Low-Cost, Embeddable, Serial 2400bps Modem

Description

Xecom's XE2400 provides the lowest cost alternative for embedding a complete modem. Its compact size, TTL level, serial interface and low cost allows for quick integration into virtually any new or existing equipment.

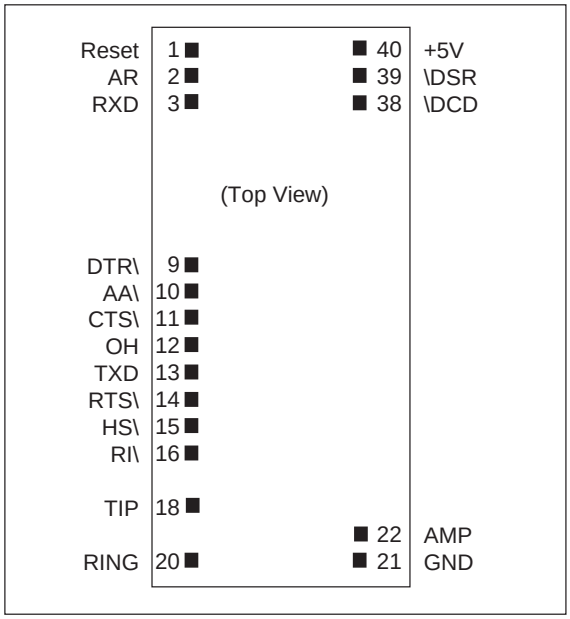
The XE2400 contains all of the circuitry required for complete modem operation, including the DAA. The XE2400 provides user transferable FCC Part 68 registration, allowing direct connection to the Telephone Network without additional FCC testing.

Xecom designed the XE2400 specifically to provide systems manufacturers with a quick, cost-effective way to integrate data communications into their products. The low -speed data transfer the XE2400 provides is ideal for applications with small amounts of data to transfer in each session. The combination of a complete, modular modem, user transferable FCC Registration, the easily integrated serial interface, and low cost makes the XE2400 ideal for all applications which rely on low speed communications

Features

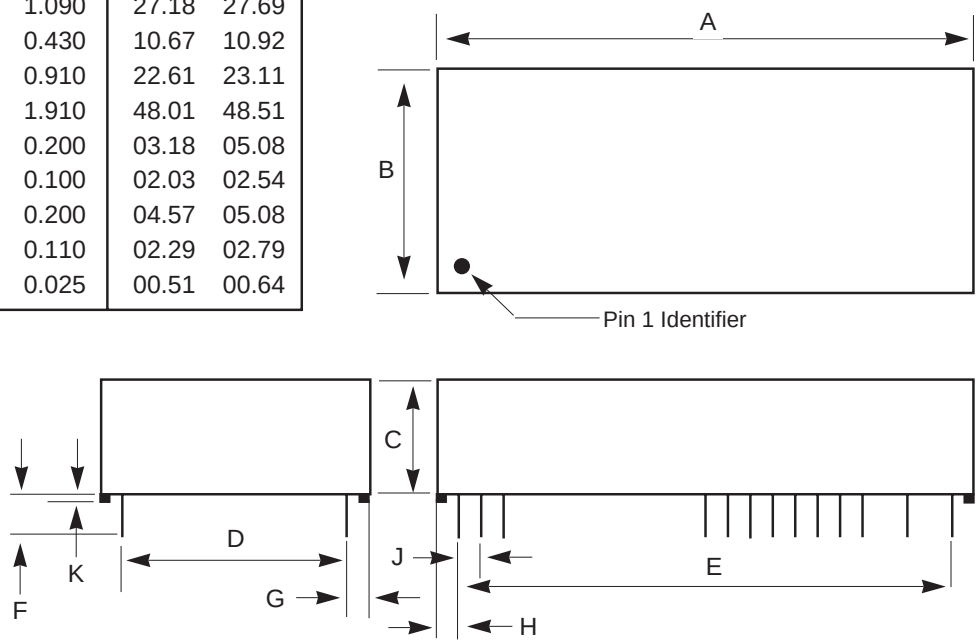
- Small Size 1.08” x 2.28” x 0.42”,
- User Transferable FCC Part 68 Registration
- Data Transfer at 2400, 1200 and 300 bps
- Low Power operation:
  On Line: 40 milliamps at 5 Volts
  Sleep: <10 milliamps at 5 Volts
- TTL level serial interface
- Modem control with Industry standard “AT” command set
- Pin compatible with a family of fax and higher speed modems for an easy upgrade path

PIN CONFIGURATION



XE2400 Mechanical Specifications

	INCHES		METRIC(MM)	
PIN	MIN	MAX	MIN	MAX
A	2.270	2.290	57.66	58.17
B	1.070	1.090	27.18	27.69
C	0.420	0.430	10.67	10.92
D	0.890	0.910	22.61	23.11
E	1.890	1.910	48.01	48.51
F	0.125	0.200	03.18	05.08
G	0.080	0.100	02.03	02.54
H	0.180	0.200	04.57	05.08
J	0.090	0.110	02.29	02.79
K	0.020	0.025	00.51	00.64



XE2400 Pin Descriptions

PIN	NAME	DESCRIPTION
1	RESET	External reset pin active HI, TTL. An internal circuit resets the modem when power is applied, no external reset is required. Any external reset applied to the modem must be applied for a minimum of 100 milliseconds.
2	AR	Auxiliary Data/Voice Relay output, active HI, TTL/CMOS. When high the external, auxiliary telephone set relay is closed and the modem is in the voice mode.
3	RXD	Serial data output to the DTE (i.e. external UART). A logic "high" represents a "mark" and a logic "low" represents a "space", TTL.
4-8	No Pin	
9	\DTR	Data Terminal Ready, input, active LO, TTL. The function of this pin is set by the &D command and the value in register S21.
10	\AA	Auto Answer enable indicator, output, active LO, TTL/CMOS.

XE2400 Pin Descriptions

PIN	NAME	DESCRIPTION
11	\CTS	Clear to Send, output, active LO, TTL/CMOS. A low indicates the modem is ready to accept data signals for transmission.
12	OH	Off-Hook, output, active HI, TTL/CMOS. A high indicates the modem's hookswitch relay is closed connecting the modem to the telephone line.
13	TXD	Serial data input from the DTE (i.e. external UART). A logic "high" represents a "mark" and a low represents a"space", TTL.
14	\RTS	Request to Send, input, active LO, TTL.
15	HS	High Speed indicator, output, active LO, TTL/CMOS. Low when operating at 2400bps rate, high otherwise.
16	\RI	Ring Indicator, output, active LO, TTL. When low indicates the modem is receiving a ring signal.
17	No Pin	
18	TIP	Tip connection to the phone line (RJ11 pin3) from the internal DAA.
19	No Pin	
20	RING	Ring connection to the phone line (RJ11 pin4) from the internal DAA. **Caution: Observe design rules for Tip & Ring trace layout.**
21	GND	Ground.
22	AMP	Audio output to speaker. Function is determined by L & M commands and the value in register S22. The input impedance to the speaker driver must be greater than 300 ohms.
23-37	No Pin	
38	\DCD	Data Carrier Detect, output, active LO, TTL/CMOS. Function is set by the &C command and the value in register S21.
39	\DSR	Data Set Ready, output, active LO, TTL/CMOS. Function is set by the &S command and the value in register S21.
40	Vcc	+5 Volts.

XE2400 AT Commands

The XE2400 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. XE2400 "AT" commands have two operational modes; Command Mode and Data Mode.

Data Mode: The XE2400 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 XE2400 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 40 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 40 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, 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.

XE2400 AT Command List

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

En - Command Echo
- n=0 Do not echo commands
- n=1 Enable command echo*

Hn - Switch Hook Control -
- n=0 Switch hook relay closes*
- n=1 The switch hook relay opens

In - Modem Identification

Ln - Speaker Volume -
- n=0 Low speaker volume
- n=1 Low speaker volume
- n=2 Moderate speaker volume*
- n=3 High speaker volume

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

Yn - Long Space Disconnect -
- n=0 Disabled *
- n=1 Enabled

Z - Reset -

&Cn - DCD Operation
- n=0 DCD is forced active*
- n=1 DCD indicates a valid carrier signal

&Dn - DTR
- n=0 DTR is ignored by the modem*
- 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

&Ln - Line Type
- n=0 Modem operates on dial-up lines*
- n=1 Modem operates on leased lines

&Tn - Test Modes
- n=0 Exit test mode
- n=1 Local analog loopback
- n=3 Initiate local digital loopback
- n=4 Respond to remote loop request*
- n=5 Deny remote loop request
- n=6 Initiate a Remote Digital loopback
- n=7 Remote digital loopback w self-test
- n=8 Local analog loopback w self-test

&V - View Active Profile -

XE2400 S-Registers

REG.	RANGE/UNITS	DESCRIPTION	DEFAULT
S0	0-255/rings	Number of rings on which the modem will answer	000
S1	0-255/rings	Count number of incoming rings (read only)	000
S2	0-127/ASCII	Escape character	043
S3	0-127/ASCII	Carriage return character	013
S4	0-127/ASCII	Line feed character	010
S5	0-32,127/ASCII	Backspace character	008
S6	2-255/sec	Dial tone wait time	002
S7	1-60/sec	Wait time for remote carrier	030
S8	0-255/sec	Comma pause time	002
S9	1-255/0.1 sec	Carrier detect response time	006
S10	1-255/0.1 sec	Delay from loss of carrier to hang up	014
S14	Bit Mapped	E,Q,V,T,P,D,A,R accept/ignore	170
S16	Bit Mapped	Modem loopback tests	000
S18	0-255/sec	Modem test timer	000
S21	Bit Mapped	J, &R, &D, &C, &S, Y	000
S22	Bit Mapped	L, M, X, &P, &T4, &T5, DTE speed and parity	118
S23	Bit Mapped	&T4,&T5, DTE speed, parity	007
S27	Bit Mapped	&Q, &L, &X, B commands	064

XE2400 Result Codes

DIGIT	CODE	WORD CODE MEANING
0	OK	Successfully executed command line
1	CONNECT	300 bps connection established
2	RING	Ring signal detected
3	NO CARRIER	Carrier not detected within Register S7 detect time
4	ERROR	Error found in command line; returns to command line
5	CONNECT 1200	1200 bps connection established
6	NO DIAL TONE	No dial tone detected within 5 Sec. after going off-hook
7	BUSY	Busy signal detected after automatically dialing a call
8	NO ANSWER	Five seconds of silence was not detected when using the @ command in the Dial command line
10	CONNECT 2400	Connection established at 2400 bps

XE2400 Electrical Specifications

ABSOLUTE MAXIMUM RATINGS*	
SUPPLY VOLTAGE - Vcc	+6.5 Volts
DC INPUT VOLTAGE	-0.6 Volts to +6.5 Volts
STORAGE TEMPERATURE RANGE	-25° C TO +85° C
LEAD TEMPERATURE(Soldering, 2sec/wave)	260° C
OPERATING TEMPERATURE RANGE	0 TO 70° C

*Exceeding these values may result in permanent damage to the device.

XE2400 Power Supply Characteristics *(TA = 0 - 70°C, Vcc = 5v ±5%)*

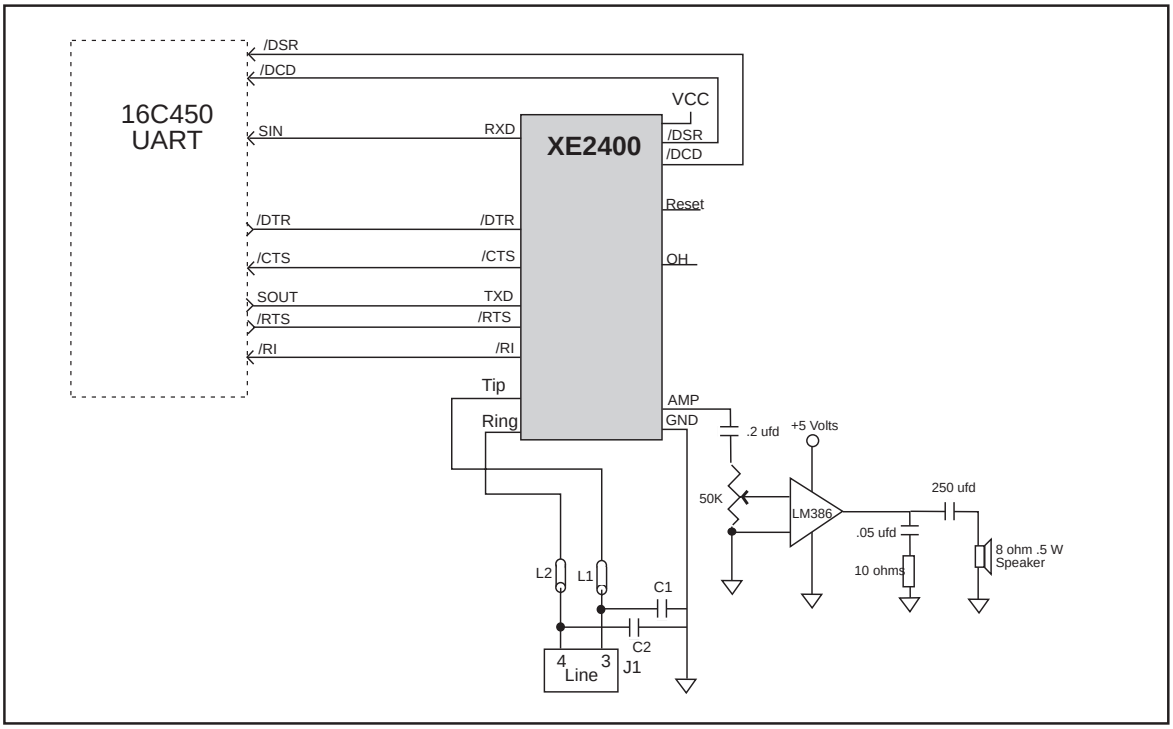
Symbol	Parameter	Min	Typ	Max	Units	Comments
Vcc	Supply Voltage	4.75	5.0	5.25	V	
Icc	Vcc Supply Current		40		mA	All outputs Disconnected
Iccpd	Sleep Mode Current		8		mA	

The XE2400 has an integrated, advanced power management capability. If no activity is detected on the RXD, DTR, or RI lines the modem will automatically go into a smart power down mode. In this mode power consumption is typically less than 60 milliwatts.

Telephone Line Interface Specifications

PARAMETER	MIN	TYP	MAX	UNIT
Telephone Line Impedance Match		600		ohms
Ring Detect Sensitivity (on hook, Type B ringer)	38			Vrms
Telephone Line Holding Current	20		100	mA

XE2400 Applications Schematic



Note: RJ11 Pin assignments reflect a 6-pin connector. Tip and Ring are always the center pins of the RJ11 jack.

Recommended Parts

Reference Designation	Description	Recommended Part Number
L1, L2	Ferrite Beads	TDK CB30-1812
C1, C2	Capacitors	Sprague 30GAT47, 470 pfd, 3000 Volts
J1	RJ11 Jack	Stewart SS6446NF

FCC Instructions

The XE2400 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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