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EXM-31 14.4K Baud V.32bis Modem Hardware Reference

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1. Product Description

This manual contains the information required to install and use the EXM-31 High Speed Modem expansion module.

The EXM-31 is a plug-in PC-compatible internal modem for computer systems with EXM expansion capabilities. As an internal modem, it includes an 16550-compatible serial port, and can be set to standard PC I/O COM1-COM4. It can also be configured to use one of eight interrupts.

The EXM-31 is based on the AT&T HSM144DC chip set. When configuring with standard PC software, use a classification such as "Generic AT&T Class 1 Fax, 14400 Data Modem." The EXM-31 supports the following features:

- Data Modes
  - — CCITT V.32bis: 14400 (TCM), 12000 (TCM), 7200 (TCM)
  - — CCITT V.32: 9600 (TCM), 4800 (QAM)
  - — CCITT V.22bis: 2400 (QAM)
  - — CCITT V.22: 1200 (DPSK)
  - — CCITT V.21: 300 (FSK)
  - — CCITT V.23: 75/1200 (FSK)
  - — Bell 212A: 1200 (DPSK)
  - — Bell 103: 300 (FSK)

- Fax Modes
  - — CCITT V.17: 14400 (TCM), 12000 (TCM), 9600 (TCM), 7200 (TCM)
  - — CCITT V.29: 9600 (QAM), 7200 (QAM)
  - — CCITT V.27ter: 4800 (DPSK), 2400 (DPSK)
  - — CCITT V.21 Channel 2: 300 (FSK)

- V.42 error correction (LAPM and MNP)
- V.42bis and MNP 5 data compression
- V.42bis data compression over MNP
- Extensive AT commend set
- EIA/TIA 578 Class 1

- One of the following options:
  — Classic A: Hayes *Auto Sync*
  — Classic B: Class 2 (August 1990) Fax Interface

- Integrated 550 UART emulation

Note that there are two versions of this product: on is for international markets, and the other is a U.S. version. This is a build-time option.

Specifications

Table 1 defines the environmental and electrical specifications of the EXM-31.

Characteristic		Value
Environmental		
Temperature	operating	0° to 60° C (* see below)
	storage	-40° to 85° C
Humidity	operating	5% - 95% (non-condensing)
	storage	5% - 95% (non-condensing)
Vibration	operating	.015"displacement with 2.5 g peak (max) acceleration over 5 to 2000 Hz
	storage	.030" displacement with 5 g peak (max) acceleration over 5 to 2000 Hz
Shock	operating	30g 11 msec duration, half-sine shock pulse
	storage	50g 11 msec duration, half-sine shock pulse
Electrical		
Current	maximum	5V @ 700 mA
	typical	5V @ 500 mA

Table 1. EXM-31 Environmental and Electrical Specifications.

* Upper temperature limit degrades 2° C per 1000 ft. elevation. Maximum elevation 10,000 ft.

2. Installation

2 2

Before installing the EXM-31, unpack and inspect it for shipping damage.

- **DO NOT REMOVE THE MODULE FROM ITS ANTI-STATIC BAG UNLESS YOU ARE IN A STATIC-FREE ENVIRONMENT. THE EXM-31, LIKE MOST OTHER ELECTRONIC DEVICES, IS SUSCEPTIBLE TO ESD DAMAGE. ESD DAMAGE IS NOT ALWAYS IMMEDIATELY OBVIOUS, IN THAT IT CAN CAUSE A PARTIAL BREAKDOWN IN SEMICONDUCTOR DEVICES THAT MIGHT NOT IMMEDIATELY RESULT IN A FAILURE.**
- **ENSURE THAT THE INSTALLATION PROCESS AS DESCRIBED HEREIN IS ALSO PERFORMED IN A STATIC-FREE ENVIRONMENT.**

Insertion in an EXM Carrier

Insertion of the EXM-31 into an EXM carrier is straightforward. Remove a blank EXM panel from the carrier (by unscrewing the thumbscrews) and insert the EXM-31 into the card guides. Firmly press the EXM-31 front panel to ensure that the module is properly seated in the subplane and secure it with the thumbscrews. DO NOT OVERTIGHTEN.

- **MAKE SURE THAT POWER TO YOUR SYSTEM IS OFF. THIS EXM IS NOT DESIGNED TO BE INSERTED OR REMOVED FROM A LIVE SYSTEM.**
- **WHEN INSERTING THE EXM, AVOID TOUCHING THE CIRCUIT BOARD, AND MAKE SURE THE ENVIRONMENT IS STATIC-FREE.**
- **INSERT IT WITH ADEQUATE CONTINUOUS FORCE RATHER THAN TAPPING OR HAMMERING ON IT.**

2 2

Configuring the BIOS Setup

Once the EXM-31 is inserted into the carrier, turn the system on and boot it up. The EXM configuration data in the EPC to which the EXM-31 is connected now must be modified to recognize and enable the card and select from the available options. Invoke the BIOS setup function from the command line by pressing the CTRL-ALT-ESC keys simultaneously.

Enabling the EXM module

Once in the setup program, a menu displays specifying which function keys are available for further configuration. Press the F2 function key to invoke the EXM menu. The screen display resembles the figure below.

```
          ID OB1 OB2
Slot 0    DC  00  00
     1    DB  C1  00
     2    D0  07  DD
     3    DE  00  39
     4    F5  05  00
     5    DC  F5  00
```

Figure 1. EXM Setup Screen.

The EXM Setup Screen displays the EXM configuration data (in hexadecimal) stored in nonvolatile memory which the EPC uses at power-up to recognize and configure each installed EXM. An example of configuration data for the EXM-31 is shown in **bold** in slot 2. The displayed data shows SLOT, ID, OB1 and OB2. These are defined as follows:

SLOT	indicates the slot in which the EXM is installed. See the diagram below to determine which EXM slot the EXM-31 occupies. Note that dashed lines indicate EXM slots that may not be available on all systems.
ID	is a hard-wired ID value. Each EXM has a unique ID value.
OB1/OB2	are two bytes of option information.

EXM Slots

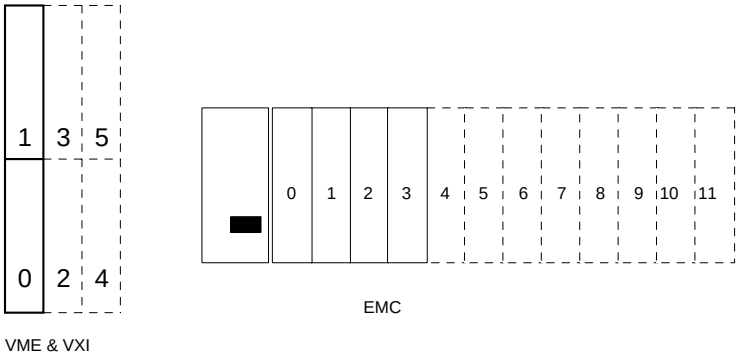


Figure 2. EXM Slot Numbering.

Figure 2 lists two sample EXM slot configurations, but there are several chassis options available. Consult the specification sheet that shipped with your chassis if you are unsure about slot numbering for your particular system.

All slots **not** occupied by an EXM module should show an ID of FF and OB1/OB2 of 00 00 indicating that no EXM is present.

To add or change an EXM configuration, use the cursor keys (arrows) to move between the fields on the screen. Move the cursor to the appropriate slot entry and type in the correct value.

The **ID** for the EXM-31 should be set to **D0**h (D-zero).

OB1 is a hexadecimal value derived by combining the following:

Reserved (bits 7-4)				INT Select (bits 3,2,1)	Card Enable (bit 0)
0	0	0	0	see below	0 disable 1 enable

Figure 3. OB1 Register.

OB1 contains the interrupt select and the card enable bit.

The interrupt select is as follows:

Bit 3	Bit 2	Bit 1	Interrupt
0	0	0	IRQ9
0	0	1	IRQ3
0	1	0	IRQ4
0	1	1	IRQ5
1	0	0	IRQ7
1	0	1	IRQ11
1	1	0	IRQ12
1	1	1	IRQ15

Table 2. OB1 Settings.

For example, a typical OB1 value is **07**h (0000 0111) indicating the card is enabled at IRQ5.

Note that interrupts cannot be disabled. Make sure that the IRQ chosen for the EXM-31 does not conflict with any other modules that use an IRQ. Some common IRQs to avoid are the following:

IRQ3	if already using COM2
IRQ4	if already using COM1
IRQ6	if using floppy disk controller
IRQ7	if using LPT1

OB2 is used to select the base address.

Reserved bit 7	Base Address Select (bits 6-0)
Set to 1	see below

Figure 4. OB2 Register.

Base Address specifies the base address of the UART I/O registers. This value is matched against SA[9..3] to provide an I/O chip select.

The EXM-31 consumes a contiguous eight byte region of I/O space. Some suggested address ranges are given below:

Address	*Hex Value*	*OB2 Value*
3F8-3FF	7F	FF
2F8-2FF	5F	DF
3E8-3EF	7D	FD
2E8-2EF	5D	DD
2A0-2A7	54	D4
2B0-2B7	56	D6



It is suggested that the address range of 000 - 107 not be used as the base address due to possible conflicts while configuring other EXMs or AT peripherals in the system. Some other common base I/O address ranges to avoid are the following:

1F0-1FF	IDE disk controller
278-27F	Parallel port (LPT2)
378-37F	Parallel port (LPT1)
3F0-3F7	Floppy disk controller

For example, a typical OB2 setting would be **DD**, setting the modem to use base address 2E8-2EF.

NOTES



3. Connector

RJ-11 Connector

The EXM-31 has two RJ-11 connectors on the front-panel for connection to the phone line and to the telephone. They are shielded connectors equivalent to AMP 555154-2.

The phone jack pinouts are identical, and are defined in the following table:

RJ-11	Signal
1	Not used
2	Not used
3	TIP
4	Ring
5	Not used
6	Not used

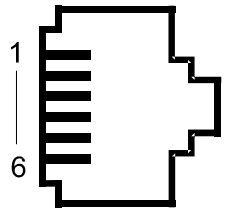


Table 3. RJ-11 Phone Jacks Pin-out.

The front panel connectors of the EXM-31 are labeled “IN” for the line that comes in from the wall, and “OUT” for the line that leads to the telephone.

NOTES

3 3

4. Programming Interface

This chapter contains information needed to write custom software drivers for the EXM-31. Anyone using the EXM-31 with software compatible with standard PC modems in general, or specifically a “generic AT&T Class 1 Fax, 14400 Data Modem” can skip reading this chapter.

The EXM-31defines the following registers in the I/O space (the MSB is the left-most bit).

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	I/O Port
1	1	0	1	0	0	0	0	100
Device ID Register								
Reserved				Interrupt Select			CDEN	102
Configuration Option Byte 1 Register								
1	Base Address Select							103
Configuration Option Byte 2 Register								

These registers are standard EXM registers for device identification and configuration. The EXM-31 responds to accesses to these ports only if EXM expansion interface line -EXMID is asserted. An 8-bit read from I/O address 100h returns the value D0, the device ID of the EXM-31. Read/write configuration registers appear at I/O address 102h and 103h. The bit encodings are defined in chapter 2.

The upper four bits of register 102 are reserved.

Interrupt selects the interrupt to be generated.

Base address selects the place in the I/O space in which the 8-byte I/O port area of EXM-31 appears.

CDEN specifies whether the EXM is disabled or enabled. If disabled, the EXM will not respond to any I/O or memory addresses and will not assert an interrupt output; it will only respond to reads from I/O port 100h and reads and writes from I/O port 102h, and then only if EXM expansion interface line -EXMID is asserted.

UART Registers

The table below describes the 16C550 registers.

Bit #	Register Address											
	OD=0	OD=0	1D=0	2	2	3	4	5	6	7	OD =1	1D=1
	RBR	THR	IER	IIR	FCR	LCR	MCR	LSR	MSR	SCR	DLL	DLM
0	Data bit 0	Data bit 0	ERBFI	0 if IRQ pend	FIFO enable	WLS0 Bit 0	DTR	DR	DCTS	Bit 0	Bit0	Bit 8
1	Data bit 1	Data bit 1	ETBEI	INT ID (0)	RCVR FIFO reset	WLS1 Bit 1	RTS	OE	DDSR	Bit 1	Bit1	Bit 9
2	Data bit 2	Data bit 2	ELSI	INT ID (1)	XMIT FIFO reset	# of stop bits	Out 1	PE	TERI	Bit 2	Bit2	Bit10
3	Data bit 3	Data bit 3	EDSSI	INT ID (2) [2]	DMA mode select	parity enable (PEN)	Out 2	FE	DDCD	Bit 3	Bit3	Bit11
4	Data bit 4	Data bit 4	0	0	resvd	Even Parity Select (EPS)	Loop	BI	CTS	Bit 4	Bit4	Bit12
5	Data bit 5	Data bit 5	0	0	resvd	Stick parity	0	THRE	DSR	Bit 5	Bit5	Bit13
6	Data bit 6	Data bit 6	0	FIFO enable[2]	RCVR Trig (LSB)	Set break	0	TEMT	RI	Bit 6	Bit6	Bit14
7	Data bit 7	Data bit 7	0	FIFO enable[2]	RCVR Trig (MSB)	DLAB	0	RCVR FIFO Err [2]	DCD	Bit 7	Bit7	Bit15

Table 4. UART Registers.

NOTES:

[1] Bit 0 is the least significant bit. It is the first bit serially transmitted or received.

[2] Interrupt ID Bit (2): These bits are always 0 in NS16450 mode

The following abbreviations are used for the bits in the table:

ERBFI Enable Received Data Available Interrupt
ETBEI Enable Transmitter Holding Register Empty Interrupt
ELSI Enable Receive Line Status Interrupt
EDSSI Enable Modem Status Interrupt
WLS0 Word Length Select Bit 0
WLS1 Word Length Select Bit 1
DLAB Divisor Latch Access Bit
DTR Data Terminal Ready
RTS Request To Send
DR Data Ready
OE Overrun Error
PE Parity Error
FE Framing Error
BI Break Interrupt
THRE Transmitter Holding Register
TEMT Transmitter Empty
DCTS Delta Clear to Send
DDSR Delta Data Set Ready
TERI Trailing Edge Ring Indicator
DDCD Delta Data Carrier Detect
CTS Clear To Send
DSR Data Set Ready
RI Ring Indicator
DCD Data Carrier Detect

The following abbreviations are used for the registers:

RBR Receiver Buffer Register (Read Only)
THR Transmitter Holding Register (Write Only)
IER Interrupt Enable Register
IIR Interrupt Identification Register (Read Only)
FCR FIFO Control Register (Write Only)
LCR Line Control Register
MCR Modem Control Register
LSR Line Status Register
MSR Modem Status Register
SCR Scratch Register
DLL Divisor Latch (LS)
DLM Divisor Latch (MS)



4 4

AT Commands

AT commands are issued from an asynchronous DTE, such as a PC, and control the modem's operating and software configuration. The following section lists all AT commands supported by the AT&T HSM Complete Chip Set. The defaults for each command are in bold.

Initialization Strings

Initialization strings are used to initialize the modem before beginning to dial a number. One of the most common is to return the modem to the factory default values:

AT&F&W0

This command loads the factory default settings stores them as the active user profile #0 into one of the two nonvolatile stored profile memory locations. Other commands can be used in tandem, in addition to, or mixed.

Basic AT Commands

A/ Repeat Last Command

This command re-executes last command string (not to be preceded with AT or followed by pressing the Return key.)

A Answer Command

This command instructs the modem to go off-hook and attempt to establish a connection without waiting for a ring.

Bn Communication Standard Option

This command is used to configure the modem to the desired communications standard settings at particular line speed.

B0 **Selects CCITT V.22 when modem is at 1200 bits/s**
Selects CCITT V.21 when modem is at 300 bits/s
B1 **Selects Bell 212A when modem is at 1200 bits/s**

Selects Bell 103 when modem is at 300 bits/s

B2 **Selects V.23 originate mode receive 1200 bits/s, transmit 75 bits/s;**
Answer mode receive 75 bits/s, transmit 1200 bits/s

B3 **Selects V.23 originate mode receive 75 bits/s, transmit 1200 bits/s;**
answer mode receive 1200 bits/s, transmit 75 bits/s

B15 Selects CCITT V.21 when the modem is at 300 bits/s
B16 Selects Bell 103 when the modem is a 300 bits/s
B30 Selects V.22bis when the modem is at 4800 bits/s
B41 Selects V.32 full duplex when the modem is at 4800 bits/s
B52 Selects V.32bis full duplex when the modem is at 7200 bits/s
B60 Selects V.32 full duplex when the modem is at 9600 bits/s
B70 Selects V.32bis full duplex when the modem is at 12000 bits/s
B75 Selects V.32bis full duplex when the modem is at 14400 bits/s

Result Codes:
OK n=0, 1, 2, 3, 15, 16, 30, 41, 52, 60, 70, 75.
Error Otherwise.

Cn Carrier Control Option (dummy command)

This command is used by some modems to control the transmit carrier. This chip set does not support C0 and will respond in error if this command is given. This chip set will accept C1 without error in order to ensure backward compatibility with communications software that issues this command.

C0 Transmit carrier always off (returns ERROR).
C1 Normal transmit carrier switching.

Result Codes:
OK n=1.
Error Otherwise.

Dn Dial Command

This command begins the dialing sequence. The string n (modifiers and telephone number) is entered after the D command.

Dial modifiers:

P	Pulse dial. Only digits 0-9 can be dialed in pulse dial mode.
R	Reverse dial mode. Originates call in answer mode.
S=n	Dial stored number. Dials the number stored in location n (0-3).
T	Tone DTMF dial. Any digit 0-9, *, #, A,B,C,D may be dialed
W	Wait for dial tone. Modem waits for dial tone before processing the dial string.
,	Pause. Causes modem to pause before processing the next character in the dial string.
!	Flash hook. This causes the modem to go on-hook for 0.5 s then return off-hook.
@	Wait for quiet answer. Wait for five seconds of silence after dialing the number.
;	Return to idle state. Modem returns to command mode after dialing a number without disconnecting the call.



En Off-Line Echo Command

This command determines whether characters are echoed to the DTE from the modem when it is in the command state.

E0	Echo disabled.
E1	**Echo enabled.**

Result codes:

OK	n=0,1.
Error	Otherwise.

Fn On-Line Echo Command (dummy command)

This command is used by some modems to determine whether characters are echoed to the DTE from the modem when it is in the on-line state. This chip set does not support F0 and will respond in error if this command is given. This chip set will accept F1 without error in order to ensure backward compatibility with communications software that issues this command.

F0	Returns Error.
F1	On-line echo disabled.

Result Codes:

OK	n=1
Error	Otherwise

Hn Switch-hook Control

This command provides control over the line relay.

H0	Modem goes on-hook.
H1	Modem goes off-hook.

Result Codes:

OK	n=1.
Error	Otherwise.



In Identification/Checksum Option

This command instructs the modem to query its memory for information about itself.

I0	Reports product code.
I1	Reports a 3-digit ROM checksum
I2	Performs a ROM check.
I3	Report ROM components
I4	Modem capabilities.

Result Codes:

OK	n=0, 1, 2, 3, 4.
Error	Otherwise.

Ln Speaker Volume

This command determines the volume level of the speaker, when supported by the modem.

L0	Lowest speaker volume.
L1	Low speaker volume.
L2	**Medium speaker volume.**
L3	High speaker volume.

Result Codes:

OK	n=0, 1, 2, 3.
Error	Otherwise.

Mn Speaker Control

This command determines whether the speaker function of the modem is on or off.

M0	Speaker always off.
M1	**Speaker on until carrier present.**
M2	Speaker always on.
M3	Speaker off during dialing and on until carrier.



Result Codes:

OK	n=0, 1, 2, 3.
Error	Otherwise.

Nn Select Negotiate Handshake

This command controls automode enable/disable.

N0	When originating or answering, handshake only at the communication standard specified by S register 37 and Bn.
N1	**When originating or answering, start handshake only at the communication standard specified by S register 37 and Bn. During handshake, fallback to a lower speed may occur.**

Result Codes:

OK	n=0,1.
Error	Otherwise.

On Go On-Line

This command returns the modem to on-line mode or data mode.

O0	Returns modem to on-line mode or data mode.
O1	Begins an equalizer retrain sequence, then returns to on-line state.
O3	Issues rate renegotiation sequence, then returns to on-line state for V32bis only.

Return Codes:

OK	n=0,1,3
Error	Otherwise

P Enable Pulse Dialing

This command instructs the modem to use pulse dialing. Dialed digits will be pulsed until a T command or dial modifier is received.

Result Codes:

OK

Qn Results Code Display Option

This command controls whether the result codes are displayed to the DTE.

Q0	**Result codes enabled.**
Q1	Result codes disabled.

Result Codes:

OK	n=0,1
Error	Otherwise

Sn Selects S Register

This command selects a specific S register.

n = 0 ~ 112

Sn=x Writes to an S Register

This command writes a value to a specified register.

n = 0 ~ 112
x = 0 ~ 255



Sn? Read an S Register

The contents of S register *n* are sent to the DTE as three decimal digits. This informational text response is formatted with <CR><LF> as determined by the V command currently in effect.

n = 0 - 112

T Enable Tone Dialing

This command instructs the modem to send DTMF tones while dialing. Dialed digits will be tone dialed until a P command or dial modifier is received.

Result Codes:
OK

Vn Result Code Form

This command determines whether result codes (including call progress and negotiation progress messages) are displayed as numbers or words.

V0 Numeric form.
V1 Verbose form.

Result Codes:
OK n=0,1.
Error Otherwise.

Wn Select Extended Result Codes

This command determines which result codes will be used to describe the type of connection and protocol that resulted from handshaking and negotiation.

W0 CONNECT result code reports DTE speed; if S register 95 = 0, disable all extended result codes.
W1 CONNECT result code reports DTE speed; enable the CARRIER and PROTOCOL extended result code based on S95.
W2 CONNECT result code reports DCE speed; if S register 95 = 0, disable all extended result codes.

Result Codes:

OK n=0,1,2.
Error Otherwise.

Xn Select Result Codes/Call Progress Options

This command enables tone detection options used in the dialing process. As these functions are chosen, the modem chip set's result codes are also affected. This command is therefore frequently used to control the modem chip set's responses. The primary function of this control is to control the modem chip set's call response capabilities.

X0 Result codes 0-4 enabled. Busy and dial tone detect disabled.
X1 Result codes 0-5, 18-88 enabled. Busy and dial tone detect disabled.
X2 Result codes 0-6, 8-88 enabled. Busy detect disabled and dial tone detect enabled.
X3 Result codes 0-5, 7-88 enabled. Busy detect enabled and dial tone detect disabled.
X4 All Result Codes 0-88 enabled. Busy and dial tone detect enabled.

Result Codes:
OK n=0,1,2,3,4.
Error Otherwise.



Yn Long Space Disconnect

This command determines if the modem will disconnect a call upon receiving a long space (1.6 sec break) signal. or transmit a 4.0 s space when initiating a disconnect.

Y0 Disables long space disconnect.
Y1 Enables long space disconnect.

Result Codes:
OK n=0,1.
Error Otherwise.

Zn Recall Stored Profile

This command instructs the modem chip set to go on hook and restore the selected stored profile. Any non-storable parameters previously set are returned to their factory settings.

Z0 Reset and recall user profile 0.
Z1 Reset and recall user profile 1.

Result Codes:
OK n=0,1.
Error Otherwise.

4 4

AT& (Ampersand) Commands

&Bn V.32 Autoretrain

This command controls the modem action when the threshold set by S108 is encountered.

&B0 Hang up if threshold reached.
&B1 Retrain if threshold reached.
&B2 Do not hang up and do not retrain (i.e., tolerate any line).

Result Codes:
OK n=0,1,2
Error Otherwise

&Cn Data carrier Detect Option

This command controls how the state of the DCD or RLSD (receive line signal detect) relates to the carrier from the remote modem.

(If Q0 is selected)
&C0 State of carrier from remote modem is ignored. RLSD circuit is always on.
&C1 State of carrier from remote modem is tracked. RLSD circuit reflects the state of carrier

(If &Q1, &Q2, &Q3, or &Q4 are selected)

&Cn has no effect. RLSD shows current state of carrier.

Result Codes:
OK n=0,1.
Error Otherwise.

&Dn Data Terminal Ready Option

This command interprets how the modem will respond to the state of the DTR signal and changes to the DTR signal.

&D0 DTR ignored.
&D1 Go to command mode on on-to-off DTR transition.
&D2 Hang up and go to command mode on on-to-off DTR transition. Autoanswer is disabled if DTR is low.
&D3 Reset on on-to-off DTR transition.

Result Codes:
OK n=0,1,2,3.
Error Otherwise.

&F Load Factory Settings

This command loads the configuration stored and programmed at the factory. This operation replaces all of the command options and S register settings in the active configuration with factory values stored in nonvolatile RAM.

&F Recall factory settings as active configuration.

Result Codes:
OK n=0.
Error Otherwise.

&Gn Guard Tone Option

This command determines which guard tone, if any, to transmit while transmitting in the high band (answer mode). This command is only used in V22 and V22bis mode.

&G0 No guard tones.



&G1 550 Hz guard tone.
&G2 1800 Hz guard tone.

Result Codes:
OK n=0,1,2.
Error Otherwise.

&Kn Select Flow Control

This command selects the flow control method the modem chip set provides to the DTE to prevent the modem's buffer from overflowing with data. A data buffer holds the data until the modem is ready to transmit it. When the data buffer is full, flow control instructs the DTE to stop sending to the modem while the modem continues to send characters.

&K0 Disable flow control.
&K1 Reserved.
&K2 Reserved.
&K3 Enable bidirectional hardware flow control (RTS/CTS).
&K4 Enable bidirectional XON/XOFF flow control.
&K5 Reserved.

Result Codes:
OK n=0,3,4
Error Otherwise

&Ln Dial Up./Lease Line Option

This command is used to select between dial-up operations or leased-line operations.

&L0 Dial Line.
&L1 Leased Line.

Result Codes:
OK n=0,1.
Error Otherwise.

&Mn Asynchronous Mode

This command is used to select the communication mode.

On-Line State *Idle State*

&M0	**Async**	**Normal**
&M1	Sync	Normal
&M2	Sync	Dial when DTR = 1
&M3	Sync	Talk/Data, DTR = 0/1

Result Codes:

OK	n=0,1,2,3
Error	Otherwise

&Pn Dial Pulse Ratio

This command determines the make/break ratio used during pulse dialing.

&P0	**Make = 39%, Break = 61% for use in the United States.**
&P1	Make = 33%, Break = 66% for use in some other countries.

Result Codes:

OK	n=0,1.
Error	Otherwise.

&Qn Communication Mode Option

This command will select the communication mode. It determines how the chip set will treat transmit and receive data while in the on-line state and establishes certain call setup procedures.

	On-Line State	*Idle State*
&Q0	Async	Normal
&Q1	Sync	Normal
&Q2	Sync	Dial when DTR = 1, Hang up when DTR = 0
&Q3	Sync	Talk/Data, DTR = 0/1
&Q4	**AutoSync if applicable**	

Result Codes:

OK	n=0,1,2,3,4.
Error	Otherwise.

&Rn CTS/RTS Option (non-CTS flow control mode)

The functions of CTS and RTS are determined by this command.

&R0 CTS follows RTS (synchronous modes only).
&R1 CTS always true.

Result Codes:
OK n=0,1.
Error Otherwise.

&Sn Data Set Ready Option

This command controls the functions of DSR. DSR indicates when the modem is connected to a communications channel and is ready.

(If &Q0 is selected)
&S0 DSR circuit always on.
&S1 DSR circuit on during handshaking, and in test modes/off in idle mode and when carrier is lost.

(If &Q1, &Q2, &Q3 or &Q4 is selected)
DSR circuit on during handshaking, off in test or idle mode.

Result Codes:
OK n=0,1
Error Otherwise

&Tn Self-Test Commands

These commands are used to configure and place the modem chip set in various test modes as defined by CCITT V.54. These tests are typically used to verify the analog and digital portions of a modem's operation.

&T0 Terminate test.
&T1 Local analog loopback.
O = Low-frequency band.
A = High-frequency band.
&T3 Local activated Remote Digital Loopback (RDL).
&T4 Grant request from remote for RDL test.
&T5 Deny request from remote for RDL test.
&T6 Remote digital loopback test.
&T7 Remote digital loopback with self-test.
&T8 Local analog loopback with self-test.

Result Codes:

OK	n=0,3,4,5,7,8.
CONNECT	n=1,6.
Error	Otherwise.

&Un Disable Trellis Coding

This command is used to enable and disable trellis coding for V.32 9600 bps connections only.

&U0	**Enable trellis coding.**
&U1	Disable trellis coding.

Result Codes:

OK	n=0,1.
Error	Otherwise.

&Vn View Active Configuration and Stored Profile

This command is used to display the active and stored profiles (commands and S register settings) along with any stored telephone numbers. The following example illustrates typical &V information displayed for the AT&T HSM Complete Modem Chip Set.

Example:

```
ACTIVE PROFILE

B1 B116 B30 B41 B60 E1 L2 M1 N1 P Q0 V1 W0 X4 Y0 &B1 &C1 &D2 &G0 &J0
&K3 &L0 &P0 &Q0 &R0 &S0 &U0 &X0 &Y0
%A013 %C1 %E1 %G0 %01 \A3 \C0 \G0 \J0 \K5 \N3 \Q3 \T000 \V1 \X0 -J1 *H3
*O016
S00:000 S01:000 S02:043 S03:013 S04:010 S05:008 S06:002 s07:030
S08:002 S09:006 S10:014 S11:095 S12:050 S18:000 S25:005 S26:001
S37:000 S112:000
```

```
STORED PROFILE 0

B1 B16 B30 B41 B60 E` L2 M1 N1 P Q0 V1 W0 X4 Y0 &B1 &C1 &D2 &G0 &J0
&K0 &L0 &P0 &Q0 &R0 &S0 &U0 &X0
%A013 %C1 %E1 %G0 %01 \A3 \C0 \G0 \J0 \K5 \N3 \Q3 \T000 \V0 \X0 -J1 *H3
*O016
S00:000 S02:043 S06:002 S07:030 S08:002 S09:006 S10:014 S11:095
S12:050 S18:000 S25:000 S26:001 S37:000 S112:000

TELEPHONE NUMBERS:

       &Z0 =          &Z1 =
       &Z2 =          &Z3 =
```

Result Codes:

OK	n=0,1.
Error	Otherwise

&Wn Store Active Profile.

This command stores certain command options and S register values into one of the two nonvolatile stored profile memory locations.

&W0	Save active configuration as user profile 0.
&W1	Save active configuration as user profile 1.

Result Codes:

OK	n= 0 or 1
Error	Otherwise

&Xn Synch Transmit Clock Source Option

This command determines how the DTE transmit clock is generated while the modem is in synchronous modes.

&X0	**The modem generates the transmit clock and applies it to pin 15 (RS232)**
&X1	The DTE generates the transmit clock on pin 24 (RS232) and the modem applies it to pin 15 (RS232).
&X2	The modem derives the transmit clock from the receive carrier signal and applies it to pin 15 (RS232).

Result Codes:

OK	n=0,1,2
Error	Otherwise

Yn Select Stored Profile on Powerup

This command selects which user profile will be recalled into the active profile (powerup).

&Y0	**Recall user profile 0 on powerup.**
&Y1	Recall user profile 1 on powerup.

Result Codes:

OK	n=0,1.
Error	Otherwise.

Zn=x Stored Telephone Number

This command is used to store up to four telephone numbers. The maximum number of digits per number is 36.

x = 0-9, A, B, C, D, #, *, T, P, R, W, @, comma, !, ; (dial string).
n = 0-3.

AT% Commands

%An Set Auto-reliable Fallback Character

This command allows the user to specify the character that tells the modem to return (or fall back) from auto-reliable (MNP) mode to a normal connection on the answering modem.

Result Codes:

OK	n = 0-127 (ASCII character).
Error	Otherwise.
Default	013.

%Cn Data Compression

This command controls the MNP Class 5. The modem can only perform data compression on an error corrected link.

%C0	No compression.
%C1	**MNP Class 5 compression.**

Result Codes:

OK	n=0,1.
Error	Otherwise.



%Dn 108 Mode Select

This command selects the 108 mode to user for V.25 bis.

0 =	108/2 mode (default).
1 =	108/1 mode.

%Fn Character Framing Select

This command selects the V.25bis character framing.

0 =	Asynchronous
1 =	HDLC
2 =	BISCYNC 0 = Default

%En Enable/Disable Autoretrain

This command controls whether or not the modem will automatically monitor the line quality and request a retrain when necessary.

%E0	Disable autoretrain
%E1	Enable autoretrain.

Result Codes:

OK	n=0,1
Error	Otherwise

%Gn Auto Fallback Enable (V.32bis only)

This command selects the auto fallback option.

%G0	Disabled.
%G1	Enabled.

Result Codes:

OK	n=0,1.
Error	Otherwise.

%O Escape Method

This command controls the escape method.

n = 0	Disables escape.
n = 1	+++AT method enabled.
n = 2	<BREAK> AT method.
n = 3	Enables both +++AT and <BREAK>AT.

%V Command Set Switch

This command switches from the AT command set to V.25bis when entered in V.25bis Async only.

AT\ (back slash) commands

\An Block Size

This command sets the maximum block size during a MNP and LAPM connection. This option forces the modem chip set to transmit smaller blocks of data. This command is typically used for poor quality telephone lines where transmitting smaller blocks of data avoids retransmissions, thus improving throughput.



MNP		*LAPM*
\A0	Max 64 characters	Max 64 characters
\A1	Max 128 characters	Max 128 characters
\A2	Max 192 characters	Max 128 characters
\A3	**Max 256 characters**	**Max 128 characters**

Result Codes:

OK	n=0,1,2,3.
Error	Otherwise.

\Bn Transmit Break

This command sends a break to the remote modem. It is equivalent to using the <BREAK> key on your terminal. This command can be used if your keyboard does not have a <BREAK> key.

\B1 - \B9	Break length in 100 ms.
Default = 0	Break of 300 ms is transmitted.

\Cn Set Autoreliable Buffer

This command determines whether the modem chip set buffers the data it receives during link negotiation.

\C0	**Does not buffer data.**
\C1	Buffers data on answering modem for 4 seconds, until 200 characters have been buffered, and then switches to normal mode and the buffered characters are passed to the serial port. If a SYN character is detected, reliable mode is attempted.
\C2	Does not buffer data on answering modem. Switches to normal mode upon receipt of autoreliable character and passes it to serial port.

Result Codes:

OK	n=0,1,2.
Error	Otherwise.

\Gn Set modem Port Flow Control

This command selects the modem chip set's DE or port flow control. If the modem chip set is receiving data from the remote modem faster than it can be processed, enabling port flow control allows the modem chip set to handle the data efficiently.

\G0 Disable port flow control.
\G1 Set port flow control to XON/XOFF flow control.

Result Codes:
OK n=0,1.
Error Otherwise.

\Jn Bits/s Rate Adjust



This command allows the modem chip set and the DTE to exchange asynchronous data up to 57,600 bits/s, regardless of the speed of the data connection between the modem chip set and the remote modem.

\J0 Turn off feature.
\J1 Turn on feature.

Result Codes:
OK n=0,1.
Error Otherwise.

\Kn Set Break Control

This command selects the way in which the modem handles a break signal. This modem chip set can handle a break signal in one of three ways: expedited destructive, expedited, or queued break.

(In command state, if reliable mode, then transmit break, to remote)
0,1 Destructive/Expedited
2,3 Nondestructive/Expedited
4,5 Nondestructive/Nonexpedited

(In connect state, if direct mode then receive break at serial port)
0,2,4 Immediately send break and enter command state
1,3,5 Immediately send break through

(In connect state, receive break at modem port, send to serial port)
0,1 Destructive/Expedited

2,3 Nondestructive/Expedited
4,5 Nondestructive/Nonexpedited
Default = 5

Result Codes:
OK n=0,1,2,3,4,5
Error Otherwise

/Nn Set Operating Mode

This command selects the type of data connedt5ion the modem chip set can establish.

	Classic Feature	*Gold Feature*
\N0	Normal Mode	Normal Mode
\N1	Direct Mode	Direct Mode
\N2	MNP Reliable Mode	MNP Reliable Mode
\N3	V.42 Autoreliable Mode	MNP Autoreliable Mode
\N4	V.42 Reliable Mode	LAPM Reliable Mode
\N5		LAPM Autoreliable Mode
\N6		V.42 Reliable Mode
\N7		V.42 Autoreliable Mode

Result Codes:
OK n=0,1,2,3,4.
Error Otherwise.

\Qn Set Serial Port Flow Control

This command selects the flow control method the modem chip set provides to the DTE to prevent the modem's buffer from overflowing with data. A data buffer holds the data until the modem is ready to transmit it. When the data buffer is full, flow control instructs the DTE to stop sending to the modem while the modem continues to send characters.

\Q0 Disables flow control.
\Q1 Enable bidirectional XON/XOFF flow control.
\Q2 Enable unidirectional hardware flow control.
\Q3 Enable bidirectional hardware flow control.

Result Codes:
OK n=01,2,3.
Error Otherwise.

\Tn Set Inactivity Timer

This command allows the modem chip set to disconnect if no data activity has occurred for the selected period of time.

n = 0 - 90	Length in minutes.
Default	000.

\Vn Modify Result Code Form

This command option selects the extended MNP/V.42 CONNECT responses.

\V0	**Enable codes defined by ATV command.**
\V1	Enable modified MNP codes.

Result Codes:

OK	n=0,1.
Error	Otherwise.

\Xn Set XON/XOFF Pass-through

This command allows or prevents the modem chip set from passing XON and XOFF characters through to the remote system.

\X0	**Process flow control characters.**
\X1	Process flow control characters and pass them through to the local or remote so they can process the characters.

Result Codes:

OK	n=0,1
Error	Otherwise

AT- (Dash) Commands

-Cn Set Calling Tone in Data Mode

This command instructs the modem to generate a FAX calling tone when originating a data call.



-C0 **Disables calling tone.**
-C1 Enables calling tone.

Result Codes:
OK n=0,1.
Error Otherwise.

-Jn Set V.42 Detect Phase

This command determines whether the originating modem sends a sequence to the answering modem to determine the type of error correction it has enabled.

-J0 Disables the V.42 detect phase.
-J1 **Enables the V.42 detect phase.**

Result Codes:
OK n=0,1.
Error Otherwise.

-Kn MNP Extended Services

This command determines whether a LAPM connection will be converted to an MNP connection. This will occur only if AT-K1 is set on both sides.

-K0 Disables MNP extend services.
-K1 **Enables MNP extend services.**

Result Codes:
OK n=0,1
Error Otherwise

-Qn Fallback Modulation Speeds (MNP 10)

This command controls whether the modem can fall back from a V.32 or V.32bis MNP reliable connection to 2400 bits/s or 1200 bits/s.

-Q0 Disables fallback to both V.22bis (2400) and V.22 (1200)
-Q1 Enables fallback to V.22bis (2400)
-Q2 **Enables fallback to V.22bis (2400 and V.22 (1200)**

Result Codes:

OK n=0,1,2
Error Otherwise

-V Display Number

This command will display “Modem Firmware Version XXXX.”

AT” (Double-quote) Commands

“Hn V.42bis Compression Control



This command controls V.42bis data compression over an error correction link.

“H0 Disable V.42bis
“H1 Enable V.42bis only when transmitting data
“H2 Disable V.42bis only when receiving data
“H3 Enable V.42bis for both directions.

Result Codes:
OK n=0.1.2
Error Otherwise

“On n = 6 - 256

This command selects the string size for V.42bis compression.

Default = 16

“Mn MNP 10 Control

This command enables and disables MNP1 10 protocol for impaired or cellular control.

“M0	Disables MNP 10 protocol.
“M1	**Enables MNP 10 protocol.**

Result Codes:

OK	n=0,1
Error	Otherwise

S Registers

The S registers are summarized below. Registers denoted with an asterisk (*) may be stored in one of the two user profiles by entering the &Wn command. One of these profiles may be loaded at any time by using the Zn command. Registers or register fields quoted as “reserved” are reserved for current or future use by the firmware, or are permanently overridden by PTT limitations.

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

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

All of the factory default values may be loaded at any time by entering the &F command. All factory defaults are for the 9.6 Data/FAX, 14.4 Data/FAX, 19.2 Data/FAX, 14.4 Data/FAX/Cell, and 14.4 Data/FAX/Voice unless otherwise specified.



S0 Ring to Autoanswer On

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

Range: 0 - 255
Default: 000
Units: Rings

S1 Ring Count

Sets the number of rings required before the modem answers a call. If no rings occur over an eight second interval, this register is cleared.

Range: 0 - 255
Default: 000
Units: Rings

S2 Escape Character

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

Range: 0 - 255
Default: 043
Units: ASCII

S3 Carriage Return <CR> Character

Sets the command line and result code terminator character. Pertains to asynchronous operation only.

Range: 0 - 127, ASCII decimal
Default: 013 (carriage return)
Units: ASCII

S4 Line Feed <LF> Character

Sets the character recognized as a line feed. Pertains to asynchronous operation only. The line feed control character is output after the carriage return control character if verbose result codes are used.

Range: 0 - 127, ASCII character
Default: 010 (Line Feed)
Units: ASCII

S5 Back Space <BS> Character

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

Range: 0 - 127, ASCII decimal
Default: 008 (Backspace)
Units: ASCII

S6 Wait Before Dialing

Sets the length of time, in seconds, that the modem must wait (pause) after going off-hook before dialing the first digit of the telephone number. The modem always pauses for a minimum of 2 seconds, even if the value of S6 is less than 2 seconds. The Wait for Dial Tone call progress feature (W dial modifier in the dial string) will override the value in register S6. This operation, however, may be affected by some ATX options according to country restrictions.

Range: 2 - 255
Default: 002
Units: seconds

S7 Wait for Carrier

Sets the time, in seconds, that the modem must wait before hanging up because a carrier is not detected. The timer is started when the modem finishes dialing (originate) or goes off-hook (answer). In originate mode, the timer is reset upon detection of an answer tone if allowed by country restrictions. This timer also specifies the wait for silence time for the @ dial modifier in seconds. S7 is not associated with the W dial modifier.

Range: 1 - 255
Default: 030 (090 for MNP 10)
Units: Seconds

S8 Pause Time for Command or Dial Modifier

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

Range: 0 - 255
Default: 002
Units: Seconds

S9 Carrier Recovery Time

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

Range: 1 - 255
Default: 006 (0.6 seconds)
Units: 0.1 seconds

S10 Lost Carrier Hang Up Delay

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

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

Range: 1 - 255
Default: 014 (14 seconds)
Units: 0.1 seconds

S11 DTMF Dialing Speed

Range: 50 - 255
Default: 095
Units: 0.001 seconds

S12 Guard Time

Defines the maximum period, in 2-hundredths of a second, allowed between consecutive asynchronous escape characters (+) for the escape sequence to be considered valid.

Range: 0 - 255
Default: 050 (1 second)
Units: 0.02 seconds

S14 Bit Mapped Options

Indicates the status of command options.

Default: (AAh), (176d), (10101010b)

Bit 0 Reserved
Bit 1 Command echo (En)
- 0 E0 is selected
- 1 E1 is selected *

Bit 2 Quite Mode (Qn)
- 0 Q0 is selected*
- 1 Q1 is selected

Bit 3 Result codes (Vn)
- 0 V0 is selected
- 1 V1 is selected *

Bit 4 Dumb Mode
- 0 dumb mode off (normal)*
- 1 dumb mode on

Bit 5 Tone (T) Pulse (P)
- 0 T is selected
- 1 P is selected

Bit 6 Reserved
Bit 7 Originate/Answer
- 0 answer
- 1 originate *

S16 Modem Test Options (read only)

Indicates the test in progress status.

Default: 000

Bit 0 Local analog loopback
- 0 local ALB disabled *
- 1 local ALB enabled (&T1)

Bit 1 Reserved
Bit 2 Local digital loopback
- 0 local DL disabled *
- 1 local DL enabled (&T3)

Bit 3 Remote digital loopback (RDL) status
- 0 RDL off *

	1	RDL on
Bit 4	RDL requested (AT&T6)	
	0	RDL not active *
	1	RDL request from distant end is in service
Bit 5	RDL w/ self-test	
	0	RDL w/ self-test disabled *
	1	RDL w/ self-test enabled (&T7)
Bit 6	Local analog loopback (ALB) w/ self-test	
	0	ALB w/ self-test disabled *
	1	ALD w/ self-test enabled (&T8)
Bit 7	Reserved	



S 18 Modem Test Timer

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

Range: 0 - 255 seconds
Default: 000

S19 Autosync Protocol Support Mode

Bit 1	0	Bisync protocol *
	1	SDLC protocol
Bit 2	0	SDLC address detect disabled *
	1	SDLC address detect enabled
Bit 3	0	NRZI bit encoding *
	1	NRZ bit encoding
Bit 4	0	Selects mark idle *
	1	Selects flag or sync idle

S20 Autosync Protocol Support Mode

In SDLC mode: SDLC address
In Bisync mode: definition of Bisync sync character

S21 Bit-Mapped Options

Indicates the status of command options.

Default: (30h), (048d), (00110000b)

Bit 0 Reserved
Bit 1 Reserved
Bit 2 CTS behavior
- 0 &R0 is selected*
- 1 &R1 is selected

Bits 4,3 DTR behavior (&Dn)
- 00 &D0 is selected
- 01 &D1 is selected
- 10 &D2 is selected *
- 11 &D3 is selected

Bit 5 RLSD (DCD) behavior (&Cn)
- 0 &C0 is selected
- 1 &C1 is selected *

Bit 6 DSR behavior (&Sn)
- 0 &S0 is selected *
- 1 &S1 is selected

Bit 7 Long space disconnect (Yn)
- 0 Y0 is selected *
- 1 Y1 is selected

S22 Bit-Mapped Options

Indicates the status of command options.

Default: (76h), (118d), (01110110b)

Bits 0,1 Speaker Volume (Ln)
- 00 L0 is selected
- 01 L1 is selected
- 10 L2 is selected *
- 11 L3 is selected

Bits 2,3 Speaker Control (Mn)
- 00 M0 is selected
- 01 M1 is selected *
- 10 M2 is selected
- 11 M3 is selected

Bits 6,5,4 Limit Result Codes (Xn)
- 000 X0 is selected
- 001 Reserved

010 Reserved
011 Reserved
100 X1 is selected
101 X2 is selected
110 X3 is selected
111 X4 is selected *

Bit 7 Dial Pulse Ratio (&Pn)
0 &P0 is selected *
1 &p1 is selected

S23 Bit Mapped Options

Indicates the status of the command options.

Default: 0Fh), (015d), (00001111b)

Bit 0 Grant PDL
0 &T5 is selected
1 &T4 is selected *

Bits 3,2,1 Assumed DTE rate
000 0 - 600 bits/s
001 600 bits/s
010 1200 bits/s
011 2400 bits/s
100 4800 bits/s
101 9600 bits/s
110 19.2 Kbits/s
111 38.4 Kbits/s or 57.6 Kbits/s *

Bits 5,4 Assumed DTE Parity
00 Even parity *
01 space parity/no parity
10 odd parity
11 mark

Bits 7,6 Guard Tone (&Gn)
00 &G0 is selected *
01 &G1 is selected
10 &G2 is selected
11 Reserved

S25 Detect DTR Change

Sets the length of time that the modem will ignore DTR for before hanging up. Its units are seconds for synchronous mode 1 and one hundredths of a second for other modes.

Range: 0 - 255 (1 second for synchronous mode 1; 0.01 second otherwise)
Default: 005

S26 RTS to CTS Delay Interval

Sets the time delay, in hundredths of a second, before the modem turns CTS ON after detecting an OFF-to-ON transaction on RTS when &R0 is commanded. Pertains to synchronous operation only.



Range: 0 - 255
Default: 001
Units: 0.01 seconds

S27 Bit-Mapped Option

Indicates the status of command options.

Default: (40h), (064d), (01000000b)

Bit 3, 1, 0 Synchronous/asynchronous selection (&Qn)
- 000 &Q0 is selected *
- 001 &Q1 is selected
- 010 &Q2 is selected
- 011 &Q3 is selected
- 100 &Q4 is selected

Bit 2 Leased Line control (&Ln)
- 0 &L0 is selected *
- 1 &L1 is selected

Bits 5,4 Internal Clock Select (&Xn)
- 00 &X0 is selected *
- 01 &X1 is selected
- 10 &X2 is selected
- 11 &X3 is selected

Bit 6 CCITT/Bell mode select (Bn)
- 0 B0 is selected
- 1 B1 is selected *

Bit 7 Reserved

S30 Inactivity Timer Value

Range: 0 - 90
Default: 000
Units: Minutes



S32 Wait for <CR> Time

Range: 0 - 255
Default: 020

S37 Desired DCE Speed

- 0 Attempt to connect at the last AT speed *
- 3 Attempt a 300 bits/s connection
- 5 Attempt a 1200 bits/s connection
- 6 Attempt a 2400 bits/s connection
- 7 Attempt a 4800 bits/s connection
- 8 Attempt a 7200 bits/s connection
- 9 Attempt a 9600 bits/s connection
- 10 Attempt a 12000 bits/s connection
- 11 Attempt a 14400 bits/s connection
- 12 Attempt a 16800 bits/s connection
- 13 Attempt a 19200 bits/s connection

S95 Extended Result Code Bit Map

Default: 00h

Bit 0 Verbose CONNECT result code indicates the DCE speed (rather than the DTE speed)

Bit 1 Append /ARQ to the verbose CONNECT result code when an error control connection is established

Bit 2 Enable the CARRIER result code
Bit 3 Enable the PROTOCOL result code
Bit 4 Reserved
Bit 5 Enable the COMPRESSION result codes
Bit 6 Enable the PROTOCOL result codes 81-88 for MNP connections (in place of result code 80)

S108 Signal Quality Selector

0 No limit
1 Low quality
2 Medium quality
3 High quality

Default: 001



S109 V.32terbo Carrier Speed Selector

Bit 0 Reserved
Bit 1 4800 bits/s *
Bit 2 7200 bits/s
Bit 3 9600 bits/s
Bit 4 12.0 Kbits/s
Bit 5 14.4 Kbits/s
Bit 6 16.8 Kbits/s (if applicable)
Bit 7 19.2 Kbits/s (if applicable)

S110 V.32/V.32bis/V.32terbo Selector

0 V.32 enabled
1 V.32bis enabled
2 V.32bis and automatic rate renegotiation enabled
3 V.32terbo enabled
4 V.32terbo and automatic rate renegotiation

Default: 002 (004 for 19.2 Data/FAX)

S112 DTE Speed Select During Data Transfer

0	Last AT speed *
1	Reserved
2	300 bits/s
3	1200 bits/s
4	2400 bits/s
5	4800 bits/s
6	7200 bits/s
7	9600 bits/s
8	12.0 Kbits/s
9	14.4 Kbits/s
10	16.8 Kbits/s
11	19.2 Kbits/s
12	38.4 Kbits/s
13	57.6 Kbits/s
14	600 bits/s

Default: 000

V.25bis Commands Set

The following commands are implemented, and parameters applicable to each command are noted following the description of the command.

CIC Enable Autoanswer

The modem will go on-line in answer mode canceling any DIC command previously issued. If no incoming call is present, the modem will issue the invalid message.

CRN Dial Command

The modem will go on-line, according to the dial string entered, and attempt to establish a connection.

0-9	Digits 0 through 9
A-D	TONE DIALING ONLY
*	The star sign: tone dialing only
#	The pound sign: tone dialing only
T	Select tone dialing: affects current and subsequent dialing
P	Select pulse dialing: affects current and subsequent dialing
<	Short dial pause: period controlled by S8: the modem will pause before dialing the digits following "<"
=	Long dial pause: period twice as long as the short dial pause
:	Wait for dial tone: the modem will wait for dial tone before dialing the digits following ":"
&	Flash: the modem will go off-line for 0.25 s. then return on line

CRS Dial Stored Number

The modem will go on-line, dial according to the dial string entered in the dial string memory addressed, and attempt to establish a connection.

0-2	Dial string memory address

DIC Disable Autoanswer

The modem, though configured for autoanswer, will disregard the incoming call. If there is no incoming call or autoanswer is not enabled, the modem will issue the invalid message, the command not being applicable to the subsequent incoming calls.

PRN Store Telephone Number

The modem will store the dial string specified into the dial string memory referenced.

0-2	Dial string memory address
:	Separator: inserted between dial string memory address and dial string
x..x	Dial string: A string of dial characters. An empty string clears the identification memory referenced. The maximum length of the dial string is 18 characters. The following characters are accepted: 0-9, A-d, *, #, T, P, <, >, +, :, &.

RLD Display Delayed Numbers

The modem will return the list of numbers which have been delayed by country-dependent blacklisting procedures.

NO-LSD1	Phone Number	Delay
	12345	1

RLN Display Stored Numbers

The modem will return the dial string or the list of dial strings according to the parameter supplied.

0-2 Dial string memory address: If no address is supplied, a full set of all stored dial strings will be returned.



Standard V.25bis Indications

The modem provides the indications/responses listed, and parameters applicable to each message are noted following the description of the response.

CFI Call Failure Indication

The modem sends this message when a call fails to connect. A parameter is included to give the reason for the failure.

AB No dial tone or the call abort timer expired with no call progress tone detected or during handshaking after answer tone detected
CB Local circuit busy (phone off-hook)
ET Busy (engaged tone) detected
FC Requested number on forbidden call list (call not placed)
NS No number stored at dial string memory requested (call not placed)
NT Ringback detected: Ringback stopped: Call abort timer expired with no answer tone detected
RT Ringback detected: Call abort timer expired with ringback still detected

CNX Connect

The modem returns this message when a connection has been established. The message may be followed by a value indicating the connection speed (e.g., CNX 9600).

DLC Delayed Call

The modem returns this message when a call fails to connect and the number dialed is considered delayed. The message indicates the delay (in minutes) before the call may be reattempted as shown in the following example:

DLCn

This message will be preceded by the message indicating call failure.



INC Incoming Call

The modem will send this message when incoming ringing is detected on the line.

INV Invalid

The modem will send this message if the command line contains a syntax error, or if it is unable to execute the command.

LSD List of Delayed Call Numbers

The modem will return this message in response to the RLD command as shown by the example following:

NO	*Phone Number*	*Delay*
LSD 1	7503857609	2
LSD 2	1349579050	1
LSD 3	4146949385	1
LSD 4	3479784564	3
LSD 5	5529685740	1

LSN List of Stored Numbers (Dial Strings)

The modem will return this message in response to the RLN command.

LSN 0 Response to RLN
LSN 1
LSN 2

VAL Valid

The modem will send this message when it successfully executes the command issued and there is no other applicable response (message or circuit transition).

Result Codes

The EXM-31 responds to commands with result codes, which may be numerical or English-language phrases. Numerical responses consist of a numerical character followed by a CR (carriage return) character. Phrase responses are preceded and followed by a CR/LF character sequence. The result codes are shown in the following table. For additional result code information refer to S Register 95.

Digit Code	Word Code	Meaning
0	OK	Command line executed successfully
1	CONNECT	Connection successful
2	RING	Ringing signal detected
3	NO CARRIER	Carrier lost or not present
4	ERROR	Invalid command, checksum, command line, or command-line length
5	CONNECT xxxx	Connection at stated bps
6	NO DIALTONE	No dial tone detected
7	BUSY	Busy signal detected
8	NO ANSWER	No silence detected when dialing a system not providing a dial tone

Table 5. Result Codes.

5. Support and Service

In North America

Technical Support

RadiSys maintains a technical support phone line at (503) 646-1800 that is staffed weekdays (except holidays) between 8 AM and 5 PM Pacific time. If you have a problem outside these hours, you can leave a message on voice-mail using the same phone number. You can also request help via electronic mail or by FAX addressed to RadiSys Technical Support. The RadiSys FAX number is (503) 646-1850. The RadiSys E-mail address on the Internet is *support@radisys.com*. If you are sending E-mail or a FAX, please include information on both the hardware and software being used and a detailed description of the problem, specifically how the problem can be reproduced. We will respond by E-mail, phone or FAX by the next business day.

Technical Support Services are designed for customers who have purchased their products from RadiSys or a sales representative. If your RadiSys product is part of a piece of OEM equipment, or was integrated by someone else as part of a system, support will be better provided by the OEM or system vendor that did the integration and understands the final product and environment.

Bulletin Board

RadiSys operates an electronic bulletin board (BBS) 24 hours per day to provide access to the latest drivers, software updates and other information. The bulletin board is not monitored regularly, so if you need a fast response please use the telephone or FAX numbers listed above.

The BBS operates at up to 14400 baud. Connect using standard settings of eight data bits, no parity, and one stop bit (8, N, 1). The telephone number is (503) 646-8290.

Repair Services

Factory Repair Service is provided for all RadiSys products. Standard service for all RadiSys products covers factory repair with customers paying shipping to the factory and RadiSys paying for return shipment. Overnight return shipment is available at customer expense. Normal turn-around time for repair and re-certification is five working days.

Quick Exchange services (immediate shipment of a loaner unit while the failed product is being repaired) or other extra-cost services can be arranged, but need to be negotiated in advance to allow RadiSys to pool the correct product configurations. RadiSys does not maintain a general "loaner" pool: units are available only for customers that have negotiated this service in advance.

RadiSys does not provide a fixed-price "swap-out" repair service, as customers have indicated that issues of serial number tracking and version control make it more convenient to receive their original products back after repair.

Warranty Repairs

Products under warranty (see warranty information in the front of this manual) will have manufacturing defects repaired at no charge. Products sent in for warranty repair that have no faults will be subject to a recertification charge. Extended Warranties are available and can be purchased at a standard price for any product still under warranty. RadiSys will gladly quote prices for Extended Warranties on products whose warranties have lapsed; contact the factory if this applies.

Customer induced damage (resulting from misuse, abuse, or exceeding the product specifications) is not covered by the standard product warranty.

Non-Warranty Services

There are several classes of non-warranty service. These include repair of customer induced problems, repairs of failures for products outside the warranty period, recertification (functional testing) of a product either in or out of warranty, and procurement of spare parts.

All non-warranty repairs are subject to service charges. RadiSys has determined that pricing repairs based on time and materials is more cost-effective for the customer than a flat-rate repair charge. When product is received, it will be analyzed and, if appropriate, a cost estimate will be communicated to the customer for authorization. After the customer authorizes the repair and billing arrangements have been made, the product will be repaired and returned to the customer.

A recertification service is provided for products either in or out of warranty. This service will verify correct operation of a product by inspection and testing of the product with standard manufacturing tests. There is a product-dependent charge for recertification.

There are only a few components that are generally considered field-repairable, but, because RadiSys understands that some customers want or need the option of repairing their own equipment, all components are available in a spares program. There is a minimum billing charge associated with this program.

Arranging Service

To schedule service for a product, please call RadiSys Technical Support directly at (503) 646-1800. Have the product model and serial numbers available, along with a description of the problem. A Technical Support representative will issue a Returned Materials Authorization (RMA) number, a code number by which we track the product while it is being processed. Once you have received the RMA number, follow the instructions of the Technical Support representative and return the product to us, freight prepaid, with the RMA number clearly marked on the exterior of the package. If possible re-use the original shipping containers and packaging. In any case, be sure you follow good ESD-control practices when handling the product, and ensure that anti-static bags and packing materials with adequate padding and shock-absorbing properties are used.

Ship the product, freight prepaid, to

Product Service Center
RadiSys Corporation
15025 SW Koll Parkway
Beaverton, Oregon 97006-6902

When shipping the product, include the following information: return address, contact names and phone numbers in purchasing and engineering, and a description of the suspected problem. Any ancillary information that might be helpful with the debugging process will be appreciated.

Other Countries

Contact the sales organization from which you purchased your RadiSys product for service and support.

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