Rockwell

RCV144ACi-BA Desktop Integrated High Speed Data/Fax/Voice/Audio Modem Device Set

INTRODUCTION

The Rockwell RCV144ACi-BA desktop integrated data/fax/voice/audio modem device set supports the Integrated Communications System program. The modem supports data throughput in excess of 176 kbps utilizing the Rockwell High Speed Interface (RHSI), fax operation up to 14400 bps, ADPCM voice compression/decompression at 7200 Hz, and audio 8- and 16-bit record/playback at 11.025 kHz or 7200 Hz. Extended "AT" commands provide data, fax class 1 and class 2, MNP 10, voice, and audio functions.

The modem device set consists of data/fax/voice/audio modem data pump (MDP) and microcontroller (MCU) devices with supporting MCU firmware.

As a data modem, the modem operates at line speeds to 14400 bps. Error correction (V.42/MNP 2–4), data compression (V.42 bis/MNP 5), and RHSI maximize data transfer integrity and boost data throughput beyond the normal maximum DTE speed. The modem also operates in non-error-correcting mode.

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

The modem uses enhanced Adaptive Differential Pulse Coded Modulation (ADPCM) coding and decoding to support efficient digital storage of voice using 2-bit or 4-bit compression and decompression at 7200 bps. Coder silence deletion and decoder silence interpolation is available to significantly increase compression rates.

In audio mode, the modem supports record and playback of monophonic (mono) audio data in 8-bit unsigned linear pulse code modulation (PCM) or 16-bit signed linear PCM format at 11.025 kHz or 7200 Hz sampling rate.

Microsoft Windows is supported in the host using the proprietary RHSI. The use of RHSI overcomes the limitation of predefined UART speeds. Support for RHSI is in the form of modem microcomputer firmware and Windows driver RHSICOMM.DRV. The Rockwell RHSICOMM.DRV driver is downward compatible with the standard Microsoft Windows communications driver COMM.DRV. Use of RHSI allows slower PCs such as 16 MHz 386-based computers to sustain data rates of 115.2 kbps and higher.

A PC half-card, designed for superior voice and audio performance, is available in an AccelerATor Kit to minimize application design time and development costs. The kit also includes design layout files on floppy disk, sample modem devices, crystals, and full documentation.

FEATURES

- Data modem throughput up to 57.6 kbps (beyond 57.6 kbps when RHSI is active)
- V.32 bis, V.32, V.22 bis, V.22A/B, V.23, and V.21; Bell 212A and Bell 103
  - —V.42 LAPM and MNP 2-4 error correction
  - —V.42 bis and MNP 5 data compression
- MNP 10 data throughput enhancement
- Hayes AutoSync
- Fax modem send and receive rates up to 14400 bps
  - —V.17, V.29, V.27 ter, and V.21 channel 2
- Voice mode
  - —Enhanced ADPCM compression/decompression
  - —Tone detection/generation and call discrimination
  - —Concurrent DTMF detection
  - —Timing marks
- Audio mode
  - —Record mono data using 8-bit or 16-bit audio data encoding at 11.025 kHz or 7200 Hz
  - —Playback at 11.025 kHz or 7200 Hz
  - —Concurrent DTMF/tone detection
- Supports business audio applications, e.g., digital answering machine, voice annotation, audio file play and record, and text-to-speech
- Communication software-compatible AT, fax class 1 and 2, and Rockwell voice commands
- Built-in parallel 16550A UART-compatible interface
- Proprietary Rockwell High Speed Interface (RHSI)
- Line quality monitoring and auto retrain
- NVRAM directory and stored profiles
- Flow control and speed buffering
- Automatic format/speed sensing
- Parallel asynchronous data
- Auto dial and auto answer
- Tone, pulse, and adaptive dialing
- Calling Number Delivery (Caller ID) detect
- Diagnostics
- Extended operating temperature model available
- +5V operation; typical power consumption:

Operating	850 mW
Sleep mode	21.0 mW

- Two CMOS VLSI devices
  - —MCU: 84-pin PLCC; MDP: 68-pin PLCC

Data Sheet
(Preliminary)

Order No. MD106
April 22, 1994

TECHNICAL OVERVIEW

GENERAL DESCRIPTION

The modem device set provides the processing core of the modem. The OEM adds external memory, crystal, discrete components, and a digital access arrangement (DAA) circuit to complete the modem system.

Modem Data Pump (MDP)

The MDP is a Rockwell RCV144DPi-BA data/fax/voice/audio modem data pump packaged in a 68-pin PLCC.

As a data modem, the MDP can operate in 2-wire, full-duplex, asynchronous modes at line rates up to 14400 bps.

As a fax modem, the MDP fully supports Group 3 facsimile send and receive speeds of 14400 12000, 9600, 7200, 4800, and 2400 bps.

Microcontroller (MCU)

The MCU is a Rockwell C40 microcomputer packaged in a 84-pin PLCC. The MCU performs the command processing and host interface functions. The MCU connects to the host via a parallel microcomputer bus. The MCU connects to the MDP via dedicated lines and an external bus. The external bus also connects to the OEM-supplied 128k-byte ROM and 32k-byte RAM. The crystal frequency is 9.8304 MHz.

MCU Firmware

MCU firmware performs processing of general moder control, command sets, error correction, data compres sion, MNP 10, fax class 1 and class 2, voice, audio, RHSI, and DTE 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.

SUPPORTED INTERFACES

The major hardware signal interfaces of the modem device set are illustrated in Figure 1.

Parallel Interface

A 16550A UART-compatible parallel interface and a supporting stop mode control signal are provided.

Host Bus Interface. Eight data lines, three address lines, four DMA request/acknowledge lines, four control/status lines, and a reset line are supported.

NVRAM Interface

A serial interface to the optional OEM-supplied 256-byte non-volatile RAM (NVRAM) is provided. Data stored in NVRAM can take precedence over the factory default settings. The 256-byte NVRAM can store up to two user-selectable configurations and can store up to four 35-digit dial strings.

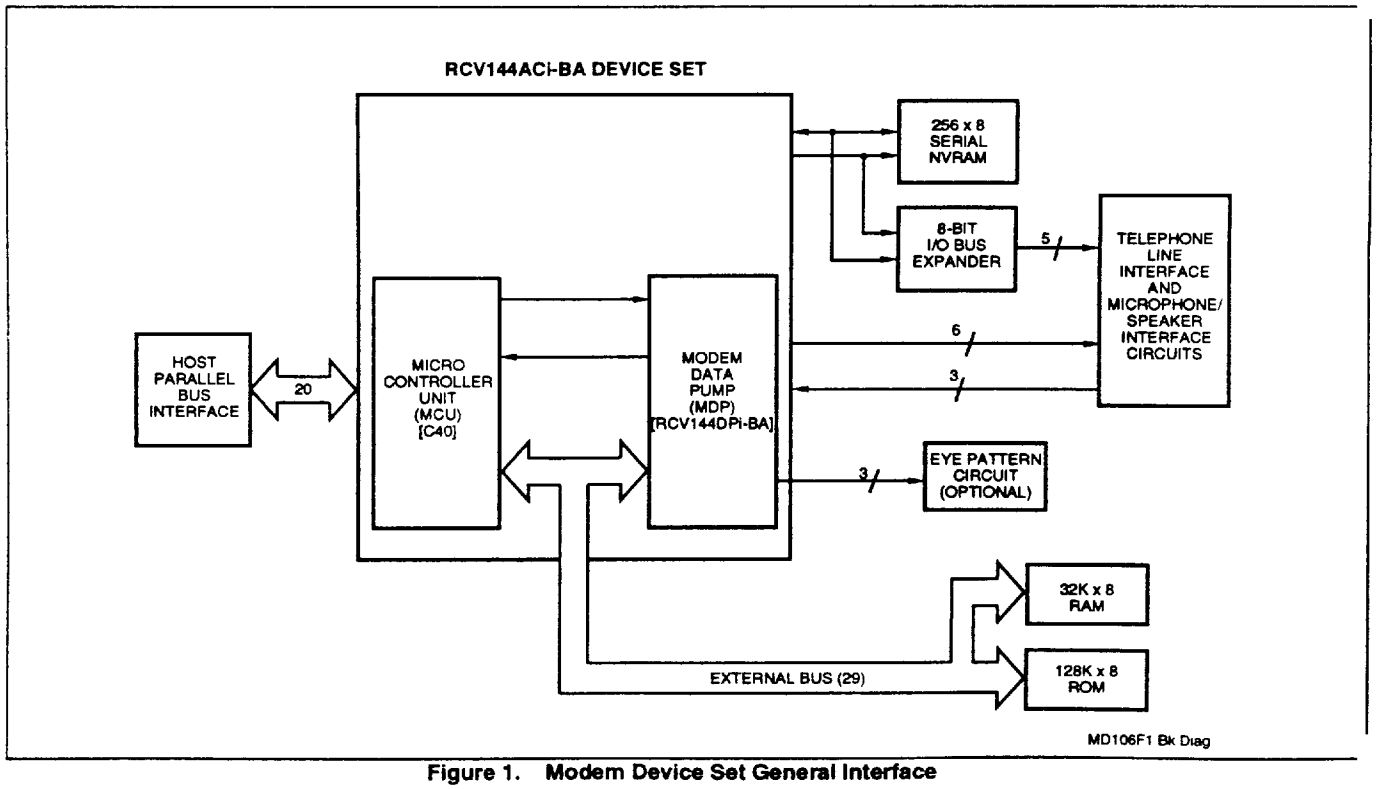

Figure 1. Modem Device Set General Interface

Speaker Interface

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

MCU External Bus Interface

The MCU external bus connects to MDP and to OEM-supplied 128k-byte ROM and 32k-byte RAM. The non-multiplexed bus supports eight bidirectional data lines and 17 address lines. Dedicated MDP, ROM, and RAM chip select outputs are also provided for selecting external devices.

Line Interface

MDP. The MDP connects to the line interface circuitry via a receive analog input, two transmit analog outputs, two relay driver outputs, and a ring signal input. The relay outputs may be used to drive Caller ID and voice relays.

MCU. The MCU provides one output to control the off-hook/pulse dial relay. The MCU also uses the NVR AM lines to control an 8-bit bus expander which outputs two encoded analog switch control signals to select RIN and TXA1/TXA2 routing. In addition, three outputs are provided by the bus expander to select volume control, control volume up/down direction, and volume increment. The MCU accepts ring signal and line current sense from the line interface.

Eye Pattern Generator Interface

Eye pattern data, clock, and sync interface signals are provided to allow an external eye pattern generator circuit to be easily added in order to observe modem performance relative to line impairments.

COMMANDS

The modem supports data modem, fax class 1 and 2, MNP 10, and voice commands and S Registers (See Tables 1 and 2, respectively) depending on the modem model.

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

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

AutoSync Operation. AutoSync operates in response to the &Q4 command.

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/audio commands when #CLS=8 and #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 or #VBS=16 is selected. Sampling rate is determined by #VSR=11025 or #VSR=7200.

DATA MODEM OPERATION

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.

Adaptive Dialing. If DTMF dialing is selected (T command) and the telephone network will not recognize DTMF tones, the modem will switch to pulse dialing. If pulse dialing is selected (P command), pulse dialing will be used.

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 detection 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. The possible data connection modes/speeds are listed in Table 3. Two methods of establishing a connection are supported: use of the F command and use of N command, speed sense, and S37 register combination.

Table 1. AT Commands

Command	Function
	Basic AT 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 selected S Register
Sn?	Read selected 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
&Cn	RLSD (DCD) option
&Dn	DTR option
&F	Restore factory configuration (profile)
&Gn	Select guard tone
&Jn	Telephone jack control
&Kn	Flow control
&Ln	Leased line operation
&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 stored profiles
&Wn	Store current configuration
&Xn	Select synchronous clock source
&Yn	Designate a default reset profile
&Zn=x	Store phone number
%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
\Gn	Modem-to-modem flow control (XON/XOFF)
\Kn	Break control
\Nn	Operating mode
#CID	Enable Caller ID detection and select reporting format
**	Download to flash memory

Table 1. AT Commands (Cont'd)

Command	Function
	ECC AT Commands
%C	Select data compression
\An	Maximum MNP block size
\Bn	Transmit BREAK to remote
\Ln	MNP block transfer control
	MNP 10 AT Commands
)Mn	Enable cellular power level adjustment
* Hn	Set link negotiation speed
-Kn	MNP extended services
-Qn	Enable fallback to V.22 bis/V.22
@Mn	Select initial transmit level
	Fax Class 1 AT+F Commands
+FCLASS=n	Service class
+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 AT+F 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 identification
+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
	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

Table 1. AT Commands (Cont'd)

Command	Function
	Voice AT# Commands
#BDR	Select baud rate
#CLS	Select data, fax, voice, or audio
#MDL?	Identify model
#MFR?	Identify manufacturer
#REV?	Identify revision level
#TL	Audio output transmit level
#VBQ?	Query buffer size
#VBS	Bits per sample
#VBT	Beep tone timer
#VCI?	Identify compression method
#VGT	Volume selection
#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
#VTM	Place timing marks
#VTS	Generate tone signals
#VTX	Voice transmit mode

Note:
Embedded DLE commands and responses are described in the AT Command Reference Manual.

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 code guard time
S13	Reserved
S14	General bit mapped options
S15	Reserved
S16	Test mode bit mapped options (&T)
S17	Reserved
S18	Test timer
S19-S20	Reserved
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
S99	Leased line transmit level
	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

Table 3. Connection Speed Options

Configuration	Rate
V.32 bis	14400, 12000, 9600, 7200, or 4800 bps
V.32	9600 or 4800 bps
V.22 bis	2400 or 1200 bps
V.22	1200 bps
V.23	1200Tx/75Rx or 75Tx/1200Rx
V.21	0-300 bps
Bell 212A	1200 bps
Bell 103	0-300 bps

Automode

Automode detection can be enabled by the N1 or F0 commands to allow the modem to connect to a remote modem in accordance with EIA/TIA-PN2330.

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 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.

Modem-to-Modem Flow Control. When enabled by the \G1 command, the modem supports XON/XOFF flow control with the remote modem to ensure data integrity. Modem-to-modem flow control is not used in error correction mode. In this case, flow control is accomplished within the error-correction protocol.

Escape Sequence Detection

The "+++" escape sequence with guard time can be used to return control to the command mode from the data mode. Escape sequence detection is disabled by a 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.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. If carrier is lost for a time greater than specified by the S10 register, the modem will disconnect.

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

Fall Forward/Fallback (V.32 bis/V.32)

During initial handshake, the modem will fallback to the optimal line connection within V.32 bis/V.32 mode depending upon signal quality if automode is enabled by the N1 command.

When connected in V.32 bis/V.32 mode, the modem will fall forward or fallback to the optimal line speed within V.32 bis/V.32 mode 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 i 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 register S30. A value of 0 disables the inactivity timer.

ERROR CORRECTION AND DATA COMPRESSION

V.42 Error Correction

V.42 supports two methods of error correction: LAPM and, as an alternative, 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. MNP block or stream mode operation may be selected by the \Ln command.

In stream mode, the modem sends data frames in varying lengths depending on the amount of time between characters coming from the DTE.

In block mode, the modem sends data frames of 25€ characters in length. Special communication software must be used when using block mode.

V.42 bis Data Compression

V.42 bis data compression mode, enabled by the %Cn or S46 command, operates when a LAPM or an 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 are used to store the strings. These dictionaries are dynamically updated during normal operation.

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

MNP10 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 a LAPM or an MNP 2-4 connection is negotiated with a remote modem supporting MNP 10. MNP 10 functions include:

Robust Auto-Reliability. 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 in 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. 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 quickly switch to MNP 10 operation when the remote modem supports MNP 10 and both modems are configured to operate in V.42.

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

FAX CLASS 1 AND CLASS 2 OPERATION

The modem operates as a facsimile (fax) DCE whenever the +FCLASS=1, +FCLASS=2, #CLS=1, or #CLS=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 the fax commands. Some AT commands are still valid but may operate differently from data modem mode.

Calling Tone

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. (See Table 1.)

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 and, optionally, select silence deletion including silence detection period adjustment.

Received analog mono audio samples are converted to digital form and formatted into 8-bit unsigned linear PCM or 16-bit signed 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 to the TXA1/TXA2 output pins, 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 to the TXA1/TXA2 pins. Optional silence interpolation is enabled if silence deletion was selected for voice compression.

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

DIAGNOSTICS

Commanded Tests

Diagnostics are performed in response to &T commands.

Analog Loopback. Data from the local DTE is sent to the modem, which loops the data back to the local DTE.

Analog Loop Self Test. 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). 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. 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. When local digital loop is requested from 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 RAM, ROM, NVRAM, and MDP.

LOW POWER SLEEP MODE

Entry. The modem will enter 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 lower power but be able to immediately wake up and resume normal operation.

Wake-up. Wake-up occurs when the host writes to the modem or ring is detected on the telephone line.

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.

ADDITIONAL INFORMATION

Additional information is described in the RCV144ACi-BA Modem Designer's Guide (Order No. 1018) and the AT Command Reference Manual (Order No. 1019).

HARDWARE INTERFACE

HARDWARE INTERFACE SIGNALS

The modem hardware interface signals are shown in Figure 2.

The MCU pin assignments are shown in Figure 3 and are listed in Table 4.

The MDP pin assignments are shown in Figure 4 and are listed in Table 5.

The MCU hardware interface signals are defined in Table 6.

The MDP 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.

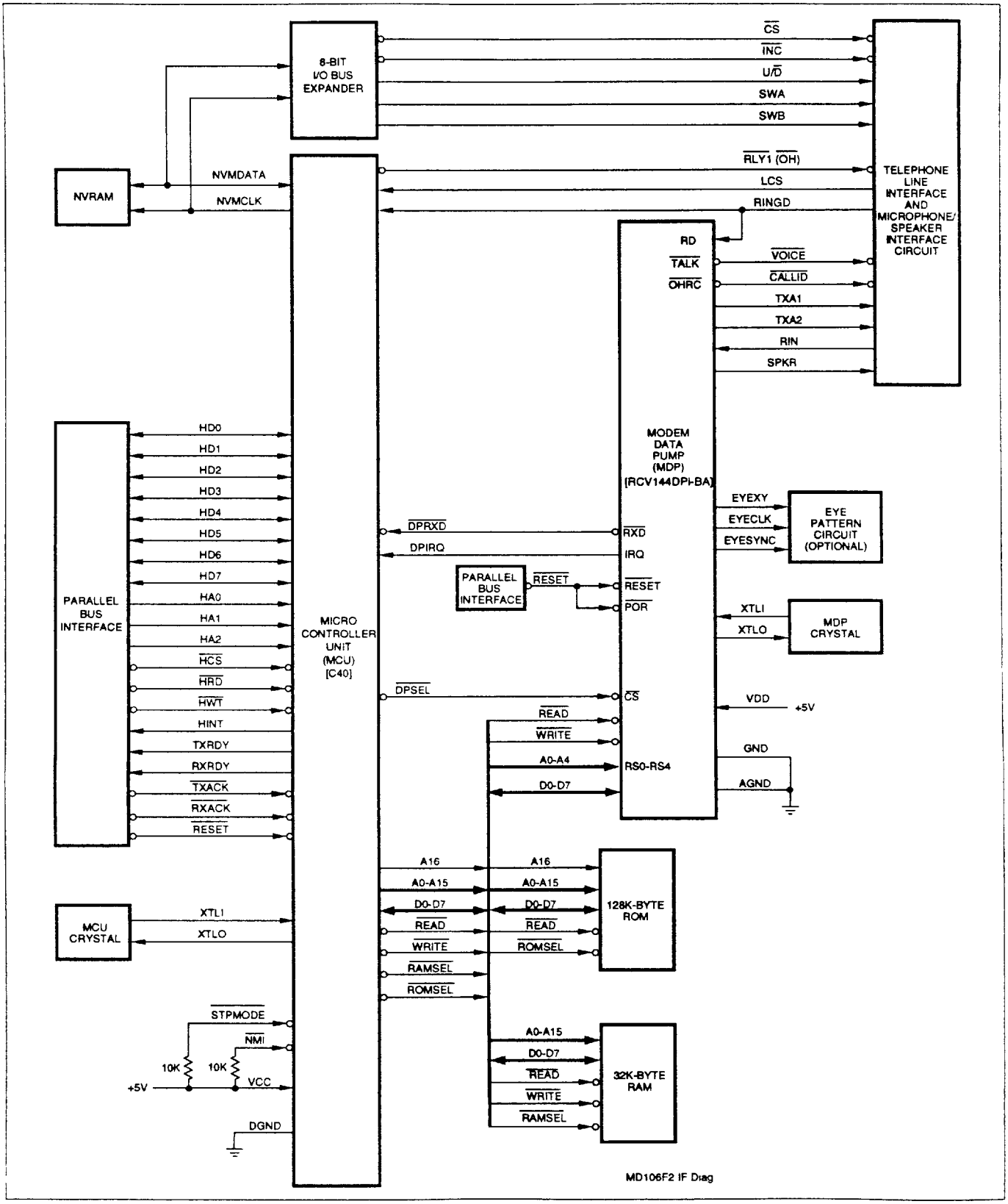

Figure 2. Hardware Interface Signals

Table 4. MCU Pin Signals - 84-Pin PLCC

Pin	MCU Signal	I/O Type	Modem Signal
1	PE0	OA	RLY1 (OH)
2	PE1	OA	RLY2 (PULSE)
3	GND	GND	GND
4	PB0	OA	A16
5	PB1	MI	DPSEL
6	PB2	OA	ROMSEL
7	PB3	OA	RAMSEL
8	PB4		NC
9	PB5		NC
10	PB6		NC
11	PB7	OA	HINT
12	RES	IC	RES
13	NMI		+5VD (Note 4)
14	WT	OA	WRITE
15	RD	OA	READ
16	PE2		NC
17	PE3		NC
18	NC		NC
19	VCC	PWR	+5VD
20	XTLI	IE	XTLI
21	XTLO	OE	XTLO
22	GND	GND	GND
23	GND	GND	GND
24	GND	GND	GND
25	PC0	IA/OA	HD0
26	PC1	IA/OA	HD1
27	PC2	IA/OA	HD2
28	PC3	IA/OA	HD3
29	PC4	IA/OA	HD4
30	PC5	IA/OA	HD5
31	PC6	IA/OA	HD6
32	PC7	IA/OA	HD7
33	NC		NC
34	PD0	IA	HA0
35	PD1	IA	HA1
36	PD2	IA	HA2
37	PD3	IA	STPMODE (Note 4)
38	PD4	IA	HCS
39	PD5	IA	HWT
40	PD6	IA	HRD
41	PD7	MI	DPIRQ
42	GND	GND	GND
43	PE4	IA	LCS
44	PE5		NC
45	PA0	IA	RINGD
46	PA1	IA/OA	NVMDATA (Note 4)
47	PA2		NC
48	PA3	IA	TXACK
49	PA4	IA	RXACK
50	PA5	OA	TXRDY
51	PA6	OA	RXRDY
52	PA7	OA	NVMCLK
53	TST		Connect to GND
54	D0	IA/OA	D0
55	D1	IA/OA	D1
56	D2	IA/OA	D2
57	D3	IA/OA	D3
58	D4	IA/OA	D4
59	D5	IA/OA	D5
60	D6	IA/OA	D6

Table 4. MCU Pin Signals - 84-Pin PLCC (Cont'd)

Pin	MCU Signal	I/O Type	Modem Signal
61	D7	IA/OA	D7
62	PE6		NC
63	PE7		NC
64	VCC	PWR	+5VDC
65	GND	GND	GND
66	GND	GND	GND
67	GND	GND	GND
68	A0	OA	A0
69	A1	OA	A1
70	A2	OA	A2
71	A3	OA	A3
72	A4	OA	A4
73	A5	OA	A5
74	A6	OA	A6
75	NC		NC
76	A7	OA	A7
77	A8	OA	A8
78	A9	OA	A9
79	A10	OA	A10
80	A11	OA	A11
81	A12	OA	A12
82	A13	OA	A13
83	A14	OA	A14
84	A15	OA	A15

Notes:
1. MI = Modem interconnect.
2. NC = No external connection.
3. NU = Not used; connect as noted.
4. Connect to +5 VDC through 10 KΩ.

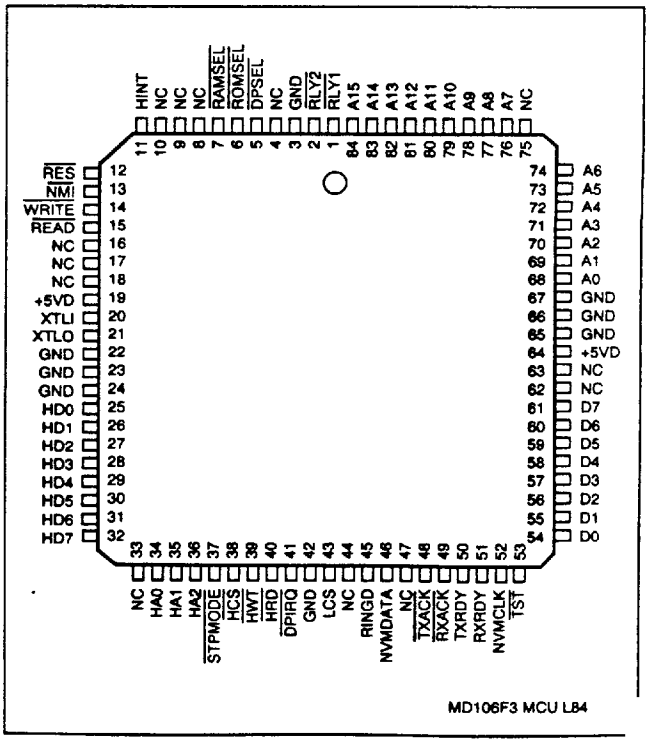

Figure 3. MCU Pin Signals - 84-Pin PLCC

Table 5. MDP Pin Signals - 68-Pin PLCC

Pin	Signal Label	I/O Type	Interface
1	VREG[3]	MI	To GND thru 0.1 µF (Optional)
2	DSP_RESET	MI	MDP: $\overline{RES}$
3	IA_CLKIN	MI	MDP: CLKIN
4	DSP_IRQ	MI	MDP: $\overline{IRQ}$
5	$\overline{RI}$	OA	NC
6	$\overline{RD}$	IA	RINGD from Line Interface
7	$\overline{RTS}$	IA	To +5VD through 10KΩ
8	IRQ	OA	MCU: $\overline{DPIRQ}$
9	D1	IA/OA	MCU: D1
10	DGND1	GND	GND
11	+5VD1	PWR	+5VDC
12	XTLI	I	Crystal/Clock Circuit
13	XTLO	O	Crystal/Clock Circuit
14	D0	IA/OA	MCU: D0
15	D2	IA/OA	MCU: D2
16	D3	IA/OA	MCU: D3
17	D5	IA/OA	MCU: D5
18	D7	IA/OA	MCU: D7
19	DGND2	GND	GND
20	RS0	IA	MCU: A0
21	+5VA	PWR	+5VA
22	AGND1	GND	GND
23	RIN	I(DA)	Line Interface
24	VC		To GND through RC circuit
25	VREF		To VC through capacitors
26	TXA2	O(DD)	Line Interface
27	$\overline{TXA1}$	O(DD)	Line Interface
28	$\overline{TALK}$	OD	$\overline{VOICE}$ to Line Interface
29	SPKR	O(DF)	Speaker Circuit
30	AGND2	GND	GND
31	$\overline{OHRC}$	OD	$\overline{CALLID}$ to Line Interface
32	$\overline{POR}$	MI	MDP. $\overline{RESET}$
33	CLKIN	MI	MDP: IA_CLKIN
34	$\overline{DTR}$	IA	To +5VD through 10KΩ
35	RXD	OA	NC
36	+5VD2	PWR	+5VD
37	$\overline{CTS}$	OA	NC
38	$\overline{IRQ}$	MI	MDP. DSP_IRQ
39	$\overline{RES}$	MI	MDP: DSP_RESET
40	DGND3	GND	GND
41	+5VD3	PWR	+5VD
42	RXOUT	MI	NC
43	DGND4	GND	GND
44	RMODE	MI	MDP: TMODE
45	TMODE	MI	MDP: RMODE
46	EYESYNC	OA	Eye Pattern Circuit
47	EYECLK	OA	Eye Pattern Circuit
48	EYEXY	OA	Eye Pattern Circuit
49	TXDAT	MI	NC
50	TDCLK	OA	MCU: $\overline{TXCLK}$
51	$\overline{RLSD}$	OA	NC
52	$\overline{RDCLK}$	OA	NC
53	GP0	MI	Connect to EYESYNC
54	XTCLK	IA	NC
55	DGND5	GND	GND
56	+5VD4	PWR	+5VD
57	TXD	IA	To +5VD through 10KΩ
58	DSR	OA	NC
59	$\overline{RESET}$	OA	MDP. $\overline{POR}$
60	$\overline{READ}$	IA	MCU: $\overline{READ}$

Table 5. MDP Pin Signals - 68-Pin PLCC (Cont'd)

Pin	Signal Label	I/O Type	Interface
61	$\overline{WRITE}$	IA	MCU: $\overline{WRITE}$
62	$\overline{CS}$	IA	MCU: $\overline{DPSEL}$
63	RS4	IA	MCU: A4
64	RS3	IA	MCU: A3
65	RS2	IA	MCU: A2
66	RS1	IA	MCU: A1
67	D6	IA/OA	MCU: D6
68	D4	IA/OA	MCU: D4

Notes:
1. I/O types:
   MI = Modem interconnect
   Digital input (IA, IB, etc.) and output (OA, OB, etc.).
   Analog input [I(DA)] and output [O(DD), O(DF), etc.]
2. NC = No external connection.
3. VREG pin can be NC; capacitor connection required only for compatibility with future products.

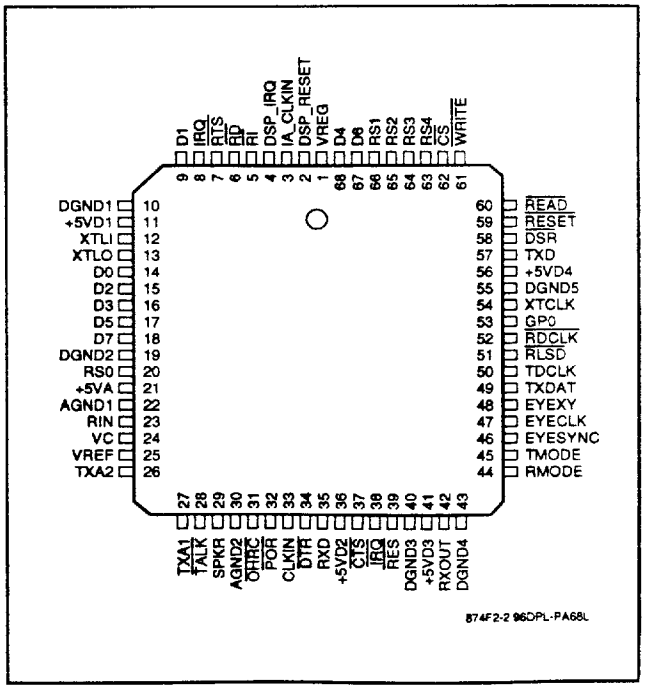

Figure 4. MDP Pin Signals - 68-Pin PLCC

Table 6. MCU Signal Definitions

Label	I/O Type	Signal Name/Description
		MCU SYSTEM
XTLI, XTLO	IE, OE	**MCU Crystal/Clock In and Crystal Out.** Connects to an external crystal circuit consisting of a 9.8304 MHz crystal and a capacitance network.
$\overline{RES}$	IC	**MCU Reset.** The active low $\overline{RES}$ input resets the MCU logic and returns the AT command set and S registers to factory default values and to "stored values" in NVRAM. The $\overline{RES}$ input is typically connected to the host bus RESET line through an inverter.
DPIRQ	IA	**MDP Interrupt Request.** Connects to the MDP IRQ output.
$\overline{DPRXD}$	IA	**MDP Received Data.** Connects to the MDP MRXD output.
+5VD	PWR	**+5V Digital Supply.** +5VDC ± 5%.
GND	GND	**Digital Ground.** Connect to ground.
		LINE INTERFACE
$\overline{RLY1}$	OA	**Relay 1 Control.** The active low $\overline{RLY1}$ output can be used to control the normally open off-hook/pulse dial relay.
LCS	IA	**Line Current Sense.** LCS is an active high input that indicates handset off-hook status.
RINGD	IA	**Ring Frequency.** The RINGD input from an external ring detect circuit is monitored to determine when to wake up from sleep or stop mode.
		NVRAM AND I/O BUS EXPANDER INTERFACE
NVMCLK	OA	**NVRAM Clock.** NVMCLK output high enables the NVRAM and the I/O Bus Expander.
NVMDATA	IA/OA	**NVRAM Data.** The NVMDATA pin supplies a serial data interface to the NVRAM and the I/O Expander. Unique device addresses included in the data stream designate the data for the NVRAM or the I/O Bus Expander.
		EXTERNAL BUS INTERFACE
A0-A15	OA	**Address Lines 0-15.** A0-A15 are the external bus address lines used to address the MDP interface memory registers and the external RAM and ROM.
A16	OA	**Address Line 16.** A16 is a bank select line.
D0-D7	IA/OA	**Data Line 0-7.** D0-D7 are the external bus data lines.
$\overline{READ}$	OA	**Read Enable.** $\overline{READ}$ output low enables data transfer from the selected device to the D0-D7 lines.
$\overline{WRITE}$	OA	**Write Enable.** $\overline{WRITE}$ output low enables data transfer from the D0-D7 lines to the selected device.
$\overline{DPSEL}$	OA	**Modem Data Pump Select.** $\overline{DPSEL}$ output low selects the MDP.
$\overline{RAMSEL}$	OA	**RAM Select.** $\overline{RAMSEL}$ output low selects the external 32k-byte RAM.
$\overline{ROMSEL}$	OA	**ROM Select.** $\overline{ROMSEL}$ output low selects the external 128k-byte ROM.

Table 6. MCU Signal Definitions (Cont'd)

Label	I/O Type	Signal Name/Description
		PARALLEL HOST INTERFACE The parallel interface emulates a 16550A UART interface. The parallel interface is compatible with communications software designed to operate with a 16450/16550 interface.
HA0-HA2	IA	**Host Bus Address Lines 0-2.** During a host read or write operation, HA0-HA2 select an internal MCU 16550A-compatible register.
HD0-HD7	IA/OA	**Host Bus Data Lines 0-7.** HD0-HD7 are comprised of eight three-state input/output lines providing bidirectional communication between the host and the MCU. Data, control words, and status information are transferred through HD0-HD7.
$\overline{HCS}$	IA	**Host Bus Chip Select.** $\overline{HCS}$ input low selects the host bus.
$\overline{HRD}$	IA	**Host Bus Read.** $\overline{HRD}$ is an active low, read control input. When $\overline{HCS}$ is low, $\overline{HRD}$ low allows the host to read status information or data from a selected MCU register.
$\overline{HWT}$	IA	**Host Bus Write.** $\overline{HWT}$ is an active low, write control input. When $\overline{HCS}$ is low, $\overline{HWT}$ low allows the host to write data or control words into a selected MCU 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.
$\overline{TXACK}$	IA	**Host Transmit Acknowledge.** $\overline{TXACK}$ is an active low transmit acknowledge input acknowledging that the DMA controller received the Transmit Ready (TXRDY) data transfer request output.
$\overline{RXACK}$	IA	**Host Receive Acknowledge.** $\overline{RXACK}$ is an active low receive acknowledge input acknowledging that the DMA controller received the Receiver Ready (RXRDY) data transfer request output.
TXRDY	OA	**Transmitter Ready.** TXRDY is an active high transmit ready output in the FIFO mode (FCR0 = 1). When asserted, TXRDY indicates that the TX FIFO is not full, i.e., the TX FIFO can accept data to be transmitted.
RXRDY	OA	**Receiver Ready.** RXRDY is an active high receiver ready output in the FIFO mode (FCR0 = 1). When asserted, RXRDY indicates that the RX FIFO is not empty, i.e., the RX FIFO has received data ready for transfer.
		8-BIT I/O EXPANDER TO MICROPHONE/SPEAKER INTERFACE
SWA, SWB	OA	**Analog Switch Control.** Encoded outputs select the RIN and TXA1/TXA2 routing as follows: **SWA** / **SWB** / **Description** 0 / 0 / Data mode (connect RIN to the line and the speaker; connect TXA1/TXA2 to the line and the speaker). 0 / 1 / Voice mode - playback to or record from the line or the telephone set (connect RIN to the line; connect TXA1/TXA2 to the line). 1 / 0 / Voice mode - record from the microphone (connect RIN to microphone input circuit; connect TXA1/TXA2 to line). 1 / 1 / Not used.
U/$\overline{D}$	OA	**Volume Up/Down Select.** Controls increase (high) or decrease (low) of volume when $\overline{INC}$ is pulsed and $\overline{CS}$ = low.
$\overline{INC}$	OA	**Volume Increment.** When $\overline{INC}$ is pulsed while $\overline{CS}$ is low, the volume is increased (U/$\overline{D}$ = high) or decreased (U/$\overline{D}$ = low).
$\overline{CS}$	OA	**Volume Control Chip Select.** Enables (low) or disables (high) adjustment of volume using U/$\overline{D}$ and $\overline{INC}$.

Table 7. MDP Signal Definitions

Label	I/O Type	Signal/Definition
		OVERHEAD SIGNALS
XTLI, XTLO	I, O	**Crystal In and Crystal Out.** Connect to an external crystal circuit consisting of a 35.251200 MHz crystal, three capacitors, and an inductor, or to a square wave generator/sine wave oscillator.
$\overline{\text{RESET}}$	IA	**Reset.** Connect to MDP $\overline{\text{POR}}$ and, optionally, to MCU $\overline{\text{RES}}$.
+5VD	PWR	**+ 5V Digital Supply.** +5V ± 5%.
+5VA	PWR	**+ 5V Analog Supply.** +5V ± 5%.
DGND	GND	**Digital Ground.** Connect to ground.
AGND	GND	**Analog Ground.** Connect to ground.
VC	MI	**Centerpoint Voltage.** Connect to analog ground through 10 µF (polarized, + terminal to VC) and 0.1 µF (ceramic) in parallel.
VREF	MI	**Voltage Reference.** Connect to VC through 10 µF (polarized, + terminal to VREF) and 0.1 µF (ceramic) in parallel.
VREG	MI	**Voltage Reference.** Can be left open. Connect to ground through 0.1 µF for compatibility with future products.
		LINE INTERFACE
TXA1, TXA2	O(DF)	**Transmit Analog 1 and 2.** The TXA1 and TXA2 outputs are differential outputs 180 degrees out of phase with each other.
RIN	I(DA)	**Receive Analog.** RIN is a single-ended receive data input from the telephone line interface or an optional external hybrid circuit.
RINGD	IA	**Ring Frequency (MDP $\overline{\text{RD}}$).** A low-going edge on the RING input initiates an internal ring frequency measurement. The RING input is typically connected to the output of a 4N35 optoisolator or equivalent. The optoisolator output should not respond to a voltage less than 40VRMS appearing across TIP and RING with respect to ground.
$\overline{\text{CALLID}}$	OD	**Caller ID Relay Control (MDP $\overline{\text{OHRC}}$).** Typically, the MDP $\overline{\text{CALLID}}$ 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.
$\overline{\text{VOICE}}$	OD	**Voice Relay Control (MDP $\overline{\text{TALK}}$).** Typically, the MDP $\overline{\text{VOICE}}$ output is connected to the normally open Voice relay (DPDT). In voice mode, $\overline{\text{VOICE}}$ 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 MDP $\overline{\text{CALLID}}$ and $\overline{\text{VOICE}}$ outputs can each directly drive a +5V reed relay coil with a minimum resistance of 360 ohms 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).
		SPEAKER INTERFACE
SPKR	O(DF)	**Speaker Analog Output.** The SPKR output reflects the received analog input signal. The SPKR is controlled by the ATMn command. The SPKR output can drive an impedance as low as 300 ohms. In a typical application, the SPKR output is an input to an external LM386 audio power amplifier.

Table 7. MDP Signal Definitions (Cont'd)

Label	I/O Type	Signal/Definition
		MCU INTERFACE
D0–D7	IA/OB	**Data Lines.** Connect to the MCU D0-D7, respectively.
RS0–RS4	IA	**Register Select Lines.** Connect to the MCU A0–A4, respectively.
$\overline{CS}$	IA	**Chip Select.** Connect to MCU $\overline{DPSEL}$ output.
$\overline{READ}$	IA	**Read Enable.** Connect to MCU $\overline{READ}$.
$\overline{WRITE}$	IA	**Write Enable.** Connect to MCU $\overline{WRITE}$.
IRQ	OA	**Interrupt Request.** Connect to MCU $\overline{DPIRQ}$.
		DIAGNOSTIC SIGNALS
		Three signals provide the timing and data necessary to create an oscilloscope quadrature eye pattern. The eye pattern is simply a display of the received baseband constellation. By observing this constellation, common line disturbances can usually be identified.
EYEXY	OA	**Serial Eye Pattern X/Y Output.** EYEXY is a serial output containing two 15-bit diagnostic words (EYEX and EYEY) for display on the oscilloscope X axis (EYEX) and Y axis (EYEY). EYEX is the first word clocked out; EYEY follows. Each word has 8-bits of significance. Each 15-bit data word is shifted out most significant bit first with the seven most significant bits set to zero. EYEXY is clocked by the rising edge of EYECLK. This serial digital data must be converted to parallel digital form by a serial-to-parallel converter and then to analog form by two digital-to-analog (D/A) converters.
EYECLK	OA	**Serial Eye Pattern Clock.** EYECLK is a 288 kHz output clock for use by the serial-to-parallel converters. The low-to-high transitions of $\overline{RDCLK}$ coincide with the low-to-high transitions of EYECLK. EYECLK, therefore, can be used as a receiver multiplexer clock.
EYESYNC	OA	**Serial Eye Pattern Strobe.** EYESYNC is a strobe for loading the D/A converters.
		SERIAL INTERFACE SIGNALS (NOT USED; CONNECT AS DESCRIBED)
$\overline{TXD}$	IA	**Transmitted Data.** Not used; leave open.
$\overline{RXD}$	IA	**Received Data.** Not used; leave open.
$\overline{TDCLK}$	OB	**Transmit Data Clock.** Not used; leave open.
$\overline{XTCLK}$	IA	**External Transmit Clock.** Not used; leave open.
$\overline{RDCLK}$	OB	**Receive Data Clock.** Not used; leave open.
$\overline{RLSDIND}$	OA	**Received Line Signal Detector.** Not used; leave open.
$\overline{RTS}$	IA	**Request to Send.** Not used; connect to +5VD through 10KΩ.
$\overline{DTR}$	IA	**Data Terminal Ready.** Not used; connect to +5VD through 10KΩ.
$\overline{DSR}$	OA	**Data Set Ready.** Not used; leave open.
$\overline{CTS}$	OA	**Clear to Send.** Not used; leave open.

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 IE		–	4.0	–		Note 2.
Input Low Voltage	V_{IL}				Vdc	
Type IA,IC, and ID		–0.3		0.8		
Type IE		–	1.0	–		Note 2.
Input Leakage Current	I_{IN}				µAdc	V_{IN} = 0 to V_{CC}
$\overline{RES}$ and PD0-PD7		–	–	±2.5		
XTLI		–	–	±10		
NMI and $\overline{TST}$		–	–	±100		
Output High Voltage	V_{OH}				Vdc	
Type OA and OB		2.4	–	–		I_{LOAD} = – 100 µA
Type OD		–	–	V_{CC}		I_{LOAD} = 0 mA
Type OE						Note 3.
Output Low Voltage	V_{OL}				Vdc	
Type OA		–	–	0.4		I_{LOAD} = 1.6 mA
Type OB		–	–	0.4		I_{LOAD} = 0.8 mA
Type OD		–	0.75	–		I_{LOAD} = 15 mA
Three-State (Off) Current	I_{TSI}			±10	µAdc	V_{IN} = 0 V to V_{CC}

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-A15), chip selects, $\overline{READ}$, and $\overline{WRITE}$ = 70 pF + one TTL.
   Other = 50 pF + one TTL.
2. Type IE inputs are centered approximately 2.5 V and swing 1.5 V_{PEAK} in each direction.
3. Type OE outputs provide oscillator feedback when operating with an external crystal.

Table 9. Analog Characteristics

Name	Type	Characteristic	Value
RIN	I (DA)	Input Impedance	> 70K Ω
		Voltage Range	2.5 ±1.6 V
TXA1, TXA2	O (DD)	Minimum Load	300 Ω
		Maximum Capacitive Load	0.01 µF
		Output Impedance	10 Ω
		Output Voltage	2.5 ± 1.6 V
		D.C. Offset	< 200 mV
SPKR	O (DF)	Minimum Load	300 Ω
		Maximum Capacitive Load	0.01 µF
		Output Impedance	10 Ω
		Output Voltage	2.5 ± 1.6 V
		D.C. Offset	< 20 mV

Table 10. Current and Power Requirements

Mode	Current (I_D)		Power (P_D)		Notes
	Typical Current @ 25°C	Maximum Current @ 0°C	Typical Power @ 25°C	Maximum Power @ 0°C	
MCU (C40)					f_{IN} = 9.8304 MHz
Normal mode	30 mA	34 mA	150 mW	180 mW	(internal divide by 1)
Sleep mode	2.2 mA	2.7 mA	11 mW	14.2 mW	
MDP (RCV144DPi-BA)					f_{IN} = 35.2512 MHz
Normal mode	140 mA	176 mA	700 mW	925 mW	
Sleep mode	2.0 mA	2.4 mA	10 mW	12.6 mW	
RCV144ACi-BA					
Normal mode	170 mA	210 mA	850 mW	1105 mW	
Sleep mode	4.2 mA	5.1 mA	21 mW	26.8 mW	

Notes:
1. Test conditions: VDD = 5.0 VDC for typical values; VDD = 5.25 VDC for maximum values.
2. Input voltage ripple < 0.1 V peak-to-peak.

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}	±2500	V
Latch-Up Current (@ 25°C)	I_{TRIG}	±200	mA
Operating Temperature Range	T_A		°C
Commercial		0 to +70	
Extended		-40 to +85	
Storage Temperature Range	T_{STG}	-55 to +125	°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 Receiver Data Available Interrupt (ERBFI)
0 DLAB = 0	Transmitter Buffer (TX Buffer) (THR)	Transmitter Buffer (TX Buffer) (Write Only)							
0 DLAB = 0	Receiver Buffer (RX Buffer) (RBR)	Receiver Buffer (RX Buffer) (Read Only)							
1 DLAB = 1	Divisor Latch MSB Register (DLM)	Divisor Latch MSB							
0 DLAB = 1	Divisor Latch LSB Register (DLL)	Divisor Latch LSB							