Rockwell

SSV288ACW SocketModem™ Family

INTRODUCTION

Rockwell's SSV288ACW SocketModem™ family provides the OEM with a complete V.34 data/fax/voice modem in a compact socket-mountable module. This complete solution allows OEMs to bring new features to market immediately, with minimal engineering resources. Its socketable design provides system designers the flexibility to include optional modem functionality in any system product. The small size of the modem module makes it ideally suited for use directly on portable computer motherboards, in pocket modems, embedded control applications, or anywhere users demand computer communications on the go.

As a data modem, the SocketModem operates at line speeds to 28800 bps. Error correction (V.42/MNP 2-4) and data compression (V.42bis/MNP 5) maximize data transfer integrity and boost data throughput beyond the normal maximum DTE speed. The SocketModem also operates in non-error-correcting mode.

As a fax modem, the SocketModem supports Group 3 send and receive rates up to 14400 bps and supports T.30 protocol.

In voice mode, enhanced Adaptive Differential Pulse Coded Modulation (ADPCM) coding and decoding supports efficient digital storage of voice using 2-bit or 4-bit compression and decompression at 7200 bps.

The SSV288ACW SocketModem is available with serial EIA-232, serial TTL, or parallel host interface.

The SSV288ACW SocketModem is identical to the SMV288ACW SocketModem with the addition of ~ES4 chip select signal in all models and the addition of synchronous DTE support in the serial TTL model.

Parallel interface models support business audio and the Integrated Communications System (ICS) program. These models support applications such as digital answering machine, voice annotation, and audio file play/record.

In audio mode, the modem supports record and playback of monophonic audio data in 8-bit unsigned linear pulse code modulation (PCM) format at 11.025 kHz or 7200 Hz sampling rate.

Additional SSV288ACW information can be found in the SocketModem™ Designer's Guide (Order No. 1009) and in the RC288ACL Modem Designer's Guide (Order No. 1056).

FEATURES

- Data modem throughput up to 115.2 kbps
  - V.34, V.FC, V.32 bis, V.32, V.22 bis, V.22A/B, V.23, and V.21
  - Bell 212A and 103
  - V.42 LAPM and MNP 2-4 error correction
  - V.42 bis and MNP 5 data compression
- MNP 10 data throughput enhancement
- MNP 10EC™ enhanced cellular performance
- Hayes AutoSync
- Fax modem send and receive rates up to 14.4 kbps
  - V.33, V.17, V.29, V.27ter, and V.21 channel 2
- Voice mode
  - Enhanced ADPCM compression/decompression
  - Tone detection/generation and call discrimination
  - Concurrent DTMF detection
- Business audio mode (with parallel bus interface)
  - Record or playback monophonic data using 8-bit audio data encoding at 11.025 kHz or 7200 Hz
- VoiceView alternating voice and data (AVD)
- World-class operation
  - Call progress, blacklisting, multiple country support
- ConfigurACE™ utility program
- Communication software compatible command sets - AT, fax class 1 and class 2, and voice commands
- Serial EIA-232, serial TTL, or parallel DTE/host interface
  - Serial EIA/TIA-232-E DTE: Asynchronous
  - Serial TTL DTE: Asynchronous and synchronous
  - Parallel host: 16550A UART compatible
  - Interface speed to 115.2 kbps
- NVRAM directory and stored profiles
- Line quality monitoring and retrain
- Flow control and speed buffering
- Automatic format/speed sensing to 115.2 kbps
- Auto dial and auto answer; tone and pulse dialing
- Calling Number Delivery (Caller ID) detect
- Diagnostics
- Single +5VDC power supply
- Low power consumption (typical):

Interface	Operating	Sleep
Serial EIA-232	940 mW	171 mW
Serial TTL	810 mW	26 mW
Parallel	800 mW	21 mW

Patent Pending

Data Sheet
(Preliminary)

Order No. MD136
June 30, 1995

ORDERING INFORMATION

Part Number	Function
SSV288ACW-H0-D0-A0-P0	Data/Fax/Voice World-class V.34 SocketModem with parallel interface, customer-designed DAA interface, 0.400" pins
SSV288ACW-H1-D0-A0-P0	Data/Fax/Voice World-class V.34 SocketModem with TTL serial interface, customer-designed DAA interface, 0.400" pins
SSV288ACW-H2-D0-A0-P0	Data/Fax/Voice World-class V.34 SocketModem with EIA-232 serial interface, customer-designed DAA interface, 0.400" pins

TECHNICAL SPECIFICATIONS

GENERAL DESCRIPTION

Modem Data Pump. SSV288ACW SocketModems use Rockwell V.34 Data Pumps.

Microcontroller (MCU). The microcontroller (MCU) performs the command processing and host interface functions. The MCU is a Rockwell L39 microcomputer. The MCU connects to the host via a V.24 (EIA/TIA-232-E) or TTL serial interface or a 16550A-compatible parallel microcomputer bus. The MCU also connects to the OEM-supplied 128k-byte ROM.

MCU Firmware. MCU firmware performs processing of general modem control, command sets, error correction, data compression, MNP 10, Hayes Autosync, fax Class 1 and Class 2, voice/audio, VoiceView, and DTE/host interface functions. The MCU firmware is provided by Rockwell in object code form for the OEM to program into external ROM. The MCU firmware may also be provided in source code form under a source code addendum license agreement.

MODEL-DEPENDENT SUPPORTED INTERFACES

Parallel Host Interface

The parallel host configuration supports a 16550A UART-compatible interface with eight data lines, three address lines, and five control lines.

Serial EIA-232 DTE Interface and Indicator Outputs

Serial Interface. The serial V.24 / EIA/TIA-232-E configuration supports the asynchronous DTE interface with 8 lines signals at V.24 / EIA/TIA-232-E voltage levels and signal ground.

Indicator Interface. Four direct connect LED indicator outputs are supported.

Serial TTL DTE Interface and Indicator Outputs

Serial Interface. The serial V.24/EIA-232-E configuration supports the asynchronous DTE interface with 8 lines signals at TTL voltage levels and signal ground.

An additional 3 lines at TTL voltage levels are provided to support the synchronous DTE interface.

Indicator Interface. Four direct connect LED indicator outputs are supported.

COMMON SUPPORTED INTERFACES

External Bus Interface (High Speed)

An external bus interface is provided on SSV288ACW SocketModems to OEM-supplied 128k-byte ROM. The non-multiplexed bus supports eight bidirectional data lines and 17 address lines.

The ~ES4 chip select output is also provided.

Line Interface

The SocketModem connects to the line interface circuitry via a receive analog input, two transmit analog outputs, and a ring signal input. The relay outputs are designed to drive Caller ID and Voice (local handset) relays.

The SocketModem provides four relay control outputs to the line interface. These outputs may be used to control relays such as off-hook, pulse, mute, and earth.

A 2.5 VDC reference voltage is also provided.

Speaker Interface

A speaker output, controlled by AT commands, is provided for an optional OEM-supplied speaker circuit.

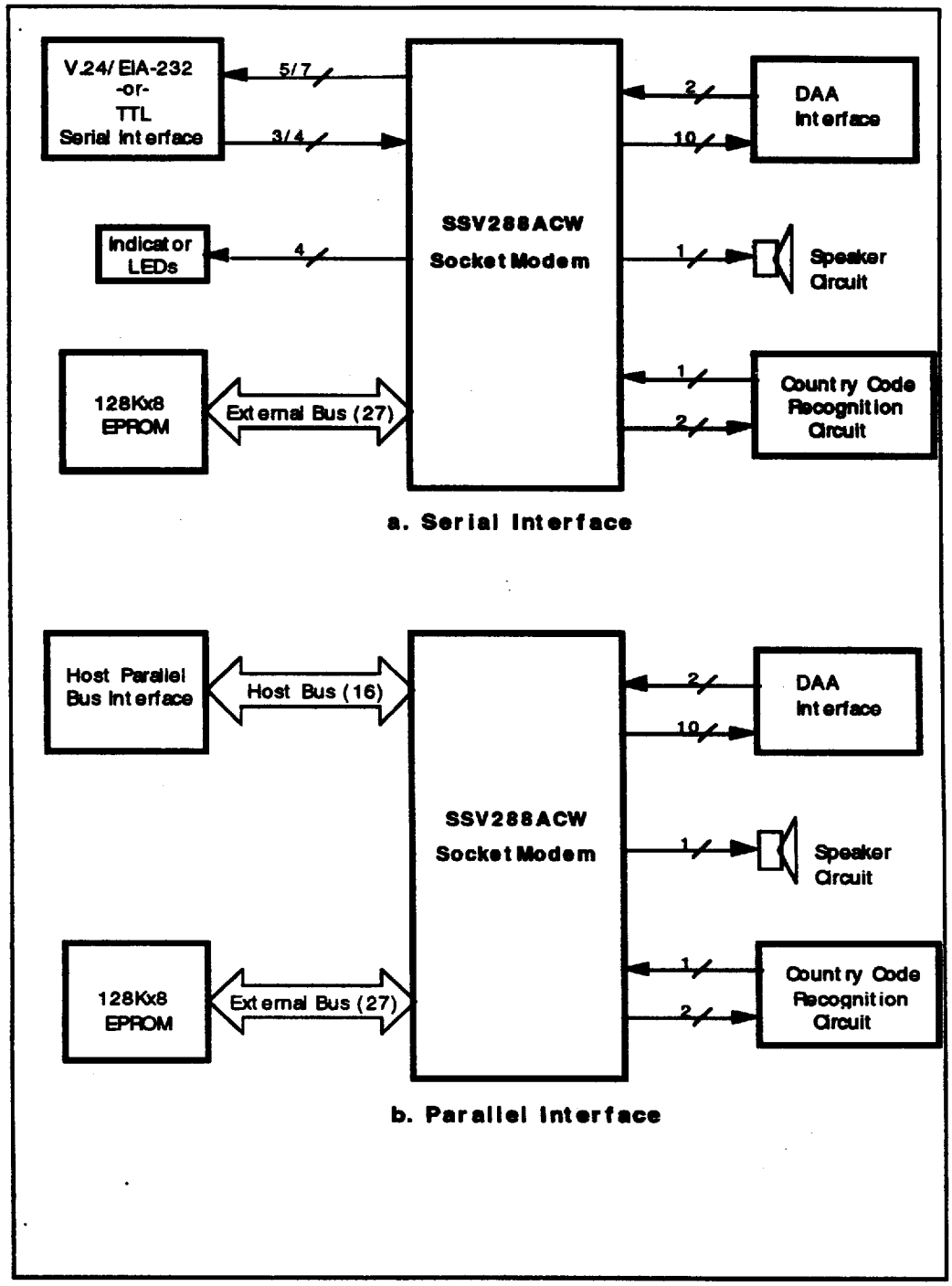

Figure 1. SocketModem Integrated System Block Diagram

COMMANDS

The modem supports data modem, fax Class 1 and Class 2, MNP 10, voice/audio, VoiceView, and W-Class commands (Table 1), and S Registers (Table 2). The AT commands and S registers are described in the AT Command Reference Manual (Order No. 1048).

Data Modem Operation. All models operate as a data modem in response to the basic AT commands when +FCLASS=0. Default parameters support US/Canada operation.

Fax Modem Operation. Facsimile functions operate in response to fax class 1 commands when +FCLASS=1 or #CLS=1 or to fax class 2 commands when +FCLASS=2 or #CLS=2.

Voice Operation. Voice mode functions operate in response to voice commands when #CLS=8 and either #VBS=2 or #VBS=4 is selected.

Audio Operation. Audio mode functions operate in response to voice/audio commands when #CLS=8 and #VBS=8 is selected.

VoiceView Operation. VoiceView alternating voice and data functions operate in response to VoiceView commands.

MNP 10 Operation. MNP 10 functions operate in response to MNP 10 commands.

World-Class (W-Class) Operation. W-class functions operate in response to W-class AT commands.

Table 1. AT Commands

Command	Function
	Basic Commands
A/	Re-execute command
A	Answer a call
Bn	Set CCITT or Bell Mode
Cn	Carrier control
Dn	Dial (originate a call)
E	Command echo
Fn	Select line modulation
Hn	Disconnect (hang-up)
In	Identification
Ln	Speaker volume
Mn	Speaker control
Nn	Automode enable
On	Return to on-line data mode
P	Set pulse dial default
Qn	Quiet results codes control
Sn=x	Write to S Register
Sn?	Read S Register
T	Set tone dial default
Vn	Result code form
Wn	Error correction message control
Xn	Extended result codes
Yn	Long space disconnect
Zn	Soft reset and restore profile

Table 1. AT Commands (Cont'd)

Command	Function
&Cn	RLSD (DCD) option
&Dn	DTR option
&F	Restore factory configuration (profile)
&Gn	Select guard tone
&Jn	Telephone jack control
&Kn	Flow control
&Mn	Asynchronous/synchronous mode selection
&Pn	Select pulse dial make/break ratio
&Qn	Asynchronous/synchronous mode selection
&Rn	RTS/CTS option
&Sn	DSR override
&Tn	Test and diagnostic
&V	Display current configuration and profiles
&Wn	Store current configuration
&Xn	Select synchronous clock source
&Yn	Designate a default reset profile
&Zn=x	Store phone number
+MS	Modulation select
%En	Enable/disable line quality monitor and auto-retrain or fallback/fall forward
%L	Report line signal level
%Q	Report line signal quality
%TTn	PTT testing utilities
\Kn	Break control
\Nn	Operating mode
#CID	Caller ID detection and reporting
-SDR	Enable/disable distinctive ring
**	Download to flash memory
	Cellular Commands
^C2	Download Cellular Phone Driver
^I	Identify Cellular Phone Driver
^T6	Indicate Status Of Cellular Phone

Table 1. AT Commands (Cont'd)

Command	Function
	ECC Commands
%C	Select data compression
\An	Maximum MNP block size
\Bn	Transmit BREAK to remote
	MNP 10 Commands
)Mn	Enable/disable cellular power level adjust
* Hn	Set link negotiation speed
-Kn	MNP extended services
-Qn	Enable fallback to V.22 bis/V.22
-SEC=n	Enable MNP 10EC
@Mn	Select initial transmit level
:E	Compromise equalizer enable
	Fax Class 1 Commands
+FCLASS=n	Service class
+FAE	Data/fax auto answer
+FTS=n	Stop transmission and wait
+FRS=n	Receive silence
+FTM=n	Transmit data
+FRM=n	Receive data
+FTH=n	Transmit data with HDLC framing
+FRH=n	Receive data with HDLC framing
	Fax Class 2 Commands
+FCLASS=n	Service class
	Class 2 Action Commands
+FCIG	Set the polled station identification
+FDT	Data transmission
+FET=N	Transmit page punctuation
+FDR	Begin or continue Phase C receive data
+FK	Terminate session
+FLPL	Document for polling
+FSPL	Enable polling
	Class 2 DCE Responses
+FCIG:	Report the polled station identification
+FCON	Facsimile connection response
+FDCS:	Report current session
+FDIS:	Report remote capabilities
+FDTC:	Report the polled station capabilities
+FCFR	Indicate confirmation to receive
+FTSI:	Report the transmit station ID
+FCSI:	Report the called station ID
+FPTS:	Page transfer status
+FET:	Post page message response
+FHNG:	Call termination with status
+FPOLL	Indicates polling request

Table 1. AT Commands (Cont'd)

Command	Function
	Class 2 Session Parameters
+FMFR?	Identify manufacturer
+FMDL?	Identify model
+FREV?	Identify revision
+FDCC	DCE capabilities parameters
+FDIS	Current sessions parameters
+FDCS	Current session results
+FLID	Local ID string
+FPTS	Page transfer status
+FCR	Capability to receive
+FAA	Adaptive answer
+FBUF?	Buffer size (read only)
+FPHCTO	Phase C time out
+FAXERR?	Fax error value
+FBOR	Phase C data bit order
	Voice Commands
#BDR	Select baud rate
#CLS	Select data, fax, or voice
#MDL?	Identify model
#MFR?	Identify manufacturer
#REV?	Identify revision level
#VBQ?	Query buffer size
#VBS	Bits per sample
#VBT	Beep tone timer
#VCI?	Identify compression method
#VLS	Voice line select
#VRA	Ringback goes away timer (originate)
#VRN	Ringback never came timer (originate)
#VRX	Voice receive mode
#VSD	Enable silence deletion
#VSK	Buffer skid setting
#VSP	Silence detection period (voice receive)
#VSR	Sampling rate selection
#VSS	Silence detection tuner (voice receive)
#VTD	DTMF/tone reporting
#VTS	Generate tone signals
#VTX	Voice transmit mode

Table 1. AT Commands (Cont'd)

Command	Function
	VoiceView Commands
+FCLASS=n	Service class
-SVV	Originate VoiceView data mode
-SAC	Accept data mode request
-SIP	Initialize VoiceView parameters
-SIC	Reset capabilities data to default setting
-SSQ	Initiate capabilities query
-SDA	Originate modem data mode
-SFX	Originate FAX data mode
-SMT	Mute telephone
-SDS	Disable switchhook status monitoring
-SQR	Capabilities query response control
-SCD	Capabilities data
-SER?	Error status (read only)
-SSP	VoiceView transmission speed
-SSR	Start sequence response control
+FLO	Flow control select
+FPR	Serial port rate control
-SSV	VoiceView data mode start sequence event
-SFA	Facsimile data node start sequence event
-SMD	Modem data mode start sequence event
-SRA	Receive ADSI response event
-SRQ	Receive capabilities query event
-SRC:	Receive capabilities information event
-STO	Talk-off event
	W-Class Commands
*B	Display blacklisted numbers
*D	Display delayed numbers
*NCnn	Country select

Table 2. S Registers

Register	Function
S0	Rings to auto-answer
S1	Ring counter
S2	Escape character
S3	Carriage return character
S4	Line feed character
S5	Backspace character
S6	Maximum time to wait for dial tone
S7	Wait for carrier
S8	Pause time for dial delay modifier
S9	Carrier detect response time
S10	Carrier loss disconnect time
S11	DTMF tone duration
S12	Escape prompt delay
S13	Reserved
S14	General bit mapped options
S15	Reserved
S16	Test mode bit mapped options (&T)
S17	Reserved
S18	Test timer
S19	AutoSync Bit Mapped Options
S20	AutoSync HDLC Addr or BSC Sync Char
S21	V24/general bit mapped options
S22	Speaker/results bit mapped options
S23	General bit mapped options
S24	Sleep inactivity timer
S25	Delay to DTR (CT108) off
S26	RTS-to-CTS (CT105-to-CT106) delay
S27	General bit mapped options
S28	General bit-mapped options
S29	Flash modifier time
S30	Inactivity timer
S31	General bit-mapped options
S32	XON character
S33	XOFF character
S34-S35	Reserved
S37	Line connection speed
S38	Delay before forced hangup
S39	Flow control
S40	General bit-mapped options
S41	General bit-mapped options
S42-S45	Reserved
S91	PSTN transmit attenuation level
S92	Fax transmit attenuation level
S95	Result code messages control
	ECC S Registers
S36	LAPM failure control
S46	Data compression control
S48	V.42 negotiation control
S82	Break handling control
S86	Call failure reason code
	Cellular Registers
S201	Cellular transmit level

DTE SERIAL INTERFACE OPERATION

Automatic Speed/Format Sensing

Command Mode and Data Modem Mode. The modem can automatically determine the speed and format of the data sent from the DTE. The modem can sense speeds of 300, 600, 1200, 2400, 4800, 7200, 9600, 12000, 14400, 16800, 19200, 21600, 24000, 26400, 28800, 38400, 57600, and 115200 bps and the following data formats:

Parity	Data Length (No. of Bits)	No. of Stop Bits	Character Length (No. of Bits)
None	7	2	10
Odd	7	1	10
Even	7	1	10
None	8	1	10
Odd	8	1	11*
Even	8	1	11*

* 11-bit characters are sensed, but the parity bits are stripped off during data transmission in Normal and Error Correction modes. Direct mode does not strip off the parity bits.

The modem can speed sense data with mark or space parity and configures itself as follows:

DTE Configuration	Modem Configuration
7 mark	7 none
7 space	8 none
8 mark	8 none
8 space	8 even

Fax Modem Mode. The DTE to modem data rate is 19200 bps.

HOST PARALLEL BUS INTERFACE OPERATION

Command Mode and Data Modem Mode. The modem can operate at rates up to 115200 bps by programming the Divisor Latch in the parallel interface registers.

Fax Modem Mode. The host to modem data rate is 19200 bps.

ESTABLISHING DATA MODEM CONNECTIONS

Telephone Number Directory

The modem supports four telephone number entries in a directory that can be saved in a serial NVRAM. Each telephone number can be up to 35 characters in length. A telephone number can be saved using the &Zn=x command, and a saved telephone number can be dialed using the DS=n command.

Dialing

DTMF Dialing. DTMF dialing using DTMF tone pairs is supported in accordance with CCITT Q.23. The transmit tone level complies with Bell Publication 47001.

Pulse Dialing. Pulse dialing is supported in accordance with EIA/TIA-496-A.

Blind Dialing. The modem can blind dial in the absence of a dial tone if enabled by the X0, X1, or X3 command.

Modem Handshaking Protocol

If a tone is not detected within the time specified in the S7 register after the last digit is dialed, the modem aborts the call attempt.

Call Progress Tone Detection

Ringback, equipment busy, and progress tones can be detected in accordance with the applicable standard.

Answer Tone Detection

Answer tone can be detected over the frequency range of 2100 ± 40 Hz in CCITT modes and 2225 ± 40 Hz in Bell modes.

Ring Detection

A ring signal can be detected from a TTL-compatible 15.3 Hz to 68 Hz square wave input.

Billing Protection

When the modem goes off-hook to answer an incoming call, both transmission and reception of data are prevented for 2 seconds (data modem) or 4 seconds (fax adaptive answer) to allow transmission of the billing signal.

Connection Speeds

The modem functions as a data modem when the +FCLASS=0 command is active. Line connection is selected using the +MS command in accordance with the draft PN-3320 standard presented to the TR30-4 committee (which is a candidate for the definition of V.25 ter at the ITU). The +MS command selects modulation, enables/disables automode, and selects minimum and maximum line speeds. ATNn and S37=n commands are supported up to V.32 bis speeds (Table 3).

Automode

Automode detection can be enabled by the +MS command to allow the modem to connect to a remote modem in accordance with draft PN-3320 for V.34. Alternatively, N1 commands allow the modem to connect to a remote modem in accordance with EIA/TIA-PN2330 for V.32 bis speeds and lower.

Table 3. Connection Speed Options

Configuration	Rate (bps)
V.34	28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, or 2400
V.FC	28800, 26400, 24000, 21600, 19200, 16800, or 14400
V.32 bis	14400, 12000, 9600, 7200, or 4800
V.32	9600 or 4800
V.22 bis	2400 or 1200
V.22	1200
V.23	1200Tx/75Rx or 75Tx/1200Rx
V.21	300
Bell 212A	1200
Bell 103	300

DATA MODE

Data mode exists when a telephone line connection has been established between modems and all handshaking has been completed.

Speed Buffering (Normal Mode)

Speed buffering allows a DTE to send data to, and receive data from, a modem at a speed different than the line

speed. The modem supports speed buffering at all line speeds.

Flow Control

DTE-to-Modem Flow Control. If the modem-to-line speed is less than the DTE-to-modem speed, the modem supports XOFF/XON or RTS/CTS flow control with the DTE to ensure data integrity.

Escape Sequence Detection

The "+++" escape sequence can be used to return control to the command mode from the data mode. Escape sequence detection is disabled by an S2 Register value greater than 127. Escape sequence detection is disabled in synchronous mode.

BREAK Detection

The modem can detect a BREAK signal from either the DTE or the remote modem. The \Kn command determines the modem response to a received BREAK signal.

Telephone Line Monitoring

GSTN Cleardown (V.34, V.FC, V.32 bis, V.32). Upon receiving GSTN Cleardown from the remote modem in a non-error correcting mode, the modem cleanly terminates the call.

Loss of Carrier (V.22 bis and Below). If carrier is lost for a time greater than specified by the S10 register, the modem disconnects (except MNP 10).

Receive Space Disconnect. If selected by the Y1 command in non-error-correction mode, the modem disconnects after receiving 1.6 ± 10% seconds of continuous SPACE.

Send SPACE on Disconnect

If selected by the Y1 command in non-error-correction mode, the modem sends 4 ± 10% seconds of continuous SPACE when a locally commanded hang-up is issued by the &Dn or H command.

Fall Forward/Fallback

During initial handshake, the modem will fallback to the optimal line connection within the current modulation depending upon signal quality if automode is enabled.

When connected in V.34/V.FC/V.32 bis/V.32 mode, the modem will fall forward or fallback to the optimal line speed within the current modulation depending upon signal quality if fall forward/fallback is enabled by the %E2 command.

Retrain

The modem may lose synchronization with the received line signal under poor line conditions. If this occurs, retraining may be initiated to attempt recovery depending on the type of connection.

The modem initiates a retrain if line quality becomes unacceptable if enabled by the %E command. The modem continues to retrain until an acceptable connection is achieved, or until 30 seconds elapse which will result in telephone line disconnect.

Programmable Inactivity Timer

The modem will disconnect from the line if data is not sent or received for a specified length of time. In normal or error-correction mode, this inactivity timer is reset when data is received from either the DTE or from the line. This timer can be set to a value between 0 and 2550 seconds by using register S30. A value of 0 disables the inactivity timer.

Synchronous Data Mode (TTL Serial Interface Only)

The modem can establish a synchronous connection in accordance with the &Mn or &Qn commands. Upon completing the physical handshake, the modem enters synchronous data mode. The inactivity timer is not used during synchronous data mode.

Direct Mode (Serial Interface Only)

The Direct mode allows data to be transmitted and received directly from the DTE and remote modem. The Direct mode is selected with the &Q0 or \N1 command. In Direct mode, no flow control characters are recognized or transmitted, the modem cannot execute error correction, and the inactivity timer is not used.

DTE Signal Monitoring

~DTR. When ~DTR is asserted, the modem responds in accordance with the &Dn and &Qn commands.

~RTS. ~RTS is used for flow control if enabled by the &K command in normal or error-correction mode, or to affect the ~CTS output if enabled by the &R command in synchronous mode.

ERROR CORRECTION AND DATA COMPRESSION

V.42 Error Correction

V.42 supports two methods of error correction: LAPM and, as a fallback, MNP 4. The modem provides a detection and negotiation technique for determining and establishing the best method of error correction between two modems.

MNP 2-4 Error Correction

MNP 2-4 is a data link protocol that uses error correction algorithms to ensure data integrity. Supporting stream mode, the modem sends data frames in varying lengths depending on the amount of time between characters coming from the DTE.

V.42 bis Data Compression

V.42 bis data compression mode, enabled by the %Cn command or S46 register, operates when a LAPM or MNP 10 connection is established.

The V.42 bis data compression employs a "string learning" algorithm in which a string of characters from the DTE is encoded as a fixed length codeword Two 2k-byte dictionaries, dynamically updated during normal operation, are used to store the strings.

MNP 5 Data Compression

MNP 5 data compression mode, enabled by the %Cn command, operates during an MNP connection.

In MNP 5, the modem increases its throughput by compressing data into tokens before transmitting it to the remote modem, and by decompressing encoded received data before sending it to the DTE.

MNP 10 DATA THROUGHPUT ENHANCEMENT

MNP 10 protocol, cellular functionality, and MNP Extended Services enhance performance under adverse channel conditions such as those found in rural, long distance, or cellular environments. An MNP 10 connection is established when an MNP 2-4 connection is negotiated with a remote modem supporting MNP 10. MNP 10 functions include:

Robust Auto-Reliability. A higher connection success rate is achieved by attempting to overcome channel interference during the modem negotiation phase while maintaining backward compatibility with non-MNP 10 modems.

Negotiated Speed Upshift. Initial connection and MNP handshake is performed at the most dependable speed, then the connection upshifts to the highest supported modem/channel speed. This function is particularly useful for channel conditions with high connection failure rates.

Aggressive Adaptive Packet Assembly. Frame size is dynamically changed to quickly adapt to varying levels of interference.

Dynamic Speed Shifting. Connection speed is shifted upward or downward to optimize data throughput for the channel conditions by continuously monitoring the line quality and link performance.

Dynamic Transmit Level Adjustment (DTLA). When enabled by the)M1 command, transmit level is dynamically adjusted to adapt to the varying cellular network environment, and to prevent "clipping" which causes data corruption due to the Preemphasis and Compander effect.

MNP Extended Services. The modem can revert from V.42 bis/LAPM operation to MNP operation when MNP extended services is enabled by the local and remote modems.

V.42 bis/MNP 5 Support. V.42 bis/MNP 10 can operate with V.42 bis or MNP 5 data compression.

MNP 10EC™ ENHANCED CELLULAR CONNECTION

A traditional landline modem, when used for high-speed cellular data transmission, typically encounters frequent signal interference and degradation in the connection due to the characteristics of the analog cellular network. In this case, cellular-specific network impairments, such as non-linear distortion, fading, hand-offs, and high signal-to-noise ratio, contribute to an unreliable connection and lower data transfer performance. Implementations relying solely on protocol layer methods, such as MNP 10, generally cannot compensate for the landline modem's degraded cellular channel performance.

The modem achieves higher cellular performance by implementing enhanced cellular connection techniques at both the physical and protocol layers, depending on modem model. The MDP enhances the physical layer within the modulation by optimizing its responses to sudden changes in the cellular connection. The MNP 10EC protocol layer implemented in the MCU firmware improves data error identification/correction and maximizes data throughput by dynamically adjusting speed and packet size based on signal quality and data error performance.

AUTOSYNC

Hayes AutoSync mode, when used with communications software incorporating the Hayes Synchronous Interface (HSI), provides synchronous communication capabilities from an asynchronous data terminal. In AutoSync, the modem places the call asynchronously then automatically switches to synchronous operation once the telephone connection has been established. AutoSync allows communication from an asynchronous DTE (typically a personal computer) to synchronous DTE (typically a mainframe computer or minicomputer).

FAX CLASS 1 AND CLASS 2 OPERATION

The modem operates as a facsimile (fax) DCE whenever the +FCLASS=1 or +FCLASS=2 command is active. In the fax mode, the on-line behavior of the modem is different from the data (non-fax) mode. After dialing, modem operation is controlled by fax commands. Some AT commands are still valid but may operate differently than in data modem mode.

Calling tone is generated in accordance with T.30.

VOICE/AUDIO MODE

Voice and audio functions are supported by the Voice Mode. Voice Mode includes three submodes: Online Voice Command Mode, Voice Receive Mode, and Voice Transmit Mode.

Online Voice Command Mode

This mode results from the connection to the telephone line or a voice/audio I/O device (e.g., microphone, speaker, or handset) through the use of the #CLS=8 and #VLS commands. After mode entry, AT commands can be entered without aborting the connection.

Voice Receive Mode

This mode is entered when the #VRX command is active in order to record voice or audio data input at the RXA pin, typically from a microphone/handset or the telephone line.

Received analog voice samples are converted to digital form and compressed for reading by the host. AT commands control the codec bits-per-sample rate.

Received analog monophonic audio samples are converted to digital form and formatted into 8-bit unsigned linear PCM format for reading by the host. AT commands control the bit length and sampling rate. Concurrent DTMF/tone detection is available at the 7200 Hz sample rate.

Voice Transmit Mode. This mode is entered when the #VTX command is active in order to playback voice or audio data, typically to a speaker/handset or to the telephone line.

Digitized voice data is decompressed and converted to analog form at the original compression quantization sample-per-bits rate then output.

Digitized audio data is converted to analog form then output to the TXA1/TXA2 pins.

Tone Detectors

The tone detector signal path is separate from the main received signal path thus enabling tone detection to be independent of the configuration status. In Tone Mode, all three tone detectors are operational.

VoiceView

Voice and data can alternately sent and received in a time-multiplexed fashion over the telephone line whenever the +FCLASS=80 command is active. This command and other VoiceView commands embedded in host communications software control modem operation. Most VoiceView commands use an extended syntax starting with the characters "-S", which signifies the capability to switch between voice and data.

CALLER ID

Caller ID can be enabled/disabled using the #CID command. When enabled, caller ID information (date, time, caller code, and name) can be passed to the DTE in formatted or unformatted form. Inquiry support allows the current caller ID mode and mode capabilities of the modem to be retrieved from the modem.

WORLD-CLASS COUNTRY SUPPORT

All models include functions which support modem operation in multiple countries. The following capabilities are provided in addition the data modem functions previously described. Country dependent parameters are all programmable by ConfigurACE.

Dialing

Dial Tone Detection. Dial tone detection levels and frequency ranges are programmable by ConfigurACE.

DTMF Dialing. Transmit output level, DTMF signal duration, and DTMF interdigit interval parameters are programmable by ConfigurACE.

Pulse Dialing. Parameters such as make/break times, set/clear times, and dial codes are programmable by ConfigurACE.

Ring Detection. The frequency range is programmable by ConfigurACE.

Blind Dialing. Blind dialing may be disabled by ConfigurACE.

Carrier Transmit Level

The carrier transmit level can be programmed through S91 for data and S92 for fax. The maximum, minimum, and default values can be defined by ConfigurACE to match specific country and DAA requirements.

Calling Tone

Calling tone is generated in accordance with V.25. Calling tone may be toggled (enabled/disabled) by inclusion of a "W" character in a dial string. It may also be disabled by programming a country specific parameter using ConfigurACE.

Call Progress Tone Detection

Frequency and cadence of tones for busy, ringback, congested, dial tone 1, and dial tone 2 are programmable by ConfigurACE.

Answer Tone Detection

The answer tone detection period is programmable by ConfigurACE.

Blacklist Parameters

The modem can operate in accordance with requirements of individual countries to prevent misuse of the network by limiting repeated calls to the same number when previous call attempts have failed. Call failure can be detected for reasons such as no dial tone, number busy, no answer, no ringback detected, voice (rather than modem) detected, and key abort (dial attempt aborted by user). Actions resulting from such failures can include specification of minimum inter-call delay, extended delay between calls, and maximum numbers of retries before the number is permanently forbidden ("blacklisted"). Up to 40 such numbers may be tabulated. The blacklist parameters are established by ConfigurACE.

Relay Control

On-hook/off-hook, make/break, and set/clear relay control parameters are programmable by ConfigurACE.

Automatic Country Code Recognition

Automatic country code recognition is supported in conjunction with country identification code circuitry provided in the DAA. Automatic country code recognition is enabled using the AT*NCnn command with nn=0. Automatic country code recognition is disabled using the AT*NCnn command with nn= any valid country code other than 0.

DIAGNOSTICS

Commanded Tests

Diagnostics are performed in response to &T commands, serial interface control signals, or switch inputs per V.54.

Analog Loopback (&T1 Command). Data from the local DTE is sent to the modem, which loops the data back to the local DTE.

Analog Loopback with Self Test (&T8 Command). An internally generated test pattern of alternating 1s and 0s (reversals) is sent to the modem. An error detector within the modem checks for errors in the string of reversals.

Remote Digital Loopback (RDL) (&T6 Command). Data from the local DTE is sent to the remote modem which loops the data back to the local DTE.

Remote Digital Loopback with Self Test (&T7 Command). An internally generated pattern is sent from the local modem to the remote modem, which loops the data back to the local modem.

Local Digital Loopback (&T3 Command). When local digital loop is requested by the local DTE, two data paths are set up in the local modem. Data from the local DTE is looped back to the local DTE (path 1) and data received from the remote modem is looped back to the remote modem (path 2).

Power On Reset Tests

Upon power on or receipt of the Z command, the modem performs tests of the MDP, RAM, ROM, and NVRAM. If a MDP, RAM, or ROM test fails, the DCD bit in the parallel interface register is pulsed (parallel interface operation) as follows:

RAM test fails: One pulse every two seconds.

ROM test fails: Two pulses every two seconds.

MDP test fails: Three pulses every two seconds.

If the NVRAM test fails (due to NVRAM failure or if NVRAM is not installed), the test failure is reported by AT commands that normally use the NVRAM, e.g., the &V command.

LOW POWER SLEEP MODE

Entry. The modem enters the low power sleep mode when no line connection exists and no host activity occurs for the period of time specified in the S24 register. All MCU circuits are turned off except the internal MCU clock circuitry in order to consume reduced power while being able to immediately wake up and resume normal operation.

Wake-up. Wakeup occurs when a ring is detected on the telephone line, the host writes to the modem (parallel interface version), or the DTE sends a character to the modem (serial interface version).

ConfigurACE™ UTILITY PROGRAM

The PC-based ConfigurACE utility program allows the OEM to customize the modem firmware to suit specific application and W-Class country requirements. This program, which runs on a PC-compatible computer, modifies the hex object code to be programmed directly into the system ROM.

ConfigurACE allows programming of functions such as:

- Loading of multiple sets of country parameters
- Loading of NVRAM factory profiles
- Call progress and blacklisting parameters
- Entry of S register maximum/minimum values
- Modification of result codes
- Modification of factory default values
- Customization of the ATI4 response
- Customization of fax OEM messages

This program directly modifies the hex object code to be programmed directly into the SocketModem EPROM. Lists of the generated parameters can be displayed or printed.

Rockwell-provided country parameter files allow a complete set of country-specific call progress and blacklisting parameters to be selected.

Refer to the ConfigurACE II Utility Program User's Manual (Order No. 893) for a detailed description of capabilities and the operating procedure.

ADDITIONAL INFORMATION

Additional information is described in the RC288ACL Integrated V.34 Data/V.17 Fax/Voice Modem Device Set Family Data Sheet (Order No. MD140) and the AT Command Reference Manual for RC288ACL and RC288ACi Modem Families (Order No. 1048).

HARDWARE INTERFACE

HARDWARE INTERFACE SIGNALS

The modem hardware interface signals for serial EIA-232, serial TTL, and parallel interface configurations are shown in Figures 2, 3 and 4, respectively.

The SSV288ACW pin assignments are the same as the SSV144ACW/U pin assignments.

The SSV288ACW pin assignments are the same as the SMV288ACW except ~ES4 replaces OH (pin 1) and VC replaces the NO PIN (pin 3) in all configurations, and ~RDCLK replaces ~RESET (pin 24), ~TDCLK replaces an extra DGROUND (pin 25), and ~XTCLK replaces a NC (pin 27) in serial TTL configuration.

The SocketModem pin assignments for serial EIA-232 interface selected are shown in Figure 2 and are listed in Table 4.

The SocketModem pin assignments for serial TTL interface selected are shown in Figure 3 and are listed in Table 5.

The SocketModem pin assignments for parallel interface selected are shown in Figure 4 and are listed in Table 6.

The SocketModem hardware interface signals are defined in Table 7.

The digital electrical characteristics for the hardware interface signals are listed in Table 8.

The analog electrical characteristics for the hardware interface signals are listed in Table 9.

The current and power requirements are listed in Table 10.

The absolute maximum ratings are listed in Table 11.

Table 12 shows the parallel interface registers and the corresponding bit assignments.

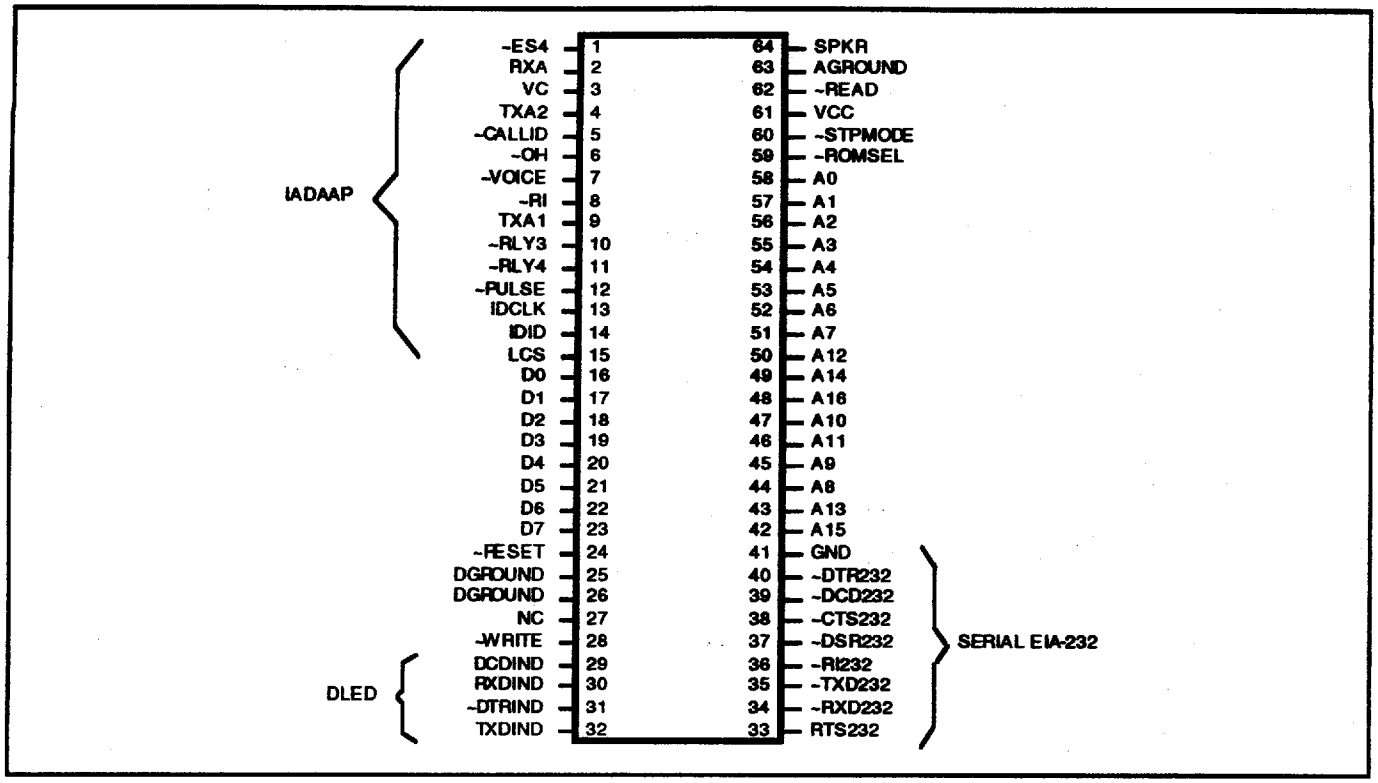

Figure 2. Serial EIA-232 Pinout

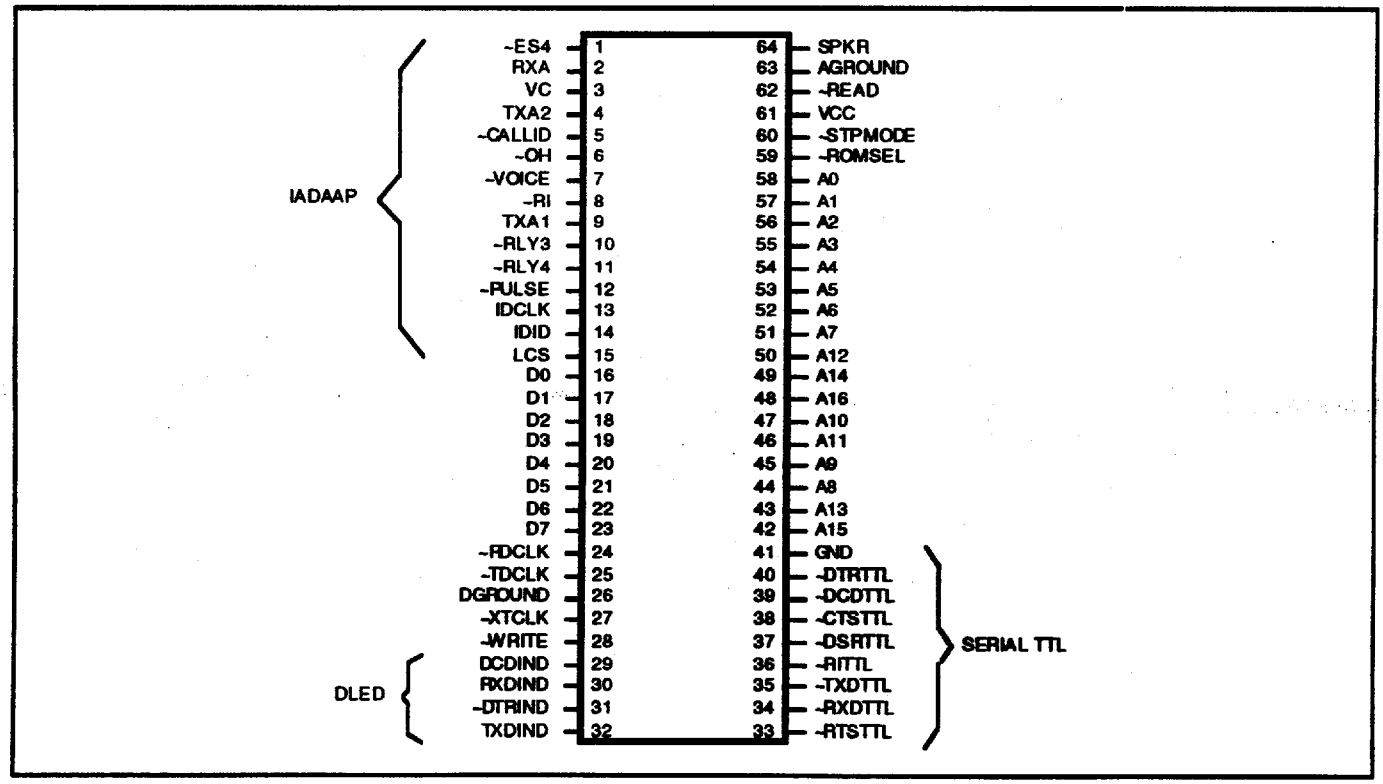

Figure 3. Serial TTL Pinout

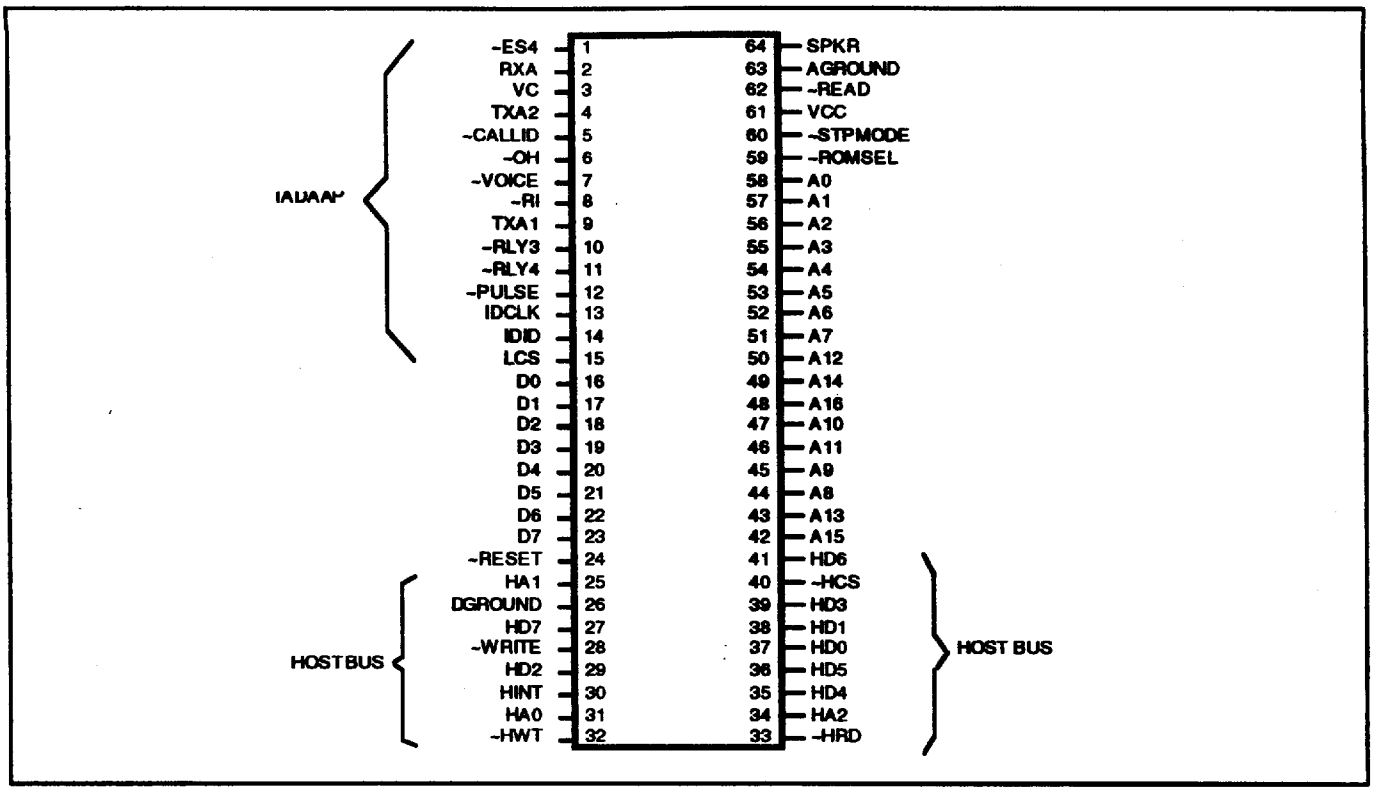

Figure 4. Parallel Pinout

Table 4. Serial EIA-232 Signals

Pin	Signal	I/O Type
1	~ES4	OA
2	RXA	I(DA)
3	VC	MI
4	TXA2	O(DD)
5	~CALLID	OD
6	~OH	OA
7	~VOICE	OD
8	~RI	IA
9	TXA1	O(DD)
10	~RLY3	OA
11	~RLY4	OA
12	~PULSE	OA
13	IDCLK	OA
14	IDID	IA
15	LCS	IA
16	D0	IA/OA
17	D1	IA/OA
18	D2	IA/OA
19	D3	IA/OA
20	D4	IA/OA
21	D5	IA/OA
22	D6	IA/OA
23	D7	IA/OA
24	~RESET	IC
25	DGROUND	GND
26	DGROUND	GND
27	NC	
28	~WRITE	OA
29	DCDIND	OG
30	RXDIND	OG
31	~DTRIND	OG
32	TXDIND	OG

Pin	Signal	I/O Type
33	RTS232	IH
34	~RXD232	OH
35	~TXD232	IH
36	~RI232	OH
37	~DSR232	OH
38	~CTS232	OH
39	~DCD232	OH
40	~DTR232	IH
41	GND	GND
42	A15	OA
43	A13	OA
44	A8	OA
45	A9	OA
46	A11	OA
47	A10	OA
48	A16	OA
49	A14	OA
50	A12	OA
51	A7	OA
52	A6	OA
53	A5	OA
54	A4	OA
55	A3	OA
56	A2	OA
57	A1	OA
58	A0	OA
59	~ROMSEL	OA
60	~STPMODE	IA
61	VCC	PWR
62	~READ	OA
63	AGROUND	GND
64	SPKR	O(DF)

Table 5. Serial TTL Signals

Pin	Signal	I/O Type
1	~ES4	OA
2	RXA	I(DA)
3	VC	MI
4	TXA2	O(DD)
5	~CALLID	OD
6	~OH	OA
7	~VOICE	OD
8	~RI	IA
9	TXA1	O(DD)
10	~RLY3	OA
11	~RLY4	OA
12	~PULSE	OA
13	IDCLK	OA
14	IDID	IA
15	LCS	IA
16	D0	IA/OA
17	D1	IA/OA
18	D2	IA/OA
19	D3	IA/OA
20	D4	IA/OA
21	D5	IA/OA
22	D6	IA/OA
23	D7	IA/OA
24	~RDCLK	OA
25	~TDCLK	OA
26	DGROUND	GND
27	~XTCLK	IA
28	~WRITE	OA
29	DCDIND	OG
30	RXDIND	OG
31	~DTRIND	OG
32	TXDIND	OG

Pin	Signal	I/O Type
33	~RTSTTL	IA
34	~RXDTTL	OA
35	~TXDTTL	IA
36	~RITTL	OA
37	~DSRTTL	OA
38	~CTSTTL	OA
39	~DCDTTL	OA
40	~DTRTTL	IA
41	GND	GND
42	A15	OA
43	A13	OA
44	A8	OA
45	A9	OA
46	A11	OA
47	A10	OA
48	A16	OA
49	A14	OA
50	A12	OA
51	A7	OA
52	A6	OA
53	A5	OA
54	A4	OA
55	A3	OA
56	A2	OA
57	A1	OA
58	A0	OA
59	~ROMSEL	OA
60	~STPMODE	IA
61	VCC	PWR
62	~READ	OA
63	AGROUND	GND
64	SPKR	O(DF)

Table 6. Parallel Signals

Pin	Signal	I/O Type
1	~ES4	OA
2	RXA	I(DA)
3	VC	MI
4	TXA2	O(DD)
5	~CALLID	OD
6	~OH	OA
7	~VOICE	OD
8	~RI	IA
9	TXA1	O(DD)
10	~RLY3	OA
11	~RLY4	OA
12	~PULSE	OA
13	IDCLK	OA
14	IDID	IA
15	LCS	IA
16	D0	IA/OA
17	D1	IA/OA
18	D2	IA/OA
19	D3	IA/OA
20	D4	IA/OA
21	D5	IA/OA
22	D6	IA/OA
23	D7	IA/OA
24	~RESET	IC
25	HA1	IA
26	DGROUND	GND
27	HD7	IA/OB
28	~WRITE	OA
29	HD2	IA/OB
30	HINT	OA
31	HA0	IA
32	~HWT	IA

Pin	Signal	I/O Type
33	~HRD	IA
34	HA2	IA
35	HD4	IA/OB
36	HD5	IA/OB
37	HD0	IA/OB
38	HD1	IA/OB
39	HD3	IA/OB
40	~HCS	IA
41	HD6	IA/OB
42	A15	OA
43	A13	OA
44	A8	OA
45	A9	OA
46	A11	OA
47	A10	OA
48	A16	OA
49	A14	OA
50	A12	OA
51	A7	OA
52	A6	OA
53	A5	OA
54	A4	OA
55	A3	OA
56	A2	OA
57	A1	OA
58	A0	OA
59	~ROMSEL	OA
60	~STPMODE	IA
61	VCC	PWR
62	~READ	OA
63	AGROUND	GND
64	SPKR	O(DF)

Table 7. Signal Descriptions

Label	I/O	Signal Name/Description
VCC	PWR	**+5VDC ± 5%.**
DGROUND	GND	**Digital Ground.** Connect to Digital Ground on the interface circuit.
AGROUND	GND	**Analog Ground.** Connect to Analog Ground on the interface circuit. Note that AGROUND is connected to DGROUND on the SocketModem.
~RESET	IC	**Modem Reset.** The active low ~RESET input resets the SocketModem logic and returns the AT command set to the original factory default values and to "stored values" in NVRAM. ~RESET on SocketModem serial models should not be connected externally; ~RESET is connected to a built-in reset circuit on the SocketModem .
~STPMODE	IA	**Stop Mode.** ~STPMODE is pulled high through a 10 kΩ resistor to prevent entry into Stop Mode. Stop Mode is not supported.
~ES4	OA	**~ES4.** ~ES4 from the MCU.
RXA	I(DA)	**RXA.** This pin is the RXA analog receive signal.
TXA2	O(OD)	**TXA2.** The TXA1 and TXA2 outputs are differential outputs 180 degrees out of phase with each other.
TXA1	O(OD)	**TXA1.** The TXA1 and TXA2 outputs are differential outputs 180 degrees out of phase with each other.
VC	MI	**Reference Voltage.** 2.5 VDC.
~CALLID	OD	**Caller ID Relay Control.** Typically, the ~CALLID output is connected to the normally closed Caller ID relay (DPDT). When Caller ID is enabled, the modem will assert this output to open the Caller ID relay and close the Off-hook relay in order to detect Caller ID information between the first and second rings.
~VOICE	OD	**Voice Relay Control.** Typically, the ~VOICE output is connected to the normally open Voice relay (DPDT). In voice mode, ~VOICE active closes the relay to switch the handset from the telephone line to a current source to power the handset so it can be used as a microphone and speaker interface to the modem. The ~CALLID and ~VOICE outputs can each directly drive a +5V reed relay coil with a minimum resistance of 360Ω and having a must-operate voltage of no greater than 4.0 Vdc. A clamp diode, such as a 1N4148, should be installed across the relay coil. An external transistor, such as an MPSA20, can be used to drive heavier loads (e.g., electro-mechanical relays).
~OH	OD	**OH Relay Control.** The active low ~OH output can be used to control the normally open off-hook relay. In this case, ~OH active closes the relay and connects the modem to the line (off-hook).
~PULSE	OD	**PULSE Relay Control.** The active low ~PULSE output can be used to control the normally open pulse dial relay. In this case, ~PULSE active closes the relay to effect loop disconnect (pulse) dialing. When a country recognition code circuit is used, the ~PULSE output is typically connected to the 74HC165 shift register SH/LD input.
~RLY3	OA	**Relay 3 Control (~MUTE).** The active low ~RLY3 output can be used to control the normally open mute relay. When configured to control the mute relay. ~MUTE active closes relay during dialing so that the loop disconnect (pulse) dialing is between an open and short circuit.
~RLY4	OA	**Relay 4 Control (~EARTH).** The active low ~RLY4 output can be used to control the normally open earthing (EARTH) relay. When configured to control the earth relay, in response to encountering the ">" dial modifier in a dial string, ~EARTH active closes a relay used to ground a signal on the telephone connector. This signal is used in some countries to instruct a PBX to request an external line.
LCS	IA	**Line Current Sense.** When enabled, the LCS input indicates whether the associated handset is off-hook (high) or on-hook (low). Bit 4 in Option Flags 1 must be set using ConfigurACE to enable LCS operation.
~RI	IA	**Ring Indicate.** ~RI is an active-low ring-indicator input.
SPKR	O(DF)	**Speaker Analog Output.** The SPKR output reflects the received analog input signal. SPKR is controlled by the ATMn command. SPKR is connected to the SPKR pin of the data pump through a 1KΩ resistor. It connects to an external speaker driver circuit.

Table 7. Signal Descriptions (Cont'd)

Label	I/O	Signal Name/Description
HA0-HA2	IA	**Host Bus Address Lines 0-2.** During a host read or write operation, HA0-HA2 select an internal 16550A-compatible register. The state of the divisor latch access bit (DLAB) affects the selection of certain registers.
HD0-HD7	IA/OB	**Host Bus Data Lines 0-7.** HD0-HD7 are comprised of eight three-state input/output lines providing bi-directional communication between the host and the SocketModem. Data, control words, and status information are transferred through HD0-HD7.
~HCS	IA	**Host Bus Chip Select.** ~HCS input low selects the host bus.
~HRD	IA	**Host Bus Read.** ~HRD is an active low, read control input. When ~HCS is low, ~HRD low allows the host to read status information or data from a selected SocketModem register.
~HWT	IA	**Host Bus Write.** ~HWT is an active low, write control input. When ~HCS is low, ~HWT low allows the host to write data or control words into a selected SocketModem register.
HINT	OA	**Host Bus Interrupt.** HINT output is set high when the receiver error flag, received data available, transmitter holding register empty, or modem status interrupt has an active high condition. HINT is reset low upon the appropriate interrupt service or master reset operation.
		The serial interface signals are either TTL-level or EIA-232-level signals.
~RTSTTL, RTS232	IA, IH	**Request To Send.** TTL active low, EIA-232 active high. ~RTS is used to condition the local modem for data transmission and, during half-duplex operation, to control the direction of data transmission. On a full-duplex channel, RTS OFF maintains the modem in a non-transmit mode. A non-transmit mode does not imply that all line signals have been removed from the telephone line. RTS OFF may be ignored if the modem is optioned to strap ~CTS ON; this allows the modem to receive from the DTE even though RTS is OFF. RTS input ON causes the modem to transmit data on ~TXD when ~CTS becomes active.
~RXDTTL, ~RXD232	OA, OH	**Received Data.** Active low. The modem uses the ~RXD line to send data received from the telephone line to the DTE and to send modem responses to the DTE. During command mode, ~RXD data represents the modem responses to the DTE. Modem responses take priority over incoming data when the two signals are in competition for ~RXD.
~DCDTTL, ~DCD232	OA, OH	**Data Carrier Detect.** Active low. When AT&C0 command is not in effect, ~DCD output is ON when a carrier is detected on the telephone line or OFF when carrier is not detected. ~DCD can be strapped ON using AT&C0 command.
~TXDTTL, ~TXD232	IA, IH	**Transmitted Data.** Active low. The DTE uses the ~TXD line to send data to the modem for transmission over the telephone line or to transmit commands to the modem. The DTE should hold this circuit in the mark state when no data is being transmitted or during intervals between characters.
~RITTL, ~RI232	OA, OH	**Ring Indicate.** Active low. Output ON (low) indicates the presence of an ON segment of a ring signal on the telephone line. The modem will not go off-hook when this signal is active; the modem waits for this signal to go inactive before going off-hook. For US models, this signal will respond to ring signals in the frequency range of 15.3 Hz to 68 Hz. The ring signal cycle is typically two seconds ON, four seconds OFF. The OFF (high) condition of the ~RI input should be maintained during the OFF segment of the ring cycle (between rings) and at all other times when ringing is not being received.
~DSRTTL, ~DSR232	OA, OH	**Data Set Ready.** Active low. ~DSR indicates modem status to the DTE. ~DSR OFF (high) indicates that the DTE is to disregard all signals appearing on the interchange circuits except Ring Indicator (~RI). ~DSR output is controlled by the AT&Sn command. If the AT&S1 option is selected, ~DSR will come ON in the handshaking state when carrier is detected in the originate mode or when carrier is first sent in the answer mode. In addition, if a test mode is entered (AT&T1, AT&T3, AT&T6-AT&T8), ~DSR will go off while the test is running. ~DSR goes OFF if ~DTR goes OFF. If AT&Q0 and AT&S0 are selected, ~DSR will remain on at all times regardless of the modem's current state.

Table 7. Signal Descriptions (Cont'd)

Label	I/O	Signal Name/Description
~CTSTTL, ~CTS232	OA, OH	**Clear To Send.** Active low. ~CTS is controlled by the modem to indicate whether or not the modem is ready to transmit data. ~CTS ON, together with the ~RTS ON, ~DSR ON, and ~DTR ON (where implemented), indicates to the DTE that signals presented on TXD will be transmitted to the telephone line. ~CTS OFF indicates to the DTE that it should not transfer data across the interface on TXD. ~CTS ON is a response to ~DTR ON and ~RTS, delayed as may be appropriate for the modem to establish a telephone connection. ~CTS output is controlled by the AT&Rn command.
~DTRTTL, ~DTR232	IA, IH	**Data Terminal Ready.** Active low. The ~DTR input is turned ON (low) by the DTE when the DTE is ready to transmit or receive data. ~DTR ON prepares the modem to be connected to the telephone line, and maintains the connection established by the DTE (manual answering) or internally (automatic answering). ~DTR OFF places the modem in the disconnect state under control of the &Dn and &Qn commands. The effect of ~DTR ON and ~DTR OFF depends on the &Dn and &Qn commands. Automatic answer is enabled when ~DTR is ON if the "Answer Ring count" selectable option is not set to 0. Regardless of which device is driving ~DTR, the modem will respond to an incoming ring by going off-hook and beginning the handshake sequence. The response of the modem to the ~DTR signal is very slow (up to 10 ms) to prevent noise from falsely causing the modem to disconnect from the telephone line.
GND	GND	**Signal Ground.**
		The Synchronous Clock and Data lines are available on the TTL Serial Interface SocketModem only.
~RDCLK	OA	**Receive Data Clock.**
~TDCLK	OA	**Transmit Data Clock.**
~XTCLK	IA	**External Transmit Clock.**
		LED driver lines are open-drain inverter-driven (74HCT05) lines with 1.5KΩ, 1/10W pull-up resistors on-board.
DCDIND	OG	**DCD LED Indicator.** Active high DCD status.
RXDIND	OG	**RXD LED Indicator.** Active high RXD status.
~DTRIND	OG	**DTR LED Indicator.** Active low DTR status.
TXDIND	OG	**DCD LED Indicator.** Active high TXD status.

Table 8. Digital Interface Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions[1]
Input High Voltage	V_{IH}				Vdc	
Type IA		2.0	–	V_{CC}		
Type IC		0.7 V_{CC}	–	V_{CC} + 0.3		
Type ID		0.8 V_{CC}	–	V_{CC} + 0.3		
Type IH		-30		30		
Input Low Voltage	V_{IL}				Vdc	
Type IA, IC, and ID		-0.3		0.8		
Input Leakage Current	I_{IN}				µAdc	V_{IN} = 0 to V_{CC}
~RESET		–	–	±2.5		
Output High Voltage	V_{OH}				Vdc	
Type OA		2.4	–	–		I_{LOAD} = – 100 µA
Type OB		2.4	–	–		I_{LOAD} = – 6 mA
Type OD		–	–	V_{CC}		I_{LOAD} = 0 mA
Type OG				V_{CC}		
Type OH		5	8	-		
Output Low Voltage	V_{OL}				Vdc	
Type OA		–	–	0.4		I_{LOAD} = 1.6 mA
Type OB		–	–	0.4		I_{LOAD} = 6 mA
Type OD		–	0.75	–		I_{LOAD} = 15 mA
Type OG		0.5	-	-		I_{LOAD} = 8 mA
Type OH		-8	-5	-		
Three-State (Off) Current	I_{TSI}			±10	µAdc	V_{IN} = 0 V

Notes:
1. Test Conditions: V_{CC} = 5V ± 5%, T_A = 0°C to 70°C, (unless otherwise stated).
   Output loads: Data bus (D0-D7), address bus (A0-A16), chip selects, ~READ, and ~WRITE = 70 pF + one TTL.
   Other = 50 pF + one TTL.

Table 9. Analog Characteristics

Name	Type	Characteristic	Value
RXA	I (DA)	Input Impedance Voltage Range	> 70KΩ 2.5 ±1.6V
TXA1, TXA2	O (DD)	Minimum Load Maximum Capacitive Load Output Impedance Output Voltage D.C. Offset	300Ω 0.01 µF 10Ω 2.5 ±1.6V < 200 mV
SPKR	O (DF)	Minimum Load Maximum Capacitive Load Output Impedance Output Voltage D.C. Offset	300Ω 0.01 µF 10Ω 2.5 ±1.6V < 20 mV
VC	MI	Reference Voltage Max. D.C. Current	2.5 VDC 100 µA

Table 10. Current and Power Requirements

Mode	Current (I_D)		Power (P_D)	
	Typical Current @ 25°C	Maximum Current @ 0°C	Typical Power @ 25°C	Maximum Power @ 0°C
Serial EIA-232				
Normal mode	188 mA	242 mA	940 mW	1209 mW
Sleep mode	34 mA	35 mA	71 mW	177 mW
Serial TTL				
Normal mode	162 mA	216 mA	810 W	1079 mW
Sleep mode	5 mA	6 mA	26 mW	32 mW
Parallel				
Normal mode	160 mA	214 mA	800 mW	1069 mW
Sleep mode	4 mA	5 mA	21 mW	27 mW

Notes:

1. Test conditions: VDD = 5.0 VDC for typical values; VDD = 5.25 VDC for maximum values.

Table 11. Absolute Maximum Ratings

Parameter	Symbol	Limits	Units
Supply Voltage	V_{DD}	-0.5 to +7.0	V
Input Voltage	V_{IN}	-0.5 to +5VD +0.5	V
Analog Inputs	V_{IN}	-0.3 to +5VA + 0.3	V
Voltage Applied to Outputs in High Z State	V_{HZ}	-0.5 to +5VD + 0.5	V
DC Input Clamp Current	I_{IK}	±20	mA
DC Output Clamp Current	I_{OK}	±20	mA
Static Discharge Voltage (@ 25°C)	V_{ESD}	±3000	V
Latch-Up Current (@ 25°C)	I_{TRIG}	±200	mA
Operating Temperature Range	T_A	-0 to +70	°C
Storage Temperature Range	T_{STG}	-40 to +80	°C

Table 12. Parallel Interface Registers

Register No.	Register Name	Bit No. 7	6	5	4	3	2	1	0
7	Scratch Register (SCR)	Scratch Register							
6	Modem Status Register (MSR)	Data Carrier Detect (DCD)	Ring Indicator (RI)	Data Set Ready (DSR)	Clear to Send (CTS)	Delta Data Carrier Detect (DDCD)	Trailing Edge of Ring Indicator (TERI)	Delta Data Set Ready (DDSR)	Delta Clear to Send (DCTS)
5	Line Status Register (LSR)	RX FIFO Error	Transmitter Empty (TEMT)	Transmitter Buffer Register Empty (THRE)	Break Interrupt (BI)	Framing Error (FE)	Parity Error (PE)	Overrun Error (OE)	Receiver Data Ready (DR)
4	Modem Control Register (MCR)	0	0	0	Local Loopback	Out 2	Out 1	Request to Send (RTS)	Data Terminal Ready (DTR)
3	Line Control Register (LCR)	Divisor Latch Access Bit (DLAB)	Set Break	Stick Parity	Even Parity Select (EPS)	Parity Enable (PEN)	Number of Stop Bits (STB)	Word Length Select Bit 1 (WLS1)	Word Length Select Bit 0 (WLS0)
2	Interrupt Identify Register (IIR) (Read Only)	FIFOs Enabled	FIFOs Enabled	0	0	Pending Interrupt ID Bit 2	Pending Interrupt ID Bit 1	Pending Interrupt ID Bit 0	"0" if Interrupt Pending
2	FIFO Control Register (FCR) (Write Only)	Receiver Trigger MSB	Receiver Trigger LSB	Reserved	Reserved	DMA Mode Select	TX FIFO Reset	RX FIFO Reset	FIFO Enable
1 (DLAB = 0)	Interrupt Enable Register (IER)	0	0	0	0	Enable Modem Status Interrupt (EDSSI)	Enable Receiver Line Status Interrupt (ELSI)	Enable Transmitter Holding Register Empty Interrupt (ETBEI)	Enable Received Data Available Interrupt (ERBFI)
0 (DLAB = 0)	Transmitter Buffer Register (THR)	Transmitter FIFO Buffer Register (Write Only)							
0 (DLAB = 0)	Receiver Buffer Register (RBR)	Receiver FIFO Buffer Register (Read Only)							
1 (DLAB = 1)	Divisor Latch MSB Register (DLM)	Divisor Latch MSB							
0 (DLAB = 1)	Divisor Latch LSB Register (DLL)	Divisor Latch LSB							

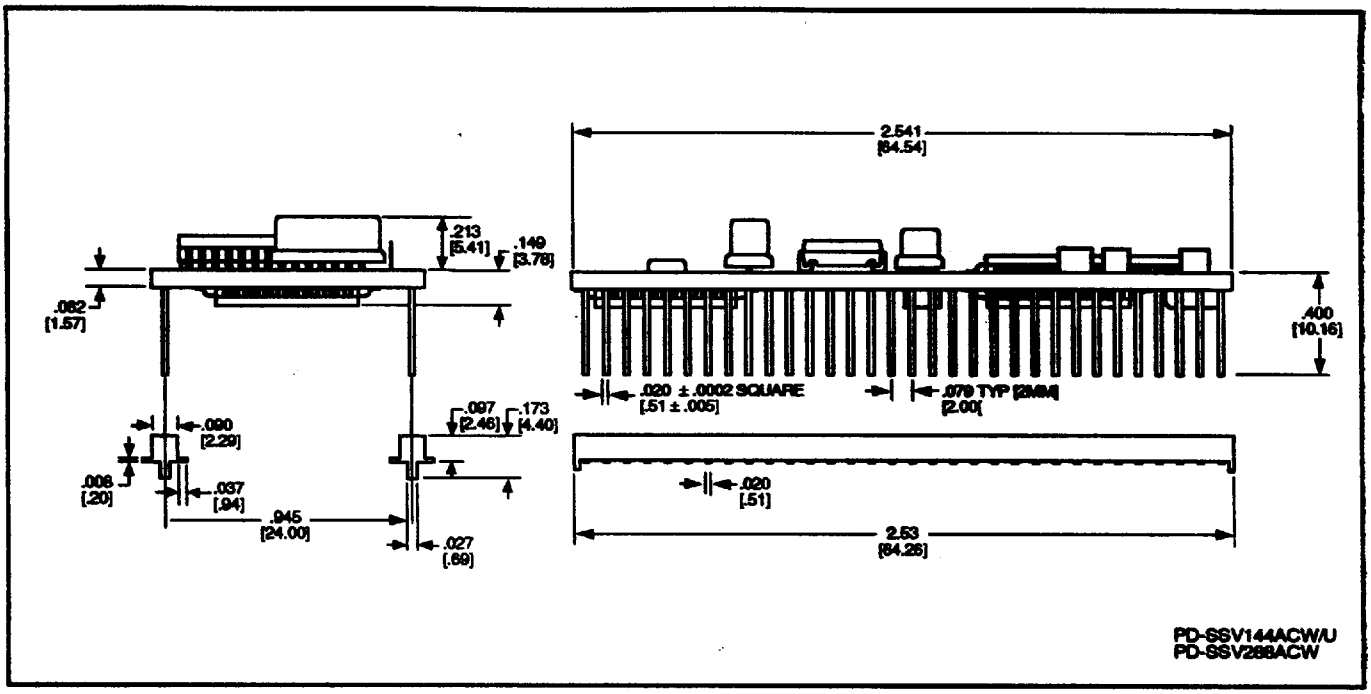

Figure 5. SocketModem Physical Dimensions