SmartV.XX Modem with 28-Pin CTLGA

V.90+/V.34/V.32bis CX81801 Smart Modem with CX20493 SmartDAA®

Data Sheet

Doc. No. 102025G
February 24, 2003

CONEXANT™

Revision Record

Revision	Date	Comments
G	2/24/2003	Rev. G release.
F	12/10/2002	Rev. F release.
E	12/6/2002	Rev. E release.
D	11/20/2002	Rev. D release.
C	8/17/2002	Rev. C release.
B	8/14/2002	Rev. B release.
A	5/17/2002	Initial release.

Reader Response: Conexant strives to produce quality documentation and welcomes your feedback. Please send comments and suggestions to tech.pubs@conexant.com. For technical questions, contact your local Conexant sales office or field applications engineer.

Contents

Figures

Tables

Revision History

Changes Incorporated in Doc. No. 102025G

1. Section 1.1: Removed V.22 bis fast connect support.
2. Section 1.2.1: Removed V.22 bis fast connect support.
3. Section 1.3.3.1: Removed V.22 bis fast connect support.

Changes Incorporated in Doc. No. 102025E

1. Figure 3-1: Revised pin 14 connection.
2. Table 3-2: Revised pin 14 definition.
3. Figure 4-1: Revised.
4. Figure 4-2: Revised.

Changes Incorporated in Doc. No. 102025D

Table 1-1: Revised part numbers.

Changes Incorporated in Doc. No. 102025C

Figure 3-2: Corrected signals on pins 15-28.

This page is intentionally blank.

1. Introduction

1.1 Overview

The Conexant™ SmartV.XX Modem supports V.90 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 (patent pending) 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 Smart 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 Smart 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 packages with low profile and reduce voltage operation with low power consumption make this device set an ideal solution for embedded and palmtop applications using serial DTE interface.

In V.90 (V.90+ models) data mode, the modem can receive data at speeds up to 56 kbps from a digitally connected V.90-compatible central site modem. A 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, the modem can transmit data at speeds up to V.34 rates.

In V.34 data mode (V.90+ 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 lines speeds up to 14.4 kbps.

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. 100722).

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

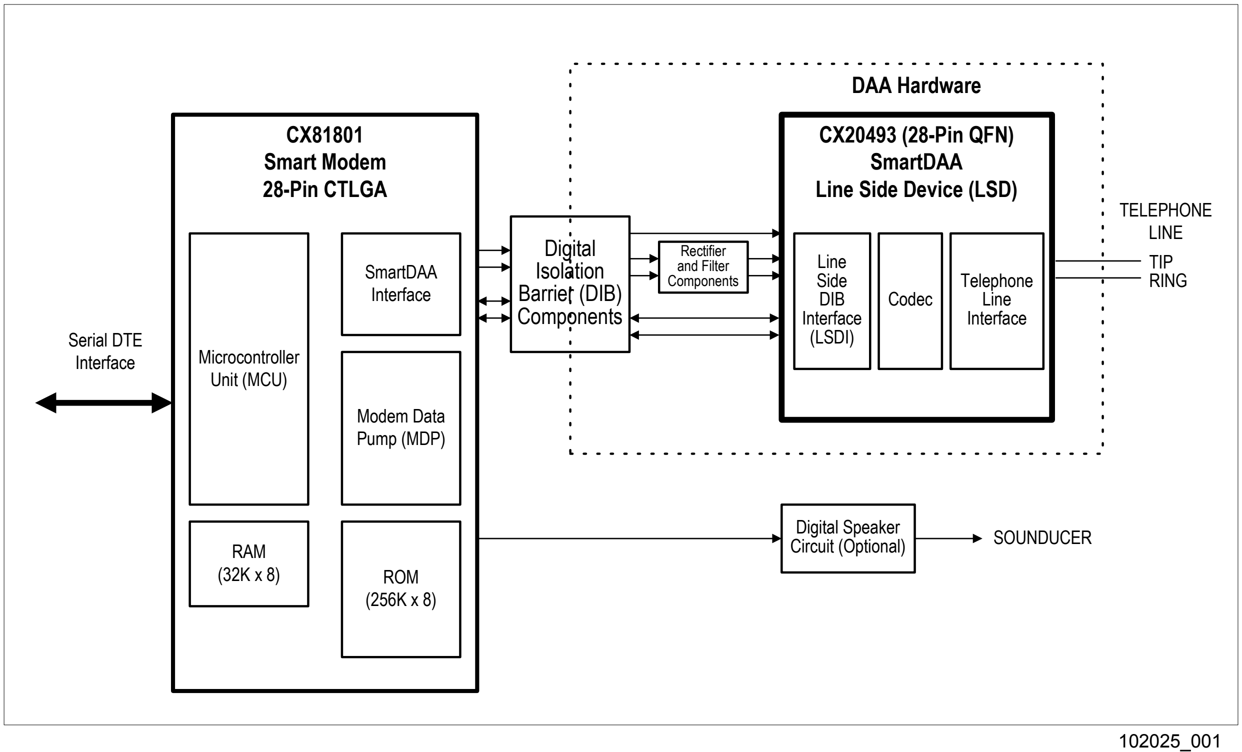
Model/Order/Part Numbers				Supported Functions		
Marketing Name	**Device Set Order No.**	**Smart Modem [28-Pin CTLGA] Part No.**	**Line Side Device (LSD) [28-Pin QFN] Part No.**	**V.90 Data, QC, MOH**	**V.34 Data**	**V.32 bis Data, V.44 Data Compression, V.17 Fax, TAM, World-wide**
SmartV.90+	DS56-L147-091	CX81801-64	CX20493-21	Y	Y	Y
SmartV.34	DS28-L147-091	CX81801-62	CX20493-21	—	Y	Y
SmartV.32bis	DS96-L147-091	CX81801-63	CX20493-21	—	—	Y

Notes:

Supported functions (Y = Supported; — = Not supported).

QC, MOH	QuickConnect and Modem-on-Hold™
TAM	Telephone answering machine (Voice playback and record through telephone line)
FDSP	Full-duplex speakerphone and voice playback and record through telephone line, handset, and mic/speaker

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



1.2 Features

1.2.1 General Modem Features

- Data modem
  - QuickConnect and Modem-on-Hold™ functions (V.90+ models)
  - ITU-T V.90 (V.90+ models), V.34 (V.90+ and V.34 models), V.32bis, V.32, V.22 bis, V.22, 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
  - Caller ID detection for many countries
  - Call progress, blacklisting
  - Internal ROM includes default values for 29 countries
  - Additional modified country profiles 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.90, 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/sync data
- Thin packages support low profile designs (1.0 mm max. height)

  - CX81801 Smart Modem in 28-pin CTLGA
  - CX20493 LSD in 28-pin QFN
- +3.3V operation with +5V tolerant digital inputs
- Typical power use
  - 220 mW (Normal Mode); 56 mW (Sleep Mode)

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 VI masks requirements

1.2.3 Applications

- Embedded systems
- Handheld computers
- Gaming devices
- Point of sale terminals
- Remote monitoring and data collection systems

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 MCU Firmware

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, voice/audio/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.90 data modem mode (V.90+ models), the modem can receive data from a digital source using a V.90-compatible central site modem at line speeds up to 56 kbps. Asymmetrical data transmission supports sending data at line speeds up to V.34 rates. This mode can fallback to full-duplex V.34 mode and to lower rates as dictated by line conditions.

The following modes are also supported in V.90+ models:

- QuickConnect 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.

In V.34 data modem mode (V.90+ 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. Additional country profiles can be stored in internal SRAM (request additional country profiles from a Conexant Sales Office). Duplicate country profiles stored in internal SRAM will override the profiles in internal RAM firmware. The default countries supported are listed in Table 1-2.

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		
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	
Greece	46	X		
India	53		X	
Ireland	57			
Italy	59	X		
Japan	00	X	X	X
Korea	61	X		
Malaysia	6C	X		
Mexico	73			
Netherlands	7B			
Norway	82	X		
Poland	8A	X		
Portugal	8B	X		
Singapore	9C	X	X	X
South Africa	9F	X		
Spain	A0	X		
Sweden	A5	X		
Switzerland	A6	X		
Taiwan	FE	X	X	
United Kingdom	B4	X	X	X
United States	B5	X	X	X

1.3.4 Reference Designs

A data/fax/TAM reference design (RD01-Dxxx) for an external modem is available to minimize application design time, reduce development cost, and accelerate market entry. These designs are:

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 format, and complete documentation.

1.4 Hardware Description

SmartDAA™ technology (patent pending) 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 Smart Modem

The CX81801 Smart 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 Smart Modem connects to host via a logical V.24 (EIA/TIA-232-E) serial DTE interface.

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

The Smart 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 Smart Modem from the LSD and telephone line. The Smart 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 Smart Modem to the LSD.

The DIB data channel supports bidirectional half-duplex serial transfer of data, control, and status information between the Smart Modem 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 Smart Modem through the DIB.

LSD power is received from the MDP PWRCLKP and PWRCLKN pins via the DIB through a half-wave rectifying diode 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 Smart Modem through the DIB_P and DIB_N pins. These pins connect to the Smart Modem 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), MNP 10/MNP 10EC, and V.80 commands, and S Registers in accordance with modem model options. See Doc. No. 100722 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.

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

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.

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 (No. of Bits)	No. of Stop Bits	Character Length (No. of Bits)
None	7	2	10
Odd	7	1	10
Even	7	1	10
None	8	1	10
Odd	8	1	11*
Even	8	1	11*
*11-bit characters are sensed, but the parity 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 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 32 characters (including the command line terminating carriage return) 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.

2.2.2 Dialing

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

2.2.3 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.

2.2.4 Call Progress Tone Detection

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

2.2.5 Answer Tone Detection

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

2.2.6 Ring Detection

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

2.2.7 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.

2.2.8 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).

2.2.9 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).

Table 2-1. +MS Command Automode Connectivity

<mod>	Modulation	Possible Rates (bps) [1]	Notes
V21	V.21	300	
V22	V.22	1200	
V22B	V.22 bis	2400 or 1200	
V23	V.23	1200	See Note 2
V32	V.32	9600 or 4800	
V32B	V.32 bis	14400, 12000, 9600, 7200, or 4800	Default for V.32 bis models
V34	V.34	33600, 31200, 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, or 2400	Default for V.34 models
V90	V.90	56000, 54667, 53333, 52000, 50667, 49333, 48000, 46667, 45333, 44000, 42667, 41333, 40000, 38667, 37333, 36000, 34667, 33333, 32000, 30667, 29333, 28000	Default for V.90+ models
B103	Bell 103	300	
B212	Bell 212	1200	

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. V.23 half duplex is not supported.
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.

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.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 (except MNP 10).

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

During initial handshake, the modem will fallback to the optimal line connection within 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.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 Modem-on-Hold

The Modem-on-Hold (MOH) function (V.90+ 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.

2.5 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 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 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 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.

2.7 Telephony Extensions

The following telephony extension features are supported and can be typically be 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

2.7.1 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”.

2.7.2 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.

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.

2.7.3 Remote Hangup Detection

The Remote Hangup Detection feature will cause the modem go back onhook 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.

2.8 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.

2.9 Voice/Audio Mode

Voice and audio 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 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.

2.9.6 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.

2.9.7 Speakerphone Modes

Speakerphone modes are controlled in voice mode with the following commands:

Use Speakerphone After Dialing or Answering (+VSP=1). +VSP=1 selects speakerphone mode while in +FCLASS=8 mode. Speakerphone operation is entered during Voice Online Command mode after completing dialing or answering.

Speakerphone Settings. The +VGM and +VGS commands can be used to control the microphone gain and speaker volume, respectively. VGM and +VGS commands are valid only after the modem has entered the Voice Online mode while in the +VSP=1 setting.

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.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 are supported for many countries. Consult firmware release notes for a list of the supported countries and the criteria 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").

These country profiles may be altered or customized by modifying the country-dependent parameters. Additional profiles may also be included. There are two ways to add or modify profiles:

- Incorporating additional or modified profiles into external flash ROM containing the entire modem firmware code.
- Linking additional or modified profiles from an external serial EEPROM (needed only if the external flash ROM capacity is exceeded.

Please contact an FAE at the local Conexant sales office if a country code customization is required.

2.12 Diagnostics

2.12.1 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.

2.12.2 Power On Reset Tests

Upon power on, the modem performs tests of the modem, internal and external RAM, and NVRAM. If the modem, internal RAM, or external RAM test fails, the TMIND# output is pulsed as follows:

- Internal or external 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.

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.

2.13 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

3.1 CX81801 Smart Modem Hardware Pins and Signals

3.1.1 CX81801 Smart 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#)

Additional clock signals provided for synchronous mode are:

- Receive Data Clock (RXCLK#)
- Transmit Data Clock (TXCLK#)

3.1.2 CX81801 Smart Modem Pin Assignments and Signal Definitions

CX81801 Smart 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 Smart 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 Smart Modem Hardware Signals

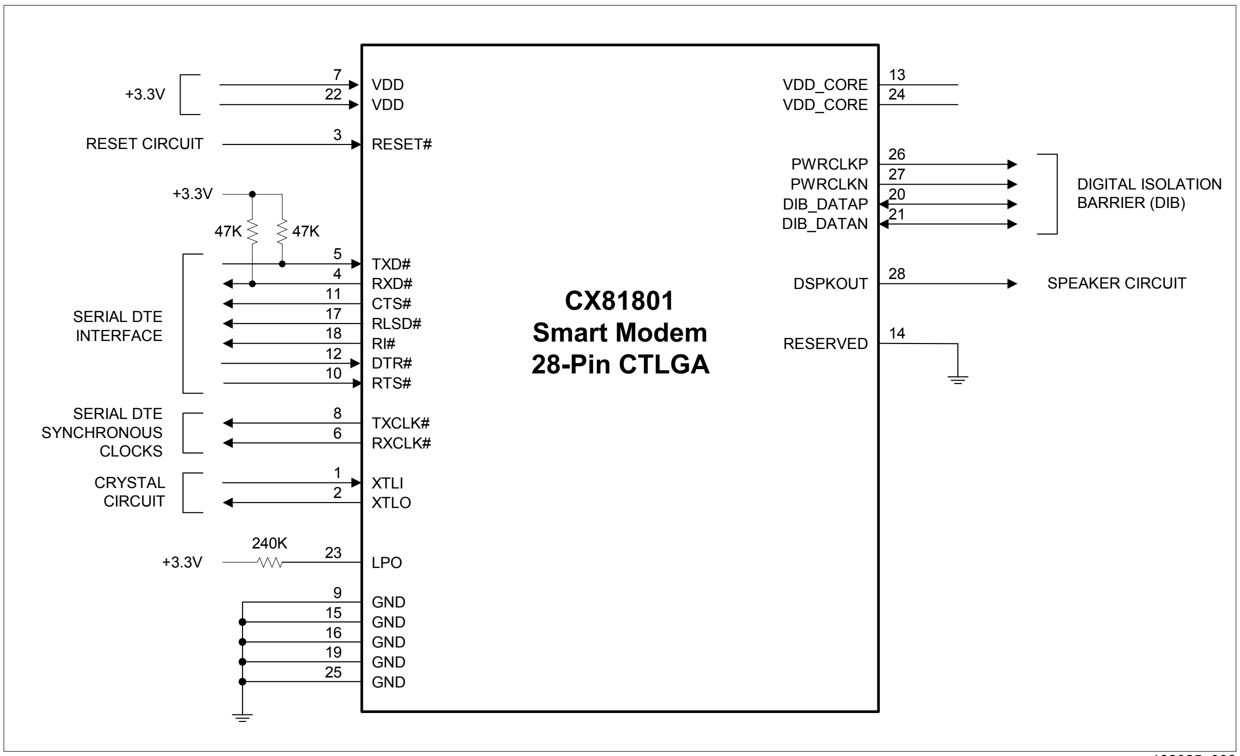


Figure 3-2. CX81801 Smart Modem 28-Pin CTLGA Pin Signals

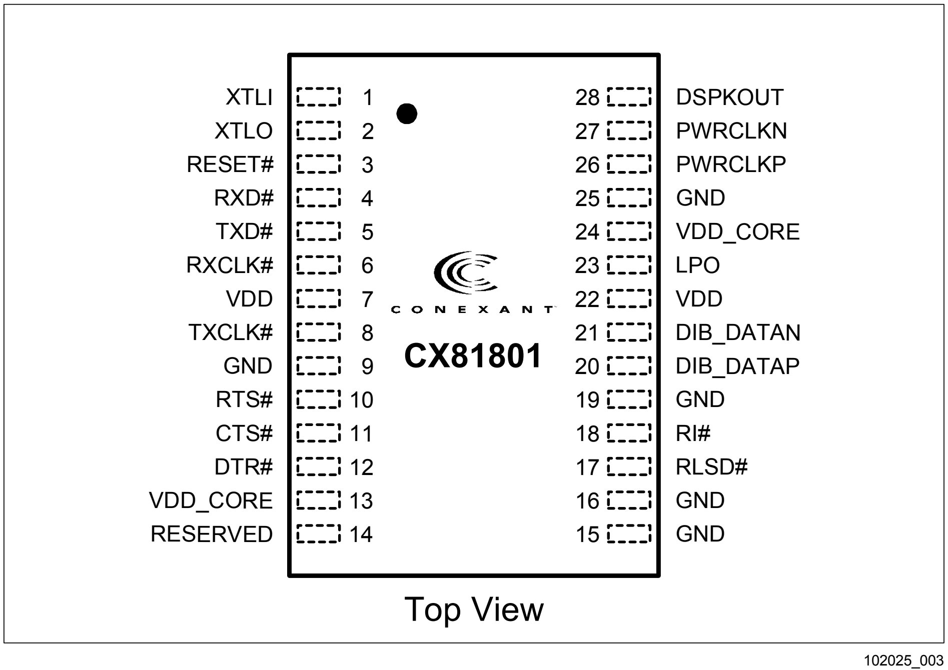


Table 3-1. CX81801 Smart Modem 28-Pin CTLGA Pin Signals

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	RXCLK#	20	DIB_DATAP
7	VDD	21	DIB_DATAN
8	TXCLK#	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 Smart Modem Pin Signal Definitions

Label	Pin	I/O	I/O Type	Signal Name/Description
				System
XTLI XTLO	1 2	I O	Ix, Ox	**Crystal In and Crystal Out.** Connect XTLI and XTLO to the external 28.224 MHz ± 0.01% crystal circuit.
RESET#	3	I	It	**Reset.** The active low RESET# input resets the Smart Modem logic and clears the internal SRAM. 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	**Digital Supply Voltage.** Connect to VCC (+3.3V, filtered).
VDD_CORE	13, 24	P	PWR	**Core Voltage.**
GND	9, 15, 16, 19, 25	G	GND	**Digital Ground.** Connect to digital ground (GND).
LPO	23	I	I/O	**Low Power Oscillator.** Connect to +3.3V through 240 KΩ.
				Speaker Interface
DSPKOUT	28	O	It/Ot2	**Modem Speaker Digital Output.** The DSPKOUT digital output reflects the received analog input signal digitized to TTL high or low level by an internal comparator.
				DIB Interface
PWRCLKP	26	O	Odpc	**Clock and Power Positive.** Provides clock and power to the LSD. Connect to DIB transformer primary winding non-dotted terminal.
PWRCLKN	27	O	Odpc	**Clock and Power Negative.** Provides clock and power to the LSD. Connect to DIB transformer primary winding dotted terminal.
DIB_DATAP	20	I/O	Idd/Odd	**Data Positive.** Transfers data, control, and status information between the Smart Modem and the LSD. Connect to LSD through DIB data positive channel components.
DIB_DATAN	21	I/O	Idd/Odd	**Data Negative.** Transfers data, control, and status information between the Smart Modem and the LSD. Connect to LSD through DIB data negative channel components.
				Reserved
RESERVED	14	I	Itpu	**Reserved.** Connect to GND.

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

Label	Pin	I/O	I/O Type	Signal Name/Description
V.24 (EIA/TIA-232-E) DTE Serial Interface				
TXD# (PA2)	5	I	It/Ot2	**Transmitted Data (EIA BA/ITU-T CT103).** 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	**Received Data (EIA BB/ITU-T CT104).** 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	Ith/Ot8	**Clear To Send (EIA CB/ITU-T CT106).** CTS# output ON (low) indicates that the modem is ready to accept data from the DTE. In asynchronous operation, in error correction or normal mode, CTS# is always ON (low) unless RTS/CTS flow control is selected by the &Kn command. In synchronous operation, the modem also holds CTS# ON during asynchronous command state. The modem turns CTS# OFF immediately upon going off-hook and holds CTS# OFF until both DSR# and RLSD# are ON and the modem is ready to transmit and receive synchronous data. The modem can also be commanded by the &Rn command to turn CTS# ON in response to an RTS# OFF-to-ON transition.
RLSD# (PC2)	17	O	Ith/Ot8	**Received Line Signal Detector (EIA CF/ITU-T CT109).** 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	Ith/Ot8	**Ring Indicator (EIA CE/ITU-T CT125).** RI# output ON (low) indicates the presence of an ON segment of a ring signal on the telephone line.
DTR# (PD4)	12	I	It	**Data Terminal Ready (EIA CD/ITU-T CT108).** 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	Ithpu	**Request To Send (EIA CA/ITU-T CT105).** RTS# input ON (low) indicates that the DTE is ready to send data to the modem. In the command state, the modem ignores RTS#. In asynchronous operation, the modem ignores RTS# unless RTS/CTS flow control is selected by the &Kn command. In synchronous on-line operation, the modem can be commanded by the &Rn command to ignore RTS# or to respond to RTS# by turning on CTS# after the delay specified by Register S26.
RXCLK# (P_PB01)	6	O	Itpu/Ot2	**Receive Data Clock.** A synchronous Receive Data Clock (RXCLK) is output in synchronous modes. The RXCLK frequency is the data rate (±0.01%) with a duty cycle of 50±1%. Leave open if not used.
TXCLK# (P_PA04)	8	O	Itpu/Ot2	**Transmit Data Clock.** A synchronous Transmit Data Clock (TXCLK) is output in synchronous modes. The TXCLK frequency is the data rate (±0.01%) with a duty cycle of 50±1%. Leave open if not used.
Notes: 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 Smart 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, +5V tolerant/ Digital output, 2 mA, Z_{INT} = 120 Ω
Itpu/Ot2	Digital input, +5V tolerant, 75k Ω pull up/ Digital output, 2 mA, Z_{INT} = 120 Ω
Ith/Ot8	Digital input, +5V tolerant, hysteresis/Digital output, 8 mA, Z_{INT} = 50 Ω
It	Digital input, +5V tolerant
Ith	Digital input, +5V tolerant, hysteresis
Itpu	Digital input, +5V tolerant, 75k Ω pull up
Ithpu	Digital input, +5V tolerant, hysteresis, 75k Ω pull up
Odpc	Digital output with adjustable drive, DIB clock and power
PWR	VCC Power
GND	Ground

NOTES:

1. See DC characteristics in Table 3-4.
2. 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 Smart Modem DC Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Input Voltage Low	VIL					
+5V tolerant		0	–	0.8	V	
+5V tolerant hysteresis		0	–	0.3 *VGG	V	
Input Voltage High	VIH		–		V	
+5V tolerant		2	–	5.25	V	
+5V tolerant hysteresis		0.7 * VDD	–	5.25	V	
Input Hysteresis	VH		–		V	
+3V hysteresis		0.5	–		V	
+5V tolerant, hysteresis		0.3	–		V	
Output Voltage Low	VOL					
Z_{INT} = 120 Ω		0	–	0.4	V	IOL = 2 mA
Z_{INT} = 50 Ω		0	–	0.4	V	IOL = 8 mA
Output Voltage High	VOH		–		V	
Z_{INT} = 120 Ω		2.4	–	VDD	V	IOL = -2 mA
Z_{INT} = 50 Ω		2.4	–	VDD	V	IOL = -8 mA
Pull-Up Resistance	Rpu	50	–	200	kΩ	
Pull-Down Resistance	Rpd	50	–	200	kΩ	
Test Conditions unless otherwise stated: VDD = +3.3 ± 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 Smart Modem 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

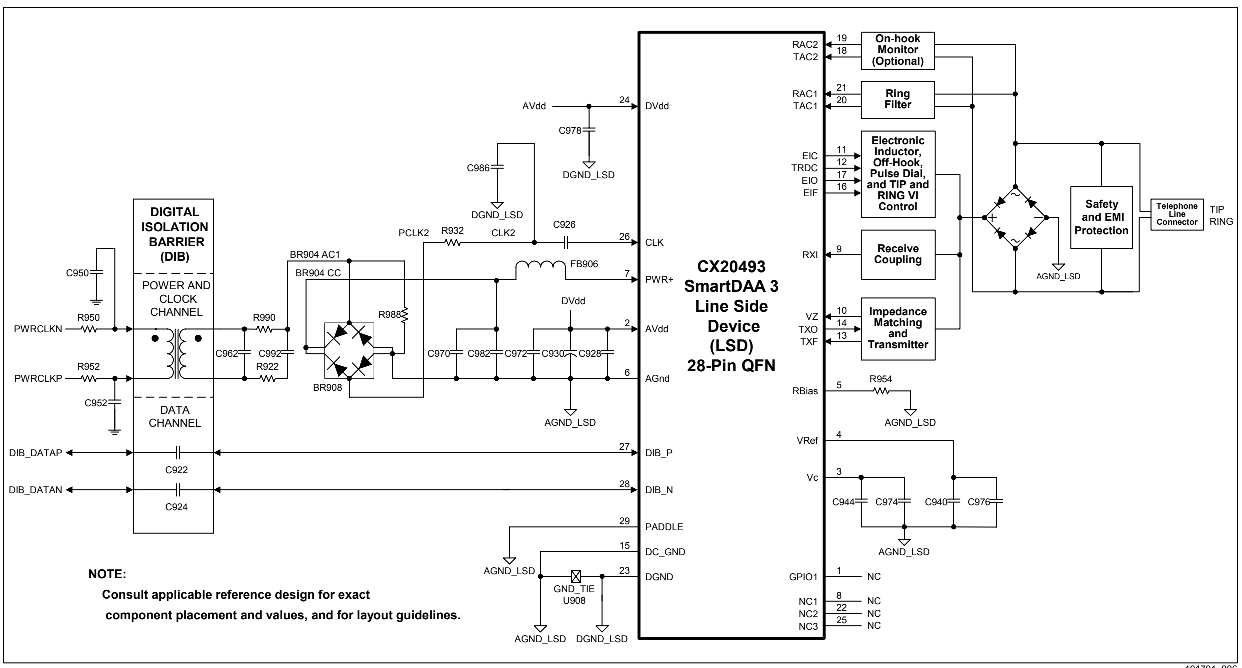


Figure 3-4. CX20493 LSD 28-Pin QFN Pin Signals

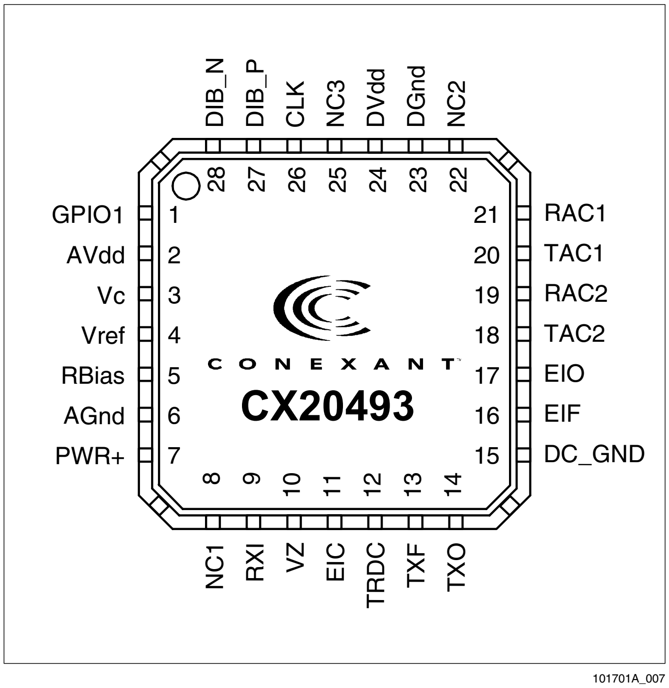


Table 3-5. CX20493 LSD 28-Pin QFN Pin Signals

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
System Signals				
AVdd	2	PWR	PWR	**Regulated Power Output.** 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, connect to AGND_LSD through C928, C930, and C972 in parallel. C928, C930, and C972 must be placed close to pins 2 and 6. C930 must have ESR < 2 Ω.
AGnd	6	AGND_LSD	AGND_LSD	**Analog Ground.** Connect to DIB transformer secondary winding undotted terminal through diode D902 and R922 in series and to AGND_LSD.
VRef	4	REF	REF	**Output Reference Voltage.** 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	**Output Middle Reference Voltage.** 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	**Unregulated Power Input.** Provides unregulated input power to the LSD. PWR+ pin is an input which takes unregulated +3.2 V to +4.5 V from the DIB power supply made up of the transformer, diode, and filter capacitors. The PWR+ input is regulated by an internal linear regulator to +3.3 V ± 5% which is routed to the AVdd pin. If PWR+ is less than +3.4 V, then AVdd is equal to the unregulated PWR+ input value minus 150 mV. Connect to DIB transformer secondary winding dotted terminal through FB906 and BR904. Connect transformer side of FB906 to AGND_LSD though C970 and C982 in parallel. Place FB906, C970, and C982 close to pin 7 and pin 6 (AGnd).
DVdd	24	PWR	PWR	**Digital Power Input.** 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	**LSD Digital Ground.** Connect to DGND_LSD, and to AGND_LSD at the DGND_LSD/AGND_LSD tie point (U908).
PADDLE	—	AGND_LSD	AGND_LSD	**Paddle Ground.** Referred to as pin 29 in schematics. Connect to AGND_LSD.
DIB Interface Signals				
CLK	26	I	I	**Clock.** 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 BR908. Place C926 near pin 26 and place R932 near C926.
DIB_P	27	I/O	I/O	**Data and Control Positive.** Connect to DIB_DATAP through C922. DIB_P and DIB_N signals are differential and half-duplex bidirectional.
DIB_N	28	I/O	I/O	**Data and Control Negative.** Connect to DIB_DATAN through 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
TIP and RING Interface				
RAC1 TAC1	21 20	I I	Ia Ia	**RING1 AC Coupled and TIP1 AC Coupled.** AC-coupled voltage from telephone line used to detect ring. Connect RAC1 to the diode bridge AC node (RING) through R902 (connects to pin 21) and C902 in series. Connect TAC1 to the diode bridge AC node (TIP) through R904 (connects to pin 20) and C904 in series.
RAC2 TAC2	19 18	I I	Ia Ia	**RING2 AC Coupled and TIP2 AC Coupled.** AC-coupled voltage from telephone line used to optionally detect signal while on-hook. Connect RAC2 to the diode bridge AC node (RING) through R948 (connects to pin 19) and C948. Leave open if not used. 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	**Electronic Inductor Capacitor Switch.** Internally switched to TRDC when pulse dialing. Connect to AGND_LSD through C958.
TRDC	12	I	Ia	**TIP and RING DC Measurement.** Input on-hook voltage (from a resistive divider). Used internally to extract TIP and RING DC voltage and Line Polarity Reversal (LPR) information. Connect to AGND_LSD through C918 and to the Bridge CC node through R906. R906 and C918 must be placed very close to pin 12.
EIO	17	O	Oa	**Electronic Inductor Output.** 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	**LSD Electronic Inductor Ground.** Connect to AGND_LSD and to the GND_LSD/AGND_LSD tie point (U908).
EIF	16	I	Ia	**Electronic Inductor Feedback.** Connect to emitter of Q904 through R968.
RXI	9	I	Ia	**Receive Analog Input.** 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	**Receiver Bias.** Connect to AGND_LSD through R954, which must be placed close to pin 5.
VZ	10	I	Ia	**Virtual Impedance.** 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	**Transmit Output.** Outputs transmit signal and impedance matching signal; connect to base of transmitter transistor Q906.
TXF	13	I	Ia	**Transmit Feedback.** Connect to emitter of transmitter transistor Q906.
Not Used				
GPIO1	1	I/O	It/Ot12	**General Purpose I/O 1**. Leave open if not used.
NC1	8			**No Connect.** No internal connection. Leave open.
NC2	22			**No Connect.** No internal connection. Leave open.
NC3	25			**No Connect.** No internal connection. Leave open.

Notes:

1. I/O types*:

Ia	Analog input
It	Digital input, TTL-compatible
Oa	Analog output
Ot12	Digital output, TTL-compatible, 12 mA, $Z_{INTERNAL}$ = 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	μA	
Output Leakage Current (High Impedance)	–	-10	–	10	μA	
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 ± 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_A	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_{IN}	-0.5 to (VGG +0.5)*	VDC
Storage Temperature Range	T_{STG}	-55 to +125	°C
Analog Inputs	V_{IN}	-0.3 to (VAA + 0.5)	VDC
Voltage Applied to Outputs in High Impedance (Off) State	V_{HZ}	-0.5 to (VGG +0.5)*	VDC
DC Input Clamp Current	I_{IK}	±20	mA
DC Output Clamp Current	I_{OK}	±20	mA
Static Discharge Voltage (25°C)	V_{ESD}	±2500	VDC
Latch-up Current (25°C)	I_{TRIG}	±400	mA
* VGG = +3.3V ± 0.3V or +5V ± 5%.			

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 VGG + 0.5V. 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 (Ityp) (mA)	Maximum Current (Imax) (mA)	Typical Power (Ptyp) (mW)	Maximum Power (Pmax) (mW)	Notes
Normal Mode: Off-hook, normal data connection	66	73	220	240	f = 28.224 MHz
Normal Mode: On-hook, idle, waiting for ring	61	67	200	220	f = 28.224 MHz
Sleep Mode	17	19	56	63	f = 0 MHz

Notes:

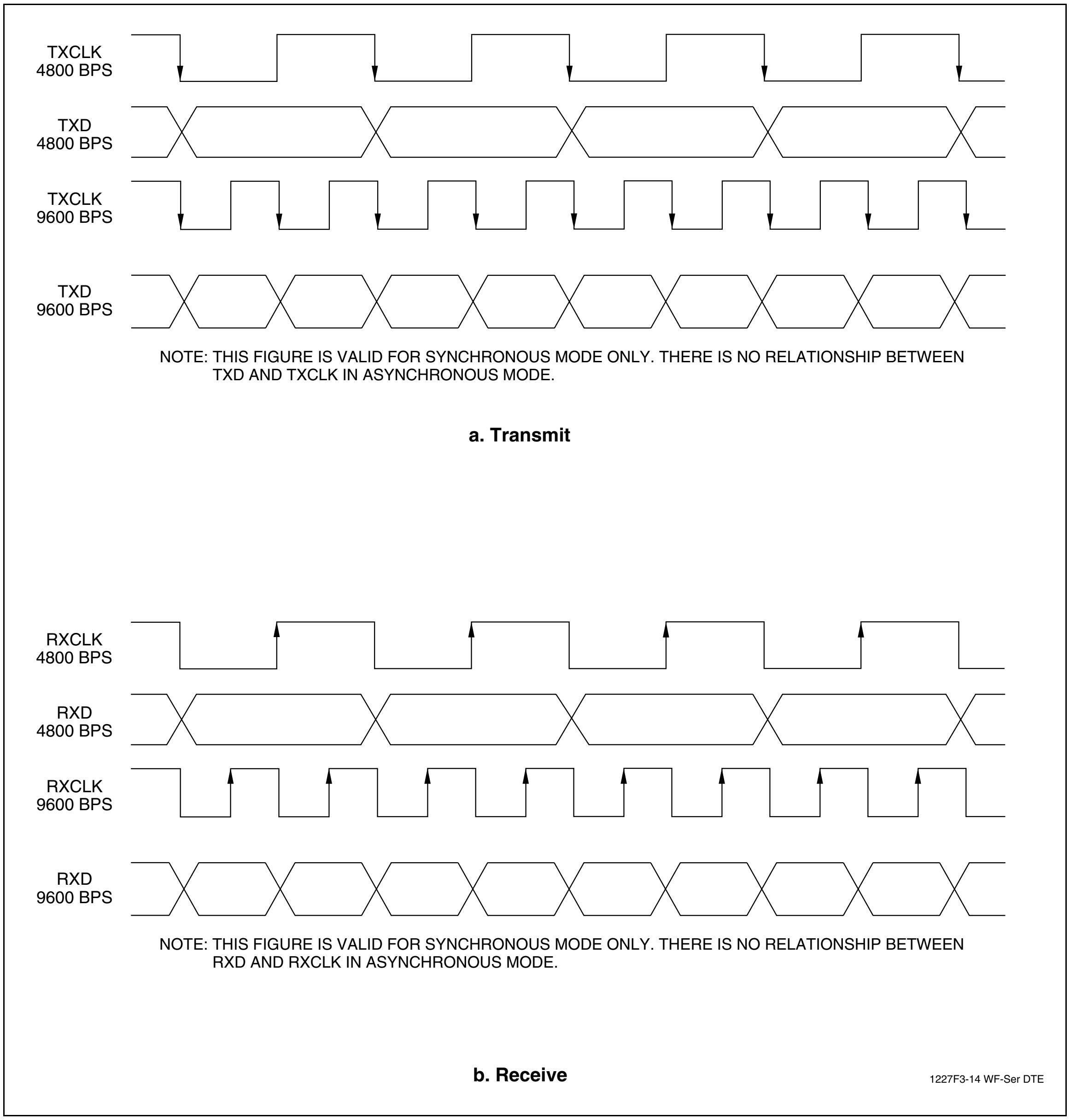
1. Operating voltage: VDD = +3.3V ± 0.3V.
2. Test conditions: VDD = +3.3V for typical values; VDD = +3.6V for maximum values.
3. Input Ripple ≤ 0.1 Vpeak-peak.
4. f = Internal frequency.
5. Maximum current computed from Ityp: Imax = Ityp * 1.1.
6. Typical power (Ptyp) computed from Ityp: Ptyp = Ityp * 3.3V; Maximum power (Pmax) computed from Imax: Pmax = Imax * 3.6V.

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

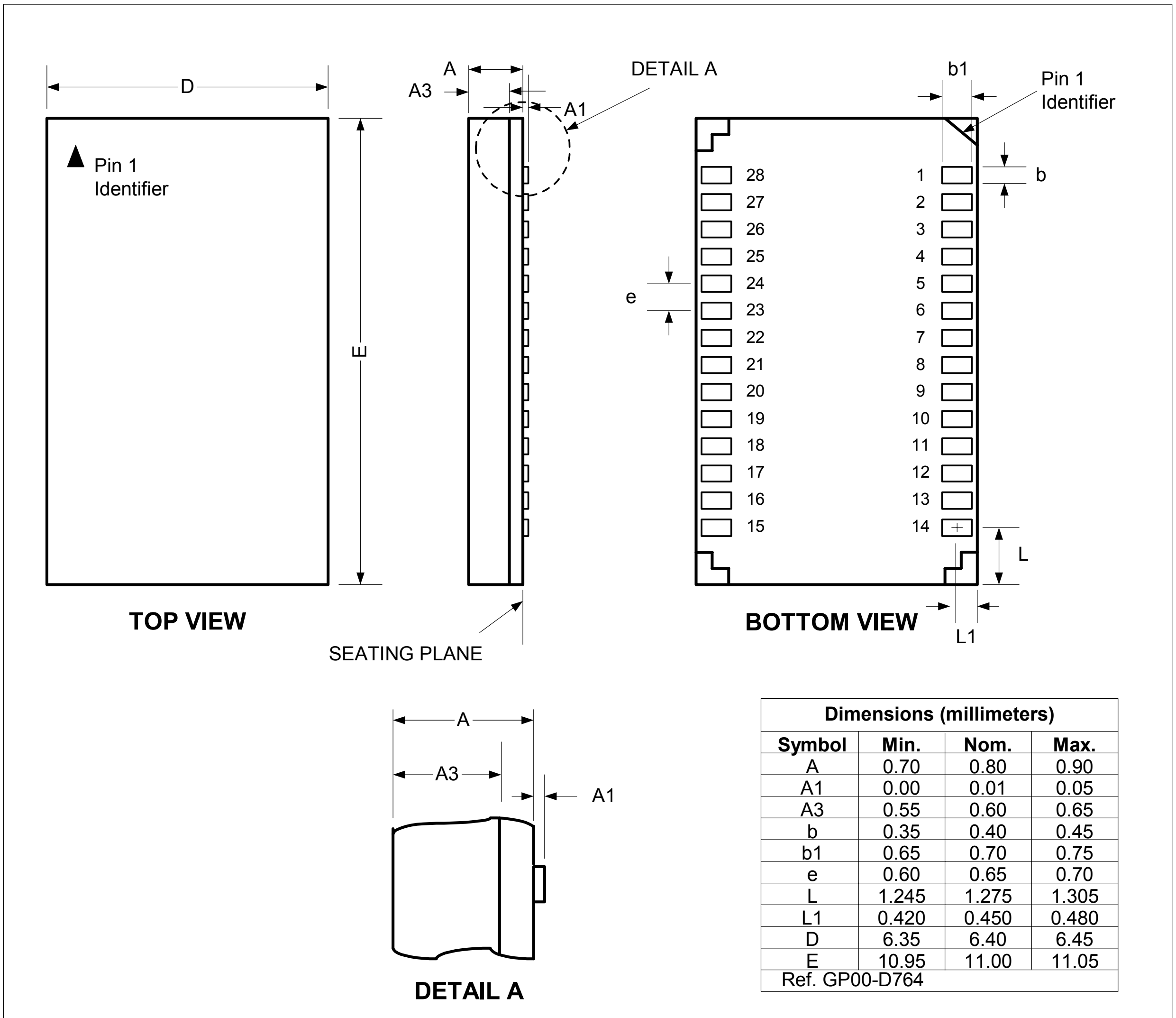
Characteristic	Value
Frequency	28.224 MHz nominal
Calibration Tolerance	±50 ppm at 25°C (C_L = 16.5 and 19.5 pF)
Frequency Stability vs. Temperature	±35 ppm (0°C to 70°C)
Frequency Stability vs. Aging	±20 ppm/5 years
Oscillation Mode	Fundamental
Calibration Mode	Parallel resonant
Load Capacitance, C_L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

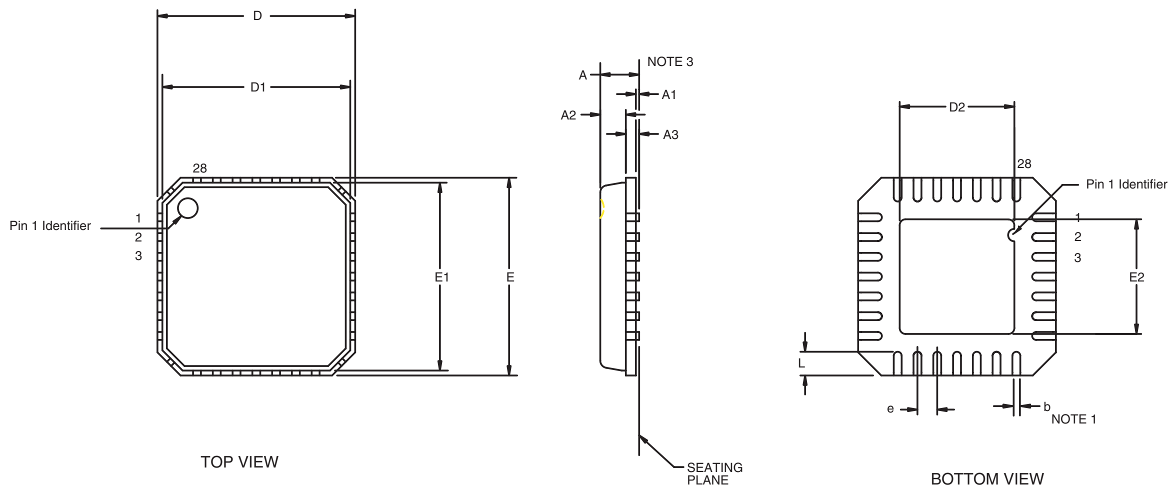
The 28-pin QFN package dimensions are shown in Figure 4-2.

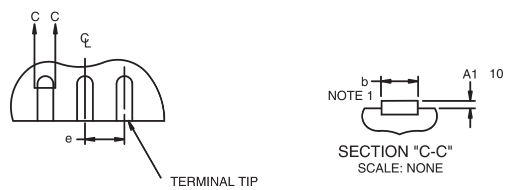
Figure 4-1. Package Dimensions - 28-Pin CTLGA



Dimensions (millimeters)			
Symbol	**Min.**	**Nom.**	**Max.**
A	0.70	0.80	0.90
A1	0.00	0.01	0.05
A3	0.55	0.60	0.65
b	0.35	0.40	0.45
b1	0.65	0.70	0.75
e	0.60	0.65	0.70
L	1.245	1.275	1.305
L1	0.420	0.450	0.480
D	6.35	6.40	6.45
E	10.95	11.00	11.05
Ref. GP00-D764			

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





Symbol	Dimensions (Millimeters)		
	Min.	Nom.	Max.
e	0.5 BSC		
L	0.50	0.60	0.75
b	0.23	0.28	0.35
D2	2.95	3.10	3.25
E2	2.95	3.10	3.25
A	-	0.85	1.00
A1	0.00	0.01	0.05
A2	-	0.65	0.80
A3	0.15	0.20	0.25
D	4.90	5.00	5.10
D1	4.65	4.75	4.85
E	4.90	5.00	5.10
E1	4.65	4.75	4.85
Ref. GP00-D682-001			

NOTES:

1. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
2. PACKAGE WARPAGE MAX 0.05mm.
3. APPLIED FOR EXPOSED PAD AND TERMINALS. EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.

PD_GP00-D682-001

NOTES

www.conexant.com
General Information:
U.S. and Canada: (800) 854-8099
International: (949) 483-6996
Headquarters – Newport Beach
4311 Jamboree Rd.
Newport Beach, CA 92660-3007

CONEXANT™
What's next in communications technologies