2. TECHNICAL SPECIFICATIONS

2.1 PARALLEL HOST BUS INTERFACE OPERATION

Command Mode and Data Modem Mode. The modem can operate at rates up to 57600 bps (RC144) or 115200 (RC288) by programming the Divisor Latch in the parallel interface registers.

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

2.2 ESTABLISHING DATA MODEM CONNECTIONS

Telephone Number Directory

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

Dialing

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

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

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

Modem Handshaking Protocol

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

Call Progress Tone Detection

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

Answer Tone Detection

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

Ring Detection

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

Billing Protection

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

Connection Speeds

The modem functions as a data modem when the +FCLASS=0 or #CLS=0 command is active.

Line connection can be selected using the +MS command in accordance with the draft PN-3320 standard presented to the TR30-4 committee (which is a candidate for the definition of V.25 ter at the ITU). The +MS command selects modulation, enables/disables automode, and selects minimum and maximum line speeds (Table 2-1).

ATNn and S37=n commands are supported up to V.32 bis speeds (Table 2-1).

For RC144 models, the F command is also supported (Table 2-2).

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 (Table 2-1).

Alternatively, N1 commands allow the modem to connect to a remote modem in accordance with EIA/TIA-PN2330 for V.32 bis speeds and lower (Table 2-2).

2.3 DATA MODE

Data mode exists when a telephone line,cellular, or GSM phone 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.

Table 2-1. +MS Command Automode Connectivity

<mod>	Modulation	Possible Rates (bps) [1]	Notes
0	V.21	300	
1	V.22	1200	
2	V.22 bis	2400 or 1200	
3	V.23	1200	See Note 2
9	V.32	9600 or 4800	
10	V.32 bis	14400, 12000, 9600, 7200, or 4800	Default
11	V.34	28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, or 4800	288ACF/SP family
64	Bell 103	300	
69	Bell 212	1200	
74	V.FC	28800, 26400, 24000, 21600, 19200, 16800, or 14400	

Notes:

1. See optional <automode>, <min_rate>, and <max_rate> subparameters for the +MS command.
2. For V.23, originating modes transmit at 75 bps and receive at 1200 bps; answering modes transmit at 1200 bps and receive at 75 bps. The rate is always specified as 1200 bps.
3. If the DTE speed is set to less than the maximum supported DCE speed in automode, the maximum connection speed is limited to the DTE speed.

Table 2-2. Command Connections

ATF Setting[1,2]	ATN Setting[1,2]	S37 Setting	ATB Setting	Speed Sensed	Connection
Note 3	0	0	0	300	V.21
Note 3	0	0	0	1200	V.22 1200
Note 3	0	0	X	2400	V.22 bis 2400
Note 3	0	0	X	4800	V.32 bis/V.32 4800
Note 3	0	0	X	7200	V.32 bis 7200
Note 3	0	0	X	9600	V.32 bis/V.32 9600
Note 3	0	0	X	12000	V.32 bis 12000
Note 3	0	0	X	Higher	V.32 bis 14400
Note 3	0	0	1	300	Bell 103
Note 3	0	0	1	1200	Bell 212A
ATF1	0	1-3	0	X	V.21
ATF4	0	5	0	X	V.22 1200
ATF5	0	6	X	X	V.22 bis 2400
ATF1	0	1-3	1	X	Bell 103
ATF4	0	5	1	X	Bell 212A
ATF3	0	7	X	X	V.23
ATF6	0	8	X	X	V.32 bis/V.32 4800
ATF8	0	9	X	X	V.32 bis/V.32 9600
ATF7	0	12	X	X	V.32 bis 7200
ATF9	0	10	X	X	V.32 bis 12000
ATF10	0	11	X	X	V.32 bis 14400
ATF0	1	X	X	X	Automode

Notes:

1. ATFn can be used in lieu of ATN0 and S37. ATFn (where n = valid number) sets ATN0 and S37 to the corresponding value.
2. ATF0 forces ATN1 and S37=0.

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 and RTS/CTS flow control with the DTE to ensure data integrity.

Escape Sequence Detection

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

BREAK Detection

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

Telephone Line Monitoring

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

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

Receive Space Disconnect (V.22 bis and Below). If selected by the Y1 command in non-error-correction mode, the modem disconnects after receiving 1.6 ± 10% seconds of continuous SPACE.

Send SPACE on Disconnect (V.22 bis and Below)

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

2.3.2 Fall Forward/Fallback (V.34/V.FC/V.32 bis/V.32)

During initial handshake, the modem will fallback to the optimal line connection within V.34/V.FC/V.32 bis/V.32 mode depending upon signal quality if automode is enabled by the +MS or N1 command.

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.

2.4 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.

2.5 MNP 10 DATA THROUGHPUT ENHANCEMENT

MNP 10 protocol 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 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.

2.6 MNP 10EC™ ENHANCED CELLULAR CONNECTION

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

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

2.7 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).

2.8 FAX CLASS 1 OPERATION

The modem operates as a facsimile (fax) DCE whenever the +FCLASS=1 command is active. In the fax mode, the on-line behavior of the modem is different from the data (non-fax) mode. After dialing, modem operation is controlled by 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.

2.9 VOICE/AUDIO MODE

2.9.1 Online Voice Command Mode

This mode results from the connection to the telephone line through the use of the #CLS=8 and #VLS commands. After mode entry, AT commands can be entered without aborting the connection.

2.9.2 Voice Receive Mode

This mode is entered when the #VRX command is active in order to record voice or audio data input at the RXA pin, i.e., from the telephone line.

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

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

2.9.3 Voice Transmit Mode

This mode is entered when the #VTX command is active in order to playback voice or audio data to the TXA1 output, i.e., 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 output.

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

2.9.4 Audio Mode

The audio mode enables the host to transmit and receive 8-bit audio signals. In this mode, the modem directly accesses the internal analog-to-digital (A/D) converter (ADC) and the digital-to-analog (D/A) converter (DAC). Incoming analog audio signals can then be converted to digital format and digital signals can be converted to analog audio output.

2.9.5 Tone Detectors

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

2.10 VOICEVIEW

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

2.11 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.

2.12 CELLULAR DIRECT CONNECT

In US models, the modem provides defined hardware and firmware interfaces for connection to a cellular telephone. The modem controls downloading and execution of a cellular phone driver firmware into MCU RAM to support direct connection to a cellular phone. Different drivers are required to support different cellular phones or phone models as required by the phone manufacturer.

2.12.1 Cellular Interface Signals

The following MCU ports are assigned to cellular phone interface signals:

	Cellular Use		Non-Cellular Use
MCU Port	Signal	I/O	Host Parallel Interface
PE0	CTRL0	O	~OH
PE1	CTRL1	O	~PULSE
PE2	CELBSY	O	~MUTE
PE5	CELDATA	I/O	None
PE7	DAA/CELL	I	IDID*
PA3	~CELBSY	I	None
PA4	CELCLK	I	None
* Used during reset initialization only.			

Support for these signals is supplied by the cellular driver. When the cellular driver is loaded and a cellular phone interface is indicated on the DAA/CELL input line, the cellular signals are used instead of the wireline signals assigned to the same lines. When the cellular driver is not loaded or when a cellular phone interface is not indicated on the DAA/CELL line when a cellular driver is loaded, the wireline signals are supported.

The cellular and wireline signals are supported in a reference design and are routed to a standard 15-pin connector which connects to a cable from the cellular phone.

2.12.2 AT Commands

The modem supports three cellular AT commands that can be used to load the cellular driver and to provide cellular phone identification and status.

^C2 - Download Cellular Phone Driver. The ^C2 command initiates download of the cellular phone driver into MCU RAM.

^I - Identify Cellular Phone Driver. The ^I command. reports the identification of the loaded cellular phone driver.

^T6 - Indicates Status Of Cellular Phone. The ^T6 command reports the status of the cellular phone connection to the modem. Status such as phone receiving an incoming call, phone in use, phone locked, no phone service, phone powered on, driver initialized, and cellular cable detected is reported.

The information obtained by issuing the ^T6 can be used to determine if the loading of the cellular phone driver is necessary by the host software. Download of the cellular phone driver is not required if a cellular interface cable is not connected to the modem (DAA/CELL = high). A download is necessary when a cellular cable is detected (DAA/CELL = low), which implies a cellular phone is also connected, before operation of the phone. Once a driver is downloaded, the modem can operate in wireline mode or cellular mode based on the connection of a cellular cable.

2.12.3 Operation

Once the cellular driver is loaded and the modem is connected to the cellular phone and the phone is powered on, dial/answer functions will be routed through the phone instead of the wireline DAA. No special commands are needed to place or answer cellular calls and the same AT commands and software packages that are used for wireline communication sessions can be used. If a V.42 bis connection is established in wireline mode, the cellular phone driver is removed from MCU RAM so that the V.42 bis dictionaries can be increased to their full size.

2.12.4 Result Messages

While the modem is being used with a cellular phone, result messages are changed from wireline operation status to reflect cellular operation status as follows:

NO DIALTONE - Indicates that cellular service is not currently available or the cellular phone is powered off.

RING - Indicates that the cellular phone is receiving an incoming call.

2.13 GSM CONNECTION

In GSM mode, the modem provides defined hardware and firmware interfaces for connection to a GSM telephone. Different driver firmware is required to support different GSM phones or phone models as required by the phone manufacturer.

2.13.1 GSM Interface Signals

The following MCU ports are assigned to GSM phone interface signals:

	GSM Use		PSTN Use	
MCU Port	Signal	I/O	Signal	I/O
PE1	CTRL0	O	~PULSE	O
PA2	GSMRXD	I	None	None
PA3	RXDCLK	I	None	None
PA4	GSMINP0	I	None	None
PA5	DAA/GSM	I	None	None
PA6	GSMTXD	O	None	None
PA7	TXDCLK	I	NVMCLK	O

Support for these signals is supplied by the GSM phone driver. When a GSM phone interface is indicated on the DAA/GSM input line, the GSM signals are used instead of the wireline signals assigned to the same lines. When a GSM phone interface is not indicated on the DAA/GSM line when a GSM driver is loaded, the wireline signals are supported.

The GSM and wireline signals are supported in an reference design and are routed to a standard 15-pin connector which connects to a cable from the cellular phone.

2.13.2 GSM AT Commands

2.13.3 Operation

Once the modem is connected to the GSM phone and the phone is powered on, dial/answer functions will be routed through the phone instead of the wireline DAA. No special commands are needed to place or answer GSM calls and the same AT commands and software packages that are used for wireline communication sessions can be used.

2.13.4 Result Messages

While the modem is being used with a GSM phone, result messages are changed from wireline operation status to reflect GSM operation status as follows:

NO DIALTONE - Indicates that GSM service is not currently available or the cellular phone is powered off.

RING - Indicates that the GSM phone is receiving an incoming call.

BUSY - The network report the number dialed is busy.

CARRIER - The carrier is established with the IWF (Interworking function) modem.

PROTOCOL RLP - The error corrected protocol on the radio link is established.

2.13.5 Additional Information

Information regarding the software hooks for adding others phone drivers is described in the GSM Data Phone Driver Designer's Guide (Order No. 1107).

2.14 WORLD CLASS COUNTRY SUPPORT

Country dependent parameters are all programmable by ConfigurACE II for Windows.

2.14.1 Dialing

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

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

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

Ring Detection. The frequency range is programmable by ConfigurACE II for Windows.

Blind Dialing. Blind dialing may be disabled by ConfigurACE II for Windows.

2.14.2 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 II for Windows to match specific country and DAA requirements.

2.14.3 Calling Tone

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

2.14.4 Call Progress Tone Detection

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

2.14.5 Answer Tone Detection

The answer tone detection period is programmable by ConfigurACE II for Windows.

2.14.6 Blacklist Parameters

The modem can operate in accordance with requirements of individual countries to prevent misuse of the network by limiting repeated calls to the same number when previous call attempts have failed. Call failure can be detected for reasons such as

no dial tone, number busy, no answer, no ringback detected, voice (rather than modem) detected, and key abort (dial attempt aborted by user). Actions resulting from such failures can include specification of minimum inter-call delay, extended delay between calls, and maximum numbers of retries before the number is permanently forbidden ("blacklisted"). Up to 40 (ACFW/SP) such numbers may be tabulated. The blacklist parameters are established by ConfigurACE II for Windows.

2.14.7 Relay Control

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

2.15 DIAGNOSTICS

2.15.1 Commanded Tests

Diagnostics are performed in response to &T commands.

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

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

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

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

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

2.15.2 Power On Reset Tests

Upon power on, the modem performs tests of the modem, RAM, ROM, and NVRAM. If the modem, RAM, or ROM test fails, the DCD bit in the parallel interface register is pulsed as follows:

RAM test fails: One pulse cycle (pulse cycle = 0.5 sec. on, 0.5 sec. off) every 1.5 seconds.

ROM test fails: Two pulse cycles every 1.5 seconds.

MDP test fails: Three pulse cycles every 1.5 seconds.

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

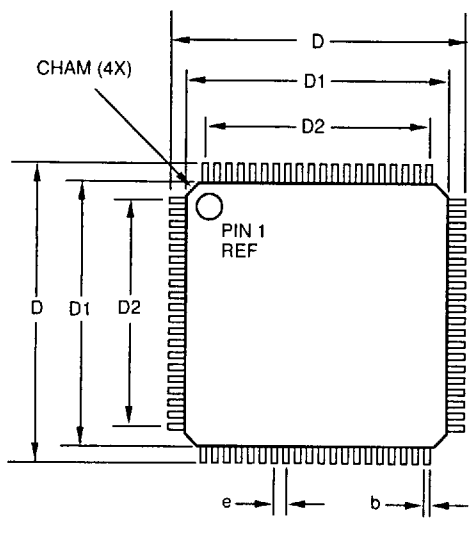
2.16 LOW POWER SLEEP AND STOP MODES

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.

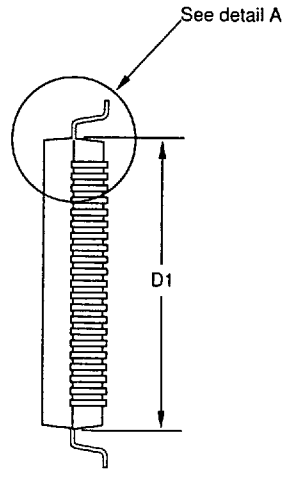
Wake-up. Wakeup occurs when a ring is detected on the telephone line, the host writes to the modem. Since the modem requires more time to attain normal operation when waking up from stop mode than sleep mode, the host must send any character to the modem before issuing the first AT command.

7. PACKAGE DIMENSIONS

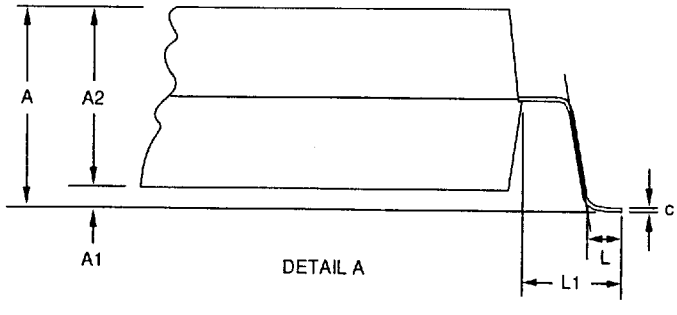
Package dimensions are shown in Figure 7-1 (80-Pin PQFP), Figure 7-2 (100-Pin PQFP), and Figure 7-3 (128-pin TQFP).



TOP VIEW



SIDE VIEW



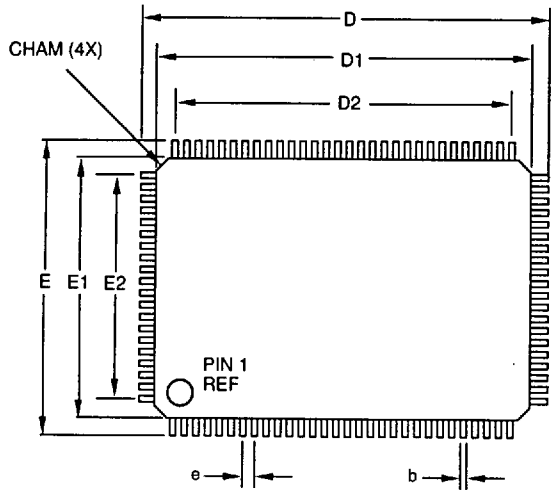
Dim.	Millimeters Min.	Millimeters Max.	Inches* Min.	Inches* Max.
A		2.4 MAX		0.0945 MAX
A1	0.05	0.35	0.0020	0.0138
A2		2.0 REF		0.0787 REF
D	16.95	17.45	0.6673	0.6870
D1		14.0 REF		0.5512 REF
D2		12.35 REF		0.4862 REF
L	0.73	1.03	0.0287	0.0406
L1		1.6 REF		0.0630 REF
e		0.65 BSC		0.0256 BSC
b	0.25	0.45	0.0098	0.0177
c	0.13	0.19	0.0051	0.0075
Coplanarity		0.1 MAX		0.004 MAX

Ref: 80-PIN PQFP (GP00-D227)

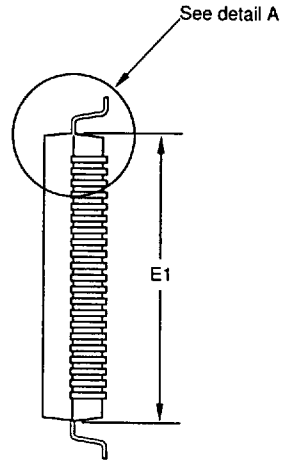
* Metric values (millimeters) should be used for PCB layout. English values (inches) are converted from metric values and may include round-off errors.

PD-PQFP-80 (040695)

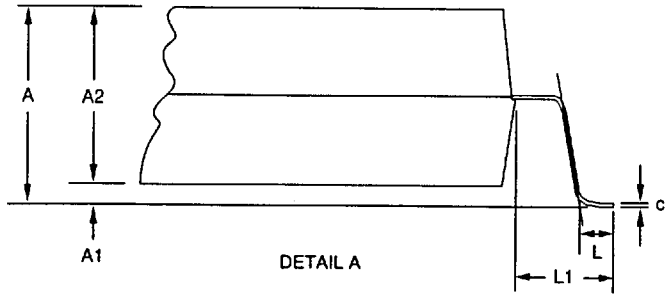
Figure 7-1. Package Dimensions - 80-Pin PQFP



TOP VIEW



SIDE VIEW



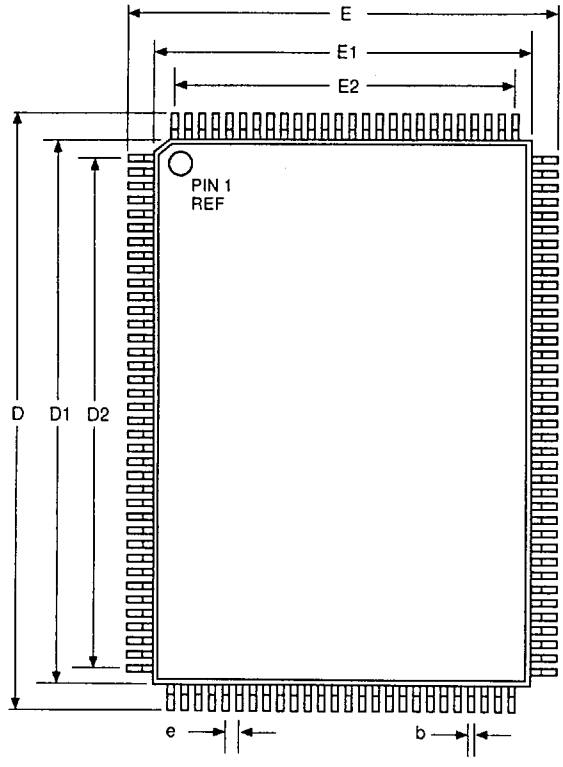
Dim.	Millimeters Min.	Millimeters Max.	Inches* Min.	Inches* Max.
A		2.4 MAX		0.0945 MAX
A1	0.05	0.35	0.0020	0.0138
A2		2.0 REF		0.0787 REF
D	22.95	23.45	0.9035	0.9232
D1		20.0 REF		0.7874 REF
D2		18.85 REF		0.7421 REF
E	16.95	17.45	0.6673	0.6870
E1		14.0 REF		0.5512 REF
E2		12.35 REF		0.4862 REF
L	0.73	1.03	0.0287	0.0406
L1		1.6 REF		0.0630 REF
e		0.65 BSC		0.0256 BSC
b	0.25	0.45	0.0098	0.0177
c	0.13	0.19	0.0051	0.0075
Coplanarity		0.10 MAX		0.004 MAX

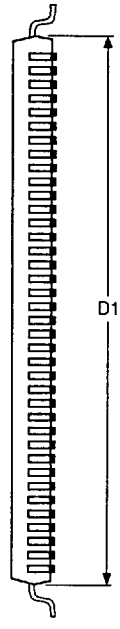
Ref: 100-PIN PQFP (GP00-D234)

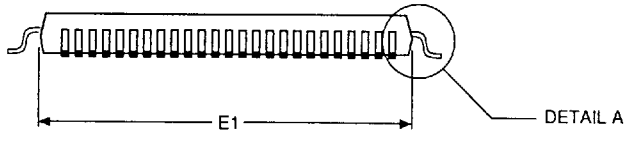
* Metric values (millimeters) should be used for PCB layout. English values (inches) are converted from metric values and may include round-off errors.

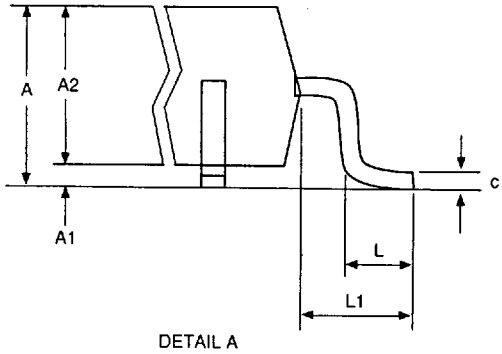
PD-PQFP-100 (040695)

Figure 7-2. Package Dimensions - 100-Pin PQFP









Dim.	Millimeters Min.	Millimeters Max.	Inches* Min.	Inches* Max.
A		1.6 MAX		0.0630 MAX
A1	0.05	0.15	0.0020	0.0059
A2		1.4 REF		0.0551 REF
D	21.75	22.25	0.8563	0.8760
D1		20.0 REF		0.7874 REF
D2		18.5 REF		0.7283 REF
E	15.75	16.25	0.6201	0.6398
E1		14.0 REF		0.5512 REF
E2		12.5 REF		0.4921 REF
L	0.5	0.75	0.0197	0.0295
L1		1.0 REF		0.0394 REF
e		0.50 BSC		0.0197 BSC
b	0.17	0.27	0.0067	0.0106
c	0.11	0.17	0.0043	0.0067
Coplanarity		0.08 MAX		0.0031 MAX

Ref: 128-PIN TQFP (GP00-D264)

* Metric values (millimeters) should be used for PCB layout. English values (inches) are converted from metric values and may include round-off errors.

PD-TQFP-128 (040395)

Figure 7-3. Package Dimensions - 128-Pin TQFP