D-Modem

AT Command Reference

The modem core of `dmodemd`, libdmodem and the `PBX` modules

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I Introduction

This manual gives the AT command set of the modem core of D-Modem (`core/` in the source). All D-Modem programs use this core. The core accepts the commands from these programs:

- **`dmodemd`**: the modem on a pseudo terminal (`/dev/ttyDM0` is a link to it). Its line is a `SIP` call. With `-a` and `-usb`, its line is an analogue telephone line.
- **libdmodem** (`dmodem.h`): the modem as a library. The program that contains the library sends the commands.
- The **Asterisk and FreeSWITCH modules** (`app_dmodem`, `mod_dmodem`). The profiles of these modules give the commands that start each call.

Feature Overview

- **Data** from 300 bit/s to 56000 bit/s: V.21, V.22, V.22bis, V.23, Bell 103 and 212A, V.32, V.32bis, V.34 up to 33600 bit/s, and V.90 and V.92 as the digital modem. Automode finds the best modulation that the two modems have (Section 7).
- **Error correction and compression**: V.42 (LAPM) and MNP 2 to 5 for error correction. V.42bis, V.44, MNP 5 and zstd for compression (Sections 8 and 9).
- **V.92's extras**: quick connect, PCM upstream and modem-on-hold. With modem-on-hold, you can answer a waiting call and then return to the data call.
- **Fax**: Class 1 (T.31), Class 2 and Class 2.0 (T.32), up to 14400 bit/s with V.17. Adaptive answer finds if a call is a fax call or a data call (Section 14).
- **Voice** (V.253): play and record audio, send and detect DTMF and tones, use a handset, and change a voice call into a fax call or a data call (Section 18).
- **Text telephones** (V.18): the 5-bit TTY of the deaf community, telex and RTTY, DTMF, EDT, Bell 103, the V.23 of Minitel, the V.21 text telephones, the mode of V.18, and automode between these modes (Section 15).
- **Caller ID** from a SIP call or from a telephone line (FSK and DTMF). In voice mode, the caller ID of a waiting call.
- **Leased lines**, 2-wire and 4-wire (V.29, V.33, V.27ter), with the simulated carrier control of V.13.
- **Digital channels**: V.91 between two digital modems, the clear 64000 bit/s channel of an ISDN data call (X.75, PPP, V.110, V.120) (Section 11), and the synchronous access of V.80.
- **V.cvm** for data on mobile speech paths, and **V.wb**, a wideband modem for a dry pair.
- **Diagnostics**: the statistics of the last call (ATI11, AT&V1, AT#UD) and loop tests (AT&T).
- **The setup strings of other modems** work. The modem accepts the commands of V.250, Rockwell and Conexant, and USRobotics modems. Most of these commands have no effect. Their entries tell you this.

Each command, range, *default* and response in this manual comes from the core. If a setting has no effect, its entry tells you.

How to Read This Manual

All command entries have the same structure:

- A strip with the name and the title of the command.
- A description of the function of the command.
- If applicable, the syntax, the result codes and a numbered table of the values. The table marks the *default* with *(default)*.

Table 1 lists all commands and has a link to the entry of each command. This manual shows the commands in capital letters, but the modem accepts the two cases. *n* is a decimal number and *h* is a hexadecimal number. `[ ]` shows an item that you do not have to type. The *default* of a setting is the value that `ATZ` sets. The program also sets this value when it starts.

The type style of the text shows what the text is:

- `Red monospace` is a command or a part of a command, as you type it (`ATD`, `+MS=V92`). If it is a link, it goes to the entry of that command.
- `Monospace on blue` is what the modem sends back: a result code or a different response, as the screen of the `DTE` shows it (`OK`, `CONNECT 33600`, `NO CARRIER`).
- `Plain monospace` is a standard, a signal or a term from a standard (`V.34`, `CNG`), an acronym (`DTE`), or a number, for example a speed (`33600` bit/s).
- *Italics* show a value that you must supply (`ATS`*n*).

II Common Terms

This section gives the terms that this manual uses frequently. The glossary (Section 22) gives the terms that are less frequent.

Answer tone
: The tone that a modem sends first when it answers a call: 2100 Hz (`ANS`). `V.8` modems send `ANSam`: the same tone, with a slow change of its amplitude. A calling modem that hears the answer tone starts its part of the handshake.

`AT` command
: `AT` is short for "attention". An `AT` command is an instruction to the modem. It is text that starts with the letters `AT`, for example `ATZ`. One line can contain more than one command (`ATE1Q0V1`).

Basic and extended commands
: A basic command is a letter and a number (`E1`, `&K3`). Some basic commands have `&`, `\` or `%` before the letter. Extended commands start with `+` or `-` and accept values (`+MS=V92`).

Baud
: Symbols per second: the number of times in one second that the modem changes its signal. Each symbol can carry more than one bit. Thus, the bit/s of a connection is frequently higher than its baud: `V.34` sends up to 3429 baud but 33600 bit/s. The sellers of old modems gave the speed in baud. For this reason, people frequently confuse the two words.

bit/s
: Bits per second, the speed of a connection. `CONNECT` gives this speed.

Caller ID
: The number of the caller, and sometimes the name, the date and the time. The telephone network sends this data on the line. On many lines, it comes between the first ring and the second ring. The modem gives it with `#CID`.

Carrier
: The signal that the far end sends during a call. If the modem loses the carrier, the call ends (`NO CARRIER`).

Command echo and line echo
: Two different echoes. The command echo is the characters that the modem sends back to the `DTE` in command mode (`E1`). The line echo is a part of the signal of the modem that comes back from the telephone line. The near echo comes from the local line, and the far echo comes from the far end of the connection. The echo canceller of the modem removes the line echo from the received signal.

Command mode and online mode
: In command mode, the modem reads the data from the `DTE` as commands. When a call is connected (`CONNECT`), the modem is online: the data from the `DTE` goes

to the far end. The escape sequence (`+++`, with a pause before it and after it) returns the modem to command mode and keeps the call. `ATO` returns the modem to online mode (Section 19).

DCE
Data Circuit-terminating Equipment. The modem: the equipment between the `DTE` and the telephone line or call. Here, the `DCE` is D-Modem.

Default
The value of a setting after `ATZ` or when the program starts. The modem has no stored profiles.

Dial string
The text after `ATD`: the number and the modifiers that change how the modem dials it (`T`, `P`, `W`, `,` and other modifiers).

Dial tone, busy tone and cadence
Tones of the telephone network. The dial tone shows that the line is ready for a number. The busy tone shows that the called line is in use. The cadence of a tone is its pattern of tone and silence, for example 0.5 s on and 0.5 s off. The modem waits for a dial tone before it dials (S6). `X` sets which tones the modem identifies.

Dry pair
A pair of copper wires with no other equipment on it: no telephone exchange, no battery voltage and no dial tone. An example is two modems with a direct wire connection. A modem uses a dry pair as a leased line. `V.wb` operates only on a dry pair.

DTE
Data Terminal Equipment. The computer or program that communicates with the modem: a terminal program, a fax program, `pppd`, or the program that contains libdmodem.

DTMF
Dual Tone Multi-Frequency. The tones of a telephone keypad: two tones at the same time for each key. The modem dials with these tones (`T`). It also detects them in voice mode and in `DTMF` caller ID.

Error correction and compression
Error correction (`V.42`, `MNP`) sends again the data that the line damaged. Compression (`V.42bis`, `V.44`) makes the data smaller, so that it goes faster. The far end must also have these functions.

Far end
The equipment at the other end of the call: the modem, the fax machine or the text telephone that this modem connects to. This manual uses “far end” for all of them.

Fax
Facsimile. A procedure that sends a page as an image through a telephone line.

The fax machine scans the page and its modem sends the image to a different fax machine. That fax machine prints the page. This modem can operate as the modem of a fax machine for a fax program on the DTE (Section 14).

Flow control
: The method that stops the flow of data when a buffer is full, and starts it again. The DTE and the modem use the RTS and CTS signals (hardware flow control) or the XON and XOFF characters (software flow control). +IFC sets it. On a pseudo terminal, the operating system controls the flow.

Frame
: A block of data with a start, an end and a checksum. An HDLC frame starts and ends with a flag (01111110). If the checksum is not correct, the receiver does not use the frame. Then the error correction sends the frame again.

Handshake
: The signals that two modems send to each other at the start of a call. With these signals, the modems select the modulation, the rate, the error correction and the compression. ATD and ATA start the handshake. If the handshake fails, the result is `NO CARRIER`.

ITU
: International Telecommunication Union. The agency of the United Nations for telecommunications. Its standards sector, ITU-T, writes the recommendations that modems obey: the V... series for modems (V.34, V.92), T... for fax (T.30), G... for audio (G.711) and other series.

LAPM
: Link Access Procedure for Modems. The error correction of V.42. Most modems use it. The data goes in numbered frames with a checksum. If a frame has damage, the modem sends it again.

Leased line
: A permanent connection between two modems, with no dialing, no ringing and no dial tone. Each end starts immediately (&L). A 2-wire leased line carries the two directions on one pair. A 4-wire line has one pair for each direction.

MNP
: Microcom Networking Protocol. An older family of error correction (classes 2 to 4) and compression (class 5), from before V.42. Many modems still have it (\N).

Modem
: Modulator-demodulator. A device that changes the data of a computer into sound that can go through a telephone line. It also changes the sound from the far end back into data. D-Modem does this in software, with no modem hardware.

Modulation
: The method that the modem uses to change data into sound on the line. The

modulation also sets the speed. Examples are `V.34`, `V.90` and `V.92`. You select the modulation with `+MS`.

Octet
: Eight bits. This manual writes “octet”, not “byte”.

On hook and off hook
: The two states of the modem on a telephone line. Off hook, the modem holds the line, as a telephone with its handset up. Then the exchange sends a dial tone, or the call connects. On hook, the modem releases the line. `ATH0` puts the modem on hook.

PCM
: Pulse Code Modulation. Sound as numbers: the telephone network carries a call as 8000 8-bit samples each second (`G.711`). `V.90` and `V.92` send data as these numbers. Thus, they can get to `56000` bit/s.

Result code
: The answer of the modem to a command line, or information about a call: `OK`, `ERROR`, `CONNECT`, `RING`, `NO CARRIER` and other codes (Section 12).

S-register
: A numbered setting. You read it with `ATS`*n*`?` and you set it with `ATS`*n*`=`*value* (Section 13).

SIP
: Session Initiation Protocol. The protocol of internet telephony. `dmodemd` makes and answers its calls as `SIP` calls (Section 20).

Training and retrain
: At the start of a call, each modem sends known signals. Each modem uses the signals from the far end to measure the line and to adjust its equalizer and its echo canceller. This is the training. During a call, the line can change. Then the modems do the training again: this is a retrain.

TTY
: Teletypewriter. A text telephone for persons who are deaf or who cannot hear well. It sends Baudot code at `45.45` or `50` bit/s (Section 15). On Linux, a tty is also a terminal device in `/dev`, for example a serial port (`/dev/ttyS0`) or a pseudo terminal (`/dev/pts/3`). `dmodemd` is a pseudo terminal. Thus, terminal programs open it as they open a serial modem.

III Command Summary

Table 1. AT command summary

Command	Description	Command	Description
`A/`	Repeat last command.	`A`	Answer.
`Bn`	Communication standard.	`Cn`	Carrier control (accepted).
`Ds`	Dial.	`En`	Command echo.
`Fn`	Online data echo (accepted).	`Hn`	Hook control.
`In`	Identification, call statistics.	`Ln`	Speaker volume.
`Mn`	Speaker control.	`Nn`	Automode.
`On`	Return to online data mode.	`P`	Pulse dialing.
`Qn`	Result codes on or off.	`Sn`	Read or set an S-register.
`T`	Tone dialing.	`Vn`	Result code form.
`Wn`	Connect message (accepted).	`Xn`	Result codes and call progress.
`Yn`	Long space disconnect (kept).	`Zn`	Reset.
`&An`	Connection lines before `CONNECT`.	`&Bn`	`V.32` retrain (accepted).
`&Cn`	Data carrier detect (kept).	`&Dn`	Data terminal ready (accepted).
`&En`	Rate in `CONNECT` (kept).	`&Fn`	Factory *defaults* (accepted).
`&Gn`	Guard tone (accepted).	`&Hn`	Flow control (kept).
`&In`	XON/XOFF flow control (accepted).	`&Jn`	Auxiliary relay (accepted).
`&Kn`	Data compression.	`&Ln`	Leased line.
`&Mn`	Asynchronous mode (accepted).	`&Nn`	Line rate (accepted).
`&Pn`	Pulse dial ratio (kept).	`&Qn`	Error control mode.
`&Rn`	RTS/CTS (accepted).	`&Sn`	Data set ready (accepted).
`&Tn`	Loop tests.	`&Vn`	View active configuration, call statistics.
`&Wn`	Store profile (accepted).	`&Yn`	Profile at power on (accepted).
`!C, !CF, !CT`	Configurators.	`!R`	Init string of the settings.
`!M`	Settings model, for programs.		
`\An`	MNP block size.	`\Gn`	XON/XOFF pass through (accepted).

Table 1. AT command summary *(continued)*

Command	Description	Command	Description
\J*n*	Rate adjust (accepted).	\K*n*	Break control (accepted).
\N*n*	Error control mode.	\Q*n*	Flow control (accepted).
\R*n*	Ring indicator (accepted).	\T*n*	Inactivity timer (accepted).
\V*n*	Protocol in CONNECT.	%B, *B	Blacklisted numbers.
%C*n*	Data compression.	%E*n*	Line quality monitor (kept).
#CID	Caller ID.	#UD	Unimodem diagnostics.
*G, *H*n*=, *HS=, *V	ZyXEL security.	&Z*n*=	Stored numbers.
CK<*key*>	ZyXEL encryption key.	S102	ZyXEL encryption.
#CLS	Data, fax or voice (Rockwell, US Robotics).	#V...	Voice, Rockwell's and US Robotics' commands.
-C, -K, -Q	MNP 10.	)M, @M, *H, :T19	MNP 10.
+MS	Modulation.	+GMI, +GMM, +GMR	Identification.
+GSN	Serial number.	+GOI	Object identifier.
+GCAP	Capabilities.	+GCI	Country.
+ES	Error control.	+ESA	V.80 synchronous access.
+ITF	V.80 transmit buffer.	+DS	V.42bis.
+DS44	V.44.	+DSZ	zstd compression.
+B2, +CBST, +CRC	B-channel protocol, V.110, ring type.	+IFC, +ICF, +IPR	DTE interface.
+ILRR, +IDSR, +ILSD	DTE interface (kept).	+MR, +ER, +DR	Reports (kept).
+PCW, +PIG	V.92 options (kept).	+PMH, +PMHT	Modem-on-hold.
+PMHR	Ask for modem-on-hold.	+CVM	V.cvm.
-SEC	MNP 10EC (kept).	+FCLASS	Data, fax or voice.
+EF	ETC transmit filter.	&F5, &F6	ETC settings (S116).
+X2UP	x2 upgrade host.	+DEBC	EBCDIC DTE.
+FAA	Adaptive answer.	+FMI, +FMM, +FMR	Fax identification.
+FTS, +FRS	Fax silence.	+FTM, +FRM	Fax data.
+FTH, +FRH	Fax HDLC frames.	+FPR	Fax DTE rate (kept).
+V...	Voice (Section 18).	+FLI, +FPI	Fax Class 2 identity.
+FLP, +FSP	Fax Class 2 polling.	+FCC, +FIS, +FCS	Fax Class 2 capabilities.
+FBO, +FHS, ...	Fax Class 2 settings.	+FDT, +FDR, +FET, +FKS	Fax Class 2 pages.

Table 1. AT command summary *(continued)*

Command	Description	Command	Description
`#F, #Bn, #Vn, #P, ...`	ZyXEL fax mode (`+FCLASS=6`).	`&N32`	ZyXEL fax call (accepted).
`+MV18S, +MV18R`	V.18 text telephone.	`+MV18AM, +MV18P`	V.18 answer message.
`+MBAUDOT`	5-bit (TTY, telex) settings.	`+A8E`	V.8 and V.8 bis.
`+DSVD`	V.70 voice and data (DSVD).	`+ASVD`	V.61 voice and data (ASVD).
`+TMO`	V.59 diagnostics.	`+TRDL, +TAL, +TTER, ...`	Loop and error rate tests (V.58).

1 Command Lines

Use AT commands to control the operation and the settings of the modem. The modem accepts the commands in command mode. The modem is in command mode at these times:

- After it starts.
- When a call ends.
- After a command, but not after a dial command or an answer command.
- Online, after the escape sequence (Section 19). The call stays connected.

The modem answers each command line with a result code (Section 12).

- A command line starts with AT. It ends with the character of S3 (carriage return) or S4 (line feed). The modem removes the spaces and the tabs in the line before it reads the line.
- The character of S5 (backspace) erases the last character that you typed.
- A line can have a maximum of **63** characters. If a line is longer, the result is ERROR.
- If echo is on (E1), the modem sends back the characters from the DTE as you type them.
- If a line does not start with AT, it is not a command. If echo is on, the modem erases the line from the screen of the DTE.

The modem does the commands of a line in sequence (ATE1Q0V1). If a basic command has no number, the number is 0 (ATE is ATE0). An extended command (+...) accepts =*values*, ? (its values) and =? (its ranges). You can put a ; between two commands. V.250 puts one after an extended command if a different command follows it (AT+IFC=2,2;+MS=V92). This modem does not need it. If you do not give a value in the =*values* of an extended command, that value does not change.

The modem keeps some extended parameters (+ILRR, +MR, +PCW, -SEC and others) for the setup strings of other modems. They have no other effect, except where an entry tells you. =*values* sets them. Each value must be in its range, or the result is ERROR. ? gives +*name*: *values*, =? gives the ranges, and ATZ sets the *defaults*.

This manual puts the commands in groups by function. Each group is a section: echo and result codes, settings and profiles, identification, dialing and answering, the speaker and the line, modulation, error control, data compression, the DTE interface, ISDN, then fax, text telephones and voice. Table 1 lists the commands by name.

If a command fails, the modem stops the line and gives ERROR. If no command fails, OK follows the last command. A, D and O end the line and give their result later (CONNECT, NO CARRIER and other codes). Z ends the line with OK. The modem does not read the text that follows these commands on the line. The exception is the ; of a dial string: after the modem dials the number, it does the remainder of the line

(ATD). A command that gives information (I, S*n*?, +MS? ...) shows it on separate lines before the result.

If the DTE sends a character while the modem makes a connection (dialing, answering, the training of the modems), the modem disconnects the call. After the ; of a dial string, the modem is in command state and accepts commands.

2 Echo and Result Code Settings

A/ — Repeat Last Command

A/ does the last command line again. You do not type AT before it or a line end after it: the modem does the command when you type the /. Its usual function is to dial a busy number again.

En — Command Echo

This command sets the echo of the characters from the DTE in command mode (S13).

Result code	When
OK	If *n* = 0 or 1.
ERROR	Otherwise.

Table 2. E*n* Commands

Command	Function
E0	No echo.
E1	Echo (*default*).

Qn — Result Code Control

This command sets the result codes on or off (S14).

Result code	When
OK	If *n* = 0 or 1.
ERROR	Otherwise.

Table 3. Q*n* Commands

Command	Function
Q0	The modem gives result codes (*default*).
Q1	The modem does not give result codes.

`Vn` — Result Code Form

This command sets the form of the result codes: words or numbers (S15). Section 12 gives the two forms.

Result code	When
`OK`	If *n* = 0 or 1.
`ERROR`	Otherwise.

Table 4. V*n* Commands

Command	Function
`V0`	Numbers. A carriage return goes after each number.
`V1`	Words (*default*). A carriage return and a line feed go before each word and after it.

`Wn` — Connect Message Control

Other modems use `W` to select the data that `CONNECT` gives. The modem accepts this command, but it changes nothing. On this modem, `&A` and `\V` select this data.

Result code	When
`OK`	If *n* = 0–2.
`ERROR`	Otherwise.

X*n* — Result Code Set and Call Progress

This command sets these items (S56):

- If `CONNECT` gives the rate.
- If the modem waits for a dial tone before it dials.
- If the modem gives a result for a busy tone.

Result code	When
`OK`	If *n* = 0–4.
`ERROR`	Otherwise.

Table 5. X*n* Commands

	CONNECT	Before dialing	BUSY
X0	Without the rate.	No wait for a dial tone.	No.
X1	With the rate.	No wait for a dial tone.	No.
X2	With the rate.	Waits for a dial tone (below).	No.
X3	With the rate.	No wait for a dial tone.	Yes.
X4	With the rate.	Waits for a dial tone (below) (*default*).	Yes.

X2 and X4 wait for 1 s of dial tone. The tone can be steady or in a cadence with gaps of 1 s maximum (for example, the tone of Italy: the modem adds the tone periods). If no dial tone comes in S6 seconds, the result is `NO DIALTONE`. This time is a minimum of 2 s. The modem adds 2 s more while it hears a dial tone in a cadence.

A busy tone is four cycles of the cadence of the busy tone or the congestion tone of the country. The modem uses the cadence from the list of the ITU, with a tolerance of 15% or 80 ms. Examples are 0.48 s on and off or 0.24 in Germany, 0.75 s in India, and 1 s on and 4 off in Egypt. The modem does not use the ringing tone. If a country has neither tone (none of the 192), the modem uses the limits of its table. `NO ANSWER` comes with all values of *n*. The W and @ of the dial string wait with all values of *n*. A SIP call has no dial tone: for `dmodemd`, use ATX3.

`&An` — Connection Lines Before CONNECT

This command adds lines about the connection before the `CONNECT` of a data call (S70). *n* is the sum of the bits that follow. With `V0`, the first three lines are numbers and the modem does not give the fourth line.

Result code	When
`OK`	If *n* = 0–7.
`ERROR`	Otherwise.

Table 6. &A*n* Bits

Bit	Line	With V0
1	`Modulation:` *name*, the modulation (`V92`, `V34`, `V32bis`, . . .).	1000 plus its number (1092, 1034, 1132, . . .).
2	`Protocol:` `LAPM`, `MNP` or `NONE`, the error correction (the `LAPM` of `V.42`, `MNP` 2 to 4).	77, 78, 76.
1 and 2	`Compression:` `V44`, `V42bis`, `MNP5`, `ZSTD` (Annex F of `V.cvm`) or `NONE`: the compression that `V.42` or `MNP` agreed.	68, 67, 66, 70, 69.
4	`TxRate:` *rate*, the rate at which the modem sends.	None.

The *default* is 0, no lines.

`&En` — Rate in CONNECT

The modem keeps the value in S71. The value changes nothing: `CONNECT` always gives the rate at which the modem receives.

Result code	When
`OK`	If *n* = 0 or 1.
`ERROR`	Otherwise.

`\Vn` — Protocol Result Code

This command sets if the `CONNECT` of a data call gives the error correction and the compression after its rate (S106). With `V0` or `X0`, this command changes nothing.

Result code	When
`OK`	If *n* = 0–2.
`ERROR`	Otherwise.

Table 7. \V*n* Commands

Command	Function
`\V0`	Only the rate: `CONNECT 33600` (*default*).
`\V1, \V2`	The rate and the protocol: `CONNECT 33600/LAPM/V42bis`, `CONNECT 2400/MNP/MNP5`, `CONNECT 28800/NONE`.

`+MR, +ER, +DR` — Modulation, Error Control and Compression Reports

On other modems, these commands enable the `+MCR:`, `+MRR:`, `+ER:` and `+DR:` reports. This modem keeps the values. Each value is 0 or 1, *default* 0.

3 Settings and Profiles

Sn — Read or Set an S-Register

ATS*n*? reads S-register *n* (0 to 255). It gives the value in decimal on a separate line. ATS*n*=*v* sets the register to *v*. The registers have 8 bits, thus the modem uses *v* modulo 256. The two numbers are decimal, also with a 0 at the start (ATS09? is S9). ATS103=*n* is \N*n*. Section 13 lists the registers.

Syntax:

- ATS*n*?
- ATS*n*=*v*

Result code	When
OK	Always.
ERROR	For a number more than 255, a read-only register (S44, S45), or if ? or = does not follow the number.

Zn — Reset

This command disconnects the call and sets the modem to its condition at the start. It sets these items: the S-registers, +MS, modem-on-hold, the data mode (+FCLASS=0), the extended parameters and the loop tests (&T5). The country does not change. The S-registers that have no *default* also do not change: S18, S28, S47 (&L), S48, S161 and the free registers. There are no stored profiles, thus *n* (0 to 3) changes nothing. The modem does not read the remainder of the line.

Result code	When
OK	Always.

&Fn — Restore Factory Defaults

The modem accepts this command, with or without a digit, and does nothing. Refer to &D. ATZ sets the *defaults* again. Two exceptions load the ETC settings of the 3Com cards (Section 8.1): &F5 and &F6.

&Vn — View Active Configuration

&V and &V0 show the active settings, in lines of a maximum of **72** columns. The list has these items:

- The settings of the basic commands.
- The S-registers that the modem uses (Snn:vvv), but not S18 or S44 to S48.
- +MS and the other extended settings.
- The extended parameters.

There are no stored profiles: the list ends with STORED PROFILES: none.

&V1 gives the statistics of the last call in the format of the Rockwell modems. Each item is on one line: the name, with dots to column 28, then the value. It gives the same call as ATI11: in online command state, the call that is connected, or else the last call. Before the first call, it gives No Previous Call. If a call did not connect, or if it was a fax call, the modem gives only the first line. If the modem does not measure a value, the value is N/A.

Table 8. AT&V1 Lines

Line	Value
TERMINATION REASON	NONE while the call is connected. LOCAL REQUEST (ATH, ATZ, DTR), KEY ABORT (a character during the connection procedure), GSTN CLEARDOWN (the LAPM DISC or MNP LD of the far end), LINK DISCONNECT (the SIP call ended), CARRIER LOSS, RETRAIN FAILURE (a retrain that failed), INCOMPATIBLE PROTOCOL (no error correction where it is necessary, errors of LAPM) or NO CONNECT (no dial tone, busy, no answer, training failed).
LAST TX rate, LAST RX rate	The rates now, or at the end, as *n* BPS. Rockwell rounds a PCM rate (53333).
HIGHEST TX rate, HIGHEST RX rate	The highest rates of the call.
PROTOCOL	LAPM, MNP or NONE.
COMPRESSION	V44, V42Bis, MNP5, ZSTD or NONE.
Line QUALITY	The mean squared error of the receiver, as the Rockwell three-digit value (the NMSE times 128: a lower value is better).
Rx LEVEL	The received power in dBm0 without its sign, three digits (015 for -15 dBm0).

Table 8. AT&V1 Lines *(continued)*

Line	Value
`Highest Rx State, Highest TX State, EQM Sum`	`N/A` (the pump states of Rockwell).
`RBS Pattern`	The frames of six in which the network uses a bit, as a hex mask (`0x08`). The `DIL` of the analogue modem finds them (`V.90`, `V.92`).
`Rate Drop`	`N/A`.
`Digital Pad`	The pad of the network: `None`, `3dB`, `6dB`, ... (`V.90`, `V.92`).
`Local Rtrn Count, Remote Rtrn Count`	The retrains of this modem and of the far end, two digits.

Result code	When
`OK`	If *n* = 0 or 1.
`ERROR`	Otherwise.

Example output: AT&V

```
ACTIVE PROFILE:
E1 L3 M1 N1 Q0 T V1 X4 Y0 &A0 &C0 &E0 &H0 &P0 \A3 \N3 \V0 %C3 %E0
S00:000 S01:000 S02:043 S03:013 S04:010 S05:008 S06:002 S07:060 S08:002
...
+MS=92,1,300,56000 +FCLASS=0 +GCI=b5 +PMH=0 +PMHT=5 #CID=0 +IFC=2,2
...
STORED PROFILES: none
```

`&Wn` — Store Current Configuration

There are no stored profiles: `&W`, `&W0` and `&W1` give `OK` and store nothing.

Result code	When
`OK`	If *n* = 0 or 1.
`ERROR`	Otherwise.

&Y*n* — Profile at Power On

The modem accepts this command, but it changes nothing: there are no stored profiles.

Result code	When
OK	If *n* = 0 or 1.
ERROR	Otherwise.

!R — Init String of the Settings

!R shows an init string: the commands that set each setting that is not at its default. You can copy this string into the next session after ATZ (there are no stored profiles). The string has the settings that the configurators (!C) show:

- The settings of the basic commands (E, X, \N, . . .).
- The S-registers that have no command (S0, S6 to S12, . . .).
- +GCI. It is first, because it sets S8 and S24.
- +MS (its four values together), +FCLASS, #CID, +PMH and the extended parameters.

A line has a maximum of **63** characters, as a command line has. If the string is longer, the modem uses more lines. Each line starts with AT. If no setting has changed, the modem shows only AT. The command operates in all states, also during a call.

Result code	When
OK	Always.

Example output: AT!R

```
AT+GCI=B4;+MS=34,1,1200,28800;\N0L1S0=2+ES=1,0,1
OK
```

!M — Settings Model, for Programs

!M lists the settings that the configurators (!C) show. A program can use this list to make its own settings page (the D-Modem desktop apps do this). There is one line for each setting and one line for each choice of a setting. Tabs separate the fields.

- The first line is model, the format (**1**) and the number of settings that follow.
- A setting line has these fields: setting, its key, its type (pick, number or text, the last is a list of numbers), its value now, its default, the lowest and highest values (only for a number), its command (%s shows the position of the value), its group, its label and a line of help.
- The choices of a pick follow it. Each choice line has these fields: choice, the value that the command accepts, its name in the command line configurator and its label.

As !R, this command operates in all states. The modem reads the remainder of the line as more commands.

Result code	When
OK	Always.

Example output: AT!M (a part; the gaps are tabs)

```
model    1          73
setting  country    pick  B5  B5        +GCI=%s  Line  Country  ...
choice   B5         usa   USA
...
setting  echo       pick  1   1         E%s  Terminal  Command echo ...
choice   0          off   Off
choice   1          on    On
OK
```

!C, !CF, !CT — Configurators

The configurators show each setting with its value and its default. They change the settings with the commands of the settings, thus they accept the same values as the commands. They operate only while the modem is idle and on hook. At other times, the result is ERROR. The modem does not read the remainder of the command line. When you exit the configurator, the result is OK. A RING stops the configurator immediately, with no OK. This also occurs when the DTE disconnects.

- !CF is a full-screen configurator in the style of the Turbo Vision of Borland, for an ANSI terminal. It has a menu bar (**F10**, Alt and a letter), the groups of settings and their settings side by side, dialogs for a value, and a status line. Use these keys:
  - The arrows move the cursor.
  - Tab moves between the groups and the settings.
  - Enter changes a setting. Left, Right and Space go through its values. Del sets its default.
  - **F2** saves the changes.
  - **F3** shows the init string of the changes (!R).
  - **F5** sets all defaults.
  - Alt-X or Esc closes the configurator. It asks if you want to save.

  The configurator sends only the cells that change, in UTF-8 or CP437 box characters.
- !CT is a command line in the style of the IOS of Cisco. dmodem# accepts show running-config (the settings that are not at their defaults), show settings [*group*], show init-string, show version, configure terminal and exit. dmodem(config)# accepts *setting value*, no *setting* (off, or its default), default *setting*, do *command*, and exit or end (or Ctrl-Z). You can type a short form of a word (sh run, conf t). ? lists the possible next words. Tab completes a word. The Up and Down arrows show the lines that you typed before. A change has an effect immediately.
- !C examines the terminal: it asks for the position of the cursor (ESC [6n). If a terminal answers in 1.5 s, the modem starts !CF. It also asks the terminal for its size and for UTF-8 in the same way. If the terminal does not answer, the modem starts !CT. !CF also asks. If it gets no answer, it uses 80 by 24 in UTF-8.

Result code	When
OK	When you exit the configurator.
ERROR	The modem is not idle and on hook.

Example: AT!CT

```
dmodem#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
dmodem(config)#modulation v34
dmodem(config)#no echo
dmodem(config)#end
dmodem#sh run
Building configuration...

Current configuration:
!
modulation v34
echo off
!
end
```

4 Identification and Diagnostics

`In` — Identification and Statistics

This command gives the identity of the modem, its settings and the statistics of the last call.

Result code	When
`OK`	If *n* = 0–7, 11 or 12.
`ERROR`	Otherwise.

Table 9. I*n* Commands

Command	Function
`I0`	The product: `D-Modem`.
`I1, I2`	The product and version (`D-Modem, 1.0.0`), then the manufacturer, `D-Modem project`.
`I3`	The name of the modem, then the type of its line (`dmodemd`: `dmodem0`, `SIP`).
`I4`	`S0` to `S23`, eight on each line (`s00=000 s01=000 ...`).
`I5`	`Stored Profile 0:` (there are no stored profiles).
`I6`	The statistics of the last call, as the link diagnostics of USRobotics (the same as `I11`).
`I7`	The country: `Country: USA`.
`I11`	The statistics of the last call, in the format of the Conexant modems.
`I12`	The carriers of the last `PEP` call: the frequency of each bin, its bits in each direction and its noise (dBm0). After a different call, `No PEP Call`.

`ATI11` lists the statistics of the last call:

- In online command state, the statistics of the call that is connected.
- After a call (dialed or answered, connected or not), the statistics of that call, until the next call.
- Before the first call, `No Previous Call`.

`ATI6` gives the same lines. `AT&V1` gives the same call in the Rockwell format. `AT#UD` gives the same values in the Unimodem format. If the call does not have a value, the modem does not give its line. Examples: the rates and the lines that follow them for a call that did not connect, the frame counts without error correction,

the coding lines without V.34, the measurements that a modulation does not make, and the cause while the call is connected.

Table 10. ATI11 Lines

Line	Value
Last Connection	The modulation of the connection (V34, V90, V92, V91, V32bis, PEP, ...), Fax, or None.
Initial Transmit/Receive Carrier Rate	The rates (bit/s) at CONNECT.
Final Transmit/Receive Carrier Rate	The rates now, or at the end (after renegotiations).
Symbol Rate (Tx/Rx)	The symbols each second in each direction (V.22 to V.92, the clear channel).
Carrier Frequency (Hz, Tx/Rx)	The carrier of each direction. PCM for a V.90, V.91 or V.92 PCM direction.
Protocol Negotiation Result	LAPM, MNP or NONE.
Data Compression Result	V44, V42bis, MNP5, ZSTD or NONE.
Trellis Code, Nonlinear Encoding, Precoding, Shaping (Tx/Rx)	The coding of V.34 in each direction (16S-4D, ON, OFF. - for a PCM direction).
Estimated SNR (dB)	The signal to noise ratio of the receiver (V.34, the upstream of V.90, V.32bis, V.29, V.33, V.27ter, V.wb).
Estimated Noise Level (dBm0)	The noise that the SNR shows: the received power minus the SNR, as the Lucent modems give it.
Receive/Transmit Signal Power Level (dBm0)	The mean power of the line in each direction while the call was connected.
Round Trip Delay (ms)	The value that phase 2 of V.34 (or the start of V.cvm) measured.
Near/Far Echo Level (dBm0)	The echoes of the signal of this modem that the canceller removes (V.34, V.90, V.92).
Carrier Frequency Offset (Hz)	The difference between the carrier of the far end and the carrier of this modem (V.22 to V.92).
Timing Offset (ppm)	The difference between the clock of the far end and the clock of this modem (V.32bis to V.92).

Table 10. ATI11 Lines *(continued)*

Line	Value
`PCM Encoding`	The law of the network, `A-law` or `u-law` (`V.90`, `V.92`).
`Digital Loss (dB), Robbed Bit Frames`	The pad of the network and the frames of six in which it uses a bit (`None`, 6, ...). The `DIL` of the analogue modem finds them (Section 7).
`Characters Sent/Received`	The characters of the `DTE`.
`Transmit Frame Count`	The frames of `LAPM` or `MNP` that the modem sent.
`Transmit Frame Error Count`	The information frames from these that the modem sent again.
`Receive Frame Count`	The frames that the modem received with no damage.
`Receive Frame Error Count`	The frames that the modem received with a bad `FCS`.
`PEP Line Rate (Tx/Rx)`	The rate of `PEP` on the line in each direction while a side has the line (bit/s).
`PEP Packets Accepted, Received Bad`	The packets of `PEP` that the modem accepted, and the packets that it received with a bad `CRC`.
`PEP Micro Turns (Tx/Rx)`	Its short turns, sent and received.
`Retrains by Local Modem, Retrains Requested by Remote Modem`	The retrains of this modem and of the far end.
`Rate Renegotiation by Local/Remote Modem`	Rate renegotiations (`V.34`, `V.90`, `V.92`, `V.32bis`).
`Call Duration`	From `CONNECT`, *h*:*mm*:*ss*.
`Call Termination Cause`	`Local hangup` (`ATH`, `ATZ`, `DTR`, a character during the connection procedure), `Remote cleardown` (the `LAPM` `DISC` or `MNP` `LD` of the far end), `Line dropped` (the `SIP` call ended), `Carrier lost`, `No dial tone`, `Busy`, `No answer`, `Training failed`, `Protocol failure` (no error correction where it is necessary, errors of `LAPM`), `No carrier`.

Example output: ATI11

```
Description                     Status
-----------                     ------
Last Connection                 V34
Initial Transmit Carrier Rate   33600
...
Call Duration                   0:00:10
Call Termination Cause          Local hangup
```

The digital modem cannot measure the digital loss or the robbed-bit signalling of the line. Thus, on the SIP line of `dmodemd`, these two lines are not there. The analogue modem (`dmodemd -a`, `-usb`) measures them.

+GMI, +GMM, +GMR — Identification

These commands give the manufacturer (`D-Modem project`), the model (`D-Modem`) and the revision (`1.0.0`, the version of the build). With `?` after them (`AT+GMI?`), they give the same data. With `=?` after them (`AT+GMI=?`), they give no data.

Result code	When
`OK`	Always.

+GSN — Serial Number

This command gives the serial number of the modem. The modem uses the first value that it has, in this sequence:

1. The serial number that the line gives.
2. The `-serial` option of `dmodemd`.
3. The name of the modem (for example, `dmodem0`).

With `?` after it, it gives the same data. With `=?` after it, it gives no data.

Result code	When
`OK`	Always.

+GOI — Global Object Identifier

This command gives the global object identifier (ITU-T X.208) of the modem, if the line gives one. D-Modem does not have an identifier of its own. Thus, usually the command gives no data.

Result code	When
OK	Always.

+GCAP — Capabilities

This command lists the command sets of the modem: +GCAP: +FCLASS,+MS. With =? after it, it gives no data.

Result code	When
OK	Always.

#UD — Unimodem Diagnostics

This command gives the statistics of the last call (or of the call that is connected), with the values of ATI11. It uses the format of the Unimodem Diagnostics Command Reference Specification (version 1.0) of Microsoft, for the modem log of Windows and the programs that read it. For each key that has a value, it gives a line DIAG <2A4D3263 *key*=*value*>. The key and the value are in hexadecimal. Before the first call: 0=10, 1=0 and 60=1. ATZ clears the log. If ATZ ended a call, the log then has only these values: 0=10, 1=0 and 60=52 (the reset of the DTE). Some measurements are only in some modulations (the CM and JM of V.8, the NMSE, the far echo, the INFO bits of V.34). For the other modulations, the modem does not give them.

Table 11. #UD Keys *(continued)*

Key	Value

Result code	When
`OK`	Always.

Table 11. #UD Keys

Key	Value
0	The format (10).
1	The setup of the call.
2, 3	The mode of the call (data or fax) and the mode of the DTE interface (async, or the transparent or framed synchronous mode of V.80).
4, 5	The CM and JM of V.8, the octets in quotes.
10-12	The receive and transmit levels, the noise.
13	The NMSE (the error of the receiver divided by the smallest distance between the points, in hundredths).
14-17	The loss of the echoes, the delay of the far echo (ms), the round trip delay.
18	The INFO bits of V.34 (its Table 5).
20, 21	The modulation (the codes of V.58).
22-27	The symbol rates, the carriers, the first rates.
30	The losses of the carrier (20 ms or more, after which the carrier came back).
31-33	The renegotiations, the retrains that the modems asked for and accepted.
34, 35	The last rates.
40, 41	The error control and its frame size.
42, 43	The timeouts of the error control and its REJs or SREJs (MNP: the acknowledgements that ask for frames again).
44, 45	The compression (the codes of V.58. 80 MNP 5, 81 V.44, 82 zstd) and the dictionary size of V.42bis.
50, 51	The flow control (&H).
52-59	The characters (54, 55: the characters that the modem lost because a buffer was full) and the frames.
60	How the call ended (*callCleared* of V.58. 2 while the call continues).

Example output: AT#UD

```
DIAG <2A4D3263 0=10>
DIAG <2A4D3263 1=7>
DIAG <2A4D3263 10=0C>
...
```

+TMO — V.59 Diagnostics

This command gives the managed objects of V.59: the data about the last call (or about the call that is connected). The data stays from the start of the call until the next call starts. V.250 uses +TMO to read these objects. Each object has a name and a four-digit hexadecimal tag. The first two digits identify its high-level object (V34Diag 0C, CnxDiag 2C, ...). The last two digits identify the object in it. If an object does not apply to the last call, it is NULL. You do not have to type the spaces between the parts. The modem accepts upper case and lower case.

Result code	When
OK	After the objects asked for.
ERROR	For a name or tag that the modem does not have, or +TMO alone before a different +TMO.

Table 12. +TMO Forms

Command	Function
+TMO	The last +TMO again.
+TMO *level*=?, +TMO *level*N=?	The objects that are available, as tags (N: as names). 0 all, 1 the high-level objects, 2 the mid-level objects, 3 the low-level objects. 4 gives +TMO: (0,1) (names and tags).
+TMO *tag*	A four-digit tag: that object, as *tag*{*value*}. Two digits: all objects of that high-level object.
+TMO *name* [All]	An object by name, or all objects of a high-level object (V34Diag, or only V34), as *name*{*value*}. If you give only the name of an object of a modulation, the modem uses the modulation of the last call.
+TMO *high name*	The object of that high-level object (+TMO V34 rxDataHistory).

Table 13. +TMO High-Level Objects

Tag	Objects
00	`ModemIdentity`: the manufacturer, model, version, the version of `V.59` (1), the functions of the modem (a bit string, in hexadecimal).
01	`ModemCapability`: the mode of each modulation and protocol (0 not there, 1 the preferred, 2 enabled, 3 disabled), and the other modulations and protocols.
02	`ModeSelected`: the modulation of the call.
07	`V8Diag`: the `CM` and `JM` of `V.8` (their octets in hexadecimal), its result.
09–23	The objects of each modulation: its mode, the transmit and receive levels and the noise (dBm0), the symbol rates and carriers (the codes of `V.59`), the rates during the call, the echoes, the round trip delay, and the robbed bits, digital loss and `G.711` law of `V.90` and `V.92`.
26	`NSMDiag`: a modulation for which `V.59` has no object (K56flex, ...).
2C	`CnxDiag`: the carriers, carrier losses, renegotiations, retrains, the length of the call, and if this modem made the call.
2E	`CallProgress`: the last step of the call, the cause of its end (the codes of `V.59`).
2F	`ErrorControl`: the protocol, its frame sizes and windows, its frames and errors, the throughput.
30	`Compression`: the agreed compression in each direction, its dictionary and string sizes.
31	`DTEDCE`: the flow control, framing, rate, throughput and the characters that the modem lost.

Example: AT+TMO V34 txDataHistory, AT+TMO 2E

```
txDataHistory{33600;31200}
OK
2E01{40}
2E02{90}
OK
```

&T*n* — Loop Tests

This command does the loop tests of V.54, with the Hayes numbers.

- Loop 3 operates offline on a leased line (&L) with a 4-wire modulation (+MS=V29, V33 or V27TC). The signal of the modem goes back into its own receiver and the line is silent.
- To get loop 2 at the far end, the modem sends a request in band (the PREP, ACK and TERM of V.54). Send this request in online command state, on a call with no error correction (\N0).
- The self-test sends and examines the 511-bit pattern of V.52.

If S18 is more than 0, a test ends after that number of seconds.

Result code	When
CONNECT	For &T1 and &T6: the data of the DTE comes back to it.
OK	For the other tests. If &T0 follows &T7 or &T8, it first gives the bit errors of the self-test, three digits (a maximum of 255).
ERROR	For &T2 and for *n* more than 8, outside the state that the test must have, or when the far end does not answer &T6 or &T7.

Table 14. &T*n* Commands

Command	Function
&T0	Ends the test (&T is the same).
&T1	Loop 3, the local analogue loop.
&T3	Loop 2 here: the data from the far end goes back to it.
&T4	The far end can ask for loop 2.
&T5	The far end cannot ask for loop 2 (*default*, also after ATZ).
&T6	Loop 2 at the far end, the remote digital loop.
&T7	Loop 2 at the far end with the self-test.
&T8	Loop 3 with the self-test.

+T... — Loop and Error Rate Tests

These are the test commands of V.250, made from the test objects of V.58: the loop tests of &T, an error rate test on these loops, and their status. Each command also accepts ? (its value) and =? (its range).

Result code	When
OK	When the command is complete. For +TRDL=1, when the far end starts the loop. For +TAL=1, when loop 3 starts. These two are in online command state (not CONNECT: use ATO for the data of the DTE). For +TRDL=0, when the TERM is sent.
ERROR	Outside the state that the test must have, when the far end does not start the loop, or for a value that the command does not have.

Table 15. +T Commands

Command	Function
+TERDL=*n*	1: the far end can ask for loop 2 (&T4). 0: it cannot (*default*).
+TLDL=*n*	1: loop 2 here, from online command state (&T3). 0 ends it.
+TRDL=*n*	1: loop 2 at the far end, from online command state (&T6). 0 ends it.
+TAL=*n* [,*band*]	1: loop 3, offline on a 4-wire leased line (&T1). 0 ends it. The modem accepts *band* but does not use it.
+TTER=*type*,*len*,*blocks*,*pattern*	The error rate test on the loop that operates (loop 2 at the far end, loop 3), from online command state. It uses the 511-bit pattern of V.52 (*pattern* 1, the only pattern) for *blocks* blocks of *len* bits (1–65535 each). *type* 1 bit errors, 2 block errors, 3 the two (the modem counts the two). +TTER=0 stops the test. +TTER? gives the type of the test (0 none), *len*, the blocks that remain and the pattern.
+TNUM?	The bit errors and block errors of the last error rate test, +TNUM: *bits*,*blocks* (a maximum of 65535).
+TALS?	Loop 3: 0 none, 3 in operation.

Table 15. +T Commands *(continued)*

Command	Function
`+TDLS?`	Loop 2 here: 1 none, 3 from this modem (`+TLDL`, `&T3`), 4 from the far end.
`+TRDLS?`	Loop 2 at the far end: 1 none, 4 in operation.
`+TSELF=`*n*	The self-test (0 full, only offline. 1 partial): the pattern generator, the checker and the recognisers of the loop tests examine themselves.
`+TRES?`	Its result: 0 none since `ATZ`, 1 pass, 2 fail.
`+TE140`, `+TE141`, `+TEPDL`, `+TEPAL`, `+TMODE`, `+TADR`	Only 0: no circuits 140 and 141, no front panel, point to point, no `V.54` address.

%E*n* — Line Quality Monitor

The modem keeps the value in S39. Its modulations retrain and renegotiate their rate automatically.

Result code	When
`OK`	If *n* = 0–2.
`ERROR`	Otherwise.

5 Dialing, Answering and Disconnection

D*string* — Dial

This command sets the modem off hook, dials the number in *string*, and then makes the call.

- The modem dials the digits and `* # A B C D` as DTMF. Each digit is S11 ms long, with S11 ms between the digits.
- T and P select tone or pulse dialing (S16) for the remainder of the call.
- The modem dials pulses on an analogue line (`-a` and `-usb` of `dmodemd`). It uses the break, the make, the gap between digits and the digit pattern of the country (`+GCI`). It ignores `* # A B C D`. On a line that cannot send pulses, for example SIP, the modem dials them in DTMF.
- With X2 or X4, the modem first waits for a dial tone.
- In `dmodemd`, the dial string is the number of the SIP call (Section 20).

Table 16. Dial Modifiers

Modifier	Function
`0-9 * # A-D`	The modem dials these as DTMF. With P, it dials the digits as pulses.
`L`	Dial the last number again (first `Dialing` *number*`...`). Use it only as the first character of the string. `ERROR` while the modem holds a call after `;`.
`T`	Tone dialing (DTMF) from this point.
`P`	Pulse dialing from this point.
`,`	Pause for S8 seconds.
`W`	Wait for a dial tone (1 s of it). If no dial tone comes in S7 seconds, `NO DIALTONE`.
`@`	Wait for the ringing of the far end (a minimum of 0.5 s of sound), then for 5 s of silence after it. If this does not occur in S7 seconds, `NO ANSWER`.
`;`	End the dial string. After the modem dials the number, it goes back to command state. It stays off hook, keeps the call and gives `OK`. Then the modem does the remainder of the line.
`S=`*n*`, S`*n*	The stored number *n* (0–9, `&Z`*n*`=`). Use it only as the first character of the string (T or P can come before it). If the slot is empty, `ERROR`. Later in the string, `ERROR`.

Table 16. Dial Modifiers *(continued)*

Modifier	Function
! $	Hook flash and bong tone: the modem ignores them (a SIP call has no hook flash).

The modem ignores all other characters. After a `;`, the call waits, silent, for the DTE:

- `ATD`*more* dials more digits on the call (as DTMF). A `;` holds the call again.
- `ATD` alone or `ATO` starts the handshake of the calling modem.
- `ATA` starts the handshake of the answering modem.
- `ATH` disconnects the call (`OK`, then `NO CARRIER`).

Result code	When
`CONNECT`	When the call is connected.
`OK`	After a `;`.
`BUSY`, `NO ANSWER`, `NO DIALTONE` or `NO CARRIER`	When the call does not connect.
`ERROR`	For an empty stored number, for `S=`*n* after the start of the string, or for `L` with no number to dial.

`P` — Select Pulse Dialing

This command sets pulse dialing for the next dial (`S16=0`). Refer to `ATD`.

Result code	When
`OK`	Always.

`T` — Select Tone Dialing

This command sets tone (DTMF) dialing for the next dial (`S16=1`, the *default*). Refer to `ATD`.

Result code	When
`OK`	Always.

&P*n* — Pulse Dial Make/Break Ratio

The modem keeps the value in S28. The table of the country sets the pulse times.

Result code	When
OK	If *n* = 0–3.
ERROR	Otherwise.

A — Answer

This command sets the modem off hook to answer a call. After S92 seconds, the modem sends the tones of the answering modem. In dmodemd, the modem answers the call that rings (RING). If the modem holds a call after the ; of a dial string, ATA answers that call. Thus, ATD*number*;A dials and then answers (the call-back of V.250).

Result code	When
CONNECT	When the call is connected.
NO CARRIER	When the call does not connect.
ERROR	If there is no call to answer.

H*n* — Hook Control

This command sets the modem on hook or off hook. H or H0 disconnects a call. In voice mode, ATH releases the line and goes back to data mode (Section 18).

Result code	When
OK	If *n* = 0 or 1.
ERROR	For a different number, or when the hook cannot change.

Table 17. H*n* Commands

Command	Function
H0	On hook (disconnect).
H1	Off hook.

On — Return to On-Line Data Mode

This command sets the modem online again after the escape sequence (Section 19). If the modem holds a call after the ; of a dial string, the command starts the handshake of the calling modem (as ATD). O1 and O3 operate in V.34, V.90, V.92, V.32bis and V.32terbo calls (O3 of V.32 retrains). In the other calls, they only go back online. ATI11 counts a retrain or a renegotiation from this command as one of the local modem.

Result code	When
CONNECT	When the modem is back online.
ERROR	When there is no call, or for *n* = 2 or more than 3.

Table 18. O*n* Commands

Command	Function
O0	Back online (*default*).
O1	Back online, then retrain (the V.250 function).
O3	Back online, then renegotiate the rate (the Rockwell function).

Yn — Long Space Disconnect

Other modems use Y for long space disconnect. The modem keeps the value in S161 and does nothing more.

Result code	When
OK	If *n* = 0–3.
ERROR	Otherwise.

%B, *B — Blacklisted Numbers

These commands list the numbers that the modem must not dial. The modem keeps no numbers.

Result code	When
OK	Always.

*Gn , *Hn=, *HS=, *V, &Zn= — ZyXEL Security and Stored Numbers

These commands are the type 2 security of ZyXEL (the U-1496 and the Elite 2864). When the modem answers a call with *G3 to *G5, it sends `PassWord:` to the far end after `CONNECT`. The modem echoes each character from the far end as `*`. S3 ends the password. The data does not go through, in the two directions, until the password is correct. If the password is wrong, the modem sends `Error..., try again` and the prompt again. After the third wrong password, the modem disconnects (ATI6: `Security check`).

Table 19. ZyXEL Security

Command	Function
*G0	No security (the *default*).
*G1, *G2	Type 1 of ZyXEL (only from ZyXEL to ZyXEL): `ERROR`.
*G3	The password, then `Correct` and the data.
*G4	The password and `Correct`. Then the modem disconnects, and after 2 s it calls the stored number of the slot of the password.
*G5	The password, then `Call back phone number:`. The caller types a maximum of 26 characters (S5 erases one) and S3. Then the modem disconnects, and after 2 s it calls that number.
*H*n*=*password*	User password *n* (0–9): a maximum of 8 characters, case-sensitive, with no comma. No characters make the slot empty. Put the password in quotes, or the modem uses the remainder of the line. If a supervisory password is set, use *H*n*=*super* , *password*.
*HS=*password*	The supervisory password. If one is set, use *HS=*old* , *password*.
*V, *V=*super*	The table: *G*n*, then the number, the password and the stored number of each slot that is in use. If a supervisory password is set, use *V=*super*.
&Z*n*=*number*	Stored number *n* (0–9), for ATDS=*n* and *G4. Put the number in quotes, or the modem uses the remainder of the line.
&Z*n*?	Stored number *n*.

*H0 to *H2 without = are still the `MNP 10` command (*H). ATZ keeps the passwords, the stored numbers and *G. It also stops a call back that is pending. ATH also stops it. The modem does not store these settings. Put them in the init string.

Result code	When
OK	When the value is valid (and the supervisory password is correct).
ERROR	Otherwise.

CK<*key*> — ZyXEL Encryption Key

This command sets the key of the ZyXEL encryption (S102, the Elite 2864I). The encryption operates only on X.75 and V.120 calls on an ISDN B channel (+MS=CLEAR). The key is all the characters after <, up to > or the end of the line. The characters are case-sensitive. The modem removes the spaces from the command line, thus a key cannot have spaces. The modem makes two 8-octet registers from the key, as the Elite does. The two modems must have the same key when S102 bit 2 is 1, or when one of the two modems has bit 2. Without <, the command gives ERROR. ATZ keeps the key. The modem does not store it.

Result code	When
OK	With <.
ERROR	Without <.

#CID, +VCID — Caller ID

This command sets caller ID on or off. When caller ID is on, the modem tells the DTE who calls. After the first RING, it sends the date and time, the number of the caller and, if available, the name of the caller. Each item is on a separate line. +VCID is a different name for the same command.

Caller ID operates on a SIP call and on a telephone line. If the caller does not show the number or the name, the modem sends P (private) in its position. If the number or the name is not known, the modem sends O (out of area). Value 2 sends all of the caller ID message in hexadecimal. Use this value for programs that decode the message themselves.

Syntax:

- AT#CID=*n* (or AT+VCID=*n*)
- AT#CID?
- AT#CID=? (gives 0,1,2; AT+VCID=? gives (0-2))
- AT+VRID[=*m*] (the caller ID of the last call again: *m* 0 the fields, 1 the message in hexadecimal)
- AT+VRID=? (gives (0,1))

Result code	When
`OK`	If *n* = 0–2.
`ERROR`	Otherwise.

Table 20. #CID=*n* Values

Value	Function
0	Off (*default*).
1	The fields: `DATE =` , `TIME =` , `NMBR =` , `NAME =` , a line each.
2	All of the message in hexadecimal: `MESG =` .

Example output: AT#CID=1, then a call

```
RING

DATE = 1030
TIME = 1043
NMBR = +15551234
NAME = Alice Smith

RING
```

Technical data:

- `DATE` is the month and day (MMDD). `TIME` is the hour and minute (HHMM).
- In voice mode (`+FCLASS=8`), the lines come as the complex event report of `V.253`, between <DLE>X and <DLE>.. In the other modes, they come after an empty line.
- On a telephone line, the modem listens for caller ID after the first ring (the procedure of North America, and of `ETSI` after a short ring). The modem can hear some lines while it is on hook (`ALSA`, a pipe, the pico-serial Line). On these lines, it also listens before the ring (the procedure of `ETSI` after its alerting tone, the procedure of the UK, `DTMF` caller ID).
- It accepts Bell 202 `FSK` and `V.23 FSK` (`ETSI` EN 300 659-1, BT SIN 227). It also accepts `DTMF` caller ID: `A` and the number, or `B` (or `D`) and the reason that the number is not there (`10` private, as `P`. Other reasons `O`), up to `C`, # or a pause.
- In voice mode, when the modem has the line, it also accepts Type II caller ID: the caller of a waiting call. After the `CPE` alerting signal (2130 and 2750 Hz), it answers with `DTMF A` (the procedure of GR-30, a `CPE` without `ADSI`). Then it gives the `FSK` message that follows as a packet. During this time, the audio of the line to the `DTE` is silent.

- A `SIP` call (`dmodemd -L`) gets its caller ID from the INVITE: the P-Asserted-Identity of the caller, or else its From. The user part of the `URI` is `NMBR` and the display name is `NAME`. The date and time come from the host. If the number or the name is not shown (the `id`, `user` or `header` of the Privacy header, or an anonymous caller), the modem sends `P`. With value 2, the modem sends the `MDMF` message that it made from these items.

6 Speaker, Line and Country

Ln — Speaker Volume

This command sets the volume of the speaker (S30). With `dmodemd -speaker=`*device*, the speaker is a sound device of the computer, on all lines (`SIP`, `-a`, `-usb`, `-misdn`): Linux an ALSA PCM, Windows a waveOut device, Haiku `default`. You hear the signal that comes from the line and the signal that the modem sends. Without `-speaker`, the modem only keeps the setting. A SmartUSB56 with `dmodemd -usb-buzzer` operates its buzzer while the speaker is on, at all volumes except `L0`.

Result code	When
`OK`	If *n* = 0–3.
`ERROR`	Otherwise.

Table 21. L*n* Commands

Command	Function
L0	Off.
L1	Low volume (-12 dB).
L2	Medium volume (-6 dB).
L3	High volume, 0 dB (*default*).

`Mn` — Speaker Control

This command sets when the speaker is on (S29). Refer to `L` for the speaker of `dmodemd`.

Result code	When
`OK`	If *n* = 0–3.
`ERROR`	Otherwise.

Table 22. M*n* Commands

Command	Function
`M0`	Speaker always off.
`M1`	Speaker on until the call is connected (*default*).
`M2`	Speaker always on.
`M3`	Speaker off while the modem dials, then on until the call is connected. When the modem answers, as `M1`. On `SIP` and ISDN, the modem dials no digits: the speaker comes on at the start of the call.

`&Jn` — Auxiliary Relay

The modem accepts this command, but it changes nothing: there is no relay.

Result code	When
`OK`	If *n* = 0 or 1.
`ERROR`	Otherwise.

&L*n* — Leased Line

This command sets the type of the line (S47): a dialed line, or a leased pair or circuit with no exchange. A leased line has no dial tone, no ringing and no hook.

- On a leased line, ATD (with a number or with no number) makes the call immediately. The modem only listens for the answer tone.
- ATA answers.
- If S0 is more than 0, the modem answers automatically, with no ring, when it is idle.
- If the line ends a call (NO CARRIER), the call starts again automatically after 2 s. The modem dials or answers as before. ATH, DTR, ATZ or &L0 stop this until the next command line.

All voice band modulations of +MS operate on &L1. On &L2, the 4-wire modulations (+MS=V29, V33, V27TC) operate as duplex pumps on a continuous carrier. Each end starts immediately with its own synchronizing signal. The other modulations operate as on &L1.

With S48=1, on a call with no error correction, the modem does the simulated carrier control of V.13. Between the bursts of data from the DTE, the line carries the idle pattern of V.13. The far end uses this pattern as carrier detect OFF. Each burst sets it to ON again.

A line at 48000 Hz or more (-r 96000 of dmodemd) is always leased. Its mode is +MS=VWB. Its start and its retrains take a maximum of S7 seconds.

Result code	When
OK	If *n* = 0–2.
ERROR	Otherwise.

Table 23. &L*n* Commands

Command	Function
&L0	A dialed line (*default*).
&L1	A 2-wire leased line.
&L2	A 4-wire leased line.

+GCI — Country of Installation

This command sets the country with its T.35 code in hexadecimal (+GCI:b5 is the USA). The country sets its dial pause (S8) and hook flash (S24) times, its pulse dialing and its tones.

The -c option of dmodemd sets the country at the start (-countrylist lists the countries). You can use a country of the table of the modem. You can also use one of the 192 countries of the list of the tones of national networks of the ITU (after E.180). Use its name from that list in capital letters, or its name in the table (-c FIJI, -c UNITED_KINGDOM:UK). The countries of the table have their own dialing settings. The other countries use the settings of the USA (ATI7: Country: FIJI (USA line)). All countries have their own busy and congestion tones. ATZ does not change the country.

Syntax:

- +GCI=*h*
- +GCI? (gives +GCI:b5)
- +GCI=? (lists the codes)

Result code	When
OK	Always.
ERROR	For a code that is not in the table.

7 Modulation

+MS — Modulation Selection

This command sets these items:

- The modulation that the modem uses to call or to answer.
- If the modem can use a slower modulation (*automode* 1, as N1. S31). With *automode* 0, the V.8 CM and JM of the modem give only the modulation of *mod*, on all lines: no V.32bis, V.22bis, V.23 or V.21. K56flex (56) and x2 (57) then do not offer V.90.
- The rates at which the modem can connect, *min* to *max* bit/s.

mod is a number or its V.250 name, in upper case or lower case (AT+MS=V34 is AT+MS=34). If you do not give a parameter, it keeps its value: AT+MS=,0 only sets automode off. In V.34, *max* is the limit of the rates in the two directions (the modem sends it in its MP sequences).

Syntax:

- +MS=[*mod*][,[*automode*][,[*min*][,[*max*]]]]
- +MS? (gives 92,1,300,56000. 200,1,300,56000 at 48000 Hz or more)
- +MS=?
  gives (21,22,23,26,126,226,27,29,229,122,32,132,232,168, 128,61,33,34,103,18,45,110,5,12,212,201,202,208, 56,90,91,92,150,200,255,64),(0,1),(300-56000),(300-56000): the modulations of the program

Result code	When
OK	Always.
ERROR	For a modulation that the modem does not have, *automode* more than 1, *min* more than *max*, or a rate outside 300 to 56000.

Table 24. +MS Modulations

mod	Name	Standard	Description
21	V21	ITU V.21	300 bit/s FSK.
23	V23C	ITU V.23	1200/75 bit/s FSK.
103	B103, BELL103	Bell 103	300 bit/s FSK.
22	V22	ITU V.22	1200 bit/s DPSK.

Table 24. +MS Modulations *(continued)*

mod	**Name**	**Standard**	**Description**
212	`B212, BELL212A`	Bell 212A	1200 bit/s `DPSK`.
122	`V22B`	`ITU V.22bis`	2400 bit/s, with `V.22` as its fallback.
32	`V32`	`ITU V.32`	4800 and 9600 bit/s.
132	`V32B`	`ITU V.32bis`	4800 to 14400 bit/s.
232	`V32T, V32TERBO`	`V.32terbo`	`V.32bis` and 16800, 19200 bit/s (from AT&T. The number is from D-Modem).
234	`ZYX`	ZyXEL ZyX	7200 to 19200 bit/s: `V.32bis` at `2742.857` baud, with a frame of 8 symbols and a ring table (from ZyXEL. Only from D-Modem to D-Modem. The number is from D-Modem).
168	`HST`	USRobotics HST	4800 to 16800 bit/s in one direction, 300 bit/s in the other. The channels change direction with the data. The start of a Courier at 2400 bit/s (`V.22bis` and `V.42`), and the link layer of `HST` (the number is from D-Modem).
128	`VFC`	Rockwell `V.FC`	14400 to 28800 bit/s: the start of `V.34`, then the data mode of `V.FC` if the two ends ask for it, or else `V.34` (the number is from D-Modem).
61	`V61`	`ITU V.61`	4800 bit/s with speech, 4800 to 14400 bit/s without speech (`+ASVD`. The number is from D-Modem).
29	`V29`	`ITU V.29`	4800 to 9600 bit/s, 4-wire leased.
229	`V29FP, V29FASTPOS`	V.29 FastPOS	9600 bit/s (or 7200, 4800) half duplex on a dial-up line, for point of sale terminals (from Hypercom. The number is from D-Modem).

Table 24. +MS Modulations *(continued)*

mod	**Name**	**Standard**	**Description**
33	V33	ITU V.33	12000 and 14400 bit/s, 4-wire leased.
27	V27TC	ITU V.27ter	2400 and 4800 bit/s, 4-wire leased.
26	V26	ITU V.26	2400 bit/s DPSK (alternative A), 4-wire leased.
126	V26T, V26TER	ITU V.26ter	2400 and 1200 bit/s DPSK, duplex on a 2-wire dial-up line with echo cancellation (the number is from D-Modem).
226	V26B, V26BIS	ITU V.26bis	2400 or 1200 bit/s DPSK from the answering side, 75 bit/s FSK in the other direction (the number is from D-Modem).
201	B201, BELL201	Bell 201	2400 bit/s DPSK (V.26's alternative B), 4-wire leased.
202	B202, BELL202	Bell 202	1200 bit/s FSK in the two directions, 4-wire leased.
208	B208, BELL208	Bell 208	4800 bit/s 8-phase DPSK, 4-wire leased.
34	V34	ITU V.34	2400 to 33600 bit/s, after V.8.
90	V90	ITU V.90	After V.8. On a digital line, the digital modem or the analogue modem (V.8 selects the end, S117). On an analogue line, the analogue modem.
91	V91	ITU V.91	Two digital modems, after V.8. The calling modem must select it.
92	V92	ITU V.92	V.90 with quick connect, PCM upstream and modem-on-hold (*default*).

Table 24. +MS Modulations *(continued)*

mod	**Name**	**Standard**	**Description**
56	K56	K56flex	After V.8 bis and V.8. When it answers on a digital line, the modem is the server: it answers a K56flex modem with K56flex, and other modems with V.90. When it calls (on an analogue line or a digital line), it is the analogue modem: it calls with K56flex when the server answers with K56flex, and with V.90 when not (only with automode).
57	X2	USRobotics x2	When it answers on a digital line, the modem is the server: it answers an x2 modem with x2, and other modems with V.34. When it calls (on an analogue line or a digital line), it is the client: it calls an x2 server with x2.
150	VCVM	V.cvm	Data on mobile speech paths, 175 to 3500 bit/s, after V.8 (+CVM).
200	VWB	V.wb	Wideband DMT on a dry pair, at 48000 Hz or more, up to 148656 bit/s in each direction.
255	PEP	Telebit PEP	Up to 511 carriers, half duplex with turns, up to about 20000 bit/s. CONNECT FAST. In automode, it calls and answers other modems with V.34 and V.32bis (the number is from Telebit, as its S50=255).
64	CLEAR	Clear channel	64000 bit/s on a clear digital channel (an ISDN data call), with no modulation (+B2).
18	V18	ITU V.18	Text telephone automode (Section 15).

Table 24. +MS Modulations *(continued)*

mod	**Name**	**Standard**	**Description**
45	BAUDOT	V.18, TIA-825-A	5-bit text telephone: TTY, telex, RTTY (+MBAUDOT).
110	EDT	V.18	EDT text telephone, 110 bit/s.
118	DTMF	V.18	DTMF text telephone.
121	V21TXT	V.18	V.21 text telephone (7 bits, even parity).
123	V23TXT	V.18	V.23 Videotex text telephone (Minitel, Prestel), 1200/75 bit/s.
203	B103TXT	V.18	Bell 103 text telephone (7 bits, even parity).
5	CONTACTID	SIA DC-05	Contact ID alarm reports. The answering modem is the receiver. The calling modem is the panel (Section 16).
12	SMS	ETSI ES 201 912	Fixed-line text messages. The answering modem receives. The calling modem sends (Section 17).

The 4-Wire Modulations. V.29, V.33, V.27ter, V.26 and Bell 201, 202 and 208 are the modulations for a 4-wire leased line (&L2). Each end sends on its own pair, on a carrier that stays on.

- V.26 and Bell 201 send their data with no scrambler, as those modems do. They use the phase changes of alternative A or B of V.26.
- Bell 208 sends the 4800 bit/s signal of V.27ter. V.27 took this modulation from Bell 208.
- Bell 202 is 1200 Hz mark and 2200 Hz space at 1200 bit/s in each direction.
- The DPSK modulations start with the training of V.27ter as their synchronizing signal. A different D-Modem must have this signal. If an old modem of these types does not send this signal, the modem does not find it.

max sets the rate at which each end sends. *min* sets the lowest rate that it can use. A receiver finds the rate of the far end automatically. If an end is faster than the far end, it decreases to the rate of the far end. If an end loses its equalization two times in 20 s at its own rate, it decreases to the next lower rate. If a receiver loses its equalization, it sends its synchronizing signal again. Then it gets the signal of the far end again (V.29 10, V.33 9).

Point of Sale. Card terminals and vending machines dial their host. They use two short start procedures that no Recommendation gives. Thus, a transaction of some hundred octets takes some seconds, not ten.

- *Fast connect* (S49=1) makes the handshake of V.22, Bell 212A and V.22bis shorter. The answering modem sends a short answer tone (S50, 400 ms by default). The calling modem answers it immediately with its scrambled ones (with V.22bis, its S1 when it hears the unscrambled ones). Each side starts the data 150 ms after 50 ms of the signal of the other side. The connection is complete in about 0.9 s from the answer (V.22bis, 1.4 s), not 5 s. S49=3 sends HDLC flags, scrambled, in place of the scrambled ones at 1200 bit/s. Some hosts must have these flags. The modem accepts the two types from the far end.
- *V.29 FastPOS* (+MS=V29FP) is V.29 half duplex. The calling modem sends a steady 980 Hz calling tone. The answering modem sends a 2225 Hz answer tone (S50). Then the two modems give CONNECT. After this, the side whose DTE has data sends it in a burst, with the V.29 training first. The other side listens. The turn changes when the data stops (32 idle bits: marks or HDLC flags). The DTEs take turns, as the SDLC of a terminal and its host does. V.29 has no rate signal: the two ends must have the same *max*.

The two types are for synchronous DTEs. Use the framed sub-mode of V.80 (+ES=6,,8, with the FCS: +ESA=0,0,0,,1) or \N0 and the framing of the DTE. The two ends must have the same setting. If a modem with the usual handshake gets such a call, the call connects late or does not connect. Refer to docs/dsp/fastpos.md.

V.90, V.91 and V.92. V.90 and V.92 are available as the *digital* modem (the side of the server, as on a G.711 VoIP line), on an 8000 Hz G.711 line. Analogue V.90 and V.92 modems that call can connect at up to 56000 bit/s downstream. When the modem answers, 90 and 92 also offer V.91, which two digital modems use, and V.34 for the other modems. On a line at a different sample rate, they are V.34. On a digital line, they are also available as the *analogue* modem (refer to the client on a digital line). With automode, V.8 and the V.34 modem change to V.32bis (and its V.22bis and V.22) for a modem without V.34. For a modem without V.8, the answering modem tries V.23 and Bell 103.

On an Analogue Line. On an analogue telephone line (-a and -usb of dmodemd), the modem is the analogue end of the call. V.90 and V.92 operate as the analogue modem with a V.90 or V.92 server (at 9600 Hz. Refer to docs/hardware.md). V.91 and CLEAR must have a digital line, thus they operate as V.34.

The Client on a Digital Line. On a digital line (SIP, or the line of a telephone system), the modem can also be the analogue end of the call, with no modem hardware. It calls the 56k server of a provider with V.92, V.90 (90 and 92), K56flex (56) or x2 (57). When the modem calls, its V.8 CM gives only the mode of +MS: the two ends of V.90 or V.92 without V.91, or V.91 with +MS=V91. When it answers, it offers the two ends and V.91, and the CM selects one:

- Against a server, the modem is the analogue modem.
- Against an analogue modem, the modem is the digital modem.
- Against another D-Modem that calls with +MS=V91, the two modems use V.91.
- If the two modems offer the two ends, the calling modem is the analogue modem.

S117 selects the end on a digital line. The path must be G.711 from end to end, with no transcoding. The quick connect of V.92 is not used as the analogue modem on a digital line. Refer to docs/dsp/sip-client.md.

V.cvm. VCVM is the proposed Recommendation of docs/v_cvm.pdf. It is for calls whose speech path uses a mobile codec (AMR, AMR-WB). These calls cannot carry V.34 or V.32. The call starts with V.8, with V.22 and V.21 as the fallback. Then the modem probes the codec and loads a mode for it. The start takes 15 to 21 s. Make sure that S7 is sufficiently long for it. The connection uses LAPM. The modem also accepts V_CVM, its old name.

V.wb. VWB is the mode of D-Modem for a dry copper pair between two D-Modem modems (the WB stick of pico-serial, a codec at 96 kHz). It uses discrete multitone. The calling modem uses the lower tones and the answering modem uses the upper tones. The modem loads each tone from its measured SNR. Refer to docs/dsp/vwb.md. It operates only at 48000 Hz or more. There, it is the only mode and the *default* (ATZ sets it again), as a leased line (&L1). The rates of +MS do not limit it.

Clear Channel. CLEAR is a clear 64 kbit/s digital channel, for example the data call of an ISDN B-channel (a SIP call in CLEARMODE, RFC 4040, or a call of a PBX with an unrestricted digital bearer). There is no modulation. Each octet of the channel is 8 bits of the link. `CONNECT 64000` in the two directions. It starts immediately on ATD and ATA, with no call progress and no answer tone. The first bit of each octet is its most significant bit (I.460, RFC 4040). Some lines tell the modem that the call is clear (the SIP of dmodemd for a CLEARMODE call, app_dmodem for an ISDN data call). On these lines, the modem uses this mode, whatever +MS says. +B2 sets the protocol on the channel, X.75 by *default*, or the rate adaption of V.110 with +CBST. Refer to docs/isdn.md.

+A8E — V.8 and V.8 bis Controls

This command gives the controls of V.251 for V.8 and V.8 bis.

- *v8o* and *v8a* are 1: the modem does V.8 itself when it calls and when it answers (+MS sets if it does).
- *v8o* 6 and *v8a* 5: the same, and the modem reports the V.8 session before CONNECT. The caller gives +A8A:1 (ANSam), +A8M: *JM* and +A8J:1. The answerer gives +A8M: *CM* and +A8J:1. The octets are in hexadecimal, the call function first.
- *v8cf* is 0: the DTE has no call function.
- *v8b* 1 starts a data call with V.8 bis. When the modem answers, it sends MRe before its answer tone. If the caller answers MRe, the two modems agree on the data mode (CL, MS, ACK). Then they continue with V.8. When the modem calls, it answers the MRe of the far end in the same way. If a caller does not have V.8 bis, the modem answers with V.8 after 3 s.

This applies only to the modulations that start with V.8 (V.34, V.90, V.91, V.92, V.cvm). It does not apply to a leased line or a clear channel. Refer to docs/dsp/v8bis.md.

Syntax:

- +A8E=[*v8o*][,[*v8a*][,[*v8cf*][,[*v8b*]]]]
- +A8E? (gives +A8E: 1,1,0,0)
- +A8E=? (gives +A8E: (1,6),(1,5),(0),(0,1))

Result code	When
OK	Always.
ERROR	For a value outside its range: *v8b* 2 (the V.8 bis of the DTE, +A8M), *cfrange* and *protrange*.

The *default v8b* of V.251 is 1. The *default* of D-Modem is 0, because an answer with V.8 bis makes a caller without it wait about 3.5 s.

+DSVD — Voice and Data Together

This command is from D-Modem. *on* 1 offers the digital simultaneous voice and data (DSVD) of V.70 in V.8 bis (*v8b* 1 of +A8E). The modem selects it if the other modem also offers it. The call then continues with V.8 and its modulation. The link is the multiplexer of V.76. The data of the DTE goes on its data channel, which the messages of V.75 open. The data channel has error correction and no compression. The protocol is then V.76 (ATI11, the Protocol: report). Some modems have a voice path (the handset of a SmartUSB56, or the -dsvd-audio command of dmodemd). On these modems, a voice channel opens next to the data. The speech is coded with G.729 Annex A. If the two ends send the audio header of V.75, silence is coded with Annex B (comfort noise, and the data gets the line). If the far end does not have DSVD, the call is a usual data call. Refer to docs/v70.md.

Syntax:

- +DSVD=[*on*]
- +DSVD? (gives +DSVD: 0)
- +DSVD=? (gives +DSVD: (0,1))

Result code	When
OK	Always.
ERROR	For a value outside its range.

+ASVD — Analogue Voice and Data Together

This command is from D-Modem. *on* 1 offers the analogue simultaneous voice and data (ASVD) of V.61 in V.8 bis (*v8b* 1 of +A8E). The modem selects it if the other modem also offers it. The call then continues with the start procedure of V.61, not with V.8. One carrier of 3000 (or 2800) symbols each second carries 4800 bit/s of data, with the speech around it. While neither end speaks, it carries only data, at up to 14400 bit/s. The data of the DTE has the error correction of V.42, as on all calls. The speech uses the same voice path as +DSVD (the handset of a SmartUSB56, or the -dsvd-audio command of dmodemd). If there is no voice path, each frame has only data. If the two ends also offer +DSVD, the modem selects DSVD. If the far end does not have ASVD, the call is a usual data call. AT+MS=V61 uses V.61 without V.8 bis. Refer to docs/dsp/v61.md.

Syntax:

- +ASVD=[*on*]
- +ASVD? (gives +ASVD: 0)
- +ASVD=? (gives +ASVD: (0,1))

Result code	When
OK	Always.
ERROR	For a value outside its range.

B*n* — Communication Standard Setting

ATB with no number sets V.22 at 1200 bit/s only, without automode. It is the same as AT+MS=22,0,1200,1200. Other modems use B0 to B3, B15 and B16 to select the ITU or the Bell modulation at 1200 and 300 bit/s. The modem accepts these commands, but they change nothing: the negotiation of the call and +MS select the modulation.

Result code	When
OK	If there is no *n*, or *n* = 0–3, 15 or 16.
ERROR	Otherwise.

Table 25. B*n* Commands

Command	Function
B	V.22 at 1200 bit/s, no automode.
B0, B1	Accepted (other modems: V.22 or Bell 212A at 1200 bit/s).
B2, B3	Accepted (other modems: the reverse channel of V.23).
B15, B16	Accepted (other modems: V.21 or Bell 103 at 300 bit/s).

N*n* — Automode

This command sets if the modems can find their best common modulation, from the modulation that +MS selected and lower (S31). It is the same as the second parameter of +MS. With N0, the V.8 CM and JM give only the modulation of +MS, on all lines.

Result code	When
OK	If *n* = 0 or 1.
ERROR	Otherwise.

Table 26. N*n* Commands

Command	Function
N0	Only the modulation that +MS selected.
N1	Automode: that modulation or the best common modulation below it (*default*).

C*n* — Carrier Control

The modem accepts C1, so that software that sends it operates correctly. The modem does not have C0. On some other modems, C0 sends no carrier (receive only).

Result code	When
OK	If *n* = 1.
ERROR	Otherwise (C alone is C0).

Table 27. C*n* Commands

Command	Function
C0	Carrier always off (not available).
C1	Usual carrier operation (*default*).

&B*n* — V.32 Auto Retrain

Other modems use &B for the retrain of V.32 (on USRobotics modems: a fixed DTE rate). The modem accepts this command, but it changes nothing: its modulations retrain automatically.

Result code	When
OK	If *n* = 0–2.
ERROR	Otherwise.

&G*n* — V.22bis Guard Tone

The modem accepts this command, but it changes nothing: the modem sends no guard tone.

Result code	When
OK	If *n* = 0–2.
ERROR	Otherwise.

`&Nn` — Line Rate

On USRobotics modems, this command selects the rate of the line. This modem accepts it, but it changes nothing. `+MS` sets the rates.

Result code	When
`OK`	If *n* = 0–14.
`ERROR`	Otherwise.

7.1 V.cvm

+CVM — V.cvm Settings

This command is for +MS=VCVM. It has these parameters:

- *modes*: the permitted modes, a sum of the values that follow.
- *rate*: the rate of the signal interface, 8000 or 16000.
- *report*: 0 or 1. 1 asks for +CVMR at each renegotiation.

D-Modem keeps *rate* and *report*, but it operates only at 8000 Hz, without the wideband modes. It sends no +CVMR. During and after a V.cvm call, +CVM? gives a second line with the values of that call: +CVM: *raw tx*, *raw rx*, *coded tx*, *coded rx*, *symbol ms*, *tones tx*, *tones rx*, *code rate*, *renegotiations*, *erasures* (+CVM: 1600,1600,1400,1400, 20.0,16,16,7/8,0,0. The tones are 0 in the parametric mode). The CONNECT of the call has its coded receive rate and /CVM: CONNECT 1200/CVM, with \V1 CONNECT 1200/CVM/LAPM. S44 and S45 contain the number of loaded tones and the number of renegotiations.

Syntax:

- +CVM=[*modes*][,[*rate*][,[*report*]]]
- +CVM? (gives +CVM: 63,8000,0)
- +CVM=? (gives +CVM: (0-63),(8000,16000),(0,1))

Result code	When
OK	Always.
ERROR	For a value outside its range.

Table 28. +CVM Modes

Value	Mode
1	The robust mode.
2	Narrowband.
4	Wideband (not available).
8	8-DPSK.
16	The amplitude rings.
32	The parametric mode.
63	All modes (*default*).

7.2 V.92 Call Waiting and Modem-on-Hold

+PCW, +PIG — V.92 Call Waiting and PCM Upstream

+PCW (0 to 2, *default* 2) is the call waiting of V.92. This modem does not detect call waiting. +PIG (0 or 1, *default* 1) is the PCM upstream of V.92, a setting of an analogue modem. The modem keeps the two values.

+PMH — Modem-on-Hold Enable

This command sets if the far end can put the call on hold.

Syntax:

- +PMH=*n*
- +PMH? (gives +PMH: 0)
- +PMH=? (gives +PMH: (0-1))

Result code	When
OK	If *n* = 0 or 1.
ERROR	Otherwise.

Table 29. +PMH Values

Value	Meaning
0	The far end can put the call on hold (*default*).
1	The far end cannot put the call on hold.

+PMHT — Modem-on-Hold Timer

This command sets the maximum time of a hold that the modem accepts: the code of Table 33 of V.92, 0 to 13. 0 accepts no hold.

Syntax:

- +PMHT=*n*
- +PMHT? (gives +PMHT: 5)
- +PMHT=? (gives +PMHT: (0-13))

Result code	When
OK	If *n* = 0–13.
ERROR	Otherwise.

+PMHR — Modem-on-Hold Request

In online command mode on a V.92 connection, this command asks the far end to go on hold for *s* seconds (1 to 960. If there is no *s*, 10).

Syntax:

- +PMHR[=*s*]

Result code	When
OK	Always.
ERROR	Outside online command mode of a V.92 call, or for *s* outside 1 to 960.

8 Error Control

+ES — Error Control Selection

This command is the error control selection of V.250. It sets these items:

- *orig*: the error control that the modem tries first when it calls.
- *orig_fb*: the error control that can follow if the first one fails.
- *ans_fb*: the error control that the modem accepts when it answers.

\N sets this command. This command sets S103 to the \N that has the same values (if no \N has them, S103 does not change). The Synchronous Mode and the Frame Tunnelling Mode of V.80 (5 and 7, 7 and 9) are not available.

Syntax:

- +ES=[*orig*][,[*orig_fb*][,[*ans_fb*]]]
- +ES? (gives +ES: 3,0,2)
- +ES=? (gives +ES: (0-4,6),(0-4),(0-6,8))

Result code	When
OK	Always.
ERROR	For a value outside its range.

Table 30. +ES Values

Parameter	Value	Meaning
orig	0, 1	No error correction.
	2	V.42 (LAPM) without the detection phase.
	3	V.42 with the detection phase (*default*).
	4	MNP first (no detection phase, no LAPM).
	6	The Synchronous Access Mode of V.80 (Section 8.2).
orig_fb	0, 1	None (*default* 0).
	2	V.42 or MNP, or disconnect.
	3	Only V.42.
	4	Only MNP (and first).
ans_fb	0, 1	No error correction.
	2, 3	V.42, MNP or none (*default* 2).
	4	V.42 or MNP, or disconnect.
	5	Only V.42.

Table 30. +ES Values *(continued)*

Parameter	Value	Meaning
	6	Only `MNP`.
	8	The Synchronous Access Mode of `V.80`.

`&Q`*n* — Error Control Mode

Other modems use this command to select the error correction, as `\N`. `&Q` alone is `&Q0`. The synchronous modes are not available.

Result code	When
`OK`	If *n* = 0, 5, 6, 8 or 9.
`ERROR`	Otherwise.

Table 31. &Q*n* Commands

Command	Function
`&Q0, &Q6`	No error correction (`\N0`).
`&Q5, &Q8, &Q9`	`V.42`, then `MNP`, then none (`\N3`).

\Nn — Error Control Mode

This command sets the error correction (S103), as on the Rockwell modems. Each value sets +ES to the equivalent value of V.250. ATS103=*n* is \N*n*.

The detection phase of V.42 selects LAPM or no error correction. If the answering modem sends no V.42 answer, the calling modem sends the LR of MNP. If the answering modem gets an LR (from a modem with only MNP, or a modem with this setting), it starts MNP. With only MNP, the calling modem starts with its LR. MNP 5 compression operates with MNP (%C). \A sets the block size of MNP.

Result code	When
OK	If *n* = 0–5.
ERROR	Otherwise.

Table 32. \N*n* Commands

Command	Function	+ES
\N0	Normal: no error correction.	1,0,1
\N1	Direct: no error correction.	0,0,0
\N2	Reliable: V.42 (LAPM) or MNP, or else disconnect.	3,2,4
\N3	Auto-reliable: V.42, MNP, or none (*default*).	3,0,2
\N4	Only V.42 (LAPM), or else disconnect.	3,3,5
\N5	Only MNP, or else disconnect.	4,4,6

&Mn — Asynchronous Communications Mode

The modem accepts this command, but it changes nothing (other modems: asynchronous mode. USRobotics modems: error correction, on this modem \N).

Result code	When
OK	If *n* = 0, 4 or 5.
ERROR	Otherwise.

\A*n* — MNP Block Size

This command sets the block size of MNP, the longest information field that it offers (S105). As on other modems, an LR offers 64 and the 256-octet data phase optimization.

Result code	When
OK	If *n* = 0–3.
ERROR	Otherwise.

Table 33. \A*n* Commands

Command	Function
\A0	64 octets.
\A1	128 octets.
\A2	192 octets.
\A3	256 octets (*default*).

-SEC — MNP 10EC

This command is the MNP 10EC of Rockwell, and its transmit level (1,12). The modem keeps the values, *default* 0. -SEC? gives only the values, without the name. =? gives (0,1),(0-30).

-C, -K, -Q,)M, @M, *H, :T19 — MNP 10

These commands control the MNP 10 of Microcom. The modem offers MNP 10 in all MNP calls (S113 bit 0, *default* on). The packets of the link become larger and smaller with the quality of the line. The call changes between modulations when the line becomes better or worse. If the far end is a D-Modem (S113 bit 1, *default* on), the call can change between all modulations that the two modems have, from V.34 and V.32bis to V.21. With other MNP 10 modems, the call changes only in V.34, and in V.32bis, V.22bis and V.22.

Table 34. MNP 10 Commands

Command	Function
-K0	A V.42 call stays V.42 (S107, *default*).
-K1, -K2	If the far end offers MNP 10 in its XID, a V.42 call changes to MNP 10, in HDLC frames (it loses V.42bis).

Table 34. MNP 10 Commands *(continued)*

Command	Function
-Q0	No rate below 4800 bit/s (S108).
-Q1	No rate below 2400 bit/s.
-Q2	Down to the lowest rate (*default*).
)M0	Not cellular (S109, *default*).
)M1,)M2	Cellular: the transmit level changes with the reports of the far end, and the fallbacks are faster.
@M*n*	The start value of the cellular transmit level (S110): @M0 8 dB down, @M1 20 dB, @M10 to @M30 0 to 20 dB.
*H0	The call starts at the highest rate (S111, *default*).
*H1, *H2	The calling modem starts at V.22 (1200 bit/s) or V.32bis at 4800, and increases the rate.
:T19*n*	1 (*default*): at 1200 bit/s, disconnect after 120 s with no data from the far end (S112).

The LR of the caller is 38 octets or less, because some modems refuse a longer LR. Thus, some MNP 10 parameters are only in the LR when they fit. With V.42bis offered (S114=1), the LR does not offer MNP 10. S113 bit 2 (*default* off) sends the long LR: all the MNP 10 parameters and the mark of the originator (parameter 0x11), with no limit. Set it only for a modem that must have them. The modem accepts -C, but it changes nothing. The modem does not have the modulations of MNP 10EC. A modem with MNP 10EC connects with V.42 or with MNP 10.

Result code	When
OK	For -C0, -C1, -K0 to -K2, -Q0 to -Q2,)M0 to)M2, @M0 to @M30, *H0 to *H2, :T190, :T191.
ERROR	Otherwise.

8.1 ETC (Enhanced Throughput Cellular)

ETC is the cellular mode of AT&T Paradyne. The 3Com Megahertz PC Cards (3CXM556 and others) have it. The firmware of these cards uses V.32bis or lower, error control, a transmit filter, and other timers. D-Modem uses the parts of this firmware that are known: S116, &F5, &F6 and +EF.

&F5, &F6, S116 — ETC Settings

S116 holds the ETC flags, with the bits of the 3Com firmware (*default* 0, off). D-Modem uses these bits:

Table 35. S116 Bits

Bit	Function
0 to 2	If one of them is set, ETC is on: /ETC follows the error correction in CONNECT (with \V1), and #UD gives 82 for error control (key 40).
1	The cellular side: the caller sends a calling tone of 1500 Hz (0.7 s on, 1.5 s off).
4	The landline side: if bits 0 to 2 are not set, the answerer listens for the 1500 Hz tone in the first 10 s. If it finds the tone, ETC is on for the call. The transmit level is 6.6 dB lower.
5	The transmit filter of +EF is on.
any	If S116 is not 0, V.42 offers frames of 64 octets (N401), and T401 is 3 s plus the time of three frames.

Table 36. ETC Profiles

Command	Function
&F5	The cellular side (ETC_CELL): S116 = 238 (0xEE), +MS=V32B (V.32bis and lower), \N2 (error control is necessary), S10 = 40 (4 s), S7 = 90.
&F6	The landline side (ETC_LAND): S116 = 176 (0xB0), \N3 (error control if possible). The modulations do not change.

With &F6, ETC is on only for a call from an ETC caller.

Result code	When
OK	Always.

+EF=*n* — ETC Transmit Filter

The set of coefficients of the 6-tap transmit filter (0 to 10, *default* 5), as the 3Com firmware has them. The filter operates when bit 5 of S116 is set. Set 0 has a flat response. Sets 1 to 6 decrease the high frequencies, to compensate for the pre-emphasis of a cellular voice channel. Set 5 changes the gain from +3.5 dB at 300 Hz to −7.6 dB at 3600 Hz. D-Modem sets the gain of each set to 0 dB at 1800 Hz. `+EF?` gives the set, and `+EF=?` gives `(0-10)`.

Result code	When
`OK`	If *n* is 0 to 10.
`ERROR`	Otherwise.

8.2 V.80 Synchronous Access

With +ES=6 (calling) or +ES=„8 (answering), the call has no error correction and no compression. After CONNECT, the modem moves the octets of the DTE as a synchronous bit stream. The in-band commands of V.80 follow EM (0x19) in the two directions (Table 9/V.80).

The modem starts in the *transparent* sub-mode. The octets of the DTE go out with no change, least significant bit first. The bits of the line come back as octets. When the DTE has no data, the modem sends *syn1* and tells the DTE <EM><under>. With the *trans_idle* 1 or 2 of +ESA, the receiver first searches for the SYN. It gives the DTE no data before the SYN.

<EM><flag> from the DTE starts the *framed* sub-mode:

- The data goes in HDLC frames. The <EM><flag> of the DTE ends each frame. The modem adds the zero insertion, the flags and the FCS.
- The modem gives back the octets of each received frame (without the FCS, which it examined). It adds <EM><flag> for a good frame or <EM><err> for a bad frame.
- It gives an <EM><err> when its search finds a flag, and <EM><mark> for an abort or marks.
- <EM><mark> from the DTE goes back to transparent.

The modem shields EM and 0x99 in the data in the two directions (<EM><t1>, <EM><t2>). It also shields DC1 and DC3 with DC1/DC3 flow control (+IFC). From the DTE, the modem accepts all codes T1 to T20. The half duplex of V.34 is not available.

Table 37. V.80 In-Band Commands

Command	From	Meaning
<EM><ecs>	DTE	Online command state (in place of +++, which is data). The modem answers <EM><ecs>, then OK. ATO goes back.
<EM><eot>	DTE	Disconnect: <EM><eot>, then NO CARRIER.
<EM><rate><tx><rx>	DTE	The highest rates to send and to receive (the *max* of +MS), for the next retrain or renegotiation (AT+MS sets the two again).
<EM><hunt>	DTE	Start the search of the receiver again (framed, or transparent with *trans_idle* 1 or 2). The modem discards the data that waits for the DTE.

Table 37. V.80 In-Band Commands *(continued)*

Command	From	Meaning
<EM><resume>	DTE	Continue after an underrun (the *framed_un_ov* of +ESA).
<EM><rtn>, <EM><rrn>	DTE	Retrain, or renegotiate the rate, as ATO1 and ATO3.
<EM><eot>	Modem	The carrier of the far end stopped (before NO CARRIER).
<EM><rtn>, <EM><rrn>	Modem	A retrain or renegotiation that the DTE did not ask for (from the far end, or from this modem after a loss of signal).
<EM><rate><tx><rx>	Modem	The rates, after each of these, or when they change during the call.
<EM><rover>	Modem	The modem lost received octets (the DTE read no data for 2048 octets).
<EM><tover>	Modem	The modem lost octets of the DTE (the buffer was full).
<EM><under>	Modem	The DTE has no more data.
<EM><bnum>	Modem	The count of the transmit buffer, with +ITF.

+ESA — Synchronous Access Mode Settings

These are the eight settings of the Synchronous Access Mode. If you do not give a setting, it does not change.

Syntax:

- +ESA=[*trans_idle*][,*framed_idle*...][,*syn2*]
- +ESA? (gives +ESA: 0,0,0,0,0,0,255,255)
- +ESA=? (gives +ESA: (0-2),(0,1),(0,1),(0),(0-2),(0),(0-255),(0-255))

Result code	When
OK	Always.
ERROR	For a value outside its range.

Table 38. +ESA Parameters

Parameter	Value	Meaning
`trans_idle`	0	The modem sends *syn1* when the `DTE` has no data. The receiver gives the octets as they come (*default*).
	1	The same, but the receiver searches for *syn1*.
	2	The modem sends *syn1* and *syn2* in turn. The receiver searches for the two (*syn1* first). Each search gives the `DTE` the octets from the `SYN`, aligned on it.
`framed_idle`	0	Flags between frames (*default*).
	1	Marks between frames.
`framed_un_ov`	0	The `DTE` has no more data in a frame: an abort (*default*).
	1	A flag (no `FCS`). For the two values, the modem then discards the octets of the `DTE` until its `<EM><resume>`. `<EM><unum>` and their count answer it (for the two: `<EM><under>`).
`hd_auto`	0	Only 0.
`crc_type`	0	No `FCS` (*default*).
	1	FCS-16.
	2	FCS-32 (`V.42`'s).
`nrzi_en`	0	Only 0.
`syn1, syn2`	0–255	The `SYN` octets (*default* 255).

+ITF — Transmit Buffer Thresholds

This command controls the transmit buffer of the Synchronous Access Mode. If the number of octets of the DTE in the buffer (with the EM codes) is more than *off*, the modem does not accept more octets. The modem keeps *on*. If *report_period* is not 0, the modem gives <EM><bnum> with the number of octets every *report_period* times 10 ms.

Syntax:

- +ITF=[*off*][,[*on*][,[*report_period*]]]
- +ITF? (gives +ITF: 383,128,0)
- +ITF=? (gives +ITF: (1-4095),(0-4094),(0-500))

Result code	When
OK	Always.
ERROR	For a value outside its range, or if *off* is not more than *on*.

9 Data Compression

&Kn — Data Compression

&K0 to &K3 set data compression as on the USRobotics modems. They are the same as %C (S104). The Rockwell and Conexant modems use &K for flow control. The modem accepts their &K4 to &K6, but these have no effect. Their &K3 (RTS/CTS) keeps the compression of V.42 on.

Result code	When
OK	If *n* = 0–6.
ERROR	Otherwise.

Table 39. &K*n* Commands

Command	Function
&K0	No compression (%C0).
&K1, &K2	V.44, V.42bis or MNP 5 (%C3).
&K3	V.44 or V.42bis, no MNP 5 (%C2).
&K4–&K6	Accepted (the flow control of other modems).

%C*n* — Data Compression Control

This command sets data compression (S104). Data compression must have error correction (\N). V.42 offers V.44 and V.42bis, and the far end selects one. +DS, +DS44 and +DSZ give the detailed settings. &K sets the same item.

Result code	When
OK	If *n* = 0–3.
ERROR	Otherwise.

Table 40. %C*n* Commands

Command	Function
%C0	No compression.
%C1	MNP 5 (with MNP).
%C2	V.44 or V.42bis (with the LAPM of V.42). Also V.42bis with MNP, if the far end offers it (S114).
%C3	One of the two, as applicable to the error correction of the call (*default*).

+DS — V.42bis Data Compression

This command controls V.42bis (V.250 6.6.1), in the compression that %C sets.

Syntax:

- +DS=[*direction*][,[*neg*][,[*dict*][,[*string*]]]]
- +DS? (gives +DS: 3,0,2048,34)
- +DS=? (gives +DS: (0-3),(0,1),(512-65535),(6-250))

Result code	When
OK	Always.
ERROR	For a value outside its range.

Table 41. +DS Parameters

Parameter	Values	Meaning
direction	0-3	The directions of the DTE: 0 none, 1 the data that it sends, 2 the data that it receives, 3 the two (*default*).
neg	0, 1	1: disconnect (NO CARRIER) if the link starts without compression in those directions. *Default* 0.
dict	512-65535	The largest dictionary that the XID of V.42 offers. A maximum of 2048, the *default*.
string	6-250	The longest string that the modem offers. A maximum of 34, the *default*.

+DS44 — V.44 Data Compression

This command controls V.44 (V.250 6.6.2), in the same way. AT+DS=0 with AT+DS44=3 offers only V.44. AT+DS44=0 offers only V.42bis (and zstd, if +DSZ=0 is not set). If the two are 0, there is no compression, as AT%C0. zstd uses the directions of the two.

Syntax:

- +DS44=[*direction*][,[*neg*][,[*capability*][,...]]]
- +DS44? (gives +DS44: 3,0,0,4096,4096,255,255,12288,12288)
- +DS44=? (gives the ranges below)

Result code	When
OK	Always.
ERROR	For a value outside its range.

Table 42. +DS44 Parameters

Parameter	Values	Meaning
direction	0-3	As for +DS (*default* 3).
neg	0, 1	1: disconnect if the link starts without V.44, or zstd in its place, in those directions.
capability	0, 1	The modem keeps the value, but it always uses the stream method.
codewords tx, rx	256-65535	The largest codewords, in each direction. A maximum of 4096.
strings tx, rx	32-255	The longest strings. A maximum of 255.
history tx, rx	512-65535	The history, in each direction. A maximum of 12288.

For each pair, the modem uses the smaller value in the two directions.

+DSZ — zstd Data Compression

This command is from D-Modem. *on* 1 offers zstd (Zstandard, Annex F of docs/v_cvm.pdf) in the XID of V.42, next to V.42bis and V.44, when compression is on (%C). *dict* 1 offers zstd with the dictionary of V.cvm. A call uses zstd only if the far end also offers it (a different D-Modem). Then CONNECT ends in /ZSTD, and the compression result is ZSTD (70 with V0). With other modems, the call continues with V.44 or V.42bis. 0 offers only V.44 and V.42bis.

Syntax:

- +DSZ=[*on*][,[*dict*]]
- +DSZ? (gives +DSZ: 1,1)
- +DSZ=? (gives +DSZ: (0,1),(0,1))

Result code	When
OK	Always.
ERROR	For a value outside its range.

+X2UP — x2 Upgrade Host

D-Modem's own: the host side of the USRobotics remote feature upgrade (`docs/x2-upgrade.md`). After `LAPM` connects, *mode* 1 reads the serial number and the feature records of a Courier, and *mode* 2 also enables the features in *enable* and disables the features in *disable*. These are sums of Terbo (4), V.FC (8) and x2 (16). The defaults are 16 and 0, thus `AT+X2UP=2` enables x2. The modem then sends one line to the `DTE`: `+X2UP:` *result*`,"`*serial*`",`*before*`,`*after*. *result* is `ENABLED`, `DISABLED`, `CHANGED`, `ALREADY`, `REFUSED`, `QUERIED` or `NO REPLY`; *before* and *after* are record 2 in decimal, as the Courier's `ATY14` shows it. `0` does nothing.

Syntax:

- `+X2UP=[`*mode*`][,`*enable*`][,`*disable*`]`
- `+X2UP? (gives +X2UP: 0,16,0)`
- `+X2UP=? (gives +X2UP: (0-2),(0,4,8,12,16,20,24,28),(0,4,8,12,16,20,24,28))`

Result code	When
`OK`	Always.
`ERROR`	For a value outside its range, or for a feature in *enable* and in *disable*.

+DEBC — EBCDIC DTE

This command is from D-Modem (`docs/ebcdic.md`). It sets the character set of the DTE. With *mode* 1, the first two characters of each command line identify the character set: AT in EBCDIC is 0xC1 0xE3. Then the modem sends the echo, the information text and the result codes of that line in the same character set, and it also sends the unsolicited result codes (for example `RING` and `CONNECT`) in that character set. In EBCDIC, the escape character (S2) is also in EBCDIC: + is 0x4E. *mode* 0 accepts only ASCII. *mode* 2 accepts only EBCDIC. *data* 1 also changes the data of a call: the modem changes the EBCDIC of the DTE to ISO 8859-1 for the far end, and the ISO 8859-1 of the far end to EBCDIC. With *data* 0, the modem does not change the data. *cp* is the IBM code page. The default is 37 (USA and Canada). The result of the command line that sets +DEBC is in the character set of that command line. Z sets +DEBC=1,0,37.

Syntax:

- +DEBC=[*mode*][,[*data*][,*cp*]]
- +DEBC? (gives +DEBC: 1,0,37)
- +DEBC=? (gives +DEBC: (0-2),(0,1),(37,273,275,277,278,280,284,285,297,500,871,1047))

Result code	When
OK	Always.
ERROR	For a value outside its range.

10 DTE Interface and Flow Control

+IFC, +ICF, +IPR — DTE Interface

+IFC sets the flow control in each direction (DC1/DC3 in the Synchronous Access Mode of V.80, Section 8.2). +ICF sets the character framing of the DTE. +IPR sets the rate of the DTE (0 automatic).

Table 43. DTE Interface Parameters

Name	Default	Range
+IFC	2,2	(0-3),(0-2)
+ICF	3,3	(1-6),(0-3)
+IPR	0	0, 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600

&H*n* — Flow Control

The modem keeps the value in S62. The pty controls the flow, thus the value changes only the report of #UD.

Result code	When
OK	If *n* = 0–3.
ERROR	Otherwise.

Table 44. &H*n* Commands

Command	Function (as in the report)
&H0	None (*default*).
&H1	RTS/CTS.
&H2	XON/XOFF.
&H3	Both.

&I*n* — XON/XOFF Flow Control

This is the software flow control of USRobotics. The modem accepts this command, but it changes nothing.

Result code	When
OK	If *n* = 0–5.
ERROR	Otherwise.

\Q*n* — Flow Control

The modem accepts this command, but it changes nothing: the pty controls the flow.

Result code	When
OK	If *n* = 0–3.
ERROR	Otherwise.

\G*n* — XON/XOFF Pass Through

The modem accepts this command, but it changes nothing.

Result code	When
OK	If *n* = 0 or 1.
ERROR	Otherwise.

&C*n* — Data Carrier Detect (DCD) Control

The modem keeps the value in S60. The value changes nothing: a pty has no carrier line.

Result code	When
OK	If *n* = 0 or 1.
ERROR	Otherwise.

Table 45. &C*n* Commands

Command	Function
&C0	DCD always on (*default*).
&C1	DCD follows the carrier (on other modems).

&D*n* , &F*n* , &R*n* , &S*n* — DTR, Factory Defaults, RTS, DSR

The modem accepts these commands, with or without a digit, and does nothing. ATZ sets the *defaults*. When the DTE sets DTR off, dmodemd disconnects the call, whatever &D says (Section 19).

Result code	When
OK	Always.

F*n* — On-Line Data Character Echo

The modem accepts F1, so that software that sends it operates correctly. On other modems, F0 echoes the online data. This modem never echoes the online data.

Result code	When
OK	If *n* = 1.
ERROR	Otherwise (F alone is F0).

\Jn — Rate Adjust

On other modems, this command makes the rate of the DTE follow the rate of the line. This modem accepts it, but it changes nothing.

Result code	When
OK	If *n* = 0 or 1.
ERROR	Otherwise.

+ILRR, +IDSR, +ILSD — DTE Rate Report, DSR, Long Space

These commands are the rate report of the DTE, DSR and long space disconnect. The modem keeps the values. Each value is 0 or 1, *default* 0.

\Kn — Break Control

On other modems, this command sets the function of a break. This modem accepts it, but it changes nothing.

Result code	When
OK	If *n* = 0–5.
ERROR	Otherwise.

\Rn — Ring Indicator After Answer

The modem accepts this command, but it changes nothing.

Result code	When
OK	If *n* = 0 or 1.
ERROR	Otherwise.

\Tn — Inactivity Timer

The modem accepts this command, but it changes nothing.

Result code	When
OK	If *n* = 0–255.
ERROR	Otherwise.

11 ISDN and Cellular

+B2 — B-Channel Protocol

This command is from D-Modem. It uses the numbers of CAPI 2.0 for layer 2. It sets the protocol on a clear 64 kbit/s channel (+MS=CLEAR, or a line that tells the modem that its call is clear). Other modes do not use it. &V lists it.

Syntax:

- +B2=*n*
- +B2? (gives +B2: 0)
- +B2=? (gives +B2: (0,5,7,9))

Result code	When
OK	If *n* = 0, 5, 7 or 9.
ERROR	Otherwise.

Table 46. +B2 Values

Value	Protocol
0	X.75 (LAPB in HDLC, basic mode, a window of 7, the calling modem at address B). This is the protocol of ISDN terminal adapters, BBSes and mailers. The characters of the DTE go in I frames of up to 256 octets. CONNECT 64000, with \V1 CONNECT 64000/X.75. ATH sends DISC (*default*).
5	Synchronous PPP (RFC 1618). The DTE uses the asynchronous framing of PPP (RFC 1662, as pppd does on a serial port). Each frame goes to the line in HDLC without its escapes, and comes back with escapes. /PPP with \V1.
7	The link of the modem (V.42, MNP or plain characters, as \N sets), for the clear channel of an earlier D-Modem.
9	V.120 (the frames of Q.921 for logical link 256 in extended mode, the information of each I frame after the header octet 0x83 of V.120). This is the protocol of North American terminal adapters. /V.120 with \V1.

+CBST — Bearer Service Type (V.110)

This command is the bearer service of 27.007: the rate adaption of V.110 on a clear channel (+MS=CLEAR).

- *name* 0 (the *default*) is asynchronous: the characters of the DTE go through the link of the modem (\N), whatever +B2 says.
- *name* 1 is synchronous: the protocol of +B2 in HDLC at the user rate.
- *ce* has no function here.

CONNECT gives the user rate (with \V1 and no V.42, /V.110). &V lists it. Refer to docs/isdn.md.

Syntax:

- +CBST=[*speed*][,[*name*][,[*ce*]]]
- +CBST? (gives +CBST: 0,0,0)
- +CBST=?

Result code	When
OK	For a *speed* below, *name* 0 or 1, *ce* 0 or 1.
ERROR	Otherwise.

Table 47. +CBST Speeds

Value	User rate
0	None (*default*). An answering modem uses the rate of the frames of the caller (600 to 38400), if they come.
65, 66, 68, 70	300, 1200, 2400, 4800 bit/s (intermediate rate 8k).
71	9600 bit/s (16k).
75, 79	14400, 19200 bit/s (32k).
80, 81	28800, 38400 bit/s (64k).
83	56000 bit/s (7 bits in each octet, no frames).

+CRC — Cellular Result Codes

This command is from 27.007. With 1, the modem gives a different result in place of RING for each ring of a call:

- +CRING: SYNC for a call on a clear 64 kbit/s channel (an ISDN data call: the CLEARMODE of SIP, the digital bearer of a PBX, the unrestricted digital call of an mISDN card).
- +CRING: VOICE for all other calls.

These results are always words, whatever V says. A program that answers automatically (dmodem-capid, CAPI on a D-Modem) uses them to identify the two types of call. &V lists the setting.

Syntax:

- +CRC=*n*
- +CRC? (gives +CRC: 0)
- +CRC=? (gives +CRC: (0,1))

Result code	When
OK	If *n* = 0 (RING, the *default*) or 1.
ERROR	Otherwise.

12 Result Codes

The modem answers each command line with a result code, as a word (V1) or a number (V0). Each result code is on a separate line. Q1 sets the result codes off.

The modem uses the line format of ITU-T V.250. This format does not change when echo is off (E0):

- V1: a carriage return and a line feed (S3 and S4) go before each word result code and after it. The same pair goes before the first line of a response and after each line of it. Thus, ATE0 and then AT give <CR><LF>OK<CR><LF>.
- V0: a carriage return (S3) goes after each number. Thus, AT gives 0<CR>. Each line of a response ends with a carriage return and a line feed.

Table 48. Result Codes

Result code	Number	Description
OK	0	The modem did the command line.
CONNECT	1	The call is connected (X0, fax and voice), or the data of a fax command starts.
CONNECT *rate*	Below	A data call is connected at *rate*.
RING	2	A call rings (dmodemd: every 3 s, Section 20).
NO CARRIER	3	No call connected, or the call ended.
ERROR	4	A command failed, or a line was too long.
NO DIALTONE	6	No dial tone (X2, X4).
BUSY	7	A busy tone (X3, X4).
NO ANSWER	8	No answer in S7 seconds after the modem dialed.
FAX	88	Adaptive answer (+FAA=1): a fax call. Class 1 follows.
DATA	89	Adaptive answer: a data call. Its CONNECT follows.
VCON	90	Voice mode, set with #CLS=8: the modem has the line for voice (A, the answer of D, #VLS=1). In this condition, +FCLASS=8 gives OK.

The CONNECT of a data call gives the rate at which the modem receives, in bit/s (CONNECT 33600). With V0, it gives the number of that rate (23). With X0, in fax mode and in voice mode, it is only CONNECT (1). \V1 adds the error correction

and the compression (`CONNECT 33600/LAPM/V42bis`). `&A` adds lines about the connection before it. For a `PEP` call, it is `CONNECT FAST`, as on a Telebit. Its number is the number of the rate at which the modem receives. The table that follows gives the number of each rate. A rate that is not in the table is 1.

Table 49. CONNECT Rates and Their Numbers

Rate	n	Rate	n	Rate	n	Rate	n
75	80	24000	19	37333	51	50666	58
300	9	25333	81	38000	43	52000	32
600	10	26400	20	38666	52	53333	59
1200	5	26666	82	40000	25	54000	33
2400	11	28000	46	41333	53	54666	60
4800	12	28800	21	42000	26	56000	34
7200	13	29333	47	42666	54	57333	83
9600	27	30666	48	44000	28	57600	35
12000	14	31200	22	45333	55	58000	44
14400	15	32000	40	46000	29	58666	84
16800	16	33333	49	46666	56	60000	45
19200	17	33600	23	48000	30	61333	85
21600	18	34666	50	49333	57	62666	86
		36000	42	50000	31	64000	87

13 S-Registers

The S-registers contain the settings of the modem, 8 bits each. `ATS` reads and sets them: `ATS`*n*`?` gives the value of register *n*, and `ATS`*n*`=`*v* sets it. Registers 0 to 255 are available. The registers that this section does not list are 0 and free. The modem keeps the values that you write in them. In this section, “kept” means that you can set and read the value, but it has no other effect.

Table 50. S-Register Summary

Reg.	Description	Range	Unit	Default
S0	Rings before the modem answers.	0–255	rings	0
S1	Ring counter.	0–255	rings	0
S2	Escape character.	0–255	ASCII	43
S3	Command line end.	0–255	ASCII	13
S4	Line feed.	0–255	ASCII	10
S5	Backspace.	0–255	ASCII	8
S6	Wait for dial tone.	0–255	s	2
S7	Wait for the call to connect.	0–255	s	60
S8	Pause of the comma.	0–255	s	2
S9	Carrier detect time (kept).	0–255	0.1 s	6
S10	Carrier loss before disconnection.	0–255	0.1 s	7
S11	DTMF tone and gap.	0–255	ms	100
S12	Escape guard time (kept).	0–255	20 ms	50
S13	Echo (E).	0, 1	–	1
S14	Quiet (Q).	0, 1	–	0
S15	Verbose (V).	0, 1	–	1
S16	Tone or pulse dialing.	0, 1	–	1
S18	Loop test time.	0–255	s	0
S24	Hook flash time.	0–255	10 ms	20
S28	Pulse ratio (kept).	0–3	–	0
S29	Speaker control (M).	0–3	–	1
S30	Speaker volume (L).	0–3	–	3
S31	Automode (N).	0, 1	–	1
S32	Modulation (+MS).	Table 24	–	92
S39	Line quality (kept).	0–2	–	0

Table 50. S-Register Summary *(continued)*

Reg.	Description	Range	Unit	Default
S44	V.cvm: tones loaded (read only).	0–255	tones	0
S45	V.cvm: renegotiations (read only).	0–255	–	0
S46	Hayes sets and ADC in V.42.	0–255	–	0
S47	Leased line (&L).	0–2	–	0
S48	V.13 simulated carrier.	0, 1	–	0
S49	Point of sale fast connect.	0, 1, 3	–	0
S50	Fast answer tone.	0–255	10 ms	0
S56	Result codes and dial tone (X).	0–4	–	4
S60	Carrier detect (kept).	0, 1	–	0
S62	Flow control (kept).	0–3	–	0
S70	CONNECT's lines (&A).	0–7	–	0
S71	CONNECT's rate (kept).	0, 1	–	0
S92	Answer delay.	0–255	s	2
S103	Error correction (\N).	0–5	–	3
S104	Data compression (%C).	0–3	–	3
S105	MNP block size (\A).	0–3	–	3
S106	Protocol in CONNECT (\V).	0–2	–	0
S114	V.42bis offered in an MNP call.	0, 1	–	0
S116	ETC flags (&F5, &F6).	0–255	–	0
S117	PCM end on a digital line.	0–2	–	0
S161	Y (kept).	0–3	–	0

13.1 S-Register Definitions

The range is the range of the function of the register. `ATS` accepts all values from 0 to 255 for all registers, but not for S44 and S45, which are read only. `ATZ` sets the registers to their *defaults*, but S18, S28, S47, S48 and S161 keep their values.

S0—Auto-Answer Ring Number

The number of rings that the modem counts before it answers a call automatically. 0 disables auto-answer: the modem then answers only with `ATA`. On a leased line (`&L`), a value more than 0 makes the modem answer, with no ring, when it is idle.

- Range: 0–255
- *Default*: 0
- Units: rings

S1—Ring Counter

The number of rings until now. The modem compares it with the value of S0.

- Range: 0–255
- *Default*: 0
- Units: rings

S2—Escape Character

The `ASCII` value of the character of the escape sequence, `+++` (Section 19).

- Range: 0–255
- *Default*: 43 (+)
- Units: `ASCII`

S3—Command Line Termination Character

The character that ends a command line and the result codes.

- Range: 0–255
- *Default*: 13 (carriage return)
- Units: `ASCII`

S4—Response Formatting Character

The line feed after the result codes. A command line also ends at this character.

- Range: 0–255
- *Default*: 10 (line feed)
- Units: `ASCII`

S5—Command Line Editing Character

The backspace: it erases the last character that you typed. If echo is on, the modem sends back the backspace, a space and the backspace again.

- Range: 0–255
- *Default*: 8 (backspace)
- Units: `ASCII`

S6—Wait Time for Dial Tone

With `X2` or `X4`, the time that the modem waits for a dial tone before `NO DIALTONE`. The time is a minimum of 2 s, whatever the value. The modem adds 2 s more while it hears a dial tone in a cadence.

- Range: 0–255
- *Default*: 2
- Units: seconds

S7—Connection Completion Time-Out

The time that the modem waits for the call to connect after it dials or answers: the answer and the training. The `W` and `@` of the dial string also wait for this time. The `+VRN` of voice mode does not wait longer than this time. The start of `V.cvm` takes 15 to 21 s, thus make sure that S7 is sufficiently long.

- Range: 0–255
- *Default*: 60
- Units: seconds

S8—Pause Time for Comma Dial Modifier

The pause of a `,` in the dial string. The country (`+GCI`) sets it.

- Range: 0–255
- *Default*: 2 (the country's)
- Units: seconds

S9—Carrier Detect Response Time

Kept: the modulations detect the carrier automatically.

- Range: 0–255
- *Default*: 6
- Units: 0.1 s

S10—Automatic Disconnect Delay

The time that the carrier can be absent before the modem disconnects with `NO CARRIER`.

- Range: 0–255
- *Default*: 7
- Units: 0.1 s

S11—`DTMF` Dialing Speed

The length of each `DTMF` digit that the modem dials, and of the gap after it. If the value is less than 40, the modem uses 95.

- Range: 0–255
- *Default*: 100
- Units: milliseconds

S12—Escape Guard Time

Kept: the guard time of the escape sequence is always 0.5 s.

- Range: 0–255
- *Default*: 50
- Units: 0.02 s

S13—Echo

The setting of `E`.

- Range: 0, 1
- *Default*: 1
- Units: none

S14—Quiet

The setting of `Q`.

- Range: 0, 1
- *Default*: 0
- Units: none

S15—Verbose

The setting of `V`.

- Range: 0, 1
- *Default*: 1
- Units: none

S16—Tone or Pulse Dialing

1 tone (T), 0 pulse (P).

- Range: 0, 1
- *Default*: 1
- Units: none

S18—Loop Test Timer

A loop test (&T) ends after this number of seconds. If the value is 0, the test does not end. ATZ does not change it.

- Range: 0–255
- *Default*: 0
- Units: seconds

S24—Hook Flash Time

The length of a hook flash. The country sets it.

- Range: 0–255
- *Default*: 20 (the country's)
- Units: 0.01 s

S28—Pulse Dial Ratio

The setting of &P, kept: the table of the country sets the pulse times. ATZ does not change it.

- Range: 0–3
- *Default*: 0
- Units: none

S29—Speaker Control

The setting of M.

- Range: 0–3
- *Default*: 1
- Units: none

S30—Speaker Volume

The setting of L.

- Range: 0–3
- *Default*: 3
- Units: none

S31—Automode

The setting of N, and the second parameter of +MS. 0: the V.8 CM and JM give only the modulation of +MS, with no slower modulation.

- Range: 0, 1
- *Default*: 1
- Units: none

S32—Modulation

The modulation of +MS, by its number (Table 24).

- Range: the numbers of Table 24
- *Default*: 92 (200 at 48000 Hz or more)
- Units: none

S39—Line Quality Monitor

The setting of %E, kept.

- Range: 0–2
- *Default*: 0
- Units: none

S44—V.cvm Tones Loaded

The number of tones that the modem loaded in the receive direction of the last V.cvm call (+CVM). Read only.

- Range: 0–255
- *Default*: 0
- Units: tones

S45—V.cvm Renegotiations

The number of renegotiations of the last V.cvm call. Read only.

- Range: 0–255
- *Default*: 0
- Units: none

S46—Hayes Protocol Selection

Not 0: the `XID` of a `V.42` call has the private sets of the Hayes V-series modems (`AFT` and `HMP`). The value has the coding of the Hayes S46: 136 `LAP-M`, 138 `LAP-M` with compression (bit 1). When the two modems agree on the compression and not on `V.42bis`, the call uses Hayes `ADC` in the two directions, and `CONNECT` shows `COMPRESSION: ADC` (68). When the two modems send the sets and one of them does not agree on the compression, the call has no compression. 0: no Hayes sets.

- Range: 0–255
- *Default*: 0
- Units: none

S47—Leased Line

The setting of `&L`: 0 a dialed line, 1 a 2-wire leased line, 2 a 4-wire leased line. `ATZ` does not change it.

- Range: 0–2
- *Default*: 0
- Units: none

S48—Simulated Carrier Control

1: the simulated carrier control of `V.13` on a leased line, on a call with no error correction (`&L`). `ATZ` does not change it.

- Range: 0, 1
- *Default*: 0
- Units: none

S49—Point of Sale Fast Connect

1: the short handshake of `V.22`, Bell 212A and `V.22bis` that point of sale terminals and their hosts use. 3: the same, with HDLC flags in place of the scrambled ones at 1200 bit/s (Section 7). 0: the handshakes of the Recommendations.

- Range: 0, 1, 3
- *Default*: 0
- Units: none

S50—Fast Answer Tone

The length of the answer tone when S49 is set, and of the answer tone of `V.29` FastPOS. 0 is 400 ms.

- Range: 0–255
- *Default*: 0
- Units: 10 ms

S56—Result Code Set

The setting of `X`.

- Range: 0–4
- *Default*: 4
- Units: none

S60—Data Carrier Detect

The setting of `&C`, kept.

- Range: 0, 1
- *Default*: 0
- Units: none

S62—Flow Control

The setting of `&H`, kept.

- Range: 0–3
- *Default*: 0
- Units: none

S70—Connection Lines

The setting of `&A`.

- Range: 0–7
- *Default*: 0
- Units: bits

S71—Rate in CONNECT

The setting of `&E`, kept.

- Range: 0, 1
- *Default*: 0
- Units: none

S92—Answer Delay

The time that the modem waits after it goes off hook to answer, before it sends its answer tone. If the value is 0, the modem waits 10 ms. On other modems, S92 is a fax transmit level: on this modem, `ATS92=10` makes the modem wait 10 s.

- Range: 0–255
- *Default*: 2
- Units: seconds

S103—Error Correction

The setting of `\N`. A value in the register sets `\N`.

- Range: 0–5
- *Default*: 3
- Units: none

S104—Data Compression

The setting of `%C`, and of `&K`.

- Range: 0–3
- *Default*: 3
- Units: none

S105—`MNP` Block Size

The setting of `\A`.

- Range: 0–3
- *Default*: 3
- Units: none

S106—Protocol in CONNECT

The setting of `\V`.

- Range: 0–2
- *Default*: 0
- Units: none

S114—V.42bis in MNP

1: when the modem calls with `MNP`, its `LR` offers `V.42bis` (with `%C2` or `%C3`) in place of `MNP 5`. 0: the `LR` offers `MNP 5` only. When the modem answers, it always accepts `V.42bis` from the far end. Some modems do not complete a call with this `LR`: thus the default is 0.

- Range: 0, 1
- *Default*: 0
- Units: none

S102—ZyXEL Encryption

The encryption of the Elite 2864I on `X.75` and `V.120` (`ATCK`). Bit 0: the modem offers the encryption. Bit 1: triple `DES` (the two modems must set it). Bit 2: no key exchange, use the `ATCK` key. Bit 3: if the far end does not agree, the modem disconnects. After the link is up, each modem sends an `XID` frame with the ZyXEL parameters. The data waits until the far end's parameters come. If the far end sends no `XID` reply, the modem continues without encryption after 4 tries. Refer to `docs/zyxel-des.md`.

- Range: 0–15
- *Default*: 0
- Units: none

S115—ZyXEL Peer Marker

1: in a `V.32bis` or ZyX call (`+MS`), the modem sends a marker in the start-up. If the far end also sends its marker, the two modems change to ZyX. If not, the call continues as `V.32bis`. 0: the modem sends no marker and does not change to ZyX. Use the same value on the two modems. The answerer marker is not the ZyXEL signal, thus the marker finds only a D-Modem.

- Range: 0, 1
- *Default*: 0
- Units: none

S116—ETC Flags

The `ETC` flags, with the bits of the 3Com firmware: 238 (0xEE) for the cellular side, 176 (0xB0) for the landline side, 0 for off. Refer to `&F5, &F6`.

- Range: 0–255
- *Default*: 0
- Units: none

S117—PCM End on a Digital Line

The end of `V.90` and `V.92` that the modem offers in `V.8` on a digital line (refer to the client on a digital line). 0: automatic. The modem offers the two ends, and `V.8` selects one. When it answers, it also offers `V.91`. 1: the digital modem (the server) only. 2: the analogue modem (the client) only. With 1 and 2, the modem does not offer `V.91`. `+MS=V91` ignores this register. On an analogue line, the modem is always the analogue modem.

- Range: 0–2
- *Default*: 0
- Units: none

S161—Long Space Disconnect

The setting of `Y`, kept. `ATZ` does not change it.

- Range: 0–3
- *Default*: 0
- Units: none

14 Fax Commands

With AT+FCLASS=1, the modem accepts the Class 1 commands of T.31. The DTE does the functions of the fax machine. (The PBX modules and libdmodem also have their own T.30 engine.) When the modem calls, it sends CNG after it dials, until the flags of the answering modem come in its first +FRH=3 (T.30 sends it until the DIS).

+FCLASS — Service Class

This command sets the modem as a data modem, a Class 1, 1.0, Class 2 or 2.0 fax modem, a ZyXEL fax modem, or a voice modem. ATZ sets 0.

Syntax:

- +FCLASS=*n*
- +FCLASS? (gives the class)
- +FCLASS=? (gives 0,1,1.0,2,2.0,6,8)

Result code	When
OK	If *n* = 0, 1, 1.0, 2, 2.0, 6 or 8.
ERROR	Otherwise.

Table 51. +FCLASS Values

Value	Class
0	Data (*default*).
1	Fax Class 1 (T.31).
1.0	Fax Class 1.0: Class 1 with V.34 half-duplex fax (T.31 Annex B, +F34).
2	Fax Class 2 (Section 14.1).
2.0	Fax Class 2.0 (T.32, Section 14.1).
6	ZyXEL fax mode (Section 14.2).
8	Voice (V.253, Section 18).

+FAA — Adaptive Answer

With +FAA=1, the modem answers a call (ATA, S0) in data mode or fax mode as a data call. Its answer tone, the ANSam of V.8, is also the CED for a fax machine. Then the modem finds if the caller is a fax machine or a data modem:

- A fax call has one of these signals:
  - The CNG of the caller (1100 Hz, 0.5 s of each 3.5 s), or a short burst that stops when the answer tone starts (a fax machine that stops its CNG when it hears the answer tone).
  - The V.8 CM of a fax call (a call function of facsimile). V.34 fax machines and some Class 1 modems send it on ANSam.
  - The far end changes to T.38 (the SIP calls of dmodemd).
  - The caller stays silent through all answer signals of the automode sequence (ANSam, then the answer signals of V.32, V.22, V.21, V.23 and Bell 103, about 20 s, in the T1 of 35 s of T.30).

  The modem then gives FAX, +FCLASS becomes 1, and the modem continues as a Class 1 answering modem. It sends the remainder of the 3 s of CED, then CONNECT, as after AT+FTH=3, for the first frames of the DTE.
- A data call has the handshake of its modem. The modem gives DATA when the call connects, then its CONNECT. +FCLASS becomes 0.

If a call ends with neither result, +FCLASS does not change. A V.22, V.21 or Bell 103 caller stays silent until it hears its own answer signal. It answers its step of the sequence: DATA. For voice mode, refer to Section 18: a calling tone on the call changes it to fax or data. The Rockwell modems also give FAX and DATA, as 33 and 35 with V0. On this modem, those numbers are the numbers of the CONNECTs of rates, thus the modem uses 88 and 89.

Syntax:

- +FAA=*n*
- +FAA? (gives +FAA: 0)
- +FAA=? (gives +FAA: (0,1))

Result code	When
OK	If *n* = 0 or 1.
ERROR	Otherwise.

Table 52. +FAA Values

Value	Meaning
0	Answer as +FCLASS says (*default*. Z sets it).
1	Adaptive answer: fax or data.

+FMI, +FMM, +FMR — Fax Identification

These commands give the manufacturer, the model and the revision, as +GMI, +GMM and +GMR give them, in all modes.

Result code	When
OK	Always.

+FTS, +FRS — Transmit Silence, Receive Silence

+FTS sends silence for *n* times 10 ms. +FRS waits for silence of *n* times 10 ms.

Syntax:

- +FTS=*n*
- +FRS=*n*

Result code	When
OK	When the command is complete.
ERROR	Outside fax mode, or with no *n*.

+FTM, +FRM — Transmit Data, Receive Data

These commands send or receive data at modulation *m*: CONNECT, then the data with <DLE> doubled. <DLE><ETX> ends the data.

Syntax:

- +FTM=*m*, +FRM=*m*
- +FTM=?, +FRM=? (give 24,48,72,73,74,96, 97,98,121,122,145,146)

Result code	When
CONNECT	Then OK after the data.
+FCERROR	+FRM only: a different signal came before the training, for example V.21 flags. The frames go to the +FRH=3 that follows. With AT+FAR=1, the modem gives +FRH:3, then it does +FRH=3.
ERROR	Outside fax mode, or for a modulation that the modem does not have.

Table 53. +FTM and +FRM Modulations

m	Modulation
24, 48	V.27ter, 2400 and 4800 bit/s.
72, 96	V.29, 7200 and 9600 bit/s.
73, 97, 121, 145	V.17, 7200 to 14400 bit/s, long training.
74, 98, 122, 146	V.17, 7200 to 14400 bit/s, short training.

+FTH, +FRH — Transmit HDLC, Receive HDLC

These commands send or receive HDLC frames at V.21 channel 2 (300 bit/s). This is the only modulation for the frames.

Syntax:

- +FTH=3, +FRH=3
- +FTH=?, +FRH=? (give 3)

Result code	When
CONNECT	Then OK or ERROR after each frame.
+FCERROR	+FRH only: a fast modulation came, not V.21 flags.
ERROR	Outside fax mode.

+FPR — Fax DTE Rate

This is the rate of the fax DTE. The modem keeps the value, but it has no effect. 0 (*default*), 1, 2, 4, 8, 10 or 18.

+F34 — V.34 Fax Rates

In Class 1.0 (+FCLASS=1.0), a fax call starts with V.8 and V.34 half-duplex (T.30 Annex F), not with CNG or CED. Fax software, for example HylaFAX, expects this with AT+F34. If the two ends have it, the modem gives +F34:*p*,*c* (the rate of the primary channel in 2400 bit/s, and of the control channel: 1 for 1200 bit/s), then CONNECT. After this, the call is the V.34 data mode of T.31, with no more commands:

- The DTE sends its frames without their FCS, and <DLE><ETX> ends each frame. The modem sends its frames with their FCS, in the same way.
- <DLE><0x6B> from the DTE (the sender) asks for the primary channel. At the two ends, the modem gives <DLE><0x6B><DLE><r> when the channel is available (*r* = 0x6F + the rate in 2400 bit/s). Then the frames of the ECM block follow.
- <DLE><0x6D> from the DTE ends the block. At the two ends, the modem gives <DLE><0x6D><DLE><0x6E> when the control channel (1200 bit/s) is available again.
- <DLE><EOT> from the DTE ends the call (OK). The modem gives it when the line stops (NO CARRIER).

With a fax machine that has no V.8, the call continues as Class 1. The first CONNECT of the calling modem is for the frames of the answering modem, as after +FRH=3. The first CONNECT of the answering modem is for its own frames, as after

+FTH=3 (its ANSam was the CED). V.34 fax must have ECM, and the modem does not poll on it. It is not available on T.38, or after adaptive answer. ATZ sets the defaults.

Syntax:

- +F34=[*maxp*][,[*minp*][,[*prefc*][,[*maxp2*][,*minp2*]]]]
- +F34? (gives 14,1,0,14,1)
- +F34=? (gives (0-14),(0-14),(0-2),(0-14),(0-14))

Result code	When
OK	If each value is in its range.
ERROR	Otherwise.

Table 54. +F34 Values

Value	Meaning
maxp	The highest rate of the primary channel, in 2400 bit/s (14: 33600, *default*). 0: no V.34, Class 1 as before.
minp	Its lowest rate (1: 2400, *default*).
prefc	The preferred rate of the control channel (0 any, *default*. 1 1200. 2 2400). The modem keeps the value, but it always uses 1200.
maxp2, *minp2*	For the other direction. The modem keeps the values.

14.1 Class 2 and 2.0

With AT+FCLASS=2.0 (T.32) or AT+FCLASS=2 (the older Class 2 that fax programs know), the modem does T.30 itself. The DTE sends and receives the pages in T.4 MH with EOLs, with <DLE> doubled. <DLE><ETX> ends each page. The DTE controls the call with the commands that follow.

- Class 2 has the older names: +FLID, +FDCC, +FDIS, +FDCS, +FBOR, +FK, +FPTS and +FHNG. The two names operate in the two classes. Its reports are +FCON, +FCSI, +FTSI, +FDIS, +FDCS, +FPTS and +FHNG.
- The rates are the rates of V.17, V.29 and V.27ter. If +FIS has error correction mode, the modem does the error correction itself (the data of the DTE does not change).
- The pages are MH, whatever the far end uses (MR or ECM: the modem codes them again), A4 width.
- A call changes to T.38 as a Class 1 call does (with the same commands and results).
- +FAA (adaptive answer) is for Class 1 only. The Class 1 commands +FTH, +FRH, +FTM, +FRM, +FTS and +FRS are ERROR in Class 2 mode.

Example session: send two pages, then receive them

```
ATD<number>          +FCO              the DIS came
                     +FCI:"<id>"
                     +FIS:1,5,0,2,0,0,0,0
                     OK
AT+FDT               +FCS:1,5,0,2,0,0,0,0
                     CONNECT           DCS, training, CFR
<page><DLE><ETX>     OK
AT+FET=0             +FPS:1,0,0,0,0
                     OK                MPS, MCF
AT+FDT               CONNECT
<page><DLE><ETX>     OK
AT+FET=2             +FPS:1,0,0,0,0
                     +FHS:00
                     OK                EOP, MCF, DCN

ATA                  +FCO              the CFR went out
                     +FTI:"<id>"
                     +FCS:1,5,0,2,0,0,0,0
                     OK
AT+FDR               CONNECT
<DC2>                <page><DLE><ETX>
                     +FPS:1,<lines>,0,0,0
                     +FET:0
                     OK
AT+FDR               ... +FET:2, OK
```

```
AT+FDR              +FHS:00
                    OK
```

In Class 2, an XON follows the CONNECT for a send. The page of +FDR waits for the <DC2> of the DTE (a maximum of one second). The modem accepts and confirms the pages when they come, and they wait for +FDR. When the call ends, the modem gives the hangup status and the result of the command that is in progress (NO CARRIER for ATD and ATA). Then it goes on hook.

Table 55. +FHS Hangup Status

Value	Meaning
00	The call is complete.
02	+FKS ended the call.
11	No fax machine answered.
2x	Send, phase B (the DIS, the training).
4x, 5x	Send a page, or the exchange after the page.
7x, 9x	Receive.

Class 2.0 gives the status in hexadecimal digits (T.32 Table 23). Class 2 gives it in decimal.

+FLI, +FPI — Local ID, Polling ID

The identity of this modem in TSI and CSI (+FLI, +FLID in Class 2), and in CIG when this modem polls (+FPI, +FCIG in Class 2. If empty, the modem uses the identity of +FLI). The identity is a maximum of 20 printable characters. The modem keeps the spaces in the quotes.

Syntax:

- +FLI="*id*", for example AT+FLI="Fax ID with Spaces"
- +FPI="*id*"
- +FLI?, +FPI? (give the identity in quotes)
- +FLI=?, +FPI=? (give (20)(32-127))

Result code	When
OK	Always.
ERROR	For more than 20 characters.

+FSA, +FPA, +FPW, +FAP — Subaddress, Polling Address, Password, Address Enable

The subaddress to send in SUB (+FSA), the selective polling address to send in SEP (+FPA), and the password to send in SID or PWD (+FPW). Each is a maximum of 20 printable characters. The modem sends a frame only if the remote fax machine accepts it (DIS bits 47, 49 and 50). +FAP=*sub*,*sep*,*pwd* tells the remote fax machine which frames this modem accepts (1) and reports. When it accepts a frame, the modem gives +FSA:, +FPA: or +FPW: before +FTI: or +FPI:. These commands are in Class 2.0 only.

Syntax:

- +FSA="*text*", +FPA="*text*", +FPW="*text*"
- +FSA?, +FPA?, +FPW? (give the text in quotes)
- +FSA=?, +FPA=?, +FPW=? (give (20)(32-127))
- +FAP=*sub*,*sep*,*pwd* (each 0, the *default*, or 1)
- +FAP?, +FAP=? (give the values, or (0-1),(0-1),(0-1))

Result code	When
OK	Always.
ERROR	For more than 20 characters, or a value that is not 0 or 1.

+FNS — Non-Standard Frame

The data (FIF) of the non-standard frame that the modem sends: NSF with the DIS, NSC with the DTC and NSS with the DCS. The first octet is the T.35 country code. Each command adds its octets to the data. The modem ignores the spaces. +FNS="" makes the data empty. When the fourth value of +FNR is 1, the modem reports the non-standard frames that it receives: +FNF:, +FNC: or +FNS: and the octets in hexadecimal, before the identity. This command is in Class 2.0 only.

Syntax:

- +FNS="*hex*", for example AT+FNS="B5 00 01"
- +FNS? (give the octets in quotes)
- +FNS=? (give (90))

Result code	When
OK	Always.
ERROR	For more than 90 octets, or a character that is not a hexadecimal digit.

+FLP, +FSP — Document to Poll, Request to Poll

- +FLP=1 (+FSPL in Class 2): this modem has a document that a different modem can poll. The DIS tells this. If a caller sends a DTC, ATA gives +FCO, +FPI:"*cig*" and +FTC:*dtc* (Class 2: +FCIG, +FDTC) and OK. Then +FDT sends the document.
- +FSP=1: this modem polls. The DIS offers a document (ATD gives +FPO, Class 2 +FPOLL). After this DIS, +FDR sends the CIG and DTC. Then it receives as the answering modem does (+FTI, +FCS, CONNECT and the page).

Syntax:

- +FLP=*n*, +FSP=*n*
- +FLP?, +FSP?
- +FLP=?, +FSP=? (give (0,1))

Result code	When
OK	If *n* = 0 or 1.
ERROR	Otherwise. The +FDR of the caller is ERROR without +FSP=1.

+FCC, +FIS, +FCS — Capabilities, Session Parameters

+FCC sets the capabilities (+FDCC in Class 2). It also sets +FIS. +FIS sets the parameters of the session (+FDIS in Class 2). The modem reads them again at each +FDT. +FCS? gives the parameters of the last session. At the start, the values are 1,5,0,2,0,0,0,0.

Syntax:

- +FCC=*vr*,*br*,*wd*,*ln*,*df*,*ec*,*bf*,*st*
- +FIS=*vr*,*br*,...
- +FCC?, +FIS?, +FCS?
- +FCC=?, +FIS=? (give (0,1),(0-13),(0-2),(0-2),(0),(0-2),(0),(0-7))

Result code	When
OK	If every value is in its range.
ERROR	Otherwise.

Table 56. +FCC Values

Value	Meaning
vr	0 normal, 1 fine resolution.
br	0 to 5: 2400, 4800, 7200, 9600, 12000, 14400 bit/s. 6 to 13: also V.34 half-duplex (T.30 Annex F), 16800 to 33600 bit/s, only with error correction mode. V.8 offers it at the start of the call. If the remote modem does not have it, it uses V.17 and the other modulations. A caller that polls sets +FSP=1 before it dials, so that V.8 tells this. +FCS then gives the V.34 rate.
wd	The widest page: 0 A4 (1728 pels), 1 B4 (2048 pels), 2 A3 (2432 pels). The DIS offers it. The session has the widest page that the two fax machines accept. +FIS: gives the remote's, and +FCS: the session's.
ln	The longest page: 0 A4 (297 mm), 1 B4 (364 mm), 2 unlimited. The DIS offers it. +FIS: gives the remote's, and +FCS: the session's.
ec	0 none, 1 or 2 error correction mode.
others	The modem accepts them in their ranges.

+FIE, +FVO — Procedure Interrupts

A procedure interrupt stops the fax procedure after a page, so that the operators can talk. To ask for one, put <DLE>! in the page data of +FDT. +FIE=1 accepts the requests of the remote fax machine (0, the *default*: the modem ignores them). A receiving modem then reports +FET:3, +FET:4 or +FET:5 and sets +FPS to 5. The next +FDR accepts the request if +FPS is 4 or 5. When the two modems agree, they report +FVO and stay off-hook. Then ATA sends the DIS again and ATD waits for the DIS of the remote (phase B again). ATH ends the call. With error correction mode, the request is in the PPS of the last block of the page. This command is in Class 2.0 only.

Syntax:

- +FIE=*n*, +FIE?, +FIE=? (give (0,1))

+FPP — Packet Protocol

+FPP=1 sends the information text, the result codes and the received page data to the DTE in packets (T.32 clause 9), so that the DTE can find lost octets (0, the *default*: no packets). It starts with the result code of its own command line. Each packet is a length octet (0 to 254), the body, and <ETB>. The DTE sends <ACK> after the length octet. After the body, it sends <ACK>, or <NAK> to get the body again. After 3 s with no answer, the modem sends the length octet or <ETB> again. A single <DC1>, <DC3> or <CAN> is not in a packet. In the page data, the modem sends <DLE>A for an octet of 01h and <DLE>W for an octet of 17h. The modem does not echo the command lines. A change of +FCLASS sets +FPP to 0.

Syntax:

- +FPP=*n*, +FPP?, +FPP=? (give (0,1))

+FFC — Format Conversion

What the modem does with the format codes in the page data of +FDT (<DLE>a to <DLE>n, T.32 Table 9) when they are not the format of the session. If the data has no code, the format is that of the session.

Syntax:

- +FFC=*vrc*,*dfc*,*lnc*,*wdc*
- +FFC?, +FFC=? (give (0-3),(0-2),(0-3),(0-2))

Table 57. +FFC Values

Value	Meaning
vrc	The resolution (<DLE>a, <DLE>b). 0 (the *default*) ignores the code. 1 ends the call (+FHS:41). 2 or 3 converts the page: it sends each normal row two times, or each second fine row.
dfc	The coding (<DLE>k to <DLE>n). 0 ignores the code: the data is MH. 1 ends the call for a code that is not MH (+FHS:47). 2 reads MR, MR with uncompressed rows, and MMR data.
lnc	The length (<DLE>c A4, <DLE>d B4, <DLE>e unlimited). 0 ignores the code. 1 ends the call for a length that is longer than the length of the session (+FHS:46). 2 or 3 divides a page that is longer than the length of the session (297 or 364 mm) into partial pages. The DTE sees one page.
wdc	The width (<DLE>f to <DLE>j). 0 ignores the code. 1 ends the call (+FHS:45). 2 converts the page to the width of the session: it puts a narrower page in the centre, and makes a wider page smaller.

+FBO, +FCR, +FPS, +FHS — Bit Order, Receive, Page Status, Hangup Status

+FBO (+FBOR in Class 2): if bit 0 is set, the first bit of the page data is the top bit of each octet (0, the *default*: the lowest bit). The modem keeps +FCR and +FPS. +FHS? gives the last hangup status. The modem keeps the other parameters of T.32 (+FNR, +FCQ, +FCT, +FRY, +FMS, +FEA, +FBU, +FND and +FRQ) in their ranges, with the T.32 values at the start. In Class 2.0 their numbers are hexadecimal. Only +FNR has an effect: in Class 2.0, +FNR=*rpr*,*tpr*,*idr* enables the +FIS: and +FTC:, the +FCS:, and the +FTI:, +FCI: and +FPI: reports (all off at the start). Class 2 gives all the reports. +FIP sets the Class 2 parameters as at the start, and keeps +FCLASS. Other +F settings in Class 2 are kept with no effect.

Syntax:

- +FBO=*n*, +FCR=*n*, +FPS=*n*
- +FHS?

Result code	When
OK	Always.

+FDT, +FDR, +FET, +FKS — Send, Receive, End Page, End Call

+FDT sends a page. +FDR receives a page. +FET gives the command after the page that the modem sent. +FKS (+FK in Class 2) ends the call with a DCN (+FHS:02), as in the example above.

Syntax:

- +FDT, +FDR, +FKS
- +FET=*n*

Result code	When
CONNECT	Then the page and OK; or the reports, then OK.
ERROR	With no Class 2 call.

Table 58. +FET Values

Value	Meaning
0	MPS: another page follows.
1	EOM: another document follows.
2	EOP: the last page.

14.2 ZyXEL Fax Mode (Class 6)

With AT+FCLASS=6, the modem operates as the ZyXEL U-1496 and Elite modems do with their *extended fax AT commands*. Old ZyXEL fax programs (ZFAX, the rcvfax of a BBS) use this mode. The modem does T.30 itself. There are no +F commands to control the call:

- ATD makes a fax call. The modem sends the DCS for V.17 at 14400 bit/s at most, with no error correction mode. When the CFR comes, the modem gives CONNECT FAX/*Srate*V*n*T0R0L2C7P*id*. Then the DTE sends the pages.
- ATA (or S0) answers. The modem answers as a data modem first, as the ZyXEL modems do. If the caller is a data modem, the call is a data call (CONNECT *rate*). If the caller is a fax machine (+FAA tells how the modem finds it), the modem gives CONNECT FAX/... when the CFR goes out. Then the modem sends the pages to the DTE.
- At the end of the fax call, the modem gives DISCONNECT0P*id* if the fax machine at the far end confirmed the last page. Otherwise it gives DISCONNECT1P*id*. The modem is then in command mode. If the call ends before CONNECT FAX, the modem gives NO CARRIER.
- ATV0 and ATQ1 have no effect on CONNECT FAX and DISCONNECT.

The fields of CONNECT FAX:

Table 59. CONNECT FAX Fields

Field	Meaning
Srate	The first four digits of the rate: 1440, 1200, 9600, 7200, 4800 or 2400.
V*n*	0 normal resolution, 1 fine resolution.
T0	The data is one-dimensional (MH).
R0	1728 pels for each row.
L2	Any page length.
C7	No minimum row time: the data has no fill.
P*id*	The identity of the fax machine at the far end (its CSI or TSI), 20 characters, with spaces at the end.

The page data:

- The data is T.4 MH with EOLs. The first bit of each octet is the lowest bit. There are no <DLE> codes.
- An RTC (six EOLs) ends each page. When the modem sends, it finds the RTC in the data of the DTE. If more data follows, the modem sends MPS and the next page.

- The ZyXEL modems end the document when the DTE sets RTS off. D-Modem has no RTS signal. Thus the document ends when the DTE sends no data for 2 s. If the DTE sends no data for 30 s after `CONNECT FAX`, the modem stops the call.
- When the modem receives, it sends each page to the DTE when the page is complete.

Example session: send two pages

```
AT+FCLASS=6#P5551111      OK
ATD<number>               CONNECT FAX/S1440V1T0R0L2C7P5552222
<page><RTC><page><RTC>    (then no data for 2 s)
                          DISCONNECT0P5552222
```

#F, #B*n*, #V*n*, #T*n*, #R*n*, #L*n*, #C*n*, #P*id*, &N32 — ZyXEL Fax Settings

These are the ZyXEL fax settings.

- #F and &N32 set a V.17 fax call on the ZyXEL modems. In Class 6 all calls are fax calls, thus the modem accepts them with no effect.
- #B0 (*default*): the modem sends the pages to the DTE after CONNECT FAX/....
- #B1 is for a BBS. The modem gives CONNECT FAX and ZyXEL on two lines. Then it waits for a <DC2> (hex 12) from the DTE. After the <DC2>, it sends <CR><LF>/S*rate*V*n*T0R0L2C7P*id*<CR><LF> (with 18 characters of the identity, as the ZyXEL modems do) and the first page. Each subsequent page needs one more <DC2>.
- #B2 sets polling for the next call. After D, the modem sends its identity (CIG) and a DTC in place of the DCS. Then it receives the document of the remote, as with #B0 or #B1. If the remote has no document to be polled, the modem gives NO CARRIER. The setting is for one call only.
- #B3 measures the ring cadence. The modem must be idle. It gives Start to measure ring cadence... and Hit any key to stop!. Then, at each start and end of a ring burst, it gives one line: OFF when a burst starts, ON when a burst ends, and the time that ended, in steps of 10 ms (for example ON 1980 ms). The modem gives no RING during the measurement. A character from the DTE stops it, and the modem gives OK. Only a line with its own ring signal (a sound card or a USB modem) has ring bursts; a SIP call does not.
- #V0 sets normal resolution, #V1 (*default*) fine resolution, if the fax machine at the far end has it.
- The modem keeps #T, #R, #L and #C, but they have no effect: the data is always MH, 1728 pels, any length, with no fill.
- #P*id* sets the identity of the modem (its CSI and TSI). It is the remainder of the command line, or a string in quotes. The CSI and the TSI have the first 20 characters.

Syntax:

- #F, &N32
- #B*n*, #V*n*, #T*n*, #R*n*, #L*n*, #C*n*
- #P*id*

Result code	When
`OK`	If *n* is in its range (#B 0–3, #V and #T 0–1, #R and #L 0–2, #C 0–7) and *id* has 25 characters or fewer. For #B3, after a character from the `DTE`.
`ERROR`	Otherwise, or #B3 when the modem is not idle.

15 Text Telephone Commands

The modem is a text telephone in the modes of V.18 (+MS or +MV18S selects one mode). These are the modes:

- The 5-bit (Baudot) mode of the TTYs, at 45.45 bit/s on 1400 and 1800 Hz (TIA-825-A). With +MBAUDOT, also the telex and RTTY variants (50 bit/s, the figures of ITA2, other tones).
- DTMF (each character is one to four DTMF digits, Annex B).
- EDT (channel 1 of V.21 at 110 bit/s, 7 bits, even parity, 2 stop bits).
- Bell 103 (300 bit/s), the Minitel and Prestel terminals of V.23 (1200/75 bit/s) and the V.21 text telephones of the Nordic countries and the UK (300 bit/s). These three modes use 7 bits, even parity and a stop bit.
- The mode of V.18 between two V.18 modems (V.21, 8 bits and no parity, the T.140 of the DTE).

The 5-bit mode, DTMF and EDT are half duplex. The modem sends 150 ms of mark, the characters, and 300 ms of mark after the last character (DTMF: 75 ms for each digit, 55 ms between digits). During this time, the modem does not hear the line. It does not start characters while the carrier of the far end is on.

The other modes are duplex on a continuous carrier. When the modem calls, it sends in the calling channel of V.21 and Bell 103, and in the 75 bit/s channel of V.23, as a Minitel does. When it answers, it sends in the other channels. The `CONNECT` gives the received rate (`CONNECT 10` for DTMF, about its characters each second). No mode disconnects because the carrier is absent.

The DTE sends and receives ASCII:

- In the 5-bit mode, lower case letters go as capitals. The modem sends the shift codes. It discards the characters that the code does not have.
- DTMF has no CR. The modem discards the CR of the DTE. It gives CR LF to the DTE for each new line.
- The modes with parity send even parity and ignore the parity that they receive.

A text telephone call has no answer tone. When the modem dials, it goes into its mode at the end of the dialing. When it answers, it goes into its mode immediately.

AT+MS=V18 (or AT+MV18S=1) finds the mode of the far end.

- When the modem calls, it sends the calling signals of V.18: 1 s of silence, then three times the CI of V.8 coded for a textphone (400 ms) and 2 s of silence, then the XCI of V.23 (3 s). Then it starts again.
- When the modem answers, it listens for 3 s.
- When it calls and when it answers, the modem listens for a 5-bit character, DTMF, an EDT character, V.21 characters, a V.21, Bell 103 or V.23 carrier, and the V.18 signals of the far end.

- If an answering V.18 modem hears CI or XCI, it sends the answer tone (2100 Hz) for a maximum of 3 s. The calling modem sends TXP 0.5 s after the tone starts, while the tone continues. When the answering modem hears TXP, it sends three TXP. Then the two modems are in the mode of V.18.
- If a calling modem hears the answer tone of a data modem, it continues with the carrier of that modem (V.21, V.23 or Bell 103).

If the answering modem hears nothing, it probes the line in this sequence:

1. The answer message (+MV18AM) and a new line in the 5-bit mode, then in EDT, then in DTMF. The modem listens for 2 s after each one.
2. 3 s each of its own V.21, Bell 103 and V.23 mark. The modem listens for the answer to each.
3. The modem starts the sequence again until the time of S7 ends.

When the modem finds the mode of the far end when it has no carrier, it answers in that mode. It waits until the far end is silent, so that a different automode modem (if this was its probe) also finds the mode. The modem sends the characters that it received during the search to the DTE after the CONNECT. The CM of V.8 and V.8 bis (clause 6/V.18) are not available. The answering modem sends the answer tone of V.25, not ANSam, so that a V.18 calling modem continues with TXP.

+MV18S — V.18 Selection

This command selects the text telephone mode (as +MS does. 0 sets +MS=92 if +MS had a text mode). It also sets if the modem probes a silent far end, and if it sends the answer message when it answers. Z sets 0,0,0,0,1.

Syntax:

- +MV18S=[*mode*][,[*dflt*][,[*fbk*][,[*msg*][,[*probe*]]]]]
- +MV18S? (gives +MV18S: 0,0,0,0,1)
- +MV18S=? (gives +MV18S: (0-7),(0-7),(0,1),(0,1),(0-2))

Result code	When
OK	Always.
ERROR	For a value outside its range.

Table 60. +MV18S Values

Value	Meaning
mode	0 off. 1 automode (+MS=18). 2 5-bit (45). 3 DTMF (118). 4 EDT (110). 5 V.21 (121). 6 V.23 (123). 7 Bell 103 (203): their text telephones.
dflt	The *default* answer mode. The modem keeps the value.
fbk	The modem keeps the value.
msg	1: the modem sends the answer message when it answers in one of the modes 2 to 7.
probe	0: automode only listens. 1 or 2: automode probes.

+MV18R — V.18 Report

With +MV18R=1, automode gives the mode that it found before the CONNECT, as +MV18R: *mode* with the numbers of +MV18S (+MV18R: 2 for a TTY. +MV18R: 1 for the mode of V.18, with a different V.18 modem).

Syntax:

- +MV18R=*n*
- +MV18R? (gives +MV18R: 0)
- +MV18R=? (gives +MV18R: (0,1))

Result code	When
OK	If *n* = 0 or 1.
ERROR	Otherwise.

+MV18AM, +MV18P — Answer Message, Probe Order

+MV18AM sets the answer message, a maximum of 63 printable characters. The modem keeps the spaces in the quotes (AT+MV18AM="GA"). The modem sends the message in the probes, and when it answers with the *msg* of +MV18S. The modem keeps the value of +MV18P (2 to 7), but the probes always go in the sequence above.

Syntax:

- +MV18AM="*text*", +MV18AM?, +MV18AM=?
  =? gives +MV18AM: (63)(32-126)
- +MV18P=*n*, +MV18P? (gives +MV18P: 2), +MV18P=?

Result code	When
OK	Always.
ERROR	For a message that is too long or a value outside its range.

+MBAUDOT — 5-bit Mode

This command is from D-Modem. It sets the rate, the tones and the figures of the 5-bit mode, for telex and RTTY: AT+MBAUDOT=50,2125,2295,1 is 50 baud ITA2 on the 170 Hz shift of RTTY. The two ends must have the same settings. Automode listens on these tones. Z sets the values of the US TTY: 45,1400,1800,0.

Syntax:

- +MBAUDOT=[*rate*][,[*mark*][,[*space*][,[*code*]]]]
- +MBAUDOT? (gives +MBAUDOT: 45,1400,1800,0)
- +MBAUDOT=?
  gives +MBAUDOT: (45,50,75,100),(300-3400),(300-3400),(0,1)

Result code	When
OK	Always.
ERROR	For a value outside its range, or if the mark and the space are the same.

Table 61. +MBAUDOT Values

Value	Meaning
rate	45 (45.45), 50, 75 or 100 bit/s.
mark	The mark (1) tone, Hz.
space	The space (0) tone, Hz.
code	The figures: 0 the figures of the US TTY ($ on D, " on Z, ; on V, unshift on space), 1 the figures of ITA2 (telex).

16 Alarm Reports: Contact ID

With AT+MS=CONTACTID, the modem uses Contact ID (SIA DC-05). Alarm panels use this DTMF format to send events to the receiver of a central station. This mode has no commands of its own. ATA (or S0) makes the modem the receiver. ATD makes the modem the panel. The call is in data mode from the handshake, with CONNECT 40 on the two sides. Neither side disconnects because the carrier is absent. ATH or the far end ends the call.

A message has 16 digits:

- The account (4).
- The message type (18, or 98).
- The qualifier (1 a new event or an opening, 3 a restore or a closing, 6 a previous event that is still there).
- The event code (3).
- The partition (2).
- The zone or user (3).
- The checksum. It makes the sum of the values of the digits a multiple of 15 (0 counts as 10. B to F are 11 to 15, sent as *, #, A, B and C).

The Receiver. When the modem answers, it sends the handshake (1400 Hz, then 2300 Hz, 100 ms each). It sends the handshake again after 3 s with no message (four times in total). If a message has a good checksum, the modem sends it to the DTE as a line of its 16 digits (1234181131010158). Then it sends the kissoff (1400 Hz for 900 ms). If a message has a bad checksum, the modem sends nothing, and the panel sends the message again. The modem discards the characters from the DTE.

The Panel. When the modem dials, it waits for the handshake. Then it sends each line from the DTE (1234 18 1131 01 015). A line has 16 digits, or 15 digits and the modem adds the checksum. The modem ignores spaces and dashes. A message starts 250 ms after the handshake or the last kissoff, with 55 ms for each digit and 55 ms between digits. If no kissoff comes in 1.25 s, the modem sends the message again (four times in total). The modem gives one of these results for each line: ACK (kissoff received), NAK (four times without a kissoff), or ERROR (no message).

17 Text Messages: Fixed-Line SMS

With AT+MS=SMS, the modem uses fixed-line SMS (ETSI ES 201 912, protocol 1). Some home telephones use this procedure to send and receive text messages through the message centre of their telephone company. This mode has no commands of its own. ATA (or S0) makes the modem the receiving side. ATD makes the modem the sending side. The call is in data mode from the start, with CONNECT 1200 on the two sides. The line uses the 1200 bit/s channel of V.23 (1300 and 2100 Hz) in the two directions, one side at a time.

The Receiving Side. When the modem answers, it asks the caller for its messages. It receives each message and gives it to the DTE:

- A delivery (from a message centre to a telephone) as +CMT: "*from*","*time*".
- A submission (from a telephone to its message centre) as +SUBMIT: "*to*".

A line of the text (UTF-8. 8-bit data in hex) follows each one. All other messages come as +PDU: *hex*. The call ends when the caller tells that it has no more messages. The modem discards the characters from the DTE.

Example session: send two pages

```
+CMT: "+441234567890",,"26/10/31,09:05:07+00"
Your code is 1234
```

The Sending Side. When the modem dials, it waits for the request for messages. Then it sends each line from the DTE:

Table 62. Lines a Sending Modem Takes

Line	Sends
number,*text*	A submission of *text* to *number* (a message from a telephone).
<*number*,*text*	A delivery of *text* from *number* (a message from a message centre), with the time now (UTC). If *number* has letters, it is a name.
:*hex*	The message (the TPDU of 3GPP TS 23.040) with no change.

A *number* is digits (and *, #), with + first for an international number. The text goes in the 7-bit alphabet of GSM, up to 160 characters. If the text has a character that is not in that alphabet, it goes in UCS2, up to 70 characters. The modem gives one of these results for each line: OK (accepted), +CMS ERROR: *cause* (refused, with

the cause from the far end), or `ERROR` (not a message, or no answer after three attempts). If no line comes for 3 s, the modem tells the far end that it has no more messages and disconnects.

18 Voice Commands

With AT+FCLASS=8, the modem accepts the voice commands of V.253. In the other modes, they are ERROR, but +VCID and +VRID are not. Each +V parameter accepts ? (its values, for example 128) and =? (their ranges, for example (0-128)), as V.253 tells.

+VIP — Initialize Voice Parameters

This command sets the voice settings to their values at the start.

Result code	When
OK	Always.

+VNH — Automatic Hangup Control

0 or 1. The modem accepts this command, but it has no effect: if the handshake of a held call fails, the modem disconnects the call.

+VGT, +VGR — Transmit and Receive Gain

The gain when the modem sends (+VGT) and receives (+VGR), 0 to 128.

Result code	When
OK	If *n* = 0–128.
ERROR	Otherwise.

+VIT — Inactivity Timer

The inactivity timer, 0 to 255.

+VSD — Silence Detection

The sensitivity and the period of silence detection, each 0 to 255.

Syntax:

- +VSD=*s*,*t*

+VSM — Voice Compression Method

This command sets the format of the samples that +VTX, +VRX and +VTR carry: format *m* at *r* samples/s (if there is no *r*: 8000, or the rate of the format). The modem accepts *s* and *e* for silence compression (0 to 255) and keeps them, but the modem does not compress silence.

Syntax:

- +VSM=*m*[,*r*[,*s*[,*e*]]]
- +VSM? (gives 1,8000,0,0 at the start)
- +VSM=? (lists the formats, one on each line)

Result code	When
OK	Always.
ERROR	For a different format, or a rate that the format does not use. The setting does not change.

Table 63. +VSM Formats

m	Format
0, 1	8-bit linear, signed and unsigned (offset by 128), at 7200, 8000 or 11025 (V.253's numbers).
4, 5	G.711 u-law and A-law, at 8000.
128	8-bit linear unsigned, as 1 (from this point, the numbers are from Conexant).
129	16-bit linear signed, the low octet first, at 7200, 8000 or 11025.
130, 131	A-law and u-law, as 5 and 4.
132	IMA ADPCM, 4 bits for each sample, two in each octet with the first in the low nibble (as in a WAV file), at 7200, 8000 or 11025. The coder starts again at each +VTX, +VRX, +VTR.
133	G.726 ADPCM at 32 kbit/s (G.721), 4 bits for each sample, two in each octet with the first in the low nibble, at 8000: the ADPCM of US Robotics (#VSM=129). The coder starts again as for 132. The number is from D-Modem.

Table 63. +VSM Formats *(continued)*

m	Format
134, 135, 136	The ADPCM of the ZyXEL U-1496 and Elite 2864, with 2, 3 or 4 bits for each sample, at 9600 (the rate of ZyXEL), 8000 or 7200. The first sample is in the most significant bits of an octet. A sample can go across two octets. These are the file formats of the ZyXEL vcnvt program and of the zyxel formats of vgetty (the ZyXEL +VSM=2, 3 or 30, and 4). The coder starts again as for 132. The numbers are from D-Modem.

+VLS — Analog Source/Destination Selection

This command connects the voice engine to the line or releases the line. It can also connect the voice engine to a handset. When you change between 1, 14 and 15, the voice engine continues to operate, and the line stays connected or released.

Result code	When
OK	Always.
ERROR	For a device that the modem does not have.

Table 64. +VLS Values

Value	Device
0	Release the line, on hook (*default*).
1	Connect to the line for voice (on SIP: answer the call that rings).
14	Only a handset of the modem, with the line on hook. +VRX records its microphone and +VTX plays to its earpiece. The modem gives the DTMF from the handset.
15	The line with the handset on the call. The DTE hears the line and the handset. The line gets the samples of the DTE and the handset.

AT+VLS=? gives the list of the devices of V.253. For each device, it gives the events that the device reports in the transmit, receive and command states, as hex bit fields (bit *n* for the event *n* of V.253, event 0 the leftmost of 32):

Example output: AT+VLS=?

```
0,"",00000000,00000000,90000000
1,"T",0B043060,0B043060,0B043060
```

On hook (0), the events are caller ID (with +VCID) and RING. On the line (1), the events are DTMF, the two calling tones, the loop current interruption, a ringing tone, a busy tone and the two answer tones, in all states. Some lines can detect the phone on the jack of the modem (a SmartUSB56 with dmodemd -usb-handset). These lines add event 8 to the two devices, in all states (00800000, 0B843060, ...). A modem with its own handset (a SmartUSB56 with dmodemd -usb-voice-codec) lists two more devices:

Example output: AT+VLS=?, the handset's lines

```
14,"H",08000000,08000000,08000000
15,"HT",0B043060,0B043060,0B043060
```

+VEM — Event Reporting and Masking

0 or 1: the event reports of V.253 in the speakerphone state. The modem does not have this state. The modem keeps the value. It is 0 at the start and with +VIP.

D — Voice Dial

In voice mode, ATD*number* dials. It gives OK when the far end answers, BUSY, NO ANSWER after S7, or ERROR when the call fails for a different cause. On all lines, an answer tone is the answer and a busy tone is BUSY (on SIP, also in its early media). On SIP, the answer is also the 200 OK, on a line that does not tell the end of the ringing tone (+VRA), or +VRN without a ringing tone. On an analogue line, the modem first waits 2 s for the dial tone. When the modem has the line, it dials the digits as DTMF, S11 ms each.

H — Voice Hang Up

In voice mode, ATH releases the line and goes back to data mode, +FCLASS=0.

+VRA — Ringback Goes Away Timer

The far end has answered when the ringing tone is absent for this time after its last ring. The unit is 100 ms, 0 to 255 (0: when the first ring ends). The value is 50 at the start.

+VRN — Ringback Never Appeared Timer

The far end has answered when no ring comes for this time after the modem dials. The unit is seconds, 0 to 255 (not more than S7). The value is 10 at the start.

+VTX, +VRX, +VTR — Voice Transmit, Receive, Duplex

These commands send, receive, or send and receive at the same time: CONNECT, then samples in the format and rate of +VSM, with <DLE> doubled. If there is a gap in the samples from the DTE, the modem plays silence.

Result code	When
CONNECT	Then OK when it ends.
ERROR	If the modem does not have the line or a handset (+VLS).

Table 65. Voice Data Commands

Command	Ends at
+VTX	<DLE><ETX>, <DLE>! or <DLE><CAN> from the DTE, then OK.
+VRX	A character from the DTE. The modem ends its samples with <DLE><ETX>, then OK.
+VTR	Only <DLE>^ from the DTE, then <DLE><ETX> and OK.

+VTD — Beep Tone Duration

The duration of a +VTS element that has no duration. The unit is 10 ms, 0 to 6000 (0: 1 s). The value is 100 at the start.

+VTS — DTMF and Tone Generation

This command plays the elements of *string* in sequence. Commas separate the elements. The command gives OK after the last element. The unit of the durations is 10 ms, 0 to 6000. A field can be empty. An empty frequency is 0, an empty digit is none (silence), and an empty duration is the duration of +VTD. Thus, {5}, [440] and [] have the duration of +VTD, and {} is silence for the same time. The modem puts 50 ms of silence between two digits that follow each other: +VTS=1,2,3 dials 123. The line does the hook flash: on SIP, an RFC 4733 event (16), and the audio is silent during the event.

Syntax:

- +VTS=*string*
- +VTS? (gives the tone settings)
- +VTS=? (gives (0-4000),(0-4000),(0-6000))

Result code	When
OK	After the last element.
ERROR	If the modem cannot play one element (the modem plays nothing): a flash on a line that has no flash (a SIP call whose far end accepts no telephone-events), or a value outside its range.

Table 66. +VTS Elements

Element	Plays
s	The DTMF digit *s* (0–9, *, #, A–D), or ! a hook flash, for +VTD.
{*s*,*d*}	The DTMF digit or hook flash *s* for *d*.
[*f1*,*f2*,*d*]	A tone of *f1* and *f2* Hz (0 to 4000; 0 is none) for *d*.

18.1 Voice Events

While the modem has the line (+VLS=1), it gives the events that it hears, as V.253 specifies, as <DLE> and a character. The modem gives DTMF digits from the far end 51 ms after they start, and again every 70 ms while they continue. It gives them in the voice command state and also in the samples of +VRX. The audio of these samples is silence from the report of a digit until the digit ends. The modem does not give its own +VTS tones. The modem gives the calling tones when a burst ends, with a minimum of 4 s between them.

Table 67. Voice Events

Report	Event
<DLE>0-9 * # A-D	A DTMF digit from the far end.
<DLE>~	The DTMF digit ended.
<DLE>r	A ring of a ringing tone (400 to 480 Hz, or 440 and 480 Hz, or 400 and 450 Hz, on for a minimum of 0.6 s. The two bursts of the UK are one ring. The ring ends after 0.3 s without the tone).
<DLE>b	A busy or congestion tone (four cycles of 0.2 to 0.8 s on and off).
<DLE>a	An answer tone of 2100 Hz (a fax or data answer), 0.3 s after it starts.
<DLE>f	An answer tone of 2225 Hz (a data answer), 0.3 s after it starts.
<DLE>c	The CNG of a calling fax machine (1100 Hz, bursts of 0.36 to 0.8 s).
<DLE>e	The V.25 tone of a calling data modem (1300 Hz).
<DLE>l	Loop current interruption: the far end ended the call.
<DLE>H, <DLE>h	The phone on the jack of the modem is off hook, or on hook again.
<DLE>X ...<DLE>.	Caller ID (+VCID).

When the far end ends a voice call, the modem gives <DLE>l (the loop current interruption of V.253, “usually a remote hangup”). Then it goes on hook (+VLS=0). V.253 has no NO CARRIER in voice mode. The command that is in progress ends:

- +VRX ends its samples with <DLE><ETX>, then OK.

- +VTX and +VTR end when the DTE ends them (the modem discards the samples until then), then OK. For +VTR, the OK comes after <DLE><ETX>.
- The tones of +VTS end with ERROR.

In the command state, the modem gives only <DLE>1.

18.2 From Voice to Fax or Data

A voice call can change to a fax call or a data call (V.253 5.3.2 and its example I.6). In the voice command state, off hook, +FCLASS=1 (or 0) keeps the call. The voice engine stops, and the line stays off hook and silent. Then A answers on the line as a fax modem (Class 1: CED, then CONNECT for the DIS) or as a data modem. Or D calls on the line (call progress waits for the answer tone of the far end). H, Z or a disconnection from the far end ends the held call. For example, a fax machine calls while the greeting plays:

Example session: from voice to fax

```
AT+VTX                  CONNECT      the greeting's samples follow
                        <DLE>c       the caller's CNG
<DLE><ETX>              OK
AT+FCLASS=1             OK
ATA                     CONNECT      class 1, as after AT+FTH=3
```

With +FAA=1, the modem does this automatically, in the voice command state. (If a +VTX, +VRX, +VTR or +VTS is in progress, it ends first.) After <DLE>c, the modem gives FAX, +FCLASS=1 and the CONNECT of the fax answer. After <DLE>e, it sets +FCLASS=0 and does the adaptive data answer (DATA, then its CONNECT).

18.3 Rockwell's and US Robotics' Voice Commands

Before V.253, the Rockwell and US Robotics modems had their own voice commands, with # in place of +. The Unimodem/V of Windows 95, the Rockwell and US_Robotics drivers of vgetty and many answering machine programs of that time use them. The modem also accepts them. The voice mode that #CLS=8 sets is the same voice mode as +FCLASS=8, with these differences:

- When the modem has the line, it gives VCON, not OK.
- A answers a call for voice (as +VLS=1 does).
- The durations of #VTS are in 100 ms.

+FCLASS=8 removes these differences. The <DLE> events and the ends of #VTX and #VRX are the same as in the section above.

#CLS — Data, Fax or Voice

As +FCLASS: 0 data, 1 Class 1 fax, 2 Class 2 fax, 8 voice in this command set.

Syntax:

- #CLS=*n*
- #CLS? (gives the mode, as +FCLASS?)
- #CLS=? (gives 0,1,2,8)

#VLS — Voice Line Select

The device, with the numbers of Rockwell. 0 and 4 are the line (the modem has no speaker to monitor it). A or D connects the line, and each gives VCON when the line is connected. 1 is a handset of the modem (a SmartUSB56 with dmodemd -usb-voice-codec). The modem connects it immediately (VCON), with the line if the line is connected. US Robotics modems answer with #VLS=0A: #VLS=0, then A.

Syntax:

- #VLS=*n*
- #VLS? (gives the device)
- #VLS=? (gives 0,4, or 0,1,4 with a handset)

Result code	When
OK, VCON	As above.
ERROR	For a speaker or a microphone (2, 3, 5, 6, 7), or 1 without a handset.

#VBS, #VSR, #VSM — Voice Sample Format

#VBS is the number of bits in each sample and #VSR is the number of samples each second. Together, they set the format of +VSM. #VSM=129 is the ADPCM of US Robotics, which is G.726 at 32 kbit/s. vgetty reads it in this way. The modem does not have the ADPCM of Rockwell (2, 3 and 4 bits) or the GSM of US Robotics (#VSM=128). They are ERROR. For these, vgetty must have rec_compression 8 (8-bit linear at 7200) in its voice.conf.

Table 68. #VBS and #VSM Values

Command	Format
#VBS=8	8-bit linear unsigned (+VSM=1), at 7200, 8000 or 11025. The 8-bit PCM of Rockwell.
#VBS=16	16-bit linear signed, the low octet first (+VSM=129), at 7200, 8000 or 11025.
#VSM=129[,8000]	The ADPCM of US Robotics (+VSM=133), at 8000. Then #VBS=4 keeps it, and #VBS=8 or 16 changes it.
#VSR=*r*	*r* samples each second, if the format operates at *r* (or else ERROR).

Each command gives its value with ? and its values with =?.

#VTX, #VRX, #VTS, ... — Voice Commands

#VTX, #VRX, #VTS, #VGT, #VGR, #VRA, #VRN, #VIT and #VIP are the same as the +V commands with the same names, with two differences. The durations of #VTS are in 100 ms (#VTS=[440,0,5] makes a beep for half a second). The modem accepts the settings in all modes.

The modem keeps these settings for ?, but they have no other effect, because the modem has no silence deletion and no level controls of Rockwell: #VTD (<DLE> report masks, three hex values), #VSD (silence deletion, 0 or 1), #VSS (silence sensitivity, 0 to 3), #VSK (buffer skid), #BDR (the rate of the DTE), #TL and #RG (levels, hex). The modem keeps #VSP (the silence period, in 100 ms) as the value of +VSD.

Example session: vgetty's Rockwell driver answers

```
AT#VSP=55#VSD=0#VTD=3F,3F,3F#VSS=1       OK
AT#CLS=8                                 OK
                                         RING
AT#VBS=8#VSR=7200                        OK
ATA                                      VCON
AT#VTX                                   CONNECT  the greeting
<DLE><ETX>                               OK
AT#VRX                                   CONNECT  the message
!                                        <DLE><ETX>OK
ATHO                                     OK
```

19 Online Mode, the Escape Sequence and Disconnection

In online mode, the data from the DTE goes to the far end. The exception is the escape sequence: three S2 characters (+++), each in 0.5 s of the character before it, with 0.5 s of no data before them and after them. The modem then gives OK and goes into online command mode. The call stays connected.

- ATO goes back online.
- ATH disconnects the call.
- On a V.92 connection, AT+PMHR asks for modem-on-hold.

The +++ is also data, because the modem cannot know that it is the escape sequence until the guard time after it. The modem keeps the data that the DTE sent before the escape sequence and that the modem did not send yet. It does not discard this data. The data goes to the other modem, with +++ last, when ATO goes back online.

The call ends with NO CARRIER when the other side disconnects, or when its carrier is absent for S10 tenths of a second. dmodemd also disconnects when the DTE sets DTR off (it sets the speed of the pty to 0). If HUPCL is set on the pty, dmodemd also disconnects when the DTE closes the pty. It then makes a new pty (/dev/ttyDM0 follows it).

20 dmodemd on a SIP Line

- ATD*number* calls sip:*number*@*domain* of SIP_LOGIN. A telephone number has only the dial characters of V.250: digits, * # + A B C D, the modifiers T P W , @ ! ;, - ( ) . and spaces. It goes as its digits and DTMF characters: ATDT555-1000 calls sip:5551000@*domain*. All other strings are the name of a SIP user, with no change: ATDalice.
- The line has no dial tone. Use ATX3 (or X1), or else the result is NO DIALTONE.
- A dial string with a ; (ATDT5551000;) makes the SIP call and gives OK immediately. The modem is then in command state. The digits that ATD adds go as DTMF on the call (the choices of a menu, an extension). ATD alone or ATA starts the handshake of the modem.
- With -L, dmodemd registers and accepts calls. While a call waits, the modem gives RING every 3 seconds. ATA or S0 rings (ATS0=1) answer the call. The rings stop if the caller stops the call. If a call comes while the line is in use, dmodemd refuses it (486, busy). Without -L, it refuses all calls (480).
- The call is G.711 at 8000 Hz. V.90 and V.92 must have this (AT+MS=92, the *default*). A lower modulation can operate better through a real PSTN gateway, for example AT+MS=132,0,4800,9600.

21 Compatibility

21.1 Differences of D-Modem

- &K is the compression, as on the USRobotics modems. On the Rockwell and Conexant modems, it is flow control. &K3 keeps the compression of V.42 on (MNP 5 off). &K0 sets it off.
- The S-registers after S16 are specific to D-Modem. S29 and S30 are for the speaker (on other modems, the hook flash time and the inactivity timer). S92 is the delay of the answer (on other modems, a fax transmit level). The other registers (S36, S37, S91 ...) are free. The modem keeps the values that you write in them. S7 and S11 start at 60 and 100.
- There are no stored numbers or profiles. &Z and ATDS=*n* are ERROR. &W stores nothing.
- The numbers of ATI are specific to the modem (I0 to I7), but not for the call statistics. I6 is as on USRobotics modems, I11 as on Conexant modems, I12 as S71, S72 and S73 of Telebit (the carriers of a PEP call), and &V1 as on Rockwell modems.
- The numeric results (V0) and the number of CONNECT for each rate are specific to D-Modem. The numbers of the USRobotics and Conexant modems are different.
- MNP is classes 2 to 5 (\N, %C) and MNP 10 (-K). The cellular modulations of MNP 10EC are not available. A modem with MNP 10EC connects with V.42 or with MNP 10 (the modem ignores its "EM" detection patterns). Refer to docs/link.md, MNP.
- K56flex (+MS=56) is tested against the Motorola SM56 soft modem and against this modem. It is not tested against a hardware K56flex modem. Refer to docs/dsp/k56flex.md.
- The analogue modem on a digital line (SIP, the client on a digital line) is tested only against this modem, on a simulated network. It is not tested against the server of a real provider.

21.2 Not Available

These commands are `ERROR`: `&V2` and higher, `&Z` (no stored numbers), `&T2`, `&T9` and higher, `\B` (a break), `X5` and higher, `ATI8` to `ATI10`, `ATI13` and higher, `-V90` (`+MS` selects the modulation), `+MA`, `+MSC`, `+EB`, `+ESR`, `+ETBM`, `+EWIND`, `+EFRAM`, `+A8M`, `+A8T` and `+PMHF`. The names of `+MS` for modulations that the modem does not have (`V23S`, `V27` ...) are also `ERROR`.

22 Glossary

Term	Meaning
A-law, u-law	The two methods that G.711 uses to code telephone audio in 8 bits. A-law is for Europe. u-law is for North America and Japan.
ADPCM	Adaptive Differential Pulse Code Modulation. Compressed audio, one of the voice formats of +VSM.
ADSI	Analog Display Services Interface. The screen and keys of a telephone, which tones control.
ALSA	Advanced Linux Sound Architecture. The sound system of Linux. dmodemd uses it to connect to a telephone line through a sound card.
AMR	Adaptive Multi-Rate. The speech codec of GSM and of other mobile networks. It compresses speech, thus a modem signal cannot go through it.
ANS, ANSam	Answer tone and Answer tone, amplitude modulated. The 2100 Hz answer tone, and the same tone with a 15 Hz change of amplitude that V.8 modems send.
ANSI	American National Standards Institute. An ANSI terminal uses its escape codes to move the cursor and to set colours.
ASCII	American Standard Code for Information Interchange. The 7-bit character code of most computers. The S-registers for characters (S2 to S5) hold ASCII values.
ASVD	Analogue Simultaneous Voice and Data. Speech and data on one modem carrier (V.61, +ASVD).
Asynchronous, synchronous	Asynchronous data goes as separate characters. Each character has a start bit (0) before it and a stop bit (1) after it. Synchronous data goes as a continuous bit stream, with no start bits and no stop bits (V.80).
Automode	A procedure that tries the modulations, from the fastest to the slowest, until the two modems find a common modulation (N, +MS).
B channel	Bearer channel. A 64000 bit/s channel of ISDN that carries a call. A basic rate line has two B channels.
Baudot	The 5-bit code (ITA2) of teleprinters, of the TTY of the deaf community, of telex and of RTTY.

Term	Meaning
Bearer service	The type of connection that a digital network gives to a call: speech, 3.1 kHz audio or unrestricted digital data (+CBST).
Bell 103, Bell 212A	The North American 300 and 1200 bit/s modulations, similar to V.21 and V.22.
Bong tone	The tone that some long-distance networks send to ask for a calling card number. On other modems, the dial modifier $ waits for it. This modem ignores $.
Call waiting	A service of the telephone network. A tone tells you that a different call arrives while you are on a call. A V.92 modem can answer it with modem-on-hold (+PCW).
CAPI	Common ISDN Application Programming Interface. The programming interface of ISDN cards. +B2 uses its numbers.
CED, CNG	Called terminal identification and Calling tone. The fax answer tone (2100 Hz) and the tone of the calling fax (1100 Hz).
CIG, CSI, TSI	Calling subscriber identification, Called Subscriber Identification and Transmitting Subscriber Identification. The fax identities of the modem that polls, the answering modem and the calling modem (+FLI).
Class 1, Class 2, Class 2.0	The fax command sets. In Class 1 (T.31), the DTE does the fax protocol. In Class 2 and Class 2.0 (T.32), the modem does the fax protocol.
Clear channel	A 64000 bit/s digital channel that the modem uses with no change and with no modulation, as in an ISDN data call.
CM, JM	Call Menu and Joint Menu. The messages of V.8. The calling modem sends its functions in CM. The answering modem sends the common functions in JM.
Codec	Coder-decoder. The device or the program that changes audio into numbers, and numbers into audio. An example is the G.711 codec of a telephone exchange or of a sound card.
Configurator	A screen of D-Modem that shows each setting with its value and its default. You can change the settings on it (!C).
Contact ID	The DTMF format of SIA DC-05. Alarm panels use it to send events to a central station (Section 16).
CP437	Code page 437. The character set of the IBM PC, with box characters and other symbols.
CPE	Customer Premises Equipment. The equipment at the end of the line, at the subscriber.

Term	Meaning
CRC, FCS	Cyclic Redundancy Check and Frame Check Sequence. A checksum on a frame that shows if the frame has damage.
Data pump	The part of a modem that does the modulation and the demodulation. The other parts (error correction, compression and the commands) operate on the data from the data pump.
dBm0	The level of a signal in dB, relative to 1 mW at the reference point of the telephone network. The modem gives the received level and the noise level in dBm0.
DCD, DSR, DTR, RTS, CTS	Data Carrier Detect, Data Set Ready, Data Terminal Ready, Request To Send and Clear To Send. The control signals of the serial port.
DCN	Disconnect. The T.30 message that ends a fax call.
DES	Data Encryption Standard. A block cipher. Triple DES uses it three times with two or three keys.
DIL	Digital Impairment Learning. The V.90 and V.92 sequence that measures the digital network.
DIS, DTC, DCS	Digital Identification Signal, Digital Transmit Command and Digital Command Signal. The fax messages that offer (DIS), ask for polling (DTC) and select (DCS) the settings of the session.
DISC	Disconnect. The LAPM frame that ends the link.
DLE	Data Link Escape (0x10). In fax and voice modes, the character that starts a code in the data, for example <DLE><ETX>.
DMT	Discrete Multitone. Many carriers side by side, as in V.wb and ADSL.
DSVD	Digital Simultaneous Voice and Data. A conversation and a data connection on one modem call (V.70, +DSVD).
Duplex, half duplex	A duplex modem sends and receives at the same time. A half duplex modem sends in one direction at a time, and the direction changes during the call (fax, PEP).
EBCDIC	Extended Binary Coded Decimal Interchange Code. The 8-bit character code of IBM mainframe computers (+DEBC).
ECM	Error Correction Mode. Fax pages sent in frames. The modem sends a frame again if it has damage.
EDT	European Deaf Telephone. A text telephone at 110 bit/s (V.18).

Term	Meaning
EOL	End of Line. The code (eleven 0 bits, then a 1 bit) before each row of a T.4 fax page.
EOM, EOP, MPS	End of Message, End of Procedure and Multi-Page Signal. The T.30 messages after a page: another document follows (EOM), the fax ends (EOP), or another page follows (MPS).
Equalizer	A filter in the receiver that corrects the distortion of the line. The training adjusts it. If the line changes too much, the equalizer cannot correct it, and the modems retrain.
ETC	Enhanced Throughput Cellular. The cellular mode of AT&T Paradyne (Section 8.1).
ETSI	European Telecommunications Standards Institute. The European standards organization.
Fallback	A slower modulation or rate that a modem uses when the line is not sufficiently good for the faster one. For example, V.22 is the fallback of V.22bis.
Fast connect, quick connect	Shorter handshakes. Fast connect (S49) is for point of sale terminals. The quick connect of V.92 uses the line data from the last call.
Fine resolution	A fax resolution of 7.7 rows for each millimetre. Normal resolution is 3.85 rows for each millimetre.
FSK, DPSK, QAM	Frequency Shift Keying, Differential Phase Shift Keying and Quadrature Amplitude Modulation. Methods that put data on a carrier: with its frequency, with its phase, or with its phase and amplitude together.
GSM	Global System for Mobile Communications. The second generation of mobile telephones. Its 7-bit alphabet is also the alphabet of SMS text.
Guard time	The pause before and after the escape sequence. The modem accepts +++ only with this pause. On this modem, it is always 0.5 s (S12).
Guard tone	A tone of 550 or 1800 Hz that the answering V.22bis modem sends in some countries. This modem sends no guard tone (&G).
Hayes	Hayes Microcomputer Products. The company that made the first AT commands. Many basic commands keep their Hayes meaning.
HDLC	High-level Data Link Control. Frames with flags and an FCS. It is the base of LAPM, of the T.30 messages of fax and of PPP.

Term	Meaning
Hexadecimal	Numbers to the base 16, with the digits 0 to 9 and A to F. In the text, `0x` comes before a hexadecimal value (`0x10`). In a syntax, *h* is a hexadecimal value.
Hook flash	A short on hook that tells the exchange to do a function, for example to answer a waiting call. The dial modifier `!` sends it. A `SIP` call has no hook flash.
HST	High Speed Technology. The modulation of USRobotics: up to 16800 bit/s in one direction and 300 bit/s in the other direction.
INFO	Information sequences. The messages of `V.34` phase 2. In them, the modems tell each other their functions and data about the line.
Init string	A command line that sets the modem for a program. `!R` shows an init string for the settings now.
ISDN	Integrated Services Digital Network. Digital telephone lines with 64000 bit/s channels.
ITU-T	International Telecommunication Union, Telecommunication Standardization Sector. The standards organization that writes the V... recommendations (modems), the T... recommendations (fax) and other series.
K56flex	The 56000 bit/s modulation of Rockwell and Lucent, before `V.90`. `+MS=56` selects it.
Kissoff	The tone (1400 Hz for 900 ms) that the receiver of Contact ID sends to confirm a message.
LAPB	Link Access Procedure, Balanced. The `HDLC` procedure of `X.25` and `X.75`.
Loop test	A test in which the data goes back to its source. A local loop tests this modem. A remote loop tests the line and the far end (`V.54`, `&T`).
LR, LD	Link Request and Link Disconnect. The messages of `MNP` that start and end its link.
MCF, CFR	Message Confirmation and Confirmation to Receive. The `T.30` messages of the receiver: the page came correctly (`MCF`), or the training was good (`CFR`).
MDMF, SDMF	Multiple Data Message Format and Single Data Message Format. The two forms of a caller ID message.
MH	Modified Huffman. The most simple fax page coding (`T.4`).

Term	Meaning
Modem-on-hold	The procedure of V.92 that puts a data call on hold, so that you can answer a different call (+PMH).
NMSE	Normalized Mean Square Error. A measure of the quality of the received signal. A lower value is better.
Parity	An extra bit in each character. It makes the number of 1 bits even (even parity) or odd (odd parity). With it, the receiver can find some errors.
PBX	Private Branch Exchange. An office telephone system, for example Asterisk or FreeSWITCH.
PEP	Packetized Ensemble Protocol. The modulation of Telebit: up to 511 carriers, half duplex.
Polling	A fax procedure in which the calling fax machine receives a document from the answering fax machine (+FSP).
PPP	Point-to-Point Protocol. The protocol that a computer uses to carry internet data through a modem call.
PREP, ACK, TERM	Preparatory, Acknowledgement and Termination. The signals of V.54 that start, confirm and end a remote loop test.
Profile	A stored set of settings. Other modems store profiles with &W and load them with ATZ. This modem has no stored profiles.
PSTN	Public Switched Telephone Network. The usual telephone network.
Pulse dialing	Dialing with short breaks of the line, one break for each unit of the digit (P). Older exchanges use it. Tone dialing uses DTMF.
REJ, SREJ	Reject and Selective Reject. The LAPM frames that ask for frames again: all the frames from a number (REJ), or one frame only (SREJ).
Renegotiation	During a call, the modems change only the rate, with no retrain. A retrain measures the line again (see Common Terms).
RFC	Request for Comments. A standard of the internet, for example RFC 4040.
Robbed-bit signalling	A digital network uses a bit of some samples for its own signals. A V.90 modem must correct for this.
Round trip delay	The time that a signal takes to go to the far end and come back, in ms. V.34 measures it at the start of the call.
RTC	Return to Control. Six EOLs in a sequence. They end a T.4 fax page.

Term	Meaning
RTTY	Radio Teletypewriter. Baudot through radio, as radio amateurs send it.
Sample	One measurement of an audio signal. The telephone network takes 8000 samples each second (G.711).
Scrambler	A function that changes the data into a pattern that looks random, before the modulation. The receiver changes the pattern back. Thus, a long row of the same bit does not make a steady tone.
SIA	Security Industry Association. The organization that wrote the Contact ID standard (DC-05).
SMS	Short Message Service. Text messages. On a fixed line, the modem sends and receives them as ETSI ES 201 912 tells (Section 17).
SNR	Signal-to-Noise Ratio. The level of the signal above the level of the noise, in dB.
Symbol rate	The baud of a modulation. V.34 has six symbol rates, from 2400 to 3429 baud.
SYN	Synchronous idle. The idle octet of the synchronous mode of V.80.
T.30	The fax protocol: its messages, phases and timers.
Terbo	V.32terbo. The 16800 and 19200 bit/s extension of V.32bis from AT&T. USRobotics modems also have it.
TPDU	Transfer Protocol Data Unit. The coded form of one SMS message (3GPP TS 23.040).
Transparent and framed sub-modes	The two sub-modes of the synchronous access of V.80. In the transparent sub-mode, the octets go with no change. In the framed sub-mode, the modem puts the data in HDLC frames.
Type II caller ID	The caller ID of a waiting call, which the network sends during a call.
UCS2	Universal Character Set, 2 octets for each character. The 16-bit alphabet of SMS for text that GSM characters cannot show.
Unimodem	The modem driver of Windows. #UD gives its diagnostics.
Upstream, downstream	The two directions of a V.90 or V.92 call. Downstream goes from the digital modem of the server to the analogue modem of the user. Upstream goes in the opposite direction. V.92 can also send PCM upstream.

Term	Meaning
URI	Uniform Resource Identifier. The address of a SIP user, for example `sip:100@pbx`.
UTC	Coordinated Universal Time. The time at longitude 0, with no summer time.
V.8	The start of a modern call. The modems tell each other their functions.
V.cvm, V.wb	The D-Modem modes for data on mobile speech paths, and for a wideband modem on a dry pair.
V.FC	V.Fast Class. The 28800 bit/s modulation of Rockwell, before V.34.
Voice mode	The mode for audio. The modem plays and records audio, and it identifies DTMF tones (+FCLASS=8).
WAV	Waveform Audio File Format. A file format for audio.
X.75, V.110, V.120	Protocols on an ISDN data channel (+B2).
x2	The 56000 bit/s modulation of USRobotics, before V.90. +X2UP enables it on a Courier.
XID	Exchange Identification. The message of V.42 that agrees the compression.
XON, XOFF	Transmit On and Transmit Off. The characters (DC1 and DC3) that start and stop the flow of data.
zstd	Zstandard. A modern compression that D-Modem offers between two D-Modem modems (+DSZ).

Notes

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D-Modem AT Command Reference

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https://github.com/D-Modem/D-Modem

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