CX93010-2x UCMxx

USB V.92/V.34/V.32bis Controllered Modem with CX20548 SmartDAA®

Data Sheet

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Revision Record

Revision	Date	Comments
A	7/2/2008	Initial release.
B	7/29/2008	Rev B release
C	7/31/2008	Rev C release

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1. Introduction

1.1 Overview

The Conexant® UCMxx USB V.92 Controllered Modem supports V.92 analog data modem operation with V.44 data compression and supports 14.4 kbps fax modem operation. In addition, the modem supports remote telephone answering machine (TAM) and USB host interface operation. Table 1-1 lists the ordering information.

The modem operates with PSTN telephone lines worldwide.

The UCMxx Modem is CDC-compliant and is supported by Microsoft CDC modem drivers.

The UCMxx Modem device set, consisting of a CX93010-2x USB V.92 Modem in a 20-pin QFN and a CX20548 SmartDAA LSD in a 16-pin QFN, supports data/fax/TAM operation with hardware-based modem controller, digital signal processing, and DAA/telephone line interface functions (Figure 1-1and Figure 1-2).

The UCMxx Modem is compatible with both USB 1.1 and USB 2.0 host controllers and hubs. This device can send and receive serial data at the maximum 12 Mbps rate.

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.

Table 1-1. UCMxx USB Modem Ordering Information

Model/Order/Part Numbers				Supported Functions			
Marketing Name	Device Set Order No.	UCMxx USB Modem [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	Fax Class 1 / Class 2, TAM, Worldwide DAA
UCM92(EM)	DS92-UCM-21Z	CX93010-21Z	CX20548-11Z (Note 3)	Y	Y	Y	Y
UCM34(EM)	DS34-UCM-22Z	CX93010-22Z	CX20548-11Z (Note 3)	—	Y	Y	Y
UCM32bis(EM)	DS32-UCM-23Z	CX93010-23Z	CX20548-11Z (Note 3)	—	—	Y	Y
UCM92(PC)	DS56-L931-21Z	CX93010-21Z	CX20548-11Z (Note 3)	Y	Y	Y	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 on the package

The CX93010-2x USB Modem integrates modem controller (MCU), modem data pump (MDP), ROM, RAM, and SmartDAA system side device (SSD) functions onto a single die.

Low profile, small QFN packages and reduced voltage operation with low power consumption make this device set an ideal solution for V.92 modem USB adapters.

The modem operates by executing firmware from internal ROM and RAM. Customized modem firmware and added/modified country profiles can be executed from internal SRAM or serial EEPROM.

In V.92 and V.90 data modes, the modem can receive data at speeds up to 56 kbps from a digitally connected V.92-compatible central site modem. A V.92 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, the modem operates at line speeds up to 33.6 kbps.

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

Data compression (V.44/V.42bis/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.42bis 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. V.44 data compression is not limited to the DTE rate since USB operates at 12 Mbps. Non-error-correcting mode is also supported.

In V.22bis fast connect mode, the modem can connect at 2400 bps with a very short training time, which is very efficient for small data transfers.

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 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.

In-band digital call progress enables the user to hear the call progress during modem negotiation. This software-enhanced feature eliminates several external components including an amplifier and a digital speaker. In-band digital call progress contributes to lower BOM cost and smaller PCB size.

Figure 1-1. UCMxx USB Modem Simplified Interface Diagram
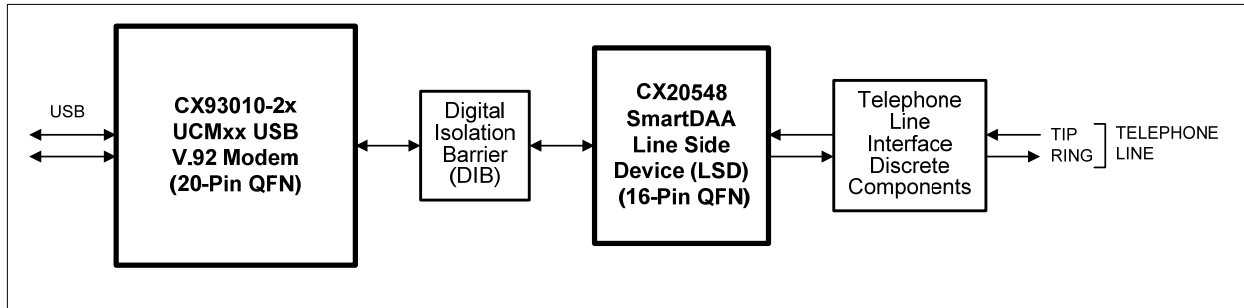
Figure 1-2. UCMxx USB Modem Major Interfaces
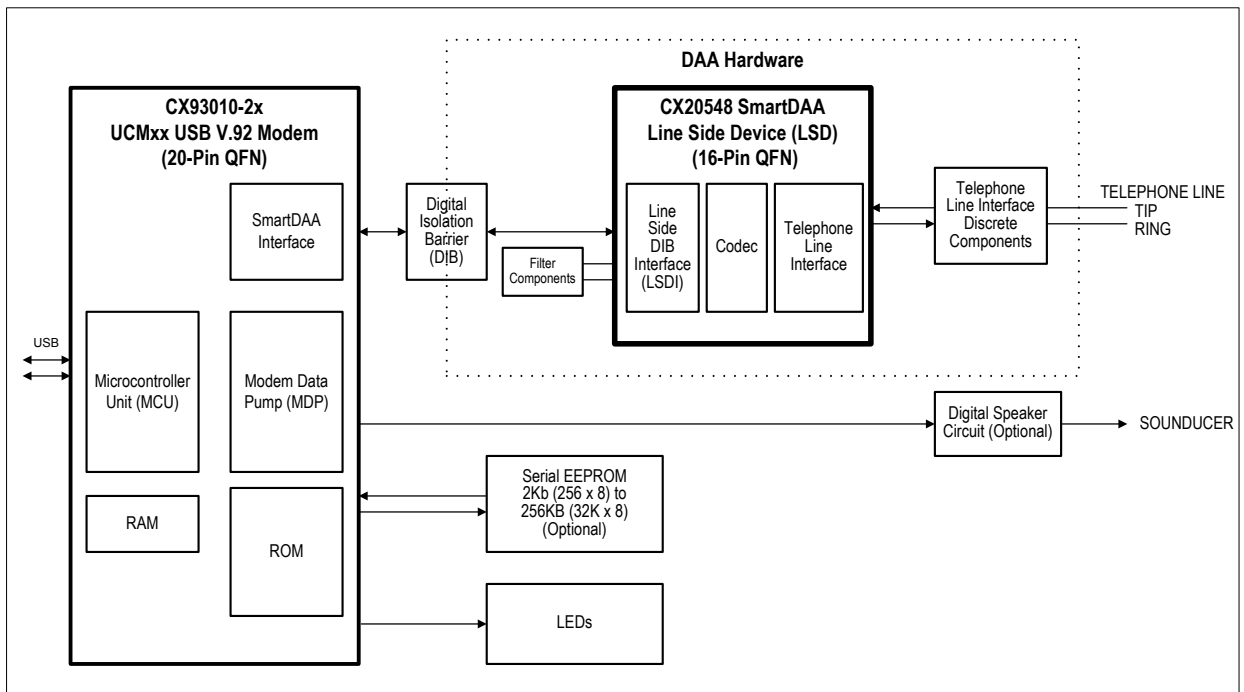
1.2   Features

1.2.1   Modem Features

- Full speed (12 MHz) USB interface device implementation
  - Suspend/Resume
  - Vendor specific descriptions
  - Bus powered USB device
  - Compatible with USB 2.0
- Data modem
  - 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 model)
  - V.32bis, V.32, V.22bis, V.22, V.23, and V.21, Bell 212A and Bell 103
  - V.22bis fast connect
  - V.250 and V.251 commands
  - V.80 Synchronous Access Mode
- Data compression and error correction
  - V.44, 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, T.31 Class 1.0, and Class 2
- Interfaces to optional serial EEPROM
- Data/Fax/Voice call discrimination
- Hardware-based modem controller
- Hardware-based digital signal processor (DSP)
- Worldwide operation
  - Complies to TBR21 and other country requirements
  - On-hook and/or off-hook Caller ID detection for selected countries
  - Call progress, blacklisting
  - Internal ROM includes default values for 63 countries
  - Additional modified country profiles can be stored in internal SRAM or optional serial EEPROM
- In-band digital call progress
- Caller waiting detection
- Caller ID detect
  - On-hook Caller ID detection
  - Off-hook Call Waiting Caller ID detection during data mode when connected to V.92 server

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- Modem customization available through patch code that can be stored in optional serial EEPROM or internal SRAM
- 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
- Flow control and speed buffering
- Automatic format/speed sensing
- Asynchronous data
- LED driver outputs
- +5V to +3.3V voltage regulators on-chip
- +3.3V to +1.2V voltage regulators on-chip
- System compatibility – CDC-compliant systems
  - Microsoft Windows 98SE, Windows ME, Windows 2000 and Windows XP operating systems; Linux operating systems
  - Macintosh computers and Sun workstations
- Thin packages support low profile designs
  - CX93010-2x USB Modem in 20-pin QFN
  - CX20548 LSD in 16-pin QFN
- Selectable 28.224 MHz or 27.000 MHz frequency of operation
- +3.3V operation
- Typical power use: 435 mW (operating)

1.2.2   SmartDAA Features

- System side powered DAA operates under poor line current supply conditions
- 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

- V.92 modem USB adapters
- Embedded systems
- Gaming devices
- Remote monitoring and data collection systems

1.3   Technical Overview

1.3.1   General Description

The UCMxx USB Device Set provides the processing core for a complete system design featuring data/fax modem, and remote TAM.

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

The modem hardware connects to the host PC via a USB connection. The OEM adds a crystal circuit, serial EEPROM, telephone line interface, and other discrete components as required by the modem model, and a Microsoft CDC-compliant modem driver to complete the system.

The modem hardware connects to the host via a USB interface. The OEM adds a crystal circuit, DIB components, telephone line interface, optional external serial EEPROM, and other supporting discrete components as required by the application to complete the system.

Customized modem firmware can be supported by the use of serial EEPROM (256 to 32 KB). To support country profile addition or modification, external serial EEPROM (256 to 32 KB) can be installed. Customized code can include OEM-defined commands, i.e., identification codes (I3), identifier string (I4), manufacturer identification (+GMI), model identification (+GMM), and revision identification (+GMR), as well as code modification.

1.3.2   Embedded MCU Firmware

Embedded MCU firmware performs processing of general modem control, command sets, data modem, error correction and data compression (ECC), fax class 1, fax class 1.0, fax class 2, voice/audio/TAM, worldwide, V.80, and USB host interface functions.

MCU firmware can be customized to include OEM-defined commands, i.e., identification codes (I3), identifier string (I4), manufacturer identification (+GMI), model identification (+GMM), and revision identification (+GMR), as well as code modification.

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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/V.90 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 (V.92 only), 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 full-duplex V.34 mode and to lower rates as dictated by line conditions.

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

- Quick connect: Allows quicker subsequent connections to a server by using stored line parameters obtained during the initial connection.

- Modem-on-Hold: 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.

- PCM upstream: Boosts the upstream data rates. A maximum of 48 kbps is supported when connected to a V.92 server that supports PCM upstream.

In V.34 data modem mode (V.92 model), 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 V.22bis fast connect data mode, the modem can connect at 2400 bps with a very short training time, which is very efficient for small data transfers.

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, T.31 Fax Class 1.0, or Fax Class 2 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.

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

1.3.3.4 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 63 countries including TBR21-compliant profiles. Additional country profiles can be stored in internal SRAM or external serial EEPROM (request additional country profiles from a Conexant Sales Office). Duplicate country profiles stored in internal SRAM or external serial EEPROM 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 Caller ID (CID2) Supported
Argentina	7	X		X
Australia	9	X	X	X
Austria	0A	X	X	X
Belgium	0F	X		X
Brazil	16	X		X
Bulgaria	1B	X		X
Canada	20	X	X	X
Chile	25	X		X
China	26	X	X	X
Colombia	27	X		X
Croatia	FA	X		X
Cyprus	2D	X		X
Czech Republic	2E	X		X
Denmark	31	X	X	X
Egypt	36	X		X
Estonia	F9	X		X
Finland	3C	X	X	X
France	3D	X	X	X
Germany	42	X	X	X
Greece	46	X		X
Hong Kong	50	X	X	X
Hungary	51	X		X
Iceland	52	X		X
India	53	X	X	X
Indonesia	54	X		X

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Table 1-2. Default Countries Supported (Continued)

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
Ireland	57	X	X	X
Israel	58	X		X
Italy	59	X	X	X
Japan	00	X	X	X
Korea	61	X	X	X
Kuwait	62	X		X
Lebanon	64	X		X
Luxembourg	69	X		X
Malaysia	6C	X		X
Mexico	73	X		X
Morocco	77	X		X
Netherlands	7B	X	X	X
New Zealand	7E	X	X	X
Norway	82	X	X	X
Pakistan	84	X		X
Philippines	89	X		X
Poland	8A	X		X
Portugal	8B	X		X
Romania	8E	X		X
Russia	B8	X		X
Saudi Arabia	98	X		X
Senegal	99	X		X
Singapore	9C	X	X	X
Slovakia	FB	X		X
Slovenia	FC	X		X
South Africa	9F	X		X
Spain	A0	X	X	X
Sri Lanka	A1	X		X
Sweden	A5	X	X	X
Switzerland	A6	X		X
Taiwan	FE	X	X	X
Thailand	A9	X		X
Tunisia	AD	X		X
Turkey	AE	X		X
UK	B4	X	X	X
United Arab Emirates	B3	X		X
Uruguay	B7	X		X
USA	B5	X	X	X
Reserved	FD			

1.3.3.5 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.

1.3.4 Reference Designs

Data/fax/TAM reference design for an external modem is available to minimize application design time, reduce development cost, and accelerate market entry. The part number for this design is: CZ-9Z-NR0226.

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 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 CX93010-2x UCMxx USB Modem

The CX93010-2x UCMxx USB Modem, packaged in a 20-pin QFN, includes a USB interface, Microcontroller (MCU) (controllered modem only), a Modem Data Pump (MDP), 256 KB internal ROM, 20 KB internal RAM, and SmartDAA interface functions.

The UCMxx USB Modem performs the command processing and host interface functions. The crystal frequency is 28.224 or 27.000 MHz.

The UCMxx USB Modem optionally connects to an external OEM-supplied serial EEPROM over a dedicated 2-line serial interface. The capacity of the EEPROM can be 256 bytes up to 32 KB. The EEPROM can hold information such as firmware configuration customization, country code parameters, and cellular drivers.

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

The SmartDAA 4 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 UCMxx USB Modem from the LSD and telephone line. The UCMxx USB 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, clock, and data from the UCMxx USB Modem to the LSD over two lines.

The DIB data channel supports bidirectional half-duplex serial transfer of data, control, and status information.

1.4.3　CX20548 SmartDAA 4 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, fax class 1, 1.0, or 2 modem, TAM, V.80 commands, and S Registers in accordance with modem model options. See Doc. REM-201692 for a description of the commands.

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

Fax Mode Operation. Facsimile functions operate in response to fax class 1 commands when +FCLASS=1, to fax class 1.0 commands when +FCLASS=1.0, or to fax class 2 commands when +FCLASS=2.

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2. Technical Specifications

2.1 USB Interface Operation

See Chapter 6.

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 an optional 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

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[1]	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[1]	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[1]	V92	48000, 46667, 45333, 44000, 42667, 41333, 40000, 38667, 37333, 36000, 34667, 33333, 32000, 30667, 29333, 28000, 26667, 25333, 24000
Notes: 1. V.92 model.		

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.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 (except MNP 10).

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.

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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.

2.4 V.92 Features (V.92 Model)

Modem-on-Hold, quick connect, and PCM upstream are only available in V.92 models 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 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 utilizes the Conexant Modem-on-Hold drivers under Windows PC operating systems. 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.

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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 31.2 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 or MNP 10 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. Two 2-KB dictionaries are used to store the strings. These dictionaries are dynamically updated during normal operation.

2.5.5 MNP 5 Data Compression

MNP 5 data compression mode, enabled by the %Cn command, operates during an MNP connection.

In MNP 5, the modem increases its throughput by compressing data into tokens before transmitting it to the remote modem, and by decompressing encoded received data before sending it to the DTE.

2.6   Telephony Extensions

The following telephony extension features are supported and can be typically be implemented in designs for software applications to enhance end-user experience:

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

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

2.6.1   Line In Use Detection

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

2.6.2   Extension Pickup Detection

The Extension Pickup Detection feature (also commonly referred as PPD or Parallel phone detection) allows the modem to detect when another telephony device (i.e., fax machine, phone, satellite/cable box) is attempting to use the phone line.

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

2.6.3   Remote Hangup Detection

The Remote Hangup Detection feature will cause the modem go back on-hook during a data connection when the remote modem is disconnected for abnormal termination reasons (remote phone line unplugged, remote server/modem shutdown.

2.7   Fax Class 1, Fax Class 1.0, and Fax Class 2 Operation

Facsimile functions operate in response to fax class 1 commands when +FCLASS=1, to fax class 1.0 commands when +FCLASS=1.0, or to fax class 2 commands when +FCLASS=2.

In the fax mode, the on-line behavior of the modem is different from the data (non-fax) mode. After dialing, modem operation is controlled by fax commands. Some AT commands are still valid but may operate differently than in data modem mode.

Calling tone is generated in accordance with T.30.

2.8 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 2.9). 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.

2.9 Worldwide Country Support

Internal modem firmware supports 63 country profiles (see Section 1.3.3.4). These country profiles include the following country-dependent parameters:

- Dial tone detection levels and frequency ranges.
- DTMF dialing parameters: Transmit output level, DTMF signal duration, and DTMF interdigit interval.
- Pulse dialing parameters: Make/break times, set/clear times, and dial codes are programmable
- Ring detection frequency range.
- Type I and Type II Caller ID detection are supported for many countries. Contact your local Conexant sales office for additional country support.
- Blind dialing enabled/disable.
- Carrier transmit level (through S91 for data and S92 for fax). The maximum, minimum, and default values can be defined to match specific country and DAA requirements.
- Calling tone is generated in accordance with V.25. Calling tone may be toggled (enabled/disabled) by inclusion of a "^" character in a dial string. It may also be disabled.
- Frequency and cadence of tones for busy, ringback, congested, warble, dial tone 1, and dial tone 2.
- Answer tone detection period.
- Blacklist parameters. The modem can operate in accordance with requirements of individual countries to prevent misuse of the network by limiting repeated calls to the same number when previous call attempts have failed. Call failure can be detected for reasons such as no dial tone, number busy, no answer, no ringback detected, voice (rather than modem) detected, and key abort (dial attempt aborted by user). Actions resulting from such failures can include specification of minimum inter-call delay, extended delay between calls, and maximum numbers of retries before the number is permanently forbidden ("blacklisted").
- These country profiles may be altered or customized by modifying the country-dependent parameters. Additional profiles may also be included.

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

2.10 Diagnostics

2.10.1 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.

PTT Signal Generation (%TTn Command). Continuous tones or modulation are generated by the DSP and output through the DAA.

2.11 Low Power Stop Mode

Stop Mode. The modem enters the low power stop mode when no line connection exists and no host activity occurs for the period of time specified in the USB specification. All modem circuits are turned off in order to reduce consumed power while being able to immediately wake up and resume normal operation.

3. Hardware Interface

3.1 CX93010-2x UCMxx USB Modem Hardware Pins and Signals

3.1.1 General

3.1.1.1 USB Interface

Differential data plus and data minus signals (USB_DP and USB_DN) interface to the USB port.

3.1.1.2 LED Interface

Dedicated LED output signals are provided for Transmit/Receive Data and Off-Hook status.

3.1.1.3 LSD Interface (Through DIB)

The DIB interface signals are:

- DIBP
- DIBN

3.1.1.4 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.

3.1.1.5 Serial EEPROM Interface

A 2-line serial interface to an optional serial EEPROM is supported. The interface signals are:

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

The EEPROM can hold information such as firmware customization and country code parameters. Data stored in EEPROM takes precedence over the factory default settings. The EEPROM size can range from 2 Kb (256 x 8) to 256 Kb (32K x 8) and must support a clock frequency of at least 400 kHz. For overriding, adding new country profiles, or loading NVRAM patches, the EEPROM size must be larger than 2Kb. The size of the EEPROM device will depend on the number of country profiles added or patch size.

The serial EEPROM is required to store the USB device, configuration, interface, and endpoint descriptors. Device descriptors include Vendor ID, Product ID, Device Release Number, Manufacturer Name, Product Name, and Serial Number.

Connection to an Atmel AT24C04N-10-2.7 or equivalent is supported.

3.1.2 CX93010-2x Signal Interface, Pin Assignments, and Signal Definitions

CX93010-2x 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.

The CX93010-2x Modem hardware interface signals are defined in Table 3-2.

Figure 3-1. CX93010-2x UCMxx USB Modem Hardware Signals

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Figure 3-2. CX93010-2x UCMxx USB 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.
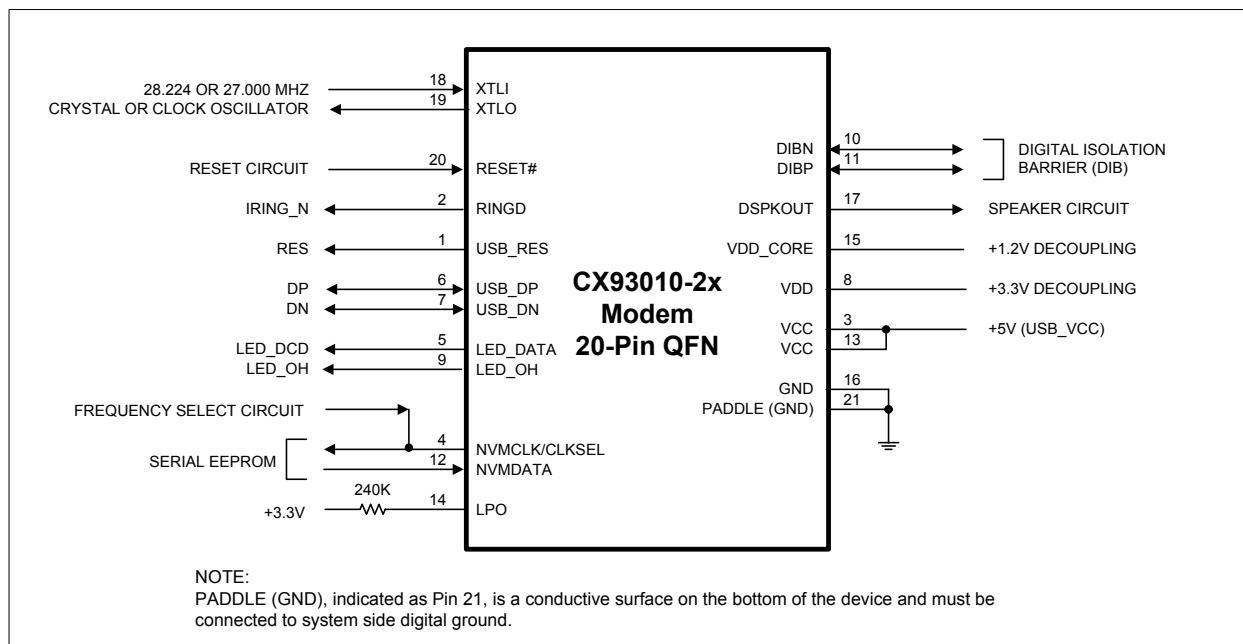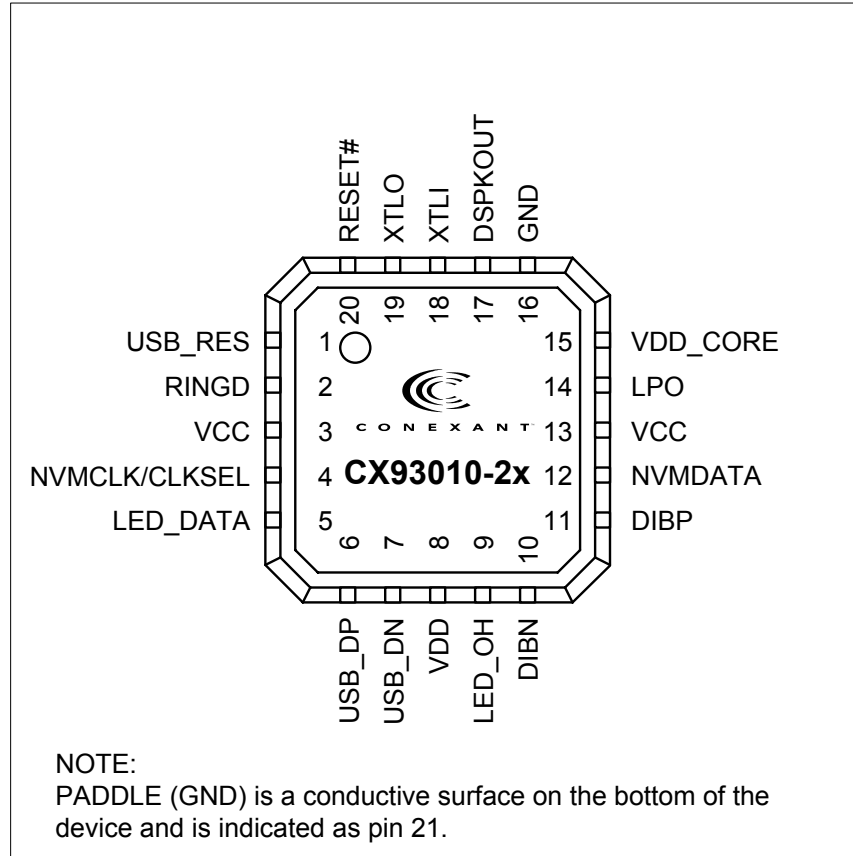
Table 3-1. CX93010-2x UCMxx USB Modem 20-Pin QFN Pin Signals

Pin No.	Signal Name	Pin No.	Signal Name
1	USB_RES	11	DIBP
2	RINGD	12	NVMDATA
3	VCC	13	VCC
4	NVMCLK/CLKSEL	14	LPO
5	LED_DATA	15	VDD_CORE
6	USB_DP	16	GND
7	USB_DN	17	DSPKOUT
8	VDD	18	XTLI
9	LED_OH	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.			

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Table 3-2. CX93010-2x UCMxx USB Modem Pin 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.
RESET#	20	I	Ipu/It	**Reset.** The active low RESET# input resets the CX93010-2x logic, and restores the saved configuration from serial EEPROM or returns the modem to the factory default values if NVRAM is not present. 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#. Connect RESET# input to the CX93010-2x XRESET_N pin through 51 Ω.
VCC	3, 13	P	PWR	**Digital Supply Voltage.** Connect to USB VCC (+5V, filtered).
VDD	8	P	PWR	**+3.3 Internal I/O Voltage Filter.** Connect to +3.3V decoupling capacitors only.
VDD_CORE	15	P	PWR	**+1.2 Internal Core Voltage Filter.** Connect to +1.2V decoupling capacitors only.
GND	16	G	GND	**Digital Ground.** Connect to digital ground (GND).
PADDLE (GND)	21	G	GND	**Paddle Ground.** Connect to digital ground (GND).
LPO	14	I	I/O	**Low Power Oscillator.** Connect to +3.3V through 240 KΩ.
Serial EEPROM (NVRAM) Interface				
NVMCLK/CLKSEL	4	I/O	Ipu/O2	**NVRAM Clock (NVMCLK).** NVMCLK output high enables the EEPROM. Connect to EEPROM SCL pin. This signal is multiplexed with the CLKSEL signal. **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 the NVMCLK signal.
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.
LED Interface				
LED_OH	9	O	Ipu/O8	**Off-Hook Indicator.** Active low. Connect to LED circuit.
LED_DATA	5	O	Ipu/O8	**Data Indicator.** Active low. Connect to LED circuit.
USB Interface				
USB_DP USB_DN	6 7	I/O I/O	I/O I/O	**USB Port**. USB_DP and USB_DN are the differential data plus and data minus signals of the USB port, the upstream differential port. These lines do not have internal pullup resistors. Connect DP and DM to USB_DATAP and USB_DATAM, respectively, through 43 Ω. Connect USB_DM to GND through a 5.1 MΩ resistor. Connect USB_DM to GND through a 5.1 MΩ resistor.
USB_RES	1	I	Ipd/It	**Reset.** Connect to USB_DATAP through 1.5 KΩ.
Wake-on-Ring Circuit Interface				
RINGD	2	I	Ipd/It	**Ring Wakeup.** Active high input that indicates that a ring has been detected to wake up the UID from suspend mode. Connect to Suspend/Resume and Wake-on-Ring circuit.

Table 3-2. CX93010-2x UCMxx USB Modem Pin Signal Definitions (Continued)

Label	Pin	I/O	I/O Type	Signal Name/Description
DIB Interface				
DIBN	10	I/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	I/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.
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. Typically, connect to a digital call progress speaker circuit.
Notes:				
1. I/O Types: See Table 3-4.				

2. Interface Legend:
    DIB   Digital Isolation Barrier
    NC   No internal pin connection
    RESERVED = No external connection allowed (may have internal connection).				

Table 3-3. CX93010-2x UCMxx USB Modem I/O Type Definitions

I/O Type	Description
Ix/Ox	I/O, wire
It/O2	Digital input, +3.3V tolerant/ Digital output, 2 mA
Itpd/It	Digital input, +3.3V tolerant, 120 kΩ pull down/ Digital input
Itpd/O2	Digital input, +3.3V tolerant, 120 kΩ pull down/ Digital output, 2 mA
Itpu/It	Digital input, +3.3V tolerant, 120 kΩ pull up/ Digital input
Itpu/O2	Digital input, +3.3V tolerant, 120 kΩ pull up/ Digital output, 2 mA
Itpu/O8	Digital input, +3.3V tolerant, 120 kΩ pull up/ Digital output, 8 mA
Odpc	Digital output with adjustable drive, DIB clock and power
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.	

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Table 3-4. CX93010-2x UCMxx USB Modem DC Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Input Voltage Low	VIL					
+3.3V tolerant		0	–	0.8	V	
+3.3V tolerant hysteresis		0	–	0.3 *VDD	V	
Input Voltage High	VIH		–		V	
+3.3V tolerant		2	–	3.6	V	
+3.3V tolerant hysteresis		0.7 * VDD	–	3.6	V	
Input Hysteresis	VH		–		V	
+3V hysteresis		0.5	–		V	
+3.3V 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	120	–	500	kΩ	
Pull-Down Resistance	Rpd	120	–	500	kΩ	
Test Conditions unless otherwise stated: VCC = +5 ± 0.25 VDC; TA = 0°C to 70°C; external load = 50 pF.						

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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 one 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

NOTES:

1. Consult applicable reference design for exact component placement and values, and for layout guidelines.

2. The PADDLE (indicated as Pin 17) 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 printed circuit board (PCB).
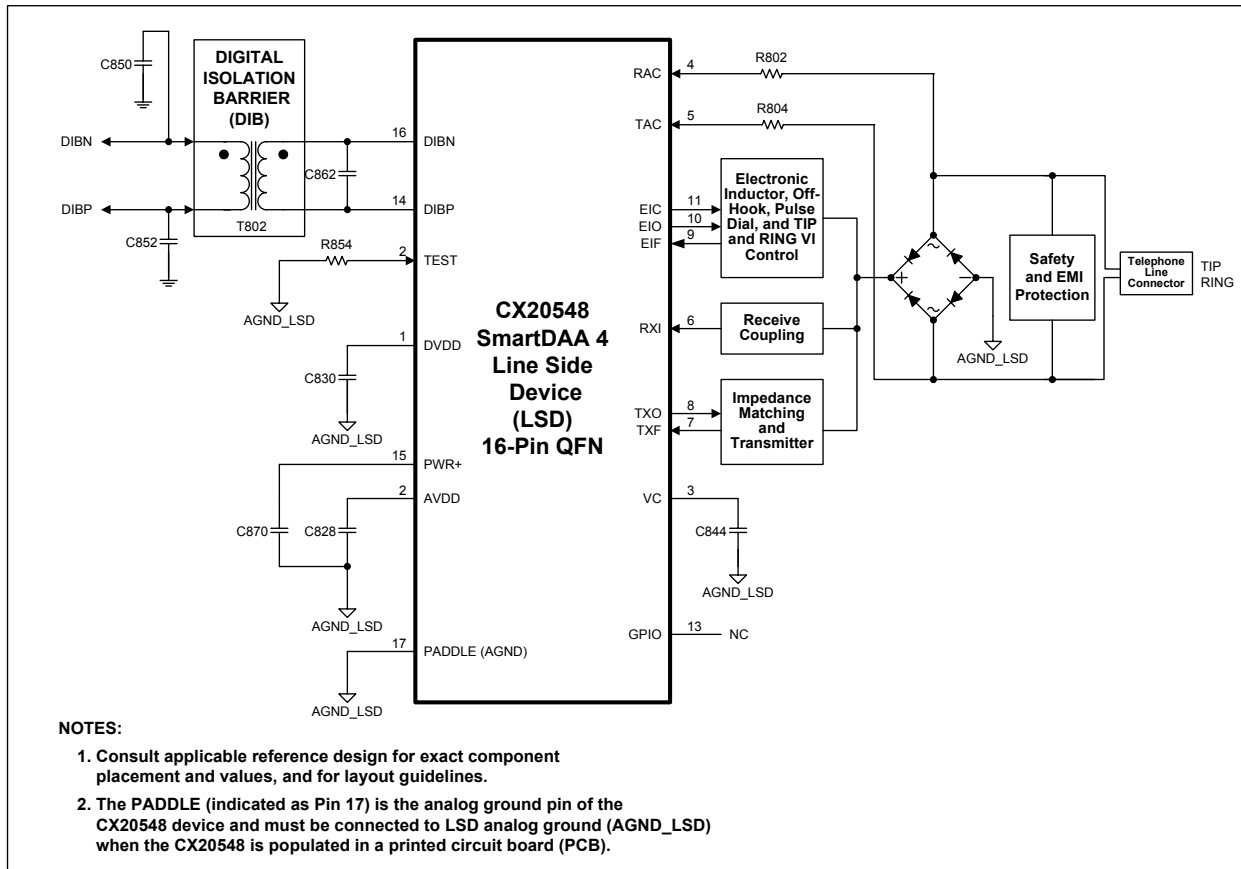
Figure 3-4. CX20548 LSD 16-Pin QFN Pin Signals

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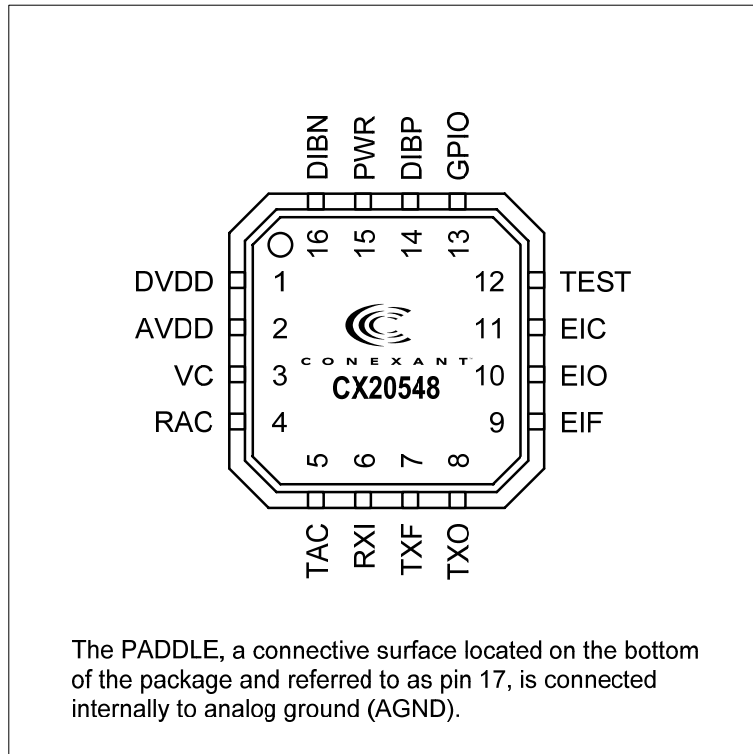
Table 3-5. CX20548 LSD 16-Pin QFN Pin Signals

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.
EIF	9	I	Ia	**Electronic Inductor Feedback.** Connect to emitter of Q804 through R826.
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.

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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 = 0°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 ± 5%	+3.0 V ± 5%
PWR must be at least 100mV higher than AVDD.		
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	VCC	+4.75 to 5.25	VDC
Operating Ambient Temperature	T_A	0 to +70	°C

Table 3-10. Absolute Maximum Ratings

Parameter	Symbol	Limits	Units
Supply Voltage	VCC	-0.5 to +6.0	VDC
Input Voltage	V_{IN}	-0.3 to (VDD +0.3)*	VDC
Voltage Applied to Outputs in High Impedance (Off) State	V_{HZ}	-0.3 to (VDD +0.3)*	VDC
Storage Temperature Range	T_{STG}	-55 to +125	°C
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
* VCC = +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 -0.3V to VDD + 0.3V. 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	Current		Power	
	Typical Current (mA)	Maximum Current (mA)	Typical Power (mW)	Maximum Power (mW)
Enumeration	76	77	380	404
Operating (Idle)	76	77	380	404
Operating (Connected)	87	88	435	462
Notes:				
1. Test conditions: VCC = +5.0 V for typical values; VCC = + 5.25 V for maximum values.				
2. Input Ripple $\leq$ 0.1 Vpeak-peak.				

3.4 Crystal Specifications

Crystal specifications are listed in Table 3-12.

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 (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	100 μW correlation; 500 μW max.
Operating Temperature	0°C to 70°C
Storage Temperature	–40°C to 85°C

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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"

SCALE: NONE

SEE DETAIL "A"
FOR PIN #1 ID AND
TIE BAR MARK OPTION

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 (05-1499ill)

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

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			
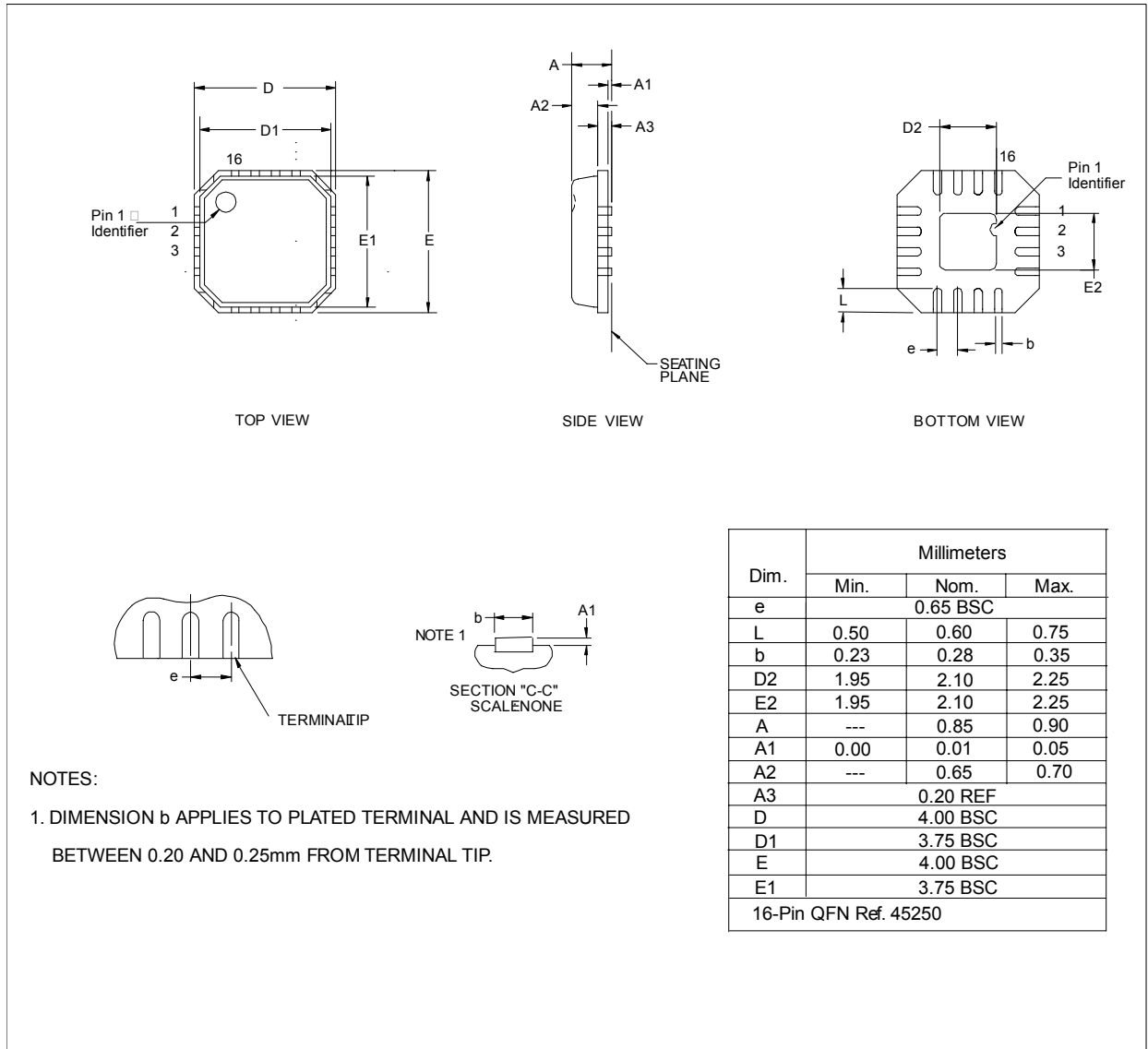
PD_QFN016

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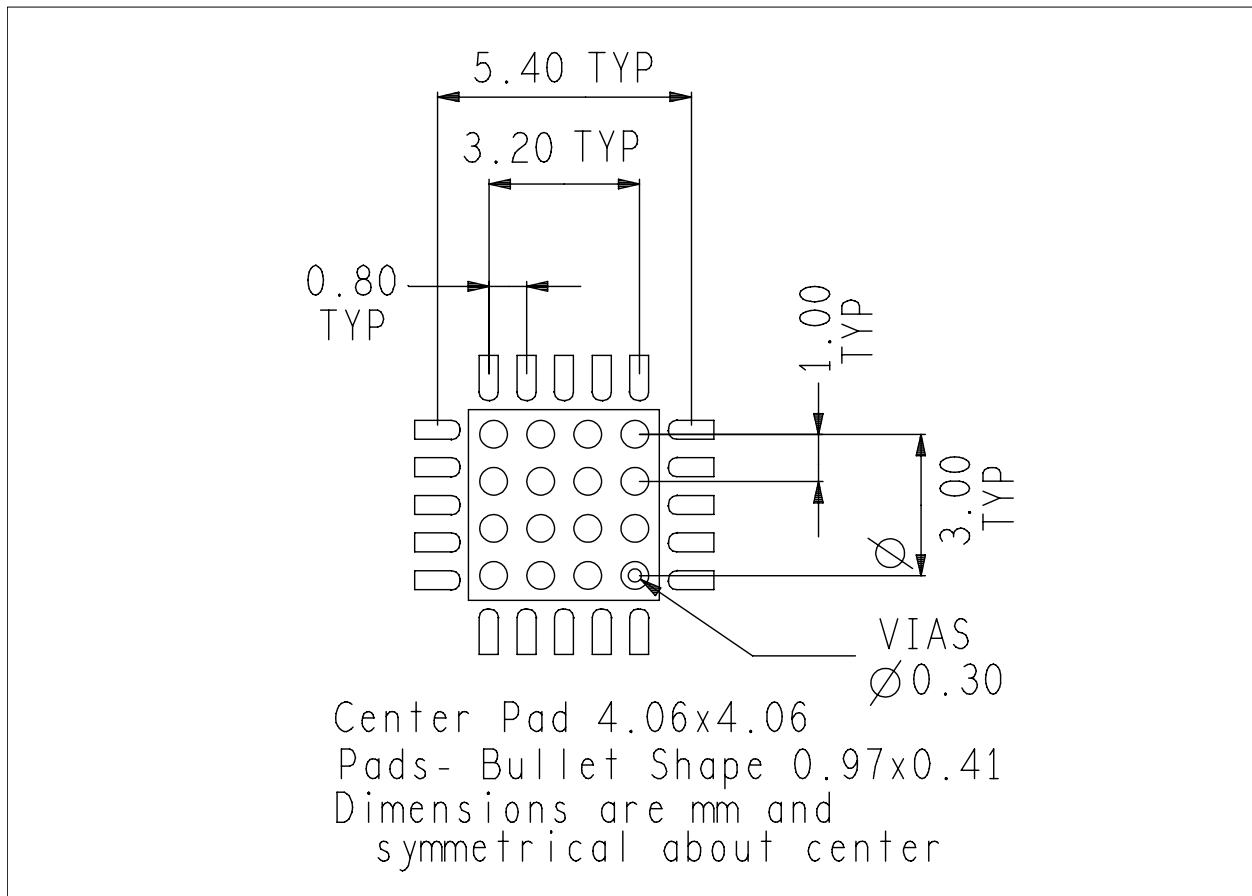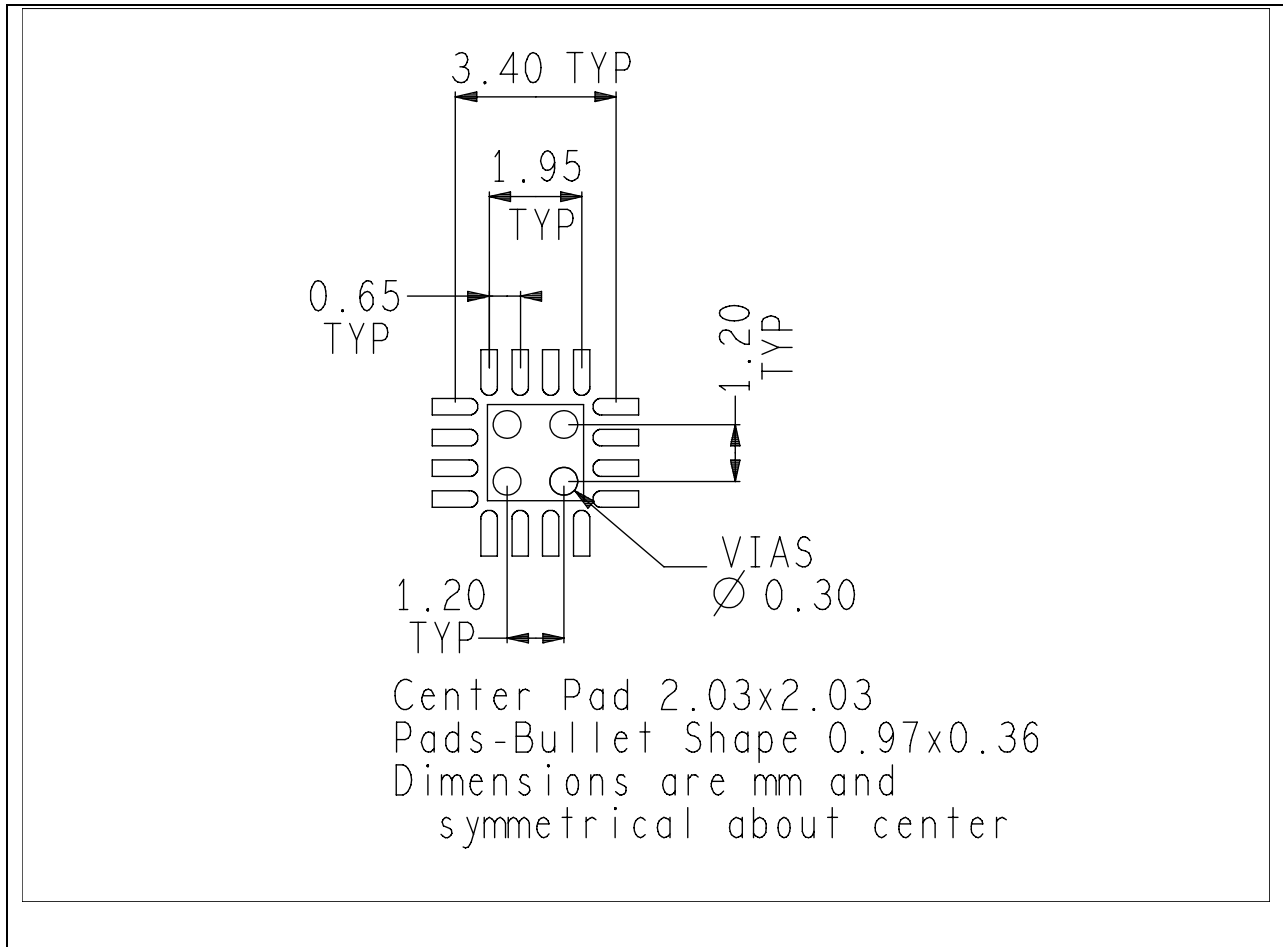
Figure 5-2. Recommended Surface Mount Land Pattern for 16-Pin QFN

3.40 TYP

1.95 TYP

0.65 TYP

1.20 TYP

1.20 TYP

VIAS
Ø 0.30

Center Pad 2.03x2.03
Pads-Bullet Shape 0.97x0.36
Dimensions are mm and
symmetrical about center

6.   USB General Operation

6.1   Descriptors

USB devices report their attributes using descriptors. A descriptor is a data structure with a defined format, which begins with a byte-wide field that contains the total number of bytes in the descriptor followed by a byte-wide field that identifies the descriptor type.

Class and vendor specific descriptors may be returned in one of two ways. Class and vendor specific descriptors that are related to standard descriptors are returned in the same data buffer as the standard descriptor. If a class or vendor specific descriptor is not related to a standard descriptor, it is returned using class or vendor specific requests.

6.1.1   Device Descriptor

A device descriptor describes general information about a USB device, which applies globally to the device and all of the device's configurations (Table 6-1). A USB device has only one device descriptor. Vendor ID, Product ID, and Device Release Number can be changed. The Manufacturer Name, Product Name, and Serial Number can also be customized.

Table 6-1. Device Descriptors

Offset	Field	Size	Value	Default (Hex.)	Description
0	bLength	1	Number	12	Size of this descriptor in bytes.
1	bDescriptorType	1	Constant	01	DEVICE Descriptor Type.
2	bcdUSB	2	BCD	0110	USB Specification Release Number in Binary-Coded Decimal (i.e., 2.10 is 0x210). This field identifies the release of the USB Specification that the device and its descriptors are compliant with.
4	bDeviceClass	1	Class	02	Class code (assigned by USB). If this field is reset to 0, each interface within a configuration specifies its own class information and the various interfaces operate independently. If this field is set to a value between 1 and 0xFE, the device supports different class specifications on different interfaces and the interfaces may not operate independently. This value identifies the class definition used for the aggregate interfaces. (For example, a CD-ROM device with audio and digital data interfaces that require transport control to eject CDs or start them spinning.) If this field is set to 0xFF, the device class is vendor specific.
5	bDeviceSubClass	1	SubClass	00	Subclass code (assigned by USB). These codes are qualified by the value of the bDeviceClass field. If the *bDeviceClass* field is reset to 0, this field must also be reset to 0. If the *bDeviceClass* field is not set to 0xFF, all values are reserved for assignment by USB.
6	bDeviceProtocol	1	Protocol	00	Protocol code (assigned by USB). These codes are qualified by the value of the *bDeviceClass* and the *bDeviceSubClass* fields. If a device supports class-specific protocols on a device basis as opposed to an interface basis, this code identifies the protocols that the device uses as defined by the specification of the device class. If this field is reset to 0, the device does not use class specific protocols on a device basis. However, it may use class specific protocols on an interface basis. If this field is set to 0xFF, the device uses a vendor specific protocol on a device basis.
7	bMaxPacketSize0	1	Number	40	Maximum packet size for endpoint zero (only 8, 16, 32, or 64 are valid).
8	idVendor	2	ID	0572	Vendor ID (Conexant ID assigned by usb.org). The OEM ID will be assigned by usb.org.
10	idProduct	2	ID	1340	Product ID (assigned by Conexant) and stored in OEM-supplied serial EEPROM: 1340 for data/fax
12	bcdDevice	2	BCD	0100	Device release number in binary-coded decimal.
14	iManufacturer	1	Index	01	Index of string descriptor describing manufacturer.
15	iProduct	1	Index	02	Index of string descriptor describing product.
16	iSerialNumber	1	Index	03	Index of string descriptor describing the device's serial number.
17	bNumConfigurations	1	Number	02	Number of possible configurations.

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6.1.2   Configuration Descriptor

A configuration descriptor describes information about a specific device configuration (see Table 6-2). The descriptor describes the number of interfaces provided by the configuration.

Table 6-2. Configuration Descriptors

Offset	Field	Size	Value	Default (Hex.)	Description
0	bLength	1	Number	09	Size of this descriptor in bytes.
1	bDescriptorType	1	Constant	02	CONFIGURATION.
2	wTotalLength	2	Number	0049	Total length of data returned for this configuration. Includes the combined length of all descriptors (configuration, interface, endpoint, and class or vendor specific) returned for this configuration.
4	bNumInterfaces	1	Number	02	Number of interfaces supported by this configuration.
5	bConfigurationValue	1	Number	01	Value to use as an argument to Set Configuration to select this configuration.
6	iConfiguration	1	Index	00	Index of string descriptor describing this configuration.
7	bmAttributes	1	Bitmap	A0	Configuration characteristics D7 Bus Powered D6 Self Powered D5 Remote Wakeup D4..0 Reserved (reset to 0) A device configuration that uses power from the bus and a local source sets both D7 and D6. The actual power source at runtime may be determined using the Get Status device request. If a device configuration supports remote wakeup, D5 is set to 1.
8	MaxPower	1	mA	32	Maximum power consumption of USB device from the bus in this specific configuration when the device is fully operational. Expressed in 2 mA units (i.e., 50 = 100 mA). Note: A device configuration reports whether the configuration is bus-powered or self-powered. Device status reports whether the device is currently self-powered. If a device is disconnected from its external power source, it updates device status to indicate that it is no longer self-powered. A device may not increase its power draw from the bus, when it loses its external power source, beyond the amount reported by its configuration. If a device can continue to operate when disconnected from its external power source, it continues to do so. If the device cannot continue to operate, it fails operations it can no longer support. Host software may determine the cause of the failure by checking the status and noting the loss of the device's power source.

6.1.3   Interface Descriptor

An interface descriptor describes a specific interface provided by the associated configuration (see Table 6-3Table 6-3). It is always returned as part of a configuration descriptor. An interface descriptor never includes endpoint zero in the number of endpoints.

Table 6-3. Interface Descriptors

Offset	Field	Size	Value	Default (Hex.)	Description
0	*bLength*	1	Number	09	Size of this descriptor in bytes.
1	*bDescriptorType*	1	Constant	04	INTERFACE Descriptor Type.
2	*bInterfaceNumber*	1	Number	00	Number of interface. Zero-based value identifying the index in the array of concurrent interfaces supported by this configuration.
3	*bAlternateSetting*	1	Number	00	Value used to select alternate setting for the interface identified in the prior field.
4	*bNumEndpoints*	1	Number	01	Number of endpoints used by this interface (excluding endpoint zero). If this value is 0, this interface only uses endpoint zero.
5	*bInterfaceClass*	1	Class	02	Class code (assigned by USB). If this field is reset to 0, the interface does not belong to any USB specified device class. If this field is set to 0xFF, the interface class is vendor specific. All other values are reserved for assignment by USB.
6	*bInterfaceSubClass*	1	SubClass	02	Subclass code (assigned by USB). These codes are qualified by the value of the *bInterfaceClass* field. If the *bInterfaceClass* field is reset to 0, this field must also be reset to 0. If the *bInterfaceClass* field is not set to 0xFF, all values are reserved for assignment by USB.
7	*bInterfaceProtocol*	1	Protocol	01	Protocol code (assigned by USB). These codes are qualified by the value of the *bInterfaceClass* and the *bInterfaceSubClass* fields. If an interface supports class-specific requests, this code identifies the protocols that the device uses as defined by the specification of the device class. If this field is reset to 0, the device does not use a class specific protocol on this interface. If this field is set to 0xFF, the device uses a vendor specific protocol for this interface.
8	*iInterface*	1	Index	00	Index of string descriptor describing this interface.

6.1.4 Endpoint Descriptor

Each endpoint used for an interface has its own descriptor, which contains the information required by the host to determine the bandwidth requirements of each endpoint (see Table 6-4). An endpoint descriptor, like an Interface Descriptor, is always returned as part of a configuration descriptor. The default values are:

Interrupt In 1: 07058103400080

Bulk In 2:   07058202400001

Bulk Out 2:   07050202400001

Table 6-4. Endpoint Descriptors

Offset	Field	Size	Value	Description
0	*bLength*	1	Number	Size of this descriptor in bytes.
1	*bDescriptorType*	1	Constant	ENDPOINT Descriptor Type.
2	*bEndpointAddress*	1	Endpoint	The address of the endpoint on the USB device described by this descriptor. The address is encoded as follows: Bit 0..3: The endpoint number Bit 4..6: Reserved, reset to 0 Bit 7: Direction, ignored for control endpoints 0 OUT endpoint 1 IN endpoint
3	*bmAttributes*	1	Bit Map	This field describes the endpoint's attributes when it is configured using the *bConfigurationValue*. Bit 0..1: Transfer Type 00 Control 01 Isochronous 10 Bulk 11 Interrupt All other bits are reserved
4	*wMaxPacketSize*	2	Number	Maximum packet size this endpoint is capable of sending or receiving when this configuration is selected. For isochronous endpoints, this value is used to reserve the bus time in the schedule, required for the per frame data payloads. The pipe may, on an ongoing basis, actually use less bandwidth than that reserved. The device reports, if necessary, the actual bandwidth used via its normal, non-USB defined mechanisms. For interrupt, bulk, and control endpoints smaller data payloads may be sent, but will terminate the transfer and may or may not require intervention to restart.
6	*bInterval*	1	Number	Interval for polling endpoint for data transfers. Expressed in milliseconds. This field is ignored for bulk and control endpoints. For isochronous endpoints this field must be set to 1. For interrupt endpoints, this field may range from 1 to 255.

6.1.5   Enumeration

The CX93010-2x enumeration process consists of the following steps:

1. Get device descriptor. The host requests and reads the device descriptor to determine maximum packet size.

2. Set address. The host sends the CX93010-2x's function address in a data packet using function endpoint 0. Device firmware interprets this data.

3. Get device descriptor. The host requests and reads the device descriptor to determine such information as device class, USB Specification compliance level, maximum packet size for endpoint 0, vendor id, product id, etc.

4. Get configuration descriptor. The host requests and reads the device configuration descriptor to determine such information as the number of interfaces and endpoints; endpoint transfer type, packet size, and direction; power source; maximum power; etc. When the host requests the configuration descriptor, all related interface and endpoint descriptors are returned.

5. Set configuration. The host assigns a configuration value to the device to establish the current configuration.

6.1.6   Endpoints

Data transfers with the host are made to/from endpoints on the USB module. The CX93010-2x provides the function endpoints listed in Table 6-5.

Table 6-5. Endpoints

Endpoint Pair	Max. Packet Size	USB Data Transfer Types
Function Endpoint 0	64 bytes	Control
Function Endpoint 1	64 bytes	Interrupt
Function Endpoint 2	64 bytes	Bulk

NOTES

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