CX93011 CSMxx

V.92/V.34/V.32bis Controlled Serial Modem with CX20548 SmartDAA®

Data Sheet

Conexant Proprietary Information

Conexant Confidential Information

Dissemination, disclosure, or use of this information is not permitted without the written permission of Conexant Systems, Inc.

Revision Record

Revision	Date	Comments
A	6/21/2005	Initial release.
B	7/15/2005	Rev. B release.
C	3/30/2006	Rev. C release.
D	4/18/2006	Rev. D release.
E	4/25/2006	Rev. E release.
F	5/22/2006	Rev. F release.

Contents

Figures

Conexant Proprietary and Confidential Information

Tables

Document Revision History

Incorporated in Doc. No. 102635A – 102635E

Preliminary releases.

Incorporated in Doc. No. 102635F

Revised Section 2.16, Table 3-11, and Figure 4-1.

Conexant Proprietary and Confidential Information

1. Introduction

1.1 Overview

The Conexant® CSMxx V.92 Modem supports V.92 analog data modem operation and 14.4 kbps fax modem operation. In addition, the modem supports remote telephone answering machine (TAM). The modem also supports V.44/V.42bis/MNP 5 data compression for greater data throughput and V.42 LAPM/MNP2-4 error correction protocol for increased data integrity and reliability. Table 1-1 lists the ordering information.

The CSMxx device set consists of a CX93011 V.92/V.34/V.32bis Modem device in a 20-pin QFN and a CX20548 SmartDAA® 4 Line Side Device (LSD) in a 16-pin QPN. The CX93011 has a serial interface.

The CX93011 modem device integrates a microcontroller (MCU), a digital signal processor (DSP), internal RAM, internal ROM, and a SmartDAA system side device (SSD) onto a 20-pin QFN. Figure 1-1 illustrates the top-level modem interface connection.

Conexant's SmartDAA technology used in the SmartDAA 4 LSD eliminates the need for bulky analog transformers, relays, and opto-isolators typically used in discrete DAA implementations. The SmartDAA 4 LSD operates without drawing power from the phone line, unlike line-powered DAAs, and is therefore not subject to variations in line voltage conditions. The SmartDAA 4 LSD also adds enhanced telephony extension features to the modem's operation and other functions such as Call Waiting detection, and Caller ID decoding. Incorporating Conexant's proprietary Digital Isolation Barrier (DIB) design and other innovative DAA features, the SmartDAA architecture simplifies application design and minimizes layout area to reduce design cost.

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 A-law, μ-law, and linear coding and IMA 4-bit ADPCM coding. This mode supports applications such as digital telephone answering machine, voice annotation, and recording from and playback to the telephone line.

The modem operates by executing masked code from internal ROM. The modem features internal RAM memory that enhances the modem's flexibility. The modem's internal RAM can be used to load new country profiles, override existing country profiles or add customized firmware code. An optional external serial NVRAM is supported. The optional external NVRAM adds the convenience of permanent storage, just like internal RAM, NVRAM can be used to store new country profiles, override existing ones or add customized firmware code.

Small, low-profile packages, reduced voltage operation, and low power consumption make this device set an ideal solution for embedded applications.

Table 1-1. CSMxx Modem Models and Functions

Model/Order/Part Numbers				Supported Functions		
Marketing Name	Device Set Order No.	Modem Device [20-Pin QFN] Part No.	Line Side Device (LSD) [16-Pin QFN] Part No.	V.92/V.90/ Data	V.34 Data	V.32bis Data, V.17 Fax, TAM, Worldwide
CSM92	DS92-CSM-11Z	CX93011-11Z	CX20548-11Z (Note 3)	Y	Y	Y
CSM34	DS34-CSM-11Z	CX93011-12Z	CX20548-11Z (Note 3)	—	Y	Y
CSM32bis	DS32-CSM-11Z	CX93011-13Z	CX20548-11Z (Note 3)	—	—	Y
Notes:						
1. Supported functions (Y = Supported; — = Not supported).						
2. All devices are lead-free (Pb-free) and RoHS-compliant. These devices are compatible with leaded reflow processes.						
3. Device is marked 20548-A						

Figure 1-1. CSMxx Modem Simplified Interface Diagram
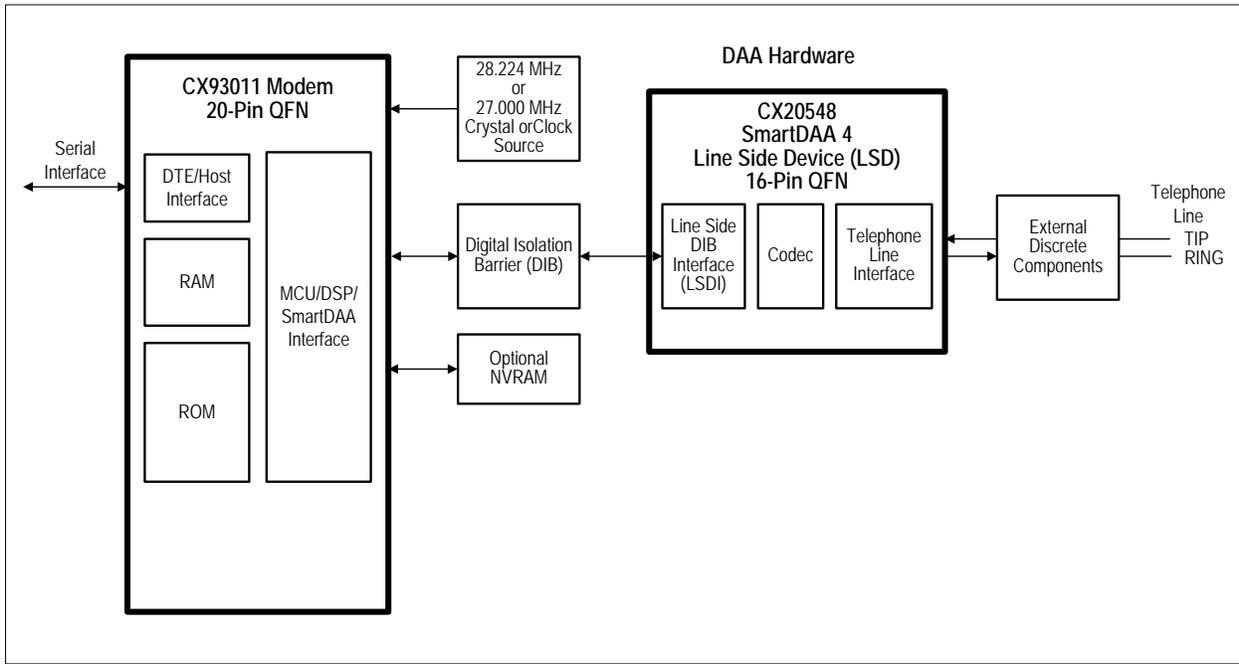
1.2   Features

- Modulations and protocols
  - ITU-T V.92 (V.92 model)
    - ♦ Modem-on-Hold (MOH)
    - ♦ Quick connect (QC)
    - ♦ PCM upstream
  - V.90 (V.92 model)
  - V.34 (V.92 and V.34 models)
  - V.32bis, V.32, V.22bis, V.22, V.23, V.21
  - V.23 reverse, V.23 half-duplex
  - Bell 212A/Bell 103
  - V.29 FastPOS
  - V.22bis fast connect
  - V.80 Synchronous Access Mode
- Data compression and error correction
  - V.44 data compression (V.92 model)
  - V.42bis 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
- Call Waiting (CW) detection and Type II Caller ID decoding during data mode
- Type I Caller ID (CID) decoding
- Telephony/TAM
  - V.253 commands
  - 2-bit and 4-bit ADPCM, 4-bit IMA ADPCM, 8-bit and 16-bit linear PCM, and 8-bit µ-law and A-law PCM coding
  - 8 kHz sample rate
  - Concurrent DTMF, ring, and Caller ID detection
- DTE/host interface
  - Serial DTE interface
  - Direct Mode
  - Asynchronous Mode
- No external memory required
- Sixty-three embedded and upgradeable country profiles
- Serial NVRAM interface for optional permanent country profile storage
- Embedded AT commands

- SmartDAA
  - Extension pick-up detection
  - Digital line protection
  - Line reversal detection
  - Line-in-use detection
  - Remote hang-up detection
  - Worldwide compliance
- Selectable 28.224 MHz or 27.000 MHz frequency of operation
- Low power and voltage
  - Single +3.3V supply
  - Low power consumption mode
  - +3.3V I/O level
- Compact, robust board design
  - Small, low-profile modem packages
  - SmartDAA and DIB technologies
  - Reference design supports 5 kV isolation
- Small packages
  - CX93011 Modem: 20-pin QFN
  - CX20548 LSD: 16-pin QFN

1.2.1   Applications

- Set top boxes
- Point-of-Sale terminals
- ATM machines
- Metering terminals
- Video game consoles
- Internet appliances

Conexant Proprietary and Confidential Information

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 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), 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

Data modem modes perform complete handshake and data rate negotiations. Using modem modulations to optimize modem configuration for line conditions, the modem can connect at the highest data rate that the channel can support from 56 kbps down to 2400 bps with automatic fallback.`

In V.92 data modem mode (V.92 model), 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 in V.92 models are also supported 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.32bis in accordance with PN2330. All tone and pattern detection functions required by the applicable ITU or Bell standards are supported.

In V.32bis 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.42bis 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.

1.3.3.4   TAM Mode

TAM Mode features include 2-bit/4-bit ADPCM, 4-bit IMA ADPCM, 8-bit and 16-bit linear PCM, and 8-bit μ-law and A-law PCM 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 pick-up detection, remote hang-up detection, line-in-use detection, and digital PBX line protection are supported.

Conexant Proprietary and Confidential Information

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

Internal ROM includes default profiles for 63 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. Additional country profiles can be loaded into external NVRAM for permanent storage. 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 Caller ID (CID2) Supported
Argentina	7			
Australia	9	X	X	
Austria	0A	X	X	
Belgium	0F	X		
Brazil	16	X		
Bulgaria	1B			
Canada	20	X	X	X
Chile	25	X		
China	26	X	X	
Colombia	27			
Croatia	FA			
Cyprus	2D			
Czech Republic	2E			
Denmark	31	X	X	
Egypt	36			
Estonia	F9			
Finland	3C	X	X	
France	3D	X	X	X
Germany	42	X	X	
Greece	46	X		
Hong Kong	50	X	X	X
Hungary	51			
Iceland	52			
India	53		X	
Indonesia	54			
Ireland	57	X	X	X
Israel	58	X		
Italy	59	X	X	
Japan	00	X	X	X
Korea	61	X	X	
Kuwait	62			
Lebanon	64			
Luxembourg	69			
Malaysia	6C	X		
Mexico	73			
Morocco	77			
Netherlands	7B		X	
New Zealand	7E	X	X	
Norway	82	X	X	
Pakistan	84			
Philippines	89			
Poland	8A	X		

Conexant Proprietary and Confidential Information

Country	Country Code	Call Waiting Tone Detection (CW) Supported	On-Hook Type 1 Caller ID (CID) Supported	Off-Hook Type 2 Caller ID (CID2) Supported
Portugal	8B	X		
Romania	8E			
Russia	B8			
Saudi Arabia	98			
Senegal	99			
Singapore	9C	X	X	X
Slovakia	FB			
Slovenia	FC			
South Africa	9F	X		
Spain	A0	X	X	
Sri Lanka	A1			
Sweden	A5	X	X	
Switzerland	A6	X		
Taiwan	FE	X	X	
Thailand	A9			
Tunisia	AD			
Turkey	AE			
UK	B4	X	X	X
United Arab Emirates	B3			
Uruguay	B7			
USA	B5	X	X	X
Reserved	FD			

1.3.4   Reference Designs

A reference design is available to minimize modem design time, reduce development cost, and accelerate market entry. The part number for this design is: RD02-D390-001.

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

1.4.1   CX93011 Modem

The CX93011 modem includes a Microcontroller (MCU), a Modem Data Pump (MDP), internal ROM, 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 MCU/DSP performs the command processing, host interface functions and telephone line signal modulation/demodulation 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 CX93011 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 CX93011 to the LSD.

The DIB data channel supports bidirectional half-duplex serial transfer of data, control, and status information between the CX93011 and the LSD over two lines.

1.4.3   CX20548 SmartDAA Line Side Device

The CX20548 SmartDAA 4 Line Side Device (LSD) includes a Line Side DIB Interface, a coder/decoder (codec), and a Telephone Line Interface (TLI).

The Line Side DIB Interface communicates with, and receives power and clock from, the SmartDAA 4 interface in the host side device (HSD) through the DIB transformer. The clock signal passing through the transformer is rectified in the LSD and filtered using external capacitors.

Information is transferred between the LSD and the HSD through the DIB transformer using pulse width modulation

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.

1.5   Commands

The modem supports data modem and V.80 commands, and S Registers in accordance with modem model options. See Doc. No. 102752 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.

This page is intentionally blank.

Conexant Proprietary and Confidential Information

2. Technical Specifications

2.1 Serial DTE Interface Operation

2.1.1 Automatic Speed/Format Sensing

Command Mode and Data 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

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 ± 40 Hz in ITU-T modes and 2225 ± 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 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.22bis	V22B	2400 or 1200
V.23	V23C	1200
V.32	V32	9600 or 4800
V.32bis	V32B	14400, 12000, 9600, 7200, or 4800
V.34/V.90 upstream[1]	V34/V90	33600, 31200, 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, or 2400
V.90 downstream[2]	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[2]	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[2]	V92	48000, 46667, 45333, 44000, 42667, 41333, 40000, 38667, 37333, 36000, 34667, 33333, 32000, 30667, 29333, 28000, 26667, 25333, 24000
Notes: 1. V.92 and V.34 models. 2. V.92 models		

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.32bis, 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.22bis 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.32bis/V.32)

During initial handshake, the modem will fallback to the optimal line connection within V.92/V.90/V.34/V.32bis/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.32bis/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.

Conexant Proprietary and Confidential Information

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.

2.3.10 Call Progress Speaker Interface

A digital speaker output (DSPKOUT) is supported. DSPKOUT is a square wave output in Data 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.

2.3.11 Serial EEPROM Interface

The 20-pin QFN supports a 2-line serial interface to an optional serial EEPROM.

The EEPROM can hold information such as firmware customization, and country code parameters. Data stored in EEPROM takes precedence over the factory default settings.

A serial EEPROM is required only if additional storage is required for more country profiles or customized firmware code.

The EEPROM size can range from 2 Kb (256 x 8) to 256 Kb (32K x 8). A 2 Kb EEPROM must be 100 kHz or 400 kHz; higher capacity EEPROMs must be 400 kHz.

2.4 V.92 Features (V.92 Model)

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 enables the modem to place an Internet data connection 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 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.42bis. 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.42bis Data Compression

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

The V.42bis data compression employs a "string learning" algorithm in which a string of characters from the DTE is encoded as a fixed length codeword and stored in a dictionary. The dictionary is dynamically updated during normal operation.

Conexant Proprietary and Confidential Information

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 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.

2.6.1 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.

2.6.2 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.

2.6.3 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.

2.6.4 Full-Duplex Receive and Transmit Mode

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

Conexant Proprietary and Confidential Information

2.6.5 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.

2.6.6 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.

2.7 V.80 Synchronous Access Mode (SAM)

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.

2.8 Telephony Extensions

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

- Line-in-use detection
- Extension pick-up 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.

2.8.1 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 attempt is made 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".

2.8.2 Extension Pick-up Detection

The extension pick-up 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 pick-up has been detected, the modem will go on-hook and respond with the message "OFF-HOOK INTRUSION".

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

Conexant Proprietary and Confidential Information

2.8.3   Remote Hang-up Detection

The remote hang-up 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).

2.9   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.

2.10   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.

2.11   Tone Detectors

The modem is equipped with three tone detectors with separate signal paths from the main received signal path thus enabling tone detection to be independent of the configuration status.

2.12   Call Waiting Tone Detection

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

2.13   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 2.14). 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.

2.14   Worldwide Country Support

Internal modem firmware supports 63 country profiles (see Table 1-2). 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. 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.

2.15   Diagnostics

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.

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

2.16   Low Power Modes

The modem enters a low power mode when no line connection exists and no host activity occurs for the period of time specified in the S24 register. The modem supports four low power modes: Idle Mode, Sleep Mode, Deep Sleep Mode, and Stop Mode. The low power mode entered depends on the setting of the –SLP command.

2.16.1   Idle Mode

In Idle mode, the CPU and SPX clocks stop, and the SSD clock runs at low frequency. The modem can detect and qualify ring signals and process AT commands. The modem returns to normal mode upon receiving an AT command or receiving a qualified ring.

2.16.2   Sleep Mode

In Sleep mode, the SPX clock stops, and the CPU and SSD clocks run at low frequency. The modem can detect and qualify ring signals. The modem cannot process AT commands. The modem can be awakened by the host sending a single (any) character (typically followed by an AT command) or by the modem receiving a qualified ring.

2.16.3   Deep Sleep Mode

In Deep Sleep mode, the SPX and SSD clocks stop, and the CPU clock runs at low frequency. The modem can detect and qualify ring signals. The modem cannot process AT commands. The modem can be awakened by the host sending a single (any) character (typically followed by an AT command) or by the modem receiving a qualified ring.

2.16.4   Stop Mode

In Stop mode, the CPU, SPX and SSD clocks stop. The modem cannot process AT commands and cannot detect and qualify ring signals. The modem can be awakened by the host sending a single (any) character (typically followed by an AT command).

This page is intentionally blank..

Conexant Proprietary and Confidential Information

3. Hardware Interface

3.1 CX93011 Modem Hardware Interface Signals

3.1.1 CX93011 Modem Interface Signal Summary

3.1.1.1 LSD Interface (Through DIB)

The DIB interface signals are:

- DIBP
- DIBN

3.1.1.2 Call Progress Speaker Interface

The call progress speaker interface signal is:

- Digital speaker output (DSPKOUT); output

3.1.1.3 Clock Select Interface

The clock select interface signal is:

- Clock Select (CLKSEL); input

3.1.1.4 Serial EEPROM Interface

The 2-line serial interface signals to an optional serial EEPROM are:

- Bidirectional Data input/output (NVMDATA)
- Clock output (NVMCLK)

3.1.1.5 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 output (RLSD#)
- Ring Indicator output (RI#)
- Data Terminal Ready control input (DTR#)
- Request to Send control input (RTS#)
- Data Set Ready output (DSR#)

3.1.2 CX93011 Modem Pin Assignments and Signal Definitions

CX93011 Modem 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 3-1.

CX93011 Modem hardware interface signals are defined in Table 3-2.

Figure 3-1. CX93011 Modem Hardware Interface Signals
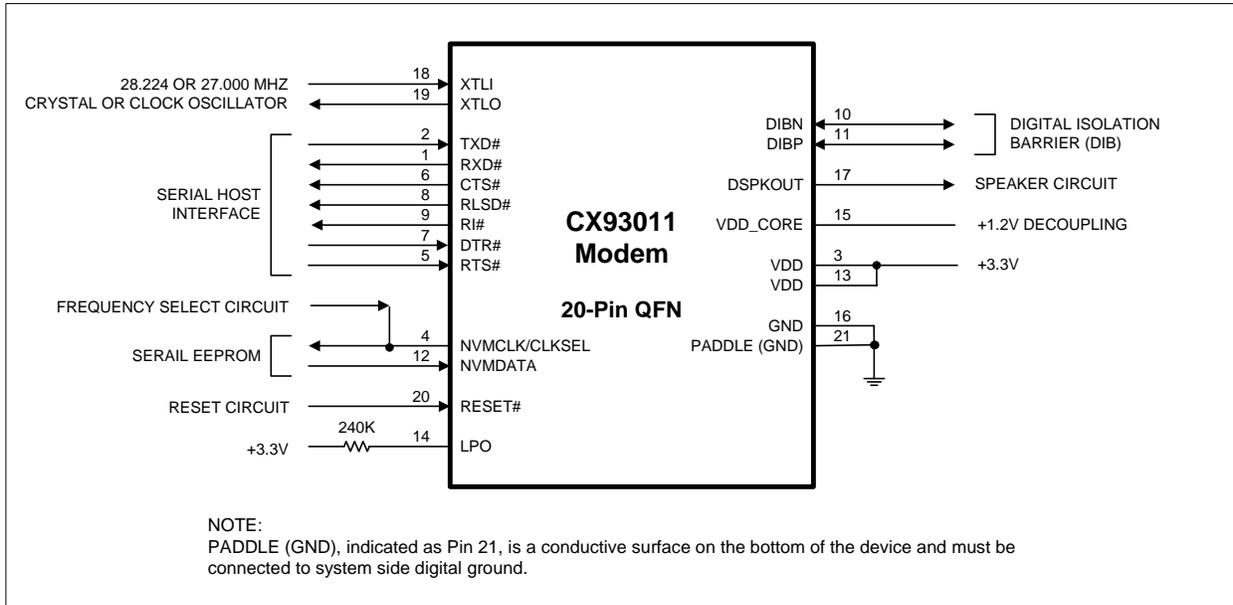
Figure 3-2. CX93011 Modem 20-Pin QFN Pin Signals

NOTE:
PADDLE (GND) is a conductive surface on the bottom of the device and is indicated as pin 21.
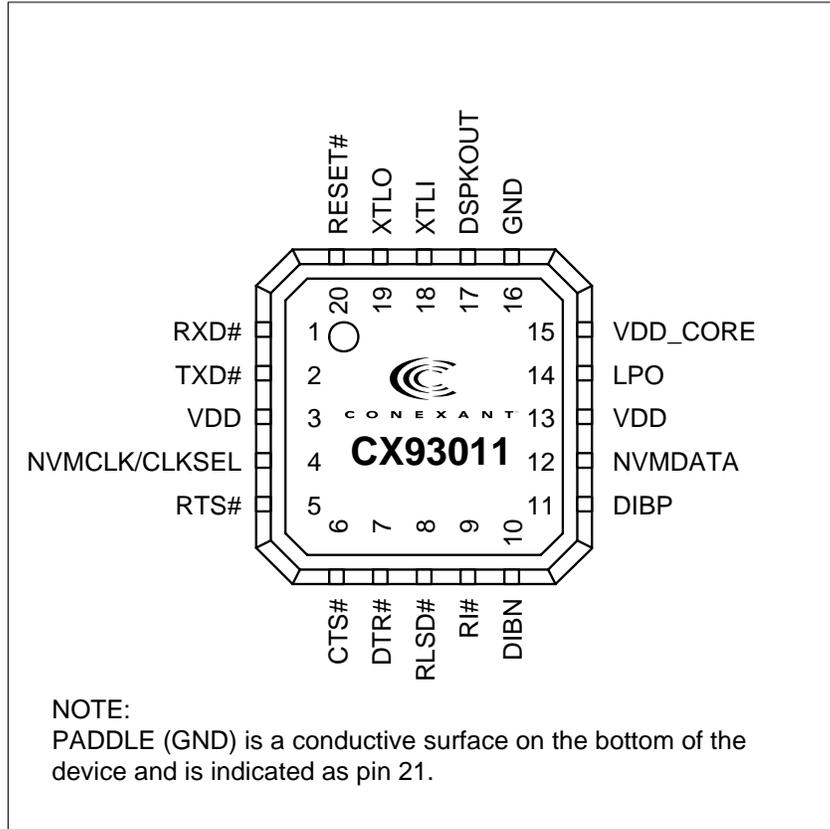
102635_004

Table 3-1. CX93011 Modem 20-Pin QFN Pin Signals

Pin No.	Signal Name	Pin No.	Signal Name
1	RXD#	11	DIBP
2	TXD#	12	NVMDATA
3	VDD	13	VDD
4	NVMCLK/CLKSEL	14	LPO
5	RTS#	15	VDD_CORE
6	CTS#	16	GND
7	DTR#	17	DSPKOUT
8	RLSD#	18	XTLI
9	RI#	19	XTLO
10	DIBN	20	RESET#
		21	PADDLE (GND)
Note: PADDLE (GND) is a conductive surface on the bottom of the device and is indicated as pin 21.			

Table 3-2. CX93011 Modem Hardware Signal Definitions

Label	Pin	I/O	I/O Type	Signal Name/Description
System				
XTLI XTLO	18 19	I O	Ix Ox	**Crystal In and Crystal Out.** If an external 27 or 28.224 MHz crystal circuit is used instead of an external clock circuit, connect XTLI and XTLO to the external crystal circuit. When an external clock circuit is used, connect the clock signal to XTLI and leave XTLO open. (See CLKSEL pin description.)
NVMCLK/CLKSEL	4	I	Ipu/O2	**Clock Frequency Select (CLKSEL)**. Clock frequency is selected by CLKSEL during reset processing. Leave open for 28.224 MHz operation; connect pin to digital ground (GND) through 10 kΩ for 27.000 MHz operation. This signal is multiplexed with NVMCLK.
RESET#	20	I	Ipu/O2	**Reset.** The active low RESET# input resets the 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_CORE	15	O	PWR	**+1.2V Internal Core Voltage Filter.** Internal +1.2 V core voltage for decoupling. Do not connect this pin to an external +1.2 V power supply.
VDD	3, 13	O	PWR	**Digital and I/O Circuits Supply Voltage.** Connect this pin to an external +3.3 V power supply.
GND	16	I	GND	**Digital Ground.** Connect to digital ground (GND).
PADDLE (GND)	21	G	GND	**Paddle Ground.** Connect to digital ground (GND).
LPO	14	I		**Low Power Oscillator.** Connect to +3.3V through 240 KΩ.
Speaker Interface				
DSPKOUT	17	O	Ipd/O2	**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				
DIBN	10	O	Odpc	**DIB Negative.** Provides clock and power to the LSD, and transfers data, control and status information between the SSD and LSD. Connect to DIB transformer primary winding terminal.
DIBP	11	O	Odpc	**DIB Positive.** Provides clock and power to the LSD and transfers data, control and status information between the SSD and LSD. Connect to DIB transformer primary winding terminal.
NVRAM Interface				
NVMCLK/CLKSEL	4	I/O	Ipu/O2	**NVRAM Clock (NVMCLK).** During normal operation, NVMCLK/CLKSEL output high enables the EEPROM. Connect to EEPROM SCL pin. This signal is multiplexed with CLKSEL.
NVMDATA	12	I/O	Ipu/O2	**NVRAM Data.** The NVMDATA pin supplies a serial data interface to the EEPROM. Connect to EEPROM SDA pin and to +3.3V through 10 KΩ.

Table 3-2. CX93011 Modem Hardware Signal Definitions (Continued)

Label	Pin	I/O	I/O Type	Signal Name/Description
V.24 (EIA/TIA-232-E) DTE Serial Interface
TXD#	2	I	Ipu/O2	**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#	1	O	Ipu/O2	**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#	6	O	Ipu/O2	**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 error correction or normal mode, CTS# is always ON (low) unless RTS/CTS flow control is selected by the &Kn command.
RLSD#	8	O	Ipu/O2	**Received Line Signal Detector (EIA CF/ITU-T CT109).** During normal operation, 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#	9	O	Ipu/O2	**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#	7	I	Ipu/O2	**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#	5	I	Ipu/O2	**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#. The modem ignores RTS# unless RTS/CTS flow control is selected by the &Kn command.
Note: I/O Types: See Table 3-3.

3.1.3   CX93011 Modem Electrical Characteristics

CX93011 I/O types are defined in Table 3-3.

CX93011 DC electrical characteristics are listed in Table 3-4.

Table 3-3. CX93011 Modem I/O Type Definitions

I/O Type	Description
Idd/Odd	Digital input/output, DIB data transceiver
Ix/Ox	I/O, wire
Ipd/O2	Digital input, 120 kΩ pull-down / Digital output, 2 mA
Ipu/O2	Digital input, 120 kΩ pull-up / Digital output, 2 mA
Ippu/O2	Digital input, Programmable 120 kΩ pull-up / Digital output, 2 mA
Odpc	Digital output with adjustable drive, DIB clock and power
Rx	Oscillator Pad, place 120 kΩ resistor from pad to VDD
PWR	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. CX93011 Modem DC Electrical Characteristics

Parameter	Symbol	Min.	Max.	Units	Test Conditions
Input Voltage Low	VIL	0	0.3 *VDD	V	
Input Voltage High	VIH	0.7 * VDD	VDD	V	
Input Current (no Pull-Down or Pull-Up)	IIL	-1	+1	uA	OEN = 1
Input Current (Pull-Down)	IPD	+6	+30	uA	VIN = VDD
Input Current (Pull-Up)	IPU	-300	-60	uA	VIN = GND
Output Voltage Low	VOL	0	0.4	V	IOL = +2 mA
Output Voltage High	VOH	VDD-0.4	VDD	V	IOL = -2 mA
Output Impedance	Z	25	95	Ω	
Pull-Up Resistance	Rpu	120	500	kΩ	VIN = GND
Pull-Down Resistance	Rpd	120	500	kΩ	VIN = VDD
Test Conditions unless otherwise stated: VDD = +3.3V ± 5%; T_A = -10°C to 70°C; external load = 50 pF.					

Conexant Proprietary and Confidential Information

3.2 CX20548 LSD Hardware Pins and Signals

3.2.1 General

3.2.1.1 Host Side Device (HSD) Interface (Through DIB)

The DIB interface signals are:
- DIB Positive (DIBP, pin 14); input/output
- DIB Negative (DIBN, pin 16); input/output

3.2.1.2 Power and Ground

The power and ground signals are:
- Unregulated Power Output (PWR, pin 15)
- Regulated Digital Power Output (DVDD, pin 1)
- Regulated Analog Power Output (AVDD, pin 2)
- Analog Ground (PADDLE [AGND]); Analog ground

3.2.1.3 Telephone Line Interface

The telephone line interface signals are:
- RING AC Coupled (RAC, pin 4); input
- TIP AC Coupled (TAC, pin 5); input
- Electronic Inductor Capacitor (EIC, pin 11)
- Electronic Inductor Output (EIO, pin 10)
- Electronic Inductor Feedback (EIF, pin 9)
- Receive Analog Input (RXI, pin 6); input
- Transmit Output (TXO, pin 8); output
- Transmit Feedback (TXF, pin 7); input

3.2.1.4 Voltage References

There is on reference voltage pin:
- Output Middle (Center) Reference Voltage (VC, pin 3); output for decoupling

3.2.1.5 General Purpose Input/Output

There is one unassigned general purpose input/output pin:
- General Purpose Input/Output (GPIO, pin 13); input/output

3.2.2   Pin Assignments and Signal Definitions

CX20548 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.

Note: ***Pin 17 is shown in Figure 3-3 to ensure that the PADDLE is considered when laying out the printed circuit board. The PADDLE is the analog ground pin of the CX20548 device and must be connected to LSD analog ground (AGND_LSD) when the CX20548 is populated in a PCB.***

CX20548 LSD hardware interface signals are defined in Table 3-6.

CX20548 LSD GPIO DC characteristics are specified in Table 3-7.

CX20548 LSD AVDD DC characteristics are specified in Table 3-8.

Figure 3-3. CX20548 LSD Hardware Interface Signals
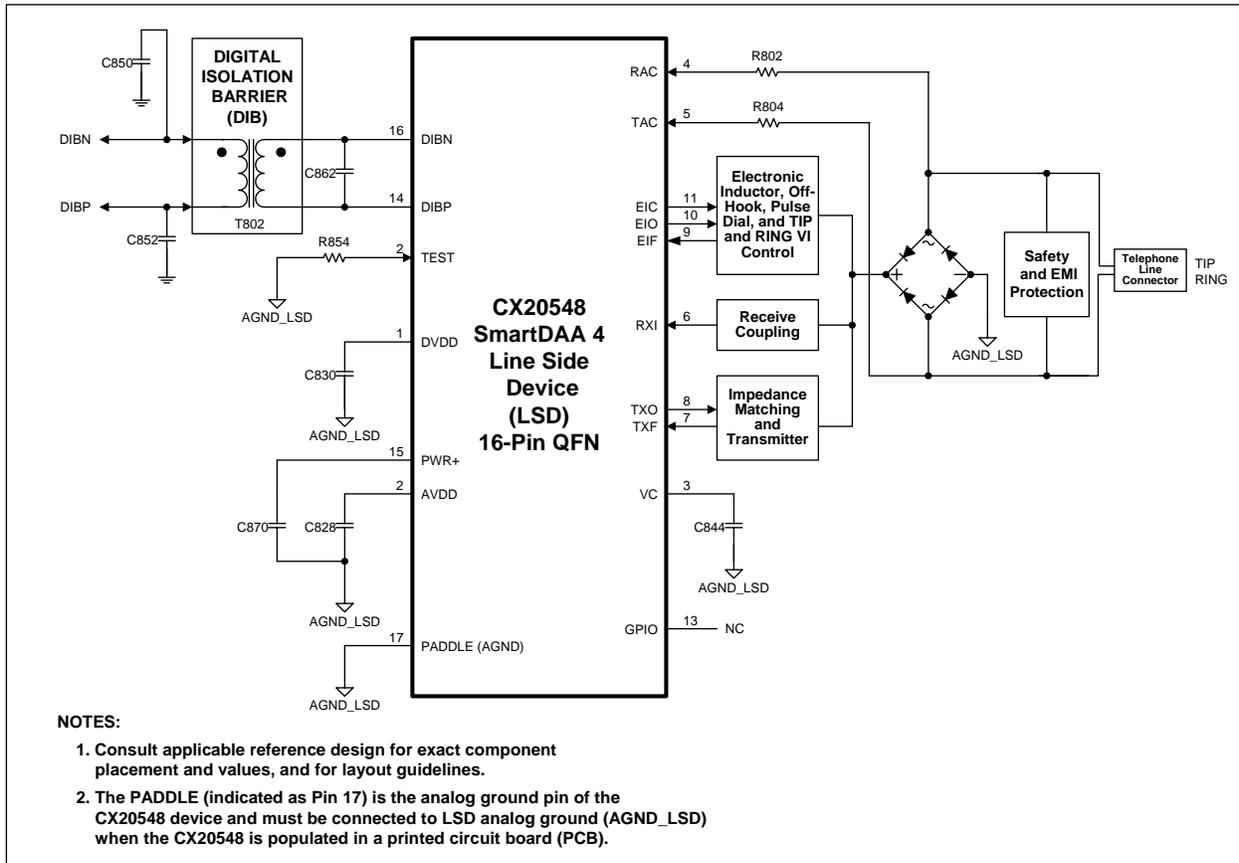
102596_007

Figure 3-4. CX20548 LSD 16-Pin QFN Pin Signals

The PADDLE, a connective surface located on the bottom of the package and referred to as pin 17, is connected internally to analog ground (AGND).
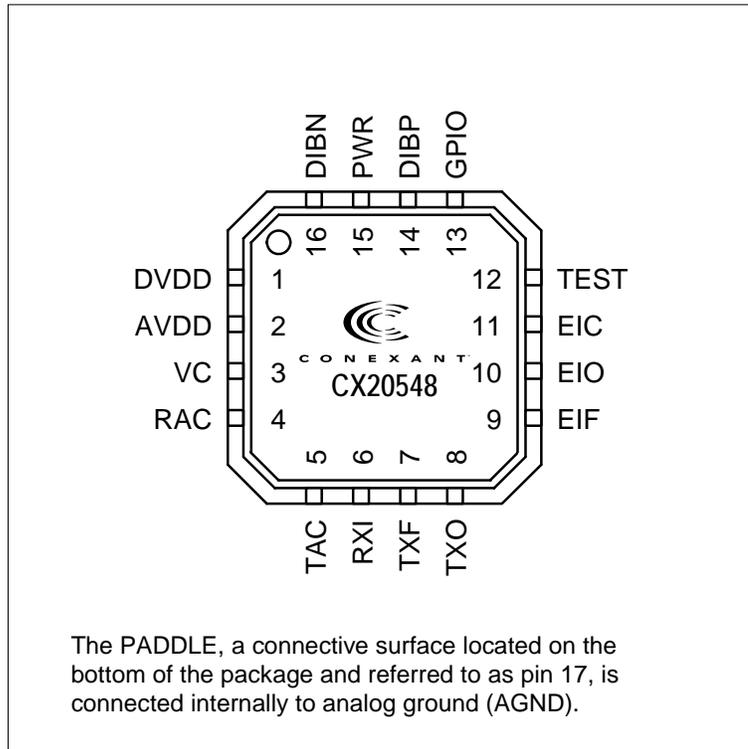
102596_008

Table 3-5. CX20548 LSD 16-Pin QFN Pin Signals

Pin	Signal Label	Pin	Signal Label
1	DVDD	9	EIF
2	AVDD	10	EIO
3	VC	11	EIC
4	RAC	12	TEST
5	TAC	13	GPIO
6	RXI	14	DIBP
7	TXF	15	PWR
8	TXO	16	DIBN
		17	PADDLE (AGND)

Table 3-6. CX20548 LSD Hardware Signal Definitions

Label	Pin	I/O	I/O Type	Signal Name/Description
System Interface Signals				
PWR	15	PWR	PWR	**Unregulated Power Output.** Unregulated power output from the internal rectifier, connect to AGND_LSD through C870.
VC	3	REF	REF	**Output Middle Reference Voltage.** Connect to AGND_LSD through C844, which must be placed close to pin 3. Use a short path and a wide trace to AGND_LSD pin.
AVDD	2	PWR	PWR	**Analog Power Output.** Provides external connection point for decoupling. (AVDD is routed internally to LSD analog circuits.). Connect to AGND_LSD through C828. C828 must be placed close to pins 2.
DVDD	1	PWR	PWR	**Digital Power Output.** Provides external connection point for decoupling. Connect to AGND_LSD through C830. Place C830 near pin 1.
PADDLE (AGND)	17	AGND_LSD	AGND_LSD	**Paddle Analog Ground.** The conductive surface located on the bottom of the package and referred to as pin 17 is connected internally to device analog ground. Connect to AGND_LSD.
DIB Interface Signals				
DIBP	14	I/O	I/O	**DIB Positive.** Positive terminal of DIB, connect to secondary of DIB transformer.
DIBN	16	I/O	I/O	**DIB Negative.** Negative terminal of DIB, connect to secondary of DIB transformer.
TIP and RING Interface Signals				
RAC TAC	4 5	I I	Ia a	**RING AC Coupled and TIP AC Coupled.** Un-rectified voltage from telephone line used to detect ring. Connect RAC to the diode bridge AC node (RING) through R802 (connects to pin 4). Connect TAC to the diode bridge AC node (TIP) through R804 (connects to pin 5).
EIC	11	O	Oa	**Electronic Inductor Capacitor.** Electronic inductor filtering capacitor. Connect to AGND_LSD through C858.
EIO	10	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 Q804 through R836.
EIF	9	I	Ia	**Electronic Inductor Feedback.** Connect to emitters of Q806 and Q808 through R830 and R834, respectively.
RXI	6	I	Ia	**Receive Analog Input.** Receiver operational amplifier inverting input. AC coupled to the Bridge_CC node through R810 (connects to pin 6) and C810 in series. R810 and C810 must be placed very close to pin 6. The length of the PCB trace connecting R810 to the RXI pin must be kept at an absolute minimum.
TXO	8	O	Oa	**Transmit Output.** Outputs transmit signal and impedance matching signal; connect to base of transistor Q802.
TXF	7	I	Ia	**Transmit Feedback.** Connect to emitter of transistor Q802.
Not Used				
GPIO	1	I/O	It/Ot12	**General Purpose I/O**. Leave open if not used.
Notes:				
1. I/O types*: Ia Analog input It Digital input* Oa Analog output Ot12 Digital output* AGND_LSD Isolated LSD Analog Ground (isolated from the host system ground) *See Section CX20548 LSD GPIO DC Electrical Characteristics (Table 3-7). 2. Refer to applicable reference design for exact component placement and values.				

Conexant Proprietary and Confidential Information

Table 3-7. CX20548 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 = -10°C to 70°C; external load = 50 pF						

Table 3-8. CX20548 LSD AVDD and DVDD DC Electrical Characteristics

PWR Input	AVDD Output	DVDD Output
+3.3 V < PWR < +4.5 V	+3.3 V $\pm$ 5%	+3.0 V $\pm$ 5%
PWR must be at least 200mV higher than AVDD. See PWR, AVDD, and DVDD descriptions in Table 3-6.		

3.3 Operating Conditions, Absolute Maximum Ratings, and Power Requirements

The CX93011 operating conditions are specified in Table 3-9.

The CX93011 absolute maximum ratings are listed in Table 3-10.

The CX93011 current and power requirements are listed in Table 3-11.

Table 3-9. CX93011 Modem Operating Conditions

Parameter	Symbol	Limits	Units
Supply Voltage	VDD	+3.3 ± 5%	VDC
Operating Ambient Temperature	T_A	-10 to +70	°C
Note: Voltages referenced to ground (VSS).			

Table 3-10. Absolute Maximum Ratings

Parameter	Symbol	Limits	Units
VDD Supply Voltage	VDD	-0.5 to +4.0	VDC
Storage Temperature Range	T_{STG}	-55 to +125	°C
Relative humidity	H_{REL}	Up to 90% non-condensing, or a wet bulb temperature up to 35 °C, whichever is less.	
Input Voltage	V_{IN}	-0.3 to (VDD + 0.3)	VDC
Voltage Applied to Outputs in High Impedance (Off) State	V_{HZ}	-0.5 to +5.5	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

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 -0.3V to (VDD + 0.3) V. This prevents forward biasing the input protection diodes and possibly entering a latch up mode due to high current transients.

Conexant Proprietary and Confidential Information

Table 3-11. CX93011 Current and Power Requirements

Mode	Typical Current (Ityp) (mA)	Maximum Current (Imax) (mA)	Typical Power (Ptyp) (mW)	Maximum Power (Pmax) (mW)
Normal Mode: On-hook, Idle, waiting for ring	82	84	271	290
Normal Mode: Off-hook, normal data connection	96	99	316	342
Idle Mode	18	18	59	64
Sleep Mode	18	18.6	59.4	64.4
Deep Sleep Mode	7.9	7.9	25.9	27.4
Stop Mode	6.0	6.0	19.6	20.7
Notes:				
1. Test conditions: VDD = +3.3V for typical values; VDD = +3.465V for maximum values.				
2. Input Ripple $\leq$ 0.1 Vpeak-peak.				

3.4 Crystal and Clock Specifications

Crystal specifications are listed in Table 3-12. Clock specifications are listed in Table 3-13.

Table 3-12. Crystal Specifications

Characteristic	Value
Frequency	28.224 or 27.000 MHz nominal
Calibration Tolerance	±50 ppm at 25°C (C_L = 16.5 and 19.5 pF)
Frequency Stability vs. Temperature	±35 ppm (-10°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	100 µW correlation; 500 µW max.
Operating Temperature	-10°C to 70°C
Storage Temperature	–40°C to 85°C

Table 3-13. Clock Specifications

| Characteristic	Value
Type	Square wave
Frequency	28.224 or 27.000 MHz nominal
Level	3.3 Vp-p ± 0.3 V zero offset
Duty Cycle	50 ± 10 %
Stability	±50 ppm

**Conexant Proprietary and Confidential Information**

4. Package Dimensions

The 20-pin QFN package dimensions are shown in Figure 4-1.

The 16-pin QFN package dimensions are shown in Figure 4-2.

Figure 4-1. Package Dimensions for 20-Pin QFN

TOP VIEW

SIDE VIEW

BOTTOM VIEW

TERMINAL/SIDE

SECTION "C-C"

NOTES:

1. NOT APPLICABLE.

2. DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. - 1994.

3. N IS THE NUMBER OF TERMINALS.
   Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION.
   Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.

4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED
   BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.

5. THE PIN #1 IDENTIFIER (INDENTATION MARK OR OTHER FEATURE).

6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.

7. ALL DIMENSIONS ARE IN MILLIMETERS.

8. THE SHAPE SHOWN ON FOUR CORNERS ARE NOT ACTUAL I/O.

9. PACKAGE WARPAGE IS 0.05mm MAXIMUM.

10. APPLIED FOR EXPOSED PAD AND TERMINALS. EXCLUDE EMBEDDING
   PART OF EXPOSED PAD FROM MEASURING.

11. APPLIED ONLY FOR TERMINALS.

SYMBOL	DIMENSIONS (mm)			NOTE
	MIN.	NOM.	MAX.	
A	-	0.85	0.90	
A1	0.00	0.01	0.05	11
A2	-	0.65	0.70	
A3	0.20 REF.			
D	6.00 BSC			
D1	5.75 BSC			
E	6.00 BSC			
E1	5.75 BSC			
θ			12°	
P	0.24	0.42	0.60	
e	0.80 BSC			
N	20			3
Nd	5			3
Ne	5			3
L	0.50	0.60	0.75	
b	0.28	0.33	0.40	4
D2	3.95	4.10	4.25	
E2	3.95	4.10	4.25	

: 20-PIN 6x6mm QFN_(REF: 45278_PVA_EPVB)

POD_20QFN_6x6mm_PVA_EPVC (05-1499iII)

Figure 4-2. Package Dimensions for 16-Pin QFN

TOP VIEW   SIDE VIEW   BOTTOM VIEW

SECTION "C-C"
SCALENONE

TERMINATIP

NOTES:

1. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED

   BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.

Dim.	Millimeters		
	Min.	Nom.	Max.
e	0.65 BSC		
L	0.50	0.60	0.75
b	0.23	0.28	0.35
D2	1.95	2.10	2.25
E2	1.95	2.10	2.25
A	---	0.85	0.90
A1	0.00	0.01	0.05
A2	---	0.65	0.70
A3	0.20 REF		
D	4.00 BSC		
D1	3.75 BSC		
E	4.00 BSC		
E1	3.75 BSC		
16-Pin QFN Ref. 45250			
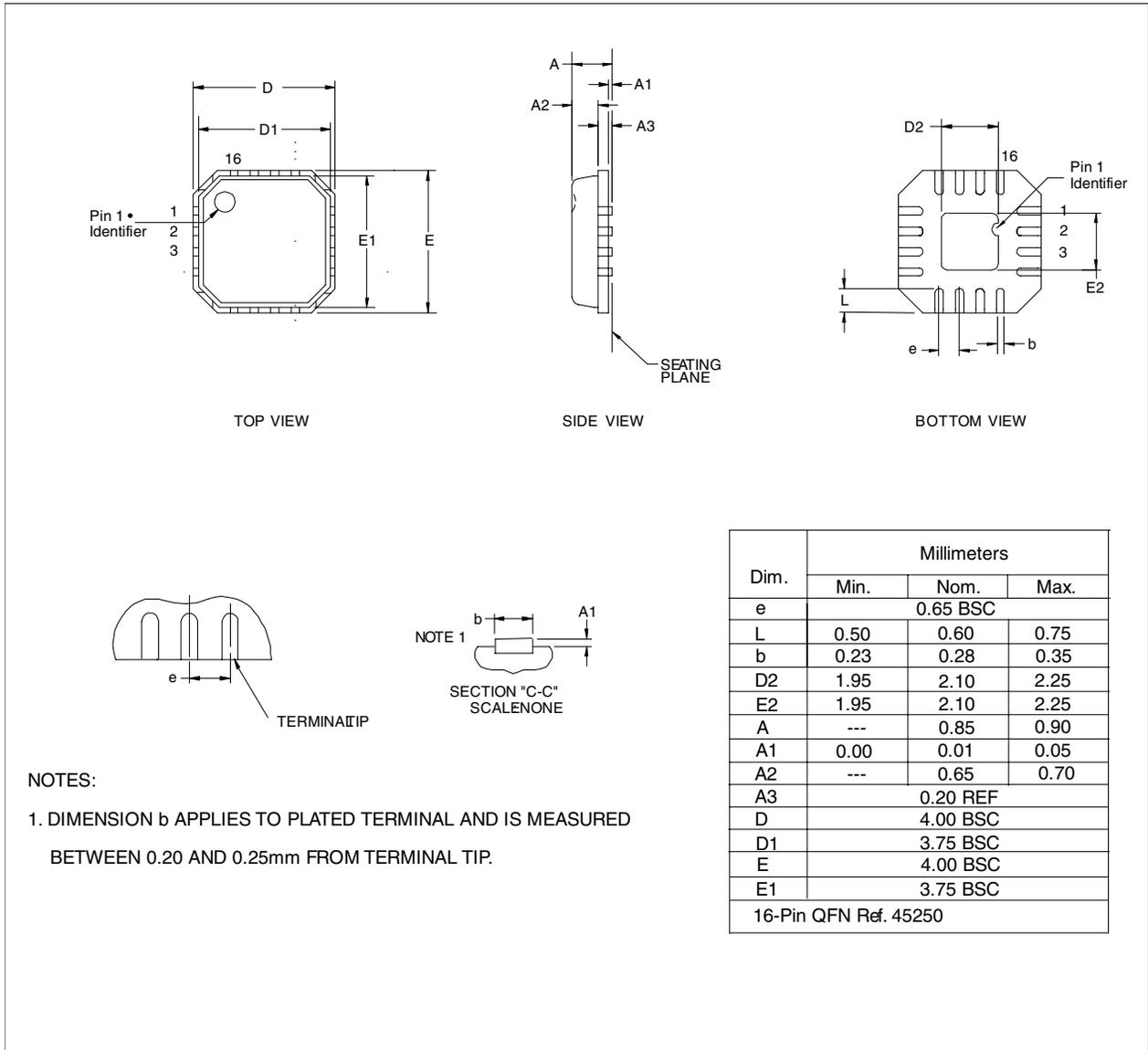
PD_QFN016

This page is intentionally blank.

5.   Recommended QFN Surface Mount Land Patterns

The recommended surface mount land patterns based on the IPC-SM-782 standard for board layout are shown in Figure 5-1 for the 20-pin QFN and Figure 5-2 for the 16-pin QFN.

*Figure 5-1. Recommended Surface Mount Land Pattern for 20-Pin QFN*
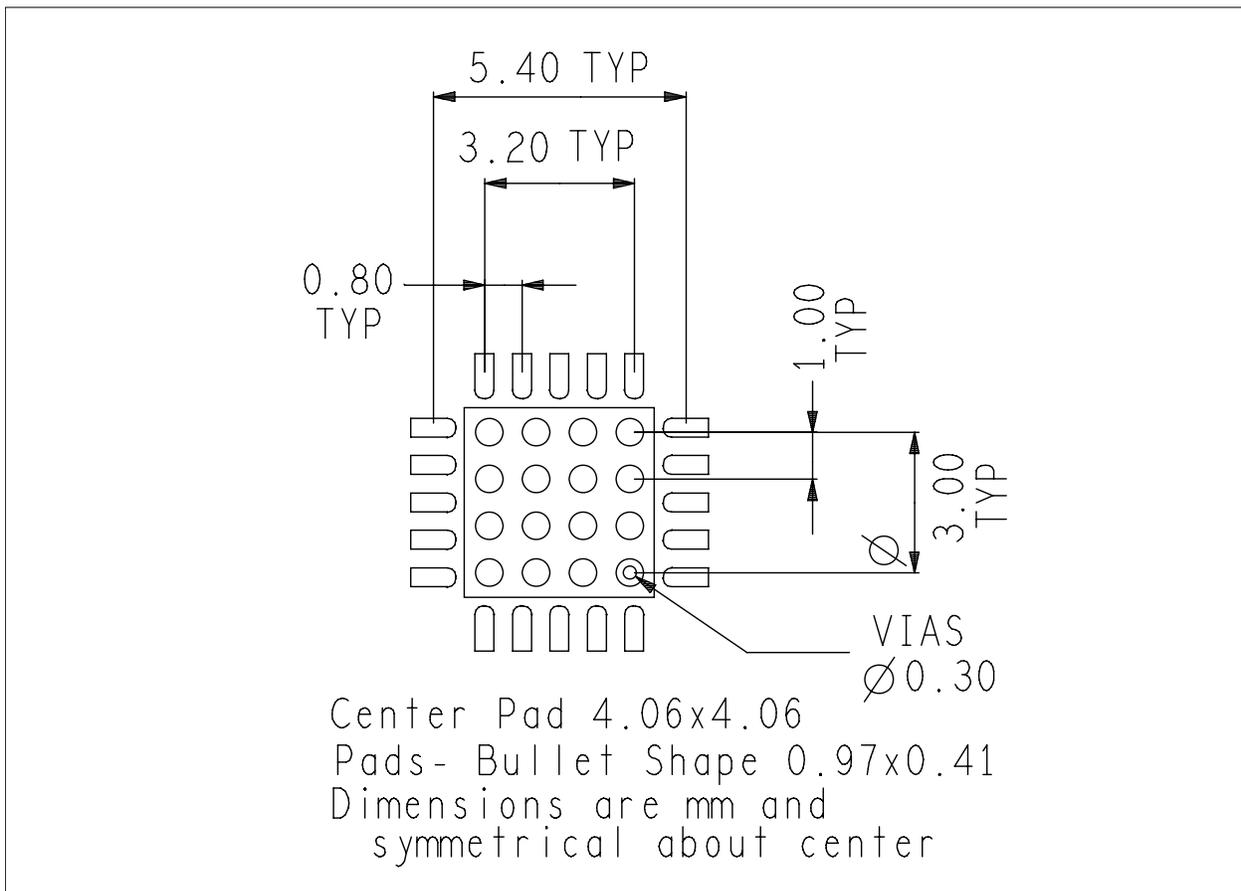
Figure 5-2. Recommended Surface Mount Land Pattern for 16-Pin QFN

Conexant Proprietary and Confidential Information

NOTES

CONEXANT®