

# **CX81801-9x**

**SmartV.XX Modem**

**28-Pin CTLGA**

**V.92/V.34/V.32bis Modem**

**with CX20493 SmartDAA®**

**Data Sheet**

## Revision Record

| Revision | Date      | Comments         |
|----------|-----------|------------------|
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# 1. Introduction

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## 1.1 Overview

The Conexant® SmartV.XX Modem supports V.92 analog data modem operation with V.44 data compression and supports 14.4 kbps fax modem operation. In addition, the modem supports remote TAM and serial host interface operation. Table 1-1 lists the available models.

The modem operates with PSTN telephone lines worldwide.

Conexant's SmartDAA® technology eliminates the need for a costly analog transformer, relays, and opto-isolators typically used in discrete DAA (Data Access Arrangement) implementations. The SmartDAA architecture also simplifies product implementation by eliminating the need for country-specific board configurations enabling worldwide homologation of a single modem board design and a single bill of materials (BOM).

The SmartDAA system-powered DAA operates reliably without drawing power from the line, unlike line-powered DAAs which operate poorly when line current is insufficient due to long lines or poor line conditions. Enhanced features, such as monitoring of local extension status without going off-hook, are also supported.

Incorporating Conexant's proprietary Digital Isolation Barrier (DIB) design (patent pending) and other innovative DAA features, the SmartDAA architecture simplifies application design, minimizes layout area, and reduces component cost.

The SmartV.XX Modem device set, consisting of a CX81801 Modem in a 28-pin CTLGA and a CX20493 SmartDAA LSD in a 28-pin QFN, supports data/fax/TAM operation with hardware-based modem controller, digital signal processing, and DAA/telephone line interface functions (Figure 1-1).

The CX81801 Modem integrates modem controller (MCU), modem data pump (MDP), 256 KB ROM, 32 KB RAM, and SmartDAA system side device (SSD) functions onto a single die.

Small, low profile packages, low voltage operation, and low power consumption make this device set an ideal solution for embedded and palmtop applications using serial DTE interface.

In V.92 and V.90 (V.92 models) data modes, the modem can receive data at speeds up to 56kbps from a digitally connected V.92/V.90 central site modem. A V.92/V.90 modem takes advantage of the PSTN which is primarily digital except for the client modem to central office local loop and are ideal for applications such as remote access to an Internet Service Provider (ISP), on-line service, or corporate site. In this mode, with PCM upstream turned off, the modem can transmit data at speeds up to V.34 rate. With PCM upstream turned on, the modem can transmit data at speeds up to 48 kbps.

In V.34 data mode (V.92 and V.34 models), the modem operates at line speeds up to 33.6 kbps.

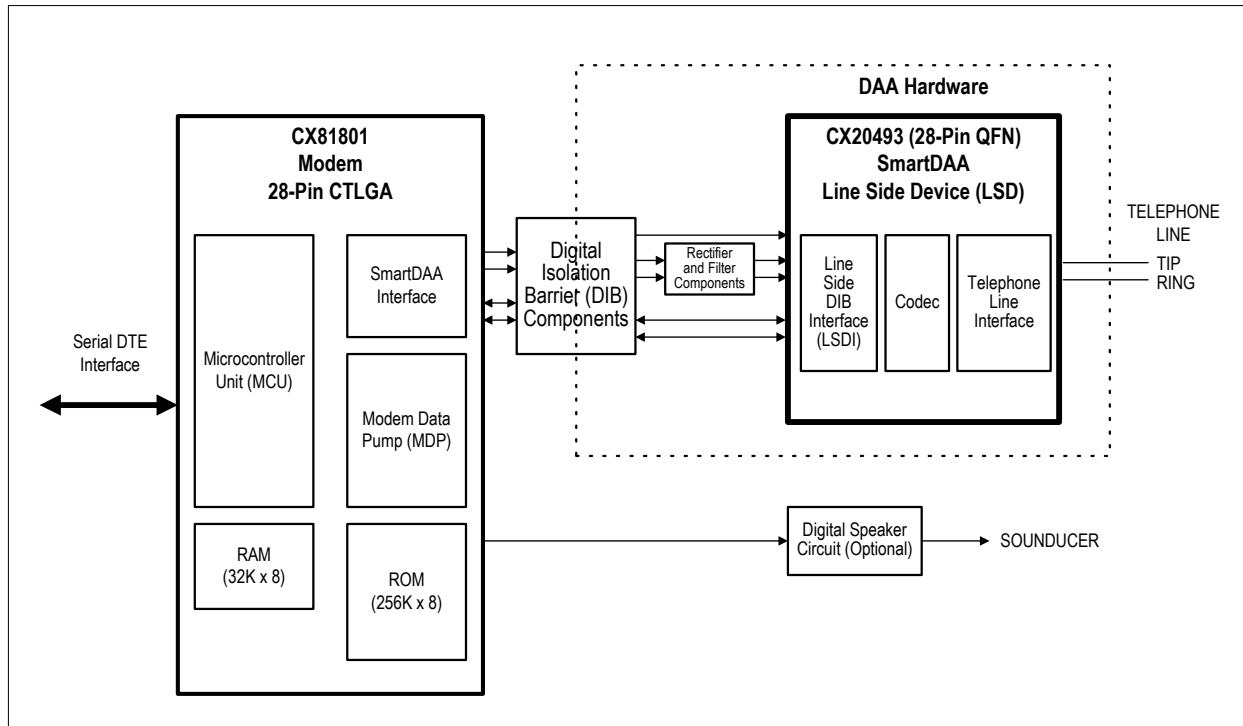
In V.32 bis data mode, the modem operates at line speeds up to 14.4 kbps.

**Table 1-1. SmartV.XX Modem Models and Functions**

| Model/Order/Part Numbers      |                      |   |  | Supported Functions     |           |   |
|-------------------------------|----------------------|---|--|-------------------------|-----------|---|
| Marketing Name                | Device Set Order No. | SmartV.XX Modem [28-Pin CTLGA] Part No. | Line Side Device (LSD) [28-Pin QFN] Part No. | V.90 Data, QC, MOH, PCM | V.34 Data | V.32bis Data, V.44 Data Compression, V.17 Fax, TAM, Worldwide |
| SmartV.92                     | DS56-L147-207        | CX81801-94                              | CX20493-21                                   | Y                       | Y         | Y   |
| SmartV.34                     | DS28-L147-207        | CX81801-92                              | CX20493-21                                   | -                       | Y         | Y   |
| SmartV.32bis                  | DS96-L147-207        | CX81801-93                              | CX20493-21                                   | -                       | -         | Y   |
| <b>Lead-Free Device Sets*</b> |                      |   |  |                         |           |   |
| SmartV.92/LF                  | DS56-L147-208        | CX81801-94                              | CX20493-31                                   | Y                       | Y         | Y   |
| SmartV.34/LF                  | DS28-L147-208        | CX81801-92                              | CX20493-31                                   | -                       | Y         | Y   |
| SmartV.32bis/LF               | DS96-L147-208        | CX81801-93                              | CX20493-31                                   | -                       | -         | Y   |

**Notes:**  
 Supported functions (Y=Supported; - = Not supported)  
 QC, MOH, PCM Quick connect, Modem-on-Hold, PCM upstream  
 TAM Telephone answering machine (Voice playback and record through telephone line)  
 \* The CX81801-9x devices are all compatible with lead-free & non-lead-free manufacturing process. The only difference between standard and lead-free device sets is the CX20493 device.

**Figure 1-1. SmartV.XX Modem Simplified Interface Diagram**



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Data compression (V.44/V.42 bis/MNP 5) and error correction (V.42/MNP 2-4) modes are supported to maximize data throughput and data transfer integrity. V.44 is a more efficient data compression than V.42 bis that significantly increases downstream throughput thus reducing the download time for the types of files associated with Internet use, such as Web pages and uncompressed files such as graphics, image, audio, and document files. V.44 data compression can achieve compression rates of more than 25% over V.42bis. Typical compression ratio for V.44 on Web type data is approximately 6-1 resulting in overall effective data throughput rate up to 300 kbps for a 56 kbps-connection. Non-error-correcting mode is also supported.

Fax Group 3 send and receive rates are supported up to 14.4 kbps with T.30 protocol.

V.80 synchronous access mode supports host-controlled communication protocols, e. g., H.324 video conferencing.

In TAM mode, enhanced 2-bit or 4-bit per sample coding schemes at 8 kHz sample rate provide flexible format compatibility and allows efficient digital storage of voice/audio. Also supported are 8-bit linear and IMA 4-bit ADPCM coding. This mode supports applications such as digital telephone answering machine (TAM), voice annotation, and recording from and playback to the telephone line.

This data sheet describes the modem capabilities. Commands and parameters are defined in the Commands Reference Manual (Doc. No. 102184).

## 1.2 Features

### 1.2.1 General Modem Features

- Data modem
  - Quick connect, Modem-on-Hold™, and PCM upstream functions (V.92 models)
  - ITU-T V.92 (V.92 models), V.90 (V.92 models), V.34 (V.92 and V.34 models), V.32bis, V.32, V.29, FastPOS (V.29), V.22 bis, V.22, V.22 FastConnect, V.23, and V.21, Bell 212A and Bell 103
  - V.250 and V.251 commands
- Data compression and error correction
  - V.44 data compression
  - V.42 bis and MNP 5 data compression
  - V.42 LAPM and MNP 2-4 error correction
- Fax modem send and receive rates up to 14.4 kbps
  - V.17, V.29, V.27 ter, and V.21 channel 2
  - EIA/TIA 578 Class 1 and T.31 Class 1.0
- V.80 synchronous access mode supports host-controlled communication protocols with H.324 interface support
- Data/Fax/Voice call discrimination
- Hardware-based modem controller
- Hardware-based digital signal processor (DSP)

- Worldwide operation
  - Complies to TBR21 and other country requirements
  - On-hook and/or on-hook Caller ID detection for many countries
  - Call progress, blacklisting
  - Internal ROM includes default values for 29 countries
  - Additional and modified country profile can be stored in internal SRAM
- Caller ID detect
  - On-hook Caller ID detection
  - Off-hook Call Waiting Caller ID detection during data mode in V.92, V.34, V.32bis, and V.32
- Distinctive ring detect
- Telephony/TAM
  - V.253 commands
  - 2-bit and 4-bit Conexant ADPCM, 8-bit linear PCM, and 4-bit IMA coding
  - 8 kHz sample rate
  - Concurrent DTMF, ring, and Caller ID detection
- Built-in DTE interface
  - Serial ITU-T V.24 (EIA/TIA-232-E) logical interface up to 115.2 kbps
- Direct mode (serial DTE interface)
- Flow control and speed buffering
- Automatic format/speed sensing
- Serial async data
- Thin packages support low profile designs (1.0 mm max. height)
  - CX81801 Modem in 28-pin CTLGA
  - CX20493 LSD in 28-pin QFN
- Pin-compatible with Conexant CX84100 (SCXV.22bis) modem
- +3.3V operation with +5V tolerant digital inputs
- Typical power use
  - TBD

### 1.2.2 SmartDAA Features

- System side powered DAA operates under poor line current supply conditions
- Modem Wake-on-Ring
- Ring detection
- Line polarity reversal detection
- Line current loss detection
- Pulse dialing
- Line-in-use detection during on-hook operation
- Remote hang-up detection for efficient call termination
- Extension pickup detection
- Call waiting detection
- Digital PBX line protection
- Meets worldwide DC V-I masks requirements

### **1.2.3 Applications**

- Embedded systems
- Set-top boxes
- Handheld computers
- Gaming devices
- Point of sale terminals
- Remove monitoring and data collection systems
- Modem modules

## **1.3 Technical Overview**

### **1.3.1 General Description**

Modem operation, including dialing, call progress, telephone line interface, telephone handset interface, and host DTE interface functions are supported and controlled through the V.250, V.251, and V.253-compatible command set.

The OEM adds a crystal circuit, DIB components, telephone line interface, telephone handset/telephony extension interface, and other supporting discrete components as supported by the modem model (Table 1-1) and required by the application to complete the system.

### **1.3.2 Embedded MCU Firmware**

Embedded MCU firmware performs processing of general modem control, command sets, data modem, error correction and data compression (ECC), fax class 1, fax class 1.0, TAM, worldwide, V.80, and serial DTE host interface functions according to modem models (Table 1-1).

### **1.3.3 Operating Modes**

#### **1.3.3.1 Data/Fax Modes**

In V.92 data modem mode (V.92 models), the modem can receive data from a digital source using a V.92-compatible central site modem at line speeds up to 56 kbps. With PCM upstream enabled, data transmission supports sending data at line speeds up to 48 kbps. When PCM upstream is disabled, data transmission supports sending data at line speeds up to V.34 rates. This mode can fallback to V.34 mode and to lower rates as dictated by line conditions.

The following modes are also supported in V.92 models, when connected to a V.92-compatible server supporting the feature listed.

- Quick connect, which allows quicker subsequent connection to a server using stored line parameters obtained during the initial connection. The server must support quick connect profiles.
- Modem-on-Hold, which allows detection and reporting of incoming phone calls on the PSTN with enabled Call Waiting. If the incoming call is accepted by the user, the user has a pre-defined amount of time of holding the data connection for a brief

conversation. The data connection resumes upon incoming call termination. The server must support Modem-on-Hold functionality.

- PCM upstream, which boosts the upstream data rates between the user and V.92 server. A maximum of 48 kbps upstream rate is supported when connected to a V.92 server that supports PCM upstream.

In V.34 data modem mode (V.92 and V.34 models), the modem can operate in 2-wire, full-duplex, asynchronous modes at line rates up to 33.6 kbps. Data modem modes perform complete handshake and data rate negotiations. Using V.34 modulation to optimize modem configuration for line conditions, the modem can connect at the highest data rate that the channel can support from 33600 bps down to 2400 bps with automatic fallback. Automode operation in V.34 is provided in accordance with PN3320 and in V.32 bis in accordance with PN2330. All tone and pattern detection functions required by the applicable ITU or Bell standards are supported.

In V.32 bis data modem mode, the modem can operate at line speeds up to 14.4 kbps.

In fax modem mode, the modem can operate in 2-wire, half-duplex, synchronous modes and can support Group 3 facsimile send and receive speeds of 14400, 12000, 9600, 7200, 4800, and 2400 bps. Fax data transmission and reception performed by the modem are controlled and monitored through the EIA/TIA-578 Fax Class 1, or T.31 Fax Class 1.0 command interface. Full HDLC formatting, zero insertion/deletion, and CRC generation/checking are provided.

### **1.3.3.2**

#### **V.44 Data Compression**

V.44 provides more efficient data compression than V.42 bis that significantly decreases the download time for the types of files associated with Internet use. This significant improvement is most noticeable when browsing and searching the web since HTML text files are highly compressible. (The improved performance amount varies both with the actual format and with the content of individual pages and files.)

### **1.3.3.3**

#### **Synchronous Access Mode (SAM) - Video Conferencing**

V.80 Synchronous Access Mode between the modem and the host/DTE is provided for host-controlled communication protocols, e.g., H.324 video conferencing applications.

Voice-call-first (VCF) before switching to a videophone call is also supported.

### **1.3.3.4**

#### **TAM Mode**

TAM Mode features include 8-bit linear coding at 8 kHz sample rate. Tone detection/generation, call discrimination, and concurrent DTMF detection are also supported.

TAM Mode is supported by four submodes:

- Online Voice Command Mode supports connection to the telephone line.
- Voice Receive Mode supports recording voice or audio data input from the telephone line.
- Voice Transmit Mode supports playback of voice or audio data to the telephone line.
- Full-duplex Receive and Transmit Mode.

### 1.3.3.5 Worldwide Operation

The modem operates in TBR21-compliant and other countries. Country-dependent modem parameters for functions such as dialing, carrier transmit level, calling tone, call progress tone detection, answer tone detection, blacklisting, caller ID, and relay control are programmable.

SmartDAA technology allows a single PCB design and single BOM to be homologated worldwide. Advanced features such as extension pickup detection, remote hang-up detection, line-in-use detection, and digital PBX detection are supported.

Country code IDs are defined by ITU-T T.35.

Internal ROM includes default profiles for 29 countries including TBR21-compliant profiles. An additional or modified country profile can be loaded into internal SRAM. A duplicate country profile stored in internal SRAM will override the profile in internal ROM firmware. The default countries supported are listed in Table 1-2. Request additional country profiles from a Conexant Sales Office.

**Table 1-2. Default Countries Supported**

| Country        | Country Code | Call Waiting Tone Detection (CW) Supported | On-Hook Type 1 Caller ID (CID) Supported | Off-Hook Type 2 Called ID (CID2) Supported |
|----------------|--------------|--|--|--|
| Australia      | 09           | X  | X  |  |
| Austria        | 0A           | X  | X  |  |
| Belgium        | 0F           | X  |  |  |
| Brazil         | 16           | X  |  |  |
| China          | 26           | X  | X  |  |
| Denmark        | 31           | X  | X  |  |
| Finland        | 3C           | X  | X  |  |
| France         | 3D           | X  | X  | X  |
| Germany        | 42           | X  | X  |  |
| Hong Kong      | 50           | X  | X  | X  |
| India          | 53           |  | X  |  |
| Ireland        | 57           |  | X  |  |
| Italy          | 59           | X  | X  |  |
| Japan          | 00           | X  | X  | X  |
| Korea          | 61           | X  |  |  |
| Malaysia       | 6C           | X  |  |  |
| Mexico         | 73           |  |  |  |
| Netherlands    | 7B           |  | X  |  |
| Norway         | 82           | X  | X  |  |
| Poland         | 8A           | X  |  |  |
| Portugal       | 8B           | X  |  |  |
| Singapore      | 9C           | X  | X  | X  |
| South Africa   | 9F           | X  |  |  |
| Spain          | A0           | X  | X  |  |
| Sweden         | A5           | X  | X  |  |
| Switzerland    | A6           | X  |  |  |
| Taiwan         | FE           | X  | X  |  |
| United Kingdom | B4           | X  | X  | X  |
| United States  | B5           | X  | X  | X  |
| Reserved       | FD           | X  | X  | X  |

### **1.3.4 Reference Designs**

A data/fax/TAM reference design (RD01-D680-6xx) is available to minimize modem design time, reduce development cost, and accelerate market entry.

A design package is available in electronic form. This package includes schematics, bill of materials (BOM), vendor part list (VPL), board layout files in Gerber and PADS formats, and complete documentation.

## **1.4 Hardware Description**

SmartDAA technology eliminates the need for a costly analog transformer, relays, and opto-isolators that are typically used in discrete DAA implementations. The programmable SmartDAA architecture simplifies product implementation in worldwide markets by eliminating the need for country-specific components.

### **1.4.1 CX81801 Modem**

The CX81801 modem, packaged in a 28-pin CTLGA, includes a Microcontroller (MCU), a Modem Data Pump (MDP), 256 KB internal ROM, 32 KB internal RAM, and SmartDAA interface functions.

The modem connects to host via a logical V.24 (EIA/TIA-232-E) serial DTE interface.

The modem performs the command processing and host interface functions. The crystal frequency is 28.224 MHz.

The modem performs telephone line signal modulation/demodulation in a hardware digital signal processor (DSP), which reduces computational load on the host processor.

The SmartDAA Interface communicates with, and supplies power and clock to the LSD through the DIB.

### **1.4.2 Digital Isolation Barrier**

The OEM-supplied Digital Isolation Barrier (DIB) electrically DC isolates the CX81801 from the LSD and telephone line. The modem is connected to a fixed digital ground and operates with standard CMOS logic levels. The LSD is connected to a floating ground and can tolerate high voltage input (compatible with telephone line and typical surge requirements).

The DIB transformer couples power and clock from the CX81801 to the LSD.

The DIB data channel supports bidirectional half-duplex serial transfer of data, control, and status information between the CX81801 and the LSD over two lines.

### **1.4.3 CX20493 SmartDAA Line Side Device**

The CX20493 SmartDAA Line Side Device (LSD) includes a Line Side DIB Interface (LSDI), a coder/decoder (codec), and a Telephone Line Interface (TLI).

The LSDI communicates with, and receives power and clock from, the SmartDAA interface in the CX81801 through the DIB.

LSD power is received from the MDP PWRCLKP and PWRCLKN pins via the DIB through a full-wave rectified bridge and capacitive power filter circuit connected to the DIB transformer secondary winding.

The CLK input is also accepted from the DIB transformer secondary winding through a capacitor and a resistor in series.

Information is transferred between the LSD and the CX81801 through the DIB\_P and DIB\_N pins. These pins connect to the CX81801 DIB\_DATAP and DIB\_DATAN pins, respectively, through the DIB.

The TLI integrates DAA and direct telephone line interface functions and connects directly to the line TIP and RING pins, as well as to external line protection components.

Direct LSD connection to TIP and RING allows real-time measurement of telephone line parameters, such as the telephone central office (CO) battery voltage, individual telephone line (copper wire) resistance, and allows dynamic regulation of the off-hook TIP and RING voltage and total current drawn from the central office (CO). This allows the modem to maintain compliance with U.S. and worldwide regulations and to actively control the DAA power dissipation.

## 1.5 Commands

The modem supports data modem, fax class 1 or 1.0 modem, voice/audio, full-duplex speakerphone (FDSP), and V.80 commands, and S Registers in accordance with modem model options. See Doc. No. 102184 for a description of the commands.

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

**Fax Modem Operation.** Facsimile functions operate in response to fax class 1 commands when +FCLASS=1 or to fax class 1.0 commands when +FCLASS=1.0.

**Voice/Audio Operation.** Voice/audio mode functions operate in response to voice/audio commands when +FCLASS=8.

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## 2. Technical Specifications

### 2.1 Serial DTE Interface Operation

#### 2.1.1 Automatic Speed/Format Sensing

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

| Parity | Data Length<br>(No. of Bits) | No. of<br>Stop Bits | Character Length<br>(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 bit is stripped off during data transmission in Normal and Error Correction modes.

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

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

**Fax Modem Mode.** In V.17 fax mode, the modem can sense speeds up to 115.2 kbps.

## **2.2 Establishing Data Modem Connections**

### **2.2.1 Dialing**

**DTMF Dialing.** DTMF dialing using DTMF tone pairs is supported in accordance with ITU-T Q.23.

**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.

### **2.2.2 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.

### **2.2.3 Call Progress Tone Detection**

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

### **2.2.4 Answer Tone Detection**

Answer tone can be detected over the frequency range of  $2100 \pm 40$  Hz in ITU-T modes and  $2225 \pm 40$  Hz in Bell modes.

### **2.2.5 Ring Detection**

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

### **2.2.6 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 tone signal.

## 2.2.7 Connection Speeds

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

Line connection can be selected using the +MS command. The +MS command selects modulation, enables/disables automode, and selects minimum and maximum line speeds (Table 2-1).

**Table 2-1. +MS Command Automode Connectivity**

| Modulation      | <carrier> | Possible (<min_rx_rate>, <min_rx_rate>, (<min_tx_rate>), and <max_tx_rate>) Rates (bps)  |
|-----------------|-----------|--|
| Bell 103        | B103      | 300  |
| Bell 212        | B212      | 1200 Rx/75 Tx or 75 Rx/1200 Tx   |
| V.21            | V21       | 300  |
| V.22            | V22       | 1200   |
| V.22 bis        | V22B      | 2400 or 1200   |
| V.23            | V23C      | 1200   |
| V.32            | V32       | 9600 or 4800   |
| V.32 bis        | V32B      | 14400, 12000, 9600, 7200, or 4800  |
| V.34            | V34       | 33600, 31200, 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, or 2400  |
| V.90            | V90       | 56000, 54667, 53333, 52000, 50667, 49333, 48000, 46667, 45333, 44000, 42667, 41333, 40000, 38667, 37333, 36000, 34667, 33333, 32000, 30667, 29333, 28000 |
| V.92 downstream | V92       | 56000, 54667, 53333, 52000, 50667, 49333, 48000, 46667, 45333, 44000, 42667, 41333, 40000, 38667, 37333, 36000, 34667, 33333, 32000, 30667, 29333, 28000 |
| V.92 upstream   | V92       | 48000, 46667, 45333, 44000, 42667, 41333, 40000, 38667, 37333, 36000, 34667, 33333, 32000, 30667, 29333, 28000, 26667, 25333, 24000                      |

## 2.2.8 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).

## 2.3 Data Mode

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

### 2.3.1 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.

### 2.3.2 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.

### 2.3.3 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.

### 2.3.4 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.

### 2.3.5 Telephone Line Monitoring

**GSTN Cleardown (V.92, V.90, V.34, 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.

### 2.3.6 Fall Forward/Fallback (V.92/V.90/V.34/V.32 bis/V.32)

During initial handshake, the modem will fallback to the optimal line connection within V.92/V.90/V.34/V.32 bis/V.32 mode depending upon signal quality if automode is enabled by the +MS or N1 command.

When connected in V.92/V.90/V.34/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.

### 2.3.7 Retrain

The modem may lose synchronization with the received line signal under poor or changing 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.

### 2.3.8 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 255 seconds by using register S30. A value of 0 disables the inactivity timer.

### 2.3.9 DTE Signal Monitoring (Serial DTE 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.

## 2.4 V.92 Features

Modem-on-Hold, quick connect, and PCM upstream are only available when connecting in V.92 data mode. V.92 features are only available when the server called is a V.92 server that supports that particular feature.

### 2.4.1 Modem-on-Hold

The Modem-on-Hold (MOH) function (V.92 models only) enables the modem to place a data call to the Internet on hold while using the same line to accept an incoming or place an outgoing voice call. This feature is available only with a connection to a server supporting MOH. MOH can be executed through either of two methods:

- One method is to enable MOH through the +PMH command. With Call Waiting Detection (+PCW command) enabled, an incoming call can be detected while on-line. Using a string of commands, the modem negotiates with the server to place the data connection on hold while the line is released so that it can be used to conduct a voice call. Once the voice call is completed, the modem can quickly renegotiate with the server back to the original data call.
- An alternative method is to use communications software that makes use of the Conexant Modem-on-Hold drivers. Using this method, the software can detect an incoming call, place the data connection on hold, and switch back to a data connection.

### 2.4.2 Quick Connect

The quick connect function (V.92 models only) enables the modem to shorten the connect time of subsequent calls to a server supporting quick connect. The quick connect feature is supported by the +PQC command.

### 2.4.3 PCM Upstream

PCM upstream boosts the upstream data rates between the user and ISP to reduce upload times for large files and email attachments. A maximum of 48 kbps upstream rate is supported with PCM upstream enabled, in contrast to a maximum of 32.2 kbps upstream rate with PCM upstream not enabled. PCM upstream is supported by the +PCM command. PCM upstream is disabled by default.

## 2.5 Error Correction and Data Compression

### 2.5.1 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.

### 2.5.2 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.

### **2.5.3 V.44 Data Compression**

V.44 data compression encodes pages and files associated with Web pages more efficiently than V.42 bis. These files include WEB pages, graphics and image files, and document files. V.44 can provide an effective data throughput rate up to DTE rate for a 56-kbps connection. The improved performance amount varies both with the actual format and with the content of individual pages and files.

### **2.5.4 V.42 bis Data Compression**

V.42 bis data compression mode, enabled by the %Cn command or S46 register, operates when a LAPM 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 2-KB dictionaries are used to store the strings. These dictionaries are dynamically updated during normal operation.

### **2.5.5 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.

## **2.6 Telephony Extensions**

The following telephony extension features are supported and are typically implemented in designs for set-top box applications and TAM software applications to enhance end-user experience:

- Line In Use detection
- Extension Pickup detection
- Remote Hang-up detection

The telephony extension features are enabled through the -STE command. The -TTE command can be used to adjust the voltage thresholds for the telephony extension features.

### **2.6.1 Line In Use Detection**

The Line In Use Detection feature can stop the modem from disturbing the phone line when the line is already being used. When an automated system tries to dial using ATDT and the phone line is in use, the modem will not go off hook and will respond with the message “LINE IN USE”.

## 2.6.2 Extension Pickup Detection

The Extension Pickup Detection feature (also commonly referred as PPD or Parallel phone detection) allows the modem to detect when another telephony device (i.e., fax machine, phone, satellite/cable box) is attempting to use the phone line. When an extension pickup has been detected, the modem will go on-hook and respond with the message “OFF-HOOK INTRUSION”.

The Remote Hangup Detection feature will cause the modem to go back on-hook and respond with the message “LINE REVERSAL DETECTED” during a data connection when the remote modem is disconnected for abnormal termination reasons (remote phone line unplugged, remote server/modem shutdown). For Voice applications, this method can be used in addition to silence detection to determine when a remote caller has hung up to terminate a voice recording.

This feature can be used to quickly drop a modem connection in the event when a user picks up a extension phone line. For example, this feature allows set top boxes with an integrated SmartV.XX modem to give normal voice users the highest priority over the telephone line.

This feature can also be used in Telephone Answering Machine applications (TAM). Its main use would be to stop the TAM operation when a phone is picked up.

## 2.6.3 Remote Hangup Detection

The Remote Hangup Detection feature will cause the modem to go back on-hook and respond with the message “LINE REVERSAL DETECTED” during a data connection when the remote modem is disconnected for abnormal termination reasons (remote phone line unplugged, remote server/modem shutdown). For Voice applications, this method can be used in addition to silence detection to determine when a remote caller has hung up to terminate a voice recording.

## 2.7 Fax Class 1 and Fax Class 1.0 Operation

Facsimile functions operate in response to fax class 1 commands when +FCLASS=1 or to fax class 1.0 commands when +FCLASS=1.0.

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.

## 2.8 Point-of-Sales Support

Point-of-Sales (POS) terminals usually need to exchange a small amount of data in the shortest amount of time. Low speed modulations such as Bell212A or V.22 are still mainly used in POS applications. Additionally, new non-standard sequences have been developed to better support POS applications.

Industry standard and shortened answer tone B103 and V.21 are supported, as well as FastPOS (V.29) and V.22 FastConnect. POS terminal modulations are supported by the \$F command.

## **2.9 TAM Mode**

Voice and TAM functions are supported by the Voice Mode. Voice Mode includes four submodes: Online Voice Command Mode, Voice Receive Mode, Voice Transmit Mode and Full-Duplex Receive and Transmit Mode.

### **2.9.1 Online Voice Command Mode**

This mode results from the connection to the telephone line or a voice/audio I/O device (e.g., microphone, speaker, or handset) through the use of the +FCLASS=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 RIN pin, typically from a microphone/handset or the telephone line.

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

Received analog 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 8 kHz 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 TXA output, 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 TXA output.

Digitized audio data is converted to analog form then output to the TXA output.

### **2.9.4 Full-Duplex Receive and Transmit Mode**

This mode is entered when the +VTR command is active in order to concurrently receive and transmit voice.

### **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.

### **2.9.6 Call Waiting Tone Detection**

Call Waiting tones can be detected when in V.92, V.90, V.34, and V.32bis data modes.

## 2.10 Caller ID

Both Type I Caller ID (On-Hook Caller ID) and Type II Caller ID (Call Waiting Caller ID) are supported for U.S. and many other countries (see Section 2.11). Both types of Caller ID are enabled/disabled using the +VCID command. Call Waiting Tone detection must be enabled using the +PCW command to detect and decode Call Waiting Caller ID. 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.

Type II Caller ID (Call Waiting Caller ID) detection operates only during data mode in V.92, V.90, V.34, V.32bis, or V.32.

## 2.11 Worldwide Country Support

Internal modem firmware supports 29 country profiles (see Section 1.3.2). These country profiles include the following country-dependent parameters:

- Dial tone detection levels and frequency ranges.
- DTMF dialing parameters: Transmit output level, DTMF signal duration, and DTMF interdigit interval.
- Pulse dialing parameters: Make/break times, set/clear times, and dial codes are programmable
- Ring detection frequency range.
- Type I and Type II Caller ID detection are supported for many countries. Contact your local Conexant sales office for additional country support.
- Blind dialing enabled/disable.
- Carrier transmit level (through S91 for data and S92 for fax). The maximum, minimum, and default values can be defined to match specific country and DAA requirements.
- 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.
- Frequency and cadence of tones for busy, ringback, congested, warble, dial tone 1, and dial tone 2.
- Answer tone detection period.
- 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").

The country profiles may be altered or customized by modifying the country-dependent parameters. Additional profiles may also be included. Additional and modified country profiles are supported by internal SRAM.

Please contact an FAE at the local Conexant sales office for additional and modified country profile support.

## 2.12 Diagnostics

### 2.12.1 Commanded Tests

Diagnostics are performed in response to test commands.

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

**DMTF Generation (%TT0 Command).** Continuous DTMF tones are generated by the DSP and output through the DAA.

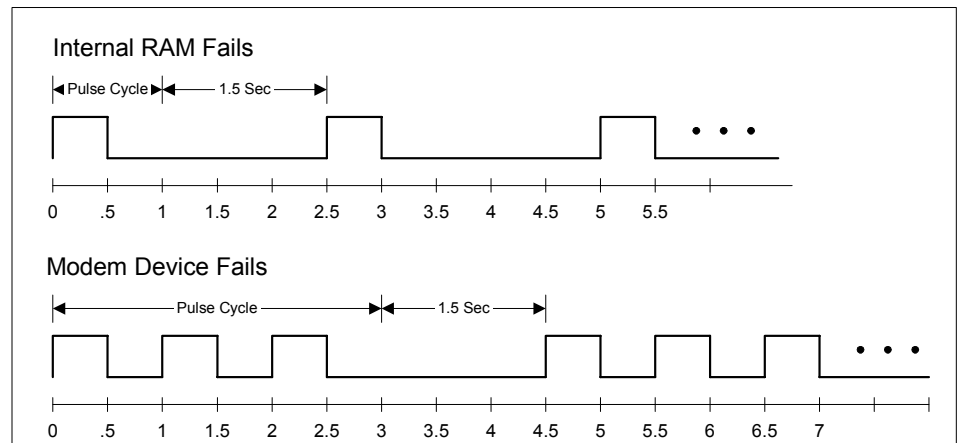
**Tone Generation (%TT3 Command).** Continuous tones are generated by the DSP and output through the DAA.

### 2.12.2 Power On Reset Tests

Upon power on, the modem performs tests of the modem and internal RAM. If the modem or internal RAM test fails, the TMIND# output is pulsed as follows (Figure 2-1):

- Internal RAM test fails: One pulse cycle (pulse cycle = 0.5 sec. on, 0.5 sec. off) every 1.5 seconds.
- Modem device test fails: Three pulse cycles every 1.5 seconds.

**Figure 2-1. TMIND# Test Results Pulse Cycles**



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## 2.13 Low Power Sleep Mode

**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 modem circuits are turned off except the internal clock circuitry in order to consume reduced power while being able to immediately wake up and resume normal operation.

**Wake-up.** Wake-up occurs when a ring is detected on the telephone line or the DTE sends a character to the modem.

## **3. Hardware Interface**

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### **3.1 CX81801 Modem Hardware Pins and Signals**

#### **3.1.1 CX81801 Modem Signal Summary**

##### **3.1.1.1 LSD Interface (Through DIB)**

The DIB interface signals are:

- Clock and Power Positive (PWRCLKP); output
- Clock and Power Negative (PWRCLKN); output
- Data Positive (DIB\_DATAP); input/output
- Data Negative (DIB\_DATAN); input/output

##### **3.1.1.2 Call Progress Speaker Interface**

The call progress speaker interface signal is:

- Digital speaker output (DSPKOUT); output

DSPKOUT is a square wave output in Data/Fax mode used for call progress or carrier monitoring. This output can be optionally connected to a low-cost on-board speaker, e.g., a sounducer, or to an analog speaker circuit.

##### **3.1.1.3 Serial DTE Interface and Indicator Outputs**

The supported DTE interface signals are:

- Serial Transmit Data input (TXD#)
- Serial Receive Data output line (RXD#)
- Clear to Send output (CTS#)
- Received Line Signal Detector (RLSD#)
- Ring Indicator (RI#)
- Data Terminal Ready control input (DTR#)
- Request to Send control input (RTS#)

### 3.1.2 CX81801 Modem Pin Assignments and Signal Definitions

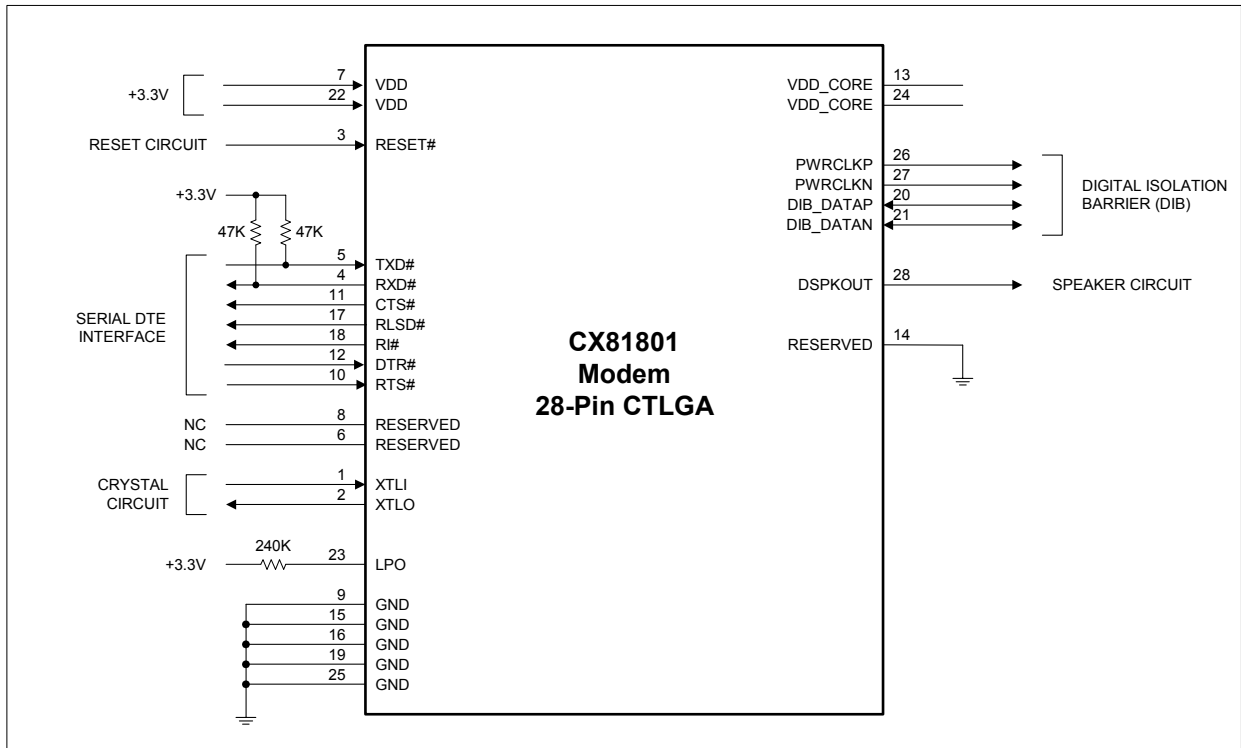
CX81801 Modem 28-pin CTLGA hardware interface signals are shown by major interface in Figure 3-1, are shown by pin number in Figure 3-2, and are listed by pin number in Table 1-1.

CX81801 Modem hardware interface signals are defined in Table 3-2.

I/O types are defined in Table 3-3.

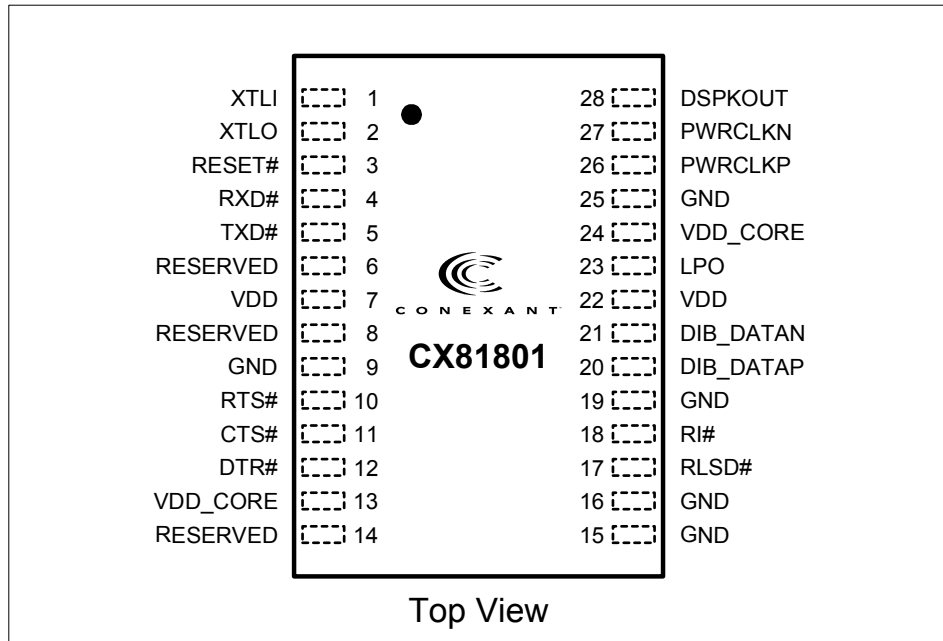
DC electrical characteristics are listed in Table 3-4.

Figure 3-1. CX81801 Modem Hardware Signals



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**Figure 3-2. CX81801 Modem 28-Pin CTLGA Pin Signals**



102179\_003

**Table 3-1. CX81801 Modem 28-Pin CTLGA Pin Signals**

| Pin No. | Signal Name | Pin No. | Signal Name |
|---------|-------------|---------|-------------|
| 1       | XTLI        | 15      | GND         |
| 2       | XTLO        | 16      | GND         |
| 3       | RESET#      | 17      | RLSD#       |
| 4       | RXD#        | 18      | RI#         |
| 5       | TXD#        | 19      | GND         |
| 6       | RESERVED    | 20      | DIB_DATAP   |
| 7       | VDD         | 21      | DIB_DATAN   |
| 8       | RESERVED    | 22      | VDD         |
| 9       | GND         | 23      | LPO         |
| 10      | RTS#        | 24      | VDD_CORE    |
| 11      | CTS#        | 25      | GND         |
| 12      | DTR#        | 26      | PWRCLKP     |
| 13      | VDD_CORE    | 27      | PWRCLKN     |
| 14      | RESERVED    | 28      | DSPKOUT     |

**Table 3-2. CX81801 Modem Pin Signal Definitions**

| Label                    | Pin                  | I/O    | I/O Type  | Signal Name/Description  |
|--------------------------|----------------------|--------|-----------|--|
| <b>System</b>            |                      |        |           |  |
| XTLI<br>XTLO             | 1<br>2               | I<br>O | Ix,<br>Ox | <b>Crystal In and Crystal Out.</b> Connect XTLI and XTLO to the external 28.224 MHz ± 50 ppm crystal circuit.  |
| RESET#                   | 3                    | I      | It        | <b>Reset.</b> The active low RESET# input resets the modem logic and clears the internal SRAM.<br>RESET# low holds the modem in the reset state; RESET# going high releases the modem from the reset state. After application of VDD, RESET# must be held low for at least 15 ms after the VDD power reaches operating range. The modem device set is ready to use 25 ms after the low-to-high transition of RESET#. |
| VDD                      | 7, 22                | P      | PWR       | <b>Digital Supply Voltage.</b> Connect to VCC (+3.3V, filtered).   |
| VDD_CORE                 | 13, 24               | P      | PWR       | <b>Core Voltage.</b>   |
| GND                      | 9, 15, 16,<br>19, 25 | G      | GND       | <b>Digital Ground.</b> Connect to digital ground (GND).  |
| LPO                      | 23                   | I      | I/O       | <b>Low Power Oscillator.</b> Connect to +3.3V through 240 KΩ.  |
| <b>Speaker Interface</b> |                      |        |           |  |
| DSPKOUT                  | 28                   | O      | It/Ot2    | <b>Modem Speaker Digital Output.</b> The DSPKOUT digital output reflects the received analog input signal digitized to TTL high or low level by an internal comparator.  |
| <b>DIB Interface</b>     |                      |        |           |  |
| PWRCLKP                  | 26                   | O      | Odpc      | <b>Clock and Power Positive.</b> Provides clock and power to the LSD. Connect to DIB transformer primary winding non-dotted terminal.  |
| PWRCLKN                  | 27                   | O      | Odpc      | <b>Clock and Power Negative.</b> Provides clock and power to the LSD. Connect to DIB transformer primary winding dotted terminal.  |
| DIB_DATAP                | 20                   | I/O    | Idd/Odd   | <b>Data Positive.</b> Transfers data, control, and status information between the CX81801 and the LSD. Connect to LSD through DIB data positive channel components.  |
| DIB_DATAN                | 21                   | I/O    | Idd/Odd   | <b>Data Negative.</b> Transfers data, control, and status information between the CX81801 and the LSD. Connect to LSD through DIB data negative channel components.  |
| <b>Reserved</b>          |                      |        |           |  |
| RESERVED                 | 14                   | I      | Itpu      | <b>Reserved.</b> Connect to GND.   |

**Table 3-2. CX81801 Modem Pin Signal Definitions (Continued)**

| Label   | Pin | I/O | I/O Type | Signal Name/Description   |
|---|-----|-----|----------|---|
| <b>V.24 (EIA/TIA-232-E) DTE Serial Interface</b>                          |     |     |          |   |
| TXD# (PA2)  | 5   | I   | It/Ot2   | <b>Transmitted Data (EIA BA/ITU-T 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# (PA6)  | 4   | O   | It/Ot2   | <b>Received Data (EIA BB/ITU-T CT104).</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# (PC1)  | 11  | O   | lth/Ot8  | <b>Clear To Send (EIA CB/ITU-T CT106).</b> CTS# output ON (low) indicates that the modem is ready to accept data from the DTE. In error correction or normal mode, CTS# is always ON (low) unless RTS/CTS flow control is selected by the &Kn command.  |
| RLSD# (PC2)   | 17  | O   | lth/Ot8  | <b>Received Line Signal Detector (EIA CF/ITU-T 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.  |
| RI# (PC5)   | 18  | O   | lth/Ot8  | <b>Ring Indicator (EIA CE/ITU-T CT125).</b> RI# output ON (low) indicates the presence of an ON segment of a ring signal on the telephone line.   |
| DTR# (PD4)  | 12  | I   | It       | <b>Data Terminal Ready (EIA CD/ITU-T 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# (PD6)  | 10  | I   | lthpu    | <b>Request To Send (EIA CA/ITU-T CT105).</b> RTS# input ON (low) indicates that the DTE is ready to send data to the modem. In the command state, the modem ignores RTS#. The modem ignores RTS# unless RTS/CTS flow control is selected by the &Kn command.  |
| RESERVED  | 6   |     |          | <b>Reserved.</b> Leave open.  |
| RESERVED  | 8   |     |          | <b>Reserved.</b> Leave open.  |
| <b>Notes:</b>   |     |     |          |   |
| 1. I/O Types: See Table 3-3.  |     |     |          |   |
| 2. Interface Legend:  |     |     |          |   |
| DIB            Digital Isolation Barrier                                  |     |     |          |   |
| NC            No internal pin connection                                  |     |     |          |   |
| RESERVED = No external connection allowed (may have internal connection). |     |     |          |   |

**Table 3-3. CX81801 Modem I/O Type Definitions**

| I/O Type | Description   |
|----------|---|
| Idd/Odd  | Digital input/output, DIB data transceiver  |
| Ix/Ox    | I/O, wire   |
| It/Ot2   | Digital input / Digital output, 2 mA, $Z_{INT} = 120 \Omega$                      |
| Itpu/Ot2 | Digital input, 75k $\Omega$ pull up/ Digital output, 2 mA, $Z_{INT} = 120 \Omega$ |
| Ith/Ot8  | Digital input, hysteresis/Digital output, 8 mA, $Z_{INT} = 50 \Omega$             |
| It       | Digital input   |
| Ith      | Digital input, hysteresis   |
| Itpu     | Digital input, 75k $\Omega$ pull up   |
| Ithpu    | Digital input, hysteresis, 75k $\Omega$ pull up                                   |
| Odpc     | Digital output with adjustable drive, DIB clock and power                         |
| PWR      | VCC Power   |
| GND      | Ground  |

**NOTES:**

- See DC characteristics in Table 3-4.
- I/O Type corresponds to the device Pad Type. The I/O column in signal interface tables refers to signal I/O direction used in the application.

**Table 3-4. CX81801 Modem DC Electrical Characteristics**

| Parameter              | Symbol | Min.      | Typ. | Max.      | Units      | Test Conditions |
|------------------------|--------|-----------|------|-----------|------------|-----------------|
| Input Voltage Low      | VIL    | 0         | –    | 0.3 * VDD | V          |                 |
| Input Voltage High     | VIH    | 0.7 * VDD | –    | 5.25      | V          |                 |
| Input Hysteresis       | VH     | 0.3       | –    |           | V          |                 |
| Output Voltage Low     | VOL    |           |      |           |            |                 |
| $Z_{INT} = 150 \Omega$ |        | 0         | –    | 0.4       | V          | IOL = 1.6 mA    |
| $Z_{INT} = 120 \Omega$ |        | 0         | –    | 0.4       | V          | IOL = 2 mA      |
| $Z_{INT} = 50 \Omega$  |        | 0         | –    | 0.4       | V          | IOL = 8 mA      |
| Output Voltage High    | VOH    |           | –    |           | V          |                 |
| $Z_{INT} = 150 \Omega$ |        | 2.4       | –    | VDD       | V          | IOL = -1.6 mA   |
| $Z_{INT} = 120 \Omega$ |        | 2.4       | –    | VDD       | V          | IOL = -2 mA     |
| $Z_{INT} = 50 \Omega$  |        | 2.4       | –    | VDD       | V          | IOL = -8 mA     |
| Pull-Up Resistance     | Rpu    | 50        | –    | 200       | k $\Omega$ |                 |
| Pull-Down Resistance   | Rpd    | 50        | –    | 200       | k $\Omega$ |                 |

Test Conditions unless otherwise stated: VDD = +3.3  $\pm$  0.3 VDC; TA = 0°C to 70°C; external load = 50 pF.

## 3.2 CX20493 LSD Hardware Pins and Signals

### 3.2.1 CX20493 LSD Signal Summary

#### 3.2.1.1 CX81801 Interface (Through DIB)

The DIB interface, power, and ground signals are:

- Clock (CLK, pin 26); input
- Digital Power (PWR+, pin 7); unregulated input power
- Regulated Digital Voltage Supply (DVdd, pin 24)
- Digital Ground (DGnd, pin 23); digital ground
- Regulated Analog Voltage Supply (AVdd, pin 2)
- Analog Ground (AGnd, pin 6); analog ground
- Data Positive (DIB\_P, pin 27); input/output
- Data Negative (DIB\_N, pin 28); input/output

#### 3.2.1.2 Telephone Line Interface

The telephone line interface signals are:

- RING 1 AC Coupled (RAC1, pin 21); input
- TIP 1 AC Coupled (TAC1, pin 20); input
- RING 2 AC Coupled (RAC2, pin 19); input
- TIP 2 AC Coupled (TAC2, pin 18); input
- TIP and RING DC Measurement (TRDC, pin 12); input
- Electronic Inductor Capacitor (EIC, pin 11)
- Electronic Inductor Output (EIO, pin 17)
- Electronic Inductor Feedback (EIF, pin 16)
- Receive Analog Input (RXI, pin 9); input
- Transmit Output (TXO, pin 14); output
- Transmit Feedback (TXF, pin 13); input
- Virtual Impedance 0 (VZ, pin 10); input
- Electronic Inductor Ground (DC\_GND, pin 15)

#### 3.2.1.3 Voltage References

There are three reference voltage pins:

- Output Middle (Center) Reference Voltage (Vc, pin 3); output for decoupling
- Output Reference Voltage (VRef, pin 4); output for decoupling
- Bias Resistor (RBias, pin 5); input

### 3.2.1.4 General Purpose Input/Output

There is one unassigned general purpose input/output pin:

- General Purpose Input/Output 1 (GPIO1, pin 1); input/output

### 3.2.1.5 No Connects

Three pins are not used:

- No Connect 1 (NC1, pin 8); no internal connection
- No Connect 2 (NC2, pin 22); no internal connection
- No Connect 3 (NC3, pin 25); no internal connection

## 3.2.2 CX20493 LSD Pin Assignments and Signal Definitions

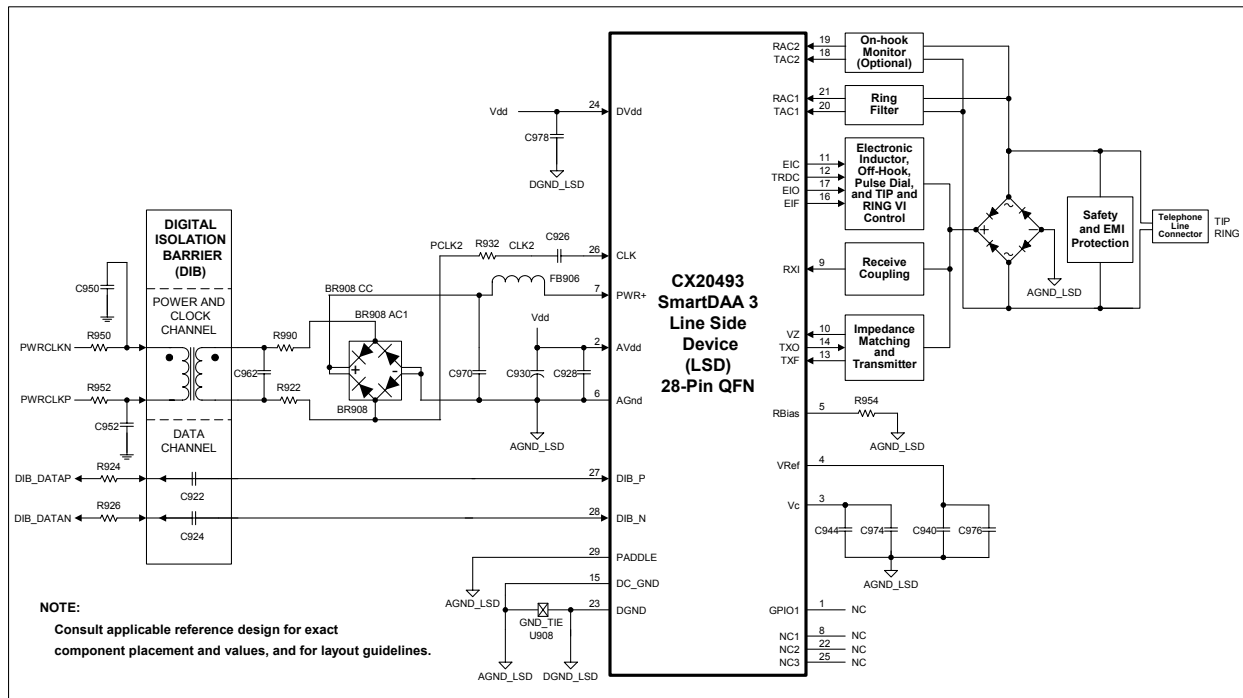
CX20493 LSD hardware interface signals are shown by major interface in Figure 3-3, are shown by pin number in Figure 3-4, and are listed by pin number in Table 3-5.

CX20493 LSD hardware interface signals are defined in Table 3-6.

CX20493 LSD GPIO DC electrical characteristics are specified in Table 3-7.

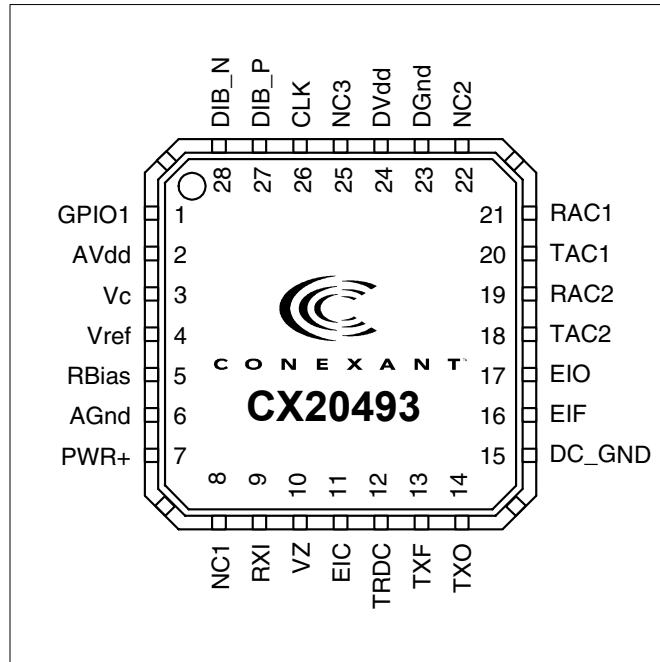
CX20493 LSD AVdd DC electrical characteristics are listed in Table 3-8.

Figure 3-3. CX20493 LSD Hardware Interface Signals



101701\_006

Figure 3-4. CX20493 LSD 28-Pin QFN Pin Signals



101701A\_007

Table 3-5. CX20493 LSD 28-Pin QFN Pin Signals

| Pin | Signal Label | Pin | Signal Label |
|-----|--------------|-----|--------------|
| 1   | GPIO1        | 15  | DC_GND       |
| 2   | AVdd         | 16  | EIF          |
| 3   | Vc           | 17  | EIO          |
| 4   | VRef         | 18  | TAC2         |
| 5   | RBias        | 19  | RAC2         |
| 6   | AGnd         | 20  | TAC1         |
| 7   | PWR+         | 21  | RAC1         |
| 8   | NC1          | 22  | NC2          |
| 9   | RXI          | 23  | DGnd         |
| 10  | VZ           | 24  | DVdd         |
| 11  | EIC          | 25  | NC3          |
| 12  | TRDC         | 26  | CLK          |
| 13  | TXF          | 27  | DIB_P        |
| 14  | TXO          | 28  | DIB_N        |

Table 3-6. CX20493 LSD Hardware Signal Definitions

| Label                        | Pin | I/O      | I/O Type | Signal Name/Description  |
|------------------------------|-----|----------|----------|--|
| <b>System Signals</b>        |     |          |          |  |
| AVdd                         | 2   | PWR      | PWR      | <b>Regulated Power Output.</b> Provides external power for LSD digital circuits and a connection point for external decoupling. (AVdd is routed internally to LSD analog circuits.) See PWR+ pin description. Connect to LSD DVdd pin and connect to AGND_LSD through C928 and C930 in parallel. C928 and C930 must be placed close to pins 2 and 6. C930 must have ESR < 2 Ω.   |
| AGnd                         | 6   | AGND_LSD | AGND_LSD | <b>Analog Ground.</b> Connect to minus (-) terminal of full wave rectifier (FWR). Connect FWR BR980 terminal to DIB transformer secondary winding undotted terminal through R922.  |
| VRef                         | 4   | REF      | REF      | <b>Output Reference Voltage.</b> Connect to AGND_LSD through C940 and C976, which must be placed close to pin 4. Ensure a very close proximity between C940 and the VRef pin. C940 must have a maximum ESR of 2 Ω.   |
| Vc                           | 3   | REF      | REF      | <b>Output Middle Reference Voltage.</b> Connect to AGND_LSD through C944 and C974, which must be placed close to pin 3. Ensure a very close proximity between C944 and the Vc pin. Use a short path and a wide trace to AGND_LSD pin.  |
| PWR+                         | 7   | PWR      | PWR      | <b>Unregulated Power Input.</b> Provides unregulated input power to the LSD. PWR+ pin is an input which takes unregulated +3.2V to +4.5V from the DIB power supply made up of the transformer, full-wave rectifier, and filter capacitors. The PWR+ input is regulated by an internal linear regulator to +3.3V ± 5% which is routed to the AVdd pin. If PWR+ is less than +3.4V, then AVdd is equal to the unregulated PWR+ input value minus 150 mV (Table 3-8).<br>Connect to plus (+) terminal of FWR. Connect terminal BR908 AC1 to DIB transformer secondary winding dotted terminal through R990. Connect transformer side of FB906 to AGND_LSD through C970. Place FB906 and C970 close to pin 7 and pin 6 (AGnd). |
| DVdd                         | 24  | PWR      | PWR      | <b>Digital Power Input.</b> Input power for LSD digital circuits. Connect to LSD AVdd pin and connect to DGND_LSD through C978. Place C978 near pin 24.  |
| DGnd                         | 23  | DGND_LSD | DGND_LSD | <b>LSD Digital Ground.</b> Connect to DGND_LSD, and to AGND_LSD at the DGND_LSD/AGND_LSD tie point (U908).   |
| PADDLE                       | —   | AGND_LSD | AGND_LSD | <b>Paddle Ground.</b> Referred to as pin 29 in schematics. Connect to AGND_LSD.  |
| <b>DIB Interface Signals</b> |     |          |          |  |
| CLK                          | 26  | I        | I        | <b>Clock.</b> Provides input clock, AC coupled to the LSD. Connect to DIB transformer secondary winding undotted terminal through C926 (closest to the CX20493), R932, then R922 in series. Connect the R932 and R922 node to LSD AGND pin through full-wave rectifier BR908. Place C926 near pin 26 and place R932 near C926.   |
| DIB_P                        | 27  | I/O      | I/O      | <b>Data and Control Positive.</b> Connect to DIBDAT_P through R924 in series with C922. DIB_P and DIB_N signals are differential and half-duplex bidirectional.  |
| DIB_N                        | 28  | I/O      | I/O      | <b>Data and Control Negative.</b> Connect to DIBDAT_N through R926 in series with C924. DIB_P and DIB_N signals are differential and half-duplex bidirectional.  |

Table 3-6. CX20493 LSD Hardware Signal Definitions (Continued)

| Label   | Pin      | I/O    | I/O Type | Signal Name/Description  |
|---|----------|--------|----------|--|
| <b>TIP and RING Interface</b>   |          |        |          |  |
| RAC1<br>TAC1  | 21<br>20 | I<br>I | Ia<br>Ia | <b>RING1 AC Coupled and TIP1 AC Coupled.</b> AC-coupled voltage from telephone line used to detect ring.<br>Connect RAC1 to the diode bridge AC node (RING) through R902 (connects to pin 21) and C902 in series.<br>Connect TAC1 to the diode bridge AC node (TIP) through R904 (connects to pin 20) and C904 in series.  |
| RAC2<br>TAC2  | 19<br>18 | I<br>I | Ia<br>Ia | <b>RING2 AC Coupled and TIP2 AC Coupled.</b> AC-coupled voltage from telephone line used to optionally detect signal while on-hook.<br>Connect RAC2 to the diode bridge AC node (RING) through R948 (connects to pin 19) and C948. Leave open if not used.<br>Connect TAC2 to the diode bridge AC node (TIP) through R946 (connects to pin 21) and C946. Leave open if not used. |
| EIC   | 11       | O      | Oa       | <b>Electronic Inductor Capacitor Switch.</b> Internally switched to TRDC when pulse dialing. Connect to AGND_LSD through C958.   |
| TRDC  | 12       | I      | Ia       | <b>TIP and RING DC Measurement.</b> Input on-hook voltage (from a resistive divider). Used internally to extract TIP and RING DC voltage and Line Polarity Reversal (LPR) information. R906 and C918 must be placed very close to pin 12.  |
| EIO   | 17       | O      | Oa       | <b>Electronic Inductor Output.</b> Calculated voltage is applied to this output to control off-hook and DC VI mask operation. Connect to base of Q902.   |
| DC_GND  | 15       | GND    | AGND_LSD | <b>LSD Electronic Inductor Ground.</b> Connect to AGND_LSD and to the GND_LSD/AGND_LSD tie point (U908).   |
| EIF   | 16       | I      | Ia       | <b>Electronic Inductor Feedback.</b> Connect to emitter of Q904 through R968.  |
| RXI   | 9        | I      | Ia       | <b>Receive Analog Input.</b> Receiver operational amplifier inverting input. AC coupled to the Bridge CC node through R910 (connects to pin 9) and C912 in series. R910 and C912 must be placed very close to pin 9. The length of the PCB trace connecting R910 to the RXI pin must be kept at an absolute minimum.   |
| RBias   | 5        | I      | Ia       | <b>Receiver Bias.</b> Connect to AGND_LSD through R954, which must be placed close to pin 5.   |
| VZ  | 10       | I      | Ia       | <b>Virtual Impedance.</b> Input signal used to provide line complex impedance matching for worldwide countries. AC coupled to Bridge CC node through R908 (connects to pin 10) and C910 in series. R908 and C910 must be placed very close to pin 10. The length of the PCB trace connecting R908 to the VZ pin must be kept at an absolute minimum.                             |
| TXO   | 14       | O      | Oa       | <b>Transmit Output.</b> Outputs transmit signal and impedance matching signal; connect to base of transmitter transistor Q906.   |
| TXF   | 13       | I      | Ia       | <b>Transmit Feedback.</b> Connect to emitter of transmitter transistor Q906.   |
| <b>Not Used</b>   |          |        |          |  |
| GPIO1   | 1        | I/O    | It/Ot12  | <b>General Purpose I/O 1.</b> Leave open if not used.  |
| NC1   | 8        |        |          | <b>No Connect.</b> No internal connection. Leave open.   |
| NC2   | 22       |        |          | <b>No Connect.</b> No internal connection. Leave open.   |
| NC3   | 25       |        |          | <b>No Connect.</b> No internal connection. Leave open.   |
| <b>Notes:</b>   |          |        |          |  |
| 1. I/O types*:  |          |        |          |  |
| Ia                   Analog input   |          |        |          |  |
| It                   Digital input, TTL-compatible                                      |          |        |          |  |
| Oa                   Analog output  |          |        |          |  |
| Ot12                Digital output, TTL-compatible, 12 mA, Z <sub>INTERNAL</sub> = 32 Ω |          |        |          |  |
| AGND_LSD        Isolated LSD Analog Ground  |          |        |          |  |
| GND_LSD         Isolated LSD Digital Ground   |          |        |          |  |
| *See CX20493 LSD GPIO DC Electrical Characteristics (Table 3-7)                         |          |        |          |  |
| 2. Refer to applicable reference design for exact component placement and values.       |          |        |          |  |

**Table 3-7. CX20493 LSD GPIO DC Electrical Characteristics**

| Parameter  | Symbol   | Min.  | Typ. | Max.  | Units   | Test Conditions |
|--|----------|-------|------|-------|---------|-----------------|
| Input Voltage  | $V_{IN}$ | -0.30 | –    | 3.465 | V       | DVdd = +3.465V  |
| Input Voltage Low  | $V_{IL}$ | –     | –    | 1.0   | V       |                 |
| Input Voltage High   | $V_{IH}$ | 1.6   | –    | –     | V       |                 |
| Output Voltage Low   | $V_{OL}$ | 0     | –    | 0.33  | V       |                 |
| Output Voltage High  | $V_{OH}$ | 2.97  | –    | –     | V       |                 |
| Input Leakage Current  | –        | -10   | –    | 10    | $\mu$ A |                 |
| Output Leakage Current (High Impedance)  | –        | -10   | –    | 10    | $\mu$ A |                 |
| GPIO Output Sink Current at 0.33 V maximum   | –        | 2.4   | –    | –     | mA      |                 |
| GPIO Output Source Current at 2.97 V minimum   | –        | 2.4   | –    | –     | mA      |                 |
| GPIO Rise Time/Fall Time   |          | 20    |      | 100   | ns      |                 |
| Test Conditions unless otherwise stated: DVdd = +3.3V +5%; TA = 0°C to 70°C; external load = 50 pF |          |       |      |       |         |                 |

**Table 3-8. CX20493 AVdd DC Electrical Characteristics**

| PWR+ Input  | AVdd Output          |
|---|----------------------|
| +3.4V < PWR+ < +4.5V                                | +3.3V $\pm$ 5%       |
| +3.2V < PWR+ < +3.39V                               | 3.05V < AVdd < 3.24V |
| See PWR+, AVdd, and DVdd descriptions in Table 3-6. |                      |

## 3.3 Electrical and Environmental Specifications

### 3.3.1 Operating Conditions, Absolute Maximum Ratings, and Power Requirements

The operating conditions are specified in Table 3-9.

The absolute maximum ratings are listed in Table 3-10.

The current and power requirements are listed in Table 3-11.

**Table 3-9. Operating Conditions**

| Parameter                     | Symbol         | Limits       | Units |
|-------------------------------|----------------|--------------|-------|
| Supply Voltage                | VDD            | +3.0 to +3.6 | VDC   |
| Operating Ambient Temperature | T <sub>A</sub> | 0 to +70     | °C    |

**Table 3-10. Absolute Maximum Ratings**

| Parameter  | Symbol            | Limits       | Units |
|--|-------------------|--------------|-------|
| Supply Voltage   | VDD               | -0.5 to +4.0 | VDC   |
| Input Voltage  | V <sub>IN</sub>   | -0.5 to +5.5 | VDC   |
| Storage Temperature Range                                | T <sub>STG</sub>  | -55 to +125  | °C    |
| Voltage Applied to Outputs in High Impedance (Off) State | V <sub>HZ</sub>   | -0.5 to +5.5 | VDC   |
| DC Input Clamp Current                                   | I <sub>IK</sub>   | ±20          | mA    |
| DC Output Clamp Current                                  | I <sub>OK</sub>   | ±20          | mA    |
| Static Discharge Voltage (25°C)                          | V <sub>ESD</sub>  | ±2500        | VDC   |
| Latch-up Current (25°C)                                  | I <sub>TRIG</sub> | ±400         | mA    |

### Handling CMOS Devices

The device contains circuitry to protect the inputs against damage due to high static voltages. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltage.

An unterminated input can acquire unpredictable voltages through coupling with stray capacitance and internal cross talk. Both power dissipation and device noise immunity degrades. Therefore, all inputs should be connected to an appropriate supply voltage.

Input signals should never exceed the voltage range from -0.5V to +5.5V. This prevents forward biasing the input protection diodes and possibly entering a latch up mode due to high current transients.

**Table 3-11. Current and Power Requirements**

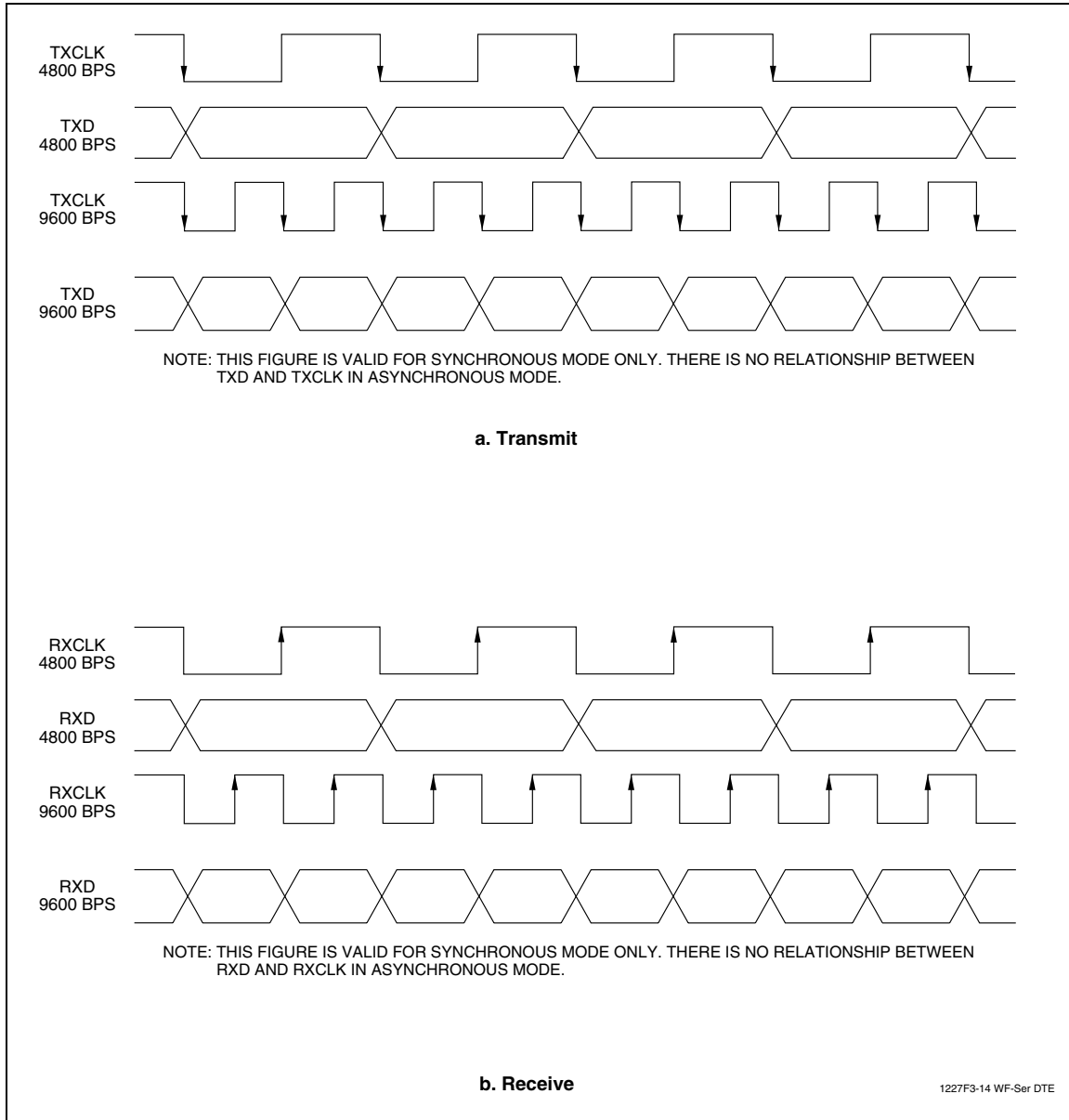
| Mode   | Typical Current (I <sub>typ</sub> ) (mA) | Maximum Current (I <sub>max</sub> ) (mA) | Typical Power (P <sub>typ</sub> ) (mW) | Maximum Power (P <sub>max</sub> ) (mW) | Notes          |
|--|--|--|--|--|----------------|
| Normal Mode: Off-hook, normal data connection  | TBD                                      | TBD                                      | TBD                                    | TBD                                    | f = 28.224 MHz |
| Normal Mode: On-hook, idle, waiting for ring   | TBD                                      | TBD                                      | TBD                                    | TBD                                    | f = 28.224 MHz |
| Sleep Mode   | TBD                                      | TBD                                      | TBD                                    | TBD                                    | f = 0 MHz      |
| <b>Notes:</b> <ol style="list-style-type: none"> <li>1. Operating voltage: VDD = +3.3V ± 0.3V.</li> <li>2. Test conditions: VDD = +3.3V for typical values; VDD = +3.6V for maximum values.</li> <li>3. Input Ripple ≤ 0.1 V<sub>peak-peak</sub>.</li> <li>4. f = Internal frequency.</li> <li>5. Maximum current computed from I<sub>typ</sub>: I<sub>max</sub> = I<sub>typ</sub> * 1.1.</li> <li>6. Typical power (P<sub>typ</sub>) computed from I<sub>typ</sub>: P<sub>typ</sub> = I<sub>typ</sub> * 3.3V; Maximum power (P<sub>max</sub>) computed from I<sub>max</sub>: P<sub>max</sub> = I<sub>max</sub> * 3.6V.</li> </ol> |  |  |  |  |                |

### 3.3.2 Interface and Timing Waveforms

#### 3.3.2.1 Serial DTE Interface

The serial DTE interface waveforms for 4800 and 9600 bps are illustrated in Figure 3-5.

Figure 3-5. Waveforms - Serial DTE Interface



## 3.4 Crystal Specifications

Crystal specifications are listed in Table 3-12.

**Table 3-12. Crystal Specifications**

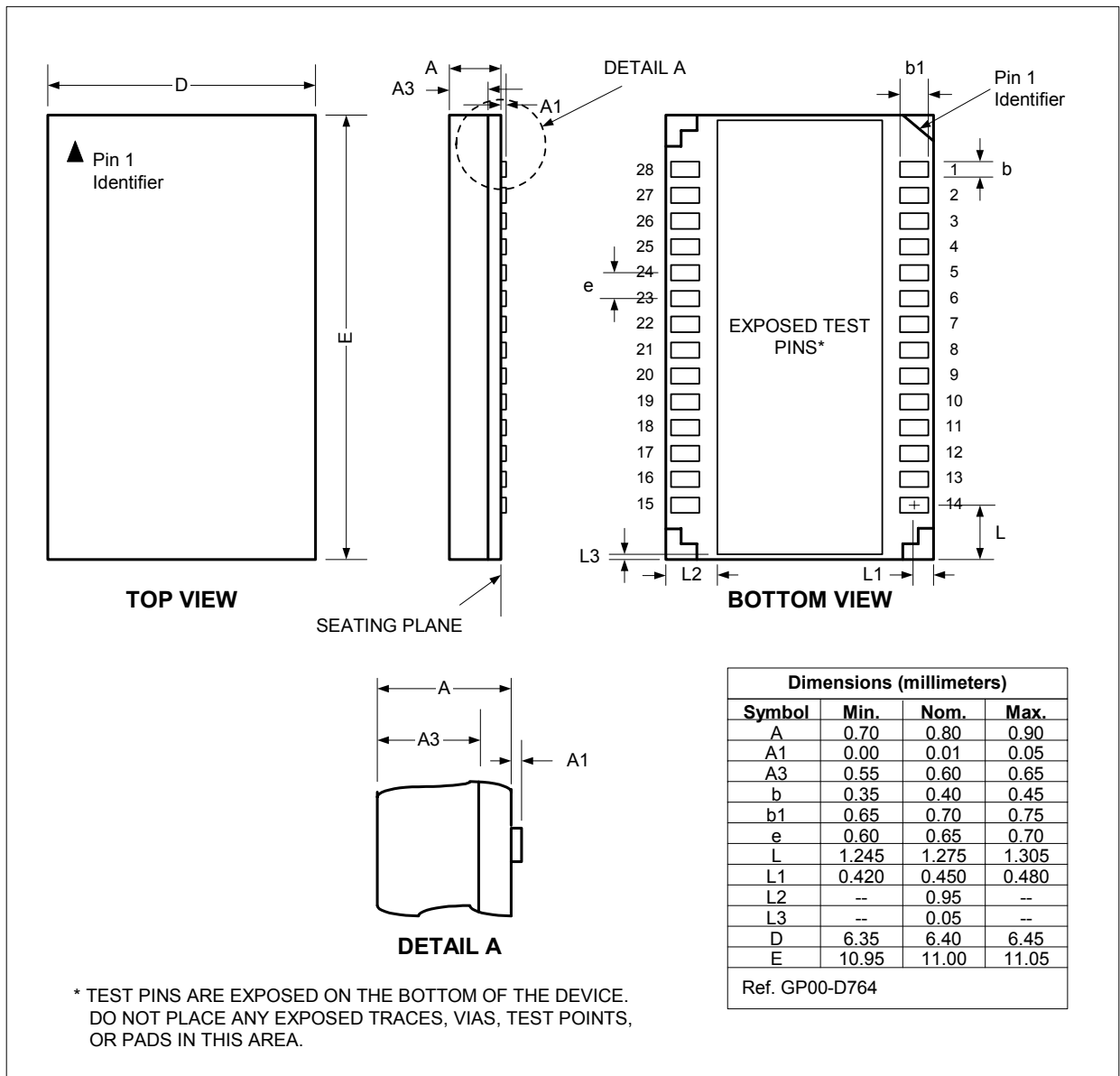
| Characteristic                      | Value   |
|-------------------------------------|---|
| Frequency                           | 28.224 MHz nominal                            |
| Calibration Tolerance               | ±50 ppm at 25°C ( $C_L = 16.5$ and $19.5$ pF) |
| Frequency Stability vs. Temperature | ±35 ppm (0°C to 70°C)                         |
| Frequency Stability vs. Aging       | ±20 ppm/5 years                               |
| Oscillation Mode                    | Fundamental                                   |
| Calibration Mode                    | Parallel resonant                             |
| Load Capacitance, $C_L$             | 18 pF nom.                                    |
| Shunt Capacitance, $C_O$            | 7 pF max.                                     |
| Series Resistance, $R_1$            | 35-60 $\Omega$ max. @20 nW drive level        |
| Drive Level                         | 100 $\mu$ W correlation; 500 $\mu$ W max.     |
| Operating Temperature               | 0°C to 70°C                                   |
| Storage Temperature                 | -40°C to 85°C                                 |

## 4. Package Dimensions

The 28-pin CTLGA package dimensions are shown in Figure 4-1.

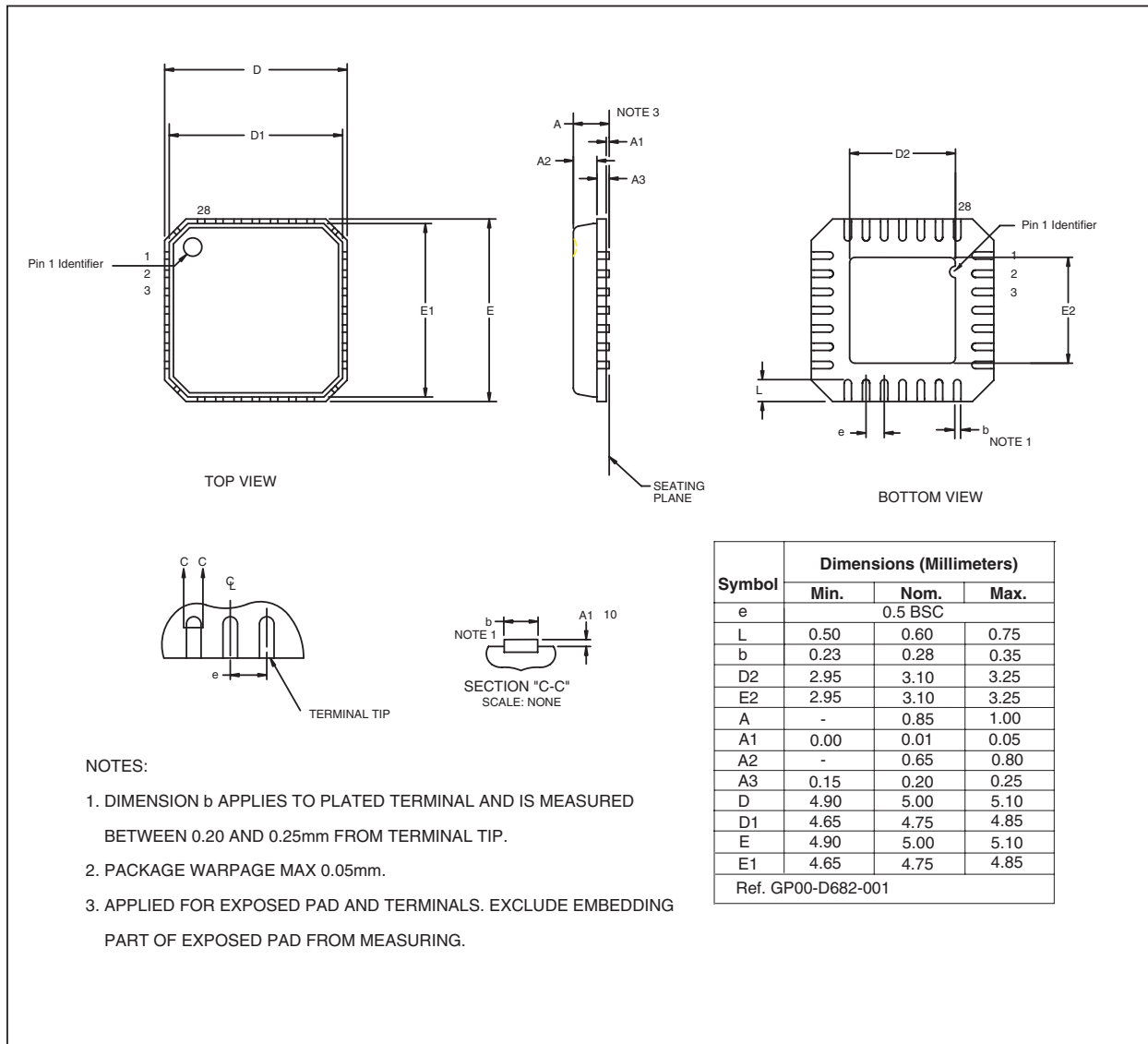
The 28-pin QFN package dimensions are shown in Figure 4-2.

Figure 4-1. Package Dimensions - 28-Pin CTLGA



PD\_GP00\_D764

Figure 4-2. Package Dimensions - 28-Pin QFN



PD\_GP00-D682-001

# NOTES

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