Rockwell

RC96V24AT-BA and RC14V24AT-BA Desktop Integrated Low Speed Data/Fax/Voice/Audio Modem Device Sets

INTRODUCTION

Rockwell RC96V24AT-BA and RC14V24AT-BA desktop integrated data/fax/voice/audio modem device sets support the Integrated Communications System program. These modems support data rates up to 2400 bps, fax data rates up to 9600 bps (RC96V24AT-BA) and 14400 bps (RC14V24AT-BA), ADPCM voice compression/decompression at 7200 Hz, and audio 8-bit record/playback at 11.025 kHz or 7200 Hz. Extended "AT" commands provide data, fax class 1, voice, and audio functions.

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

The modems operate in asynchronous mode over dial-up lines, and can auto-dial and auto-answer. Configuration information can be stored in non-volatile memory.

As data modems, each modem operates at line speeds up to 2400 bps. As fax modems, the RC96V24AT-BA and RC14V24AT-BA support Group 3 send and receive rates up to 9600 bps and 14400 bps, respectively.

The modems use enhanced Adaptive Differential Pulse Coded Modulation (ADPCM) coding and decoding to support efficient digital storage of voice using 2-, 3- and 4-bit compression and decompression at 7200 bps. Coder silence deletion and decoder silence interpolation are available to significantly increase compression rates.

In audio mode, the modems support record and playback of monophonic (mono) audio data in 8-bit unsigned linear pulse code modulation (PCM) at 11.025 kHz or 7200 Hz sampling rates.

With their small size and extremely low power consumption, these modem device sets are ideal for laptop, notebook, and palmtop applications.

Full error correction (V.42 LAPM, MNP™ 2–4) and data compression (V.42 bis, MNP 5) capabilities are supported through the Rockwell Protocol Interface (RPI™, patent pending), and host communication software supporting the RPI, a list of which can be obtained from your local Rockwell sales representative.

AccelerATor™ kits are available to minimize application design time and costs.

PCMCIA PC Card designs are supported with a Rockwell PCMCIA Interface Controller Adapter (PICA) device.

FEATURES

- Data modem throughput to 2400 bps
  - —V.22 bis, V.22 A/B, V.23, and V.21
  - —Bell 212A and 103
- Fax modem send and receive
  - —V.29 (9600 bps), V.27 ter, and V.21 Ch 2
  - —V.17 (14400 bps) [RC14V24AT-BA]
- Voice mode
  - —Enhanced ADPCM compression/decompression
  - —Tone detection/generation and call discrimination
  - —Timing marks
- Audio mode
  - —Record mono data using 8-bit audio data encoding at 11.025 kHz or 7200 Hz
  - —Playback at 11.025 kHz or 7200 Hz
  - —Tone detection and/or generation
- Supports business audio applications (e.g., digital answering machine, voice annotation, audio file play and record, and text to speech functionality)
- Communication software compatible command sets
  - —AT, fax class 1, and voice commands
  - —S registers
- Error correction (V.42 LAPM, MNP 2–4) and data compression (V.42 bis, MNP 5) supported through RPI and host software without additional hardware.
- Built-in DTE interfaces
  - —DTE speed to 19.2 Kbps (data) or 115.2 Kbps (voice)
  - —Parallel 16550A UART interface
- Line quality monitoring and auto retrain
- NVRAM directory and stored profiles
- Flow control and speed buffering
- Automatic format/speed sensing to 19.2 Kbps
- Parallel asynchronous data
- Auto dial and auto answer
- Tone, pulse, and adaptive dialing
- Calling Number Delivery (Caller ID) detection
- Diagnostics
- Memory requirements: 64k bytes of ROM and 128/256 bytes of NVRAM
- Extended operating temperature models available
- +5V operation, typical low power consumption (RC96V24AT-BA):

Operating:	340 mW
Sleep mode:	21.0 mW

- Two CMOS VLSI devices
  - —MCU: One 80-pin PQFP or one 84-pin PLCC
  - —MDP: One 100-pin PQFP or one 68-pin PLCC

Data Sheet
(Preliminary)

Order No. MD118
April 6, 1994

TECHNICAL SPECIFICATIONS

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

The modem data pump (MDP) is a Rockwell RC96V24DP (RC96V24AT-BA) or RC14V24DP (RC14V24AT-BA) data/fax/voice modem data pump, provided in a 68-pin PLCC or a 100-pin PQFP.

As a data modem, each MDP operates in a 2-wire, full-duplex, asynchronous mode at line rates up to 2400 bps.

As a fax modem, each MDP fully supports Group 3 facsimile send and receive speeds of 9600, 7200, 4800, and 2400 bps. The RC14V24DP adds Group 3 facsimile send and receive speeds of 14400 and 12000 bps.

Microcontroller (MCU)

The microcontroller (MCU) performs the command processing and host interface functions, and is a Rockwell C40 microcomputer packaged in a 84-pin PLCC or a 80-pin PQFP. The MCU connects to the host via a parallel microcomputer bus. The MCU connects to the modem data pump via dedicated lines and an external bus. The external bus also connects to the OEM-supplied 64k-byte ROM.

MCU Firmware

MCU firmware performs processing of general modem control, command sets, fax class 1, voice, audio, 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 INTERFACE

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

Parallel Interface

A 16550A UART-compatible parallel interface is provided.

Host Bus Interface. Eight data lines, three address lines, and nine control lines are supported.

NVRAM Interface

A serial interface to the optional OEM-supplied 128/256-byte non-volatile RAM (NVRAM) is provided. Data stored in NVRAM can take precedence over the factory default settings. A 256-byte NVRAM can store up to two user-selectable configurations, and can store up to four 45-digit dial strings.

Speaker Interface

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

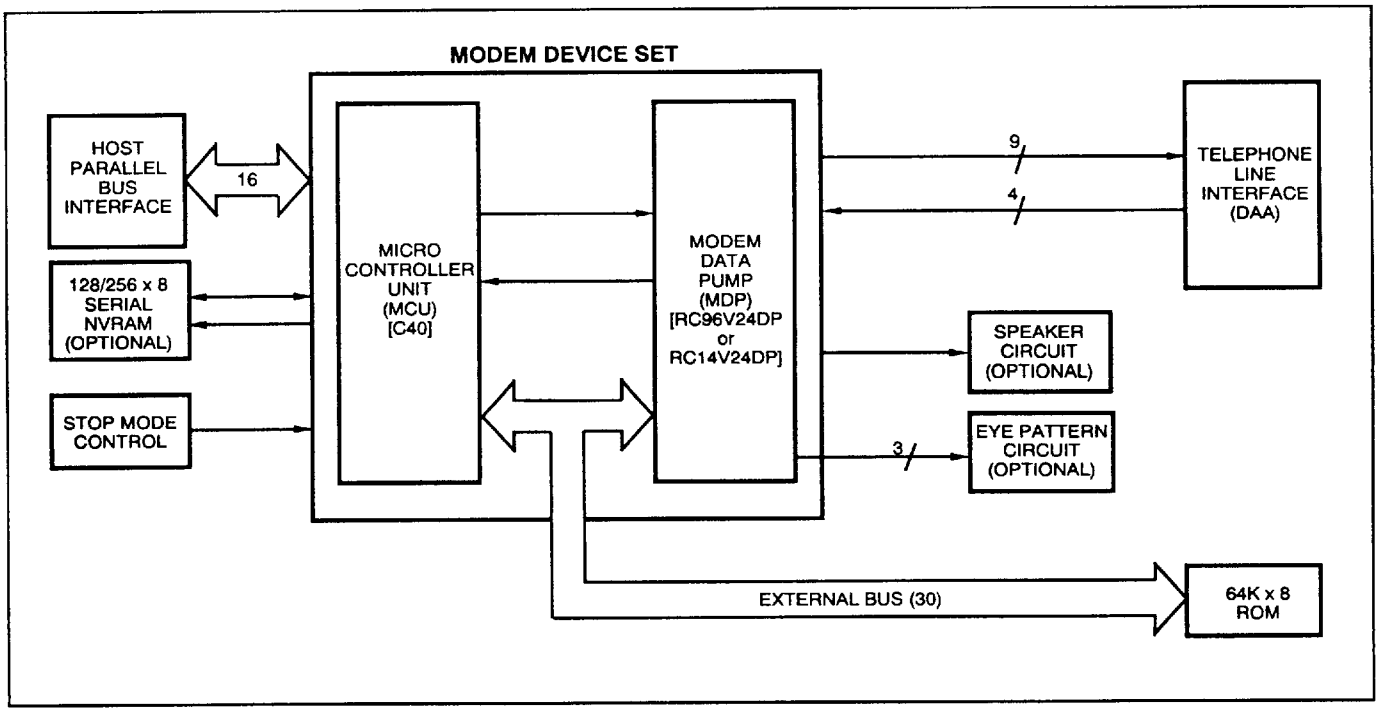

Figure 1. Modem Device Set General Interface

MCU External Bus Interface

An external bus interface is provided to OEM-supplied 64k-byte ROM. The non-multiplexed bus supports eight bi-directional data lines and 16 address lines. Dedicated ROM, MDP, and indicator outputs are also provided for selecting/enabling 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 four relay control outputs to the line interface. These outputs may be used to control relays such as off-hook, pulse, mute, A/A1, earth, and talk/data. 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 voice AT commands, and S registers (see Tables 1 and 2, respectively).

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

Fax Modem Operation. Each modem operates as a facsimile modem in response to fax class 1 commands when +FCLASS=1.

Voice Operation. Voice mode functions operate in response to voice/audio commands when #CLS=8 and #VBS=2, #VBS=3, 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. Sampling rate is determined by #VSR=11025 or #VSR=7200.

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 to 68 Hz square wave input.

Billing Protection

When the modem goes off-hook to answer an incoming call, both transmission and reception 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 the N command and S37 register combination.

Automode Detect

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.

Table 1. AT Commands

Command	Function
	Basic AT Commands
A/	Re-execute command
AT=x	Write to selected S Register
AT?	Read selected S Register
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	Read/write S Register
T	Set tone dial default
Vn	Result code form
Wn	Message control
Xn	Extended result codes
Yn	Long space disconnect
Zn	Soft reset and restore profile
#CID	Enable Caller ID detection and select reporting format
+Hn	Enable/disable RPI and DTE speed
	AT& Commands
&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 mode selection
&Pn	Select pulse dial make/break ratio
&Qn	Asynchronous mode selection
&Rn	RTS/CTS option
&Sn	DSR override
&Tn	Test and diagnostic
&V	Display current configuration and stored profiles
&Wn	Store current configuration
&Yn	Designate a default reset profile
&Zn=x	Store phone number

Table 1. AT Commands (Cont'd)

Command	Function
	AT% Commands
%En	Enable/disable line quality monitor and auto-retrain
%L	Report line signal level
%Q	Report line signal quality
	AT\ Commands
\Gn	Modem-to-modem flow control (XON/XOFF)
\Kn	Break control
\Nn	Operating mode
	Fax Class 1 AT+F Commands
+FCLASS=n	Service class
+FAE=n	Data/Fax auto answer
+FRH=n	Receive data with HDLC framing
+FRM=n	Receive data
+FRS=n	Receive silence
+FTH=n	Transmit data with HDLC framing
+FTM=n	Transmit data
+FTS=n	Stop transmission and wait
	Voice/ Audio AT# Commands
#BDR	Select baud rate
#CLS	Select data, fax, or voice/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
#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	Enable timing mark placement
#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	Reserved*
S12	Escape code guard time*
S13	Reserved
S14	General bit mapped options status*
S15	Reserved
S16	Test mode bit mapped options (&T) status*
S17	Reserved
S18	Test timer*
S19-S20	Reserved
S21	V.24/general bit mapped options status*
S22	Speaker/results bit mapped options status*
S23	General bit mapped options status*
S24	Sleep inactivity timer
S25	Delay to DTR (CT108) off*
S26	RTS-to-CTS (CT105-to-CT106) delay*
S27	General bit mapped options status*
S28	General bit-mapped options status
S29	Flash dial modifier time
S30	Disconnect Inactivity timer*
S31	General bit-mapped options status
S32	XON character
S33	XOFF character
S34-S36	Reserved
S37	Line connection speed*
S38	Reserved
S39	Flow control bit-mapped options status*
S40	General bit-mapped options status
S41	General bit-mapped options status
S42-S45	Reserved
S91	PSTN transmit level
S92	Fax transmit attenuation level
S95	Result code messages control*

* Register value may be stored in one of two user profiles with the AT&W command.

Table 3. Connection Speed Options

Configuration	Rate
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

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

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, the modem will disconnect after receiving 1.6 ± 10% seconds of continuous SPACE.

Send SPACE on Disconnect

If selected by the Y1 command, the modem will send 4 ± 10% seconds of continuous SPACE when a locally commanded hang-up is issued by the &Dn, &Qn, or H 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.

If enabled by the %E command, the modem initiates a retrain if line quality becomes unacceptable. 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 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 42 minutes with the \Tn command. The timer may also be programmed by S30 = n, where n = the number of tens of seconds.

DTE Signal Monitoring

$\overline{\text{DTR}}$. When $\overline{\text{DTR}}$ is asserted, the modem responds in accordance with the &Dn and &Qn commands.

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

FAX CLASS 1 OPERATION

The modem operates as a facsimile (fax) DCE whenever the +FCLASS=1 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 OPERATION

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 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 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.

GENERAL OPERATION

Calling Tone

Calling tone is generated in accordance with V.25. Calling tone may be toggled (enabled/disabled) by inclusion of a "^" character in a dial string.

Call Progress Tone Detection

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

Relay Control

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

DIAGNOSTICS

Commanded Tests

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

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 1's and 0's (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 on the RAM, ROM, NVRAM, and MDP.

LOW POWER MODES

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 located in the RC96V24AT-BA and RC14V24AT-BA Modem Designer's Guide (Order No. 1033) and associated AT Command Reference Manual (Order No. 1036).

HARDWARE INTERFACE

HARDWARE INTERFACE SIGNALS

The modem hardware interface signals for the parallel interface configuration are shown in Figure 2.

The MCU pin assignments for parallel interface selected 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.

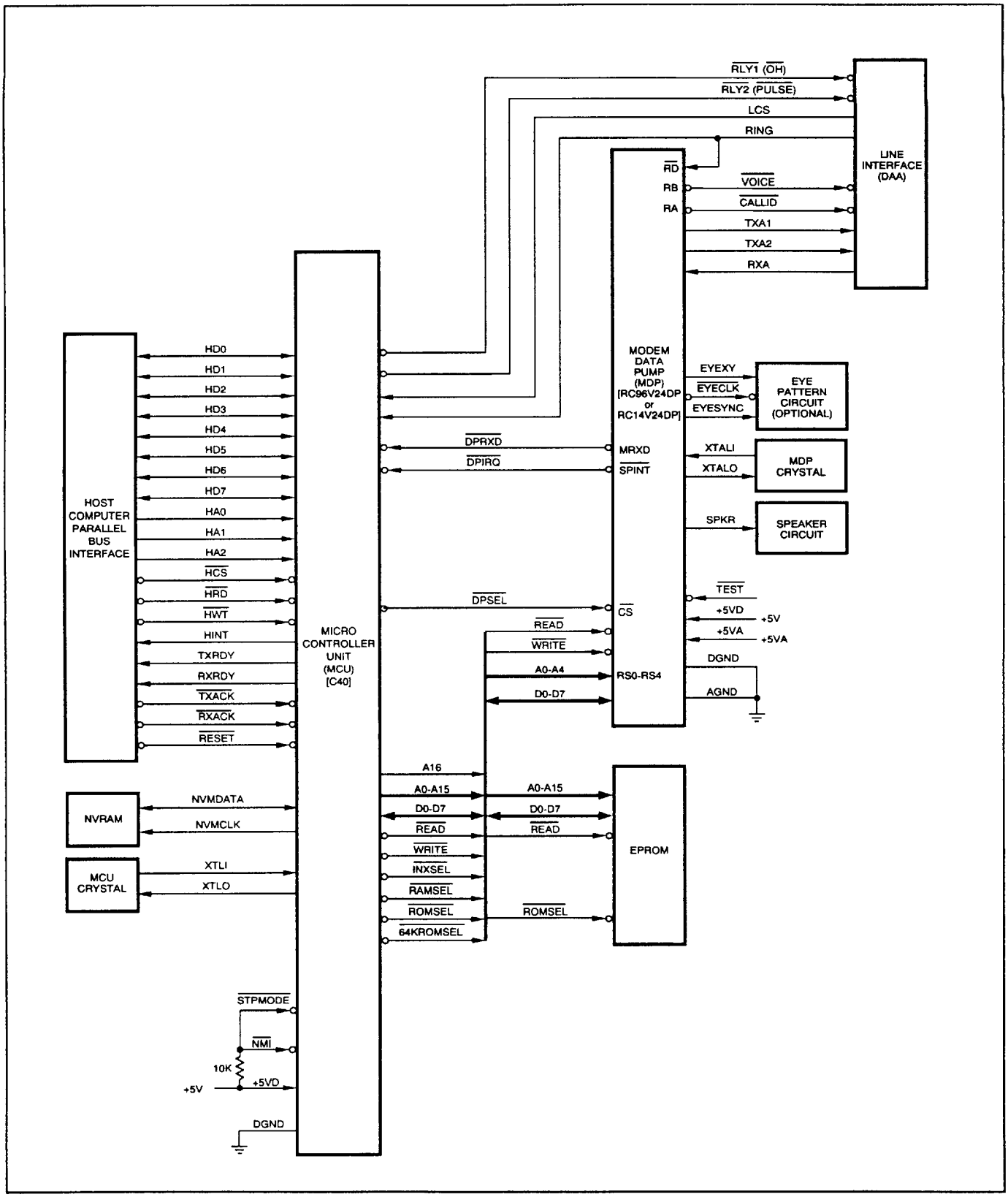

Figure 2. Hardware Interface Signals-Parallel Interface

Table 4a. MCU Signals - Parallel I/F - 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		NC
5	PB1	MI	DPSEL
6	PB2	OA	ROMSEL
7	PB3		NC
8	PB4		NC
9	PB5		NC
10	PB6		NC
11	PB7	OA	HINT
12	RES	IC	RES
13	NMI		+5VDC (Note 4)
14	NC		NC
15	RD	OA	READ
16	PE2		NC
17	PE3		NC
18	SYNC/NC		NC
19	+5VD	PWR	+5VDC
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
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	RING
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 4a. MCU Signals-Parallel I/F-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	+5VD	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.

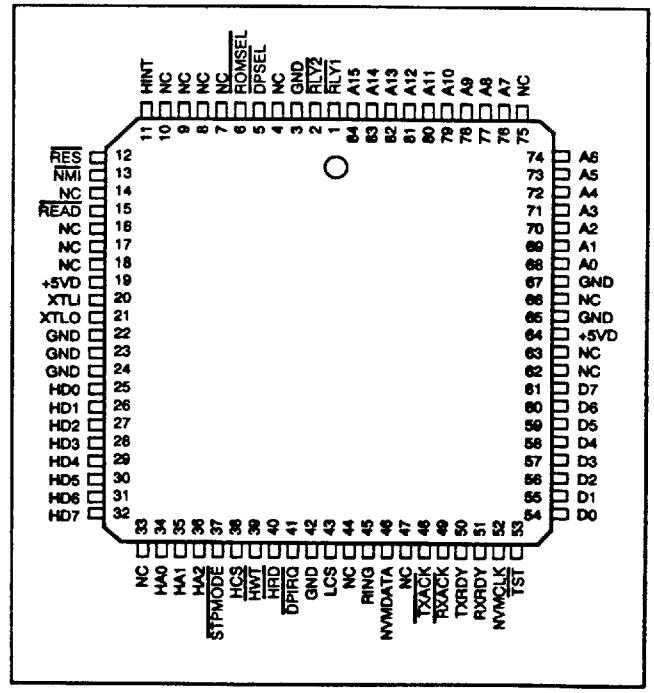

Figure 3a. MCU Signals - Parallel I/F - 84-Pin PLCC

Table 4b. MCU Signals - Parallel I/F - 80-Pin PQFP

Pin	MCU Signal	I/O Type	Modem Signal
1	$\overline{RES}$	IC	$\overline{RES}$
2	$\overline{NMI}$		+5VD (Note 6)
3	NC		NC
4	$\overline{RD}$	OA	$\overline{READ}$
5	PE2		NC
6	PE3		NC
7	SYNC/NC		NC
8	VCC	PWR	+5VD
9	XTLI	IE	XTLI
10	XTLO	OE	XTLO
11	GND	GND	GND
12	GND	GND	GND
13	PC0	IA/OA	HD0
14	PC1	IA/OA	HD1
15	PC2	IA/OA	HD2
16	PC3	IA/OA	HD3
17	PC4	IA/OA	HD4
18	PC5	IA/OA	HD5
19	PC6	IA/OA	HD6
20	PC7	IA/OA	HD7
21	PD0	IA	HA0
22	PD1	IA	HA1
23	PD2	IA	HA2
24	PD3	IA	$\overline{STPMODE}$
25	PD4	IA	$\overline{HCS}$
26	PD5	IA	$\overline{HWT}$
27	PD6	IA	$\overline{HRD}$
28	PD7	OA	$\overline{DPIRQ}$ (Note 5)
29	GND	GND	GND
30	PE4	IA	LCS
31	PE5		NC
32	PA0	IA	RING
33	PA1	OA	NVMDATA (Note 4)
34	PA2		NC
35	PA3	IA	TXACK
36	PA4	IA	RXACK
37	PA5	OA	TXRDY
38	PA6	OA	RXRDY
39	PA7	OA	NVMCLK
40	$\overline{TST}$		$\overline{TST}$ (Note 4)
41	D0	IA/OA	D0
42	D1	IA/OA	D1
43	D2	IA/OA	D2
44	D3	IA/OA	D3
45	D4	IA/OA	D4
46	D5	IA/OA	D5
47	D6	IA/OA	D6
48	D7	IA/OA	D7
49	PE6		NC
50	PE7		NC
51	VCC	PWR	+5VD
52	GND	GND	GND
53	GND	GND	GND
54	A0	OA	A0
55	A1	OA	A1
56	A2	OA	A2
57	A3	OA	A3
58	A4	OA	A4
59	A5	OA	A5
60	A6	OA	A6

Table 4b. MCU Signals-Parallel I/F-80-Pin PQFP (Cont'd)

Pin	MCU Signal	I/O Type	Modem Signal
61	A7	OA	A7
62	A8	OA	A8
63	A9	OA	A9
64	A10	OA	A10
65	A11	OA	A11
66	A12	OA	A12
67	A13	OA	A13
68	A14	OA	A14
69	A15	OA	A15
70	PE0	OA	$\overline{RLY1}$ ($\overline{OH}$)
71	PE1	OA	$\overline{RLY2}$ (PULSE)
72	GND	GND	GND
73	PB0		NC
74	PB1	MI	$\overline{DPSEL}$
75	PB2	OA	$\overline{ROMSEL}$
76	PB3		NC
77	PB4		NC
78	PB5		NC
79	PB6		NC
80	PB7	OA	HINT

Notes:
1. MI = Modem interconnect.
2. NC = No external connection.
3. NU = Not used; connect as noted.
4. Connect to GND.
5. Connect to +5 VDC through 10 KΩ.
6. Connect to +5 VDC through 4.7 KΩ.

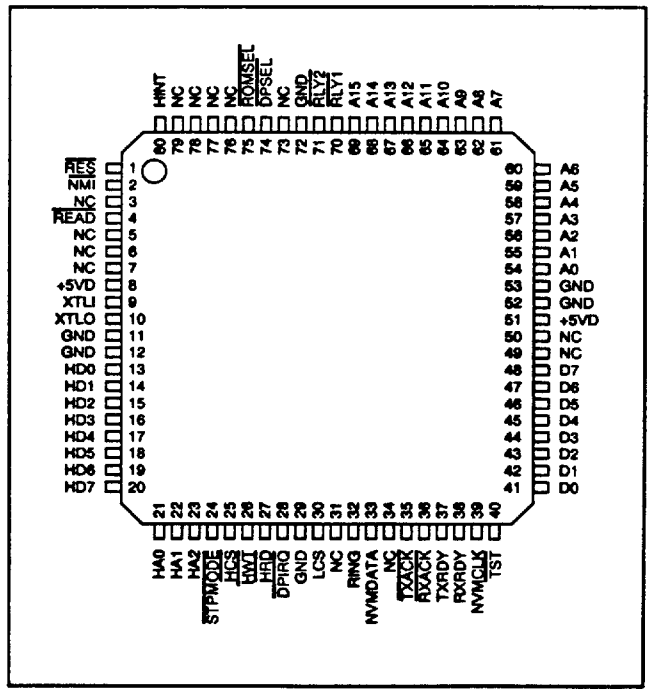

Figure 3b. MCU Signals - Parallel I/F - 80-Pin PQFP

Table 5a. MDP Signals - 68-Pin PLCC

Pin	MDP Signal	I/O Type	Modem Signal
1	RS2	IA	A2
2	RS1	IA	A1
3	RS0	IA	A0
4	TEST		TEST
5	SLEEP	MI	SLEEP
6	RING	IA	RING
7	EYEY	OB	EYEY
8	EYEX	OB	EYEX
9	EYESYNC	OB	EYESYNC
10	RESET	ID	RESET
11	XTALI	IE	XTALI
12	XTALO	OB	XTALO
13	+5VD	PWR	+5VD
14	GP18	OA	NC
15	RLSD	OA	RLSDIND
16	XTCLK	IA	XTCLK
17	DGND	GND	DGND
18	TXD	IA	TXD
19	TDCLK	OA	TXCLK
20	TRSTO	MI	TRSTO
21	TSTBO	MI	TSTBO
22	TDACO	MI	TDACO
23	RADCI	MI	RADCI
24	RAGCO	MI	RAGCO
25	MODEO	MI	MODEO
26	RSTBO	MI	RSTBO
27	RRSTO	MI	EYECLK
28	RDCLK	OA	RXCLK
29	RXD	OA	DPRXD
30	TXA2	O(DD)	TXA2
31	TXA1	O(DD)	TXA1
32	RXA	I(DA)	RXA
33	RFILO	MI	RFILO
34	AGCIN	MI	AGCIN
35	VC	OA	VC
36	NC		NC
37	NC		NC
38	NC		NC
39	RBDVR		VOICE
40	AGND	GND	AGND
41	RADVR	OD	CALLID
42	SLEEPI	IA	SLEEPI
43	RAGCI	MI	RAGCI
44	NC		NC
45	RSTBI	MI	RSTBI
46	RRSTI	MI	EYECLK
47	RADCO	MI	RADCO
48	TDACI	MI	TDACI
49	TRSTI	MI	TRSTI
50	TSTBI	MI	TSTBI
51	MODEI	MI	MODEI
52	+5VA	PWR	+5VA
53	SPKR	O(OF)	SPKR
54	DGND	GND	DGND
55	D7	IA/OB	D7
56	D6	IA/OB	D6
57	D5	IA/OR	D5
58	D4	IA/OB	D4
59	D3	IA/OB	D3
60	D2	IA/OB	D2

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

Pin	MDP Signal	I/O Type	Modem Signal
61	D1	IA/OB	D1
62	D0	IA/OB	D0
63	IRQ	OC	DPIRQ
64	WRITE	IA	WRITE
65	CS	IA	DPSEL
66	READ	IA	READ
67	RS4	IA	A4
68	RS3	IA	A3

Notes:
1. MI = Modem Interconnection.
2. NC = No external connection.

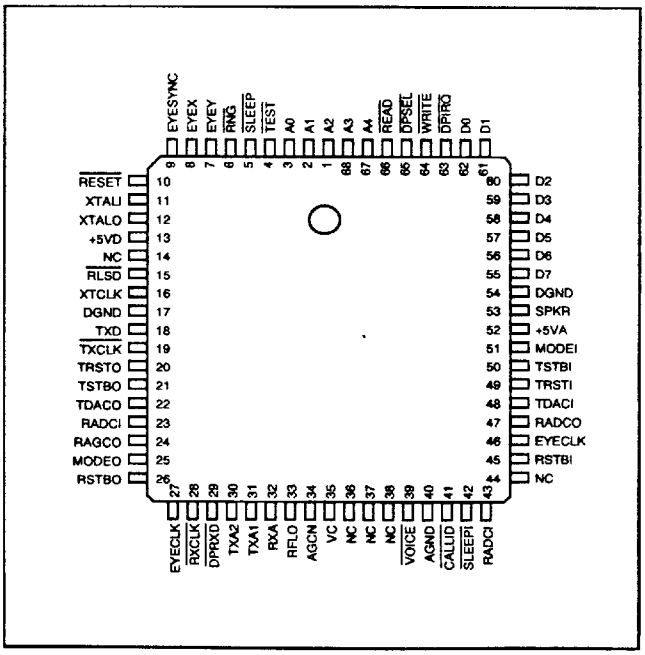

Figure 4a. MDP Signals - 68-Pin PLCC

Table 5b. MDP Signals - 100-Pin PQFP

Pin	Signal Name	I/O Type	Modem Signal
1	NC		NC
2	NC		NC
3	NC		NC
4	NC		NC
5	NC		NC
6	DGND	GND	DGND
7	DGND	GND	DGND
8	D7	IA/OB	D7
9	D6	IA/OB	D6
10	D5	IA/OR	D5
11	D4	IA/OB	D4
12	D3	IA/OB	D3
13	D2	IA/OB	D2
14	D1	IA/OB	D1
15	D0	IA/OB	D0
16	DGND	GND	DGND
17	MODEI	MI	MODEI
18	+5VA	PWR	+5VA
19	SPKR	O(OF)	SPKR
20	NC		NC
21	AGND	GND	AGND
22	TXA2	O(DD)	TXA2
23	TXA1	O(DD)	TXA1
24	NC		NC
25	RXA	I(DA)	RXA
26	NC		NC
27	RFILO	MI	RFILO
28	AGCIN	MI	AGCIN
29	VC	OA	VC
30	AGND	GND	AGND
31	NC		NC
32	NC		NC
33	NC		NC
34	NC		NC
35	NC		NC
36	RBDVR		VOICE
37	AGND	GND	AGND
38	RADVR	OD	CALLID
39	NC		NC
40	NC		NC
41	SLEEPI	MI	SLEEPI
42	RAGCI	MI	RAGCI
43	AGND	GND	AGND
44	RSTBI	MI	RSTBI
45	RRSTI	MI	EYECLK
46	RADCO	MI	RADCO
47	TDACI	MI	TDACI
48	TRSTI	MI	TRSTI
49	TSTBI	MI	TSTBI
50	IRQ	OC	DPIRQ
51	NC		NC
52	WRITE	IA	WRITE
53	CS	IA	DPSEL
54	READ	IA	READ
55	RS4	IA	A4
56	RS3	IA	A3
57	RS2	IA	A2
58	RS1	IA	A1
59	RS0	IA	A0
60	TEST		TEST

Table 5b. MDP Signals - 100-Pin PQFP (Cont'd)

Pin	Signal Name	I/O Type	Modem Signal
61	SLEEP	MI	SLEEP
62	RING	IA	RING
63	EYEY	OB	EYEY
64	EYEX	OB	EYEX
65	EYESYNC	OB	EYESYNC
66	DGND	GND	DGND
67	NC		NC
68	RESET	ID	RESET
69	XTALI	IE	XTALI
70	XTALO	OB	XTALO
71	+5VD	PWR	+5VD
72	+5VD	PWR	+5VD
73	+5VD	PWR	+5VD
74	GP18	OA	NC
75	RLSD	OA	RLSDIND
76	XTCLK	IA	XTCLK
77	DGND	GND	DGND
78	DGND	GND	DGND
79	TXD	IA	TXD
80	DGND	GND	DGND
81	DGND	GND	DGND
82	NC		NC
83	TDCLK	OA	TXCLK
84	TRSTO	MI	TRSTO
85	TSTBO	MI	TSTBO
86	TDACO	MI	TDACO
87	RADCI	MI	RADCI
88	RAGCO	MI	RAGCO
89	DGND	GND	DGND
90	MODEO	MI	MODEO
91	RSTBO	MI	RSTBO
92	RRSTO	MI	EYECLK
93	RDCLK	OA	RXCLK
94	RXD	OA	DPRXD
95	NC		NC
96	NC		NC
97	DGND	GND	DGND
98	NC		NC
99	NC		NC
100	NC		NC

Notes:
1. MI = Modem Interconnection.
2. NC = No external connection.

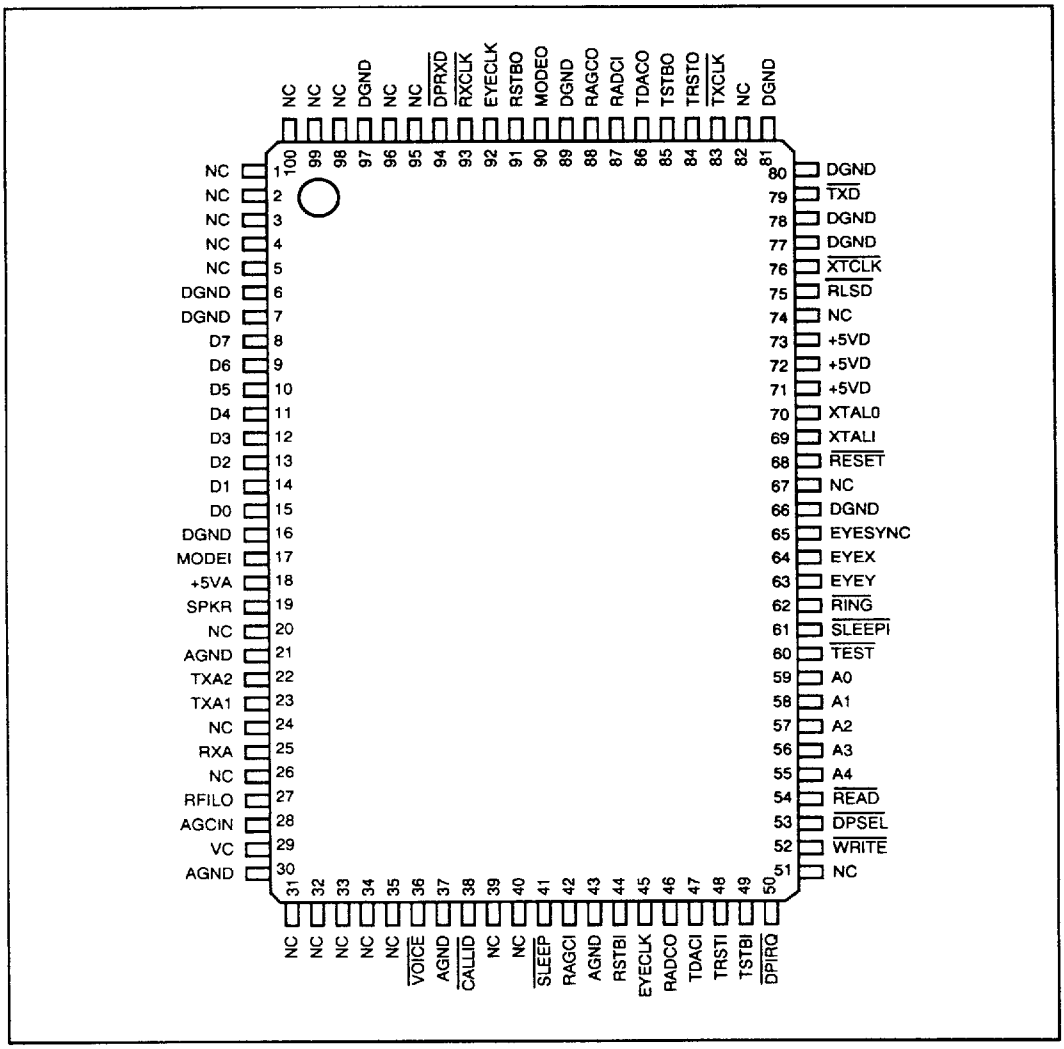

Figure 4b. MDP Signals - 100-Pin PQFP

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.
$\overline{\text{RES}}$	IC	**MCU Reset.** The active low $\overline{\text{RES}}$ input resets the MCU logic and returns the AT command set to the original factory default values and to "stored values" in NVRAM. The $\overline{\text{RES}}$ input is typically connected to the host bus RESET line through an inverter.
$\overline{\text{DPIRQ}}$	IA	**MDP Interrupt Request.** Connects to the MDP IRQ output.
$\overline{\text{DPRXD}}$	IA	**MDP Received Data.** Connects to the MDP MRXD output.
+5VD	PWR	**+ 5V Digital Supply.** +5V ± 5%.
GND	GND	**Digital Ground.** Connect to ground.
		LINE INTERFACE
$\overline{\text{RLY1}}$	OA	**Relay 1 Control ($\overline{\text{OH}}$).** The active low $\overline{\text{RLY1}}$ output can be used to control the normally open off-hook relay.
$\overline{\text{RLY2}}$	OA	**Relay 2 Control ($\overline{\text{PULSE}}$).** The active low $\overline{\text{RLY2}}$ output can be used to control the normally open pulse dial relay.
LCS	IA	**Line Current Sense.** LCS is an active high input that indicates handset off-hook status.
RING	IA	**Ring Frequency.** The RING input from an external ring detect circuit is monitored to determine when to wake up from sleep or stop mode.
		NVRAM INTERFACE
NVMCLK	OA	**NVRAM Clock.** NVMCLK output high enables the NVRAM.
NVMDATA	IA/OA	**NVRAM Data.** The NVMDATA pin supplies a serial data interface to the NVRAM.
		EXTERNAL MEMORY BUS INTERFACE
A0-A15	OA	**Address Lines 0-15.** A0-A15 are the external memory bus address lines.
D0-D7	IA/OA	**Data Line 0-7.** D0-D7 are the external memory bus data lines.
$\overline{\text{READ}}$	OA	**Read Enable.** $\overline{\text{READ}}$ output low enables data transfer from the selected device to the D0-D7 lines.
$\overline{\text{DPSEL}}$	OA	**Modem Data Pump Select.** $\overline{\text{DPSEL}}$ output low selects the MDP.
$\overline{\text{ROMSEL}}$	OA	**ROM Select.** $\overline{\text{ROMSEL}}$ output low selects an external 32k/64k/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 16450/16550A UART interface, and is compatible with communications software designed to operate with a this interface.
HA0-HA2	IA	**Host Bus Address Lines 0-2.** During a host read or write operation, HA0-HA2 select an internal MCU 16450/16550A-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.
$\overline{\text{HCS}}$	IA	**Host Bus Chip Select.** $\overline{\text{HCS}}$ input low selects the host bus.
$\overline{\text{HRD}}$	IA	**Host Bus Read.** $\overline{\text{HRD}}$ is an active low, read control input. When $\overline{\text{HCS}}$ is low, $\overline{\text{HRD}}$ low allows the host to read status information or data from a selected MCU register.
$\overline{\text{HWT}}$	IA	**Host Bus Write.** $\overline{\text{HWT}}$ is an active low, write control input. When $\overline{\text{HCS}}$ is low, $\overline{\text{HWT}}$ 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.
$\overline{\text{TXACK}}$	IA	**Host Transmit Acknowledge.** $\overline{\text{TXACK}}$ is an active low transmit acknowledge input acknowledging that the DMA controller received the Transmit Ready (TXRDY) data transfer request output.
$\overline{\text{RXACK}}$	IA	**Host Receive Acknowledge.** $\overline{\text{RXACK}}$ 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).

Table 7. MDP Signal Definitions

Label	I/O Type	Signal Name/Description
		OVERHEAD SIGNALS
XTALI, XTALO	IE, OE	**MDP Crystal/Clock In and Crystal Out.** Connect the MDP XTALI and XTALO pins to a external crystal circuit consisting of a 24.00014 MHz (RC96V24DP) or 19.000265 MHz (RC14V24DP) crystal and two capacitors. Alternatively, connect XTALI to a buffered clock or a sine wave oscillator and leave XTALO open.
$\overline{\text{RESET}}$	ID	**Reset.** Connect to MCU $\overline{\text{RES}}$.
+5VD (P5VD)	PWR	**+ 5V Digital Supply.** Connect +5V ± 5%.
+5VA (P5VA)	PWR	**+ 5V Analog Supply.** Connect to +5VA.
DGND	GND	**Digital Ground.** Connect to ground.
AGND	GND	**Analog Ground.** Connect to ground.
VC	OA	**Centerpoint Voltage.** Connect VC to ground through 0.1 µF.
		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.
$\overline{\text{CS}}$	IA	**Chip Select.** Connect to MCU $\overline{\text{DPSEL}}$ output.
$\overline{\text{READ}}$	IA	**Read Enable.** Connect to MCU $\overline{\text{READ}}$.
$\overline{\text{WRITE}}$	IA	**Write Enable.** Connect to MCU $\overline{\text{WRITE}}$.
$\overline{\text{IRQ}}$	OC	**Interrupt Request.** Connect to MCU $\overline{\text{DPIRQ}}$.
		PARALLEL INTERFACE
TXD	IA	**Transmitted Data.** Not used, leave open.
RXD	OA	**Received Data.** Not used, leave open.
$\overline{\text{TDCLK}}$	OB	**Transmit Data Clock.** Not used, leave open.
$\overline{\text{XTCLK}}$	IA	**External Transmit Clock.** Not used, leave open.
$\overline{\text{RDCLK}}$	OB	**Receive Data Clock.** Not used, leave open.

Table 7. MDP Signal Definitions (Cont'd)

Label	I/O Type	Signal Name/Description
		LINE INTERFACE (DAA)
TXA1, TXA2	O(DD)	**Transmit Analog Output.** The TXA1 and TXA2 outputs are differential outputs to the line interface or to an optional external hybrid circuit.
RXA	I(DA)	**Receive Analog Input.** RXA is a single-ended receive data input from the telephone line interface or an optional external hybrid circuit.
RING	IA	**Ring Frequency.** A low-going edge on the RING input to the MDP initiates an internal ring frequency measurement. The MDP RING input is typically connected to the output of an 4N35 optoisolator. The optoisolator output should not respond to a voltage less than 40 Vrms 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 open Caller ID relay. When the modem detects a ring signal and a Calling Number Delivery (CND) message has been enabled, the $\overline{\text{CALLID}}$ output is asserted to close the CALLID relay in order to AC couple the CND information to the modem RIN input (without allowing loop current flow which would indicate an off-hook condition). For local handset operation in voice mode, the the $\overline{\text{CALLID}}$ output is asserted to close the CALLID relay in order to AC couple and route the voice signal to the modem RIN input.
$\overline{\text{VOICE}}$	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.
		DIAGNOSTIC SIGNALS Four signals provide the timing and data necessary to create an oscilloscope quadrature eye pattern (received baseband constellation). By observing this constellation, common line disturbances can usually be identified.
EYEX, EYEY	OB	**Eye Pattern Data X and Eye Pattern Data Y.** The EYEX and EYEY outputs are two 8-bit serial bit streams containing data for display on the oscilloscope X axis and Y axis, respectively.
$\overline{\text{EYECLK}}$	OA	**Eye Pattern Clock.** EYECLK is a clock for use by the serial-to-parallel converters. The $\overline{\text{EYECLK}}$ output is a 7200-9600 Hz clock.
EYESYNC	OB	**Eye Pattern Sync.** EYESYNC is a strobe for word synchronization.

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 to 70 deg. C (Commercial) or -40 to 85 deg. C (Extended), (unless otherwise stated).
   Output loads: Data bus (D0-D7), address bus (A0-A15), chip selects, READ, and 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 Interface Characteristics

Name	Type	Characteristic	Value
RXA	I (DA)	Input Impedance	> 50K Ω
		AC Input Voltage Range	3.2 VP-P
		Reference Voltage*	+ 2.5 VDC
TXA1, TXA2	O (DD)	Minimum Load	300 Ω
		Maximum Capacitive Load	0 µF
		Output Impedance	10 Ω
		AC Input Voltage Range	3.2 VP-P
		Reference Voltage*	+ 2.5 VDC
		D.C. Offset Voltage	± 0.200 VDC
SPKR	O (DF)	Minimum Load	300 Ω
		Maximum Capacitive Load	0 µF
		Output Impedance	10 Ω
		AC Input Voltage Range	3.2 VP-P
		Reference Voltage*	+ 2.5 VDC
		D.C. Offset Voltage	± 0.200 VDC

Note: * Reference voltage provided internal to modem.

Table 10. Current and Power Requirements

Mode	Current (I_D)			Power (P_D)			Comments
	Typical Current @ 25 deg. C	Max. Current @ 0 deg. C	Max. Current @ -40 deg. C[1]	Typical Power @ 25 deg. C	Max. Power @ 0 deg. C	Max. Power @ -40 deg. C[1]	
MCU (C40)							f_{IN} = 9.8304 MHz
Normal mode	30 mA	34 mA	35 mA	150 mW	180 mW	185 mW	
Sleep mode	2.2 mA	2.7 mA	2.8 mA	11.0 mW	14.2 mW	14.7 mW	
MDP (RC96V24DP)							f_{IN} = 24.00014 MHz
Normal mode	38 mA	46 mA	60 mA	190 mW	240 mW	315 mW	
Sleep mode	2.0 mA	2.4 mA	3.1 mA	10.0 mW	12.5 mW	16.3 mW	
MDP (RC14V24DP)							f_{IN} = 19.000265 MHz
Normal mode	51 mA	61 mA	80 mA	255 mW	320 mW	420 mW	
Sleep mode	1.0 mA	1.2 mA	1.6 mA	5.0 mW	6.3 mW	8.4 mW	
RC96V24AT-BA							
Normal mode	68 mA	80 mA	95 mA	340 mW	420 mW	500 mW	
Sleep mode	4.2 mA	5.1 mA	5.9 mA	21.0 mW	26.7 mW	31.0 mW	
RC14V24AT-BA							
Normal mode	81 mA	95 mA	115 mA	405 mW	500 mW	605 mW	
Sleep mode	3.2 mA	3.9 mA	4.4 mA	16.0 mW	20.5 mW	23.1 mW	

Notes:
1. Maximum power @ -40 deg. C specified only for extended temperature range parts.
2. 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 deg. C)	V_{ESD}	±3000	V
Latch-Up Current (@ 25 deg. C)	I_{TRIG}	±200	mA
Operating Temperature Range	T_A		
Commercial		-0 to +70	deg. C
Industrial (E Model Number Suffix)		-40 to +85	deg. C
Storage Temperature Range	T_{STG}	-55 to +125	deg. 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	Ω0" 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							