



# Rockwell

## RC288ACi and RC288ACL Integrated V.34 Data/V.17 Fax/Voice Modem Device Set Family

### INTRODUCTION

The Rockwell RC288ACi and RC288ACL integrated modem device set families support ultra high speed data and high speed fax operation in the US or world-wide over a dial-up telephone line (Table 1a lists the models).

As a data modem, the modem operates at line speeds to 28800 bps. Error correction (V.42/MNP 2-4) and data compression (V.42 bis/MNP 5) maximize data transfer integrity and boost average data throughput up to 115.2 kbps. Non-error-correcting mode is also supported.

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

In voice mode, enhanced Adaptive Differential Pulse Coded Modulation coding and decoding supports 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 voice mode and in data modem mode, the modem supports data throughput in excess of 176 kbps utilizing the Rockwell High Speed Interface (RHSI). RHSI allows slower PCs such as 16 MHz 386-based computers to sustain data rates of 115.2 kbps and higher.

"AT" commands provide data, fax class 1 and class 2, MNP 10, voice, and W-class functions while using minimal external ROM, RAM, and optional NVRAM.

The ACi device set is best for desktop applications while the lower power, smaller package, ACL device set is ideal for laptop, notebook, and palmtop applications. The ACi and ACL are functional equivalent.

Two system architectures are supported: a low cost configuration using a single microcontroller and a high performance configuration employing an added co-processor.

Use of AccelerATor kits for PC half cards and PCMCIA PC cards minimize application design time and costs. The kits also include design layout files on floppy disk, sample modem devices, crystals, and full documentation.

PC-based "ConfigurACE™" software allows MCU firmware to be customized to application and country requirements.

### FEATURES

- Data modem throughput up to 115.2 kbps (beyond 115.2 kbps when RHSI is active)
  - V.34, V.FC, V.32 bis, V.32, V.22 bis, V.22A/B, V.23, and V.21; Bell 212A and 103
  - V.42 LAPM and MNP 2-4 error correction
  - V.42 bis and MNP 5 data compression
- MNP 10 data throughput enhancement (to V.32 bis)
- Fax modem send and receive rates up to 14400 bps
  - V.17, V.29, V.27 ter, and V.21 channel 2
- Voice mode (option)
  - Enhanced ADPCM compression/decompression
  - Tone detection/generation and call discrimination
  - Concurrent DTMF detection
  - Timing marks
- World-class operation (option)
  - Call progress and blacklisting parameters
  - Multiple country support
- Hayes AutoSync (option)
- Communication software compatible command sets
  - AT, fax class 1 and 2, and voice commands
- NVRAM directory and stored profiles
- Built-in DTE interfaces
  - DTE speed up to 115.2 kbps
  - Parallel 16550A UART-compatible interface
  - Serial CCITT V.24 (EIA/TIA-232-E)
- Rockwell High Speed Interface (RHSI)
- Flow control and speed buffering
- Automatic format/speed sensing
- Serial sync/async data; parallel async data
- Auto dial and auto answer
- Tone and pulse dialing
- Calling Number Delivery (Caller ID) detect
- Extended operating temperature models available
- Flexible packaging options (see Table 1b)

Device	RC288ACi	RC288ACL
MCU	84-pin PLCC	80-pin PQFP or 100-pin TQFP
MDP	68-pin PLCC	68-pin PLCC or 100-pin PQFP/80-pin PQFP or 128-pin TQFP/100-pin TQFP
CEP	84-pin PLCC	Not applicable

- +5V operation; typical power consumption:

Mode	RC288ACi (w/o CEP)	RC288ACi (w CEP)	RC288ACL
Operating	1.15 W	1.31 W	790 mW
Sleep	211 mW	222 mW	20 mW
Stop	201 mW	202 mW	9.8 mW

Table 1a. Modem Models - Functions and Memory Requirements

Model	Supported Functions					Country
	Fax	MNP10	W-Class	AutoSync	Voice	
RC288ACi-D	-	-	-	-	-	US/Canada
RC288ACi	S	-	-	-	-	US/Canada
RC288ACi(/A)	S	S	-	S	-	US/Canada
RCV288ACi	S	S	-	S	S	US/Canada
RC288ACiW-D	-	S	S	S	-	Multiple
RC288ACiW	S	S	S	S	-	Multiple
RCV288ACiW(E)	S	S	S	S	S	Multiple
RC288ACL-D	-	-	-	-	-	US/Canada
RC288ACL	S	-	-	-	-	US/Canada
RC288ACL(/A)	S	S	-	S	-	US/Canada
RCV288ACL	S	S	-	S	S	US/Canada
RC288ACLW-D	-	S	S	S	-	Multiple
RC288ACLW	S	S	S	S	-	Multiple
RCV288ACLW(E)	S	S	S	S	S	Multiple

Notes:

- Model options:
  - D Data only (no fax)
  - W World class support
  - /A Optional autosync support
  - (E) Optional industrial temperature range.
- Supported functions (S = Supported; - = Not supported):
  - Fax Fax class 1 and class 2 command functions.
  - MNP 10 Data throughput enhancement functions.
  - W-Class World class functions supporting multiple country requirements.
  - AutoSync Hayes AutoSync.
  - Voice Voice command functions.

Table 1b. Modem Packing Options

Model Family	Microcontroller Unit (MCU)				Modem Data Pump (MDP)		
	84-Pin PLCC (L39)	80-Pin PQFP (L39)	100-Pin TQFP (L39)	128-Pin TQFP (P39)	68-Pin PLCC	100-Pin PQFP & 80-Pin PQFP	128-Pin TQFP & 100-Pin TQFP
RC288ACi	X	-	-	-	X	-	-
	-	X	-	-	X	-	-
RC288ACL	-	X	-	-	X	-	-
	-	X	-	-	-	X	-
	-	-	X	-	-	-	X
	-	-	-	X	-	X	-
	-	-	-	X	-	-	X

Notes:

- Consult sales office for exact packaging options available for a specific modem model (Table 1a).

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 Hayes is a trademark of Hayes Microcomputer Products, Inc.

## TECHNICAL SPECIFICATIONS

### GENERAL DESCRIPTION

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

#### System Configurations

**High Performance.** The modem device set consists of a L39 or P39 Microcontroller (MCU), a Modem Data Pump (MDP), and a Compression Expansion Processor (CEP). This configuration provides maximum bidirectional data throughput.

In this configuration, the OEM provides external memory for the MCU (128k bytes ROM and 8k bytes RAM) and for the CEP (32k bytes RAM).

**Low Cost.** The modem device set consists of a L39 MCU and a MDP.

In this configuration, the OEM provides external memory only for the MCU (128k bytes ROM and 32k bytes RAM).

#### Modem Data Pump (MDP)

The modem data pump (MDP) in ACi models is a Rockwell RC288DPi data/fax/voice modem data pump. The MDP in ACL models is a Rockwell RC288DPL data/fax/voice modem data pump. The crystal frequency is 40.32 MHz.

As a data modem, the MDP can operate in full-duplex, synchronous/asynchronous modes at line rates up to 28800 bps. Using V.34 modulation to optimize modem configuration for line conditions, the MDP can connect at the highest data rate that the channel can support from 28800 bps to 300 bps with automatic fallback. Automode operation in V.34 is provided in accordance with PN3320 and in V.32 bis in accordance with PN2330.

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

ADPCM voice processing in the MDP is supported in ACi/ACL models supporting voice commands.

The RC288DPi MDP is provided in a 68-pin PLCC. The RC288DPL MDP is provided in a 68-pin PLCC, two PQFPs (100-pin and 80-pin), or two TQFPs (128-pin and 100-pin).

#### Microcontroller (MCU)

The MCU is a Rockwell L39 or P39 microcomputer. The MCU performs the command processing and host interface functions. The MCU crystal frequency is 14.7456 MHz (ACL or ACi with CEP) or 12.9024 (ACi with CEP).

The L39 MCU is packaged in an 84-pin PLCC for the RC1288ACi or in an 80-pin PQFP or 100-pin TQFP for the RC144ACL.

The L39 MCU connects to the host via a V.24 (EIA/TIA-232-E) serial interface or a parallel microcomputer bus depending on installed MCU firmware. In parallel interface operation, the L39 MCU can connect to a PCMCIA connector using a Rockwell PCMCIA Interface Control

Adapter (PICA) device (see data sheet Order No. MD99) and a PCMCIA Card Information Structure (CIS) memory device.

The P39 MCU performs all the functions as the L39 MCU and, in addition, incorporates a built-in PCMCIA interface and CIS memory allowing the P39 MCU to directly connect to the PCMCIA connector without requiring these two external parts. The P39 MCU is packaged in an 128-pin PQFP. The P39 MCU interface is described in Application Note 1057, "P39 MCU (8-Bit Microcontroller with PCMCIA Interface) Application to Rockwell 14400 bps and 28800 bps Low Power Modems".

The MCU connects to the MDP via dedicated lines and the external bus. The MCU external bus also connects to OEM-supplied ROM and RAM and, high performance configuration, to the CEP. The ROM size is 128k bytes. The RAM size is 32k bytes for the low cost configuration or 8k bytes for the high performance configuration.

For all models, 256 bytes NVRAM can optionally be connected to the MCU over a dedicated serial interface.

#### RC288ACi Low Cost Configuration and RC288ACL

The MCU connects to the MDP and to external memory over the MCU external bus. The MCU crystal frequency is 14.7456 MHz. The MCU external memory is 128k bytes ROM (45 ns) and 32k bytes RAM (45 ns).

**RC288ACi High Performance Configuration.** The MCU connects to the MDP, external memory, and to the CEP over the MCU external bus. The use of CEP in this configuration allows the MCU to operate slower which also permits the use of slower memory connected to the MCU bus. The MCU crystal frequency is 12.9024 MHz. The MCU external memory is 128k bytes ROM (55 ns) and 8k bytes RAM (55 ns).

#### Compression Expansion Processor (CEP)

The CEP performs the dedicated data compression and expansion functions in V.42 bis/MNP 5 modes to provide maximum bidirectional throughput for high performance operation. The CEP is packaged in a 84-pin PLCC.

The CEP host interface connects to the MCU external bus and the CEP external memory bus connects to 32k bytes RAM (55 ns). The CEP crystal frequency is 14.7456 MHz.

#### MCU Firmware

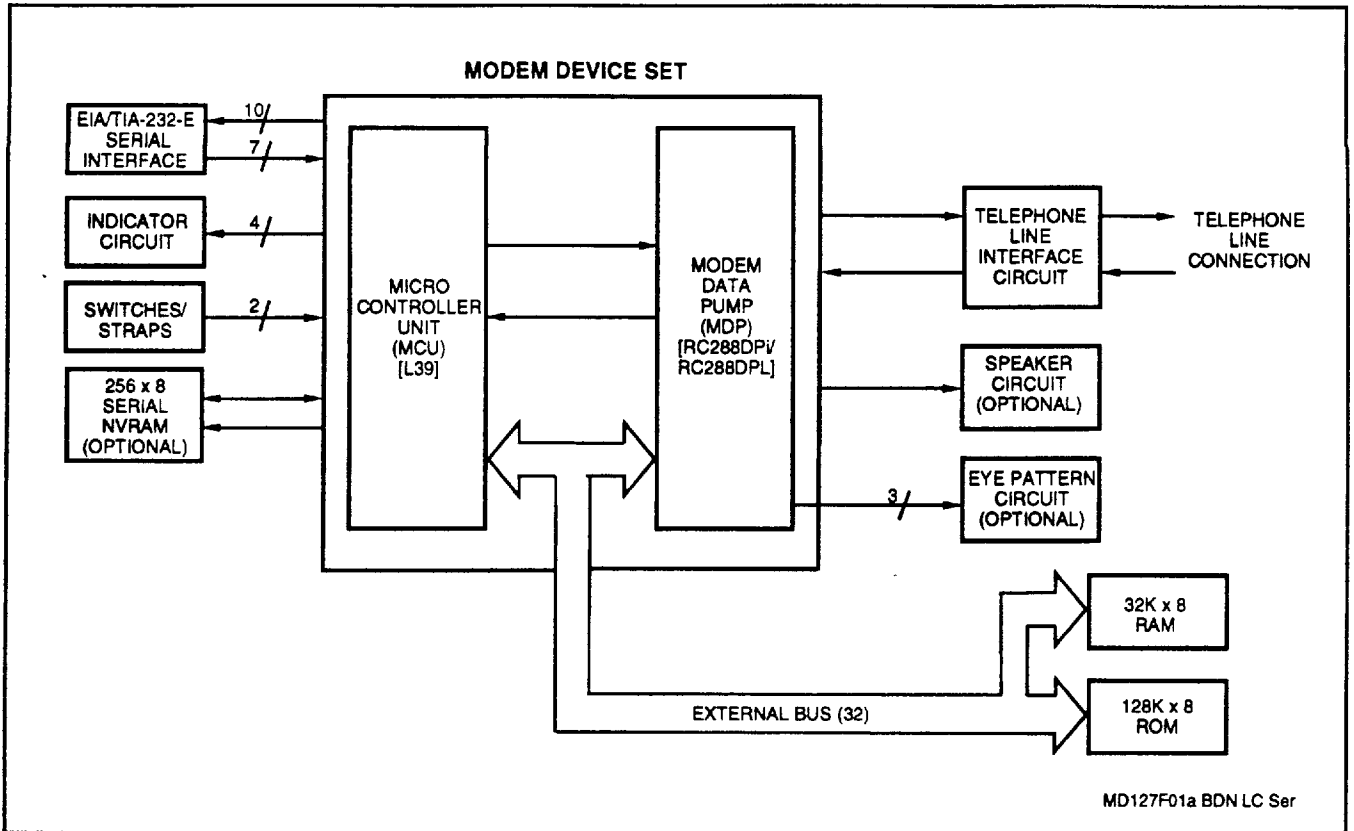
MCU firmware performs processing of general modem control, command sets, error correction, MNP 10, fax class 1 and class 2, and DTE interface functions. The MCU firmware is provided by Rockwell in object code form for the OEM to program into external ROM. The MCU firmware may also be provided in source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

### SUPPORTED INTERFACES

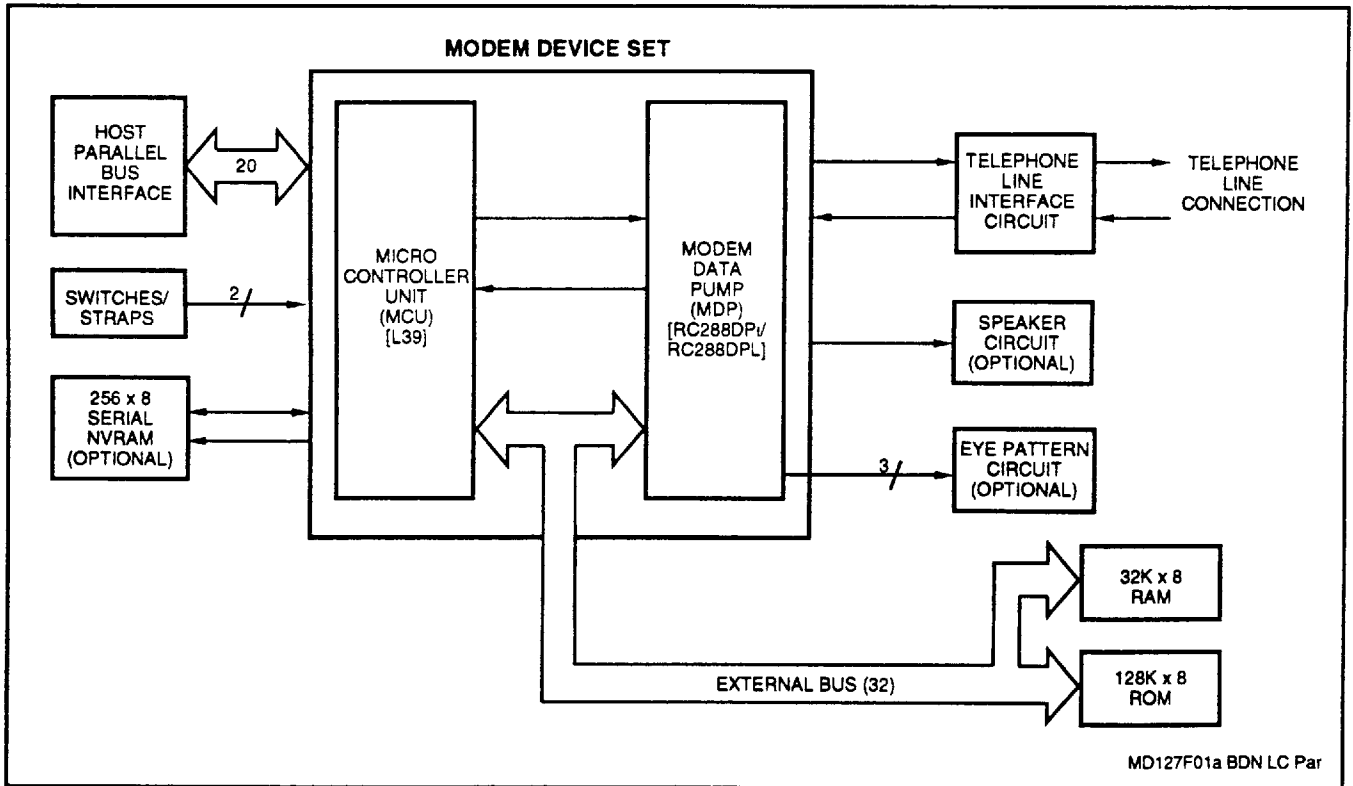
The major hardware signal interfaces of the modem device set are illustrated in Figure 1.

#### Parallel Host Bus Interface

A 16550A UART-compatible parallel interface is provided depending upon modem model. Eight data lines, three address lines, four DMA request/acknowledge lines, four control/status lines, and a reset line are supported.

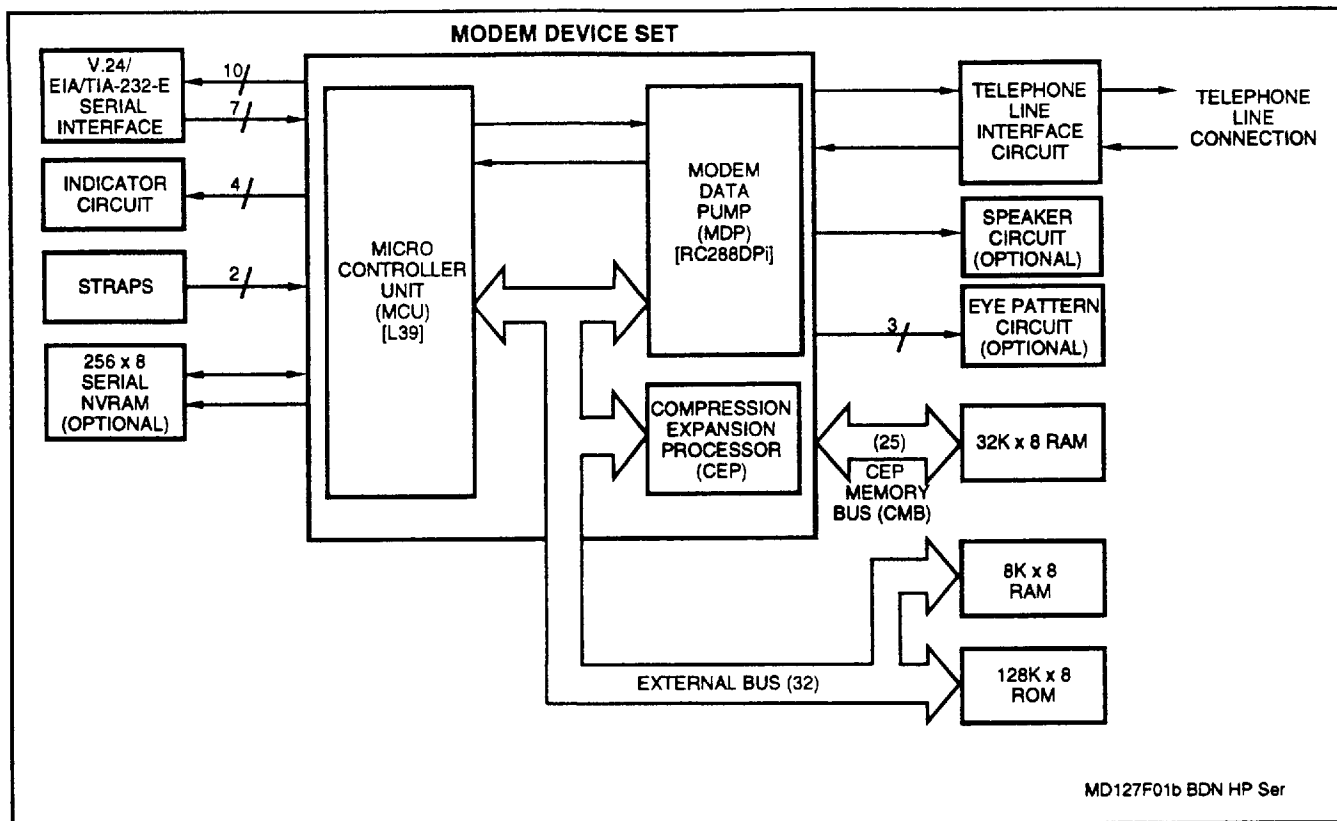


Serial Interface Version

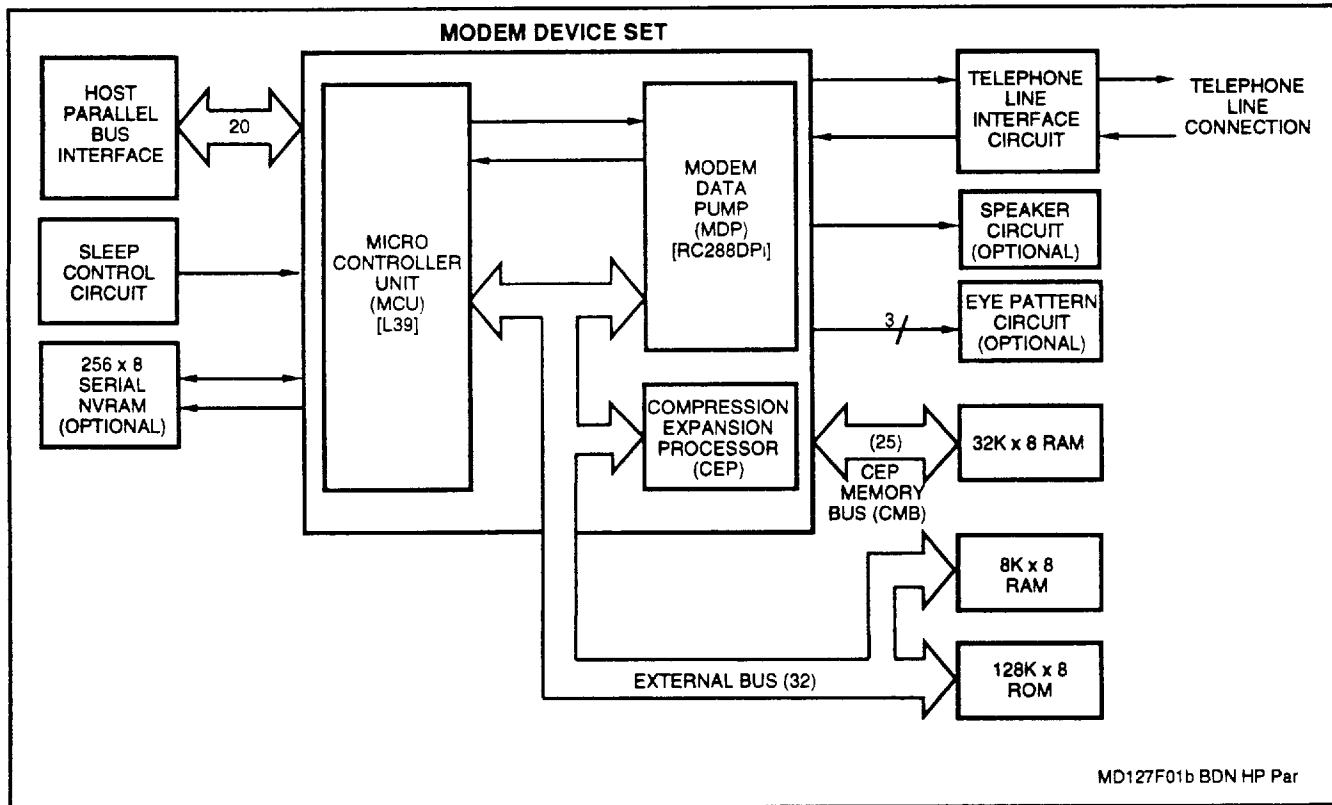


Parallel Interface Version

Figure 1a. Modem General Interface - RC288ACL and RC288ACi in Low Cost Configuration



Serial Interface Version



Parallel Interface Version

Figure 1b. Modem General Interface - RC288ACi High Performance Configuration

**DTE Serial Interface and Indicator Outputs**

A DTE serial interface and indicator/control outputs are supported.

**V.24/EIA/TIA-232-E DTE Serial Interface.** A V.24/EIA/TIA-232-E logic-compatible DTE serial interface is supported. A clock stop signal is provided which can be used to turn off transmitter and receiver clocks to the DTE in asynchronous modes.

**Indicator Outputs.** Four indicator outputs are supported.

**Stop Mode Control**

The ~STPMODE input is supported which controls modem entry into Stop Mode.

**NVRAM Interface**

A serial interface to an optional OEM-supplied 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 35-digit dial strings.

**Speaker Interface**

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

**External Bus Interface**

The MCU external bus connects to the MDP and to OEM-supplied ROM and RAM. In the high performance configuration, the external bus also connects to the CEP. The non-multiplexed bus supports eight bidirectional data lines and 17 address output lines. Read enable, write enable and chip select outputs (MDP select, ROM select, and RAM select) are also supported.

**Telephone Line Interface**

**MCU.** Four relay control outputs to the line interface are supported. 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.

**MDP.** A receive analog input, two transmit analog outputs, two relay driver outputs, and a ring signal input are supported. The relay outputs may be used to drive Caller ID and voice relays.

**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 data modem performance relative to line impairments.

**COMMANDS**

The modem supports data modem, fax class 1 and 2, MNP 10 commands, voice, and S Registers (see Tables 2 and 3, respectively) in accordance with modem model options.

**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.

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

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

**Voice Operation.** Voice mode functions operate in response to voice commands when #CLS=8.

**DTE SERIAL INTERFACE OPERATION****Automatic Speed/Format Sensing**

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

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

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

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

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

**HOST PARALLEL BUS INTERFACE OPERATION**

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

**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 does not recognize DTMF tones, the modem switches to pulse dialing. If pulse dialing is selected (P command), pulse dialing is 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 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. Speed selection is in accordance with the draft PN-3320 standard presented to the TR30-4 committee, which is a candidate for the definition of V.25 ter at the ITU. The +MS command supports V.34 line rates up to 28800 bps. ATNn and S37-n commands are supported up to V.32 bis speeds (Table 4).

Table 2. AT Commands

Command	Function
<b>Basic AT Commands</b>	
A/	Re-execute command
A	Answer a call
Bn	Set CCITT or Bell mode
Cn	Carrier control
Dn	Dial (originate a call)
E	Command echo
Fn	Select line modulation
Hn	Disconnect (hang-up)
In	Identification
Ln	Speaker volume
Mn	Speaker control
Nn	Automode enable
On	Return to on-line data mode
P	Set pulse dial default
Qn	Quiet results codes control
Sn=x	Write to S Register
Sn?	Read S Register
T	Set tone dial default
Vn	Result code form
Wn	Error correction message control
Xn	Extended result codes
Yn	Long space disconnect
Zn	Soft reset and restore profile
&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
+MS	Modulation select
%En	Enable/disable line quality monitor and auto-retrain or fallback/fall forward
%L	Report line signal level
%Q	Report line signal quality
%TTn	PTT testing utilities
\Gn	Modem-to-modem flow control (XON/XOFF)
\Kn	Break control
\Wn	Operating mode
#CID	Caller ID detection and reporting
**	Download to flash memory

Table 2. AT Commands (Cont'd)

Command	Function
<b>ECC AT Commands</b>	
%C	Select data compression
\An	Maximum MNP block size
\Bn	Transmit BREAK to remote
<b>MNP 10 AT Commands</b>	
)Mn	Enable/disable 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
:E	Compromise equalizer enable
<b>Fax Class 1 AT+F Commands</b>	
+FCLASS=n	Service class
+FAE	Data/fax auto answer
+FTS=n	Stop transmission and wait
+FRS=n	Receive silence
+FTM=n	Transmit data
+FRM=n	Receive data
+FTH=n	Transmit data with HDLC framing
+FRH=n	Receive data with HDLC framing
<b>Fax Class 2 AT+F Commands</b>	
+FCLASS=n	Service class
<b>Class 2 Action Commands</b>	
+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
<b>Class 2 DCE Responses</b>	
+FCIG:	Report the polled station identification
+FCON	Facsimile connection response
+FDCS:	Report current session
+FDIS:	Report remote capabilities
+FDTC:	Report the polled station capabilities
+FCFR	Indicate confirmation to receive
+FTSI:	Report the transmit station ID
+FCSI:	Report the called station ID
+FPTS:	Page transfer status
+FET:	Post page message response
+FHNG:	Call termination with status
+FPOLL	Indicates polling request
<b>Class 2 Session Parameters</b>	
+FMFR?	Identify manufacturer
+FMDL?	Identify model
+FREVE?	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 2. AT Commands (Cont'd)

Command	Function
<b>Voice AT# Commands</b>	
#BDR	Select baud rate
#CLS	Select data, fax, or voice
#MDL?	Identify model
#MFR?	Identify manufacturer
#REV?	Identify revision level
#VBQ?	Query buffer size
#VBS	Bits per sample
#VBT	Beep tone timer
#VCI?	Identify compression method
#VLS	Voice line select
#VRA	Ringback goes away timer (originate)
#VRN	Ringback never came timer (originate)
#VRX	Voice receive mode
#VSD	Enable silence deletion
#VSK	Buffer skid setting
#VSP	Silence detection period (voice receive)
#VSR	Sampling rate selection
#VSS	Silence detection tuner (voice receive)
#VTD	DTMF/tone reporting
#VTS	Generate tone signals
#VTX	Voice transmit mode
<b>W-Class AT Commands</b>	
*B	Display blacklisted numbers
*D	Display delayed numbers
*NCnn	Country select



Table 3. 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
<b>ECC S Registers</b>	
S36	LAPM failure control
S46	Data compression control
S48	V.42 negotiation control
S82	Break handling control

Table 4. Connection Speed Options

Configuration	Rate (bps)
V.34	28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, or 2400
V.FC	28800, 26400, 24000, 21600, 19200, 16800, or 14400
V.32 bis	14400, 12000, 9600, 7200, or 4800
V.32	9600 or 4800
V.22 bis	2400 or 1200
V.22	1200
V.23	1200Tx/75Rx or 75TX/1200Rx
V.21	0-300
Bell 212A	1200
Bell 103	0-300

**Automode**

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

**DATA MODE**

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

**Speed Buffering (Normal Mode)**

Speed buffering allows a DTE to send data to, and receive data from, a modem at a speed different than the line speed. The modem supports speed buffering at all line speeds.

**Flow Control**

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

**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 an S2 Register value greater than 127. Escape sequence detection is disabled in synchronous mode.

**BREAK Detection**

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

**Telephone Line Monitoring**

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

**Loss of Carrier.** If carrier is lost for a time greater than specified by the S10 register, the modem disconnects.

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

**Send SPACE on Disconnect**

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

**Fall Forward/Fallback**

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

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

**Retrain**

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

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

**Programmable Inactivity Timer**

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

**Synchronous Data Mode (Serial Interface Only)**

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

**Direct Mode (Serial Interface Only)**

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

**DTE Signal Monitoring (Serial Interface Only)**

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

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

**-RDL.** When -RDL is asserted, the modem requests a remote digital loop if connected in non-error-correction mode.

**-AL.** When -AL is asserted, the modem disconnects and enters analog loop.

## ERROR CORRECTION AND DATA COMPRESSION

### V.42 Error Correction

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

### MNP 2-4 Error Correction

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

### V.42 bis Data Compression

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

The V.42 bis data compression employs a "string learning" algorithm in which a string of characters from the DTE is encoded as a fixed length codeword. Two 2k-byte dictionaries 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

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

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

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

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

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

**Dynamic Transmit Level Adjustment.** When enabled by the )M2 command, transmit level is dynamically adjusted to adapt to the varying cellular network environment, and to prevent "clipping" which causes data corruption due to the Preemphasis and Compander effect.

**MNP Extended Services.** The modem can 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.** V.42 bis/MNP 10 can operate with V.42 bis or MNP 5 data compression.

## AUTOSYNC

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

## FAX CLASS 1 AND CLASS 2 OPERATION

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

Calling tone is generated in accordance with T.30.

## VOICE MODE

Voice Mode includes three submodes: Online Voice Command Mode, Voice Receive Mode, and Voice Transmit Mode. (See Table 2.)

**Online Voice Command Mode.** This mode results from the connection to the telephone line or a voice 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 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.

**Voice Transmit Mode.** This mode is entered when the #VTX command is active in order to playback voice 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.

### CALLER ID

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

### WORLD CLASS COUNTRY SUPPORT

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

#### Dialing

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

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

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

**Ring Detection.** The frequency range is programmable by ConfigurACE.

**Blind Dialing.** Blind dialing may be disabled by ConfigurACE.

#### Carrier Transmit Level

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

#### Calling Tone

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

#### Call Progress Tone Detection

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

#### Answer Tone Detection

The answer tone detection period is programmable by ConfigurACE.

### Blacklist Parameters

The modem can operate in accordance with requirements of individual countries to prevent misuse of the network by limiting repeated calls to the same number when previous call attempts have failed. Call failure can be detected for reasons such as no dial tone, number busy, no answer, no ringback detected, voice (rather than modem) detected, and key abort (dial attempt aborted by user). Actions resulting from such failures can include specification of minimum inter-call delay, extended delay between calls, and maximum numbers of retries before the number is permanently forbidden ("blacklisted"). Up to 6 such numbers may be tabulated. The blacklist parameters are established by ConfigurACE.

### Relay Control

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

### 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 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 by the local DTE, two data paths are set up in the local modem. Data from the local DTE is looped back to the local DTE (path 1) and data received from the remote modem is looped back to the remote modem (path 2).

#### Power On Reset Tests

Upon power on or receipt of the Z command, the modem performs tests of the MDP, RAM, ROM, and NVRAM.

## LOW POWER SLEEP AND STOP MODES

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

**Stop Mode Entry.** The modem enters the low power stop mode when the  $\sim$ STPMODE input is asserted. All MCU circuits are turned off including the internal MCU clock circuitry in order to consume lower power than sleep mode. The modem will enter stop mode immediately, terminating a line connection, terminating any test in process, and allowing any data in the Receive Buffer Register to clear.

$\sim$ STPMODE must be returned high before the modem can wake-up.

**Wake-up.** Wakeup occurs when a ring is detected on the telephone line, the host writes to the modem (parallel interface version), or the DTE sends a character to the modem (serial interface version). Since the modem requires more time to attain normal operation when waking up from stop mode than sleep mode, the host must send any character to the modem before issuing the first AT command.

## CONFIGURACE UTILITY PROGRAM

The PC-based ConfigurACE utility program allows the OEM to customize the MCU firmware to suit specific application and country requirements. ConfigurACE allows programming of functions such as:

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

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

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

## ADDITIONAL INFORMATION

Additional information is described in the RC288ACi Designer's Guide (Order No. 1027) and in the AT Command Reference Manual (Order No. 1048).

## HARDWARE INTERFACES

The modem hardware interface signals for serial and parallel interface configurations are shown in Figures 2 and 3, respectively.

The MCU pin assignments for the 84-pin PLCC are shown in Figure 4 and are listed in Table 5.

The MCU pin assignments for the 80-pin PQFP are shown in Figure 5 and are listed in Table 6.

The MCU pin assignments for the 100-pin TQFP are shown in Figure 6 and are listed in Table 7.

The MDP pin assignments for the 68-pin PLCC are shown in Figure 7 and are listed in Table 8.

The MDP pin assignments for the 100-pin PQFP (MDP1) and the 80-pin PQFP (MDP2) are shown in Figure 8 and are listed in Table 9.

The MDP pin assignments for the 128-pin TQFP (MDP1) and the 100-pin TQFP (MDP2) are shown in Figure 9 and are listed in Table 10.

The CEP pin assignments for the 84-pin PLCC are shown in Figure 10 and are listed in Table 11.

The MCU hardware interface signals are defined in Table 12.

The MDP hardware interface signals are defined in Table 13.

The CEP hardware interface signals are defined in Table 14.

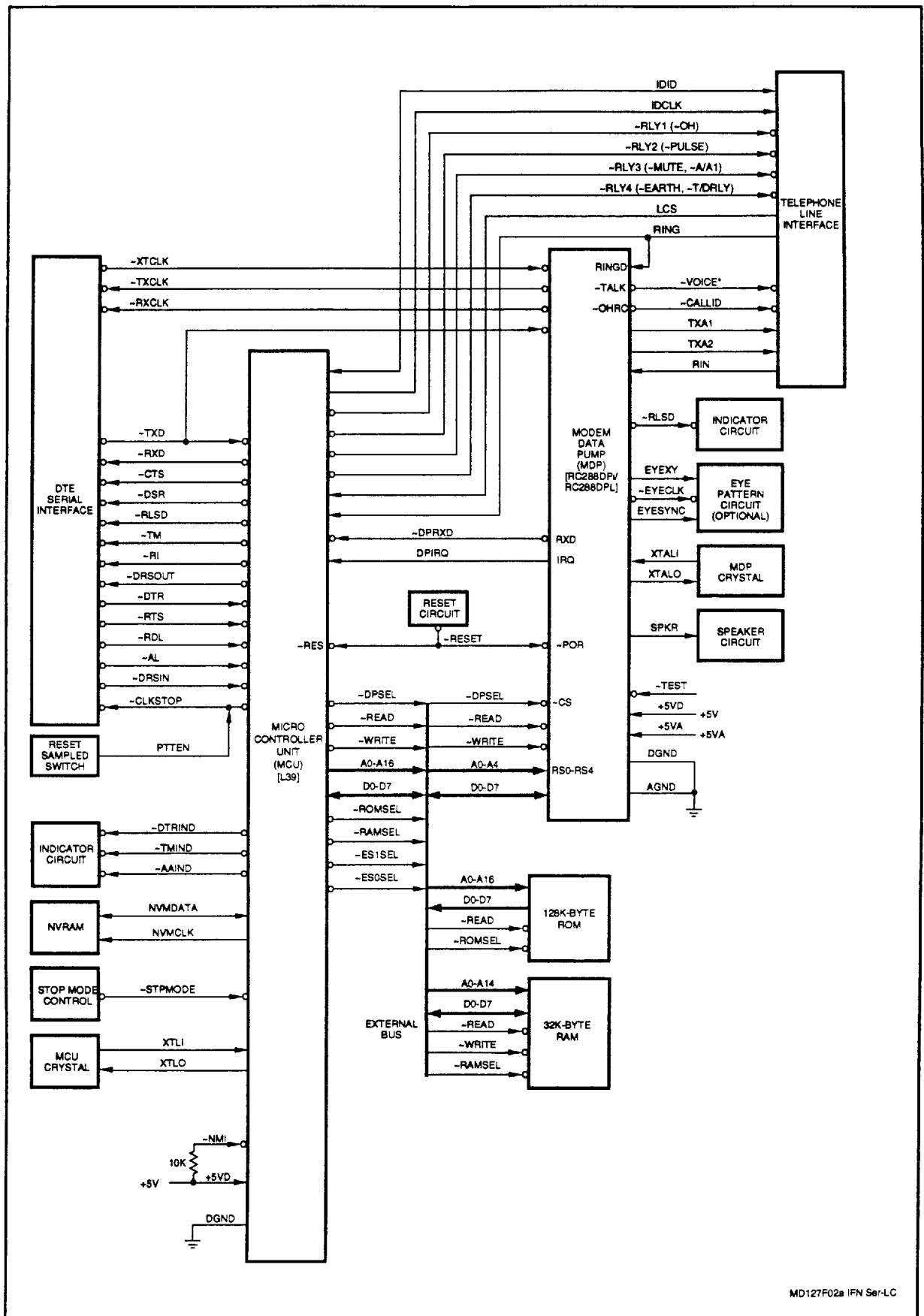
The digital electrical characteristics for the hardware interface signals are listed in Table 15.

The analog electrical characteristics for the hardware interface signals are listed in Table 16.

The current and power requirements are listed in Table 17.

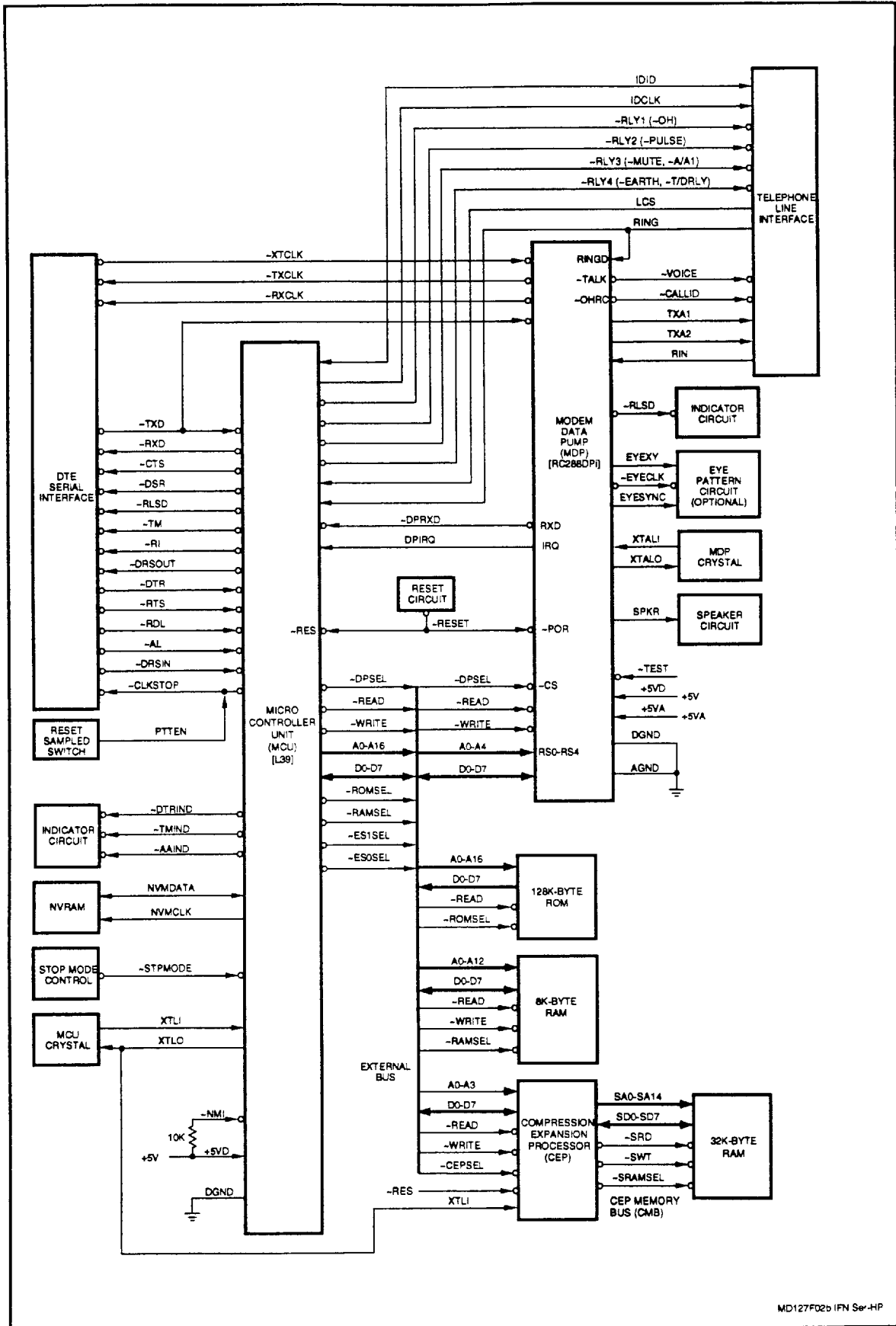
The absolute maximum ratings are listed in Table 18.

Table 19 shows the parallel interface registers and the corresponding bit assignments.



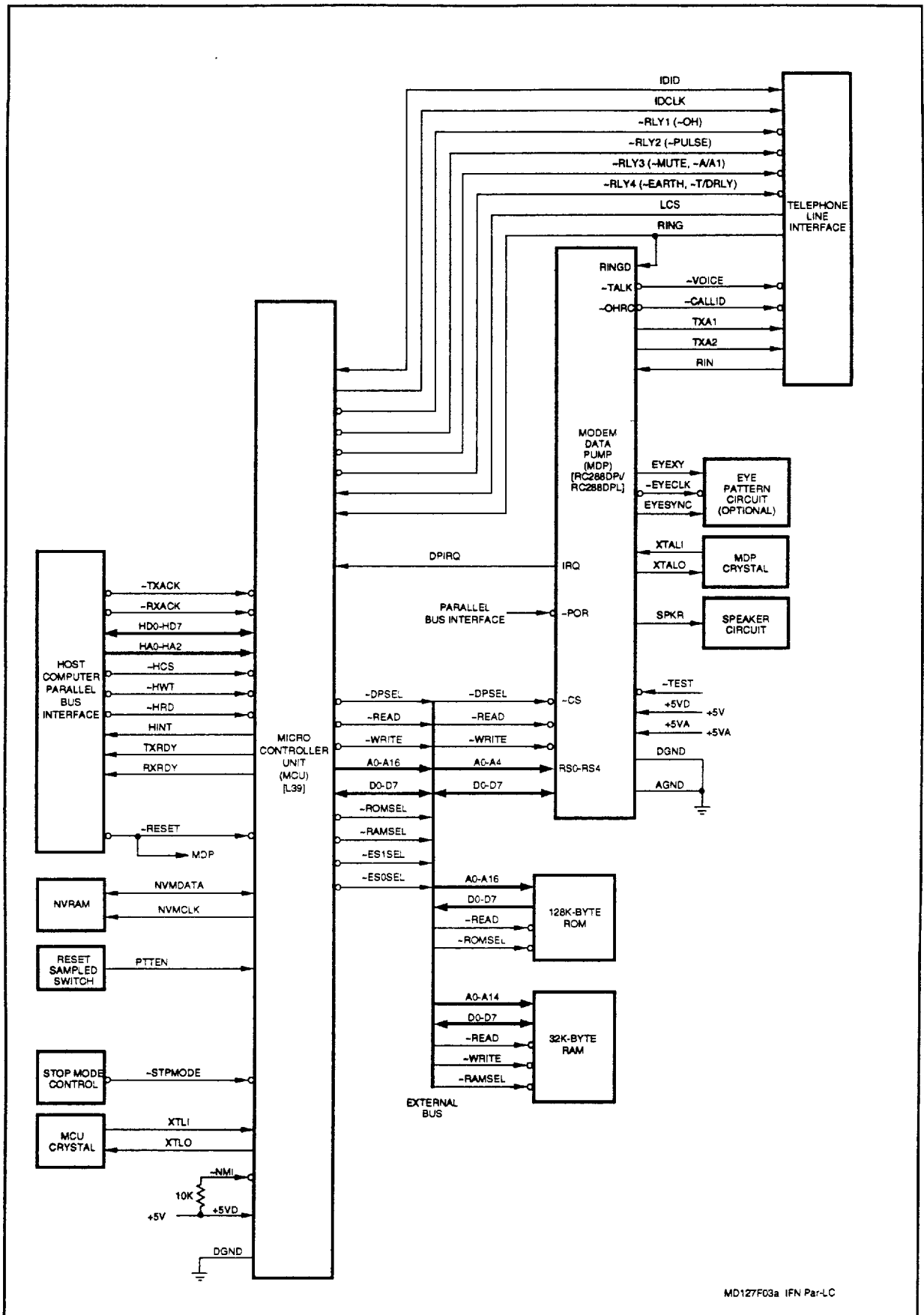
MD127F02a 1FN Ser-LC

Figure 2a. Hardware Interface Signals - Serial Interface - Low Cost



MD127F02b 1FN Ser-HP

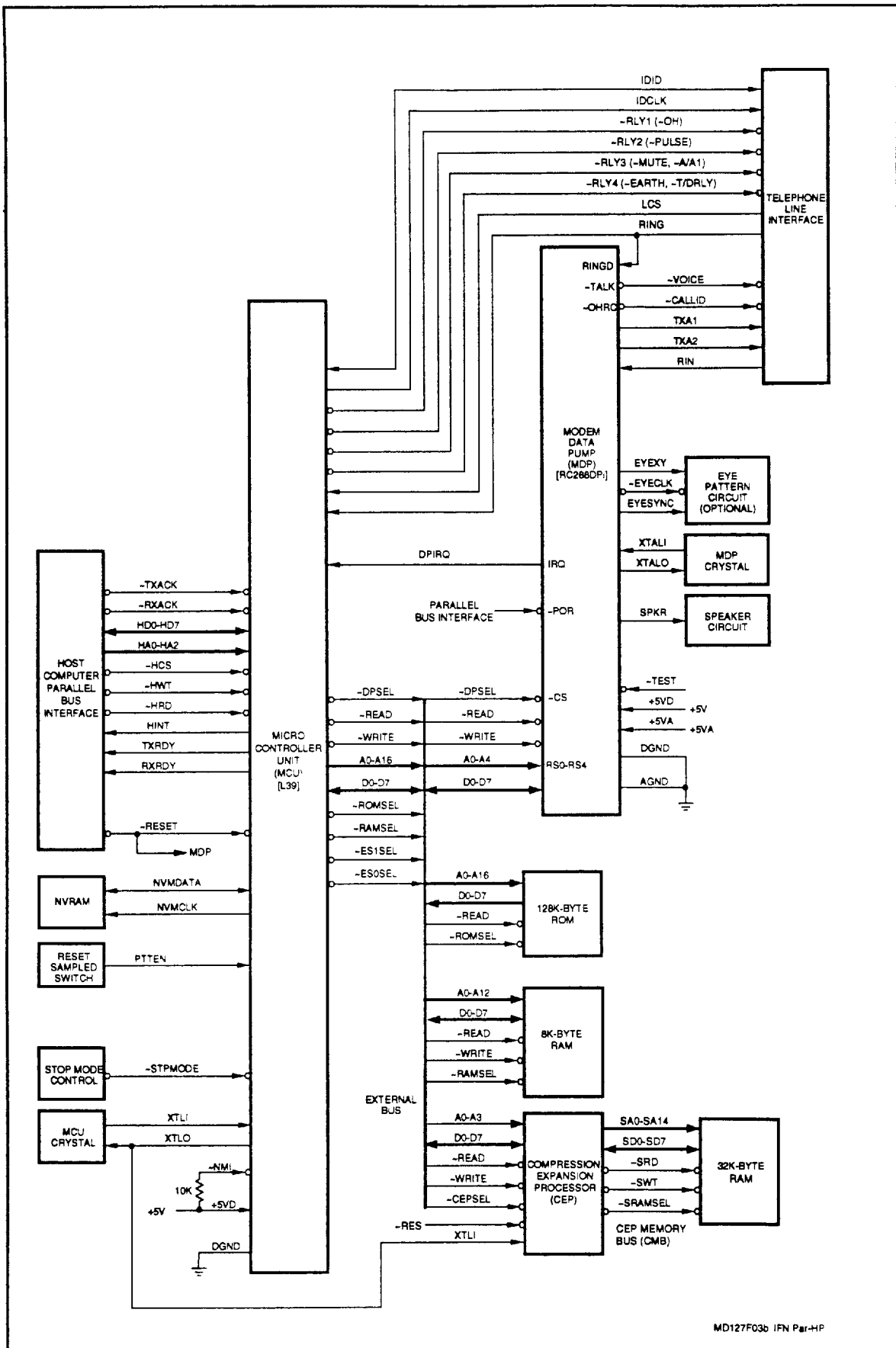
Figure 2b. Hardware Interface Signals - Serial Interface - High Performance



MD127F03a IFN Par-LC

Figure 3a. Hardware Interface Signals - Parallel Interface - Low Cost





MD127F03b 1FN Par-HP

Figure 3b. Hardware Interface Signals - Parallel Interface - High Performance

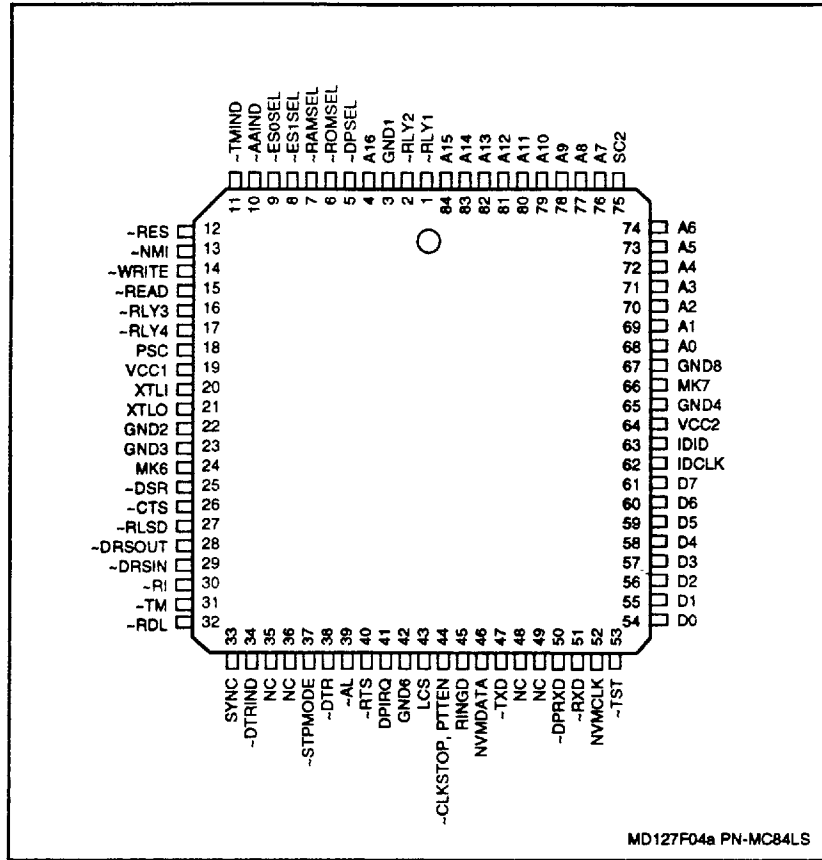


Figure 4a. MCU Pin Signals - 84-Pin PLCC - Serial Interface

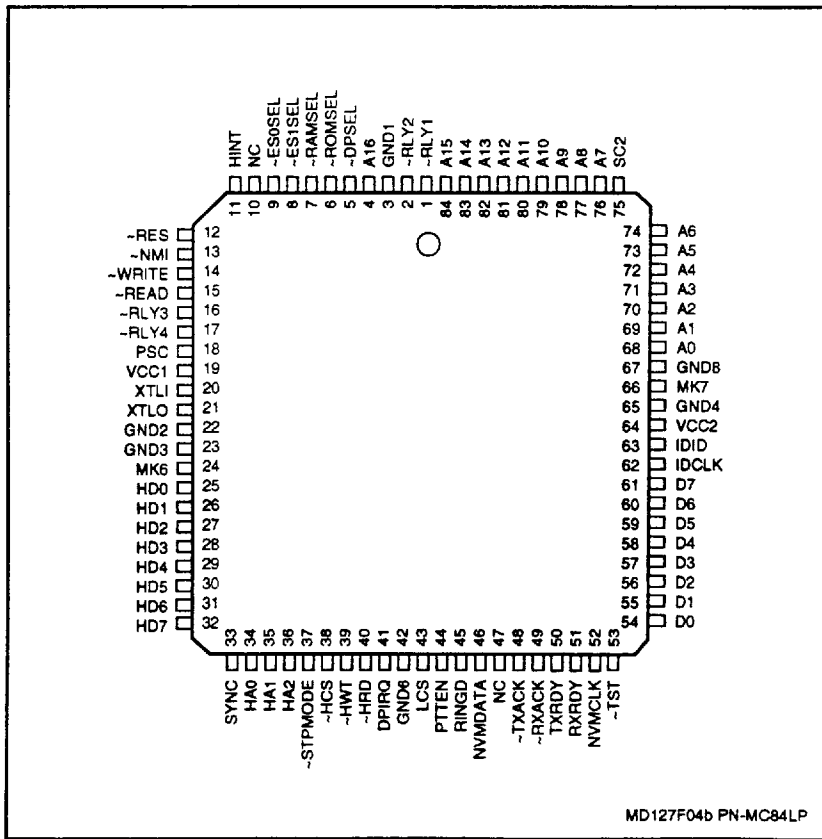


Figure 4b. MCU Pin Signals - 84-Pin PLCC - Parallel Interface

Table 5a. MCU Pin Signals- 84-Pin PLCC - Serial Interface

Pin	Signal Label	I/O Type	Interface	Pin	Signal Label	I/O Type	Interface
1	(PE0) -RLY1	OA	DAA: -OH	43	(PE4) LCS	IA	DAA: LCS
2	(PE1) -RLY2	OA	DAA: -PULSE	44	(PE5) PTTEN -CLKSTOP	OA	PTTEN -CLKSTOP
3	GND1	GND	GND	45	(PA0) RINGD	IA	DAA: RINGD
4	(PB0) A16	OA	EB: A16	46	(PA1) NVMDATA <sup>4</sup>	IA/OA	NVRAM: SDA
5	(PB1) -DPSEL	OA	MDP: -CS	47	(PA2) -TXD	IA	DTE: -TXD
6	(PB2) -ROMSEL	OA	ROM: -CE	48	(PA3) NC		NC
7	(PB3) -RAMSEL	OA	RAM: -CS	49	(PA4) NC		NC
8	(PB4) -ES1SEL	OA	Not used	50	(PA5) -DPRXD	MI	MDP: -DPRXD
9	(PB5) -ES0SEL	OA	EB: -CEPSEL	51	(PA6) -RXD	OA	DTE: RXD
10	(PB6) -AAIND	OA	Indicator Circuit	52	(PA7) NVMCLK	OA	NVRAM: SCL
11	(PB7) -TMIND	OA	Indicator Circuit	53	-TST	MI	NC (Note 5)
12	-RES	IC	MDP: -POR & -RESET (Note 6)	54	D0	IA/OA	EB: D0
13	-NMI	MI	Note 4	55	D1	IA/OA	EB: D1
14	-WRITE	OA	EB: -WRITE	56	D2	IA/OA	EB: D2
15	-READ	OA	EB: -READ	57	D3	IA/OA	EB: D3
16	(PE2) -RLY3	OA	DAA: A/A1, -MUTE	58	D4	IA/OA	EB: D4
17	(PE3) -RLY4	OA	DAA -T/DRLY, -EARTH	59	D5	IA/OA	EB: D5
18	PSC		NC	60	D6	IA/OA	EB: D6
19	VCC1	PWR	VCC	61	D7	IA/OA	EB: D7
20	XTLI	IE	XTLI	62	(PE6) IDCLK	OA	DAA: IDCLK
21	XTLO	OE	XTLO	63	(PE7) IDID	IA	DAA: IDID
22	GND2	GND	GND	64	VCC2	PWR	VCC
23	GND3	GND	GND	65	GND4	GND	GND
24	MK6		GND	66	MK7		GND
25	(PC0) -DSR	OA	DTE: -DSR	67	GND8	GND	GND
26	(PC1) -CTS	OA	DTE: -CTS	68	A0	OA	EB: A0
27	(PC2) -RLSD	OA	DTE: -RLSD	69	A1	OA	EB: A1
28	(PC3) -DRSOUT	OA	DTE: -DRSOUT	70	A2	OA	EB: A2
29	(PC4) -DRSIN	OA	DTE: -DRSIN	71	A3	OA	EB: A3
30	(PC5) -RI	OA	DTE: -RI	72	A4	OA	EB: A4
31	(PC6) -TM	OA	DTE: -TM	73	A5	OA	EB: A5
32	(PC7) -RDL	IA	DTE: -RDL	74	A6	OA	EB: A6
33	SYNC		NC	75	SC2		NC
34	(PD0) -DTRIND	OA	DTE: -DTRIND	76	A7	OA	EB: A7
35	(PD1) NC		NC	77	A8	OA	EB: A8
36	(PD2) NC		NC	78	A9	OA	EB: A9
37	(PD3) -STPMODE	IA	Stop Mode Circuit	79	A10	OA	EB: A10
38	(PD4) -DTR	IA	DTE: -DTR	80	A11	OA	EB: A11
39	(PD5) -AL	IA	DTE: -AL	81	A12	OA	EB: A12
40	(PD6) -RTS	IA	DTE: -RTS	82	A13	OA	EB: A13
41	(PD7) DPIRQ	IA	MDP: IRQ	83	A14	OA	EB: A14
42	GND6	GND	GND	84	A15	OA	EB: A15

Notes:

- I/O types:  
 MI = Modem interconnect  
 IA, IB, IC, IE = Digital input  
 OA, OB, OE = Digital output
- NC = No external connection.
- NU = Not used; connect as noted.
- Connect to VCC through 10 K ohms.
- Leave open to allow internal MCU ROM use; connect to GND through 10K ohms to force external ROM use only.
- Connect to GND through 10K ohms

Table 5b. MCU Pin Signals- 84-Pin PLCC - Parallel Interface

Pin	Signal Label	I/O Type	Interface	Pin	Signal Label	I/O Type	Interface
1	(PE0) -RLY1	OA	DAA: -OH	43	(PE4) LCS	IA	DAA: LCS
2	(PE1) -RLY2	OA	DAA: -PULSE	44	(PE5) PTTEN	OA	PTTEN
3	GND1	GND	GND	45	(PA0) RINGD	IA	DAA: RINGD
4	(PB0) A16	OA	EB: A16	46	(PA1) NVMDATA	IA/OA	NVRAM. SDA (Note 4)
5	(PB1) -DPSEL	OA	MDP: -CS	47	(PA2) NC		NC
6	(PB2) -ROMSEL	OA	ROM: -CE	48	(PA3) -TXACK	IA	HB: -TXACK
7	(PB3) -RAMSEL	OA	RAM: -CS	49	(PA4) -RXACK	IA	HB: -RXACK
8	(PB4) -ES1SEL	OA	EB: -ES1SEL (Not used)	50	(PA5) TXRDY	OA	HB: TXRDY
9	(PB5) -ES0SEL	OA	EB: -CEPSEL	51	(PA6) RXRDY	OA	HB: RXRDY
10	(PB6) HDIS	OA	NC	52	(PA7) NVMCLK	OA	NVRAM: SCL
11	(PB7) HINT	OA	HB: HINT	53	-TST	MI	NC (Note 5)
12	-RES	IC	MDP: -POR & -RESET HB: (Note 6)	54	D0	IA/OA	EB: D0
13	-NMI	MI	Note 4	55	D1	IA/OA	EB: D1
14	-WRITE	OA	EB: -WRITE	56	D2	IA/OA	EB: D2
15	-READ	OA	EB: -READ	57	D3	IA/OA	EB: D3
16	(PE2) -RLY3	OA	DAA: A/A1, -MUTE	58	D4	IA/OA	EB: D4
17	(PE3) -RLY4	OA	DAA: -T/DRLY, -EARTH	59	D5	IA/OA	EB: D5
18	PSC		NC	60	D6	IA/OA	EB: D6
19	VCC1	PWR	VCC	61	D7	IA/OA	EB: D7
20	XTLI	IE	XTLI	62	(PE6) IDCLK	OA	DAA: IDCLK
21	XTLO	OE	XTLO	63	(PE7) IDID	IA	DAA: IDID
22	GND2	GND	GND	64	VCC2	PWR	VCC
23	GND3	GND	GND	65	GND4	GND	GND
24	MK6		GND	66	MK7		GND
25	(PC0) HD0	IA/OA	HB: HD0	67	GND8	GND	GND
26	(PC1) HD1	IA/OA	HB: HD1	68	A0	OA	EB: A0
27	(PC2) HD2	IA/OA	HB: HD2	69	A1	OA	EB: A1
28	(PC3) HD3	IA/OA	HB: HD3	70	A2	OA	EB: A2
29	(PC4) HD4	IA/OA	HB: HD4	71	A3	OA	EB: A3
30	(PC5) HD5	IA/OA	HB: HD5	72	A4	OA	EB: A4
31	(PC6) HD6	IA/OA	HB: HD6	73	A5	OA	EB: A5
32	(PC7) HD7	IA/OA	HB: HD7	74	A6	OA	EB: A6
33	SYNC		NC	75	SC2		NC
34	(PD0) HA0	IA	HB: HA0	76	A7	OA	EB: A7
35	(PD1) HA1	IA	HB: HA1	77	A8	OA	EB: A8
36	(PD2) HA2	IA	HB: HA2	78	A9	OA	EB: A9
37	(PD3) -STPMODE	IA	Stop Mode Circuit	79	A10	OA	EB: A10
38	(PD4) -HCS	IA	HB: -HCS	80	A11	OA	EB: A11
39	(PD5) -HWT	IA	HB: -HWT	81	A12	OA	EB: A12
40	(PD6) -HRD	IA	HB: -HRD	82	A13	OA	EB: A13
41	(PD7) DPIRQ	IA	MDP: IRQ	83	A14	OA	EB: A14
42	GND6	GND	GND	84	A15	OA	EB: A15

**Notes:**

## 1. I/O types:

MI = Modem interconnect.

IA, IB, IC, IE = Digital input

OA, OB, OE = Digital output.

## 2. NC = No external connection.

## 3. NU = Not used; connect as noted.

## 4. Connect to VCC through 10 K ohms.

## 5. Leave open to allow internal MCU ROM use; connect to GND through 10K ohms to force external ROM use only.

## 6. Connect to HB: RESET through inverter.

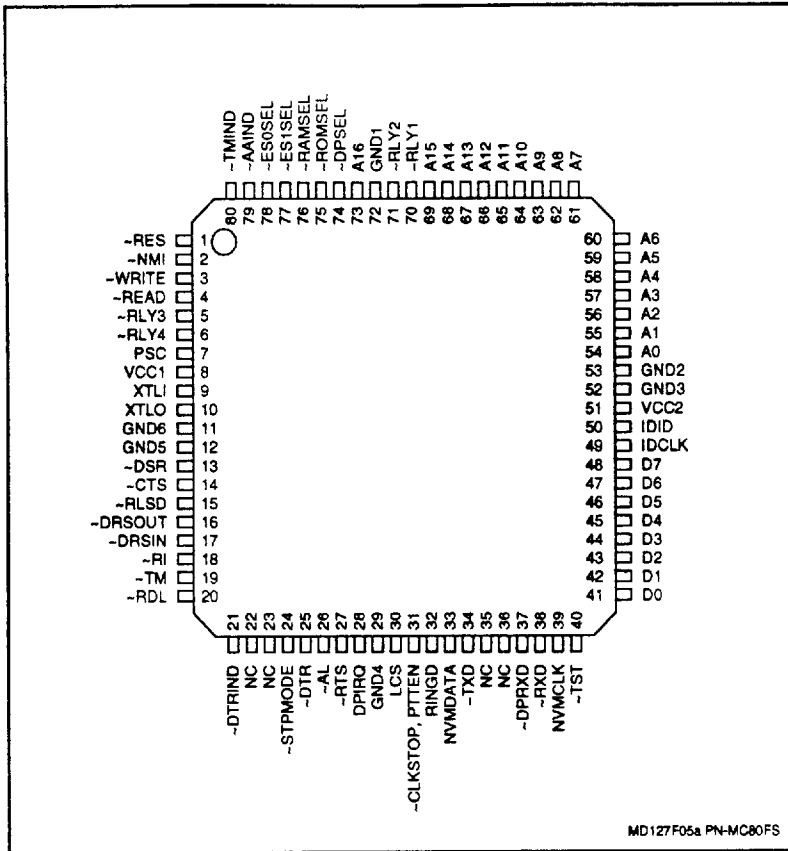


Figure 5a. MCU Pin Signals- 80-Pin PQFP - Serial Interface

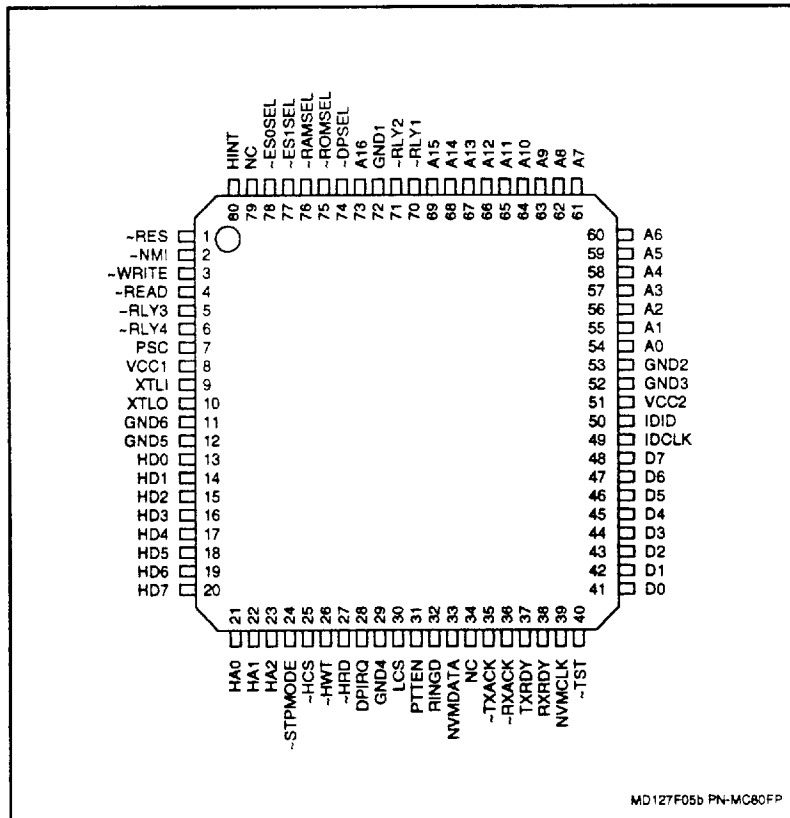


Figure 5b. MCU Pin Signals- 80-Pin PQFP - Parallel Interface

Table 6a. MCU Pin Signals - 80-Pin PQFP - Serial Interface

Pin	Signal Label	I/O Type	Interface	Pin	Signal Label	I/O Type	Interface
1	-RES	IC	MDP: -POR & -RESET (Note 6)	41	D0	IA/OA	EB: D0
2	-NMI	MI	Note 4	42	D1	IA/OA	EB: D1
3	-WRITE	OA	EB: -WRITE	43	D2	IA/OA	EB: D2
4	-READ	OA	EB: -READ	44	D3	IA/OA	EB: D3
5	(PE2) -RLY3	OA	DAA: A/A1, -MUTE,	45	D4	IA/OA	EB: D4
6	(PE3) -RLY4	OA	DAA: -T/DRLY, -EARTH	46	D5	IA/OA	EB: D5
7	PSC		NC	47	D6	IA/OA	EB: D6
8	VCC1	PWR	VCC	48	D7	IA/OA	EB: D7
9	XTLI	IE	XTLI	49	(PE6) IDCLK	OA	DAA: IDCLK
10	XTLO	OE	XTLO	50	(PE7) IDID	IA	DAA: IDID
11	GND6	GND	GND	51	VCC2	PWR	VCC
12	GND5	GND	GND	52	GND3	GND	GND
13	(PC0) -DSR	OA	DTE: -DSR	53	GND2	GND	GND
14	(PC1) -CTS	OA	DTE: -CTS	54	A0	OA	EB: A0
15	(PC2) -RLSD	OA	DTE: -RLSD	55	A1	OA	EB: A1
16	(PC3) -DRSOUT	OA	DTE: -DRSOUT	56	A2	OA	EB: A2
17	(PC4) -DRSIN	OA	DTE: -DRSIN	57	A3	OA	EB: A3
18	(PC5) -RI	OA	DTE: -RI	58	A4	OA	EB: A4
19	(PC6) -TM	OA	DTE: -TM	59	A5	OA	EB: A5
20	(PC7) -RDL	IA	DTE: -RDL	60	A6	OA	EB: A6
21	(PD0) -DTRIND	OA	Indicator Circuit	61	A7	OA	EB: A7
22	(PD1) NC		NC	62	A8	OA	EB: A8
23	(PD2) NC		NC	63	A9	OA	EB: A9
24	(PD3) -STPMODE	IA	Note 4	64	A10	OA	EB: A10
25	(PD4) -DTR	IA	DTE: -DTR	65	A11	OA	EB: A11
26	(PD5) -AL	IA	DTE: -AL	66	A12	OA	EB: A12
27	(PD6) -RTS	IA	DTE: -RTS	67	A13	OA	EB: A13
28	(PD7) DPIRQ	IA	MDP: IRQ	68	A14	OA	EB: A14
29	GND4	GND	GND	69	A15	OA	EB: A15
30	(PE4) LCS	IA	DAA: LCS	70	(PE0) -RLY1	OA	DAA: -OH
31	(PE5) PTTEN -CLKSTOP	IA OA	PTTEN -CLKSTOP	71	(PE1) -RLY2	OA	DAA: -PULSE
32	(PA0) RINGD	IA	DAA: RINGD	72	GND1	GND	GND
33	(PA1) NVMDATA	IA/OA	NVRAM: SDA (Note 4)	73	(PB0) A16	OA	EB: A16
34	(PA2) -TXD	IA	DTE: -TXD	74	(PB1) -DPSEL	OA	MDP: -CS
35	(PA3) NC		NC	75	(PB2) -ROMSEL	OA	ROM: -CE
36	(PA4) NC		NC	76	(PB3) -RAMSEL	OA	RAM: -CS
37	(PA5) -DPRXD	MI	MDP: RXD	77	(PB4) -ES1SEL	OA	Not used
38	(PA6) -RXD	OA	DTE: -RXD	78	(PB5) -ES0SEL	OA	Not Used
39	(PA7) NVMCLK	OA	NVRAM: SCL	79	(PB6) -AAIND	OA	Indicator Circuit
40	-TST	MI	NC (Note 5)	80	(PB7) -TMIND	OA	Indicator Circuit

**Notes:**

- I/O types:  
MI = Modem interconnect.  
IA, IB, IC, IE = Digital input.  
OA, OB, OE = Digital output.
- NC = No external connection.
- NU = Not used; connect as noted.
- Connect to VCC through 10 K ohms.
- Leave open to allow internal MCU ROM use; connect to GND through 10K ohms to force external ROM use only.
- Connect to GND through 10K ohms.
- Connect to GND through 100K ohms.

Table 6b. MCU Pin Signals- 80-Pin PQFP - Parallel Interface

Pin	Signal Label	Type	Interface	Pin	Signal Label	Type	Interface
1	-RES	IC	MDP: -POR & -RESET HB (Note 6)	41	D0	IA/OA	EB: D0
2	-NMI	MI	Note 4	42	D1	IA/OA	EB: D1
3	-WRITE	OA	EB -WRITE	43	D2	IA/OA	EB: D2
4	-READ	OA	EB -READ	44	D3	IA/OA	EB: D3
5	(PE2) -RLY3	OA	DAA A/A1, -MUTE	45	D4	IA/OA	EB: D4
6	(PE3) -RLY4	OA	DAA. -T/DRLY, -EARTH	46	D5	IA/OA	EB: D5
7	PSC		NC	47	D6	IA/OA	EB: D6
8	VCC1	PWR	VCC	48	D7	IA/OA	EB: D7
9	XTLI	IE	XTLI	49	(PE6) IDCLK	OA	DAA: IDCLK
10	XTLO	OE	XTLO	50	(PE7) IDID	IA	DAA: IDID
11	GND6	GND	GND	51	VCC2	PWR	VCC
12	GND5	GND	GND	52	GND3	GND	GND
13	(PC0) HD0	IA/OA	HB: HD0	53	GND2	GND	GND
14	(PC1) HD1	IA/OA	HB: HD1	54	A0	OA	EB: A0
15	(PC2) HD2	IA/OA	HB: HD2	55	A1	OA	EB: A1
16	(PC3) HD3	IA/OA	HB: HD3	56	A2	OA	EB: A2
17	(PC4) HD4	IA/OA	HB: HD4	57	A3	OA	EB: A3
18	(PC5) HD5	IA/OA	HB: HD5	58	A4	OA	EB: A4
19	(PC6) HD6	IA/OA	HB: HD6	59	A5	OA	EB: A5
20	(PC7) HD7	IA/OA	HB: HD7	60	A6	OA	EB: A6
21	(PD0) HA0	IA	HB: HA0	61	A7	OA	EB: A7
22	(PD1) HA1	IA	HB: HA1	62	A8	OA	EB: A8
23	(PD2) HA2	IA	HB: HA2	63	A9	OA	EB: A9
24	(PD3) -STPMODE	IA	Note 4	64	A10	OA	EB: A10
25	(PD4) -HCS	IA	HB: -CS	65	A11	OA	EB: A11
26	(PD5) -HWT	IA	HB: -WT	66	A12	OA	EB: A12
27	(PD6) -HRD	IA	HB -RD	67	A13	OA	EB: A13
28	(PD7) DPIRQ	IA	MDP: IRQ	68	A14	OA	EB: A14
29	GND4	GND	GND	69	A15	OA	EB: A15
30	(PE4) LCS	IA	DAA LCS	70	(PE0) -RLY1	OA	DAA: -OH
31	(PE5) PTTEN	IA IA/OA	PTTEN	71	(PE1) -RLY2	OA	DAA: -PULSE
32	(PA0) RINGD	IA	DAA: RINGD	72	GND1	GND	GND
33	(PA1) NVMDATA	IA/OA	NVRAM SDA (Note 4)	73	(PB0) A16	OA	EB: A16
34	(PA2) NC		NC	74	(PB1) -DPSEL	OA	MDP: -CS
35	(PA3) -TXACK	IA	HB: -TXACK	75	(PB2) -ROMSEL	OA	ROM: -CE
36	(PA4) -RXACK	IA	HB: -RXACK	76	(PB3) -RAMSEL	OA	RAM: -CS
37	(PA5) TXRDY	OA	HB TXRDY	77	(PB4) -ES1SEL	OA	Not used
38	(PA6) RXRDY	OA	HB RXRDY	78	(PB5) -ES0SEL	OA	Not used
39	(PA7) NVMCLK	OA	NVRAM SCL	79	(PB6) HDIS	OA	NC
40	-TST	MI	NC (Note 5)	80	(PB7) HINT	OA	HB HINT

Notes:

- I/O types:  
MI = Modem interconnect.  
IA, IB, IE = Digital input.  
OA, OB, OE = Digital output
- NC = No external connection
- NU = Not used; connect as noted
- Connect to VCC through 10 K ohms
- Leave open to allow internal MCU ROM use, connect to GND through 10K ohms to force external ROM use only.
- Connect to HB: RESET through inverter

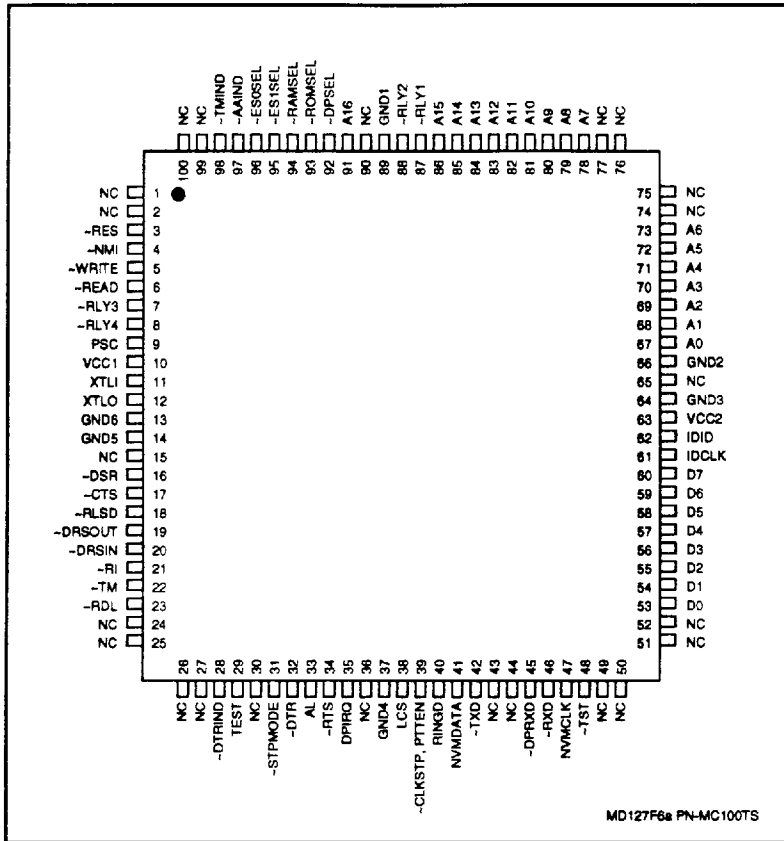


Figure 6a. MCU Pin Signals- 100-Pin TQFP - Serial Interface

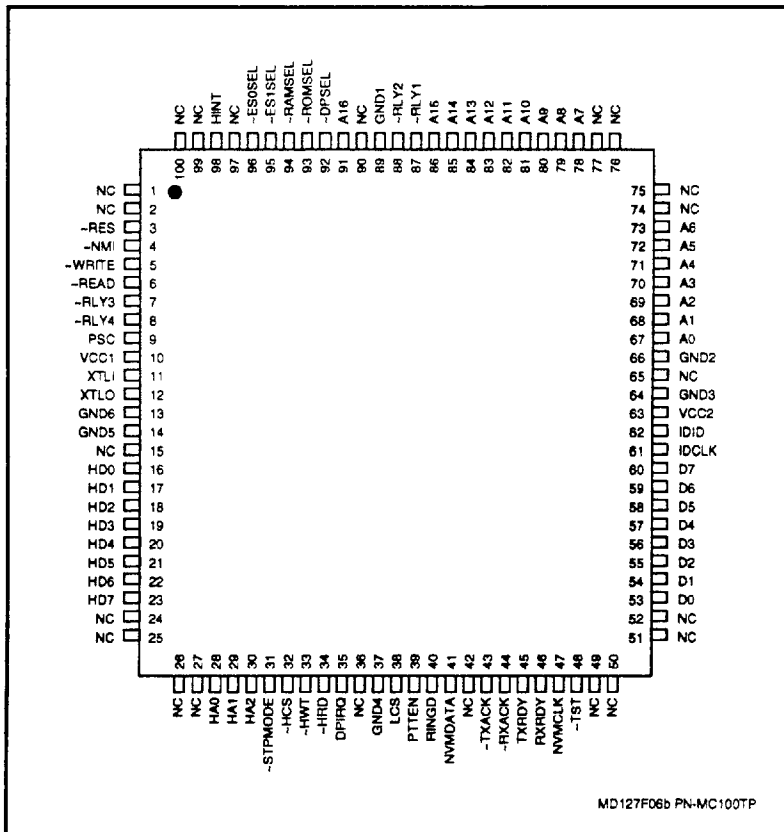


Figure 6b. MCU Pin Signals- 100-Pin TQFP - Parallel Interface



Table 7a. MCU Pin Signals- 100-Pin TQFP - Serial Interface

Pin	Signal Label	I/O Type	Interface <sup>3</sup>	Pin	Signal Label	I/O Type	Interface
1	NC		NC	51	NC		NC
2	NC		NC	52	NC		NC
3	-RES	IC	MDP: -POR & -RESET (Note 6)	53	D0	IA/OA	EB: D0
4	-NMI	MI	Note 4	54	D1	IA/OA	EB: D1
5	-WRITE	OA	EB: -WRITE	55	D2	IA/OA	EB: D2
6	-READ	OA	EB: -READ	56	D3	IA/OA	EB: D3
7	(PE2) -RLY3	OA	DAA: A/A1, -MUTE,	57	D4	IA/OA	EB: D4
8	(PE3) -RLY4	OA	DAA: -T/DRLY, -EARTH	58	D5	IA/OA	EB: D5
9	PSC		NC	59	D6	IA/OA	EB: D6
10	VCC1	PWR	VCC	60	D7	IA/OA	EB: D7
11	XTLI	IE	XTLI	61	(PE6) IDCLK	OA	DAA: IDCLK
12	XTLO	OE	XTLO	62	(PE7) IDiD	IA	DAA: IDiD
13	GND6	GND	GND	63	VCC2	PWR	VCC
14	GND5	GND	GND	64	GND3	GND	GND
15	NC		NC	65	NC		NC
16	(PC0) -DSR	OA	DTE: -DSR	66	GND2	GND	GND
17	(PC1) -CTS	OA	DTE: -CTS	67	A0	OA	EB: A0
18	(PC2) -RLSD	OA	DTE: -RLSD	68	A1	OA	EB: A1
19	(PC3) -DRSOUT	OA	DTE: -DRSOUT	69	A2	OA	EB: A2
20	(PC4) -DRSIN	OA	DTE: -DRSIN	70	A3	OA	EB: A3
21	(PC5) -RI	OA	DTE: -RI	71	A4	OA	EB: A4
22	(PC6) -TM	OA	DTE: -TM	72	A5	OA	EB: A5
23	(PC7) -RDL	IA	DTE: -RDL	73	A6	OA	EB: A6
24	NC		NC	74	NC		NC
25	NC		NC	75	NC		NC
26	NC		NC	76	NC		NC
27	NC		NC	77	NC		NC
28	(PD0) -DTRIND	OA	Indicator Circuit	78	A7	OA	EB: A7
29	(PD1) NC		NC	79	A8	OA	EB: A8
30	(PD2) NC		NC	80	A9	OA	EB: A9
31	(PD3) -STPMODE	IA	Note 4	81	A10	OA	EB: A10
32	(PD4) -DTR	IA	DTE: -DTR	82	A11	OA	EB: A11
33	(PD5) -AL	IA	DTE: -AL	83	A12	OA	EB: A12
34	(PD6) -RTS	IA	DTE: -RTS	84	A13	OA	EB: A13
35	(PD7) DPIRQ	IA	MDP: IRQ	85	A14	OA	EB: A14
36	NC		NC	86	A15	OA	EB: A15
37	GND4	GND	GND	87	(PE0) -RLY1	OA	DAA: -OH
38	(PE4) LCS	IA	DAA: LCS	88	(PE1) -RLY2	OA	DAA: -PULSE
39	(PE5) PTTEN -CLKSTOP	IA OA	PTTEN -CLKSTOP	89	GND1	GND	GND
40	(PA0) RINGD	IA	DAA: RINGD	90	NC		NC
41	(PA1) NVMDATA	IA/OA	NVRAM: SDA (Note 4)	91	(PB0) A16	OA	EB: A16
42	(PA2) -TXD	IA	DTE: -TXD	92	(PB1) -DPSEL	OA	MDP: -CS
43	(PA3) NC		NC	93	(PB2) -ROMSEL	OA	ROM: -CE
44	(PA4) NC		NC	94	(PB3) -RAMSEL	OA	RAM: -CS
45	(PA5) -DPRXD	MI	MDP: RXD	95	(PB4) -ES1SEL	OA	Not used
46	(PA6) -RXD	OA	DTE: -RXD	96	(PB5) -ES0SEL	OA	Not used
47	(PA7) NVMCLK	OA	NVRAM: SCL	97	(PB6) -AAIND	OA	Indicator Circuit
48	-TST	MI	NC (Note 5)	98	(PB7) -TMIND	OA	Indicator Circuit
49	NC		NC	99	NC		NC
50	NC		NC	100	NC		NC

Notes:

- I/O types:  
MI = Modem interconnect.  
IA, IB, IC, IE = Digital input.  
OA, OB, OE = Digital output.
- NC = No external connection.
- NU = Not used; connect as noted.
- Connect to VCC through 10 K ohms.
- Leave open to allow internal MCU ROM use; connect to GND through 10K ohms to force external ROM use only.
- Connect to GND through 10K ohms.
- Connect to GND through 100K ohms

Table 7b. MCU Pin Signals- 100-Pin TQFP - Parallel Interface

Pin	Signal Label	I/O Type	Interface <sup>3</sup>	Pin	Signal Label	I/O Type	Interface
1	NC		NC	51	NC		NC
2	NC		NC	52	NC		NC
3	-RES	IC	MDP: -POR & -RESET HB: (Note 6)	53	D0	IA/OA	EB: D0
4	-NMI	MI	Note 4	54	D1	IA/OA	EB: D1
5	-WRITE	OA	EB: -WRITE	55	D2	IA/OA	EB: D2
6	-READ	OA	EB: -READ	56	D3	IA/OA	EB: D3
7	(PE2) -RLY3	OA	DAA: A/A1, -MUTE,	57	D4	IA/OA	EB: D4
8	(PE3) -RLY4	OA	DAA: -T/DRLY, -EARTH	58	D5	IA/OA	EB: D5
9	PSC		NC	59	D6	IA/OA	EB: D6
10	VCC1	PWR	VCC	60	D7	IA/OA	EB: D7
11	XTLI	IE	XTLI	61	(PE6) IDCLK	OA	DAA: IDCLK
12	XTLO	OE	XTLO	62	(PE7) IDID	IA	DAA: IDID
13	GND6	GND	GND	63	VCC2	PWR	VCC
14	GND5	GND	GND	64	GND3	GND	GND
15	NC		NC	65	NC		NC
16	(PC0) HD0	IA/OA	HB: HD0	66	GND2	GND	GND
17	(PC1) HD1	IA/OA	HB: HD1	67	A0	OA	EB: A0
18	(PC2) HD2	IA/OA	HB: HD2	68	A1	OA	EB: A1
19	(PC3) HD3	IA/OA	HB: HD3	69	A2	OA	EB: A2
20	(PC4) HD4	IA/OA	HB: HD4	70	A3	OA	EB: A3
21	(PC5) HD5	IA/OA	HB: HD5	71	A4	OA	EB: A4
22	(PC6) HD6	IA/OA	HB: HD6	72	A5	OA	EB: A5
23	(PC7) HD7	IA/OA	HB: HD7	73	A6	OA	EB: A6
24	NC		NC	74	NC		NC
25	NC		NC	75	NC		NC
26	NC		NC	76	NC		NC
27	NC		NC	77	NC		NC
28	(PD0) HA0	IA	HB: HA0	78	A7	OA	EB: A7
29	(PD1) HA1	IA	HB: HA1	79	A8	OA	EB: A8
30	(PD2) HA2	IA	HB: HA2	80	A9	OA	EB: A9
31	(PD3) -STPMODE	IA	Note 4	81	A10	OA	EB: A10
32	(PD4) -HCS	IA	HB: -CS	82	A11	OA	EB: A11
33	(PD5) -HWT	IA	HB: -WT	83	A12	OA	EB: A12
34	(PD6) -HRD	IA	HB: -RD	84	A13	OA	EB: A13
35	(PD7) DPIRQ	IA	MDP: IRQ	85	A14	OA	EB: A14
36	NC		NC	86	A15	OA	EB: A15
37	GND4	GND	GND	87	(PE0) -RLY1	OA	DAA: -OH
38	(PE4) LCS	IA	DAA: LCS	88	(PE1) -RLY2	OA	DAA: -PULSE
39	(PE5) PTEN -CLKSTOP	IA OA	PTEN -CLKSTOP	89	GND1	GND	GND
40	(PA0) RINGD	IA	DAA: RINGD	90	NC		NC
41	(PA1) NVMDATA	IA/OA	NVRAM: SDA (Note 4)	91	(PB0) A16	OA	EB: A16
42	(PA2) NC		NC	92	(PB1) -DPSEL	OA	MDP: -CS
43	(PA3) -TXACK	IA	HB: -TXACK	93	(PB2) -ROMSEL	OA	ROM: -CE
44	(PA4) -RXACK	IA	HB: -RXACK	94	(PB3) -RAMSEL	OA	RAM: -CS
45	(PA5) TXRDY	OA	HB: TXRDY	95	(PB4) -ES1SEL	OA	Not used
46	(PA6) RXRDY	OA	HB: RXRDY	96	(PB5) -ES0SEL	OA	Not used
47	(PA7) NVMCLK	OA	NVRAM: SCL	97	(PB6) HDIS	OA	NC
48	-TST	MI	NC (Note 5)	98	(PB7) HINT	OA	HB: HINT
49	NC		NC	99	NC		NC
50	NC		NC	100	NC		NC

**Notes:**

## 1. I/O types:

MI = Modem interconnect.

IA, IB, IE = Digital input.

OA, OB, OE = Digital output.

## 2. NC = No external connection allowed.

## 3. NU = Not used; connect as noted.

## 4. Connect to VCC through 10 K ohms.

## 5. Leave open to allow internal MCU ROM use; connect to GND through 10K ohms to force external ROM use only.

## 6. Connect to HB: RESET through inverter.

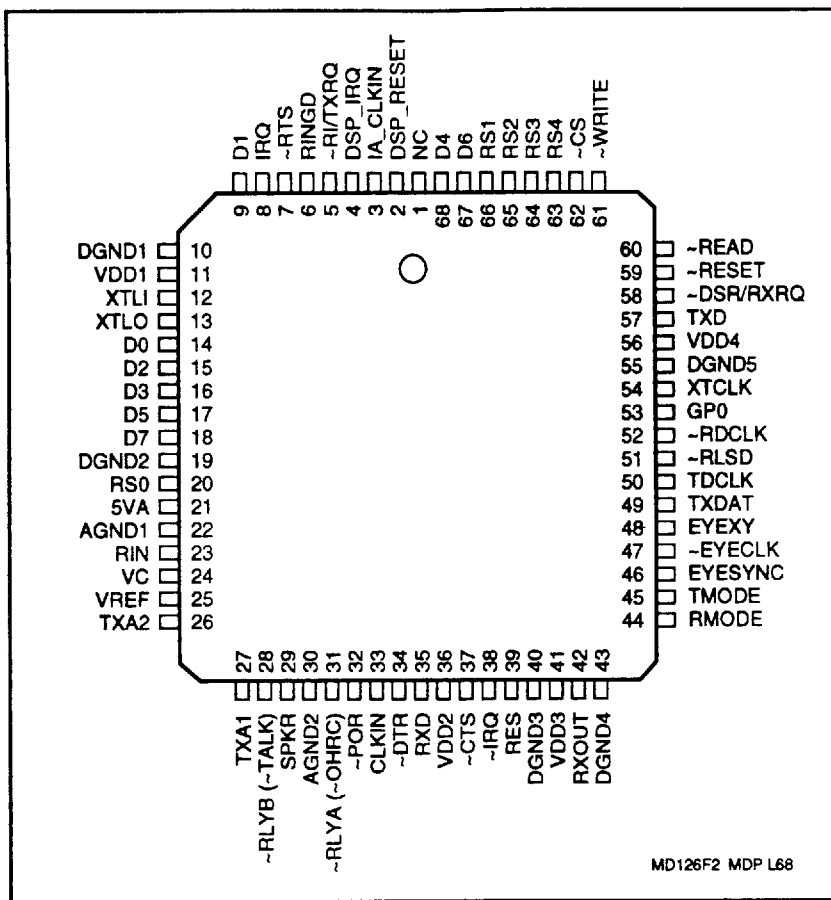


Figure 7. MDP Pin Signals - 68-Pin PLCC

Table 8. MDP Pin Signals - 68-Pin PLCC

Pin	Signal Label	I/O Type	Interface <sup>3</sup>	Pin	Signal Label	I/O Type	Interface
1	NC		NC	35	RXD	OA	MCU: -DPRXD
2	DSP_RESET	MI	MDP: -RES	36	VDD2	PWR	VCC
3	IA_CLKIN	MI	MDP: CLKIN	37	-CTS	OA	NC
4	DSP_IRQ	MI	MDP: -IRQ	38	-IRQ	MI	MDP: DSP_IRQ
5	-RI	OA	NC	39	-RES	MI	MDP: DSP_RESET
6	RINGD	IA	DAA: RINGD	40	DGND3	GND	GND
7	-RTS	IA	VCC (Note 4)	41	VDD3	PWR	VCC
8	IRQ	OA	MCU: DPIRQ	42	RXOUT		NC
9	D1	IA/OA	MCU: D1	43	DGND4	GND	GND
10	DGND1	GND	GND	44	RMODE	MI	MDP: TMODE
11	VDD1	PWR	VCC	45	TMODE	MI	MDP: RMODE
12	XTLI	I	Crystal/Clock Circuit	46	EYESYNC	OA	NC
13	XTLO	O	Crystal/Clock Circuit	47	-EYECLK	OA	NC
14	D0	IA/OA	MCU: D0	48	EYEXY	OA	NC
15	D2	IA/OA	MCU: D2	49	TXDAT		NC
16	D3	IA/OA	MCU: D3	50	TDCLK	OA	PIF: NC SIF: DTE: -TXCLK
17	D5	IA/OA	MCU: D5	51	-RLSD	OA	NC
18	D7	IA/OA	MCU: D7	52	-RDCLK	OA	PIF: NC SIF: DTE: -RXCLK
19	DGND2	GND	GND	53	GP0	MI	Connect to EYESYNC
20	RS0	IA	MCU: A0	54	XTCLK	IA	PIF: NC SIF: DTE: -XTCLK
21	5VA	PWR	AVCC	55	DGND5	GND	GND
22	AGND1	GND	AGND	56	VDD4	PWR	VCC
23	RIN	I(DA)	DAA: RIN	57	TXD	IA	SIF: DTE & MCU TXD (Note 4)
24	VC	MI	GND through capacitors	58	-DSR	OA	NC
25	VREF	MI	VC through capacitors	59	-RESET	OA	Host Parallel Interface
26	TXA2	O(DD)	DAA: TXA2	60	-READ	IA	MCU: -READ
27	TXA1	O(DD)	DAA: TXA1	61	-WRITE	IA	MCU: -WRITE
28	-RLYB (-TALK)	OD	DAA: Voice Relay	62	-CS	IA	MCU: -DPSEL
29	SPKR	O(DF)	Speaker Circuit	63	RS4	IA	MCU: A4
30	AGND2	GND	AGND	64	RS3	IA	MCU: A3
31	-RLYA (-OHRC)	OD	DAA: Caller ID Relay	65	RS2	IA	MCU: A2
32	-POR	MI	MDP: -RESET MCU: -RES	66	RS1	IA	MCU: A1
33	CLKIN	MI	MDP: IA_CLKOUT	67	D6	IA/OA	MCU: D6
34	-DTR	IA	VCC (Note 4)	68	D4	IA/OA	MCU: D4

**Notes:**

## 1. I/O types:

MI = Modem interconnect.

IA, IB = Digital input.

OA, OB = Digital output.

I(DA)] = Analog input.

O(DD), O(DF) = Analog output

## 2. NC = No external connection allowed.

## 3. Interface Legend:

PIF = Host Parallel Interface Configuration.

SIF = DTE Serial Interface Configuration.

## 4. To GND through 82k ohms at DAA interface

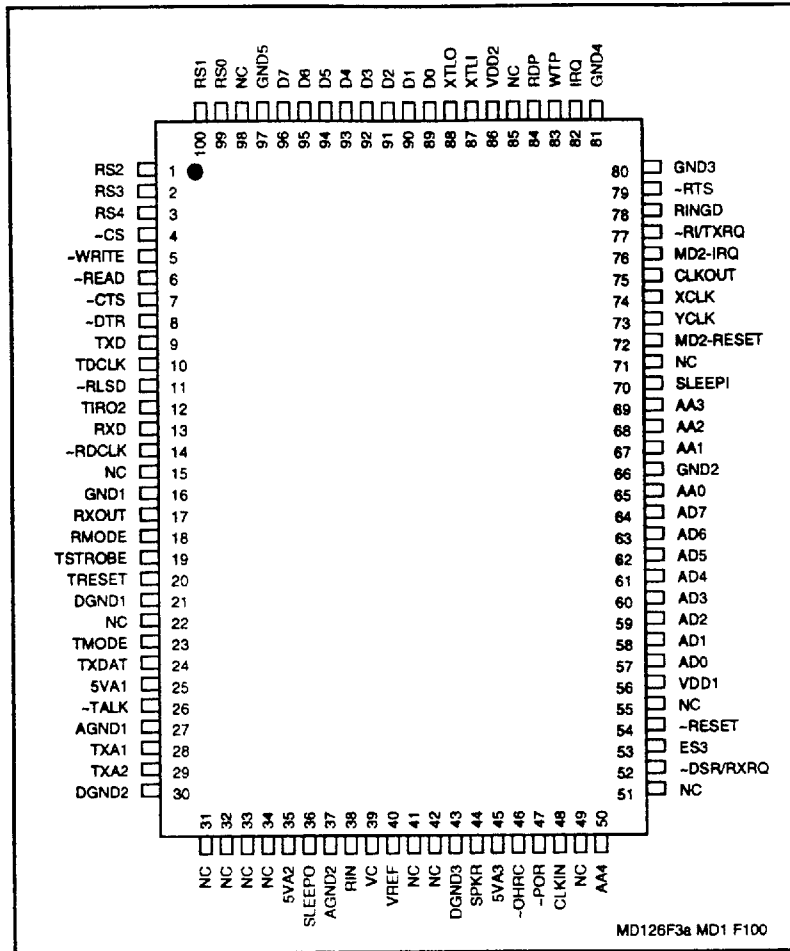


Figure 8a. MDP Pin Signals - 100-Pin PQFP (MDP1)

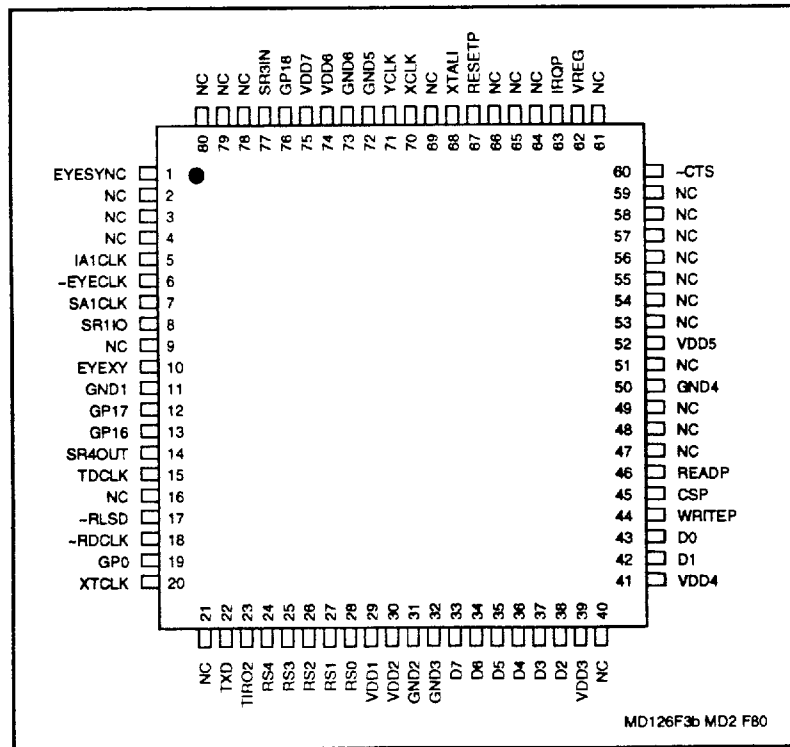


Figure 8b. MDP Pin Signals - 80-Pin PQFP (MDP2)

Table 9a. MDP Pin Signals - 100-Pin PQFP (MDP1)

Pin	Signal Label	VO Type	Interface <sup>3</sup>	Pin	Signal Label	VO Type	Interface
1	RS2	IA	MCU: A2	51	NC		NC
2	RS3	IA	MCU: A3	52	-DSR	OA	NC
3	RS4	IA	MCU: A4	53	ES3	MI	MDP2: CSP
4	-CS	IA	MCU: -DPSEL	54	-RESET	IA	MDP1: -POR, MCU: RESETP
5	-WRITE	IA	MCU: -WRITE	55	NC		NC
6	-READ	IA	MCU: -READ	56	VDD1	PWR	VCC
7	-CTS	OA	MDP2: -CTS	57	AD0	MI	MDP2: D0
8	-DTR	IA	VCC (Note 4)	58	AD1	MI	MDP2: D1
9	TXD	IA	PIF: TXD SIF: DTE: TXD	59	AD2	MI	MDP2: D2
10	TDCLK	OA	MDP2: TDCLK	60	AD3	MI	MDP2: D3
11	-RLSD	MI	MDP2: -RLSD	61	AD4	MI	MDP2: D4
12	TIRO2	MI	MDP2: TIRO2	62	AD5	MI	MDP2: D5
13	RXD	OA	MCU: -DPRXD	63	AD6	MI	MDP2: D6
14	RDCLK	MI	MDP2: RDCLK SIF: DTE: -RXCLK	64	AD7	MI	MDP2: D7
15	NC		NC	65	AA0	MI	MDP2: RS0
16	GND1	GND	GND	66	GND2	GND	
17	RXOUT	MI	MDP2: SR3IN	67	AA1	MI	MDP2: RS1
18	RMODE	MI	MDP1: TMODE MDP2: SR1IO	68	AA2	MI	MDP2: RS2
19	TSTROBE	MI	MDP2: IA1CLK	69	AA3	MI	MDP2: RS3
20	TRESET	MI	MDP2: SA1CLK	70	SLEEP1	MI	MDP1: SLEEPO; Sleep Circuit
21	DGND1	GND	GND	71	NC		
22	NC			72	MDP2-RESET	MI	MDP2: RESETP
23	TMODE	MI	MDP1: RMODE MDP2: SR1IO	73	YCLK	MI	MDP2: YCLK
24	TXDAT	MI	MDP2: SR4OUT	74	XCLK	MI	MDP2: XCLK
25	5VA1	PWR	AVCC	75	CLKOUT	MI	MDP1: CLKIN
26	-RLYB (-TALK)	OD	DAA: Voice Relay	76	MDP2-IRQ	MI	MDP2: IRQP
27	AGND1	GND	AGND	77	-RI	OA	PIF: NC SIF: -RI
28	TXA1	O(DD)	DAA: TXA1	78	RINGD	IA	DAA: RINGD
29	TXA2	O(DD)	DAA: TXA2	79	-RTS	IA	VCC (Note 4)
30	DGND2	GND	GND	80	GND3	GND	GND
31	NC		NC	81	GND4	GND	GND
32	NC		NC	82	IRQ	OA	MCU: DPIRQ
33	NC		NC	83	WTP	MI	MDP2: WRITP
34	NC		NC	84	RDP	MI	MDP2: READP
35	5VA2	PWR	AVCC	85	NC		NC
36	SLEEPO	MI	MDP1: SLEEP1; Sleep Circuit	86	VDD2	PWR	VCC
37	AGND2	GND	GND	87	XTL1	I	Crystal/Clock Circuit
38	RIN	I(DA)	DAA: RIN	88	XTLO	O	Crystal/Clock Circuit
39	VC	MI	GND through capacitors	89	D0	IA/OA	MCU: D0
40	VREF	MI	VC through capacitors	90	D1	IA/OA	MCU: D1
41	NC		NC	91	D2	IA/OA	MCU: D2
42	NC		NC	92	D3	IA/OA	MCU: D3
43	DGND3	GND	GND	93	D4	IA/OA	MCU: D4
44	SPKR	O(DF)	Speaker Circuit	94	D5	IA/OA	MCU: D5
45	5VA3	PWR		95	D6	IA/OA	MCU: D6
46	-RLYA (-OHRC)	OD	DAA: Caller ID Relay	96	D7	IA/OA	MCU: D7
47	-POR	MI	MDP1: -RESET; MCU: RESP	97	GND5	GND	GND
48	CLKIN	MI	MDP1: CLKOUT	98	NC		NC
49	NC		NC	99	RS0	IA	MCU: A0
50	AA4	MI	MDP2: RS4	100	RS1	IA	MCU: A1

**Notes:**

## 1. VO types:

MI = Modem interconnect.

IA, IB = Digital input.

OA, OB = Digital output.

2. NC = No external connection allowed.

## 3. Interface Legend:

PIF = Host Parallel Interface Configuration

SIF = DTE Serial Interface Configuration

4. Connect to VCC through 20K ohms.

5. To GND through 82k ohms at DAA interface.

Table 9b. MDP Pin Signals - 80-Pin PQFP (MDP2)

Pin	Signal Label	I/O Type	Interface	Pin	Signal Label	I/O Type	Interface
1	EYESYNC	OA	NC	41	VDD4	PWR	VCC
2	NC		NC	42	D1	MI	MDP1: AD1
3	NC		NC	43	D0	MI	MDP1: AD0
4	NC		NC	44	WRITEP	MI	MDP1: WTP
5	IA1CLK	MI	MDP1: TSTROBE	45	CSP	MI	MDP1: ES3
6	-EYECLK	OA	NC	46	READP	MI	MDP1: RDP
7	SA1CLK	MI	MDP1: TRESET	47	NC		NC
8	SR1IO	MI	MDP1: TMODE	48	NC		NC
9	NC		NC	49	NC		NC
10	EYEXY	OA	NC	50	GND4	GND	GND
11	GND1	GND	GND	51	NC		NC
12	GP17	MI	Connect to DGND	52	VDD5	PWR	VCC
13	GP16	MI	Connect to DGND	53	NC		NC
14	SR4OUT	MI	MDP1: TXDAT	54	NC		NC
15	TDCLK	IA	PIF: MDP1: TDCLK SIF: MDP1 & DTE: TDCLK	55	NC		NC
16	NC		GND	56	NC		NC
17	-RLSD	IA	MDP1: -RLSD	57	NC		NC
18	RDCLK	IA	PIF: MDP1: RDCLK SIF: MDP1 & DTE: RDCLK	58	NC		NC
19	GP0	MI	Connect to EYESYNC	59	NC		NC
20	XTCLK	IA	PIF: Connect to VCC SIF: DTE I/F	60	-CTS	MI	MDP1: -CTS
21	NC		NC	61	NC		NC
22	TXD	IA	PIF: MDP1: TXD SIF: MDP1 & DTE: TXD	62	NC		NC
23	TIRO2	MI	MDP1: TIRO2	63	IRQP	MI	MDP1: MDP2-IRQ
24	RS4	MI	MDP1: AA4	64	NC		NC
25	RS3	MI	MDP1: AA3	65	NC		NC
26	RS2	MI	MDP1: AA2	66	NC		NC
27	RS1	MI	MDP1: AA1	67	RESETP	MI	MDP1: MDP2-RESET
28	RS0	MI	MDP1: AA0	68	XTALI	I	Connect to DGND
29	VDD1	PWR	VCC	69	NC		NC
30	VDD2	PWR	VCC	70	XCLK	MI	MDP1: XCLK
31	GND2	GND	GND	71	YCLK	MI	MDP1: YCLK
32	GND3	GND	GND	72	GND5	GND	GND
33	D7	MI	MDP1: AD7	73	GND6	GND	GND
34	D6	MI	MDP1: AD6	74	VDD6	PWR	VCC
35	D5	MI	MDP1: AD5	75	VDD7	PWR	VCC
36	D4	MI	MDP1: AD4	76	GP18	MI	Connect to GND
37	D3	MI	MDP1: AD3	77	SR3IN	MI	MDP1: RXOUT
38	D2	MI	MDP1: AD2	78	NC		NC
39	VDD3	PWR	VCC	79	NC		NC
40	NC		NC	80	NC		NC

Notes:

- I/O types:  
MI = Modem interconnect.  
IA, IB = Digital input.  
OA, OB = Digital output.
- NC = No external connection allowed.
- Connect to VCC through 20K ohms

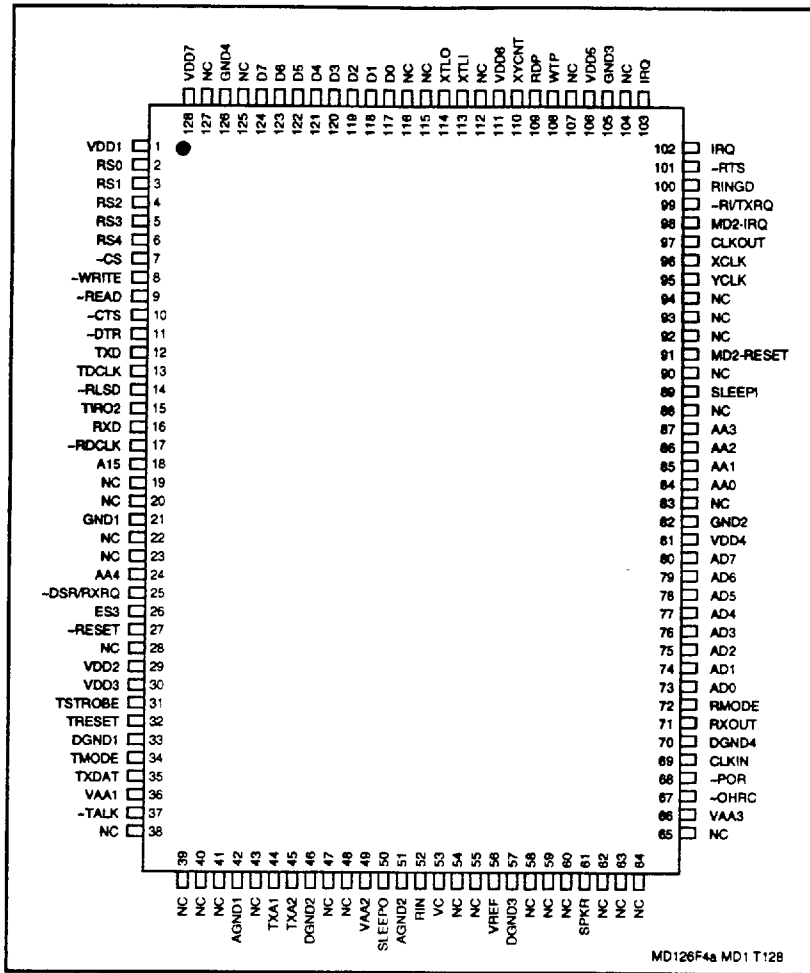


Figure 9a. MDP Pin Signals - 128-Pin TQFP (MDP1)

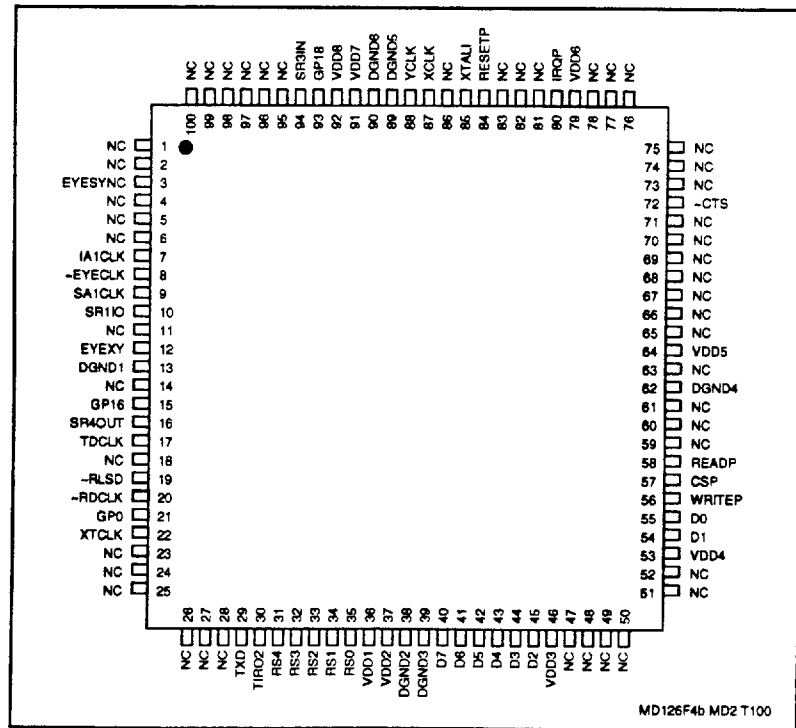


Figure 9b. MDP Pin Signals - 100-Pin TQFP (MDP2)



Table 10a. MDP Pin Signals - 128-Pin TQFP (MDP1)

Pin	Signal Label	I/O Type	Interface <sup>3</sup>	Pin	Signal Label	I/O Type	Interface
1	VDD1	PWR	+5VD	65	NC		NC
2	RS0	IA	MCU: A0	66	VAA2	PWR	+5VA
3	RS1	IA	MCU: A1	67	-RLYA (-OHRC)	OD	DAA: Caller ID Relay
4	RS2	IA	MCU: A2	68	-POR	MI	MDP1: -RESET; MCU: RESP
5	RS3	IA	MCU: A3	69	CLKIN	MI	MDP1: CLKOUT
6	RS4	IA	MCU: A4	70	DGND4	GND	DGND
7	-CS	IA	MCU: -DPSEL	71	RXOUT	MI	MDP2: SR3IN
8	-WRITE	IA	MCU: -WRITE	72	RMODE	MI	MDP1: TMODE MDP2: SR1IO
9	-READ	IA	MCU: -READ	73	AD0	MI	MDP2: D0
10	-CTS	OA	MDP2: -CTS	74	AD1	MI	MDP2: D1
11	-DTR	IA	VCC (Note 4)	75	AD2	MI	MDP2: D2
12	TXD	IA	PIF: TXD SIF: DTE: TXD	76	AD3	MI	MDP2: D3
13	TDCLK	OA	MDP2: TDCLK	77	AD4	MI	MDP2: D4
14	-RLSD	MI	MDP2: -RLSD	78	AD5	MI	MDP2: D5
15	TIRO2	MI	MDP2: TIRO2	79	AD6	MI	MDP2: D6
16	RXD	OA	MCU: -DPRXD	80	AD7	MI	MDP2: D7
17	RDCLK	MI	MDP2: RDCLK SIF: DTE: -RXCLK	81	VDD4	PWR	+5VD
18	A15	MI	NC	82	GND2	GND	DGND
19	NC		NC	83	NC		NC
20	NC		NC	84	AA0	MI	MDP2: RS0
21	GND1	GND	DGND	85	AA1	MI	MDP2: RS1
22	NC		NC	86	AA2	MI	MDP2: RS2
23	NC		NC	87	AA3	MI	MDP2: RS3
24	AA4	MI	MDP2: RS4	88	NC		NC
25	-DSR	OA	NC	89	SLEEPi	MI	MDP1: SLEEPi; Sleep Circuit
26	ES3	MI	MDP2: CSP	90	NC		NC
27	-RESET	IA	MDP1: -POR, MCU: RESETP	91	MD2-RESET		MDP2: RESETP
28	NC		NC	92	NC		NC
29	VDD2	PWR	+5VD	93	NC		NC
30	VDD3	PWR	+5VD	94	NC		NC
31	TSTROBE	MI	MDP2: IA1CLK	95	YCLK	MI	MDP2: YCLK
32	TRESET	MI	MDP2: SA1CLK	96	XCLK	MI	MDP2: XCLK
33	DGND1	GND	DGND	97	CLKOUT	MI	MDP1: CLKIN
34	TMODE	MI	MDP1: RMODE MDP2: SR1IO	98	MD2-IRQ	MI	MDP2: IRQP
35	TXDAT	MI	MDP2: SR4OUT	99	-RI	OA	PIF: NC SIF: -RI
36	VAA1	PWR	+5VA	100	RINGD	IA	DAA: RINGD
37	-RLYB (-TALK)	OD	DAA: Voice Relay	101	-RTS	IA	VCC (Note 4)
38	NC		NC	102	IRQ	OA	MCU: DPIRQ
39	NC		NC	103	IRQ	OA	MCU: DPIRQ
40	NC		NC	104	NC		NC
41	NC		NC	105	GND3	GND	DGND
42	AGND1	GND	AGND	106	VDD5	PWR	+5VD
43	NC		NC	107	NC		NC
44	TXA1	O(DD)	DAA: TXA1	108	WTP	MI	MDP2: WRITEP
45	TXA2	O(DD)	DAA: TXA2	109	RDP	MI	MDP2: READP
46	DGND2	GND	DGND	110	XYCNT	MI	NC
47	NC		NC	111	VDD6	PWR	+5VD
48	NC		NC	112	NC		NC
49	VAA2	PWR	+5VA	113	XTLI	I	Crystal/Clock Circuit
50	SLEEP0	MI	MDP1: SLEEPi; Sleep Circuit	114	XTLO	O	Crystal/Clock Circuit
51	AGND2	GND	AGND	115	NC		NC
52	RIN	I(DA)	DAA: RIN	116	NC		NC
53	VC	MI	GND through capacitors	117	D0	IA/OA	MCU: D0
54	NC		NC	118	D1	IA/OA	MCU: D1
55	NC		NC	119	D2	IA/OA	MCU: D2
56	VREF	MI	VC through capacitors	120	D3	IA/OA	MCU: D3
57	DGND3	GND	DGND	121	D4	IA/OA	MCU: D4
58	NC		NC	122	D5	IA/OA	MCU: D5
59	NC		NC	123	D6	IA/OA	MCU: D6
60	NC		NC	124	D7	IA/OA	MCU: D7

Table 10a. MDP Pin Signals - 128-Pin TQFP (MDP1) (Cont'd)

Pin	Signal Label	I/O Type	Interface <sup>3</sup>	Pin	Signal Label	I/O Type	Interface
61	SPKR	O(DF)	Speaker Circuit	125	NC		NC
62	NC		NC	126	GND4	GND	DGND
63	NC		NC	127	NC		NC
64	NC		NC	128	VDD7	PWR	+5VD

**Notes:**

## 1. I/O types:

MI = Modem interconnect.

IA, IB = Digital input.

OA, OB = Digital output.

I(DA)) = Analog input.

O(DD), O(DF) = Analog output.

## 2. NC = No external connection allowed.

## 3. Interface Legend:

MDP1 or MDP2 = Modem Data Pump 1 or Modem Data Pump 2 device.

DTE = Data Terminal Equipment.

Table 10b. MDP Pin Signals - 100-Pin TQFP (MDP2)

Pin	Signal Label	I/O Type	Interface <sup>3</sup>	Pin	Signal Label	I/O Type	Interface
1	NC		NC	51	NC		NC
2	NC		NC	52	NC		NC
3	EYESYNC	OA	NC	53	VDD4	PWR	+5VD
4	NC		NC	54	D1	MI	MDP1: AD1
5	NC		NC	55	D0	MI	MDP1: AD0
6	NC		NC	56	WRITEP	MI	MDP1: WTP
7	IA1CLK	MI	MDP1: TSTROBE	57	CSP	MI	MDP1: ES3
8	-EYECLK	OA	NC	58	READP	MI	MDP1: RDP
9	SA1CLK	MI	MDP1: TRESET	59	NC		NC
10	SR1IO	MI	MDP1 TMODE	60	NC		NC
11	NC		NC	61	NC		NC
12	EYEXY	OA	NC	62	DGND4	GND	DGND
13	DGND1	GND	DGND	63	NC		NC
14	NC		NC	64	VDD5	PWR	+5VD
15	GP16	MI	Connect to DGND	65	NC		NC
16	SR4OUT	MI	MDP1: TXDAT	66	NC		NC
17	TDCLK	IA	PIF: MDP1: TDCLK SIF: MDP1 & DTE: TDCLK	67	NC		NC
18	NC		NC	68	NC		NC
19	-RLSD	IA	MDP1 -RLSD	69	NC		NC
20	RDCLK	IA	PIF: MDP1: RDCLK SIF: MDP1 & DTE: RDCLK	70	NC		NC
21	GP0	MI	Connect to EYESYNC	71	NC		NC
22	XTCLK	IA	PIF: Connect to VCC SIF: DTE I/F	72	-CTS	MI	MDP1: -CTS
23	NC		NC	73	NC		NC
24	NC		NC	74	NC		NC
25	NC		NC	75	NC		NC
26	NC		NC	76	NC		NC
27	NC		NC	77	NC		NC
28	NC		NC	78	NC		NC
29	TXD	IA	PIF: MDP1: TXD SIF: MDP1 & DTE: TXD	79	VDD6	PWR	+5VD
30	TIRO2	MI	MDP1: TIRO2	80	IRQP	MI	MDP1: MDP2-IRQ
31	RS4	MI	MDP1: AA4	81	NC		NC
32	RS3	MI	MDP1: AA3	82	NC		NC
33	RS2	MI	MDP1: AA2	83	NC		NC
34	RS1	MI	MDP1: AA1	84	RESETP	MI	MDP1: MDP2-RESET
35	RS0	MI	MDP1: AA0	85	XTALI	I	Connect to DGND
36	VDD1	PWR	+5VD	86	NC		NC
37	VDD2	PWR	+5VD	87	XCLK	MI	MDP1: XCLK
38	DGND2	GND	DGND	88	YCLK	MI	MDP1: YCLK
39	DGND3	GND	DGND	89	DGND5	GND	DGND
40	D7	MI	MD1: AD7	90	DGND6	GND	DGND
41	D6	MI	MD1: AD6	91	VDD7	PWR	+5VD
42	D5	MI	MD1: AD5	92	VDD8	PWR	+5VD
43	D4	MI	MD1: AD4	93	GP18	MI	Connect to GND
44	D3	MI	MD1: AD3	94	SR3IN	MI	MDP1: RXOUT
45	D2	MI	MD1: AD2	95	NC		NC
46	VDD3	PWR	+5VD	96	NC		NC
47	NC		NC	97	NC		NC
48	NC		NC	98	NC		NC
49	NC		NC	99	NC		NC
50	NC		NC	100	NC		NC

Notes:

- I/O types:  
MI = Modem interconnect.  
IA, IB = Digital input.  
OA, OB = Digital output.
- NC = No external connection allowed.
- Interface Legend:  
MDP1 or MDP2 = Modem Data Pump 1 or Modem Data Pump 2  
DTE = Data Terminal Equipment

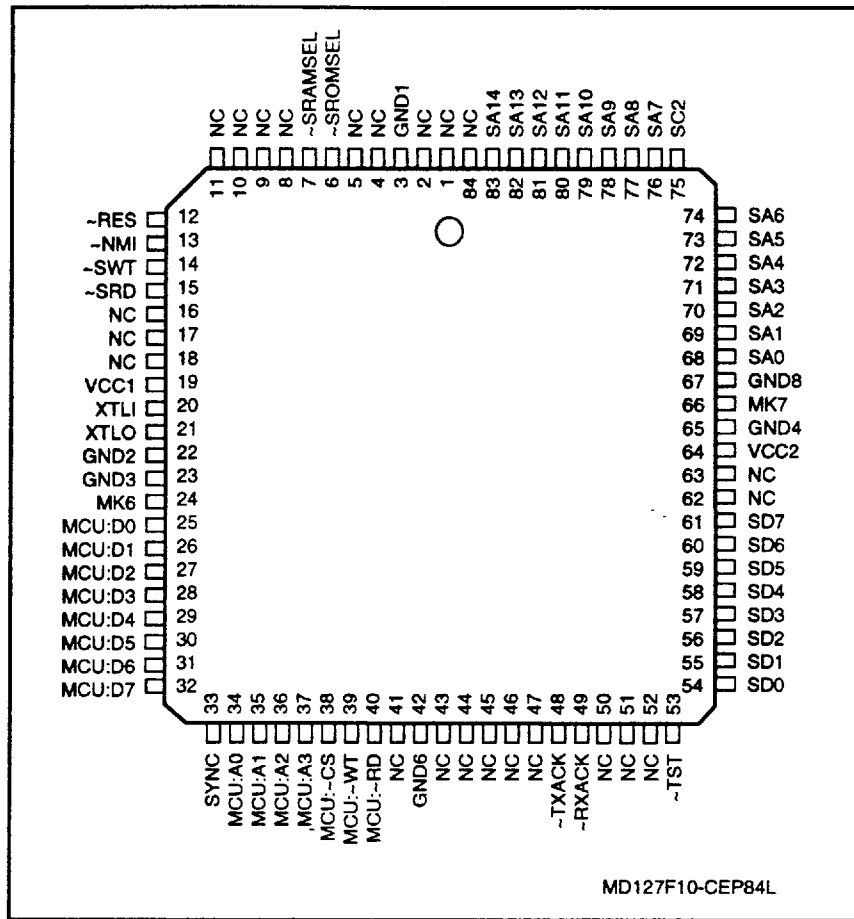


Figure 10. CEP Pin Signals - 84-Pin PLCC

Table 11. CEP Pin Signals- 84-Pin PLCC

Pin	Signal Label	I/O Type	Interface	Pin	Signal Label	I/O Type	Interface
1	(PE0) NC		NC	43	(PE4) NC		NC
2	(PE1) -RLY2		NC	44	(PE5) NC		NC
3	GND1	GND	GND	45	(PA0) NC		NC
4	(PB0) NC		NC	46	(PA1) NC		NC
5	(PB1) NC		NC	47	(PA2) NC		NC
6	(PB2) -SR0MSEL	OA	NC	48	(PA3) NC		NC
7	(PB3) -SR0MSEL	OA	RAM. -CS	49	(PA4) NC		NC
8	(PB4) NC		NC	50	(PA5) NC		NC
9	(PB5) NC		NC	51	(PA6) NC		NC
10	(PB6) NC		NC	52	(PA7) NC		NC
11	(PB7) NC		NC	53	-TST	MI	NC (Note 5)
12	-RES	IC	MCU -RES (Note 6)	54	SD0	IA/OA	EB: SD0
13	-NMI	MI	Note 4	55	SD1	IA/OA	EB: SD1
14	-WRITE	OA	CB: -SWT	56	SD2	IA/OA	EB: SD2
15	-READ	OA	CB: -SRD	57	SD3	IA/OA	EB: SD3
16	(PE2) NC		NC	58	SD4	IA/OA	EB: SD4
17	(PE3) NC		NC	59	SD5	IA/OA	EB: SD5
18	NC		NC	60	SD6	IA/OA	EB: SD6
19	VCC1	PWR	VCC	61	SD7	IA/OA	EB: SD7
20	XTLI	IE	XTLI	62	(PE6) NC		NC
21	XTLO	OE	XTLO	63	(PE7) NC		NC
22	GND2	GND	GND	64	VCC2	PWR	VCC
23	GND3	GND	GND	65	GND4	GND	GND
24	MK6		GND	66	MK7		GND
25	(PC0) MCU: D0	IA/OA	MCU: D0	67	GND8	GND	GND
26	(PC1) MCU: D1	IA/OA	MCU: D1	68	A0	OA	EB: SA0
27	(PC2) MCU: D2	IA/OA	MCU: D2	69	A1	OA	EB: SA1
28	(PC3) MCU: D3	IA/OA	MCU: D3	70	A2	OA	EB: SA2
29	(PC4) MCU: D4	IA/OA	MCU: D4	71	A3	OA	EB: SA3
30	(PC5) MCU: D5	IA/OA	MCU: D5	72	A4	OA	EB: SA4
31	(PC6) MCU: D6	IA/OA	MCU: D6	73	A5	OA	EB: SA5
32	(PC7) MCU: D7	IA/OA	MCU: D7	74	A6	OA	EB: SA6
33	SYNC		NC	75	SC2		NC
34	(PD0) MCU: A0	IA	MCU: A0	76	SA7	OA	EB: SA7
35	(PD1) MCU: A1	IA	MCU: A1	77	SA8	OA	EB: SA8
36	(PD2) MCU: A2	IA	MCU: A2	78	SA9	OA	EB: SA9
37	(PD3) MCU: A3	IA	MCU: A3	79	SA10	OA	EB: SA10
38	(PD4) MCU: -CS	IA	MCU -CEPSEL	80	SA11	OA	EB: SA11
39	(PD5) MCU: -WT	IA	MCU: -WT	81	SA12	OA	EB: SA12
40	(PD6) MCU: -RD	IA	MCU -RD	82	SA13	OA	EB: SA13
41	(PD7) NC		NC	83	SA14	OA	EB: SA14
42	GND6	GND	GND	84	SA15	OA	EB: SA15

Notes:

- I/O types:  
 MI = Modem interconnect.  
 IA, IB, IC, IE = Digital input  
 OA, OB, OE = Digital output.
- NC = No external connection.
- NU = Not used; connect as noted.
- Connect to VCC through 10 K ohms
- Leave open to allow internal MCU ROM use; connect to GND through 10K ohms to force external ROM use only.
- Connect to HB: RESET through inverter

Table 12. MCU Signal Definitions

Label	I/O Type	Signal Name/Description
<b>BASIC CONFIGURATION</b>		
<b>SYSTEM OVERHEAD</b>		
XTLI, XTLO	IE, OE	<b>MCU Crystal/Clock In and Crystal Out.</b> Connect to an external crystal circuit consisting of a 12.9024 MHz crystal (high performance configuration, i.e., with CEP) or 14.7456 MHz crystal (low cost configuration, i.e., without CEP), and a capacitance network.
~RES	IC	<b>MCU Reset.</b> The active low ~RES input resets the MCU logic, and restores the saved configuration from NVRAM or returns the modem to the factory default values if NVRAM is not present. For serial Interface, the ~RES input is typically connected to a reset switch circuit and MDP ~POR. For parallel Interface, the ~RES input is typically connected to the host bus RESET line through an inverter and to MDP ~POR.
DPIRQ	IA	<b>MDP Interrupt Request.</b> Connects to the MDP IRQ output.
~DPRXD	MI	<b>MDP Received Data.</b> Connects to the MDP RXD output (serial interface).
VCC1-VCC2	PWR	<b>+ 5V Digital Supply.</b> +5V $\pm$ 5%.
GND1-GND6	GND	<b>Digital Ground.</b> Connect to ground.
<b>DIRECT INPUTS</b>		
PTTEN	IA	<b>PTT Test Enable (W-Class Only).</b> The PTTEN input enables (high) or disables (low) the use of the PTT test commands. PTTEN is checked only for countries which do not permit the use of the %TT command at the approval site (e.g., Germany).
<b>NVRAM INTERFACE</b>		
NVMCLK	OA	<b>NVRAM Clock.</b> NVMCLK output high enables the NVRAM.
NVMDATA	IA/OA	<b>NVRAM Data.</b> The NVMDATA pin supplies a serial data interface to the NVRAM.
<b>EXTERNAL MEMORY BUS INTERFACE</b>		
A0-A15	OA	<b>Address Lines 0-15.</b> A0-A15 are the external memory bus address lines.
A16	OA	<b>Address Line 16.</b> A16 is a bank select line.
D0-D7	IA/OA	<b>Data Line 0-7.</b> D0-D7 are the external memory bus data lines.
~READ	OA	<b>Read Enable.</b> ~READ output low enables data transfer from the selected device to the D0-D7 lines.
~WRITE	OA	<b>Write Enable.</b> ~WRITE output low enables data transfer from the D0-D7 lines to the selected device.
~DPSEL	OA	<b>Modem Data Pump Select.</b> ~DPSEL output low selects the MDP.
~RAMSEL	OA	<b>RAM Select.</b> ~RAMSEL output low selects the external 128k-byte RAM.
~ROMSEL	OA	<b>ROM Select.</b> ~ROMSEL output low selects an external 128k-byte ROM or flash ROM.
~CEPSEL (~ES0SEL)	OA	<b>CEP Select.</b> ~CEPSEL output low selects the CEP.
~ES1SEL	OA	<b>ES1 Select.</b> ~ES1SEL output low selects an external device (not used).

Table 12. MCU Signal Definitions (Cont'd)

Label	I/O Type	Signal Name/Description
<b>PARALLEL HOST INTERFACE (PARALLEL INTERFACE VERSION)</b>		
		The parallel interface emulates a 16450 or 16550A/16450 UART-compatible interface. The parallel interface is compatible with communications software designed to operate with a 16450/16550A interface.
HA0-HA2	IA	<b>Host Bus Address Lines 0-2.</b> During a host read or write operation with $\sim$ HCS low, HA0-HA2 select an internal MCU 16450/16550A-compatible register.
HD0-HD7	IA/OA	<b>Host Bus Data Lines 0-7.</b> 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 over HD0-HD7.
$\sim$ HCS	IA	<b>Host Bus Chip Select.</b> $\sim$ HCS input low selects the host bus.
$\sim$ HRD	IA	<b>Host Bus Read.</b> $\sim$ HRD is an active low, read control input. When $\sim$ HCS is low, $\sim$ HRD low allows the host to read status information or data from a selected MCU register.
$\sim$ HWT	IA	<b>Host Bus Write.</b> $\sim$ HWT is an active low, write control input. When $\sim$ HCS is low, $\sim$ HWT low allows the host to write data or control words into a selected MCU register.
HINT	OA	<b>Host Bus Interrupt.</b> HINT output is set high when the receiver error flag, received data available, transmitter holding register empty, or modem status interrupt is asserted. HINT is reset low upon the appropriate interrupt service or master reset operation.
$\sim$ TXACK	IA	<b>Host Transmit Acknowledge.</b> $\sim$ TXACK is an active low transmit acknowledge input, acknowledging that the DMA controller received the Transmit Ready (TXRDY) data transfer request output.
$\sim$ RXACK	IA	<b>Host Receive Acknowledge.</b> $\sim$ RXACK is an active low receive acknowledge input, acknowledging that the DMA controller received the Receiver Ready (RXRDY) data transfer request output.
TXRDY	OA	<b>Transmitter Ready.</b> 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	<b>Receiver Ready.</b> 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).
<b>LED INDICATOR CIRCUIT INTERFACE (SERIAL INTERFACE VERSION)</b>		
$\sim$ AAIND	OA	<b>Auto Answer Indicator.</b> $\sim$ AAIND output ON (low) corresponds to the indicator on. $\sim$ AAIND output is active when the modem is configured to answer the ring automatically (ATSO command $\neq$ 0).
$\sim$ TMIND	OA	<b>Test Mode Indicator.</b> $\sim$ TMIND output ON (low) corresponds to the indicator on. $\sim$ TMIND output pulses (LED flashes) when the modem is in test mode and if an error is detected.
$\sim$ DTRIND	OA	<b>DTR Indicator.</b> $\sim$ DTRIND output ON (low) corresponds to the indicator on. The $\sim$ DTRIND state reflects the $\sim$ DTR output state except when the &D0 command is active, in which case $\sim$ DTRIND is low.

Table 12. MCU Signal Definitions (Cont'd)

Label	VO Type	Signal Name/Description
<b>V.24 (EIA/TIA-232-E) DTE SERIAL INTERFACE (SERIAL INTERFACE VERSION)</b>		
		The serial interface signals correspond functionally to V.24/EIA/TIA-232-E signals. The signal levels are TTL compatible and are inverted from V.24/EIA/TIA-232-E levels.
-TXD	IA	<b>Transmitted Data (EIA BA/CCITT CT103).</b> The DTE uses the -TXD line to send data to the modem for transmission over the telephone line or to transmit commands to the modem.
-RXD	OA	<b>Received Data (EIA BB/CCITT CT 104).</b> The modem uses the -RXD line to send data received from the telephone line to the DTE and to send modem responses to the DTE. During command mode, -RXD data represents the modem responses to the DTE.
-CTS	OA	<b>Clear To Send (EIA CB/CCITT CT106).</b> -CTS output ON (low) indicates that the DTE is ready to accept data from the DTE. In asynchronous operation, in error correction or normal mode, -CTS is always ON (low) unless RTS/CTS flow control is selected by the &Kn command.  In synchronous operation, the modem also holds -CTS ON during asynchronous command state. The modem turns -CTS OFF immediately upon going off-hook and holds -CTS OFF until both -DSR and -RLSD are ON and the modem is ready to transmit and receive synchronous data. The modem can also be commanded by the &Rn command to turn -CTS ON in response to an -RTS OFF-to-ON transition.
-DSR	OA	<b>Data Set Ready (EIA CC/CCITT CT107).</b> -DSR indicates modem status to the DTE. -DSR OFF (high) indicates that the DTE is to disregard all signals appearing on the interchange circuits except Ring Indicator (-RI). -DSR output is controlled by the AT&Sn command.
-RLSD	OA	<b>Received Line Signal Detector (EIA CF/CCITT CT109).</b> When AT&C0 command is not in effect, -RLSD output is ON when a carrier is detected on the telephone line or OFF when carrier is not detected.
-TM	OA	<b>Test Mode Indicate (EIA TM/CCITT CT142).</b> The -TM output indicates the modem is in test mode (low) or in any other mode (high).
-RI	OA	<b>Ring Indicator (EIA CE/CCITT CT125).</b> -RI output ON (low) indicates the presence of an ON segment of a ring signal on the telephone line.
-DRSOUT	OA	<b>Data Signaling Rate Indicator (EIA CV/CCITT CT112).</b> -DRSOUT is ON (low) when the modem desires or is engaged in the high speed (2400 bps or higher) mode. -DRSOUT is OFF (high) otherwise.
-DTR	IA	<b>Data Terminal Ready (EIA CD/CCITT CT108).</b> The -DTR input is turned ON (low) by the DTE when the DTE is ready to transmit or receive data. -DTR ON prepares the modem to be connected to the telephone line, and maintains the connection established by the DTE (manual answering) or internally (automatic answering). -DTR OFF places the modem in the disconnect state under control of the &Dn and &Qn commands.
-RTS	IA	<b>Request To Send (EIA CA/CCITT CT105).</b> -RTS input ON (low) indicates that the DTE is ready to accept data from the modem. In the command state, the modem ignores -RTS.  In asynchronous operation, the modem ignores -RTS unless RTS/CTS flow control is selected by the &Kn command.  In synchronous on-line operation, the modem can be commanded by the &Rn command to ignore -RTS or to respond to -RTS by turning on -CTS after the delay specified by Register S26.
-RDL	IA	<b>Remote Digital Loop Select (EIA RL/CCITT CT140).</b> -RDL input low activates remote digital loop request. The loop is executed at the speed for which the modem is currently configured.
-AL	IA	<b>Analog Loop (EIA LL/CCITT CT141).</b> -AL input low causes the modem to operate in the analog loop test mode.
-DRSIN	IA	<b>Data Signaling Rate Select (EIA CI/CCITT CT111).</b> This signal, relevant only in Central Europe, applies only to V.22 bis and V.22 modes. -DRSIN ON (low) will result in a 2400 bps connection. -DRSIN OFF (high) will force a 1200 bps connection, or will result in a fallback from 2400 bps to 1200 bps if already on-line.



Table 12. MCU Signal Definitions (Cont'd)

Label	I/O Type	Signal Name/Description
<b>TELEPHONE LINE INTERFACE</b>		
-RLY1	OA	<b>Relay 1 Control (~OH).</b> The active low -RLY1 output can be used to control the normally open off-hook relay. The -PULSE function can alternatively be provided on this line in addition to the -OH function for single -OH/~PULSE relay application.
-RLY2	OA	<b>Relay 2 Control (~PULSE).</b> The active low -RLY2 output can be used to control the normally open pulse dial relay. The -PULSE function can alternatively be provided on the -RLY1 line in addition to the -OH function for single -OH/~PULSE relay application.
-RLY3	OA	<b>Relay 3 Control (~A/A1, ~MUTE).</b> The active low -RLY3 output can be used to control the normally open key telephone hold indicator (A/A1) relay. In W-class, -RLY3 output can be used to control the normally open mute relay.
-RLY4	OA	<b>Relay 4 Control (~T/DRLY, ~EARTH).</b> The active low -RLY4 output can be used to control the normally closed talk/data relay. In W-class, -RLY4 output can be used to control the normally open earthing relay.
LCS	IA	<b>Loop Current Sense.</b> LCS is an active high input that indicates a handset off-hook status.
RINGD	IA	<b>Ring Frequency.</b> A high-going edge on the RINGD input initiates an internal ring frequency measurement. The RINGD input from an external ring detect circuit is monitored to determine when to wake up from sleep or stop mode. The RINGD input is typically connected to the output of an optoisolator or equivalent. The idle state (no ringing) output of the ring detect circuit should be low.
<b>STOP MODE CIRCUIT</b>		
-STPMODE	IA	<b>Stop Mode.</b> -STPMODE low causes the modem to enter the stop mode immediately after terminating a line connection if connected, terminating any test in process, and allowing any data in the receive buffer to clear. -STPMODE must be high before the modem can attain normal operation after power turn-on, reset, or wake-up from sleep or stop mode.

Table 13. MDP Signal Definitions

Label	I/O Type	Signal/Definition
<b>COMMON SIGNALS TO PARALLEL AND SERIAL INTERFACE VERSIONS</b>		
<b>OVERHEAD SIGNALS</b>		
XTLI, XTLO	I, O	<b>Crystal In and Crystal Out.</b> Connect to an external crystal circuit consisting of a 40.32 MHz crystal, three capacitors, and an inductor, or to a square wave generator/sine wave oscillator.
~RESET	IA	<b>Reset.</b> ~RESET low holds the modem in the reset state. ~RESET going high releases the modem from the reset state and initiates normal operation using power turn-on (default) values. ~RESET must be held low for at least 3 $\mu$ s. The modem is ready to use 400 ms after the low-to-high transition of ~RESET.
VDD	PWR	<b>+ 5V Digital Supply.</b> +5V $\pm$ 5%.
+5VA	PWR	<b>+ 5V Analog Supply.</b> +5V $\pm$ 5%.
DGND	GND	<b>Digital Ground.</b> Connect to ground.
AGND	GND	<b>Analog Ground.</b> Connect to ground.
VC	MI	<b>Centerpoint Voltage.</b> Connect to analog ground through 10 $\mu$ F (polarized, + terminal to VC) and 0.1 $\mu$ F (ceramic) in parallel.
VREF	MI	<b>Voltage Reference.</b> Connect to VC through 10 $\mu$ F (polarized, + terminal to VREF) and 0.1 $\mu$ F (ceramic) in parallel.
<b>MCU INTERFACE</b>		
D0–D7	IA/OB	<b>Data Lines.</b> Connect to the MCU D0–D7, respectively.
RS0–RS4	IA	<b>Register Select Lines.</b> Connect to the MCU A0–A4, respectively.
~CS	IA	<b>Chip Select.</b> Connect to MCU ~DPSEL output.
~READ	IA	<b>Read Enable.</b> Connect to MCU ~READ.
~WRITE	IA	<b>Write Enable.</b> Connect to MCU ~WRITE.
IRQ	OA	<b>Interrupt Request.</b> Connect to MCU DPIRQ.

Table 13. MDP Signal Definitions (Cont'd)

Label	VO Type	Signal Name/Description
<b>TELEPHONE LINE INTERFACE SIGNALS</b>		
TXA1, TXA2	O(DF)	<b>Transmit Analog 1 and 2.</b> The TXA1 and TXA2 outputs are differential outputs 180 degrees out of phase with each other. Each output can drive a 300 $\Omega$ load.
RIN	I(DA)	<b>Receive Analog.</b> RIN is a single-ended receive data input from the telephone line interface or an optional external hybrid circuit.
RINGD	IA	<b>Ring Detect.</b> The RINGD input is monitored for pulses in the range of 15 Hz to 68 Hz. The frequency detection range may be changed by the host in DSP RAM. The circuit driving RINGD should be a 4N35 optoisolator or equivalent. The circuit driving RINGD should not respond to momentary bursts of ringing less than 125 ms in duration, or less than 40 VRMS (15 Hz to 68 Hz) across TIP and RING. Detected ring signals are reflected on the $\bar{R}I$ output signal as well as the RI bit.
$\bar{R}LYA$ ( $\bar{O}HRC$ )	OD	<b>Relay A Control.</b> The MDP $\bar{R}LYA$ 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.  The $\bar{R}LYA$ output 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). $\bar{R}LYA$ is controlled by host setting/resetting of the RA bit.
$\bar{R}LYB$ ( $\bar{O}TALK$ )	OD	<b>Relay B Control.</b> The MDP $\bar{R}LYB$ output is connected to the normally open Voice relay (DPDT). In voice mode, $\bar{V}OICE$ 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 $\bar{R}LYB$ output 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). $\bar{R}LYB$ is controlled by host setting/resetting of the RB bit.
<b>SPEAKER INTERFACE</b>		
SPKR	O(DF)	<b>Speaker Analog Output.</b> 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.
<b>DIAGNOSTIC SIGNALS</b>		
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	<b>Serial Eye Pattern X/Y Output.</b> EYEXY is a serial output containing two 15-bit diagnostic words (EYEX and EYCY) for display on the oscilloscope X axis (EYEX) and Y axis (EYCY). EYEX is the first word clocked out; EYCY 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 $\bar{E}YECCLK$ . 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.
$\bar{E}YECCLK$	OA	<b>Serial Eye Pattern Clock.</b> $\bar{E}YECCLK$ is a 288 kHz output clock for use by the serial-to-parallel converters. The low-to-high transitions of $\bar{R}DCLK$ coincide with the low-to-high transitions of $\bar{E}YECCLK$ . $\bar{E}YECCLK$ , therefore, can be used as a receiver multiplexer clock.
EYESYNC	OA	<b>Serial Eye Pattern Strobe.</b> EYESYNC is a strobe for loading the D/A converters.

Table 13. MDP Signal Definitions (Cont'd)

Label	I/O Type	Signal Name/Description
<b>REFERENCE SIGNALS AND MODEM INTERCONNECT - 68-PIN PLCC</b>		
VC	MI	<b>Low Voltage Reference.</b> Connect to analog ground through 10 $\mu$ F (polarized, + terminal to VC) and 0.1 $\mu$ F (ceramic) in parallel.
VREF	MI	<b>High Voltage Reference.</b> Connect to VC through 10 $\mu$ F (polarized, + terminal to VREF) and 0.1 $\mu$ F (ceramic) in parallel.
~POR	MI	<b>Power-On-Reset.</b> Connect to ~RESET.
DSP_RESET	MI	<b>DSP Reset.</b> Connect to ~RES.
RES	MI	<b>Reset.</b> Connect to DSP_RESET.
DSP_IRQ	MI	<b>DSP Interrupt Request.</b> Connect to ~IRQ.
~IRQ	MI	<b>Interrupt Request.</b> Connect to DSP_IRQ.
IA_CLKIN	MI	<b>IA Clock.</b> Connect to CLKIN.
CLKIN	MI	<b>Clock.</b> Connect to IA_CLKIN.
RMODE	MI	<b>Receiver Mode.</b> Connect to TMODE.
TMODE	MI	<b>Transmitter Mode.</b> Connect to RMODE.
<b>REFERENCE SIGNALS AND MODEM INTERCONNECT - 100-PIN/80-PIN PQFP AND 128-PIN/100-PIN TQFP</b>		
MDP1: VC	MI	<b>Low Voltage Reference.</b> Connect to analog ground through 10 $\mu$ F (polarized, + terminal to VC) and 0.1 $\mu$ F (ceramic) in parallel.
MDP1: VREF	MI	<b>High Voltage Reference.</b> Connect to VC through 10 $\mu$ F (polarized, + terminal to VREF) and 0.1 $\mu$ F (ceramic) in parallel.
MDP1: ~POR	MI	<b>Power-On-Reset.</b> Connect to MDP1: ~RESET.
MDP1: MD2-RESET	MI	<b>DSP Reset.</b> Connect to MDP2: RESETP.
MDP1: MD2-IRQ	MI	<b>Interrupt Request.</b> Connect to MDP2: ~IRQ.
MDP1: CLKIN	MI	<b>IA Clock.</b> Connect to MDP1: CLKOUT.
MDP1: SLEEP1	MI	<b>Sleep.</b> Connect to MDP1: SLEEPO.
MDP1: AD0 - AD7	MI	<b>Data Lines.</b> Connect to MDP2: D0 - D7, respectively.
MDP1: AA0 - AA4	MI	<b>Address Lines.</b> Connect to MDP2: RS0 - RS4, respectively.
MDP1: XCLK	MI	<b>X Clock.</b> Connect to MDP2: XCLK.
MDP1: YCLK	MI	<b>Y Clock.</b> Connect to MDP2: YCLK.
MDP1: RDP	MI	<b>Read.</b> Connect to MDP2: READP.
MDP1: WTP	MI	<b>Write.</b> Connect to MDP2: WRITEP.
MDP1: ES3	MI	<b>Chip Select.</b> Connect to MDP2: CSP.
MDP1: RMODE	MI	<b>Receiver Mode.</b> Connect to MDP2: SR1IO.
MDP1: TMODE	MI	<b>Transmitter Mode.</b> Connect to MDP2: SR1IO.
MDP1: TXDAT	MI	<b>Transmit Data.</b> Connect to MDP2: SR4OUT.
MDP1: RXOUT	MI	<b>Receive Data.</b> Connect to MDP2: SR3IN.
MDP1: TIRO2	MI	<b>Transmitter Data.</b> Connect to MDP2: TIRO2.
MDP1: TRESET	MI	<b>Transmitter Reset.</b> Connect to MDP2: SA1CLK.
MDP1: TSTROBE	MI	<b>Transmitter Strobe.</b> Connect to MDP2: IA1CLK.
MDP2: GP0	MI	<b>Eye Sync.</b> Connect to MDP2: EYESYNC.
MDP2: XTALI	MI	<b>Crystal.</b> Connect to ground.
MDP2: GP16-GP18	MI	<b>Not Used.</b> Connect to ground.

Table 13. MDP Signal Definitions (Cont'd)

Label	I/O Type	Signal Name/Description
<b>SERIAL INTERFACE VERSION</b>		
<b>DTE SERIAL/CONTROL/INDICATOR SIGNALS</b>		
TXD	IA	<b>Transmitted Data.</b> The MDP obtains serial data to be transmitted from the DTE on the TXD input.
RXD	OA	<b>Received Data.</b> The MDP presents received serial data to the DTE on the RXD output. RXD is also connected to the MCU -DPRXD input.
TDCLK	OA	<b>Transmit Data Clock.</b> The modem outputs a synchronous Transmit Data Clock (TDCLK) for USRT timing. The TDCLK frequency is the data rate ( $\pm 0.01\%$ ) with a duty cycle of $50 \pm 1\%$ .
XTCLK	IA	<b>External Transmit Clock.</b> In synchronous communication, an external transmit data clock can be connected to the MDP XTCLK input. The clock supplied at XTCLK must exhibit the same characteristics as TDCLK.
-RLSD	OA	<b>Received Line Signal Detector.</b> -RLSD active indicates that energy above the receive level threshold is present on the receiver input, and that the energy is not a training sequence.
-RDCLK	OA	<b>Receive Data Clock.</b> The modem outputs a synchronous Receive Data Clock (-RDCLK) for USRT timing.
-RTS	IA	<b>Request to Send.</b> Not used; pull up to VCC through 10k $\Omega$ .
-DTR	IA	<b>Data Terminal Ready.</b> Not used; pull up to VCC through 10k $\Omega$ .
-CTS	OA	<b>Clear to Send.</b> Not used; leave open.
-DSR	OA	<b>Data Set Ready.</b> Not used; leave open.
<b>PARALLEL INTERFACE VERSION</b>		
<b>DTE SERIAL/CONTROL/INDICATOR SIGNALS</b>		
TXD	IA	<b>Transmitted Data.</b> Not used; pull up to VCC through 10k $\Omega$ .
RXD	OA	<b>Received Data.</b> Not used; leave open.
TDCLK	OA	<b>Transmit Data Clock.</b> Not used; leave open.
XTCLK	IA	<b>External Transmit Clock.</b> Not used; leave open.
-RDCLK	OA	<b>Receive Data Clock.</b> Not used; leave open.
-RLSD	OA	<b>Received Line Signal Detector.</b> Not used; leave open.
-RTS	IA	<b>Request to Send.</b> Not used; pull up to VCC through 10k $\Omega$ .
-DTR	IA	<b>Data Terminal Ready.</b> Not used; pull up to VCC through 10k $\Omega$ .
-CTS	OA	<b>Clear to Send.</b> Not used; leave open.
-DSR	OA	<b>Data Set Ready.</b> Not used; leave open.

Table 14. CEP Signal Definitions

Label	IO Type	Signal Name/Description
<b>CEP SYSTEM</b>		
XTLI, XTLO	IE, OE	<b>CEP Crystal/Clock In and Crystal Out.</b> Connects to an external crystal circuit consisting of a 14.7456 MHz crystal and a capacitance network. The CEP XTLI input can be connected to the MCU XTLO output.
-RES	IC	<b>CEP Reset.</b> The active low -RES input resets the CEP logic. For serial Interface, the -RES input is typically connected to MDP -POR, and/or a reset switch. For parallel Interface, the -RES input is typically connected to the host bus RESET line through an inverter.
VCC1, VCC2	PWR	<b>+ 5V Digital Supply.</b> +5V ± 5%.
<b>CEP MEMORY BUS (CMB) BUS INTERFACE</b>		
SD0-SD7	IA/OB	<b>Data Lines.</b> Connect the RAM D0-D7 lines to the to the SD0-SD7 lines, respectively.
SA0-SA14	OA	<b>Address Lines.</b> Connect the RAM A0-A14 lines to the to the SA0-SA14 lines, respectively.
-SRAMSEL	OA	<b>RAM Chip Select.</b> Connect the RAM -CS input to the -SRAMSEL line.
-SROMSEL	OA	<b>ROM Chip Select.</b> Not used; NC.
-SRD	OA	<b>Read Enable.</b> Connect the RAM -RD input to the -SRD line.
-SWT	OA	<b>Write Enable.</b> Connect the RAM -WT input to the -SWT line.
<b>MCU EXTERNAL BUS INTERFACE</b>		
MCU: D0-D7	IA/OB	<b>MCU Bus Data Lines.</b> Connect to the MCU D0-D7, respectively.
MCU: A0-A3	IA	<b>MCU Bus Address Lines.</b> Connect to the MCU A0-A3, respectively.
MCU: -CEPSEL	IA	<b>MCU Bus CEP Chip Select.</b> Connect to MCU -CEPSEL (-ES0SEL) output.
MCU: -RD	IA	<b>MCU Bus Read Enable.</b> Connect to MCU -READ.
MCU: -WT	IA	<b>MCU Bus Write Enable.</b> Connect to MCU -WRITE.

Table 15. Digital Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions <sup>1</sup>
Input High Voltage	$V_{IH}$				VDC	
Type IA		2.0	-	$V_{CC}$		
Type IC		$0.7 V_{CC}$	-	$V_{CC} + 0.3$		
Type IE		-	4.0	-		Note 2.
Input Low Voltage	$V_{IL}$				VDC	
Type IA and 1C		-0.3		0.8		
Type IE		-	1.0	-		Note 2.
Input Leakage Current	$I_{IN}$				$\mu$ ADC	$V_{IN} = 0$ to $V_{CC}$
-RES and PD0-PD7		-	-	$\pm 2.5$		
XTLI		-	-	$\pm 10$		
-NMI and -TST		-	-	$\pm 100$		
Output High Voltage	$V_{OH}$	2.4	-	-	VDC	
Type OA and OB		-	-	$V_{CC}$		$I_{LOAD} = -100 \mu A$
Type OD						$I_{LOAD} = 0$ 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	$I_{TSI}$			$\pm 10$	$\mu$ ADC	$V_{IN} = 0$ V to $V_{CC}$
<b>Notes:</b>						
1. Test Conditions: $V_{CC} = \pm 5\%$ , $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$ , (unless otherwise stated). Output loads: Data bus (D0-D7), address bus (A0-A15), chip selects, -READ, and -WRITE loads = 70 pF + one TTL load. Other = 50 pF + one TTL load.						
2. Type IE inputs are centered approximately 2.5 V and swing 1.5 V <sub>PEAK</sub> in each direction.						
3. Type OE outputs provide oscillator feedback when operating with an external crystal.						

Table 16. Analog Electrical Characteristics

Name	Type	Characteristic	Value
RIN	I (DA)	Input Impedance	> 70K $\Omega$
		AC Input Voltage Range	1.1 VP-P**
		Reference Voltage	+2.5 VDC
TXA1, TXA2	O (DD)	Minimum Load	300 $\Omega$
		Maximum Capacitive Load	0 $\mu$ F
		Output Impedance	10 $\Omega$
		AC Output Voltage Range	2.2 VP-P
		Reference Voltage	+2.5 VDC
		DC Offset Voltage	$\pm 200$ mV
SPKR	O (DF)	Minimum Load	300 $\Omega$
		Maximum Capacitive Load	0.01 $\mu$ F
		Output Impedance	10 $\Omega$
		AC Output Voltage Range	1.1 VP-P
		Reference Voltage	+2.5 VDC
		DC Offset Voltage	$\pm 20$ mV
* Reference Voltage provided internal to the modem data pump.			
** Corresponds to 2.2 VP-P at Tip and Ring			

Table 17. Current and Power Requirements

Mode	Current (ID)			Power (PD)			Notes
	Typical Current @ 25°C (mA)	Maximum Current @ 0°C (mA)	Maximum Current @ -40°C <sup>1</sup> (mA)	Typical Power @ 25°C (mW)	Maximum Power @ 0°C (mW)	Maximum Power @ -40°C <sup>1</sup> (mW)	
<b>RC288ACi without CEP</b>							
MCU (L39)							$f_{IN} = 14.7456 \text{ MHz}$
Normal mode	34	41	51	170	214	268	
Sleep mode	2.20	2.70	2.80	11.00	14.20	14.70	
Stop mode	0.15	0.20	0.20	0.80	1.10	1.10	
MDP							$f_{IN} = 40.32 \text{ MHz}$
Normal mode	196	255	315	980	1340	1655	
Sleep mode	40	52	64	200	273	336	
Total							
Normal mode	230	296	366	1150	1554	1923	
Sleep mode	42.20	54.70	66.80	211.00	287.20	350.70	
Stop mode	40.15	52.20	64.20	200.80	274.10	337.10	
<b>RC288ACi with CEP</b>							
MCU (L39)							$f_{IN} = 12.9024 \text{ MHz}$
Normal mode	32	39	44	160	200	230	
Sleep mode	2.20	2.70	2.80	11.00	14.20	14.70	
Stop mode	0.15	0.20	0.20	0.80	1.10	1.10	
CEP							$f_{IN} = 14.7456 \text{ MHz}$
Normal mode	34	41	51	170	214	268	
Sleep mode	2.20	2.70	2.80	11.00	14.20	14.70	
Stop mode	0.15	0.20	0.20	0.80	1.10	1.10	
MDP							$f_{IN} = 40.32 \text{ MHz}$
Normal mode	196	255	315	980	1340	1655	
Sleep mode	40	52	64	200	273	336	
Total							
Normal mode	262	335	410	1310	1754	2153	
Sleep mode	44.40	57.40	69.60	222.00	301.40	365.40	
Stop mode	40.30	52.40	64.40	201.60	275.20	338.20	
<b>RC288ACL</b>							
MCU (L39)							$f_{IN} = 14.7456 \text{ MHz}$
Normal mode	34	41	51	170	214	268	
Sleep mode	2.20	2.70	2.80	11.00	14.20	14.70	
Stop mode	0.15	0.20	0.20	0.80	1.10	1.10	
MDP							$f_{IN} = 40.32 \text{ MHz}$
Normal mode	124	161	198	620	845	1040	
Sleep mode	1.80	2.30	2.90	9.00	12.30	15.10	
Total							
Normal mode	158	202	249	790	1059	1308	
Sleep mode	4.00	5.00	5.70	20.00	26.50	29.80	
Stop mode	1.95	2.50	3.10	9.00	13.40	16.20	
<b>Notes:</b>							
1. Maximum power @ -40°C specified only for extended temperature range parts.							
2. Test conditions: VCC = 5.0 VDC for typical values; VCC = 5.25 VDC for maximum values.							



Table 18. 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
Operating Temperature Range	$T_A$		°C
Commercial		-0 to +70	
Extended		-40 to +85	
Storage Temperature Range	$T_{STG}$	-55 to +125	°C
Analog Inputs	$V_{IN}$	-0.3 to (+5VA + 0.3)	V
Voltage Applied to Outputs in High Impedance (Off) State	$V_{HZ}$	-0.5 to (+5VD + 0.5)	V
DC Input Clamp Current	$I_{IK}$	±20	
DC Output Clamp Current	$I_{OK}$	±20	
Static Discharge Voltage (25°C)	$V_{ESD}$	±2500	V
Latch-up Current (25°C)	$I_{TRIG}$	±200	

Table 19. Parallel Interface Registers

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

## SCHEMATICS

Typical interface schematics for the MCU with parallel host interface and with serial DTE interface are shown in Figures 11 and 12, respectively.

Typical interface schematics for the CEP are shown in Figure 13.

Typical interface schematics for the MDP are shown in Figure 14.

A schematic for a typical line interface circuit is shown in Figure 15.

Figure 16 is a schematic of a typical external hybrid circuit.

A schematic for a typical speaker circuit connected to the MDP SPKR output is shown in Figure 17.

Consult the AccelerATor Kits for full schematics of typical applications.

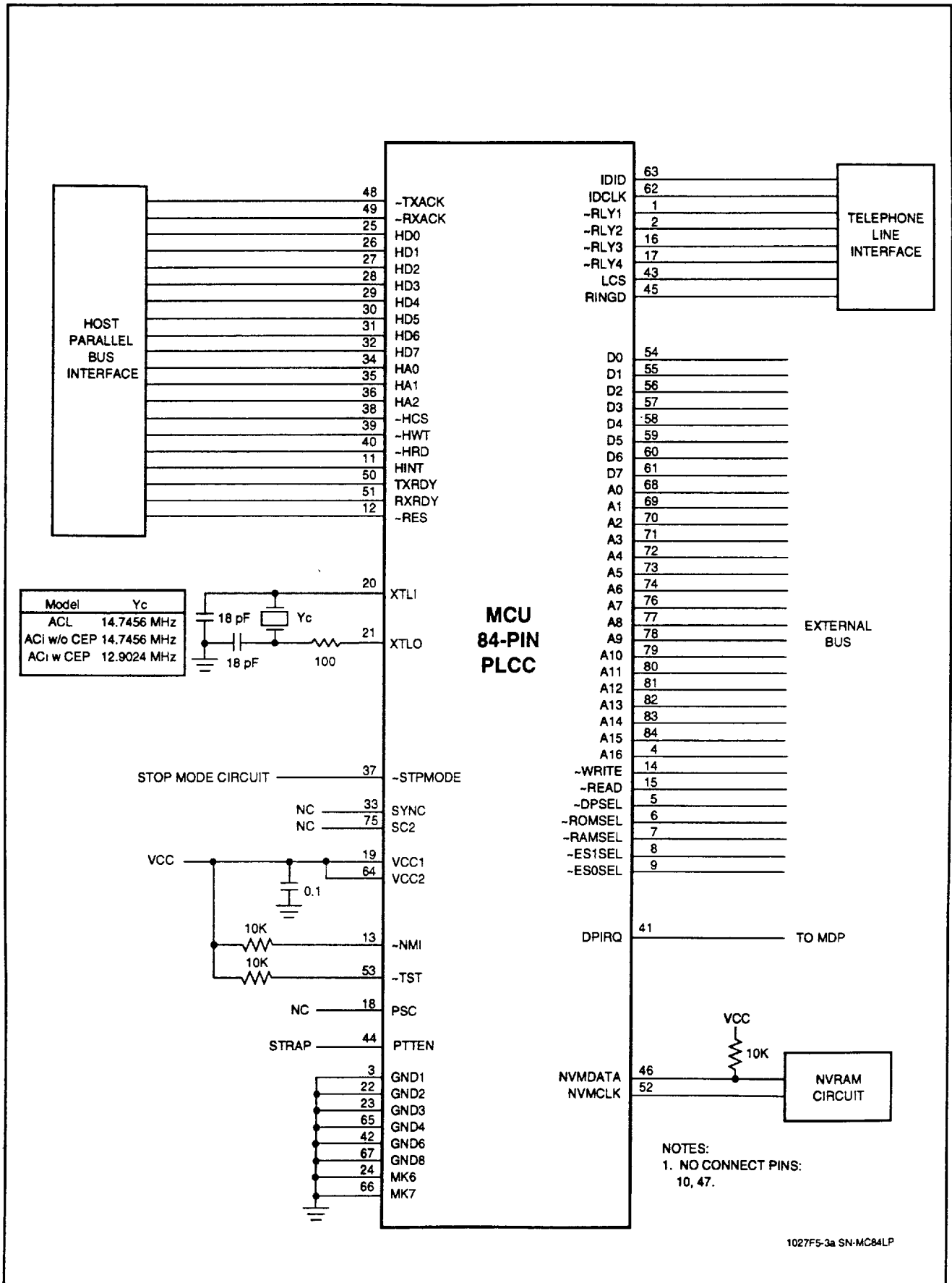
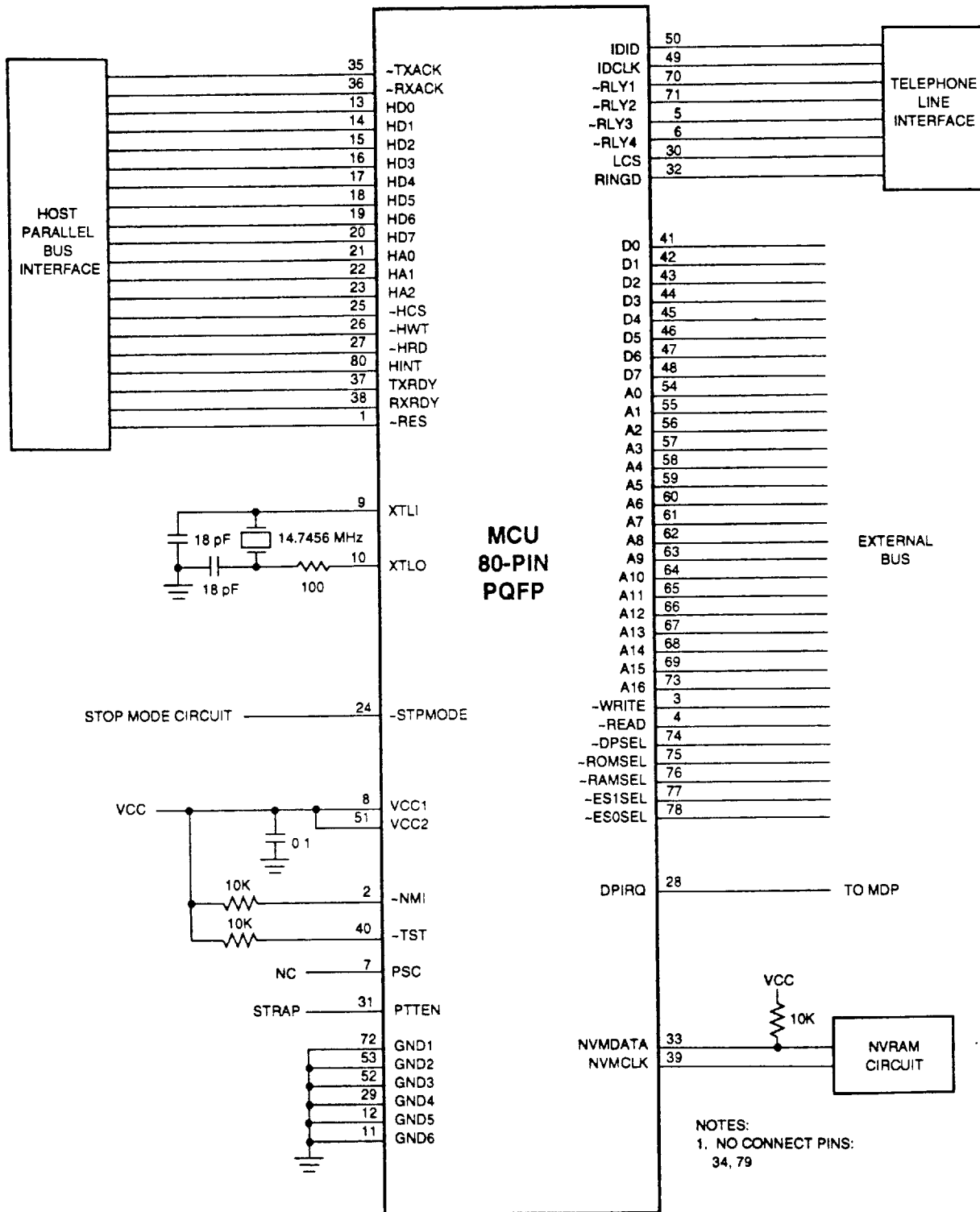


Figure 11a. Interface Schematic - MCU with Parallel Host Interface - 84-Pin PLCC



1027F5-3b SN-MC80FP

Figure 11b. Interface Schematic - MCU with Parallel Host Interface - 80-Pin PQFP

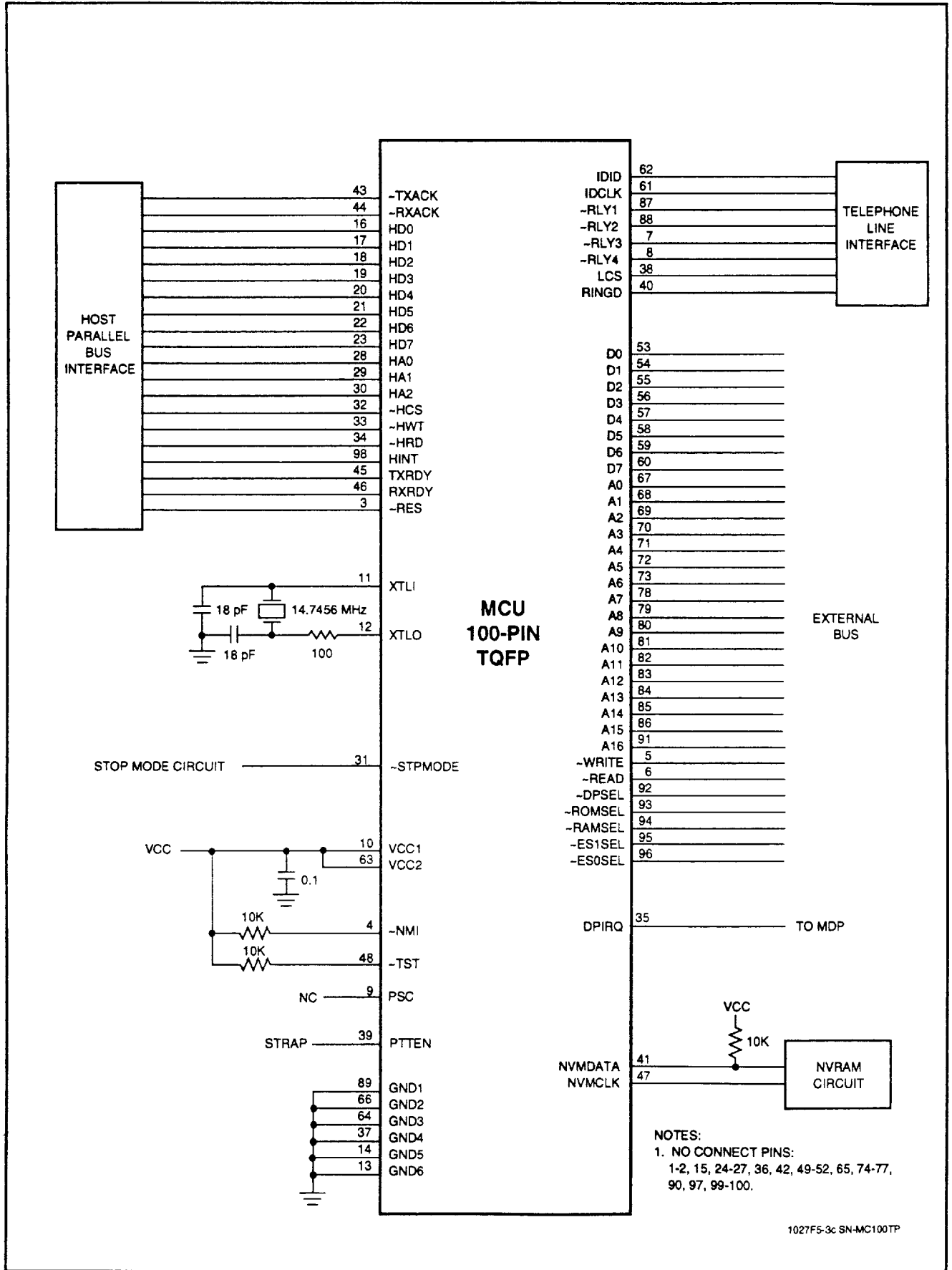


Figure 11c. Interface Schematic - MCU with Parallel Host Interface - 100-Pin TQFP

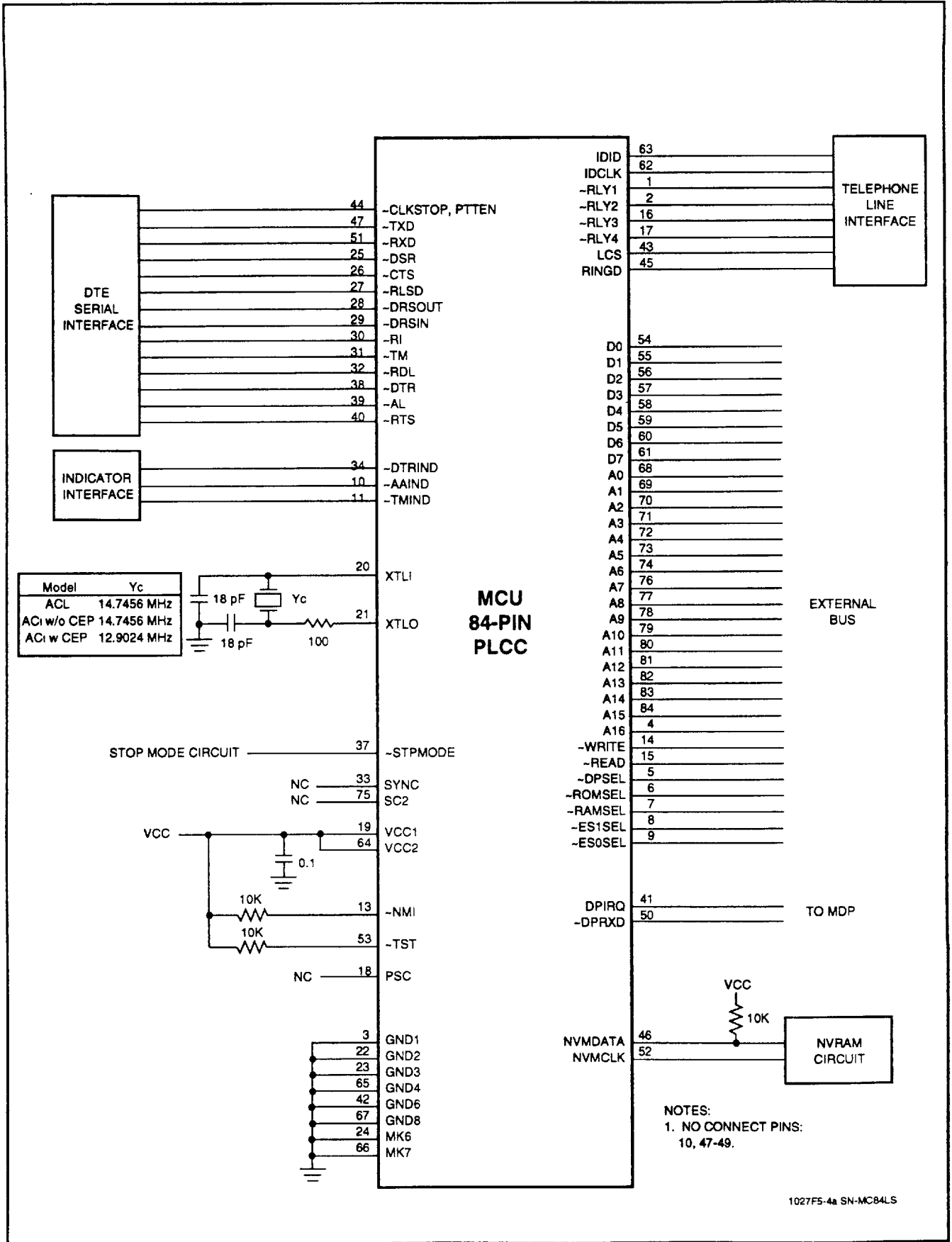


Figure 12a. Interface Schematic - MCU with Serial DTE Interface - 84-Pin PLCC

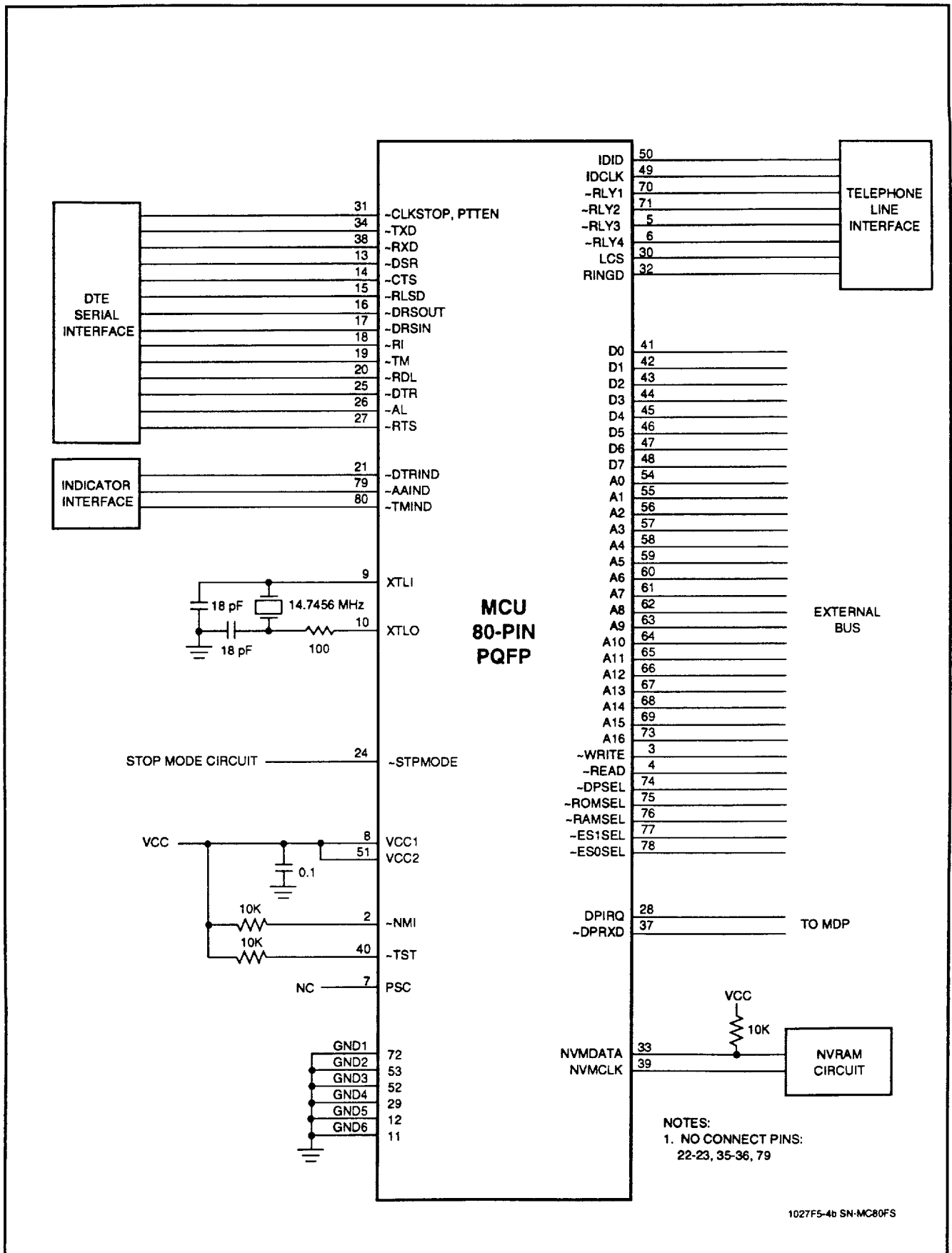


Figure 12b. Interface Schematic - MCU with Serial DTE Interface - 80-Pin PQFP



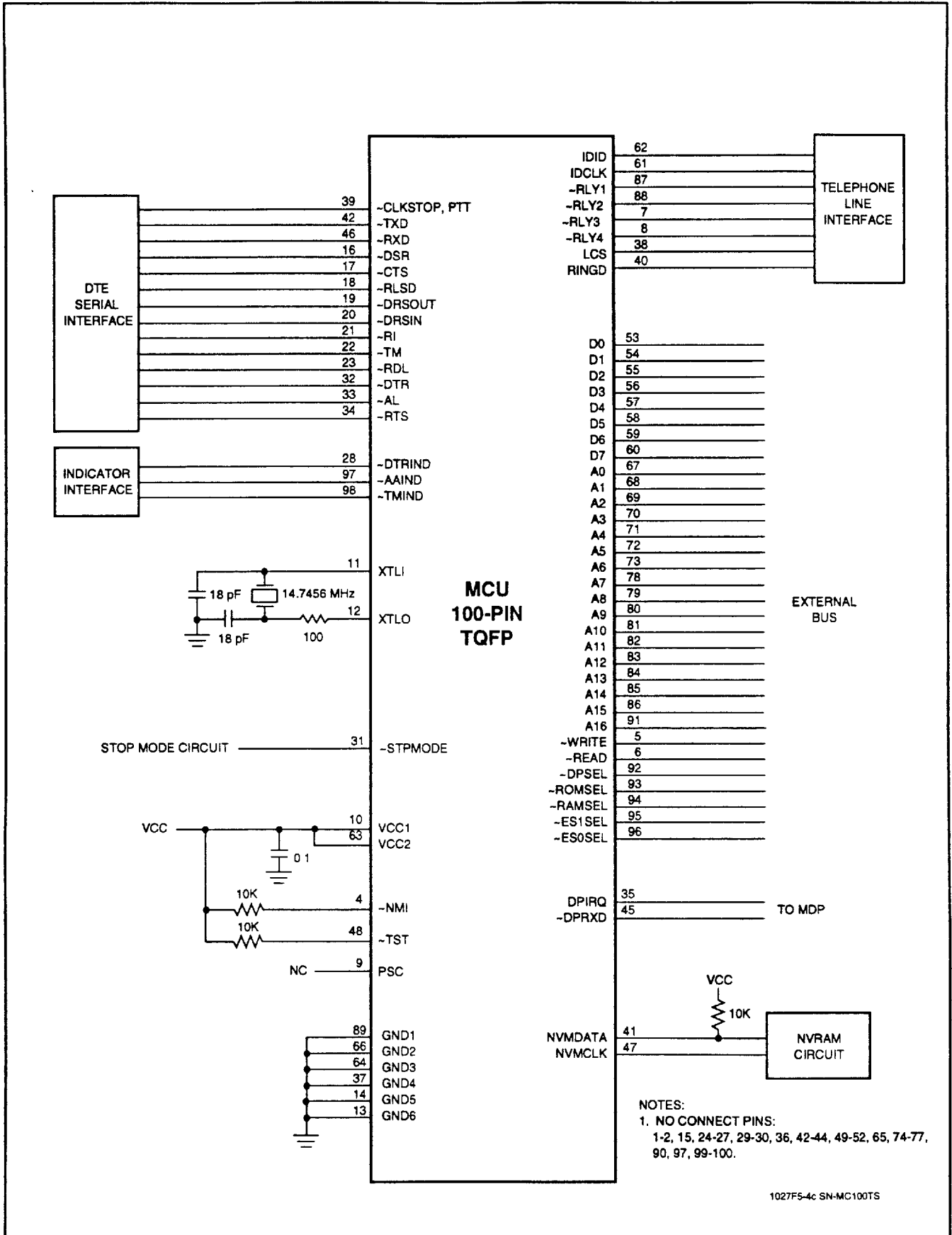


Figure 12c. Interface Schematic - MCU with Serial DTE Interface - 100-Pin TQFP

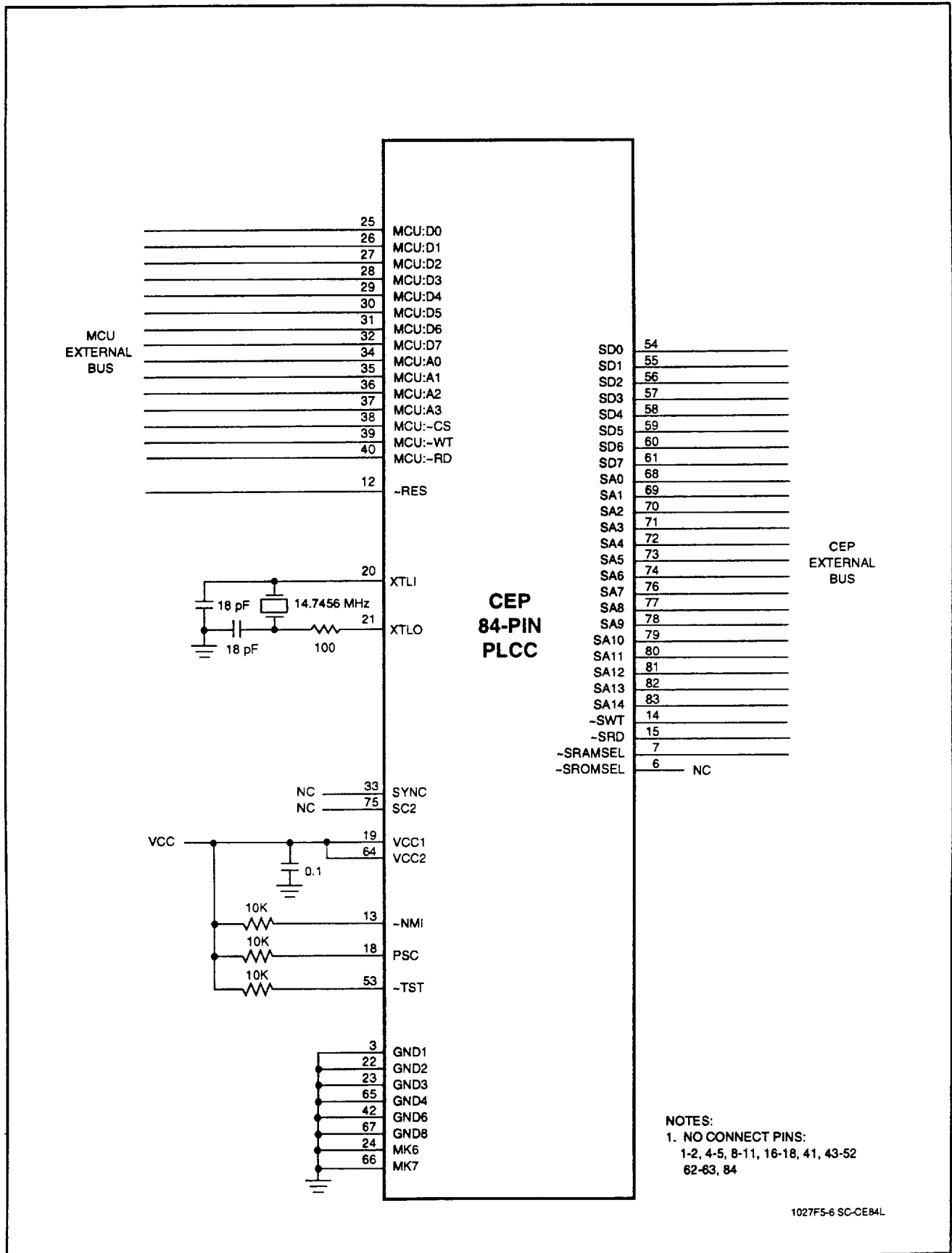
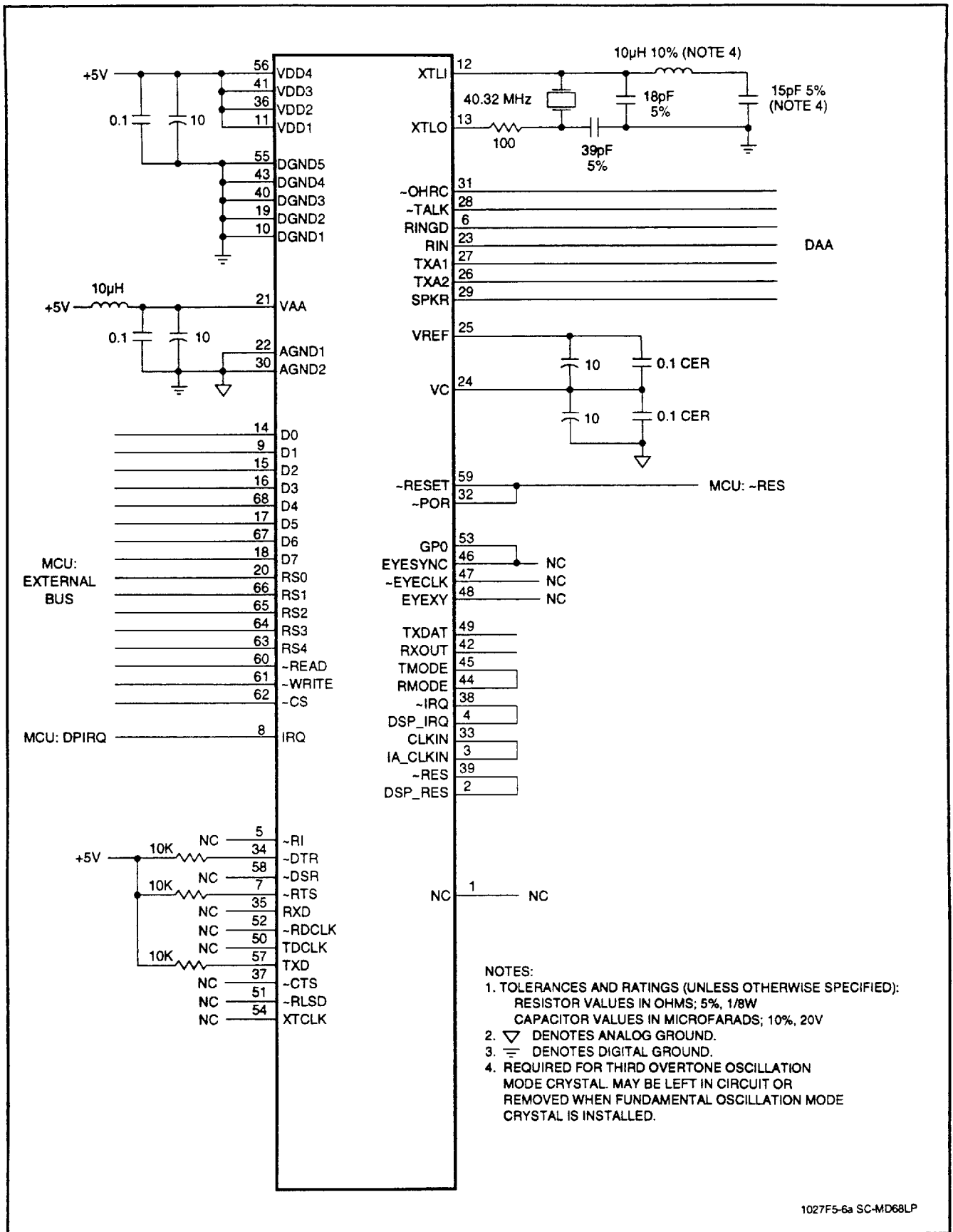


Figure 13. Interface Schematic - CEP - 68-Pin PLCC



1027F5-6a SC-MD68LP

Figure 14a. Interface Schematic - MDP with Parallel Host Interface - 68-Pin PLCC

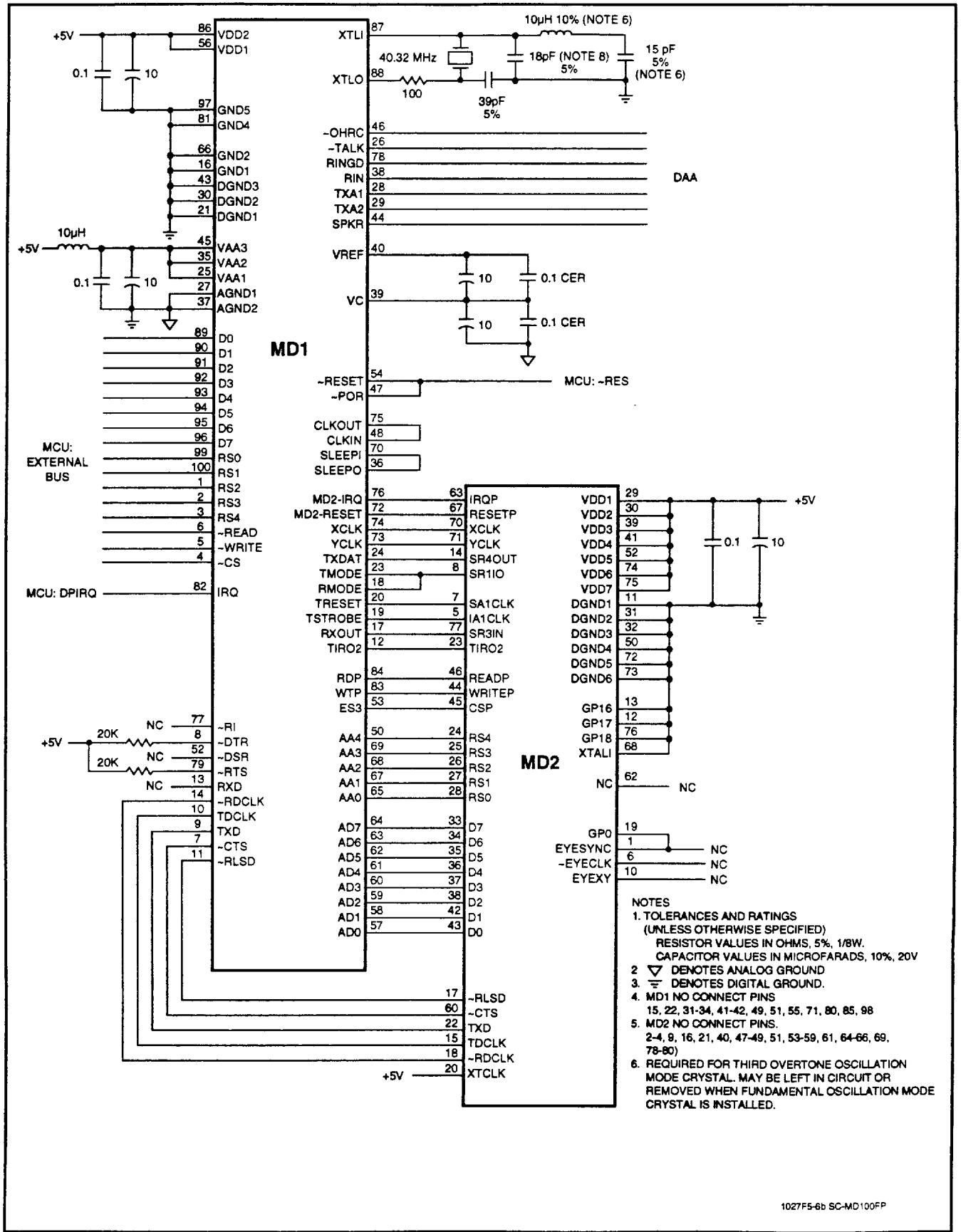
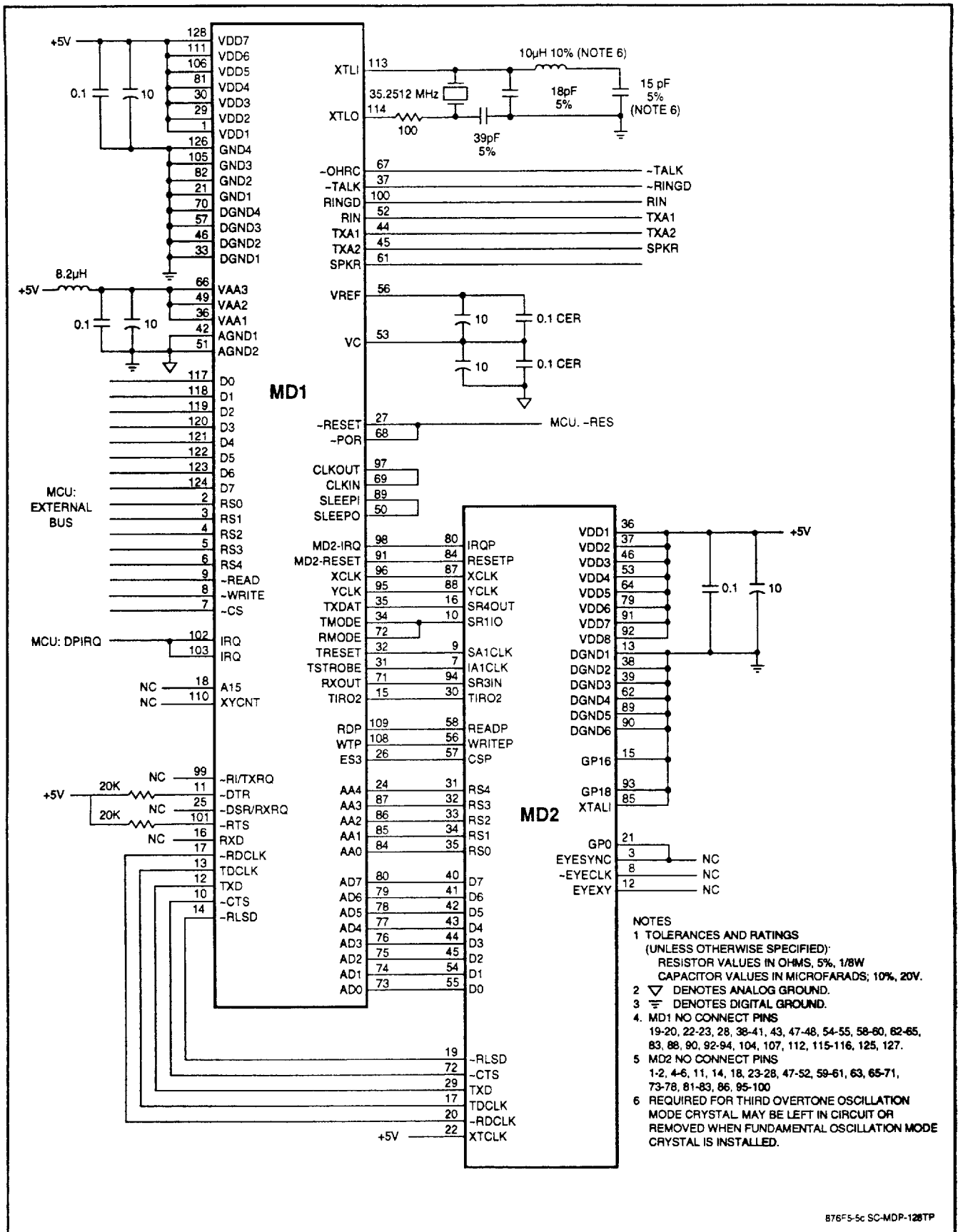


Figure 14b. Interface Schematic - MDP with Parallel Host Interface - 100-Pin PQFP and 80-Pin PQFP



B76F5-5c SC-MDP-128TP

Figure 14c. Interface Schematic - MDP with Parallel Host Interface - 128-Pin TQFP and 100-Pin TQFP

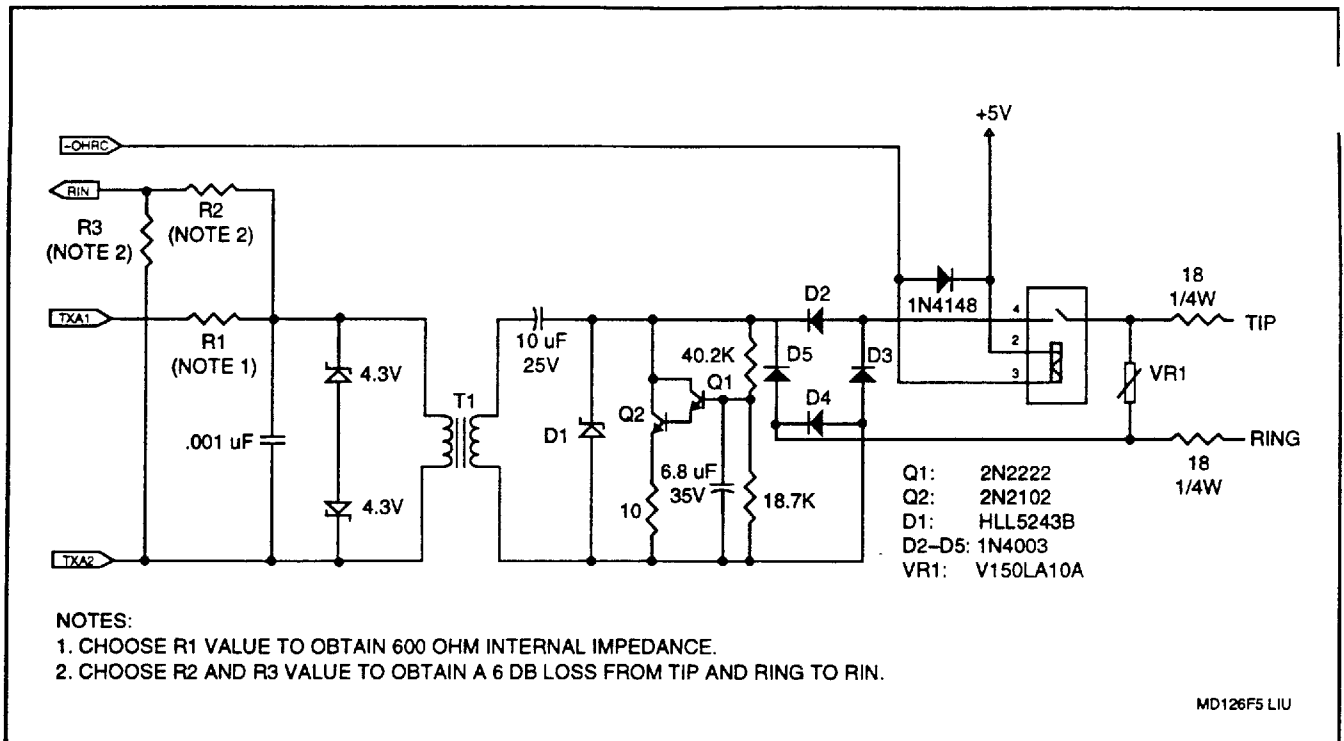


Figure 15. Typical Line Interface

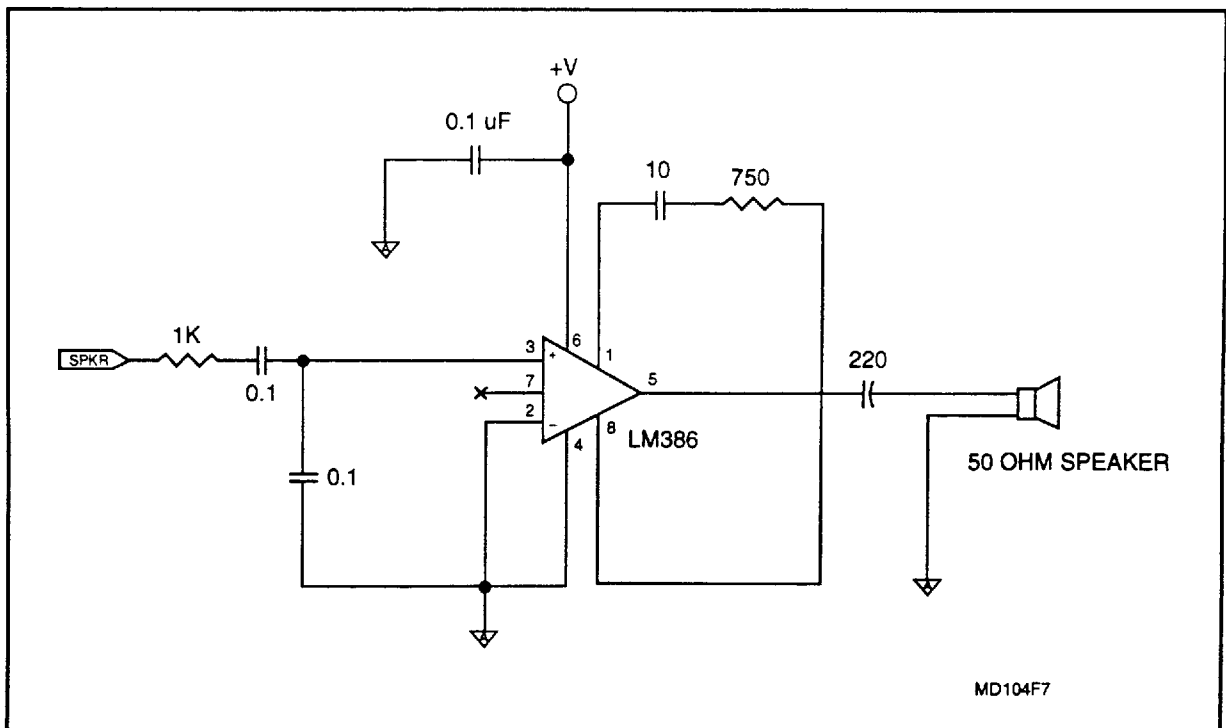


Figure 16. Typical Interface to External Hybrid

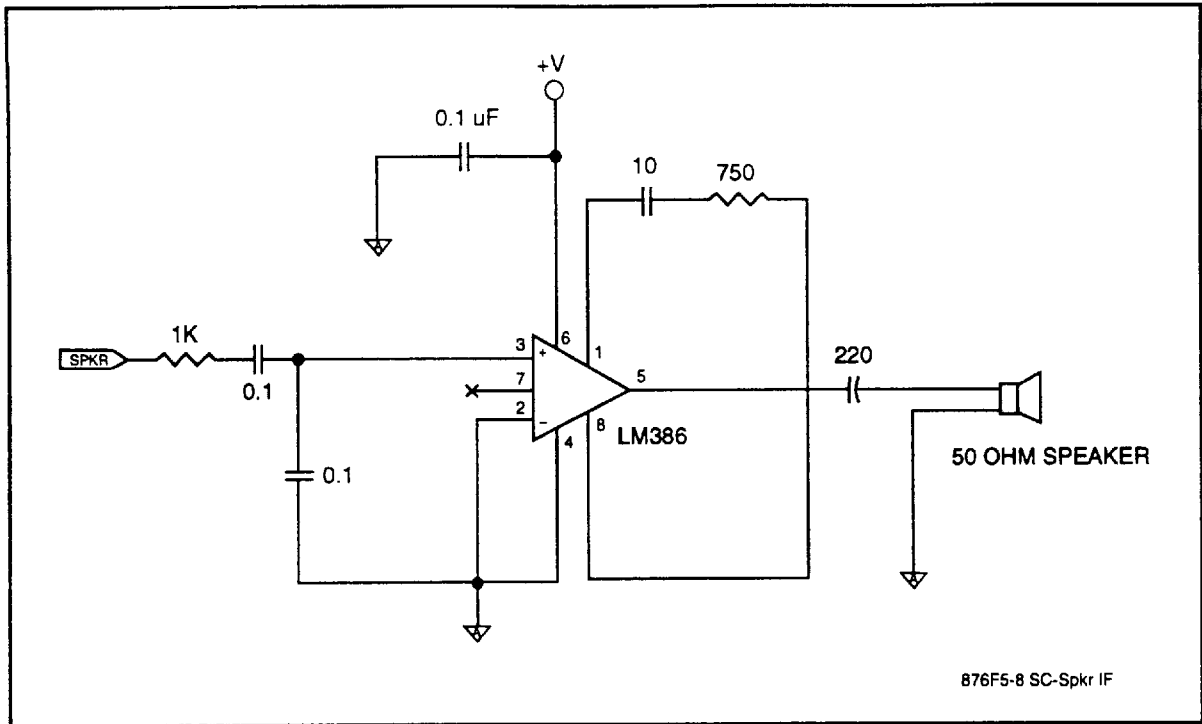


Figure 17. Typical External Speaker Circuit

**PACKAGE DIMENSIONS**

The package dimensions are shown in Figure 18.

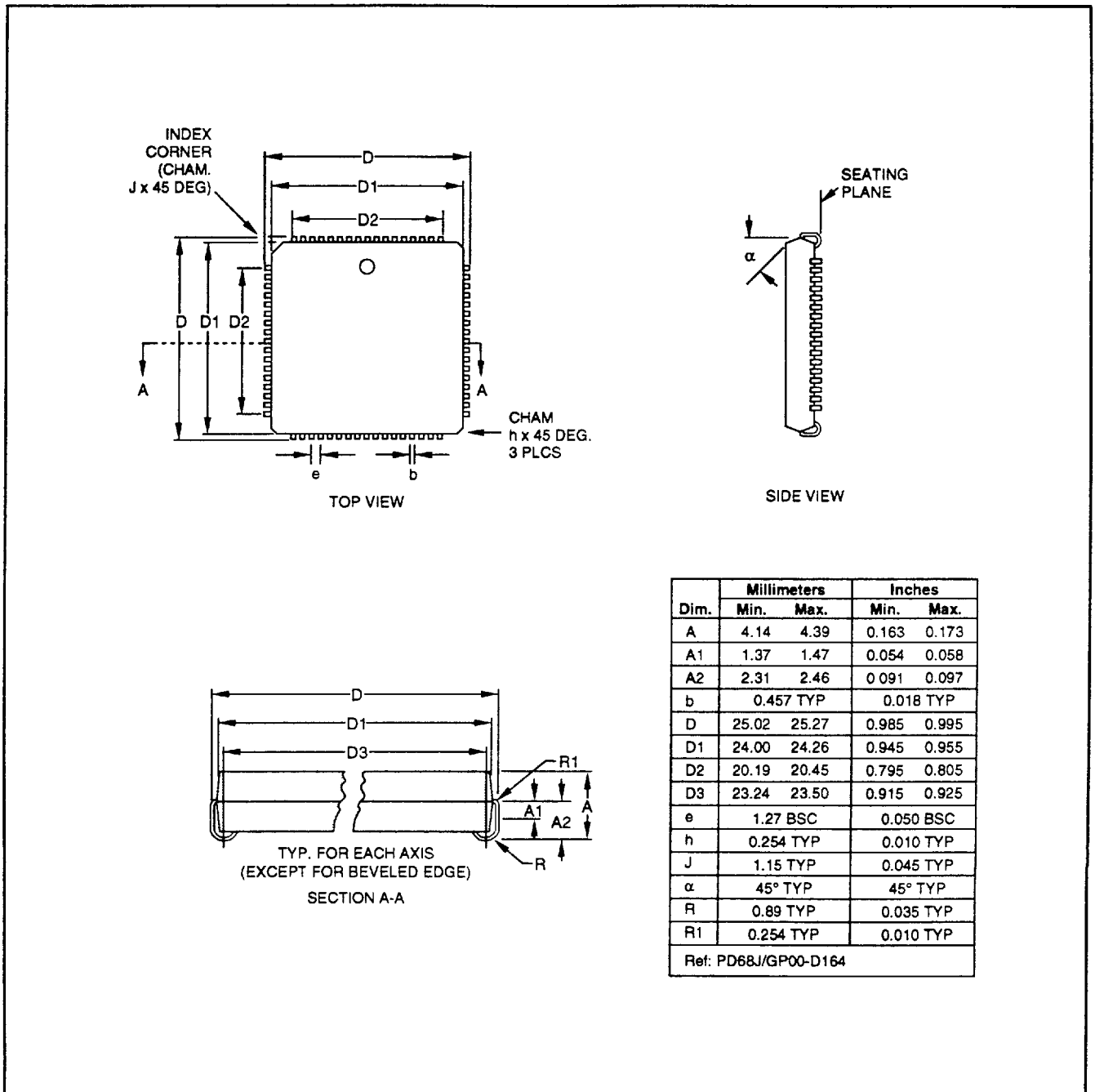


Figure 18a. Package Dimensions - 68-Pin PLCC



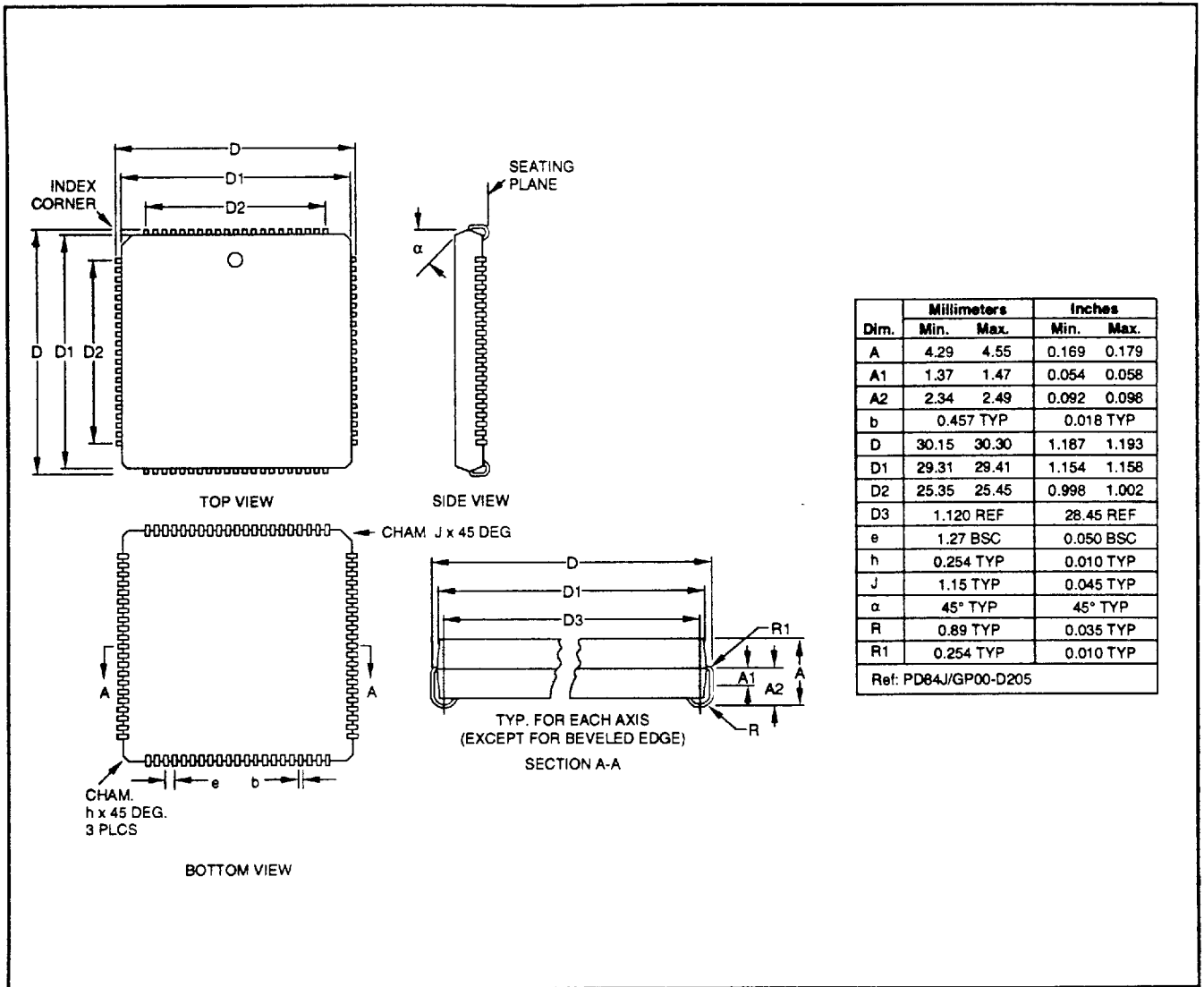


Figure 18b. Package Dimensions - 84-Pin PLCC

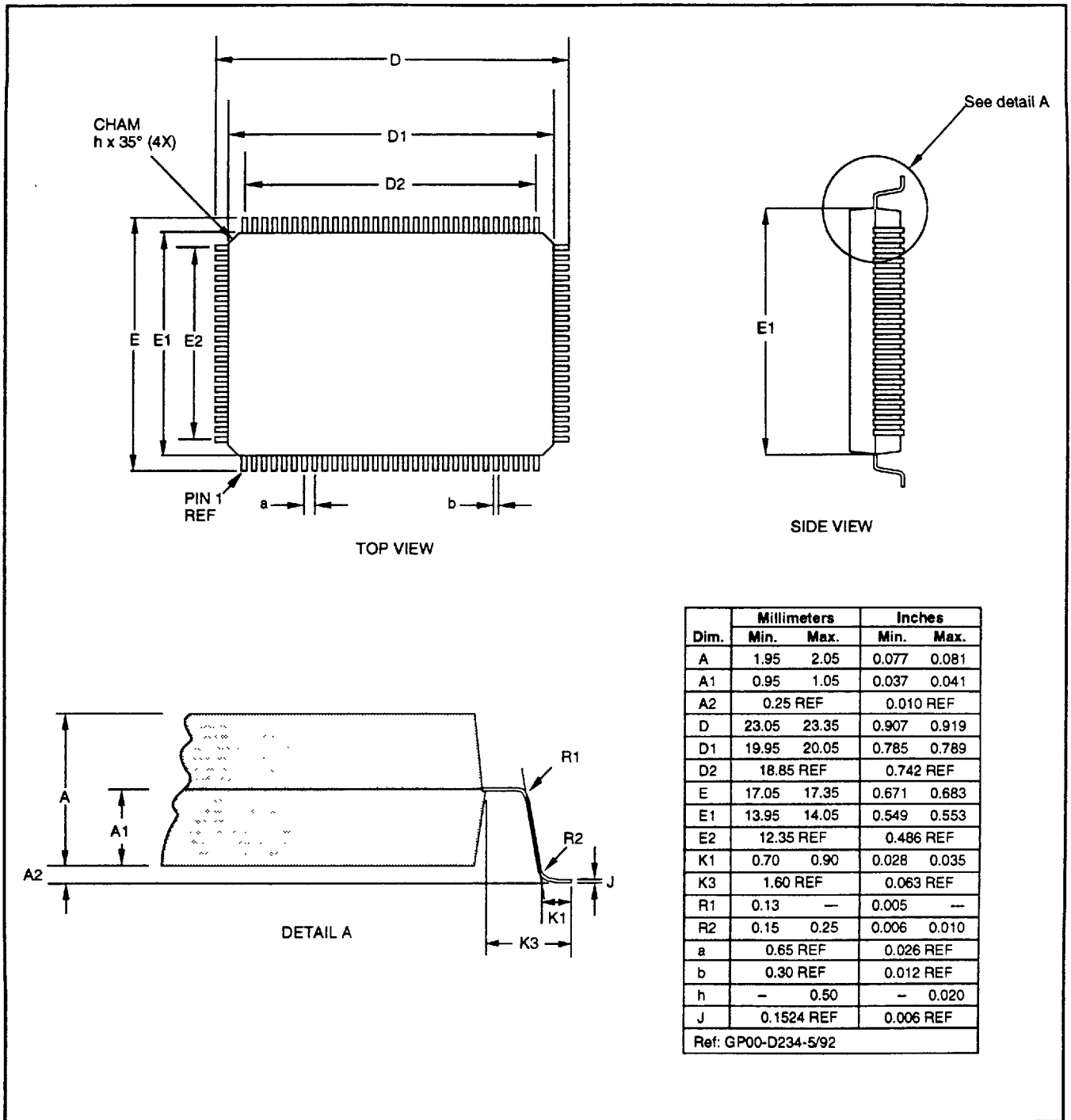


Figure 18c. Package Dimensions - 100-Pin PQFP

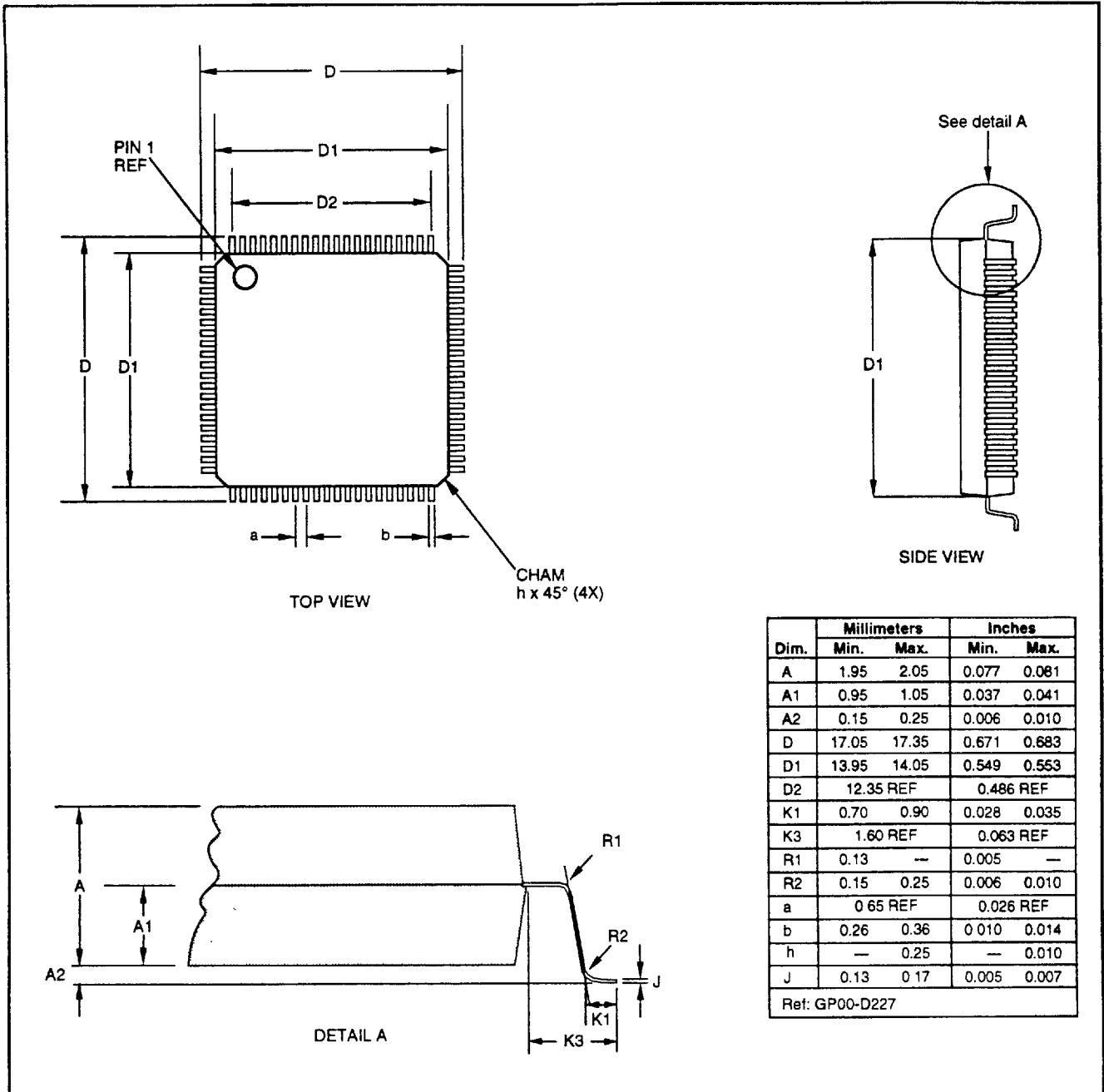


Figure 18d. Package Dimensions - 80-Pin PQFP

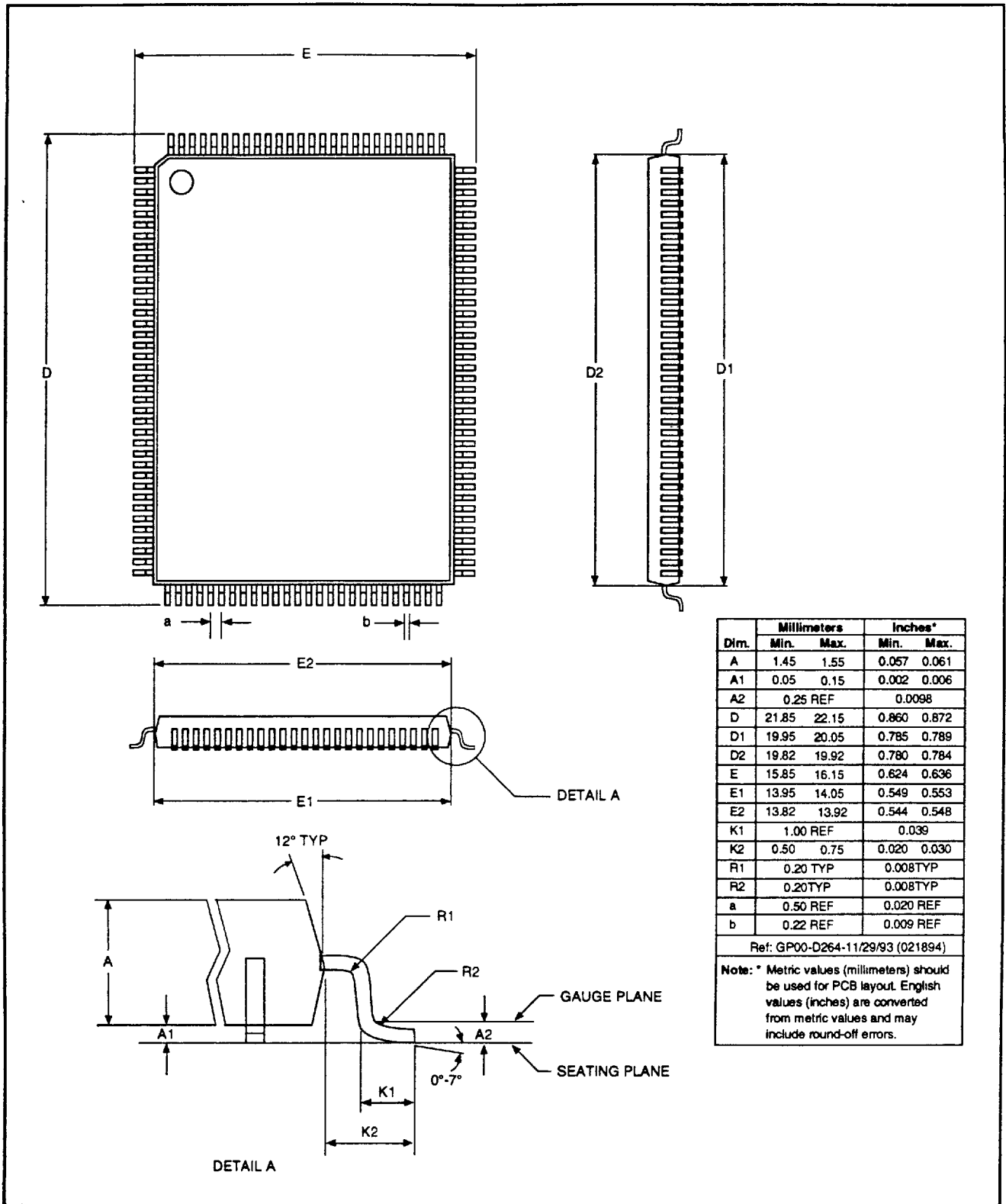


Figure 18e. Package Dimensions - 128-Pin TQFP

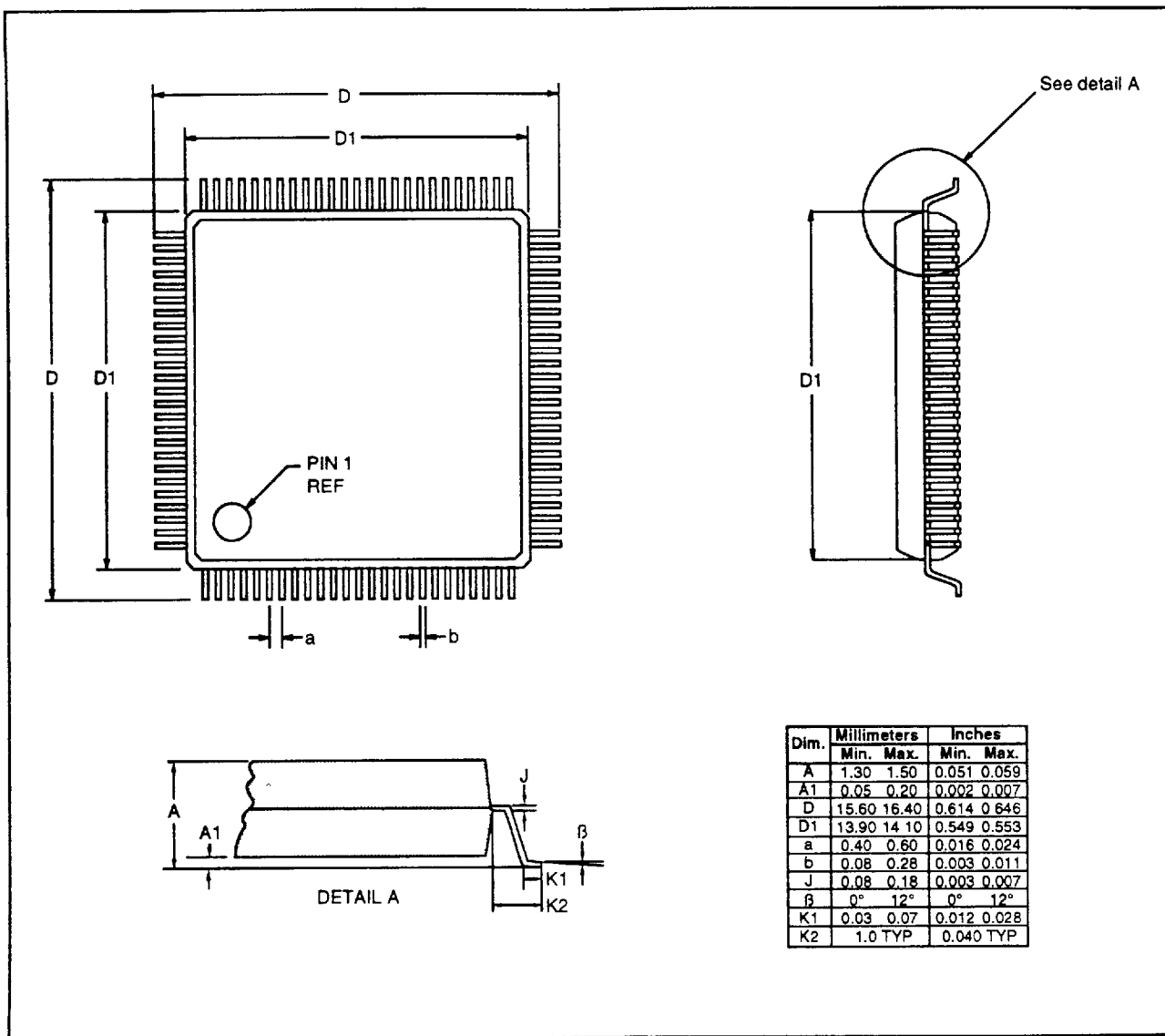


Figure 18f. Package Dimensions - 100-Pin TQFP