet Service Provider.

LED
Light-Emitting Diode. A semi-conductor which emits light when it receives an electrical current. In modems they are used as indicators for data and status signals.

Modem
Acronym of the words modulator and demodulator. Modulates or transforms the signal from computer equipment into electrical or acoustic signals for transmission. The receiver has a similar modem which retransforms the signal, demodulation.
Modem Modulation Standards

V.21	300 bit/s, similar to Bell 103
V.23	1 200/75 bit/s Split speed line
V.22	1 200 bit/s full duplex.
V.22bis	2 400 bit/s full duplex.
V.32	9 600 bit/s full duplex.
V.32bis	14 400 bit/s full duplex.
V.34	33 600 bit/s full duplex.

Modulation Techniques

DPSK
Differential Phase Shift Keying. Employed in data rates up to 4 800 bit/s.

FSK
Frequency Shift Keying. Used in the lowest data rate standards.

QAM
Quadrature Amplitude Modulation. A technique used for data rates up to 9 600 bit/s.

TCM
Trellis Coded Modulation. Used in the high speed modulations.

NVRAM
Non Volatile Random Access Memory. Consists most often by an EEPROM (Electronically Eraseable and Programmable memory). Used by the modem to store profile information and numbers even when the unit has no power.

Normal Mode
A non error corrected connection, where data is buffered.

Off Hook
Like picking up the receiver. Connecting to a line.

On Hook
Like hanging up the receiver. Disconnecting.

PSTN
Public Switched Telephone Network, i.e. a normal telephone line on which other subscribers can be called.

Parity
A mathematically derived bit which is added by the transmitter. The receiver checks it to detect any error in transmission. Occurring parities are even, odd and none.

REN Number
The Ringer Equivalence Number (REN) is a way of measuring the load on the telephone line caused by the connected equipment.

RS-232/V.24 Signals

TD
Transmitted Data. Data going from DTE to DCE.

RD
Received Data. The Data going from DCE to DTE.

RTS
Request To Send from DTE.

DSR
Data Set Ready. The DCE-equipment is powered and usable.

DTR
Data Terminal Ready. The DTE-equipment is powered and usable.

DCD
Data Carrier Detect. A signal from the DCE indicating that a carrier is present on the line.

Simplex
Uni-directional communication.

Start bit
Marks the start of a character at asynchronous communication.

Stop bit
One or more stop bits marks the end of a character at asynchronous communication. Systems that require more than one stop bit may have problems during communication via modems, since modems most often remove the second stop bit.

11. Application Examples

Several commands can be stacked on each command-line. For example:
ATE0Q1\N4D12345
can be used instead of:

```
ATE0
OK
ATQ1
OK
AT\N4
OK
ATD12345
```

with the same result.

11.1 To use MINICALL (Pager systems)
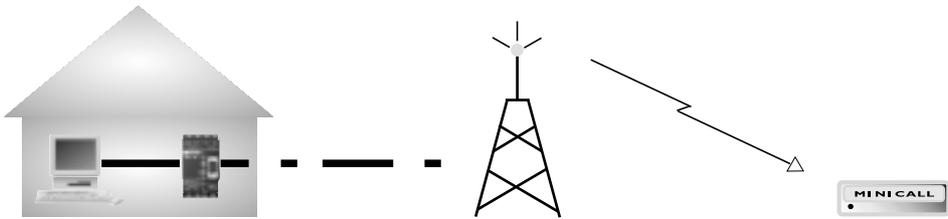
ATS6=60	Waits for tone in maximum 60 seconds.
OK	
ATD^0746xxxxxxW0yyyyyyyy#,.	Dot gives disconnection.
	Comma gives a pause.
	The telephone number shall end with # according to instructions.
	Area code and telephone numbers that will be shown on the MINICALL.
	Waiting for tone.
	Number to MINICALL search.
	Takes away calling tone.
OK	With successful dial-up.
or	
NO DIALTONE	With failure.

11.2 Frequently used settings for PLC-systems and industrial applications
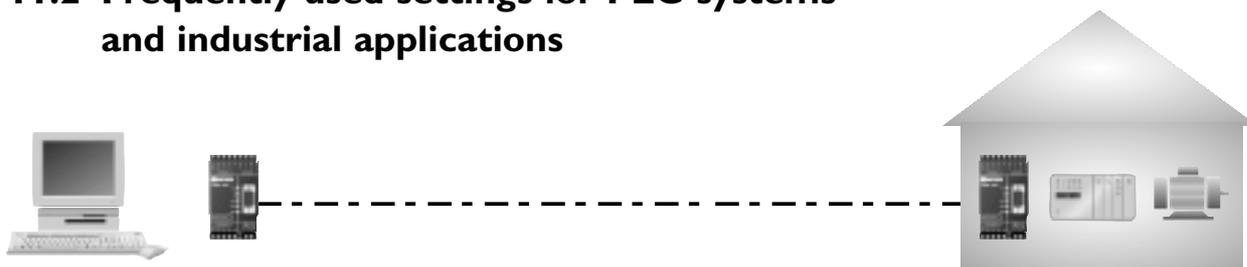
Most PLC-systems and other industrial applications where modems are used require the same changes to the standard settings.

The most commonly encountered problems concern speed, parity and control signals from the connected equipment.

Speed and parity are changed with the switches under the cover in block SW2. If this action does not solve the problem the modem's answering codes and possible echoing of commands might be the source of the difficulty.
Below follows a list of commands that might resolve the problems. The commands may of course be placed on one single command line if desired.
(Se example to the left)

ATV0	Gives the answering codes in short format. (digits)
ATQ1	No result codes are sent on the RS-232/V.24 connection.
ATE0	Commands that are sent from the terminal/computer etc. are not echoed back to the RS-232/V.24 connection.
AT&C1	DCD will follow the carrier on the line.
AT&K0	No handshaking.
AT&A1	Character abort option on.

Note: SW3:3 may be used for this purpose.
For further information regarding these commands please refer to the specific section of this manual.

11.3 Dial up with hardware signalling
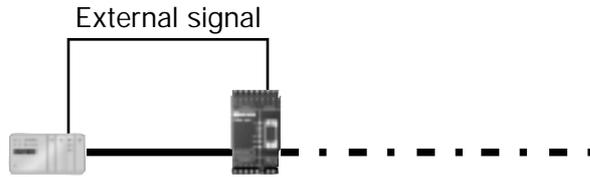
External signal

Dial up can be made by applying an external signal to the DTR-pin in the RS-232/V.24 contact. A typical application is an alarm signal from a PLC or another relay contact.

The modem reacts on the first rising edge which means that one pulse is sufficient.
The signal level should be in compliance with the RS-232/V.24 standard. If only a relay contact is available the DSR-pin will provide a suitable voltage.

The modem does not have a redialling function. If necessary this must be handled by other equipment connected. We recommend that the DCD signal is used as a control indicating whether or not connection was made.

AT&B1 Dial-up using DTR.
    AT&D3   Hang-up if DTR goes low.
    AT&Z0=nn   The number to dial, nn, is stored in memory position 0.

Please also refer to "To use minicall", as the minicall and the dial-up with hardware signalling can be used together.

11.4 Leased line applications
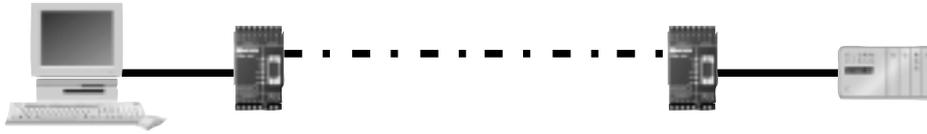
Leased line connections can be set up using either 2-wire or 4-wire.

When renting a 4-wire line from a telephone company one pair of cables for transmission and one pair for reception are usually provided.

The maximum transmission distance depends on the attenuation of the line. The maximum value is theoretically 30 dBm. To have a good error rate it is recommended to keep the attenuation under 20 dB, which is approximately 20 km in distance. When renting lines from a telephone company a longer transmission distance is normally possible as the signals are probably transmitted over PCM-lines, i.e. fibre optic or other media with low attenuation.

The best way to set the modem for leased line applications is to use the dip switches.

The settings should be as follows:

SW1:1 and 2 in modem no 1 ON and only SW1:2 in modem no 2 ON.
SW4:7 should be OFF for 2-wire and ON for 4-wire.
SW2 sets speed and parity for the RS-232 port.
SW4 decides line-speed. Must be set in direct mode applications.

Connection see page 7.

## 11.5 RS-422/485 Termination

Termination recommendations
The RS-422/485 line must be terminated. The receiver of master and receiver of final bus slave shall be terminated.

RS-422/485 connection pins can be differently named. For some brands the T+ corresponds to A, but other brands might use some other naming convention.
If a unit does not work it can help to swap A and B.

4-wire termination

| R+ |
| R– |
| T+ |
| T– |

TD-35
RS-422

☐ =Termination

R– R+ T– T+ R– R+ T– T+   B' A' B A

RS-422 UNIT   RS-422 UNIT   RS-422 UNIT

2-wire termination

| T+ |
| T– |

TD-35
RS-485

☐ =Termination

B A   B A   Max 0.3 metre   B A

RS-485 UNIT   RS-485 UNIT   RS-485 UNIT

Application example

2/4-wire leased line

TD-35   TD-35

RS-485

RS-232

Subsidiaries