CX90240 CSM22

V.22bis Controllered Serial Modem with CX20548 SmartDAA®

Data Sheet (Preliminary)

Conexant Proprietary Information

Doc. No. DSH-201065C
November 20, 2006

CONEXANT®

Revision Record

Revision	Date	Comments
A	8/1/2005	Initial release. Released as Doc. No. 102636A.
B	3/30/2006	Rev. B release. Released as Doc. No. 102636B.
C	11/20/2006	Rev. C release.

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

Contents

Figures

Tables

This page is intentionally blank.

1. Introduction

1.1 Overview

The Conexant® CSM22 V.22bis modem supports up to V.22bis data modem operation with V.42 and MNP 2-4 error correction and V.42 bis data compression over a serial host interface. Also, the V.80 synchronous access mode supports host-controlled communication protocols. Major hardware interfaces and signal interfaces are illustrated in Figure 1-1. Table 1-1 lists the ordering information.

The CSM22 device set consists of a CX90240 V.22bis Modem device in a 20-pin QFN and a CX20548 SmartDAA® 4 Line Side Device (LSD) in a 16-pin QFN.

The CX90240 V.22bis Modem integrates modem controller (MCU), serial host interface, ROM code, RAM, and analog line interface codec onto a 20-pin Quad Flat No-lead (QFN) package.

Conexant's SmartDAA technology used in the SmartDAA4 LSD eliminates the need for bulky analog transformers, relays, and opto-isolators typically used in discrete DAA implementations. The SmartDAA4 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 SmartDAA4 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.

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.

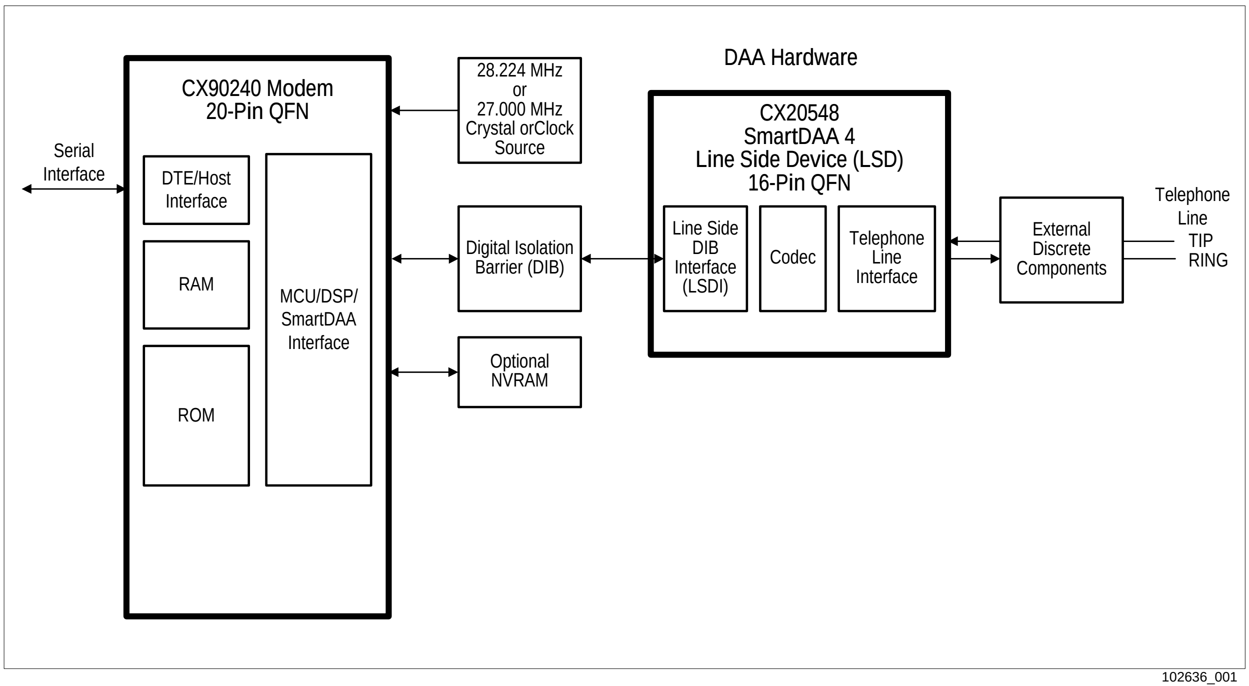
A small, low profile package, low voltage operation, low power consumption, and low Bill of Material (BOM) cost make this device set an ideal V.22bis solution for embedded applications.

This data sheet describes the modem capabilities. Commands and parameters are defined in the AT Commands Reference Manual (Doc. No. 102811).

Table 1-1. CX90240 CSM22 V.22bis Modem Models and Functions

Device Set Order No.	Modem Device [20-Pin QFN] Part No.	Line Side Device (LSD) [16-Pin QFN] Part No.
DS22-CSM-11Z	CX90240-11Z	CX20548-11Z (Device is marked 20548-A)
Notes: All devices are lead-free (Pb-free) and RoHS-compliant. These devices are compatible with leaded reflow processes.		

Figure 1-1. CX90240 CSM22 V.22bis Modem Simplified Interface



1.2 Features

- Modulations
  - ITU-T V.22bis (2400 bps)
  - ITU-T V.22 and Bell 212A (1200 bps)
  - ITU-T V.21 and Bell 103 (300 bps)
  - ITU-T V.23 1200/75 and 75/1200
  - V.23 Reverse Mode Protocol
- Error correction protocols
  - V.42 (LAPM)
  - MNP2-MNP4
- V.42bis Data Compression
- DTE/host interface
  - Serial DTE interface
  - Direct Mode
  - Asynchronous Mode
- Selectable 27.000 MHz or 28.224 MHz crystal/clock support
- Serial NVRAM support
- Asynchronous Data Mode (Normal and Direct)
  - 10- and 11-bit data
  - DTE speeds up to 57,600 bps
  - AT Command speed sensing from 300 bps to 57,600 bps
  - RTS/CTS hardware flow control
  - XON/XOFF software flow control
- AT Command Set
  - Command set includes common Hayes/legacy and V.250 commands.
- Caller ID Decoding
  - On-Hook Caller ID Type 1 decoding
  - FSK decoder for Bell 202/V.23
  - Call Waiting Caller ID (CWCID) Type 2 decoding
- Sixty-four embedded and upgradeable country profiles
- Ring detection
  - Detection mode with no additional external components
- SmartDAA
  - Extension pick-up detection
  - Digital line protection
  - Remote hang-up/Line reversal detection
  - Worldwide compliance
- Power
  - Single +3.3V supply
  - Low power 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
  - CX90240 Modem: 20-pin QFN
  - CX20548 LSD: 16-pin QFN
- Pin-to-pin compatible with CSMxx V.92/V.34/V.32bis modem

1.2.1 Applications

- Set top boxes
- Point-of-Sale terminals
- ATM machines
- Minitel terminals

1.3 Technical Overview

1.3.1 General Description

Modem operation, including dialing, call progress, telephone line interface, telephone handset interface, and host interface functions are supported and controlled through the AT command set.

The modem hardware connects to the host via a serial interface. The OEM adds a crystal circuit or clock input, telephone line interface, and other supporting discrete components as required by the application to complete the system.

1.3.2 MCU

The MCU performs processing of general modem control, command sets, data modem, error correction, country configuration, V.80, serial host interface functions, and signal processing.

1.3.3 Operating Modes

1.3.3.1 Data Modes

The modem operates in 2-wire full-duplex, asynchronous mode at line rates up to 2400 bps (V.22bis), 1200 bps (V.22 and Bell 212A), and 300 bps (V.21 and Bell 103). V.23 full duplex (asymmetrical connect rate of 1200 bps in one direction and 75 bps in the other direction) and V.23 half duplex mode (1200 bps) are also supported.

1.3.3.2 Country Operation

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.

Internal ROM includes default profiles for 64 countries. Additional country profiles can be uploaded to internal RAM (request additional country profiles from a Conexant Sales Office) or to external serial NVRAM if supplied by the OEM. Duplicate country profiles uploaded will override the default profiles in internal firmware. Country code IDs are defined by ITU-TT.35. The default countries supported are listed in Table 1-2.

Table 1-2. Default Countries Supported

Country	Country Code	Country	Country Code
Argentina	7	Luxembourg	69
Australia	9	Malaysia	6C
Austria	0A	Mexico	73
Belgium	0F	Morocco	77
Brazil	16	Netherlands	7B
Bulgaria	1B	New Zealand	7E
Canada	20	Norway	82
Chile	25	Pakistan	84
China	26	Philippines	89
Columbia	27	Poland	8A
Croatia	FA	Portugal	8B
Cyprus	2D	Romania	8E
Czech Republic	2E	Russia	B8
Denmark	31	South Africa	9F
Egypt	36	Saudi Arabia	98
Estonia	F9	Senegal	99
Finland	3C	Singapore	9C
France	3D	Slovakia	FB
Germany	42	Slovenia	FC
Greece	46	Spain	A0
Hong Kong	50	Sri Lanka	A1
Hungary	51	Sweden	A5
Iceland	52	Switzerland	A6
India	53	Taiwan	FE
Indonesia	54	Thailand	A9
Ireland	57	Tunisia	AD
Israel	58	Turkey	AE
Italy	59	UK	B4
Japan	0	UK Genesys	FD
Korea	61	United Arab Emirates	B3
Kuwait	62	Uruguay	B7
Lebanon	64	USA	B5

1.3.4 Reference Design

An RS-232 external data modem reference design is available to minimize application design time, reduce development cost, and accelerate market entry.

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

1.4 Hardware Description

1.4.1 CX90240 V.22bis Modem

The CX90240 V.22bis Modem, packaged in a 20-pin QFN, includes a Microcontroller (MCU), internal ROM code, internal RAM, and analog line interface codec functions.

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

The modem performs the command processing and host interface functions. The crystal or clock input frequency is 28.224 MHz or 27.000 MHz.

The CX90240 connects to external serial EEPROM, if supplied by the OEM, via a dedicated 2-line 400 kHz serial interface. The capacity of the EEPROM can be 256 bytes up to 32 Kbytes. The EEPROM can hold information such as patch code, OEM configuration, customization, and country code parameters.

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

1.4.2 Digital Isolation Barrier

The OEM-supplied Digital Isolation Barrier (DIB) electrically DC isolates the CX90240 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 CX90240 to the LSD.

The DIB transformer also supports bidirectional half-duplex serial transfer of data, control, and status information between the CX90240 and the LSD.

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

Modem functions operate in response to data modem and V.80 AT commands and S Register parameters (Table 1-3). See AT Commands for CX90240 V.22bis Modem Reference Guide (Doc. No. 102811) for a complete description of the commands and registers.

Table 1-3. Supported AT Commands

Command	Description
$F	Fast Connect Control
%C	Enable/Disable Data Compression
%E	Enable/Disable Line Quality Monitor and Auto-Retrain
%L	Report Line Signal Level
%Q	Report Line Signal Quality
%TT	PTT Test Command
&C	RLSD Option
&D	DTR Option
&F	Restore Factory Configuration (Profile)
&G	Select Guard Tone
&K	Flow Control
&M	Asynchronous/Synchronous Mode Selection
&P	Select Pulse Dial Make/Break Ratio
&Q	Sync/Async Mode
&R	RTS/CTS Option
&T	Local Analog Loopback Test
&V	Display Current Configuration and Stored Profiles
&V1	Display Last Connection Statistics
&X	Select Synchronous Clock Source
**	Load to Internal RAM
*B	Display Blacklisted Numbers
*D	Display Delayed Numbers
\B	Transmit Break to Remote
\K	Break Control
\N	Operating Mode
\V	Single Line Connect Message Enable
+DR	Data Compression Reporting
+DS	Data Compression
+ER	Error Control Reporting
+ES	Error Control and Synchronous Mode Selection
+ESA	Configure Synchronous Access Submode
+ESR	Selective Repeat
+ETBM	Call Termination Buffer Management

Table 1-3. Supported AT Commands (Continued)

Command	Description
+GCI	Country of Installation
+IBC	In-Band Commands
+IFC	DTE Modem Local Flow Control
+ITF	Transmit Flow Control Thresholds
+MR	Modulation Reporting Control
+MS	Modulation Selection
+PCW	Call Waiting Enable
+VCID	Type I Caller ID (CID) Enable
+VDR	Distinctive Ring
+VDT	Control Tone Cadence Reporting
+VRID	Report Retrieved CID
-HTRV	History of Tip & Ring Voltage
-SCID	Snooping CID (Type II)
-SLP	Select Low-Power Mode
-STE	Set Telephone Extension
-TRV	Tip & Ring Voltage Measurement
-TTE	Threshold Adjustments for Telephony Extension
A	Answer
B	ITU-T or Bell
D	Dial
E	Command Echo
H	Disconnect (Hang-Up)
I	Identification
L	Speaker Volume
M	Speaker Control
O	Return to On-Line Data Mode
P	Set Pulse Dial Default
Q	Quiet Results Codes Control
S	Read/Write S-Parameter
T	Set Tone Dial Default
V	Result Code Form
W	Connect Message Control
X	Extended Result Codes
Z	Soft Reset and Restore Profiles

2. Technical Specifications

2.1 Serial DTE Interface Operation

2.1.1 Automatic Speed/Format Sensing

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

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

Conventional discrete DAA designs include a ring detection circuit. To reduce BOM cost, the CX90240 device eliminates the need for this circuit. A ring signal is detected from the receive analog input by qualifying the line’s characteristics through a given set of parameters defined in the country profiles and configured by an AT command. Country parameters define the frequency range and time duration of the ring signal.

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

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).

2.2.8 Automode

Automode detection can be enabled by the +MS command to allow the modem to connect to a remote modem (Table 2-1).

Table 2-1. +MS Command Automode Connectivity

<mod>	Modulation	Possible Rates (bps) [1]	Notes
V21	V.21	300	
V22	V.22	1200	
V22B	V.22bis	2400 or 1200	Default
V23C	V.23	1200	See Note 2
B103	Bell 103	300	
B212	Bell 212	1200	

Notes:

1. See optional <automode>, <min_rate>, and <max_rate> subparameters for the +MS command.
2. For V.23, originating modes transmit at 75 bps and receive at 1200 bps; answering modes transmit at 1200 bps and receive at 75 bps. The rate is always specified as 1200 bps. V.23 half duplex is not supported.
3. If the DTE speed is set to less than the maximum supported DCE speed in automode, the maximum connection speed is limited to the DTE speed.

2.3 Data Mode

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

2.3.1 Speed Buffering (Normal Mode)

Speed buffering allows a DTE to send data to, and receive data from, a modem at a speed different than the line speed. The modem supports 64-byte 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 Direct Mode

The Direct mode allows data to be transmitted and received directly from either the DTE or remote modem. The Direct mode is selected with the AT&Q0 or AT\N1 command.

When running Direct mode, no flow control characters are recognized or transmitted, and the modem cannot perform error correction. The purpose of the Direct mode is to make the modem 'dumb' for compatibility with older style modems.

Any data received while the modem is in command mode is lost.

2.3.4 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.

2.3.5 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.

2.3.6 Telephone Line Monitoring

Loss of Carrier. If carrier is lost for a time greater than specified by the S10 register, the modem disconnects.

2.3.7 Retrain

The modem may lose synchronization with the received line signal under poor or changing line conditions. If this occurs, retraining may be initiated to attempt recovery depending on the type of connection.

The modem initiates a retrain if line quality becomes unacceptable if enabled by the %E command. The modem continues to retrain until an acceptable connection is achieved, or until 30 seconds elapse resulting in line disconnect.

2.3.8 Programmable Inactivity Timer

The modem disconnects from the line if data is not sent or received for a specified length of time. In normal or error-correction mode, this inactivity timer is reset when data is received from either the DTE or from the line. This timer can be set to a value between 0 and 255 seconds by using register S30. A value of 0 disables the inactivity timer.

2.3.9 DTE Signal Monitoring

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 Error Correction and Data Compression

2.4.1 V.42 Error Correction

V.42 supports two methods of error correction: LAPM and, as a fallback, MNP 2-4. The modem provides a detection and negotiation technique for determining and establishing the best method of error correction between two modems.

2.4.2 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.

2.4.3 V.42 bis Data Compression

V.42 bis data compression mode, enabled by the %Cn or +DS command or S46 register, operates when a LAPM or MNP 2-4 connection is established. Data compression reporting can be enabled by the +DR and W command.

The V.42 bis data compression employs a “string learning” algorithm in which a string of characters from the DTE is encoded as a fixed length codeword. Two 512-byte dictionaries are used to store the strings. These dictionaries are dynamically updated during normal operation.

2.5 Telephony Extensions

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

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

The –TTE command offers flexibility in tuning the telephony extension features’ sensitivity to accommodate various line conditions.

2.5.1 Line In Use Detection

The Line In Use Detection feature can stop the modem from seizing 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”.

2.5.2 Extension Pickup Detection

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

This feature can be used to quickly drop a modem connection in the event when a user picks up a extension phone line. For example, this feature allows set top boxes with an integrated CX90240 V.22bis Modem to give normal voice users the highest priority over the telephone line.

2.5.3 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).

2.6 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.

2.7 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.

2.8 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. 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. Table 2-2 identifies Caller ID type differences.

Table 2-2. Supported Caller ID Types

Caller ID Type	Modem State	Parallel Phone
Type I CID (On-hook)	On-hook	On-hook
Type II CID (Call Waiting)	Off-hook	On-hook

2.8.1 Type II CID

When connected in V.22bis and Call Waiting is detected (assuming Call Waiting detection is enabled by +PCW = 0 command), the modem notifies the user of incoming call by toggling the RI pin. Under similar condition except +PCW = 1, the modem will hang up. In all other modulations, when +PCW = {0 or 1} and Call Waiting comes in during data mode, the modem will hang up.

When +PCW = 1 and Caller ID is enabled, the modem will attempt to do Type II Caller ID before hanging up. The Caller ID information may then be retrieved by issuing +VRID = {0 or 1} after the modem hangs up.

The modem operates as normal when Call Waiting detection is disabled (+PCW = 2). However, the modem may also disconnect due to a carrier loss caused by the noise disturbance that the Call Waiting introduced to the line.

2.9 Country Support

Internal modem firmware supports 64 country profiles (see Section 1.3.3.2). A country profile can be uploaded via SRAM patch in addition to, or to override, one of the default countries in the code. Alternatively, multiple country profiles can also be uploaded into the external serial NVRAM if supplied by the OEM. Contact the local Conexant sales office if country code customization is required. These country profiles include the following country-dependent parameters:

- Dial tone detection levels and frequency ranges.
- Pulse dialing parameters: make/break times, set/clear times, and dial codes.
- Ring detection frequency range.
- Type I and Type II Caller ID are supported for many countries. Consult firmware release notes for a list of the supported countries and the criteria for additional country support.
- Blind dialing enabled/disable.
- 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").

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.

2.11 Low Power Mode

The S24 register sets the length of time, in seconds, that the modem will operate in normal mode with no detected telephone line or DTE line activity before entering low power mode. The timer resets upon any DTE line or telephone line activity. Neither DTE line nor telephone inactivity will cause the modem to enter into low-power mode if the S24 is set to zero.

When the S24 timer expires, the modem enters into low-power mode, which has four variations controlled by –SLP or Select Low-Power Mode command. The low-power mode can be configured either in idle, sleep, deep sleep, or stop mode as shown in Table 2-3. Either a ring input or host serial transmit activity will force the modem out of low-power mode and back to normal mode. Note that the first issued command will get processed during idle mode but not in sleep or stop mode. The first byte sent merely wakes up the modem, thus missing the first command. However, subsequent commands will get processed as normal operating mode resumes.

The device power consumption is listed in Table 2-3.

Table 2-3. Select Low-Power Mode (-SLP) Command Comparison Table

AT-SLP =	0 (Idle)	1 (Sleep)	2 (Deep Sleep)	3 (Stop)
Ring input[1]	Yes	Yes	Yes	Yes
Host serial TXD activity	Yes	Yes[2]	Yes[2]	Yes[2]

Notes:
1. Supported when optional external wake-on-ring is implemented.
2. The first AT command is ignored but modem returns to normal operating mode.

3. Hardware Interface

3.1 CX90240 Modem Hardware Interface Signals

3.1.1 CX90240 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#)

3.1.1.6 Control Signals

The supported control signals are:

- Reset (RESET#); input
- Low Power Oscillator Select (LPO); input

3.1.1.7 Crystal/Clock and Power Signals

Supported crystal and power signals are:

- Crystal/Clock input (XTLI)
- Crystal return (XTLO)
- +3.3 V power (VDD)
- Ground (VSS)

3.1.2 CX90240 Modem Pin Assignments and Signal Definitions

CX90240 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.

CX90240 Modem hardware interface signals are defined in Table 3-2.

Figure 3-1. CX90240 Modem Hardware Interface Signals

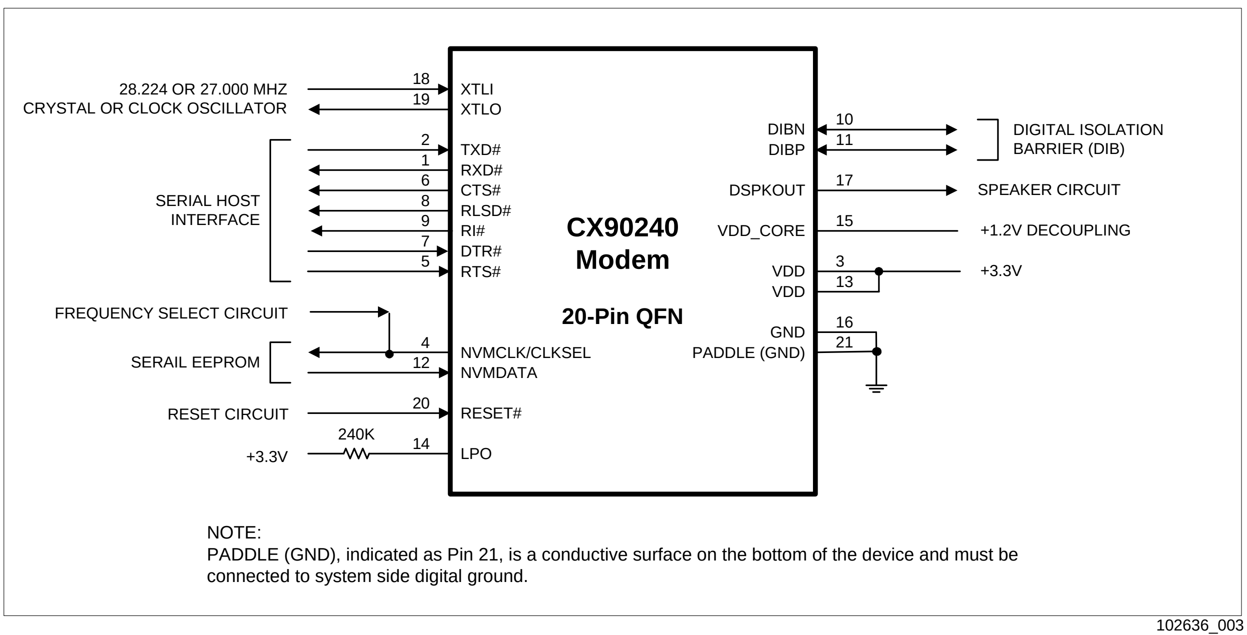


Figure 3-2. CX90240 Modem 20-Pin QFN Pin Signals

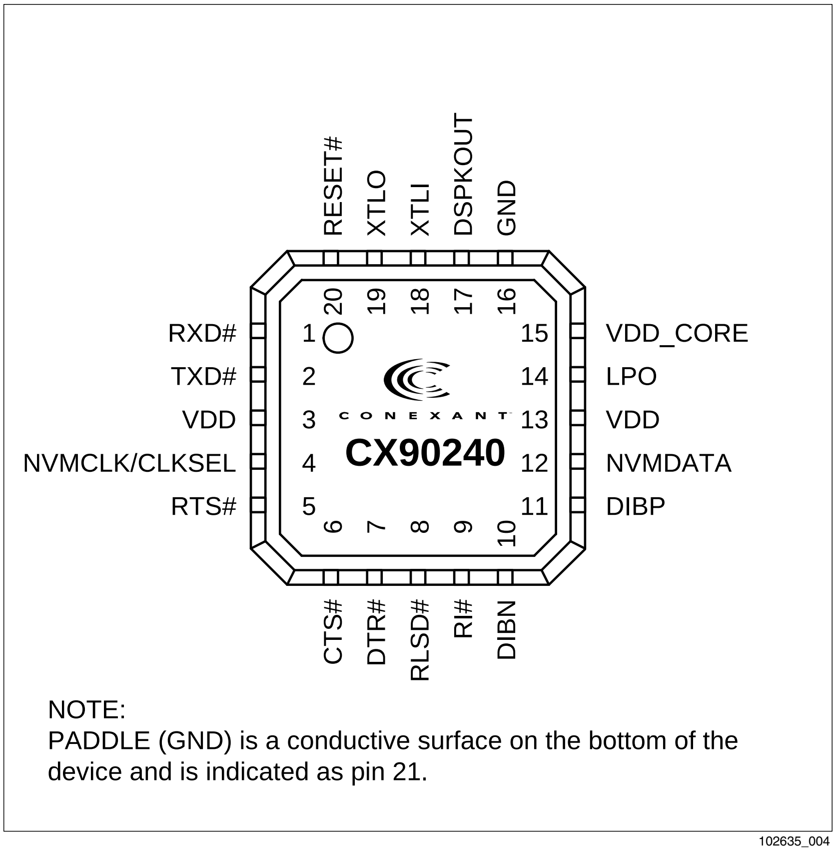


Table 3-1. CX90240 Modem 20-Pin QFN Pin Signals

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. CX90240 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) 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. CX90240 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#	3	I	Ipu/O2	**Transmit Serial Input (EIA BA/ITU-T CT103).** Serial data is sent on this line from the DTE to the DCE. The DTE holds this line at logic 1 when no data is being transmitted. The following signals must be at logic 0, where implemented, before data can be transmitted on this line: Request To Send (RTS), Clear To Send (CTS), and Data Terminal Ready (DTR).
RXD#	2	O	Ipu/O2	**Receive Serial Output (EIA BB/ITU-T CT104).** Serial data is sent on this line from the DCE to the DTE. This pin is held at logic 1 (Mark) when no data is being transmitted, and is held logic 1 for a brief interval after a logic 0 to 1 transition on the Request To Send line (RTS), in order to allow the transmission to complete.
CTS#	11	O	Ipu/O2	**Clear To Send (EIA CB/ITU-T CT106).** An answer signal to the DTE. When this signal is active, it tells the DTE that it can now start transmitting. When CTS is logic 0 and the Request To Send (RTS) and Data Terminal Ready (DTR) are both logic 0, the DTE is assured that its data will be sent to the communications link. Logic 1 indicates to the DTE that the DCE is not ready, and therefore data should not be sent. In asynchronous operation, in error correction or normal mode, CTS is always at logic 0 unless RTS/CTS flow control is selected by the &Kn command. In synchronous operation, the modem also holds CTS at logic 0 during asynchronous command state. The modem switches CTS to logic 1 immediately upon going off-hook and holds it there until RLSD is at logic 0 in which case the modem is ready to transmit and receive synchronous data. CTS can also track the state of RTS via the &Rn command.
RLSD#	13	O	Ipu/O2	**Received Line Signal Detector (EIA CF/ITU-T CT109).** The DCE uses this line to signal the DTE that a good signal is being received assuming AT&C0 command is not in effect (a "good signal" means a good analog carrier, that can ensure demodulation of received data).
RI#	14	O	Ipu/O2	**Ring Indicator (EIA CE/ITU-T CT125).** On this line the DCE signals the DTE that there is an incoming call. This signal is maintained at logic 1 at all times except when the DCE receives a ringing signal.
DTR#	12	I	Ipu/O2	**Data Terminal Ready (EIA CD/ITU-T CT108).** When at logic 0, DTR# tells the DCE that the DTE is available for receiving. The DTR signal deals with the readiness of the equipment, as opposed to the Clear To Send (CTS) and Request To Send (RTS) signals that deal with the readiness of the communication channel. Logic 1 places the modem in the disconnect state under the control of &Dn and &Qn commands.
RTS#	10	I	Ipu/O2	**Request To Send (EIA CA/ITU-T CT105).** The DTE uses this signal when it wants to transmit to the DCE. This signal, in combination with the Clear To Send (CTS) signal, coordinates data transmission between the DTE and the DCE. A logic 0 on this line keeps the DCE in transmit mode. The DCE will receive data from the DTE to be forwarded to the communication link. The RTS and CTS signals relate to a half-duplex telephone line. A half duplex line is capable of carrying signals on both directions but only one at a time. When the DTE has data to send, it raises RTS, and then waits until the DCE changes from receive to transmit mode. The logic 1 to 0 transition of the RTS instructs the DCE to switch to "transmit" mode, and when a transmission is possible, the DCE sets CTS and transmission can begin. On a full duplex line, like a hard-wired connection, where transmission and reception can occur simultaneously, the CTS and RTS signals are held to a constant logic 0 level. A logic 0 to 1 transition of the RTS instructs the DCE to complete data transmission and to switch to a “receive” (or “no transmission”) mode.

3.1.3 CX90240 Modem Electrical Characteristics

CX90240 I/O types are defined in Table 3-3.

CX90240 DC electrical characteristics are listed in Table 3-4.

Table 3-3. CX90240 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. CX90240 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 = 0°C to 70°C; external load = 50 pF.					

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.

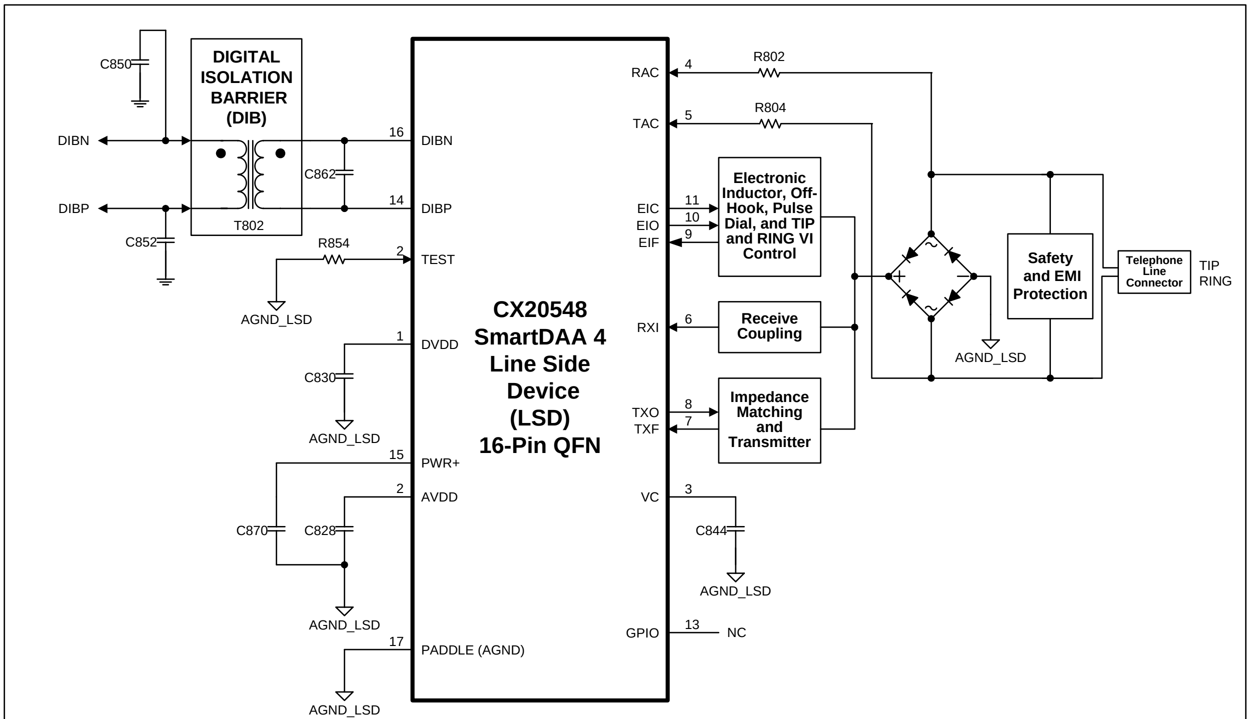
Note: ***Pin 17 is shown in Figure 3-3 to ensure that the PADDLE is considered when laying out the printed circuit board. The PADDLE is the analog ground pin of the CX20548 device and must be connected to LSD analog ground (AGND_LSD) when the CX20548 is populated in a PCB.***

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

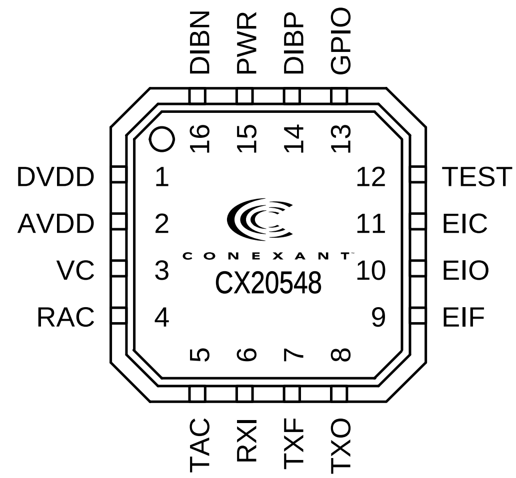


NOTES:

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).

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.
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.

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 Operating Conditions, Absolute Maximum Ratings, and Power Requirements

The CX90240 operating conditions are specified in Table 3-9.

The CX90240 absolute maximum ratings are listed in Table 3-10.

The CX90240 current and power requirements are listed in Table 3-11.

Table 3-9. CX90240 Modem Operating Conditions

Parameter	Symbol	Limits	Units
Supply Voltage	VDD	+3.3 ± 5%	VDC
Operating Ambient Temperature	T_A	0 to +70	°C
Note: Voltages referenced to ground (VSS).			

Table 3-10. Absolute Maximum Ratings

Parameter	Symbol	Limits	Units
Common			
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.	
CX90240 Modem			
VDD Supply Voltage	VDD	-0.5 to +4.0	VDC
Input Voltage	V_{IN}	-0.3 to (VDD + 0.3)	VDC
Voltage Applied to Outputs in High Impedance (Off) State	V_{HZ}	-0.5 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.

Table 3-11. CX90240 Current and Power Requirements

Mode	Typical Current (Ityp) (mA)	Maximum Current (Imax) (mA)	Typical Power (Ptyp) (mW)	Maximum Power (Pmax) (mW)
Normal Mode: Off-hook, normal data connection	61.1	69.1	201.8	248.7
Normal Mode: On-hook, idle, waiting for ring	48.5	55.6	160.1	200.0
Normal Mode: Connected (no compression)	60.7	68.6	200.4	247.1
Normal Mode: Connected (compression enabled)	60.7	68.6	200.1	247.1
Low-Power Mode: Idle (-slp = 0)	6.0	7.2	19.8	26.0
Low-Power Mode: Sleep (-slp = 1)	6.0	7.2	19.8	26.0
Low-Power Mode: Deep Sleep (-slp = 2)	5.1	6.1	16.7	21.8
Low-Power Mode: Stop (-slp = 3)	4.0	5.2	13.2	18.6

Notes:

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

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 (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

Table 3-13. Clock Specifications

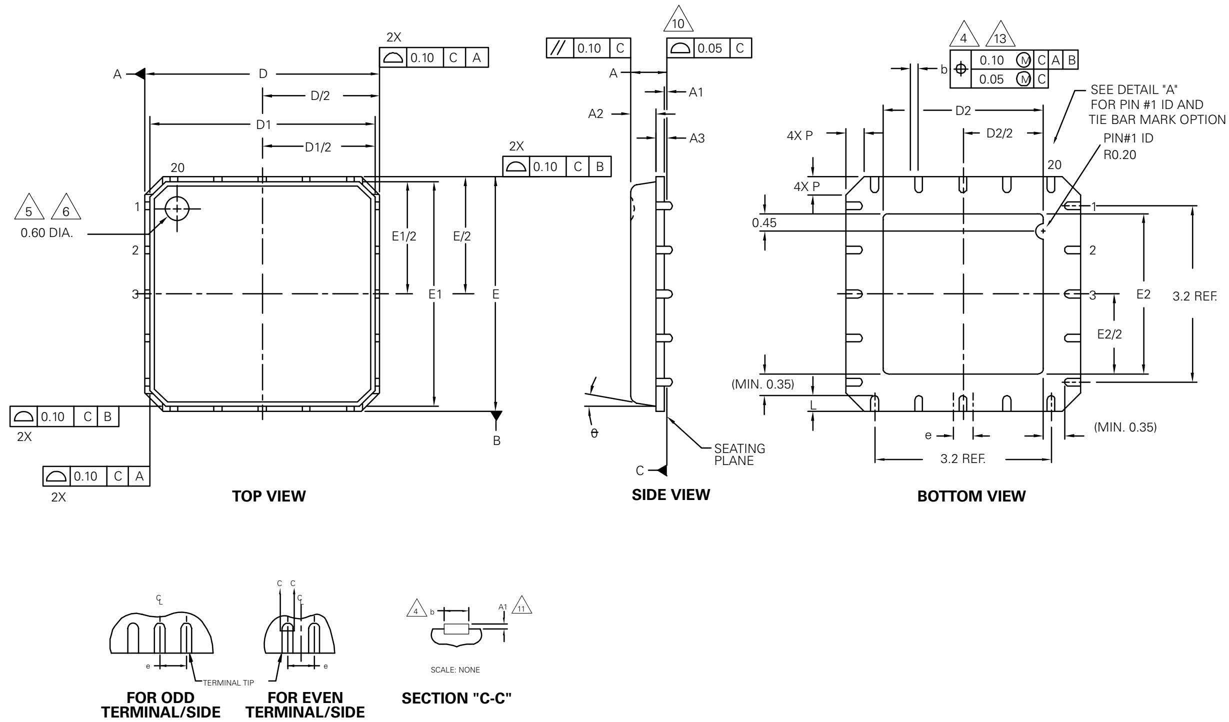
Characteristic	Value
Type	Square wave
Frequency	28.224 or 27.000 MHz nominal
Level	3.3 Vp-p ± 0.3 V zero offset
Duty Cycle	50 ± 10 %
Stability	±50 ppm

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



NOTES:

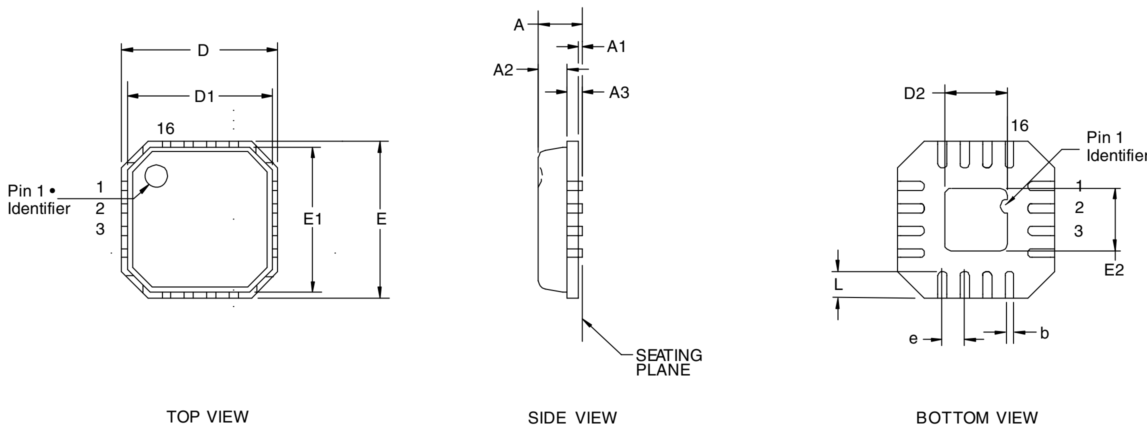
1. NOT APPLICABLE.
2. DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. - 1994.
3. N IS THE NUMBER OF TERMINALS.
   Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION.
   Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL 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.
12. Q AND R APPLIES ONLY FOR STRAIGHT TIEBAR SHAPES.

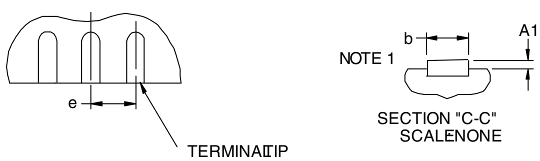
SYMBOL	DIMENSIONS (mm)			NOTE
	MIN.	NOM.	MAX.	
A	-	0.85	0.90	
A1	0.00	0.01	0.05	11
A2	-	0.65	0.70	
A3		0.20 REF.		
D		6.00 BSC		
D1		5.75 BSC		
E		6.00 BSC		
E1		5.75 BSC		
θ			12°	
P	0.24	0.42	0.60	
R	0.13	0.17	0.23	12
e		0.80 BSC		
N		20		3
Nd		5		3
Ne		5		3
L	0.50	0.40	0.75	
b	0.28	0.33	0.40	4
Q	0.30	0.20	0.45	12
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





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			

NOTES:

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

PD_QFN016

This page is intentionally blank.

NOTES

www.conexant.com
General Information:
U.S. and Canada: (800) 854-8099
International: (949) 483-6996
Headquarters – Newport Beach
4000 MacArthur Blvd.
Newport Beach, CA 92660

CONEXANT®