

D-Modem

AT Command Reference

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

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I Introduction

This manual specifies the AT command set of D-Modem's modem core (`core/` in the source). The core accepts the commands of every D-Modem program:

- **`dmodemd`**, the modem on a pseudo terminal (`/dev/ttyDM0` links to it), its line a SIP call or, with `-a` and `-usb`, an analogue telephone line;
- **libdmodem** (`dmodem.h`), the modem as a library: the program that embeds it sends the commands;
- the **Asterisk and FreeSWITCH modules** (`app_dmodem`, `mod_dmodem`), whose profiles give the commands each call starts with.

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 both ends have (Section 7).
- **Error correction and compression**: V.42 (LAPM) and MNP 2 to 5; V.42bis, V.44, MNP 5 and zstd (Sections 8 and 9).
- **V.92's extras**: quick connect, PCM upstream and modem-on-hold, to answer a waiting call and come back to the data call.
- **Fax**: Class 1 (T.31) and Class 2 and Class 2.0 (T.32), up to 14400 bit/s with V.17, and adaptive answer, which tells a fax call from a data call (Section 14).
- **Voice** (V.253): play and record audio, send and detect DTMF and tones, use a handset, and turn a voice call into a fax or data call (Section 18).
- **Text telephones** (V.18): the 5-bit TTY of the deaf community, telex and RTTY, DTMF, EDT, Bell 103, Minitel's V.23, the V.21 text telephones, V.18's own mode, and automoding between them (Section 15).
- **Caller ID**, from a SIP call or a telephone line (FSK and DTMF), and a waiting call's caller in voice mode.
- **Leased lines**, 2-wire and 4-wire (V.29, V.33, V.27ter), with V.13's simulated carrier control.
- **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 V.80's synchronous access.
- **V.cvm** for data over mobile speech paths, and **V.wb**, a wideband modem for a dry pair.
- **Diagnostics**: the last call's statistics (ATI11, AT&V1, AT#UD) and loop tests (AT&T).
- **Other modems' setup strings** work: the modem accepts the commands of V.250, Rockwell and Conexant, and USRobotics modems, most of them with no effect; their entries say so.

Every command, range, *default* and response in this manual is the core's own. A setting that is kept but changes nothing says so.

How to Read This Manual

Each command has an entry of the same form: its name and title in a strip, what it does, then where it has them its syntax, its result codes and a numbered table of its values, the *default* marked *(default)*. Table 1 lists every command and links to its entry. Commands are shown in capitals; the modem accepts either case. *n* is a decimal number, *h* a hexadecimal one; `[ ]` marks what may be left out. A setting's *default* is the one `ATZ` and the start of the program give.

The text is styled by what it is:

- `Red monospace` is a command or part of one, as you type it (`ATD`, `+MS=V92`); where it is a link it leads to that command's entry.
- `Monospace on blue` is what the modem sends back: a result code or other response, as it appears on the `DTE`'s screen (`OK`, `CONNECT 33600`, `NO CARRIER`).
- `Plain monospace` is a standard, a signal or a term from one (`V.34`, `CNG`), an acronym (`DTE`), or a number such as a speed (33600 bit/s).
- *Italics* stand for a value you fill in (`ATS`*n*).

II Common Terms

A few words this manual uses throughout. The glossary (Section 22) explains the rarer ones.

AT command
AT stands for "attention". An instruction to the modem, sent as text that starts with the letters AT, such as ATZ. One line can hold several commands (ATE1Q0V1).

Basic and extended commands
Basic commands are a letter, maybe after &, \, or %, and a number (E1, &K3). Extended commands start with + or − and accept values (+MS=V92).

Baud
Symbols per second: how many times a second the modem changes its signal. Each symbol can carry several bits, so a connection's bit/s is often higher than its baud: V.34 sends up to 3429 baud but 33600 bit/s. Older modems were sold by baud, which is why the two words are often mixed up.

bit/s
Bits per second, the speed of a connection; CONNECT gives it.

Carrier
The signal the far modem sends during a call. Losing it ends the call (NO CARRIER).

Command mode and online mode
In command mode the modem reads what the DTE sends as commands. Once a call is up (CONNECT) it is online: what the DTE sends goes to the far end as data. The escape sequence (+++, with a pause before and after) returns to command mode with the call kept, and ATO goes back online (Section 19).

DCE
Data Circuit-terminating Equipment. The modem: what sits between the DTE and the telephone line or call, here D-Modem itself.

Default
A setting's value after ATZ or when the program starts. The modem keeps no stored profiles.

Dial string
What follows ATD: the number and the modifiers that change how it is dialed (T, P, W, , and so on).

Dry pair
A pair of copper wires with nothing on it: no telephone exchange, no battery voltage and no dial tone, such as two modems wired to each other directly. A modem uses it as a leased line; V.wb runs only on one.

DTE
Data Terminal Equipment. The computer or program that talks to the modem: a terminal program, a fax program, `pppd`, or the program that embeds libdmodem.

DTMF
Dual Tone Multi-Frequency. The tones of a telephone keypad, two at once for each key. The modem dials with them (`T`), and hears them in voice mode and in `DTMF` caller ID.

Error correction and compression
Error correction (`V.42`, `MNP`) resends data the line damaged; compression (`V.42bis`, `V.44`) packs it to go faster. Both need the far modem to have them too.

Fax
Facsimile. Sending a page as an image over a telephone line: the fax machine scans the page and its modem sends it to another fax machine, which prints it. This modem can act as a fax machine's modem for a fax program on the `DTE` (Section 14).

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

LAPM
Link Access Procedure for Modems. `V.42`'s error correction, the one most modems use: data goes in numbered frames with a checksum, and a damaged frame is sent again.

Leased line
A permanent connection between two modems, with no dialing, ringing or dial tone: each end starts at once (`&L`). A 2-wire leased line carries both directions on one pair; a 4-wire line has a 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 turns a computer's data into sound that can travel over a telephone line, and turns the sound from the far end back into data. D-Modem does this in software, with no modem hardware.

Modulation
How the modem turns data into sound on the line, and so how fast it goes: `V.34`, `V.90`, `V.92` and the rest, chosen with `+MS`.

PCM
Pulse Code Modulation. Sound as numbers: the telephone network carries a call

as 8000 8-bit samples a second (`G.711`). `V.90` and `V.92` send data as these numbers, which is how they reach `56000` bit/s.

Result code
: The modem's answer to a command line, or news of a call: `OK`, `ERROR`, `CONNECT`, `RING`, `NO CARRIER` and so on (Section 12).

S-register
: A numbered setting, read with `ATSn?` and set with `ATSn=`*value* (Section 13).

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

TTY
: Teletypewriter. A text telephone used by deaf and hard of hearing people, sending Baudot code at `45.45` or `50` bit/s (Section 15). On Linux, a tty is also a terminal device in `/dev`, such as a serial port (`/dev/ttyS0`) or a pseudo terminal (`/dev/pts/3`). `dmodemd` appears as a pseudo terminal, so terminal programs open it like 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`	On-line data echo (accepted).	`Hn`	Hook control.
`In`	Identification, call statistics.	`Ln`	Speaker volume.
`Mn`	Speaker control.	`Nn`	Automode.
`On`	Return to on-line 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.		

Table 1. AT command summary *(continued)*

Command	Description	Command	Description
\A*n*	MNP block size.	\G*n*	XON/XOFF pass through (accepted).
\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.
-C, -K, -Q	MNP 10 (accepted).	)M, @M, *H	MNP 10 (accepted).
+MS	Modulation.	+GMI, +GMM, +GMR	Identification.
+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.
+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.
+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

AT commands are issued to the modem to control its operation and its settings. The modem accepts them in command mode: after it starts, when a call ends, after any command but a dial or an answer, and online after the escape sequence (Section 19), the call still up. Each command line is answered with a result code (Section 12).

- A command line begins with AT and ends with the character of S3 (carriage return) or S4 (line feed). Blanks and tabs in it are dropped before it is read.
- The character of S5 (backspace) erases the last one typed.
- A line holds **63** characters at most; a longer one is ERROR.
- With echo on (E1), what the DTE types comes back as it is typed.
- A line that does not begin with AT is not a command: with echo on it is blanked out on the DTE's screen.

The commands of a line run in turn (ATE1Q0V1). A basic command's number left out is 0 (ATE is ATE0). An extended command (+...) accepts =*values*, ? (its values) and =? (its ranges). A ; may stand between two commands, as V.250 puts one after an extended command that another follows (AT+IFC=2,2;+MS=V92); here it is not needed. A value left out of an extended command's =*values* keeps what it was.

Some extended parameters (+ILRR, +MR, +PCW, -SEC and others) are kept for other modems' setup strings, with no other effect but where an entry says so. =*values* sets them (each in its range, else ERROR), ? gives +*name*: *values*, =? the ranges, and ATZ the *defaults*.

The commands are grouped by what they do, each group a section: echo and result codes, settings and profiles, identification, dialling 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 them by name.

The first command that fails ends the line with ERROR; otherwise OK follows the last one. A, D and O end the line and give their result later (CONNECT, NO CARRIER and so on), and Z ends it with OK: whatever follows them on the line is not read, but for a dial string's ;, after which the rest of the line runs once the number is dialed (ATD). A command that reports something (I, S*n*?, +MS? ...) prints it on lines of its own before the result.

A character from the DTE while a call is being set up (dialing, answering, the modems' training) hangs up. After a dial string's ; the modem is in command state, and accepts commands.

2 Echo and Result Code Settings

A/ — Repeat Last Command

A/ runs the last command line again. It needs no AT before it and no line end after it: the modem runs it as the / is typed. It is mostly used to dial a busy number again.

E*n* — Command Echo

This command sets whether the modem echoes the DTE's characters 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*).

Q*n* — Result Code Control

This command sets whether the modem gives result codes (S14).

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

Table 3. Q*n* Commands

Command	Function
Q0	Result codes are given (*default*).
Q1	Result codes are not given.

`Vn` — Result Code Form

This command sets whether result codes are words or numbers (S15). Section 12 lists both.

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

Table 4. V*n* Commands

Command	Function
`V0`	Numbers, each on a line of its own.
`V1`	Words (*default*).

`Wn` — Connect Message Control

Other modems use `W` to choose what `CONNECT` reports. The modem accepts it and changes nothing: here `&A` and `\V` choose.

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

X*n* — Result Code Set and Call Progress

This command sets whether `CONNECT` gives the rate, whether the modem waits for a dial tone before dialing, and whether it reports a busy tone (S56).

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.

The dial tone X2 and X4 wait for is 1 s of tone, steady or in a cadence whose gaps are 1 s at most (as Italy's: its tone added up); `NO DIALTONE` if none comes in S6 seconds (2 s at least; 2 s more while a dial tone in a cadence is heard). A busy tone is four cycles of the country's busy or congestion tone's cadence (the ITU's list's, 15% or 80 ms either side: 0.48 s on and off or 0.24 in Germany, 0.75 s in India, 1 s on and 4 off in Egypt), not its ringing tone; a country with neither (none of the 192) its table's bounds. `NO ANSWER` comes with every *n*, and the dial string's W and @ wait with every *n*. A SIP call has no dial tone: `dmodemd` wants ATX3.

`&An` — Connection Lines Before CONNECT

This command adds lines on the connection before a data call's `CONNECT` (S70). *n* is a sum of the bits below. With `V0` the first three lines are numbers and the fourth is left out.

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 and its number (1092, 1034, 1132, ...).
2	`Protocol:` `LAPM`, `MNP` or `NONE`, the error correction (`V.42`'s `LAPM`, `MNP` 2 to 4).	77, 78, 76.
1 and 2	`Compression:` `V44`, `V42bis`, `MNP5`, `ZSTD` (`V.cvm`'s, Annex F) or `NONE`, what `V.42` or `MNP` agreed.	68, 67, 66, 70, 69.
4	`TxRate:` *rate*, the rate the modem sends at.	None.

The *default* is 0, no lines.

`&En` — Rate in CONNECT

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

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

\V*n* — Protocol Result Code

This command sets whether a data call's `CONNECT` gives the error correction and the compression after its rate (S106). With `V0` or `X0` it changes nothing.

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

Table 7. \V*n* Commands

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

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

On other modems these turn on the `+MCR:`, `+MRR:`, `+ER:` and `+DR:` reports. Kept; each 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) and gives its value in decimal on a line of its own. ATS*n*=*v* sets it to *v*; the registers hold 8 bits, so *v* is taken modulo 256. Both numbers are decimal, a leading 0 too (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 over 255, a read-only register (S44, S45), or neither ? nor = after it.

Zn — Reset

This command hangs up and sets the modem as it was at the start: the S-registers, +MS, modem-on-hold, the data mode (+FCLASS=0), the extended parameters and the loop tests (&T5). The country stays, and so do the S-registers without a *default* of their own: S18, S28, S47 (&L), S48, S161 and the free ones. There are no stored profiles, so *n* (0 to 3) changes nothing. The rest of the line is not read.

Result code	When
OK	Always.

&Fn — Restore Factory Defaults

Accepted, with or without a digit, and nothing done; see &D. ATZ restores the *defaults*.

&Vn — View Active Configuration

&V and &V0 show the active settings, in lines of **72** columns at most: the basic commands', the S-registers in use (S*nn*:*vvv*; not S18 or S44 to S48), +MS and the other extended settings, and the extended parameters. There are no stored profiles: the list ends with STORED PROFILES: none. &V1 gives the last call's statistics as Rockwell's modems list them: one line each, the name padded with

dots to 28 columns, then the value. It covers the same call as ATI11 (the one up in online command state, else the last; before any, No Previous Call). A call that never came up, or a fax call, gets the first line only. A value the modem does not measure is N/A.

Table 8. AT&V1 Lines

Line	Value
TERMINATION REASON	NONE while the call is up; LOCAL REQUEST (ATH, ATZ, DTR), KEY ABORT (a character while connecting), GSTN CLEARDOWN (the other modem's LAPM DISC or MNP LD), LINK DISCONNECT (the SIP call ended), CARRIER LOSS, RETRAIN FAILURE (a retrain that failed), INCOMPATIBLE PROTOCOL (no error correction where it is required, LAPM's errors) 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; a PCM rate as Rockwell rounds it (53333).
HIGHEST TX rate, HIGHEST RX rate	The highest the call reached.
PROTOCOL	LAPM, MNP or NONE.
COMPRESSION	V44, V42Bis, MNP5, ZSTD or NONE.
Line QUALITY	The receiver's mean squared error, as Rockwell's three-digit figure (the NMSE times 128: lower is better).
Rx LEVEL	The received power in dBm0 without its sign, three digits (015 for -15 dBm0).
Highest Rx State, Highest TX State, EQM Sum	N/A (Rockwell's pump states).
RBS Pattern	The frames of six whose bit the network robs, as a hex mask (08h), as the analogue modem's DIL found them (V.90, V.92).
Rate Drop	N/A.
Digital Pad	The network's pad: None, 3dB, 6dB, ... (V.90, V.92).
Local Rtrn Count, Remote Rtrn Count	Retrains, ours and the other modem's, 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` answer `OK` and store nothing.

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

`&Yn` — Profile at Power On

Accepted, changing nothing: there are no stored profiles.

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

!R — Init String of the Settings

!R prints an init string: the commands that set every setting that differs from its default, for you to copy and paste into the next session after ATZ (there are no stored profiles). It covers the settings the configurators (!C) list: the basic commands' (E, X, \N, . . .), the S-registers of their own (S0, S6 to S12, . . .), +GCI (first: it sets S8 and S24), +MS (its four values together), +FCLASS, #CID, +PMH and the extended parameters. A line is **63** characters at most, as a command line is; a longer string takes more lines, each beginning with AT. With nothing changed it prints AT alone. It works in any state, during a call too.

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 the configurators (!C) show, for a program to build its own settings page from (D-Modem's desktop apps do): one line for each setting and one for each of its choices, the fields apart by tabs. The first line is model, the format (**1**) and how many settings follow. A setting's line is setting, its key, its kind (pick, number or text, the last a list of numbers), its value now, its default, the lowest and highest values (a number's; empty for the others), its command (%s where the value goes), its group, its label and a line of help. A pick's choices follow it, each a line of choice, the value the command takes, its name in the command line configurator and its label. Like !R, it works in any state, and the rest of the line is read as further commands.

Result code	When
OK	Always.

Example output: AT!M (in 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 every setting with its value and its default, and change them through the settings' own commands, so they take what the commands take. They run only while the modem is idle and on hook: otherwise the command is ERROR. The rest of the command line is not read. Leaving the configurator gives OK; a RING (or the DTE hanging up) ends it at once, with no OK.

- !CF is a full-screen configurator in the style of Borland's Turbo Vision, for an ANSI terminal: 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. The arrows move, Tab goes between the groups and the settings, Enter changes a setting (Left, Right and Space step through its values, Del sets its default), **F2** saves the changes, **F3** shows their init string (!R), **F5** sets every default, Alt-X or Esc leaves (asking whether to save). Only the cells that change are sent, in UTF-8 or CP437 box drawing.

- `!CT` is a command line in the style of Cisco's IOS. `dmodem#` takes `show running-config` (what differs from the defaults), `show settings` [*group*], `show init-string`, `show version`, `configure terminal` and `exit`; `dmodem(config)#` takes *setting value*, `no` *setting* (off, or its default), `default` *setting*, `do` *command*, and `exit` or `end` (or Ctrl-Z). A word may be cut short (`sh run`, `conf t`); `?` lists what may come next, Tab completes a word, the Up and Down arrows recall lines. A change takes effect at once.
- `!C` looks at the terminal: it asks for the cursor's position (`ESC [6n`). A terminal that answers within 1.5 s gets `!CF`, with its size and whether it takes `UTF-8` asked the same way; one that does not gets `!CT`. `!CF` asks too, and takes 80 by 24 in `UTF-8` without an answer.

Result code	When
`OK`	When you leave 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 reports what the modem is, its settings and the last call's statistics.

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 maker, `D-Modem project`.
`I3`	The modem's name, then its line's kind (`dmodemd`: `dmodem0`, `SIP`).
`I4`	`S0` to `S23`, eight a line (`s00=000 s01=000 ...`).
`I5`	`Stored Profile 0:` (there are none).
`I6`	The last call's statistics, as USRobotics' link diagnostics (the same as `I11`).
`I7`	The country: `Country: USA`.
`I11`	The last call's statistics, as Conexant's modems give them.
`I12`	The last `PEP` call's carriers: each bin's frequency, its bits each way and the noise on it (dBm0); `No PEP Call` after another.

`ATI11` lists the last call's statistics: in online command state those of the call that is up, after a call (dialed or answered, connected or not) its own, until the next one; before any, `No Previous Call`. `ATI6` gives the same lines, `AT&V1` the same call in Rockwell's form, and `AT#UD` the same figures in Unimodem's form. A line whose value the call does not have is left out: the rates and what follows for a call that never came up, the frame counts without error correction, the coding lines without `V.34`, the measurements a modulation does not make, the cause while the call is up.

Table 10. ATI11 Lines

Line	Value
`Last Connection`	The modulation it came up with (`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)`	Each direction's symbols a second (`V.22` to `V.92`, the clear channel).
`Carrier Frequency (Hz, Tx/Rx)`	Each direction's carrier, `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)`	`V.34`'s coding each way (`16S-4D`, `ON`, `OFF`; – for a `PCM` direction).
`Estimated SNR (dB)`	The receiver's signal to noise ratio (`V.34`, `V.90`'s upstream, `V.32bis`, `V.29`, `V.33`, `V.27ter`, `V.wb`).
`Receive/Transmit Signal Power Level (dBm0)`	The line's mean power each way while the call was up.
`Round Trip Delay (ms)`	As `V.34`'s phase 2 (or `V.cvm`'s start-up) measured it.
`Near/Far Echo Level (dBm0)`	The echoes of our signal the canceller removes (`V.34`, `V.90`, `V.92`).
`Carrier Frequency Offset (Hz)`	How far the far end's carrier is from ours (`V.22` to `V.92`).
`Timing Offset (ppm)`	How far the far end's clock is from ours (`V.32bis` to `V.92`).
`PCM Encoding`	The network's law, `A-law` or `u-law` (`V.90`, `V.92`).
`Digital Loss (dB), Robbed Bit Frames`	The network's pad and the frames of six whose bit it robs (`None`, 6, ...), as the analogue modem's `DIL` found them (Section 7).

Table 10. ATI11 Lines *(continued)*

Line	Value
`Characters Sent/Received`	The DTE's.
`Transmit Frame Count`	LAPM's or MNP's frames sent.
`Transmit Frame Error Count`	The information frames among them sent again.
`Receive Frame Count`	The frames received intact.
`Receive Frame Error Count`	The frames received with a bad FCS.
`PEP Line Rate (Tx/Rx)`	PEP's rate on the line each way while a side has it (bit/s).
`PEP Packets Accepted, Received Bad`	PEP's packets taken, and received with a bad CRC.
`PEP Micro Turns (Tx/Rx)`	Its short turns, sent and taken.
`Retrains by Local Modem, Retrains Requested by Remote Modem`	Retrains, ours and the other modem's.
`Rate Renegotiation by Local/Remote Modem`	Rate renegotiations (`V.34`, `V.90`, `V.92`).
`Call Duration`	From `CONNECT`, *h*:*mm*:*ss*.
`Call Termination Cause`	`Local hangup` (`ATH`, `ATZ`, DTR, a character while connecting), `Remote cleardown` (the other modem's LAPM DISC or MNP LD), `Line dropped` (the SIP call ended), `Carrier lost`, `No dial tone`, `Busy`, `No answer`, `Training failed`, `Protocol failure` (no error correction where it is required, LAPM's errors), `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 has no view of the line's digital loss or robbed-bit signalling, so on `dmodemd`'s `SIP` line those 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 build's version). With `?` after them (`AT+GMI?`) they give the same.

Result code	When
`OK`	Always.

`+GCAP` — Capabilities

This command lists the command sets the modem has: `+GCAP: +FCLASS,+MS`.

Result code	When
`OK`	Always.

`#UD` — Unimodem Diagnostics

This command gives the last call's statistics (or this one's), as `ATI11` has them, in the form that Microsoft's Unimodem Diagnostics Command Reference Specification (version 1.0) gives, for Windows' modem log and the programs that read it: a line `DIAG <2A4D3263 key=value>` for each key there is a value for, both in hexadecimal. Before any call: `0=10`, `1=0` and `60=1`. `ATZ` clears the log; if it ended a call, the log then holds only that: `0=10`, `1=0` and `60=52` (the `DTE`'s reset). The measures only some modulations have (`V.8`'s `CM` and `JM`, the `NMSE`, the far echo, `V.34`'s `INFO` bits) are left out for the others.

Result code	When
`OK`	Always.

Table 11. #UD Keys

Key	Value
0	The format (10).
1	The call's setup.

Table 11. #UD Keys *(continued)*

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

Example output: AT#UD

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

+TMO — V.59 Diagnostics

This command gives V.59's managed objects: the facts about the last call (or this one), from its start until the next call starts, as V.250's +TMO reads them. Each object has a name and a four-digit hexadecimal tag: the first two digits its high-level object (V34Diag 0C, CnxDiag 2C, ...), the last two the object within it. An object that does not apply to the last call is NULL. Blanks between the parts may be left out; case does not matter.

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

Table 12. +TMO Forms

Command	Function
+TMO	The last +TMO again.
+TMO *level*=?, +TMO *level*N=?	The objects there are, as tags (N: as names): 0 all, 1 the high-level ones, 2 the mid-level ones, 3 the low-level ones; 4 gives +TMO: (0,1) (names and tags both).
+TMO *tag*	A four-digit tag: that object, as *tag*{*value*}; two digits: every object of that high-level object.
+TMO *name* [All]	An object by name, or every object of a high-level one (V34Diag, or V34 alone), as *name*{*value*}. A modulation's object by name alone is the last call's modulation's.
+TMO *high name*	That high-level object's object (+TMO V34 rxDataHistory).

Table 13. +TMO High-Level Objects

Tag	Objects
00	ModemIdentity: the maker, model, version, V.59's version (1), what the modem does (a bit string, in hexadecimal).
01	ModemCapability: each modulation's and protocol's mode (0 not there, 1 the preferred, 2 enabled, 3 disabled), the others there are.
02	ModeSelected: the call's modulation.

Table 13. +TMO High-Level Objects *(continued)*

Tag	Objects
07	`V8Diag`: `V.8`'s `CM` and `JM` (their octets in hexadecimal), its result.
09–23	Each modulation's: its mode, the transmit and receive levels and the noise (dBm0), the symbol rates and carriers (`V.59`'s codes), the rates during the call, the echoes, the round trip delay, `V.90`'s and `V.92`'s robbed bits, digital loss and `G.711` law.
26	`NSMDiag`: a modulation `V.59` has none for (K56flex, ...).
2C	`CnxDiag`: the carriers, carrier losses, renegotiations, retrains, the call's length, whether we called.
2E	`CallProgress`: how far the call got, why it ended (`V.59`'s codes).
2F	`ErrorControl`: the protocol, its frame sizes and windows, its frames and errors, the throughput.
30	`Compression`: what was agreed, each way, its dictionary and string sizes.
31	`DTEDCE`: the flow control, framing, rate, throughput and characters lost.

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

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

&T*n* — Loop Tests

V.54's loop tests, with Hayes' numbers. Loop 3 runs offline on a leased line (&L) with a 4-wire modulation (+MS=V29, V33 or V27TC): the modem's signal goes back into its own receiver and the line is silent. Loop 2 at the far end is asked for in band (V.54's PREP, ACK and TERM), from online command state on a call with no error correction (\N0). The self-test sends and checks V.52's 511-bit pattern. S18 above 0 ends a test after that many seconds.

Result code	When
CONNECT	For &T1 and &T6: the DTE's data comes back to it.
OK	For the others; &T0 after &T7 or &T8 first gives the self-test's bit errors, three digits (255 at most).
ERROR	For &T2 and *n* over 8, outside the state the test needs, or when the far end does not answer &T6 or &T7.

Table 14. &T*n* Commands

Command	Function
&T0	Ends the test (&T the same).
&T1	Loop 3, the local analogue loop.
&T3	Loop 2 here: the far end's data back to it.
&T4	The far end may ask for loop 2.
&T5	The far end may not ask for loop 2 (*default*, again 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

V.250's test commands, made from V.58's test objects: the loop tests of &T, an error rate test round them, and their status. Each also takes ? (its value) and =? (its range).

Result code	When
`OK`	When the command is done: for `+TRDL=1` when the far end loops, for `+TAL=1` when loop 3 runs, both in online command state (not `CONNECT`: `ATO` for the DTE's data); for `+TRDL=0` when the `TERM` has gone.
`ERROR`	Outside the state the test needs, when the far end does not loop, or for a value it does not have.

Table 15. +T Commands

Command	Function
`+TERDL=`*n*	1: the far end may ask for loop 2 (`&T4`); 0 it may not (*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. *band* is taken and ignored.
`+TTER=`*type*`,`*len*`,`*blocks*`,`*pattern*	The error rate test on the loop that runs (loop 2 at the far end, loop 3), from online command state: `V.52`'s 511-bit pattern (*pattern* 1, the only one) for *blocks* blocks of *len* bits (1–65535 each); *type* 1 bit errors, 2 block errors, 3 both (both are counted). `+TTER=0` stops it. `+TTER?` gives the type running (0 none), *len*, the blocks left and the pattern.
`+TNUM?`	The last error rate test's bit and block errors, `+TNUM:` *bits*`,`*blocks* (65535 at most).
`+TALS?`	Loop 3: 0 none, 3 running.
`+TDLS?`	Loop 2 here: 1 none, 3 ours (`+TLDL`, `&T3`), 4 the far end's.
`+TRDLS?`	Loop 2 at the far end: 1 none, 4 running.
`+TSELF=`*n*	The self-test (0 full, offline only; 1 partial): the loop tests' pattern generator, checker and recognisers check themselves.
`+TRES?`	Its result: 0 none since `ATZ`, 1 pass, 2 fail.
`+TE140`, `+TE141`, `+TEPDL`, `+TEPAL`, `+TMODE`, `+TADR`	0 alone: 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 by themselves.

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

5 Dialling, Answering and Hanging Up

D*string* — Dial

This command takes the modem off hook and dials the number in *string*, then calls. The digits and * # A B C D are dialed as DTMF, each S11 ms long with S11 ms between them; T and P choose tone or pulse dialing (S16) for the rest of the call. Pulses are dialed on an analogue line (dmodemd's -a and -usb), with the country's break, make, gap between digits and digit pattern (+GCI; * # A B C D skipped); a line that cannot pulse, such as SIP, dials them in DTMF. With X2 or X4 the modem waits for a dial tone first. In dmodemd the dial string is the SIP call's number (Section 20).

Table 16. Dial Modifiers

Modifier	Function
0-9 * # A-D	Dialed as DTMF, or as pulses for the digits with P.
L	Dial the last number again (`Dialing number...` first). Valid only as the first character of the string; `ERROR` while a call is held after ;.
T	Tone dialing (DTMF) from here on.
P	Pulse dialing from here on.
,	Pause for S8 seconds.
W	Wait for a dial tone (1 s of it): `NO DIALTONE` if none comes in S7 seconds.
@	Wait for the remote end's ringing (0.5 s of sound at least), then for 5 s of quiet after it: `NO ANSWER` if that does not come in S7 seconds.
;	End the dial string: once the number is dialed the modem is back in command state, off hook with the call kept, and says `OK`; the rest of the line runs then.
S=*n*	A stored number: `ERROR` (there are none).
! $	Hook flash and bong tone: skipped (a SIP call has no hook to flash).

Other characters are skipped. After a ; the call waits, silent, for the DTE: ATD*more* dials more on it (as DTMF; a ; again holds it again), ATD alone or ATO starts the calling modem's handshake, ATA the answering modem's, and ATH hangs up (`OK`, then `NO CARRIER`).

Result code	When
`CONNECT`	When the call is up.
`OK`	After a `;`.
`BUSY`, `NO ANSWER`, `NO DIALTONE` or `NO CARRIER`	When it is not.
`ERROR`	For `S=`*n*, or `L` with no number to dial.

`P` — Select Pulse Dialing

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

Result code	When
`OK`	Always.

`T` — Select Tone Dialing

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

Result code	When
`OK`	Always.

`&P`*n* — Pulse Dial Make/Break Ratio

The modem keeps the value in `S28`. The country's table sets the pulse times.

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

A — Answer

This command takes the modem off hook to answer a call. After S92 seconds it sends the answering modem's tones. In `dmodemd` the call that rings (`RING`) is answered. On a call held after a dial string's `;`, `ATA` answers that call: `ATD`*number*`;A` dials, then answers (`V.250`'s call-back).

Result code	When
`CONNECT`	When the call is up.
`NO CARRIER`	When no call comes up.
`ERROR`	If there is no call to answer.

Hn — Hook Control

This command puts the modem on or off hook. `H` or `H0` hangs up a call. In voice mode `ATH` leaves the line and goes back to data mode (Section 18).

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

Table 17. H*n* Commands

Command	Function
H0	On hook (hang up).
H1	Off hook.

On — Return to On-Line Data Mode

This command takes the modem back online after the escape (Section 19). On a call held after a dial string's ; it starts the calling modem's handshake (as ATD). O1 and O3 work in V.34, V.90 and V.92 calls; in the others they only go back. A retrain or renegotiation counts as the local modem's in ATI11.

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

Table 18. O*n* Commands

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

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 barred from dialing. None are kept.

Result code	When
OK	Always.

#CID, +VCID — Caller ID

This command turns caller ID on or off. With it on, the modem tells the DTE who is calling: after the first RING it sends the date and time, the caller's number and, when there is one, the caller's name, a line each. +VCID is another name for the same command.

Caller ID works on a SIP call and on a telephone line. When the caller has withheld the number or name, the modem sends P (private) in its place; when it is not known, O (out of area). Value 2 sends the whole caller ID message in hexadecimal instead, for programs that decode it themselves.

Syntax:

- AT#CID=*n* (or AT+VCID=*n*)
- AT#CID?
- AT#CID=? (gives 0,1,2)

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

Table 19. #CID=*n* Values

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

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

```
RING

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

RING
```

Technical details:

- `DATE` is the month and day (MMDD), `TIME` the hour and minute (HHMM).
- In voice mode (`+FCLASS=8`) the lines come as `V.253`'s complex event report, between `<DLE>X` and `<DLE>.`; in the other modes after an empty line.
- On a telephone line the modem listens for caller ID after the first ring (North America's way, and `ETSI`'s after a short ring). On a line it hears on hook (`ALSA`, a pipe, the pico-serial Line) it also listens before the ring (`ETSI`'s after its alerting tone, the UK's, `DTMF` caller ID).
- It accepts Bell 202 `FSK` and `V.23` `FSK` (`ETSI` EN 300 659-1, BT SIN 227) alike, and `DTMF` caller ID: `A` and the number, or `B` (or `D`) and a reason it is absent (`10` private, as `P`; others `O`), up to `C`, # or a pause.
- In voice mode with the line taken it accepts Type II caller ID too, a waiting call's caller: after the `CPE` alerting signal (2130 and 2750 Hz) it answers with `DTMF` `A` (GR-30's, a `CPE` without `ADSI`) and reports the `FSK` message that follows as a packet, the line's audio to the `DTE` silent meanwhile.
- A `SIP` call (`dmodemd -L`) has its caller ID from the INVITE: the caller's P-Asserted-Identity, else its From (the `URI`'s user part as `NMBR`, the display name as `NAME`), the date and time the host's. A withheld number or name (the Privacy header's `id`, `user` or `header`, or an anonymous caller) is `P`; with value 2 the modem sends the `MDMF` message it made of them.

6 Speaker, Line and Country

`Ln` — Speaker Volume

This command sets the speaker's volume (S30). A `SIP` line has no speaker: the setting is kept. A SmartUSB56 with `dmodemd -usb-buzzer` sounds its buzzer while the speaker is on, at any volume but `L0`.

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

Table 20. L*n* Commands

Command	Function
`L0`	Off.
`L1`	Low volume.
`L2`	Medium volume.
`L3`	High volume (*default*).

`Mn` — Speaker Control

This command sets when the speaker is on (S29).

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

Table 21. M*n* Commands

Command	Function
`M0`	Speaker always off.
`M1`	Speaker on until the call is up (*default*).
`M2`	Speaker always on.
`M3`	As `M1` (on other modems: not while dialing).

&J*n* — Auxiliary Relay

Accepted, changing nothing: there is no relay.

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

&L*n* — Leased Line

This command sets whether the line is a dialled one or a leased pair or circuit, with no exchange: no dial tone, ringing or hook (S47). On a leased line ATD (any number, or none) calls at once, listening only for the answer tone; ATA answers; with S0 above 0 the modem answers by itself, with no ring, whenever it is idle. A call the line ends (NO CARRIER) starts again by itself 2 s later, dialled or answered as before; ATH, DTR, ATZ or &L0 stop that until the next command line.

Every voice band modulation of +MS runs on &L1. On &L2 the 4-wire modulations (+MS=V29, V33, V27TC) run as duplex pumps on a continuous carrier, each end starting at once with its own synchronizing signal; the others run as on &L1. With S48=1, on a call with no error correction, the modem does V.13's simulated carrier control: between the DTE's bursts of data the line carries V.13's idle pattern, which the far end treats as carrier detect OFF, and each burst turns it ON again. A line at 48000 Hz and more (dmodemd's -r 96000) is always leased: its mode is +MS=VWB, and its start-up and retrains take S7 seconds at most.

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

Table 22. &L*n* Commands

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

+GCI — Country of Installation

This command sets the country by 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. dmodemd's -c option names the country it starts with (-countrylist lists them): one of the table's, or any of the 192 of the ITU's list of the tones of national networks (after E.180), by its name there in capitals or the table's (-c FIJI, -c UNITED_KINGDOM: UK). The table's countries have their own dialling settings; the others the USA's (ATI7: Country: FIJI (USA line)), and all of them their own busy and congestion tones. ATZ keeps 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 the modulation the modem calls or answers with, whether it may fall back (*automode* 1, as N1; S31), and the rates it may connect at, *min* to *max* bit/s. *mod* is a number or V.250's name for it, in either case (AT+MS=V34 is AT+MS=34). A parameter left out keeps its value: AT+MS=,0 only turns automode off. In V.34, *max* caps both directions' rates (sent in its MP sequences).

Syntax:

- +MS=[*mod*][,[*automode*][,[*min*][,[*max*]]]]
- +MS? (gives 92,1,300,56000; 200,1,300,56000 at 48000 Hz and 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 the program has)

Result code	When
OK	Always.
ERROR	For a modulation the modem has not, *automode* over 1, *min* over *max*, or a rate outside 300 to 56000.

Table 23. +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.
212	B212, BELL212A	Bell 212A	1200 bit/s DPSK.
122	V22B	ITU V.22bis	2400 bit/s, 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 (AT&T's; D-Modem's number).

Table 23. +MS Modulations *(continued)*

mod	**Name**	**Standard**	**Description**
168	`HST`	USRobotics HST	4800 to 16800 bit/s one way, 300 bit/s back, the channels turning with the data; a Courier's start-up at 2400 bit/s (`V.22bis` and `V.42`), and `HST`'s own link layer (D-Modem's number).
128	`VFC`	Rockwell `V.FC`	14400 to 28800 bit/s: `V.34`'s start-up, then `V.FC`'s data mode when both ends ask for it, else `V.34` (D-Modem's number).
61	`V61`	`ITU V.61`	4800 bit/s with speech, 4800 to 14400 bit/s without (`+ASVD`; D-Modem's number).
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 (Hypercom's; D-Modem's number).
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 cancelling (D-Modem's number).
226	`V26B`, `V26BIS`	`ITU V.26bis`	2400 or 1200 bit/s `DPSK` from the answering side, 75 bit/s `FSK` back (D-Modem's number).
201	`B201`, `BELL201`	Bell 201	2400 bit/s `DPSK` (`V.26`'s alternative B), 4-wire leased.

Table 23. +MS Modulations *(continued)*

mod	**Name**	**Standard**	**Description**
202	B202, BELL202	Bell 202	1200 bit/s FSK both ways, 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	As the digital modem, after V.8.
91	V91	ITU V.91	Two digital modems, after V.8.
92	V92	ITU V.92	V.90 with quick connect, PCM upstream and modem-on-hold (*default*).
56	K56	K56flex	Not implemented: runs V.90.
150	VCVM	V.cvm	Data over 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 and more, up to 148656 bit/s each way.
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 (Telebit's number, as its S50=255).
64	CLEAR	Clear channel	64000 bit/s on a clear digital channel (an ISDN data call), no modulation (+B2).
18	V18	ITU V.18	Text telephone automoding (Section 15).
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).

Table 23. +MS Modulations *(continued)*

mod	**Name**	**Standard**	**Description**
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 answerer is the receiver, the caller the panel (Section 16).
12	SMS	ETSI ES 201 912	Fixed-line text messages: the answerer receives, the caller sends (Section 17).

The 4-Wire Modulations. V.29, V.33, V.27ter, V.26 and Bell 201, 202 and 208 are the 4-wire leased line modulations (&L2): each end sends on its own pair, on a carrier that stays on. V.26 and Bell 201 send their data unscrambled, as those modems do, with the phase changes of V.26's alternative A or B; Bell 208 sends V.27ter's 4800 bit/s signal, the modulation V.27 took from it; Bell 202 is 1200 Hz mark and 2200 Hz space at 1200 bit/s each way. The DPSK ones start with V.27ter's training as their synchronizing signal, which another D-Modem needs: an old modem of these kinds that sends none is not found. *max* sets the rate each end sends at, *min* the lowest it comes down to: a receiver finds the far end's rate by itself, an end faster than the far end comes down to its rate, and one that loses its equalization twice in 20 s at its own rate drops to the next rate down. A receiver that loses its equalization sends its synchronizing signal again and gets the far end's back (V.29 10, V.33 9).

Point of Sale. Card terminals and vending machines that dial their host use two short start-ups that no Recommendation describes, so that a transaction of a few hundred octets takes a few seconds rather than ten. *Fast connect* (S49=1) shortens V.22's, Bell 212A's and V.22bis's handshake: the answering modem sends a short answer tone (S50, 400 ms by default), the calling modem answers it at once with its scrambled ones (with V.22bis, its S1 as soon as it hears the unscrambled ones), and each side starts the data 150 ms after 50 ms of the other's. It comes up in about 0.9 s from the answer (V.22bis, 1.4 s) rather than 5. S49=3 sends HDLC flags, scrambled, in place of the scrambled ones at 1200 bit/s, which some hosts want; either kind is taken 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 one a 2225 Hz answer tone (S50), and both report `CONNECT`; from then

on whichever side's DTE has data sends it in a burst, the V.29 training first, while the other listens, and the turn passes 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: both ends need the same *max*. Both kinds are made for synchronous DTEs, through V.80's framed sub-mode (+ES=6,,8, with the FCS: +ESA=0,0,0,,1) or with \N0 and the DTE's own framing. Both ends need the same setting; such a call with a modem that has the normal handshake comes up late or not at all. See docs/dsp/fastpos.md.

V.90, V.91 and V.92. V.90 and V.92 are there as the *digital* modem (the server's side, as on a G.711 VoIP line), on an 8000 Hz G.711 line: analogue V.90 and V.92 modems calling connect at up to 56000 bit/s downstream. 90 and 92 offer V.91 too, which two digital modems use instead, and V.34 for the others; on a line at another sample rate they are V.34. With automode V.8 and the V.34 modem hand over to V.32bis (and its V.22bis and V.22) for a modem without V.34, and the answering modem tries V.23 and Bell 103 for one without V.8.

On an Analogue Line. On an analogue telephone line (dmodemd's -a and -usb) the modem is the call's analogue end instead: V.90 and V.92 run as the analogue modem against a V.90 or V.92 server (at 9600 Hz; see docs/hardware.md), and V.91 and CLEAR, which need a digital line, run as V.34.

V.cvm. VCVM is the proposed Recommendation of docs/v_cvm.pdf, for calls whose speech path is a mobile codec's (AMR, AMR-WB), which carry neither V.34 nor V.32: V.8 with V.22 and V.21 as the fallback, then a probing of the codec and a mode loaded for it. The start-up takes 15 to 21 s; S7 should allow for it. The connection runs LAPM. V_CVM, its old name, is still accepted.

V.wb. VWB is D-Modem's own mode for a dry copper pair between two of its modems (pico-serial's WB stick, a codec at 96 kHz): discrete multitone, the caller on the lower tones and the answerer on the upper, each tone loaded from its measured SNR; see docs/dsp/vwb.md. It runs at 48000 Hz and more only, where it is the only mode and the *default* (ATZ sets it again there), as a leased line (&L1); the rates of +MS do not limit it.

Clear Channel. CLEAR is a clear 64 kbit/s digital channel, such as an ISDN B-channel's data call (a SIP call in CLEARMODE, RFC 4040, or a PBX's call with an unrestricted digital bearer): no modulation, each of the channel's octets 8 bits of the

link's, `CONNECT 64000` both ways. It starts at once on `ATD` and `ATA`, with no call progress and no answer tone. Each octet's first bit is its most significant (`I.460`, `RFC 4040`). A line that says its call is clear (`dmodemd`'s `SIP` for a CLEARMODE call, `app_dmodem` for an `ISDN` data call) runs it whatever `+MS` says. What runs on the channel is `+B2`'s, `X.75` by *default*, or `V.110`'s rate adaption with `+CBST`. See `docs/isdn.md`.

+A8E — V.8 and V.8 bis Controls

`V.251`'s controls of `V.8` and `V.8 bis`. *v8o* and *v8a* are 1: the modem runs `V.8` itself on calls and answers (`+MS` decides whether it does). *v8cf* is 0: no call function of the `DTE`'s. *v8b* 1 starts a data call with `V.8 bis`: answering, the modem sends MRe before its answer tone and, with a caller that answers it, agrees on the data mode with it (CL, MS, ACK), then goes on with `V.8`; calling, it answers the other modem's MRe the same way. A caller without `V.8 bis` is answered with `V.8` after 3 s. Only for the modulations that start with `V.8` (`V.34`, `V.90`, `V.91`, `V.92`, `V.cvm`), not on a leased line or a clear channel. See `docs/dsp/v8bis.md`.

Syntax:

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

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

`V.251`'s *default v8b* is 1; D-Modem's is 0, since answering with `V.8 bis` keeps a caller without it waiting about 3.5 s.

+DSVD — Voice and Data Together

D-Modem's own: *on* 1 offers V.70's digital simultaneous voice and data (DSVD) in V.8 bis (+A8E's *v8b* 1), and chooses it when the other modem offers it too. The call then goes on with V.8 and its modulation, and the link is V.76's multiplexer: the DTE's data goes on its data channel, opened with V.75's messages, with error correction and no compression. The protocol is then V.76 (ATI11, the Protocol: report). Where the modem has a voice path (a SmartUSB56's handset, or dmodemd's -dsvd-audio command), a voice channel opens beside the data, the speech coded with G.729 Annex A, and silence with Annex B (comfort noise, the line left to the data) when both ends send V.75's audio header. Without DSVD at the other end the call is an ordinary data call. See 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

D-Modem's own: *on* 1 offers V.61's analogue simultaneous voice and data (ASVD) in V.8 bis (+A8E's *v8b* 1), and chooses it when the other modem offers it too. The call then goes on with V.61's own start-up instead of V.8: one carrier of 3000 (or 2800) symbols a second carries 4800 bit/s of data with the speech around it, and data alone at up to 14400 bit/s while neither end speaks. The DTE's data has V.42's error correction as on any call. The speech comes from and goes to the same voice path as +DSVD's (a SmartUSB56's handset, or dmodemd's `-dsvd-audio` command); without one every frame is data alone. When both ends offer +DSVD as well, DSVD is chosen. Without ASVD at the other end the call is an ordinary data call. AT+MS=V61 runs V.61 without V.8 bis. See `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.

Bn — Communication Standard Setting

ATB with no number sets V.22 at 1200 bit/s only, without automode: the same as AT+MS=22,0,1200,1200. Other modems use B0 to B3, B15 and B16 to choose between the ITU and the Bell modulation at 1200 and 300 bit/s. The modem accepts them and changes nothing: the call's negotiation and +MS choose.

Result code	When
OK	If *n* is left out, or *n* = 0–3, 15 or 16.
ERROR	Otherwise.

Table 24. 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: V.23's reverse channel).
B15, B16	Accepted (other modems: V.21 or Bell 103 at 300 bit/s).

Nn — Automode

This command sets whether the modems may find their best common modulation from the one +MS chose down (S31). It is the same as +MS's second parameter.

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

Table 25. N*n* Commands

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

`Cn` — Carrier Control

The modem accepts `C1` so that software that sends it works. It does not have `C0`, which on some other modems sends no carrier (receive only).

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

Table 26. C*n* Commands

Command	Function
C0	Carrier always off (not supported).
C1	Normal carrier switching (*default*).

`&Bn` — V.32 Auto Retrain

Other modems use `&B` for `V.32`'s retrain (USRobotics': the `DTE`'s rate fixed). The modem accepts it and changes nothing: its modulations retrain by themselves.

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

`&Gn` — V.22bis Guard Tone

Accepted, changing nothing: the modem sends no guard tone.

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

`&Nn` — Line Rate

USRobotics' choice of the line's rate: accepted, changing nothing. `+MS` sets the rates.

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

7.1 V.cvm

+CVM — V.cvm Settings

For +MS=VCVM: *modes*, the modes allowed, a sum of the values below; *rate*, the signal interface's rate, 8000 or 16000; *report*, 0 or 1, asks for +CVMR on each renegotiation. D-Modem keeps *rate* and *report* but works at 8000 Hz only, without the wideband modes, and sends no +CVMR. During and after a V.cvm call, +CVM? gives a second line with that call's figures: +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 call's CONNECT has its coded receive rate and /CVM: CONNECT 1200/CVM, with \V1 CONNECT 1200/CVM/LAPM. S44 and S45 hold the tones loaded and the 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 27. +CVM Modes

Value	Mode
1	The robust mode.
2	Narrowband.
4	Wideband (not supported).
8	8-DPSK.
16	The amplitude rings.
32	The parametric mode.
63	All of them (*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 V.92's call waiting: none is detected here. +PIG (0 or 1, *default* 1) is V.92's PCM upstream, an analogue modem's setting. Kept.

+PMH — Modem-on-Hold Enable

This command sets whether the other modem may 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 28. +PMH Values

Value	Meaning
0	The other modem may put the call on hold (*default*).
1	It may not.

+PMHT — Modem-on-Hold Timer

How long a hold the modem grants: the code of V.92's Table 33, 0 to 13; 0 grants none.

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 other modem to go on hold for *s* seconds (1 to 960; 10 if left out).

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

V.250's error control selection: what the modem tries first as the originator (*orig*), what may follow when that fails (*orig_fb*), and what it accepts as the answerer (*ans_fb*). \N sets it, and it sets S103 to the \N with its values (as it was if none has them). V.80's Synchronous Mode and Frame Tunnelling Mode (5 and 7, 7 and 9) are not there.

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 29. +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	V.80's Synchronous Access Mode (Section 8.1).
orig_fb	0, 1	None (*default* 0).
	2	V.42 or MNP, or hang up.
	3	V.42 only.
	4	MNP only (and first).
ans_fb	0, 1	No error correction.
	2, 3	V.42, MNP or none (*default* 2).
	4	V.42 or MNP, or hang up.
	5	V.42 only.
	6	MNP only.
	8	V.80's Synchronous Access Mode.

&Q*n* — Error Control Mode

Other modems' choice of error correction, as \N. &Q alone is &Q0. The synchronous modes are not there.

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

Table 30. &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 Rockwell's modems have it. Each value sets +ES to V.250's equal. ATS103=*n* is \N*n*.

V.42's detection phase decides between LAPM and none. The originator sends MNP's LR when the answerer sends no V.42 answer, and the answerer treats an LR (from a modem with MNP only, or one set so) as the start of MNP. With MNP only the originator starts with its LR. MNP 5 compression goes with MNP (%C); MNP's block size is \A's.

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

Table 31. \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, else hang up.	3,2,4
\N3	Auto-reliable: V.42, MNP, or none (*default*).	3,0,2
\N4	V.42 (LAPM) only, else hang up.	3,3,5
\N5	MNP only, else hang up.	4,4,6

&Mn — Asynchronous Communications Mode

Accepted, changing nothing (other modems: asynchronous mode; USRobotics': error correction, here \N).

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

\A*n* — MNP Block Size

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

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

Table 32. \A*n* Commands

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

-SEC — MNP 10EC

Rockwell's MNP 10EC, and its transmit level (1,12): kept, *default* 0. -SEC? gives the values alone, without the name; =? gives (0,1),(0-30).

-C, -K, -Q,)M, @M, *H — Rockwell's MNP 10

Rockwell's MNP 10 and 10EC (cellular): the calling tone, MNP Extended Services, the V.22bis fallback, power levels and the link's speed. The modem has no MNP 10: it accepts them, changing nothing. A modem with MNP 10EC connects with V.42.

Result code	When
OK	For -C0, -C1, -K0 to -K2, -Q0, -Q1,)M0 to)M2, @M0 to @M30, *H0 to *H2.
ERROR	Otherwise.

8.1 V.80 Synchronous Access

With +ES=6 (calling) or +ES=„8 (answering) the call has no error correction or compression: after CONNECT the modem moves the DTE's octets as a synchronous bit stream, with V.80's in-band commands after EM (19h) both ways (Table 9/V.80).

It starts in the *transparent* sub-mode: the DTE's octets go out as they are, least significant bit first, and the line's bits come back as octets; when the DTE has nothing the modem sends *syn1* and tells it <EM><under>. With +ESA's *trans_idle* 1 or 2 the receiver first hunts for the SYN, and gives the DTE nothing before it. <EM><flag> from the DTE starts the *framed* sub-mode: HDLC frames, each ended by the DTE's <EM><flag>, the modem adding the zero insertion, the flags and the FCS. It gives back each received frame's octets (without the FCS it checked) and <EM><flag> for a good one or <EM><err> for a bad one, an <EM><err> when its hunt finds a flag, and <EM><mark> for an abort or marks. <EM><mark> from the DTE goes back to transparent. EM and 99h in the data are shielded both ways (<EM><t1>, <EM><t2>; DC1 and DC3 too with DC1/DC3 flow control, +IFC); from the DTE all the codes T1 to T20 are accepted. V.34's half duplex is not there.

Table 33. V.80 In-Band Commands

Command	From	Meaning
<EM><ecs>	DTE	Online command state (instead of +++, which is data); the modem answers <EM><ecs>, then OK; ATO goes back.
<EM><eot>	DTE	Hang up: <EM><eot>, then NO CARRIER.
<EM><rate><tx><rx>	DTE	The highest rates to send and to receive at (+MS's *max*), for the next retrain or renegotiation (AT+MS sets both again).
<EM><hunt>	DTE	Restart the receiver's hunt (framed, or transparent with *trans_idle* 1 or 2); what waits for the DTE is dropped.
<EM><resume>	DTE	Go on after an underrun (+ESA's *framed_un_ov*).
<EM><rtn>, <EM><rrn>	DTE	Retrain, or renegotiate the rate, as ATO1 and ATO3.
<EM><eot>	Modem	The remote's carrier is gone (before NO CARRIER).
<EM><rtn>, <EM><rrn>	Modem	A retrain or renegotiation but the DTE's own (the remote's, or the modem's after a loss of signal).
<EM><rate><tx><rx>	Modem	The rates, after each of those, or when they change in the call.
<EM><rover>	Modem	Received octets were lost (the DTE read nothing for 2048 octets).

Table 33. V.80 In-Band Commands *(continued)*

Command	From	Meaning
<EM><tover>	Modem	The DTE's octets were lost (the buffer full).
<EM><under>	Modem	The DTE ran out of data.
<EM><bnum>	Modem	The transmit buffer's count, with +ITF.

+ESA — Synchronous Access Mode Settings

The Synchronous Access Mode's eight settings, each left out as it is.

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 34. +ESA Parameters

Parameter	Value	Meaning
trans_idle	0	*syn1* sent when the DTE has nothing; the receiver's octets as they come (*default*).
	1	The same, but the receiver hunts for *syn1*.
	2	*syn1* and *syn2* sent in turn; the receiver hunts for the two (*syn1* first). Each hunt gives the DTE the octets from the SYN on, aligned on it.
framed_idle	0	Flags between frames (*default*).
	1	Marks between frames.
framed_un_ov	0	The DTE runs out in a frame: an abort (*default*).
	1	A flag (no FCS). Either way the DTE's octets are then dropped until its <EM><resume>, which <EM><unum> and their count answer (both: <EM><under>).
hd_auto	0	Only 0.
crc_type	0	No FCS (*default*).

Table 34. +ESA Parameters *(continued)*

Parameter	Value	Meaning
	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

The Synchronous Access Mode's transmit buffer: the DTE's octets in it, EM codes included, stop being accepted above *off*; *on* is kept. With *report_period* not 0 the modem gives <EM><bnum> with their number 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 *off* not above *on*.

9 Data Compression

&K*n* — Data Compression

&K0 to &K3 set data compression as on USRobotics' modems, the same as %C (S104). Rockwell's and Conexant's modems use &K for flow control: their &K4 to &K6 are accepted with no effect, and their &K3 (RTS/CTS) leaves V.42's compression on.

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

Table 35. &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 (other modems' flow control).

%C*n* — Data Compression Control

This command sets data compression (S104). It needs error correction (\N). V.42 offers V.44 and V.42bis both, and the other modem chooses; +DS, +DS44 and +DSZ set them in detail. &K sets the same.

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

Table 36. %C*n* Commands

Command	Function
%C0	No compression.
%C1	MNP 5 (with MNP).
%C2	V.44 or V.42bis (with V.42's LAPM).
%C3	Either, as the call's error correction has it (*default*).

+DS — V.42bis Data Compression

V.42bis (V.250 6.6.1), within %C's compression.

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 37. +DS Parameters

Parameter	Values	Meaning
direction	0-3	The DTE's directions: 0 none, 1 what it sends, 2 what it receives, 3 both (*default*).
neg	0, 1	1: hang up (NO CARRIER) when the link comes up without compression in those directions. *Default* 0.
dict	512-65535	The largest dictionary V.42's XID offers; at most 2048, the *default*.
string	6-250	The longest string offered; at most 34, the *default*.

+DS44 — V.44 Data Compression

V.44 (V.250 6.6.2), set the same way. AT+DS=0 with AT+DS44=3 offers V.44 alone, AT+DS44=0 V.42bis alone (and zstd, unless +DSZ=0), both 0 no compression, as AT%C0. zstd has the directions either has.

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 38. +DS44 Parameters

Parameter	Values	Meaning
direction	0-3	As +DS's (*default* 3).
neg	0, 1	1: hang up when the link comes up without V.44, or zstd in its place, in those directions.
capability	0, 1	Kept: the stream method is used whatever it says.
codewords tx, rx	256-65535	The largest codewords, each way; at most 4096.
strings tx, rx	32-255	The longest strings; at most 255.
history tx, rx	512-65535	The history, each way; at most 12288.

Of each pair the smaller is used both ways.

+DSZ — zstd Data Compression

D-Modem's own: *on* 1 offers zstd (Zstandard, `docs/v_cvm.pdf`'s Annex F) in `V.42`'s `XID`, beside `V.42bis` and `V.44`, whenever compression is on (`%C`); *dict* 1 offers it with `V.cvm`'s dictionary. A call has zstd only when the other modem offers it too (another D-Modem): `CONNECT` then ends in `/ZSTD`, and the compression result is `ZSTD` (70 with `V0`); other modems go on with `V.44` or `V.42bis`. `0` offers `V.44` and `V.42bis` alone.

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.

10 DTE Interface and Flow Control

+IFC, +ICF, +IPR — DTE Interface

+IFC is the flow control each way (DC1/DC3 in V.80's Synchronous Access Mode, Section 8.1), +ICF the DTE's character framing, +IPR the DTE's rate (0 automatic).

Table 39. 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. Flow control is the pty's, so it changes nothing but what #UD reports.

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

Table 40. &H*n* Commands

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

&I*n* — XON/XOFF Flow Control

USRobotics' software flow control: accepted, changing nothing.

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

\Q*n* — Flow Control

Accepted, changing nothing: flow control is the pty's.

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

\G*n* — XON/XOFF Pass Through

Accepted, changing 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. It changes nothing: a pty has no carrier line.

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

Table 41. &C*n* Commands

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

&Dn , &Fn , &Rn , &Sn — DTR, Factory Defaults, RTS, DSR

The modem accepts these, with or without a digit, and does nothing: ATZ gives the *defaults*, and dmodemd hangs up when the DTE drops DTR whatever &D says (Section 19).

Result code	When
OK	Always.

Fn — On-Line Data Character Echo

The modem accepts F1 so that software that sends it works. Other modems' F0 echoes the data online; this modem never does.

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

\Jn — Rate Adjust

Other modems' DTE rate following the line's: accepted, changing nothing.

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

\Kn — Break Control

What a break does on other modems: accepted, changing nothing.

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

\R*n* — Ring Indicator After Answer

Accepted, changing nothing.

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

\T*n* — Inactivity Timer

Accepted, changing nothing.

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

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

The DTE's rate reported, DSR, long space disconnect: kept. Each 0 or 1, *default* 0.

11 ISDN and Cellular

+B2 — B-Channel Protocol

D-Modem's own, with CAPI 2.0's numbers for layer 2: what runs on a clear 64 kbit/s channel (+MS=CLEAR, or a line that says its call is clear); other modes do not look at 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 42. +B2 Values

Value	Protocol
0	X.75 (LAPB in HDLC, basic mode, a window of 7, the caller at address B), the protocol of ISDN terminal adapters, BBSes and mailers: the DTE's characters 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 speaks PPP's asynchronous framing (RFC 1662, as pppd does on a serial port), each frame goes to the line in HDLC with its escapes undone and comes back escaped; /PPP with \V1.
7	The modem's link (V.42, MNP or plain characters, as \N says), for the clear channel of an earlier D-Modem.
9	V.120 (Q.921's frames for logical link 256 in extended mode, each I frame's information after V.120's header octet 0x83), the protocol of North American terminal adapters; /V.120 with \V1.

+CBST — Bearer Service Type (V.110)

27.007's bearer service: V.110's rate adaption on a clear channel (+MS=CLEAR). *name* 0 (the *default*) is asynchronous: the DTE's characters through the modem's link (\N) whatever +B2 says; 1 is synchronous: +B2's protocol in HDLC at the user rate. *ce* has no use here. CONNECT gives the user rate (with \V1 and no V.42, /V.110). &V lists it. See 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 43. +CBST Speeds

Value	User rate
0	None (*default*): an answerer adopts the rate of the caller's frames (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 an octet, no frames).

+CRC — Cellular Result Codes

27.007's: with 1, each ring of a call is +CRING: SYNC for a call on a clear 64 kbit/s channel (an ISDN data call: SIP's CLEARMODE, a PBX's digital bearer, an mISDN card's unrestricted digital call) and +CRING: VOICE for any other, instead of RING (in words whatever V says). A program that answers by itself (dmodem-capid, CAPI on a D-Modem) tells the two apart by it. &V lists it.

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

Each command line is answered with a result code, as a word (V1) or a number (V0), each on a line of its own; Q1 turns them off.

Table 44. Result Codes

Result code	Number	Description
OK	0	The command line ran.
CONNECT	1	The call is up (X0, fax and voice), or a fax command's data begins.
CONNECT *rate*	Below	A data call is up at *rate*.
RING	2	A call rings (dmodemd: every 3 s, Section 20).
NO CARRIER	3	No call came up, or the call is over.
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 within S7 seconds of dialing.
FAX	88	Adaptive answer (+FAA=1): a fax call; Class 1 follows.
DATA	89	Adaptive answer: a data call; its CONNECT follows.

A data call's CONNECT gives the rate the modem receives at, in bit/s (CONNECT 33600), and with V0 that rate's number (23). With X0, in fax and in voice mode it is CONNECT (1) alone. \V1 adds the error correction and the compression (CONNECT 33600/LAPM/V42bis), and &A adds lines on the connection before it. A PEP call's is CONNECT FAST, as a Telebit's, and its number is that of the rate it receives at. Each rate's number is in the table below; a rate not in it is 1.

Table 45. 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

Table 45. CONNECT Rates and Their Numbers *(continued)*

Rate	n	Rate	n	Rate	n	Rate	n
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 hold the modem's settings, 8 bits each. `ATS` reads and sets them: `ATS`*n*`?` gives register *n*'s value, `ATS`*n*`=`*v* sets it. Registers 0 to 255 are there; those not listed are 0 and free, kept as written. "Kept" below means set and read back, with no other effect.

Table 46. S-Register Summary

Reg.	Description	Range	Unit	Default
S0	Rings to answer after.	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 come up.	0–255	s	60
S8	Comma's pause.	0–255	s	2
S9	Carrier detect time (kept).	0–255	0.1 s	6
S10	Carrier loss before hanging up.	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 23	–	92
S39	Line quality (kept).	0–2	–	0
S44	V.cvm: tones loaded (read only).	0–255	tones	0

Table 46. S-Register Summary *(continued)*

Reg.	Description	Range	Unit	Default
S45	`V.cvm`: renegotiations (read only).	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
S161	Y (kept).	0–3	–	0

13.1 S-Register Definitions

The range given is what the register means; ATS accepts any value from 0 to 255 for any register but S44 and S45, which are read only. ATZ sets the registers to their *defaults*, but for S18, S28, S47, S48 and S161, which keep their values.

S0—Auto-Answer Ring Number

The number of rings the modem counts before it answers a call by itself. 0 disables auto-answer: the modem then answers only with ATA. On a leased line (&L) a value above 0 makes the modem answer, with no ring, whenever it is idle.

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

S1—Ring Counter

The rings counted so far: S0 compares it with its own value.

- 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 ends at it as well.

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

S5—Command Line Editing Character

The backspace: it erases the last character typed. With echo on, the modem echoes it, a space and the backspace again.

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

S6—Wait Time for Dial Tone

With `X2` or `X4`, how long the modem waits for a dial tone before `NO DIALTONE`: 2 s at least whatever the value, and 2 s more while a dial tone in a cadence is heard.

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

S7—Connection Completion Time-Out

How long the modem waits for the call to come up after dialing or answering: the answer and the training. The dial string's `W` and `@` wait this long too, and voice mode's `+VRN` no longer. `V.cvm`'s start-up takes 15 to 21 s, so S7 should allow for it.

- 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 by themselves.

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

S10—Automatic Disconnect Delay

How long the carrier may be gone before the modem hangs up with `NO CARRIER`.

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

S11—`DTMF` Dialing Speed

The length of each `DTMF` digit dialed, and of the gap after it. A value below 40 dials at 95.

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

S12—Escape Guard Time

Kept: the escape's guard time is always 0.5 s.

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

S13—Echo

`E`'s setting.

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

S14—Quiet

`Q`'s setting.

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

S15—Verbose

`V`'s setting.

- 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 many seconds; 0, never. `ATZ` keeps 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

`&P`'s setting, kept: the country's table sets the pulse times. `ATZ` keeps it.

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

S29—Speaker Control

`M`'s setting.

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

S30—Speaker Volume

`L`'s setting.

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

S31—Automode

`N`'s setting, and `+MS`'s second parameter.

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

S32—Modulation

`+MS`'s modulation, by its number (Table 23).

- Range: the numbers of Table 23
- *Default*: 92 (200 at 48000 Hz and more)
- Units: none

S39—Line Quality Monitor

`%E`'s setting, kept.

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

S44—V.cvm Tones Loaded

The tones 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 renegotiations of the last `V.cvm` call. Read only.

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

S47—Leased Line

`&L`'s setting: 0 a dialled line, 1 a 2-wire leased line, 2 a 4-wire one. `ATZ` keeps it.

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

S48—Simulated Carrier Control

1: `V.13`'s simulated carrier control on a leased line, on a call with no error correction (`&L`). `ATZ` keeps 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 sent for the scrambled ones at 1200 bit/s (Section 7). 0: the Recommendations' handshakes.

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

S50—Fast Answer Tone

The answer tone's length when S49 is set, and `V.29` FastPOS's; 0 is 400 ms.

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

S56—Result Code Set

`X`'s setting.

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

S60—Data Carrier Detect

`&C`'s setting, kept.

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

S62—Flow Control

`&H`'s setting, kept.

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

S70—Connection Lines

`&A`'s setting.

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

S71—Rate in CONNECT

`&E`'s setting, kept.

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

S92—Answer Delay

How long the modem waits after going off hook to answer before its answer tone; 0 waits 10 ms. Elsewhere S92 is a fax transmit level: `ATS92=10` here makes the modem wait 10 s.

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

S103—Error Correction

`\N`'s setting; setting the register is `\N`.

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

S104—Data Compression

`%C`'s setting, and `&K`'s.

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

S105—`MNP` Block Size

`\A`'s setting.

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

S106—Protocol in CONNECT

`\V`'s setting.

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

S161—Long Space Disconnect

`Y`'s setting, kept. `ATZ` keeps it.

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

14 Fax Commands

With AT+FCLASS=1, the modem accepts T.31's Class 1 commands, the fax machine's side being the DTE's (the PBX modules and libdmodem have a T.30 engine of their own as well). As the caller, the modem sends CNG after dialing until the answerer's flags come in its first +FRH=3 (T.30 has it until the DIS).

+FCLASS — Service Class

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

Syntax:

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

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

Table 47. +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).
8	Voice (V.253, Section 18).

+FAA — Adaptive Answer

With +FAA=1, a call the modem answers (ATA, S0) in data or fax mode is answered as a data call (its answer tone, V.8's ANSam, serves a fax machine as its CED), and found out to be a fax machine's or a data modem's:

- a fax call by the caller's CNG (1100 Hz, 0.5 s of every 3.5 s; or a burst cut short as the answer tone starts, a fax machine that stops its CNG on hearing it), the V.8 CM of a fax call (a call function of facsimile, as V.34 fax machines and some Class 1 modems send it on ANSam), the far end going over to T.38 (dmodemd's SIP calls), or a caller silent through every answer signal of the automode chain (ANSam, then V.32's, V.22's, V.21's, V.23's and Bell 103's, some 20 s, within T.30's T1 of 35 s): FAX, +FCLASS becomes 1, and the modem goes on as a Class 1 answerer: what is left of CED's 3 s, then CONNECT, as after AT+FTH=3, for the DTE's first frames;
- a data call by its modem's handshake: DATA when it comes up, then its CONNECT; +FCLASS becomes 0.

A call that ends with neither leaves +FCLASS as it was. A V.22, V.21 or Bell 103 caller, silent until it hears its own answer signal, answers its stage of the chain: DATA. In voice mode see Section 18: a calling tone on the call switches it to fax or data. Rockwell's modems give FAX and DATA too, as 33 and 35 with V0: here those are rates' CONNECTs, so 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 48. +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 any mode.

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 it is done.
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, ended by <DLE><ETX>.

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.
ERROR	Outside fax mode, or for a modulation the modem has not.

Table 49. +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), the only modulation for them.

Syntax:

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

Result code	When
CONNECT	Then OK or ERROR after each frame.
ERROR	Outside fax mode.

+FPR — Fax DTE Rate

The fax DTE's rate: kept, with 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) instead of CNG or CED, as fax software such as HylaFAX expects with AT+F34. When both ends have it, the modem gives +F34:*p*,*c* (the primary channel's rate in 2400 bit/s, the control channel's: 1 for 1200 bit/s), then CONNECT, and from then on the call is T.31's V.34 data mode, with no more commands:

- the DTE's frames, without their FCS, each ended by <DLE><ETX>, and the modem's, with their FCS, the same way;
- <DLE><0x6B> from the DTE (the sender) asks for the primary channel; the modem gives <DLE><0x6B><DLE><r> when it is up (*r* = 0x6F + the rate in 2400 bit/s), at either end, and the ECM block's frames follow;
- <DLE><0x6D> from the DTE ends the block; the modem gives <DLE><0x6D><DLE><0x6E> when the control channel (1200 bit/s) is back, at either end;
- <DLE><EOT> from the DTE ends the call (OK); the modem gives it when the line goes (NO CARRIER).

With a fax machine that has no V.8, the call goes on as Class 1: the caller's first CONNECT is for the answerer's frames, as after +FRH=3; the answerer's is for its own, as after +FTH=3 (its ANSam was the CED). V.34 fax needs ECM, and the modem does not poll on it. Not on T.38, nor 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 50. +F34 Values

Value	Meaning
maxp	The primary channel's highest rate, in 2400 bit/s (14: 33600, *default*); 0: no V.34, Class 1 as before.

Table 50. +F34 Values *(continued)*

Value	Meaning
minp	Its lowest (1: 2400, *default*).
prefc	The control channel's rate wanted (0 any, *default*; 1 1200; 2 2400): kept, the modem's is 1200.
maxp2, *minp2*	For the other direction: kept.

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 runs T.30 itself: the DTE sends and receives the pages in T.4 MH with EOLs, <DLE> doubled, ended by <DLE><ETX>, and steers the call with the commands below. Class 2 has the older names: +FLID, +FDCC, +FDIS, +FDCS, +FBOR, +FK, +FPTS and +FHNG (either name works in either class), and its reports say +FCON, +FCSI, +FTSI, +FDIS, +FDCS, +FPTS and +FHNG. The rates are V.17, V.29 and V.27ter's; error correction mode, when +FIS has it, is the modem's own (the DTE's data is the same). The pages are MH whatever the remote uses (MR or ECM: the modem codes them again), A4 width. A call goes over to T.38 as a Class 1 call does (the same commands and results). +FAA (adaptive answer) is Class 1's, and Class 1's +FTH, +FRH, +FTM, +FRM, +FTS and +FRS are ERROR in Class 2 mode.

Example session: sending two pages, then receiving 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 sending `CONNECT`. `+FDR`'s page waits for the `DTE`'s <DC2> (a second at most); the pages are accepted and confirmed as they come, and wait for `+FDR`. When the call ends, the modem reports the hangup status and the result of the command then under way (`NO CARRIER` for `ATD` and `ATA`), and goes on hook.

Table 51. +FHS Hangup Status

Value	Meaning
00	The call was done.
02	+FKS ended it.
11	No fax machine answered.
2x	Sending, phase B (the DIS, the training).
4x, 5x	Sending a page, or the post-page exchange.
7x, 9x	Receiving.

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

+FLI, +FPI — Local ID, Polling ID

Our identity in TSI and CSI (+FLI, Class 2's +FLID) and in CIG when we poll (+FPI, Class 2's +FCIG; empty: +FLI's): up to 20 printable characters, the blanks in the quotes kept.

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.

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

+FLP=1 (Class 2's +FSPL): we have a document to be polled; the DIS says so, and a caller's DTC has ATA report +FCO, +FPI:"*cig*" and +FTC:*dtc* (Class 2: +FCIG, +FDTC) and OK, for +FDT to send it. +FSP=1: we poll; after a DIS that offers a document (ATD reports +FPO, Class 2 +FPOLL), +FDR sends the CIG and DTC and receives as the answerer 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 caller's +FDR is ERROR without +FSP=1.

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

The capabilities (+FCC, Class 2's +FDCC, which sets +FIS as well) and the session's (+FIS, Class 2's +FDIS, read again at each +FDT). +FCS? gives the last session's. At the start 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),(0-2),(0),(0-2),(0),(0-7))

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

Table 52. +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: V.34 half-duplex (T.30 Annex F) as well, 16800 to 33600 bit/s, with error correction mode only: V.8 offers it at the start of the call, and a remote without it has V.17 and the rest. A caller that polls sets +FSP=1 before dialling, for V.8 to say so. +FCS then gives the V.34 rate.
ec	0 none, 1 or 2 error correction mode.
others	Taken in their ranges.

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

+FBO (Class 2's +FBOR): bit 0 set, the page data's first bit is the top of each octet (0, the *default*: its lowest). +FCR and +FPS are kept. +FHS? gives the last hangup status. Other +F settings that fax programs send in Class 2 (+FNR, +FIE, +FCT and the like) 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 one, +FET gives the command after the page sent, and +FKS (Class 2's +FK) 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 53. +FET Values

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

15 Text Telephone Commands

The modem is a text telephone in V.18's modes (+MS or +MV18S chooses one): the 5-bit (Baudot) mode of the TTYs, at 45.45 bit/s on 1400 and 1800 Hz (TIA-825-A), and with +MBAUDOT the telex and RTTY variants (50 bit/s, ITA2's figures, other tones); DTMF (each character one to four DTMF digits, Annex B); EDT (V.21's channel 1 at 110 bit/s, 7 bits, even parity, 2 stop bits); Bell 103 (300 bit/s), V.23's Minitel and Prestel terminals (1200/75 bit/s) and the V.21 text telephones of the Nordic countries and the UK (300 bit/s), all three 7 bits, even parity and a stop bit; and V.18's own mode between two V.18 modems (V.21, 8 bits and no parity, the DTE's T.140). 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 (DTMF: 75 ms a digit, 55 ms between), and does not hear the line meanwhile; it starts no characters while the remote's carrier is on. The others are duplex on a continuous carrier: calling, the modem sends in V.21's and Bell 103's calling channel and in V.23's 75 bit/s one, as a Minitel does; answering, in the others. The CONNECT gives the rate received (CONNECT 10 for DTMF, about its characters a second). None hangs up for want of carrier. The DTE sends and receives ASCII: in the 5-bit mode lower case goes as capitals, the shift codes are the modem's, and characters the code has not are dropped; DTMF has no CR (the modem drops the DTE's and gives it CR LF for each new line); the modes with parity send it even and ignore it received. A text telephone call has no answer tone: dialling, the modem goes into its mode as the dialling ends; answering, at once.

AT+MS=V18 (or AT+MV18S=1) finds the remote's mode. Calling, it sends V.18's calling signals: 1 s of silence, then three times V.8's CI coded for a textphone (400 ms) and 2 s of silence, then V.23's XCI (3 s), and over again. Answering, it listens for 3 s. Both listen for a 5-bit character, DTMF, an EDT character, V.21 characters, a V.21, Bell 103 or V.23 carrier, and the other modem's V.18 signals. An answering V.18 modem that hears CI or XCI sends the answer tone (2100 Hz) for up to 3 s; the caller, 0.5 s after the tone comes, sends TXP while the tone lasts; the answerer, hearing TXP, sends three of its own, and both are in V.18's mode. A caller that hears the answer tone of a data modem goes on with that modem's carrier (V.21, V.23 or Bell 103). Hearing nothing the answerer probes, in turn: the answer message (+MV18AM) and a new line in the 5-bit mode, then in EDT, then in DTMF, each followed by 2 s of listening, then 3 s each of its own V.21, Bell 103 and V.23 mark, listening for the answer to it; and over again until S7 runs out. Found, a carrierless remote is answered in its mode (once it is quiet, so that another automoding modem, whose probe this may have been, finds it too). The characters heard while the modem was finding the mode go to the DTE after the CONNECT.

V.8's CM and V.8 bis (clause 6/V.18) are not supported: the answerer sends V.25's answer tone rather than ANSam, so that a V.18 caller goes on with TXP.

+MV18S — V.18 Selection

This command chooses the text telephone mode (as +MS would; 0 sets +MS=92 if +MS had a text one), and whether the modem probes a silent remote and sends the answer message on answering. 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 out of range.

Table 54. +MV18S Values

Value	Meaning
mode	0 off; 1 automoding (+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* answering mode: kept.
fbk	Kept.
msg	1: the answer message on answering in one of the modes 2 to 7.
probe	0: automoding only listens; 1 or 2: it probes.

+MV18R — V.18 Report

With +MV18R=1 automoding reports the mode it found before the CONNECT, as +MV18R: *mode* with +MV18S's numbers (+MV18R: 2 for a TTY; +MV18R: 1 for V.18's own mode, with another 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, up to 63 printable characters, the blanks in its quotes kept (AT+MV18AM="GA"): sent in the probes, and on answering with +MV18S's *msg*. +MV18P (2 to 7) is kept: the probes go in the order 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 too long or a value out of range.

+MBAUDOT — 5-bit Mode

This command (D-Modem's own) sets the 5-bit mode's rate, tones and figures, for telex and RTTY: AT+MBAUDOT=50,2125,2295,1 is 50 baud ITA2 on RTTY's 170 Hz shift. The two ends must agree; automoding listens on these tones. Z sets the US TTY's 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 out of range, or the same mark and space.

Table 55. +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 US TTY's ($ on D, " on Z, ; on V, unshift on space), 1 ITA2's (telex).

16 Alarm Reports: Contact ID

With `AT+MS=CONTACTID` the modem speaks Contact ID (`SIA DC-05`), the `DTMF` format in which alarm panels report events to a central station's receiver. There are no commands of its own: `ATA` (or `S0`) makes the modem the receiver, `ATD` the panel, and the call is in data mode from the handshake on, `CONNECT 40` on both sides. Neither hangs up for want of carrier; `ATH` or the far end ends the call.

A message is 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 still there), the event code (3), the partition (2), the zone or user (3), and the checksum, which makes the digits' values add up to a multiple of 15 (0 counts 10; B to F are 11 to 15, sent as `*`, `#`, `A`, `B` and `C`).

The Receiver. Answering, the modem sends the handshake (1400 Hz, then 2300 Hz, 100 ms each), and again after 3 s with no message (four times in all). Each message with a good checksum goes to the `DTE` as a line of its 16 digits (`1234181131010158`) and gets the kissoff (1400 Hz for 900 ms); a bad one gets nothing, and the panel sends it again. What the `DTE` types is dropped.

The Panel. Dialling, the modem waits for the handshake, then sends each line the `DTE` types (`1234 18 1131 01 015`): 16 digits, or 15 and the modem adds the checksum; spaces and dashes are ignored. A message goes 250 ms after the handshake or the last kissoff, 55 ms a digit and 55 ms between, and again (four times in all) when no kissoff comes within 1.25 s. Each line gets `ACK` (kissed off), `NAK` (four times without), or `ERROR` (no message).

17 Text Messages: Fixed-Line SMS

With AT+MS=SMS the modem speaks fixed-line SMS (ETSI ES 201 912, protocol 1), the way some home telephones send and receive text messages through their telephone company's message centre. There are no commands of its own: ATA (or S0) makes the modem the receiving side, ATD the sending side, and the call is in data mode from the start, CONNECT 1200 on both sides. The line is V.23's 1200 bit/s channel (1300 and 2100 Hz) both ways, one side at a time.

Receiving. Answering, the modem invites the caller's messages, takes each one, and gives it to the DTE: a delivery (a message centre's to a telephone) as +CMT: "*from*","*time*", a submission (a telephone's to its message centre) as +SUBMIT: "*to*", each followed by a line of its text (UTF-8; 8-bit data in hex). Anything else comes as +PDU: *hex*. The call ends when the caller says it has no more; what the DTE types is dropped.

Example session: sending two pages, then receiving them

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

Sending. Dialling, the modem waits for the invitation, then sends each line the DTE types:

Table 56. Lines a Sending Modem Takes

Line	Sends
number,*text*	A submission of *text* to *number* (a telephone's message).
<*number*,*text*	A delivery of *text* from *number* (a message centre's), stamped with the time now (UTC); a *number* with letters is a name.
:*hex*	The message (3GPP TS 23.040's TPDU) as it is.

A *number* is digits (and *, #), + first for an international one. The text goes in GSM's 7-bit alphabet, up to 160 characters, or in UCS2, up to 70, when it has a character that alphabet lacks. Each line gets OK (taken), +CMS ERROR: *cause* (refused, with the far end's cause), or ERROR (not a message, or no answer after three tries). With no line for 3 s, the modem says it has no more and hangs up.

18 Voice Commands

With AT+FCLASS=8 the modem accepts V.253's voice commands; they are ERROR in the other modes, but for +VCID. Each +V parameter accepts ? (its values) and =? (their ranges).

+VIP — Initialize Voice Parameters

This command sets the voice settings as at the start.

Result code	When
OK	Always.

+VNH — Automatic Hangup Control

0 or 1. It is accepted and has no effect: a held call's failed handshake hangs up.

+VGT, +VGR — Transmit and Receive Gain

The gain sending (+VGT) and receiving (+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

Silence detection's sensitivity and period, each 0 to 255.

Syntax:

- +VSD=s,t

+VSM — Voice Compression Method

This command sets the format of the samples +VTX, +VRX and +VTR carry: format *m* at *r* samples/s (left out: 8000, or the rate the format runs at). *s* and *e*, silence compression's, are accepted (0 to 255) and kept, though the modem compresses no silence.

Syntax:

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

Result code	When
OK	Always.
ERROR	For another format, or a rate the format does not run at; the setting is kept.

Table 57. +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 (Conexant's numbers from here on).
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 a sample, two an octet with the first in the low nibble (as in a WAV file), at 7200, 8000 or 11025; the coder starts afresh at each +VTX, +VRX, +VTR.

+VLS — Analog Source/Destination Selection

This command takes the line for voice or leaves it, or puts the voice engine on a handset. Moving between 1, 14 and 15 keeps the voice engine running, the line taken or left.

Result code	When
OK	Always.
ERROR	For a device the modem has not.

Table 58. +VLS Values

Value	Device
0	Leave the line, on hook (*default*).
1	Take the line for voice (on SIP: answer the call that rings).
14	A handset of the modem's own alone, the line on hook: +VRX records its microphone, +VTX plays to its earpiece, and DTMF from it is reported.
15	The line with the handset on the call: the DTE hears the line and the handset, the line gets the DTE's samples and the handset.

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

Example output: AT+VLS=?

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

On hook (0) that is caller ID (with +VCID) and RING; on the line (1) DTMF, the two calling tones, the loop current interruption, a ringing tone, a busy tone and the two answer tones, in every state. A line that senses the phone on the modem's own jack (a SmartUSB56 with `dmodemd -usb-handset`) adds event 8 to both, in every state (00800000, 0B843060, ...). A modem with a handset of its own (a SmartUSB56 with `dmodemd -usb-voice-codec`) lists two more:

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: V.253's event reports in the speakerphone state, which the modem has not. Kept; 0 at the start and with +VIP.

D — Voice Dial

In voice mode, ATD*number* dials and gives OK when the far end answers, BUSY, NO ANSWER after S7, or ERROR when the call fails otherwise. An answer tone is the answer and a busy tone BUSY on any line (on SIP in its early media too); on SIP the answer is otherwise the 200 OK, on a line that does not tell the ringing tone's end (+VRA), or +VRN without one. On an analogue line the modem waits 2 s for the dial tone first. With the line taken it dials the digits as DTMF, S11 ms each.

H — Voice Hang Up

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

+VRA — Ringback Goes Away Timer

The far end has answered when the ringing tone has been gone this long since its last ring, in 100 ms, 0 to 255 (0: as the first ring ends); 50 at the start.

+VRN — Ringback Never Appeared Timer

The far end has answered when no ring has come in this long after dialling, in seconds, 0 to 255 (not beyond S7); 10 at the start.

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

These commands send, receive, or both at once: CONNECT, then samples in +VSM's format and rate, <DLE> doubled. A gap in the DTE's samples plays as silence.

Result code	When
CONNECT	Then OK when it ends.
ERROR	Without the line or a handset taken (+VLS).

Table 59. Voice Data Commands

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

+VTD — Beep Tone Duration

The duration of a +VTS element that gives none, in 10 ms, 0 to 6000 (0: 1 s); 100 at the start.

+VTS — DTMF and Tone Generation

This command plays the elements of *string*, separated by commas, in turn, and gives OK after the last. Durations are in 10 ms, 0 to 6000. A field may be left empty: a frequency is then 0, a digit none (silence), and a duration +VTD's, so {5}, [440] and [] last +VTD and {} is silence for as long. Two digits in a row get 50 ms of silence between them: +VTS=1,2,3 dials 123. A hook flash is the line's: over SIP an RFC 4733 event (16), the audio silent meanwhile.

Syntax:

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

Result code	When
OK	After the last element.
ERROR	If one element cannot be (nothing is played): a flash on a line that has none (a SIP call whose far end accepts no telephone-events), a value out of range.

Table 60. +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 line is taken (+VLS=1) the modem reports what it hears, as V.253 has it, as <DLE> and a character. DTMF digits from the far end are reported 51 ms into them and again every 70 ms while they last, in the voice command state as well as among +VRX's samples, whose audio is silence from a digit's report until it ends; the modem's own +VTS tones are not reported. The calling tones are reported as a burst ends and 4 s apart at least.

Table 61. 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 0.6 s at least; the UK's two bursts are one ring; it ends after 0.3 s without the tone).
<DLE>b	A busy or congestion tone (four rounds 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 into it.
<DLE>f	An answer tone of 2225 Hz (a data answer), 0.3 s into it.
<DLE>c	A calling fax machine's CNG (1100 Hz, bursts of 0.36 to 0.8 s).
<DLE>e	A calling data modem's V.25 tone (1300 Hz).
<DLE>l	Loop current interruption: the far end ended the call.
<DLE>H, <DLE>h	The phone on the modem's own jack off hook, on hook again.
<DLE>X ...<DLE>.	Caller ID (+VCID).

When the far end ends a voice call, the modem reports <DLE>l (V.253's loop current interruption, "usually a remote hangup") and goes on hook (+VLS=0); V.253 has no NO CARRIER in voice mode. What was under way ends: +VRX's samples with <DLE><ETX>, then OK; +VTX and +VTR when the DTE ends them (its samples until then are discarded), then OK, +VTR's after <DLE><ETX>; +VTS's tones with ERROR. In the command state <DLE>l comes alone.

18.2 From Voice to Fax or Data

A voice call can become a fax or data call (V.253 5.3.2 and its example I.6). +FCLASS=1 (or 0) in the voice command state, off hook, keeps the call: the voice engine stops, the line stays off hook and silent, and A answers on it as a fax (Class 1: CED, then CONNECT for the DIS) or data modem, or D calls on it (call progress waits for the far end's answer tone). H, Z or the far end hanging up 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 it itself, in the voice command state (a +VTX, +VRX, +VTR or +VTS under way ends first): after <DLE>c, FAX, +FCLASS=1 and the fax answer's CONNECT; after <DLE>e, +FCLASS=0 and the adaptive data answer (DATA, then its CONNECT).

19 Online, the Escape and Hanging Up

Online, what the DTE sends goes to the other modem, except the escape sequence: three S2 characters (+++), each within 0.5 s of the one before, with 0.5 s of nothing before them and after them. The modem then says OK and is in online command mode, the call still up: ATO goes back online, ATH hangs up, and on a V.92 connection AT+PMHR asks for modem-on-hold. The +++ itself is data (the modem cannot know it is the escape until the guard time after it), and what the DTE sent before the escape and the modem had not sent yet is kept, not dropped: it goes to the other modem, +++ last, once ATO is back online.

The call ends with NO CARRIER when the other side hangs up or its carrier is gone for S10 tenths of a second. dmodemd hangs up as well when the DTE drops DTR (it sets the pty's speed to 0) or, with HUPCL set on the pty, closes it; 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 (only V.250's dial characters: digits, * # + A B C D, the modifiers T P W , @ ! ; and - ( ) . and blanks) goes as its digits and DTMF characters: ATDT555-1000 calls sip:5551000@*domain*. Anything else is a SIP user's name, as it is: ATDalice.
- The line has no dial tone: ATX3 (or X1), else NO DIALTONE.
- A dial string with a ; (ATDT5551000;) makes the SIP call and says OK at once, the modem in command state: what ATD adds then goes as DTMF on the call (a menu's choices, an extension), and ATD alone or ATA starts the modem's handshake.
- With -L dmodemd registers and accepts calls: RING every 3 seconds while one waits, ATA or S0 rings (ATS0=1) answer it, and the rings stop if the caller gives up. A call that comes while the line is in use is refused (486, busy); without -L every call is (480).
- The call is G.711 at 8000 Hz, which is what V.90 and V.92 need (AT+MS=92, the *default*). Over a real PSTN gateway a lower modulation (AT+MS=132,0,4800,9600) may do better.

21 Compatibility

21.1 Where D-Modem Differs

- &K is the compression, as on USRobotics' modems; on Rockwell's and Conexant's it is flow control. &K3 leaves V.42's compression on (MNP 5 off), &K0 turns it off.
- The S-registers past S16 are D-Modem's own: S29 and S30 are the speaker's (elsewhere the hook flash time and the inactivity timer), S92 the answer's delay (elsewhere a fax transmit level). The others (S36, S37, S91 ...) are free: kept as written. S7 and S11 start at 60 and 100.
- There are no stored numbers or profiles: &Z and ATDS=*n* are ERROR, &W stores nothing.
- ATI's numbers are the modem's own (I0 to I7), but for the call statistics: I6 as USRobotics', I11 as Conexant's, I12 as Telebit's S71, S72 and S73 (a PEP call's carriers), &V1 as Rockwell's.
- The numeric results (V0) and CONNECT's number for each rate are D-Modem's own; those of USRobotics' and Conexant's modems differ.
- MNP is classes 2 to 5 (\N, %C): there is no MNP 10 or 10EC. A modem with MNP 10EC connects with V.42 (its "EM" detection patterns are passed over). See docs/link.md, MNP.
- K56flex is not there: +MS=56 runs V.90.

21.2 Not Supported

These are ERROR: &V2 and up, &Z (no stored numbers), &T2 and &T9 and up, \B (a break), X5 and up, ATI8 to ATI10 and ATI13 and up, -V90 (+MS chooses), +MA, +MSC, +EB, +ESR, +ETBM, +EWIND, +EFRAM, +A8M, +A8T, +PMHF, +GSN and +GOI; +MS's names of modulations the modem has not got (V23S, V27 ...).

22 Glossary

Term	Meaning
A-law, u-law	The two ways G.711 codes telephone audio in 8 bits: A-law in Europe, u-law in North America and Japan.
ADPCM	Adaptive Differential Pulse Code Modulation. Compressed audio, one of the voice formats of +VSM.
ADSI	Analog Display Services Interface. A telephone's screen and keys, driven by tones.
ALSA	Advanced Linux Sound Architecture. The sound system of Linux; dmodemd uses it to reach a telephone line through a sound card.
ASVD	Analogue Simultaneous Voice and Data. Speech and data on one modem carrier (V.61, +ASVD).
Automode	Trying modulations from the fastest down until both modems have one (N, +MS).
Baudot	The 5-bit code (ITA2) of teleprinters, of the deaf community's TTY, of telex and of RTTY.
Bell 103, Bell 212A	The North American 300 and 1200 bit/s modulations, akin to V.21 and V.22.
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 calling fax's tone (1100 Hz).
CIG, CSI, TSI	Calling subscriber identification, Called Subscriber Identification and Transmitting Subscriber Identification. The fax identities of the poller, the answerer and the caller (+FLI).
Class 1, Class 2, Class 2.0	The fax command sets: in Class 1 (T.31) the DTE runs the fax protocol, in Class 2 and Class 2.0 (T.32) the modem does.
Clear channel	A 64000 bit/s digital channel used as it is, with no modulation, as in an ISDN data call.
CPE	Customer Premises Equipment. The equipment at the subscriber's end of a line.
CRC, FCS	Cyclic Redundancy Check and Frame Check Sequence. A checksum on a frame that shows whether it arrived damaged.

Term	Meaning
DCD, DSR, DTR, RTS, CTS	Data Carrier Detect, Data Set Ready, Data Terminal Ready, Request To Send and Clear To Send. The serial port's control signals.
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 choose (DCS) the session's settings.
DLE	Data Link Escape (10h). In fax and voice modes, the character that starts a code in the data, such as <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).
ECM	Error Correction Mode. Fax pages sent in frames, and repeated where damaged.
EDT	European Deaf Telephone. A text telephone at 110 bit/s (V.18).
ETSI	European Telecommunications Standards Institute. The European standards body.
FSK, DPSK, QAM	Frequency Shift Keying, Differential Phase Shift Keying and Quadrature Amplitude Modulation. Ways of putting data on a carrier: by its frequency, by its phase, by phase and size together.
HDLC	High-level Data Link Control. Frames with flags and an FCS, the basis of LAPM, of fax's T.30 messages and of PPP.
ISDN	Integrated Services Digital Network. Digital telephone lines with 64000 bit/s channels.
ITU-T	International Telecommunication Union, Telecommunication Standardization Sector. The standards body whose recommendations are V.... (modems), T.... (fax) and so on.
Leased line	A permanent line between two modems, with no dialing; 2-wire or 4-wire (&L).
LR, LD	Link Request and Link Disconnect. MNP's messages that start and end its link.
MDMF, SDMF	Multiple Data Message Format and Single Data Message Format. The two forms of a caller ID message.
MH	Modified Huffman. The plainest fax page coding (T.4).

Term	Meaning
Modem-on-hold	V.92's way to put a data call on hold to answer another call (+PMH).
PBX	Private Branch Exchange. An office telephone system, such as Asterisk or FreeSWITCH.
PPP	Point-to-Point Protocol. How a computer carries the internet over a modem call.
PREP, ACK, TERM	Preparatory, Acknowledgement and Termination. V.54's signals to start, confirm and end a remote loop test.
PSTN	Public Switched Telephone Network. The ordinary telephone network.
Retrain, renegotiation	Modems re-measuring the line during a call (retrain), or changing only the rate (renegotiation).
Robbed-bit signalling	A digital network taking a bit of some samples for its own use, which a V.90 modem must allow for.
RTTY	Radio Teletypewriter. Baudot over radio, as radio amateurs send it.
SNR	Signal-to-Noise Ratio. How far the signal stands above the noise, in dB.
SYN	Synchronous idle. The idle octet of V.80's synchronous mode.
T.30	The fax protocol: its messages, phases and timers.
Type II caller ID	The caller ID of a waiting call, sent during a call.
Unimodem	Windows' modem driver; #UD gives its diagnostics.
V.8	The start of a modern call, where the modems tell each other what they have.
V.cvm, V.wb	D-Modem's data over mobile speech paths, and its wideband modem for a dry pair.
X.75, V.110, V.120	Protocols on an ISDN data channel (+B2).
XID	Exchange Identification. V.42's message 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 D-Modem offers between two D-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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