xecom®

The World's First Complete PLCC Packaged Modem

Description

Xecom's XE2420 is the first complete modem available in a PLCC package. This package is ideal for space limited applications. The XE2420 is aimed at remote monitoring applications in industrial, commercial and residential locations.

Xecom offers two XE2420 models. The base XE2420 provides 2400 BPS data transfer for remote monitoring applications. The XE2421 adds enhancements which permit it to share a telephone line without interfering with the telephone handset. Both models include user transferrable FCC Part 68 Registration permitting direct connection to the telephone line without further FCC Part 68 testing.

The XE2420 and XE2421 use a standard PLCC package with a unique lead-frame. This package design is ideal for volume applications where automated assembly can be efficiently utilized. It also provides the world's smallest embeddable modem package filling less than one quarter of a cubic inch.

Features

* 84-Pin PLCC Package (22 pins used on custom lead frame)

* Small Size: 1.19 inches long by 1.156 inches wide by 0.17 inches thick.

* Data transfer at 2400, 1200 and 300 Bits Per Second. (V.22bis, V.22, V.23, V.21, Bell 212A, and Bell 103 Protocols)

* Modem Control and Configuration via industry standard AT Commands.

* Complete integrated DAA includes, Ring Detect, Loop Current Holding Circuit, Hook Switch. Metalic Surge Protection, and Telephone Line Transformer

* XE2421 adds Handset Interrupt Feature to permit the modem to yield the phone line on demand.

* User Transferrable FCC Part 68 Registration (pending)

* Low Power operation less than 1 Watt.

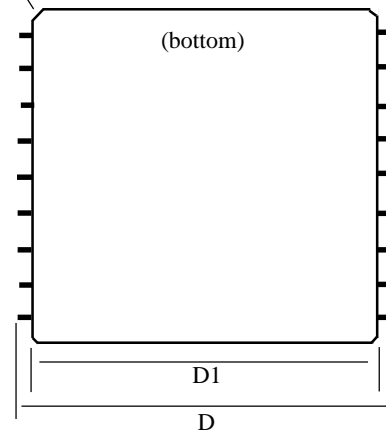* Power down operation less than 1 microWatt

XE2420 Block Diagram
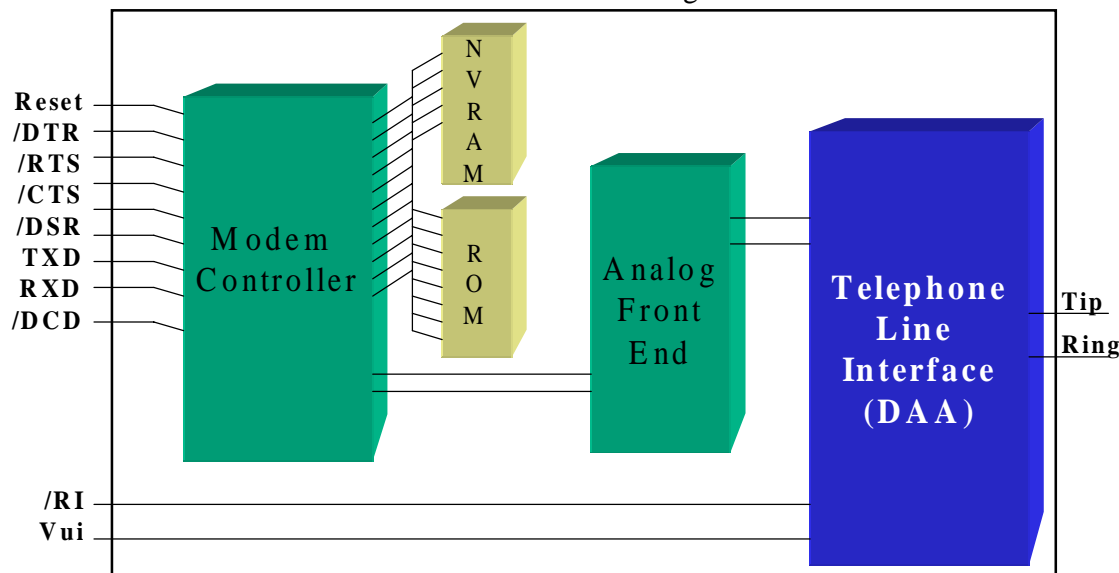
XE2420 Mechanical Specifications

h x 45 degrees
(3 Places)

Index Corner
J x 45 degrees
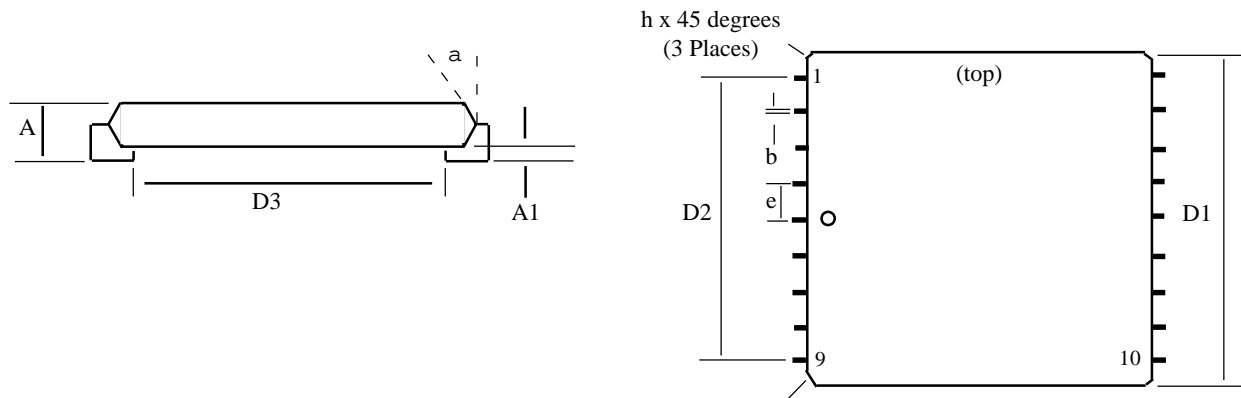
Dim	Inches			Millimeters		
	Min	Ref	Max	Min	Ref	Max
A		0.170			4.32	
A1		0.020			0.51	
b	0.017		0.021	4.32		5.33
D	1.187		1.193	30.15		30.30
D1	1.154		1.158	29.31		29.41
D2	0.998		1.002	25.35		25.45
D3		1.120			28.45	
e		0.050			1.20	
h		0.010			0.254	
J		0.045			1.15	
a		45°			45°	
coplanarity			0.004			0.10

XE2420 and XE2421 ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-25° C to +85° C
Operating Temperature Range[1]	0° C to +70° C
Maximum Solder Temperature[2]	N/A
Maximum Time Above Eutectic (183° C)	90 seconds
Preheat Dwell Time	120 to 180 seconds

[1] The XE2420 and XE2421 can be ordered with an Operating Temperature of -40° C to +85° C at extra cost. Order
XE2420-ITR or XE2421-ITR to specify Industrial Temperature Range (ITR).

[2] Xecom recommends that the XE2420 be mounted in an 84-Pin PLCC Socket and not be subjected to solder reflow

XE2420 Pin Configuration

XE2420 and XE2421

```
        Ring ■ 1                    22 ■ VCC
         Tip ■ 2                    21 ■ Reset
         N/C ■ 3                    20 ■ /TXD
         N/C ■ 4                    19 ■ /RXD
         N/C ■ 5                    18 ■ /RTS
         N/C ■ 6    ●    (top)      17 ■ /CTS
         N/C ■ 7                    16 ■ /DSR
         N/C ■ 8                    15 ■ /DCD
         N/C ■ 9                    14 ■ /DTR
       /Hint ■ 10                   13 ■ /RI
         Vui ■ 11                   12 ■ Gnd
```
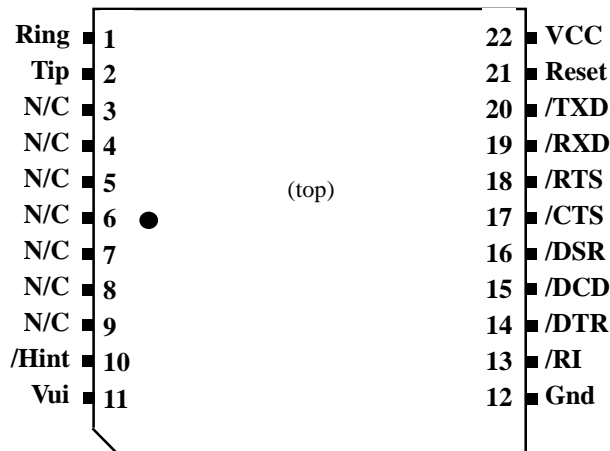
Pin Descriptions

| PIN	NAME	DESCRIPTION
1	Ring	Along with the Tip signal, Ring provides the connection to the telephone line. FCC Part 68 Rules require a 1500 volt isolation barrier between the telephone line and all other circuits. This isolation must be preserved throughout the system.
		The telephone company places a DC "Battery" voltage across Tip and Ring on all public switched telephone lines. The XEV90C will operate regardless of the polarity of this "Battery" voltage. The "Battery" voltage drives up to 100 milliamps of DC loop current.
		UL1950 requires minimum creepage and clearances distances be maintained between the Tip and Ring traces and all other circuits. Clearance is the shortest distance between conductive circuits; creepage is the distance between conductive surfaces along the surface.
3	Tip	Along with the Ring signal, Tip provides the connection to the telephone line. FCC Part 68 Rules require a 1500 volt isolation barrier between the telephone line and all other circuits. This isolation must be preserved throughout the system.
4 - 9		No Connection
10	/Hint	/Hint, Handset Interrupt, is an active low output from the XE2421. This pin is not used on the XE2420. On the XE2421 /Hint indicates that another device as attempted to sieze the attached line. Handset Interrupt is activated for approximately one second if another device siezes the telephone line while the XE2421 is on-line. When Handset Interrupt is activated, the XE2421 initiates an automatic disconnect from the telephone line.
11	Vui	Vui provides uninterrupted power to the XE2420 ring detect circuit. Placing 5 volt power on Vui insures that the CD/RI ouput will operate when VCC is removed from the modem.
12	Ground	Ground provides the reference voltage for all host interface signals.

XE2420 Pin Descriptions (continued)

PIN	NAME	DESCRIPTION
13	CD/RI	The CD/RI signal performs two functions in the XE2420 and XE2421. It reports on local telephone line availibility and the presence of an incoming ring signal. As a steady-state high, CD/RI indicates that the local telephone line is available for use by the modem. As a steady-state low, CD/RI indicates that the local telephone line is not available for use by the modem either because the modem is not connected to the line or because the line is already in use. When a ring signal is present across Tip and Ring, the CD/RI output toggles at the ring frequency. CD/RI operates off Vui and therefore operates even when VCC is removed from the modem.
14	/DTR	/DTR is an active low input to the modem. The AT&D command determines how the modem will interpret activity on /DTR.
15	/DCD	/DCD is an active low output from the modem. The AT&C command controls when the XE2420 asserts /DCD.
16	/DSR	/DSR is an active low output from the modem. The AT&S command controls when the XE2420 asserts /DSR.
17	/CTS	/CTS is an active low output from the modem. The modem asserts /CTS to indicate that it can accept data from the terminal equipment on /TXD.
18	/RTS	/RTS is an active low input to the modem. /RTS indicates to the modem that the host has data to send.
19	/RXD	/RXD provides the path for received data and modem responses to be sent from the modem to the host terminal equipment.
20	/TXD	/TXD provides the path for transmitted data and modem commands to be passed from the host terminal equipment to the modem.
21	RESET	RESET is an active high input which intiates a modem hardware reset. RESET must be active for a minimum of 100 milliseconds for a proper modem reset sequence. No external reset is required; if none is used the RESET signal should be left open.
22	VCC	VCC provides 5 volt power to the modem. The Ring Detect circuit is not powered by VCC but by Vui.

XE2420 Electrical Specifications

Parameter	Min	Typ	Max	Units	Comments
VCC	4.75		5.25	Volts	
ICC	160	180	200	ma	On Line
Vui	4.75		5.25	Volts	
Iui			1	ma	No Ring Signal Present
Ring Voltage Detected	38		150	RMS	Type B Ringer
Ring Frequency Detected	15.3		68	Hz	Type B Ringer
Connect Detect Sensitivity	20			Volts DC	Battery Voltage
Handset Interrupt Detection		1.0		Volts DC	XE2421only; Change in Battery Voltage
Telephone Loop Current	10	40	100	ma	
Line Impedance		600		Ohms	
Data Transmit level	-12	-10.5	-9.0	dBm	
DTMF Transmit Level		-2.5	0	dBm	Avg over 3 second interval
Voh	2.4			Volts	
Vol			0.4	Volts	
Vih	2.0		VCC+0.3	Volts	
Vil	-0.3		0.8	Volts	

XE2420 Typical Application Schematic
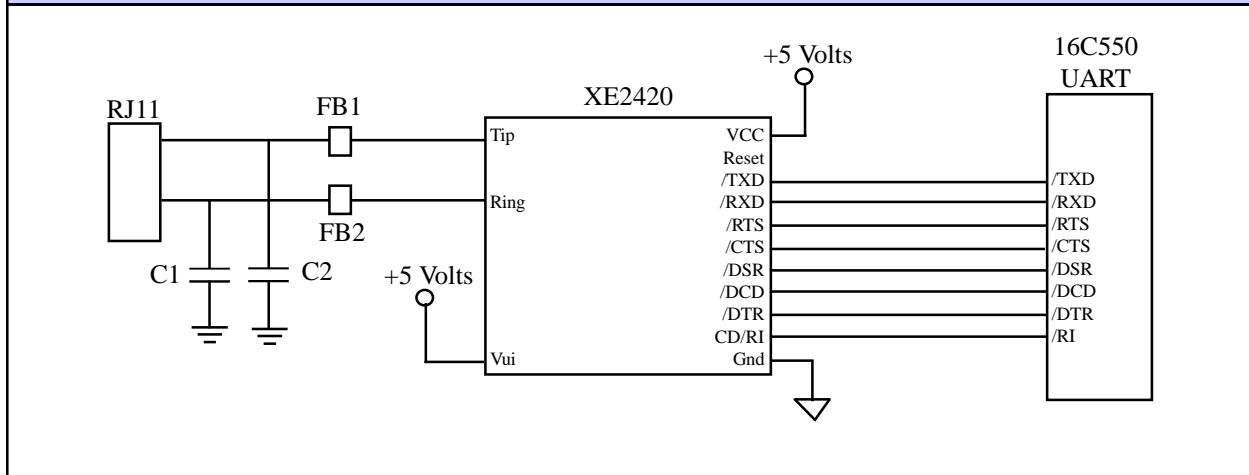
Notes:

1   FB1 and FB2 are ferrite beads which may be required for EMI filtering in your system. Without these components you may experience unintended radiation when the telephone cable is attached to your system. We recommend selecting components such as the TDK ACB2012L-120 which provide a minimum of 100 ohms of impedance at frequencies above 100 MHz.

2. C1 and C2 are high-voltage capacitors which may be required for EMI filtering in your system. Without these components you may experience unintended radiation when the telephone cable is attached to your system. We recommend selecting components such as the Panasonic ECKDRS471. This 470 pfd, 3000 volt capacitor will direct the high frequency harmonics to the system ground. These capacitors must be rated at a minimum of 1500 volts to maintain the isolation required by FCC Part 68 Rules.

XE2420 AT Commands

The XE2420 uses "AT" commands for configuration and control. This section describes use of the AT command format and lists the AT commands, Registers and Result codes. XE2420 "AT" commands have two operational modes; Command Mode and Data Mode.

Data Mode: The XE2420 enters data mode after it connects with a remote modem and issues the appropriate result code. In the Data Mode the modem sends all data presented on Transmit Data (/TXD) to the remote modem and puts data from the remote modem onto Received Data (/RXD). When the modem exits data mode, it issues a "NO CARRIER" result code.

Command Mode: The XE2420 enters command mode on power-up, reset, a lost connection, or receipt of the escape code. In command mode the modem accepts commands from the host on transmit data. Appropriate result codes are returned on received data.

Command Line Format

Command lines issued to the modem follow a strict format. Each command begins with the prefix AT. The command line is stored in the command buffer and executed upon receipt of a carriage return. Until executed, the command line can be edited with the backspace key.

Command Prefix - Each command, except the A/ command, begins with the AT prefix. The "A" and "T" may be either both upper case or both lower case but cannot be of different cases. The prefix identifies the speed and parity of the commands sent to the modem by the host. Speed is determined by measuring the width of the incoming bits. Parity is determined by comparing the parity bit of the "A" and the "T."

Command Line - Commands may be strung together in a single command line of up to 36 characters. Commands are executed in the sequence they appear. Spaces may be inserted into the command line but do not fill space in the command buffer. A carriage return terminates the command line and causes the commands to be executed. Register S3 allows the user to select a character other than a carriage return to terminate the command line.

Command Buffer - No more than 36 characters, including the AT prefix, may be loaded into the command buffer. If the command buffer overflows, the modem issues an "ERROR" result code and commands are not executed.

Command Line Editing - The backspace edits a command line before it is executed. The backspace key, (Control and H simultaneously on some systems), erases the previous character in the command line. Register S5 allows the user to select a character other than a backspace to edit the command line.

Re-Execute Last Command - The A/ command causes the modem to re-execute the last command line. This is the only command which does not require the "AT" prefix.

Omitted Parameters - Most commands include a parameter which determines how the functions will be set. When the command parameter is omitted from the command string, it is assumed to be a 0.

Escape Characters - A 3 character escape sequence maybe entered while in data mode to switch the modem into command mode while on line. The escape character, set by Register S2, must be entered 3 times in succession within a 1 second guard time to execute the escape. The default escape sequence is "+++."

Result Codes - The modem issues a result code after each action. Result codes may be provided as full words, one or two digit numeric codes, or may be disabled all together. Each result code ends with a carriage return when numeric result codes are chosen. When full word result codes are chosen, a Line Feed and Carriage Return preceed and follow each result code.

XE2420 AT Commands

An asterisk indicates the factory default

A - Answer Command -

Bn - Select Communications Standard

  n=0   Selects CCITT standards
  n=1   Selects Bell standards*

D - Dial Command -

  P = Pulse dial
  T = Tone dial
  R = Connect as an answering modem
  W = Wait for dial tone
  ,   = Pause for the duration of S8
  @ = Wait for silence
  !   = Switch hook flash
  ;   = Return to the command state
  S=n = Dial Stored Number n

En - Command Echo

  n=0   Do not echo commands
  n=1   Enable command echo*

Hn - Switch Hook Control -

  n=0   Switch hook relay opens
  n=1   Switch hook relay closes

In - Modem Identification

Mn - Speaker Activity -

  n=0   Speaker off
  n=1   Speaker on until carrier received*
  n=2   Speaker remains on
  n=3   Speaker on after dialing until carrier is detected.

On - On Line

  n=0   Return On Line with no retrain*
  n=1   Initiate retrain while returning On line.

Qn - Responses

  n=0   Send responses *
  n=1   No Responses

Sr? - Interrogate Register -

Sr=n - Set Register Value -

Vn - Result Codes -

  n=0   Numeric Result Codes
  n=1   English Word Result Codes*

Xn - Result Code Set -

  n=0   Responses 0-4
  n=1   Responses 0-5 & 10
  n=2   Responses 0-6 & 10
  n=3   Responses 0-5, 7 & 10
  n=4   Responses 0-7 & 10*

&Cn - DCD Operation

  n=0   DCD is forced active*
  n=1   DCD indicates a valid carrier signal

&Dn - DTR

  n=0   DTR is ignored*
  n=1   When the modem is on-line DTR off switches it to the command mode and issues OK response.
  n=2   Modem disconnects if the host revokes DTR.
  n=3   The modem performs a soft reset when DTR is revoked.

&F - Revert to Factory Defaults

&Gn - Guard Timer -

  n=0   None *
  n=1   550 Hz Guard Timer
  n=2   1800 Hz Guard Timer

&Kn - Flow Control

  n=0   Flow Control Disabled
  n=3   RTS/CTS Flow Control *
  n=4   XON/XOFF Flow Control

&Sn - Data Set Ready

  n=0   Data Set Ready Forced Active *
  n=1   Data Set Ready on at Start of Modem handshake

&Zn=x - Store number x in memory location n

%En - Automatic Retrain

  n=0   Automatic Retrain Disabled
  n=1   Automatically retrain on poor signal quality *

\Nn - Data Buffering

  n=0   Data Bufferred
  n=1   Direct Mode no data buffering *

XE2420 Modem Registers

S0   **Answer on nth Ring:** S0 sets the modem to automatically answer on the nth ring. Setting S0 to 0 disables automatic answer.
Range: 0 to 255
Units   Rings
Default   0

S1   **Ring Count:** S1 is a read-only register showing the number of rings detected. If a ring is not detected within 8 seconds, S1 is reset to zero.
Range: 0 to 255
Units   Rings
Default   0

S2   **Escape Character:** S2 determines the ASCII escape character. Values of 0-127 select valid ASCII escape characters; values from 128 to 255 disable the escape sequence.
Range: 0 to 255
Units   ASCII Character
Default   43 (+)

S3   **Carriage Return Character:** S3 determines the ASCII character to serve as a carriage return to terminate commands and modem responses.
Range: 0 to 127
Units   ASCII Character
Default   13 (Carriage Return)

S4   **Line Feed Character:** S4 sets the ASCII character to act as a line feed character in modem responses.
Range: 0 to 127
Units   ASCII Character
Default   10 (Line Feed)

S5   **Back Space Character:** S5 defines the ASCII character used as a backspace to edit the command line.
Range: 0 to 127
Units   ASCII Character
Default   8 (Back Space)

S6   **Dial Tone Wait Time:** S6 determines how long the modem waits for dial tone before dialing begins. The Dial Tone Wait Time cannot be set to less than two seconds.
Range: 2 to 255
Units   Seconds
Default   2

S7   **Wait for Carrier after Dialing:** S7 determines how long the modem waits for a valid carrier signal after dialing is completed.
Range: 1 to 255
Units   Seconds
Default   30

S8   **Comma Pause Time:** S8 defines the duration of the pause initiated by a comma in the dialing string. The pause is generally used when waiting for a second dial tone.
Range: 1 to 255
Units   Seconds
Default   2

S9   **Carrier Detect Response Time:** S9 establishes the length of time the remote modem's carrier must be present to be recognized as valid.
Range: 1 to 255
Units   0.1 Seconds
Default   6

S10   **Carrier Off Disconnect Delay**: S10 selects how long carrier must be lost before the modem disconnects. Note: If S10 is smaller than the value of S9, the modem will not automatically disconnect on loss of carrier.
Range: 1 to 255
Units   0.1 Seconds
Default   14

S11   **Tone Dialing Speed:** S11 sets the duration and spacing of the dialing tones. S11 does not affect the pulse dialing rate.
Range: 50 to 255
Units   1 Millisecond
Default   95

S12   **Escape Code Guard Timer:** S12 sets the escape sequence guard timer. If characters are received before or after the escape sequence, within the guard timer, the modem aborts the escape attempt and remains in data mode.
Range: 0 to 255
Units   0.02 Seconds
Default   50

XE2420 Modem Registers continued

S28   **Inactivity Timer:** S28 determines how long the modem wil remain on line with not data flowing. A 0 in this register disables the inactivity time out.

    Range: 0-255
    Units   Minutes
    Default   0

S29   **Hook Flash Time**: S29 determines the the amount of time the modem will go on-hook when a hook switch flash is called for.

    Range: 0-255
    Units   0.02 Seconds
    Default   25

S37   **Maximum Line Data Rate:** S37 sets the maximum line data rate or modulation technique that the XE2420 will support for any connection.

Register Value	Communications Supported
0	Maximum Data Rat determined by the autobaud detect of the AT Command
1	V.23 (1200BPS forward 75BPS back)
2	reserved
3	V.21, Bel 103, 300 BPS
4	Reserved
5	V.22, Bell212A 1200 BPS
6	V.22bis 2400 BPS

XE2420 Modem Responses

Digits	Verbose	Description
0	OK	Successfully executed command line
1	CONNECT	300 bps connection
2	RING	Ring signal detected
3	NO CARRIER	Carrier not detected/lost
4	ERROR	Error in command line
5	CONNECT 1200	1200 bps connection
6	NO DIAL TONE	No dial tone detected
7	BUSY	Busy signal detected
8	NO ANSWER	5 second silence not detected
10	CONNECT 2400	2400 bps Connection
16	CONNECT 1200TX/75RX	V.23 Connection transmitting at 1200 BPS
17	CONNECT 75TX/1200RX	V.23 Connection transmitting at 75 BPS

FCC Instructions

The XE2420 complies with part 68 of the FCC Rules and Regulations. With each device shipped, there is a label which contains, among other information, the FCC Registration Number and Ringer Equivalence Number (REN) for this product. You must, upon request, provide this information to your telephone company.

The mounting of this device in the final assembly must be made in such a manner as to preserve the high voltage protection between the TIP/RING Connection and the rest of the system. Typically, this may be accomplished by maintaining a minimum spacing 100 mils between the TIP/RING Traces to the RJ-11C Jack and low voltage portion of the system. No additional circuitry may be attached between TIP/RING and the telephone line connection, unless specifically allowed in the rules.

The REN is useful to determine the quantity of devices you may connect to a telephone line and still have all of these devices ring when the number is called. In most, but not all areas, the sum of the RENs of all devices connected to one line should not exceed five (5.0). To be certain of the number of devices you may connect to the line, as determined by the REN, you should contact the local telephone company to determine the maximum REN for you calling area.

If your system causes harm to the telephone network, the telephone company may discontinue service temporarily. If possible, they will notify you in advance. If advance notification is not practical, you will be notified as soon as possible.

Your telephone company may make changes in its facilities, equipment, operations or procedures that could affect proper functioning of your equipment. If they do, you will be notified in advance to give you an opportunity to maintain uninterrupted telephone service.

If you experience trouble with this device, please contact XECOM at (408) 945-6640 for information on obtaining service or repairs. The telephone company may ask you to disconnect this device from the network until the problem has been corrected or until you are sure that the device is not malfunctioning.

The device may not be used on coin service lines provided by the telephone company (this does not apply to private coin telephone applications which use standard telephone lines). Connection to party lines is subject to state tariffs.

Terms of Sale

Devices sold by XECOM are covered by the warranty provisions appearing in its Terms of Sale only. XECOM makes no warranty, express, statutory, implied, or by description regarding the information set forth herein, or regarding the freedom of the described devices from patent infringement. XECOM makes no warranty of merchantability or fitness for any purposes. XECOM reserves the right to discontinue production and change specifications and prices at any time and without notice. This product is intended for use in normal commercial applications. Applications requiring extended temperature range, unusual environmental requirements, or high reliability applications, such as military, medical life-support or life-sustaining equipment, are specifically not recommended without additional processing and authorization by XECOM for such application.

Xecom assumes no responsibility for the use of any circuitry other than circuitry embodied in a Xecom product. No other circuits, patents, or licenses are implied.

Life Support Policy

Xecom's products are not authorized for use as Critical Components in Life Support Devices or Systems.

Life Support Devices or Systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions provided in the labeling, can be reasonably expected to result in significant injury to the user.

A Critical Component is any component of a life support device or system whose failure to perform can be reasonably expected to cause failure of the life support device or system, or to affect its safety or effectiveness.

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