

### 2400bps Serial Input Component Modem

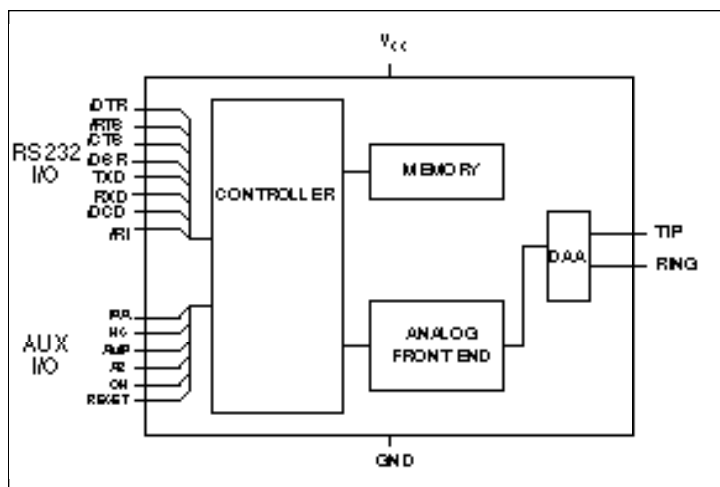
#### Description

Xecom's XE2401L component modem is a complete 2400 bps data modem. Its compact size and TTL level, serial interface allows for quick integration into virtually any new or existing design. The XE2401L contains all of the circuitry required for complete modem operation, including a user transferable FCC Part 68 registration, allowing direct connection to the Telephone Network. The XE2401L was specifically designed to provide industrial systems manufacturers with a complete, highly integrated, compact solution for adding data communication to their products.

#### Features

- Small Size 1.08" x 2.28" x 0.42",
- FCC Part 68 Registered, user transferable
- Data Transfer at 2400, 1200 and 300 bps
- Supported Protocols:
  - CCITT V.22bis, V.22, V.21
  - Bell 212A, 103
- TTL serial interface interfaces with industry standard UART's
- Single +5v supply
- Modem control with Industry standard "AT" command set
- Standard package allows easy upgrades to Fax (XE9624F) and 9600 bps (XE9601) operation

#### Block Diagram



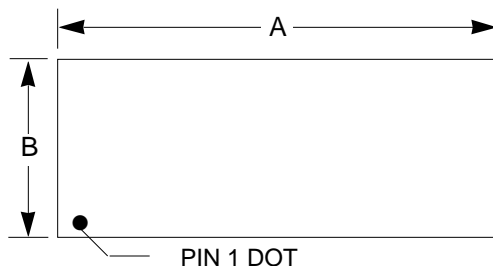
#### PIN CONFIGURATION

Reset	1	40	+5V
AR	2	39	\DSR
RXD	3	38	\DCD
(Top View)			
DTR	9		
AA	10		
CTS	11		
OH	12		
TXD	13		
RTS	14		
HS	15		
RI	16		
TIP	18		
RING	20	22	AMP
		21	GND

# Mechanical Specifications - Package type 'C2'

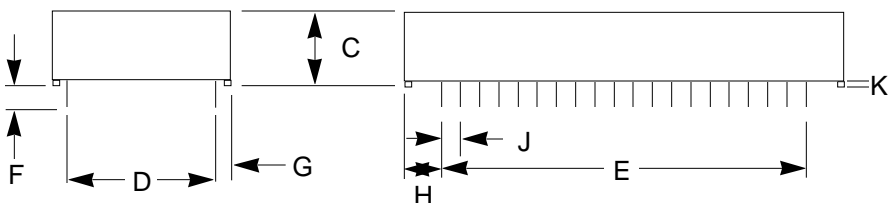
PIN	INCHES		METRIC(MM)	
	MIN	MAX	MIN	MAX
A	2.270	2.290	57.66	58.17
B	1.070	1.090	27.18	27.69
C	0.420	0.430	10.67	10.92
D	0.890	0.910	22.61	23.11
E	1.890	1.910	48.01	48.51
F	0.125	0.200	03.18	05.08
G	0.080	0.100	02.03	02.54
H	0.180	0.200	04.57	05.08
J	0.090	0.110	02.29	02.79
K	0.020	0.025	00.51	00.64

	METRIC	ENGLISH
WEIGHT	31.75 grams	1.12 oz.



Pins: 0.025" x 0.025"  
All pins tin-plated

Recommended hole  
size: 0.056"



## Pin Descriptions

PIN	NAME	I/O	DESCRIPTION
1	RESET	I	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	O	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	O	Serial data output to the DTE (i.e. external UART). A logic "high" represents a "mark" and a logic "low" represents a "space", TTL.
9	\DTR	I	Data Terminal Ready, input, active LO, TTL. The function of this pin is set by the &D command and the value in register S21.

PIN	NAME	I/O	DESCRIPTION
10	\AA	O	Auto Answer enable indicator, output, active LO, TTL/CMOS.
11	\CTS	O	Clear to Send, output, active LO, TTL/CMOS. A low indicates the modem is ready to accept data signals for transmission.
12	OH	O	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	I	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	I	Request to Send, input, active LO, TTL.
15	HS	O	High Speed indicator, output, active LO, TTL/CMOS. Low when operating at 2400bps rate, high otherwise.
16	\RI	O	Ring Indicator, output, active LO, TTL. When low indicates the modem is receiving a ring signal.
18	TIP	---	Tip connection to the phone line (RJ11 pin3) from the internal DAA.
20	RING	---	Ring connection to the phone line (RJ11 pin4) from the internal DAA. <b>Caution: Observe design rules for Tip &amp; Ring trace layout.</b>
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.
38	\DCD	O	Data Carrier Detect, output, active LO, TTL/CMOS. Function is set by the &C command and the value in register S21.
39	\DSR	O	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.

Note: No other pin positions are present, i.e. only 18 physical pins are on this device.  
No pins are present at positions 4, 5, 6, 7, 8, 17, 19, 23 - 37

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# AT Commands

The XE2401L 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.

## Modes of Operation

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

**Data Mode:** The XE2401L enters data mode after it connects with a remote modem and issues an appropriate "CONNECT" 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 XE2401L 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 can be used to edit 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 reexecute the last command line. This is the only command which does not require the "AT" prefix.

**Ommitted 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.

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## 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

## AT Commands (Continued)

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# S-Register Summary

REG.	RANGE/UNITS	DESCRIPTION	DEFAULT
S0	0-255/rings	Number of rings to answer on	000
S1	0-255/rings	Count number of incoming rings	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

# Result Code Summary

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

# Electrical Specifications

## ABSOLUTE MAXIMUM RATINGS\*

SUPPLY VOLTAGE - V <sub>cc</sub>	+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.

## Power Supply Characteristics<sub>(TA = 0 - 70°C, V<sub>cc</sub> = 5v ±5%)</sub>

Symbol	Parameter	Min	Typ	Max	Units	Comments
V <sub>cc</sub>	Supply Voltage	4.75	5.0	5.25	V	All outputs Disconnected
I <sub>cc</sub>	V <sub>cc</sub> Supply Current		50	80	mA	
I <sub>ccpd</sub>	Sleep Mode Current		10	15	mA	

## I/O Characteristics

Signals	Description
<b>DIGITAL INPUTS</b>	
\DTR, \RTS, TXD	CMOS/TTL
RESET	CMOS/TTL
<b>DIGITAL OUTPUTS</b>	
AR	CMOS/TTL
\CTS, \DSR, \DCD	CMOS/TTL
OH	CMOS/TTL
RXD	CMOS/TTL
\RI	CMOS/TTL
<b>ANALOG OUTPUTS</b>	
AMP	Z <sub>0</sub> > 300 ohms

## Power Management Specifications/ Issues

The XE2401 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.



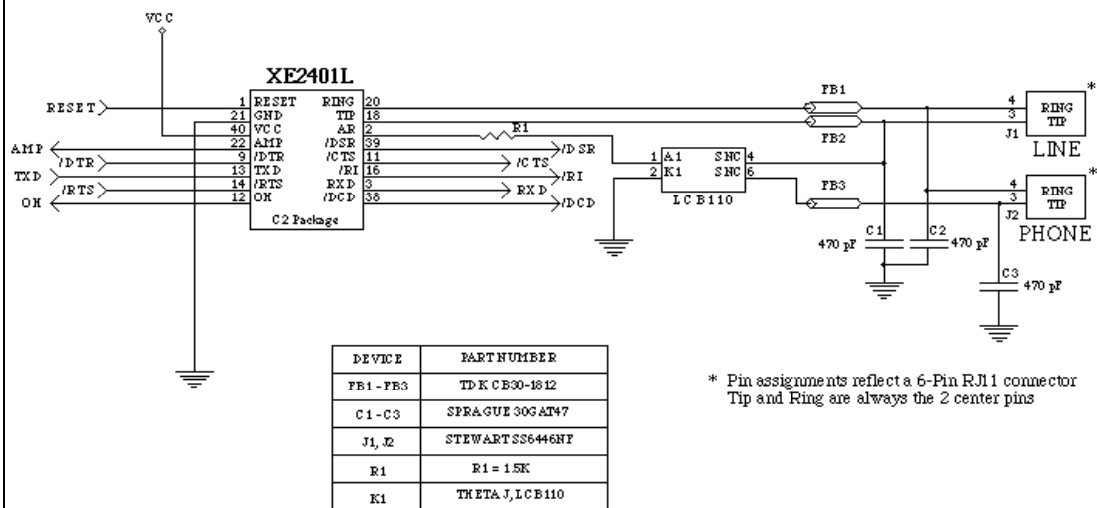
## Other Performance Specifications

PARAMETER		MIN	TYP	MAX	UNIT	COMMENTS
DTMF Level			-7.5	0	dBm	
DTMF Twist (Balance)				3	dB	
DTMF Tone Duration			70		ms	
Pulse Dialing Rate			10		pps	
Pulse Dialing Make/Break			39/61		%	USA
			33/67		%	CCITT
Pulse Interdigit Interval			785		ms	
Billing Delay Interval		2.0			sec.	
Guard Tone	Frequency		550		Hz	Referenced to high channel transmit
	Amplitude		-3		dB	
	Frequency		1800		Hz	
	Amplitude		-6		dB	
High Channel Transmit Amplitude			-1		dB	Ref. to low channel guard tone enabled
Tone Detection Bandpass Frequency		290		665	Hz	3 dB point
Tone Detection OFF to ON Threshold		-33			dBm	into 600 ohms
Tone Detection ON to OFF Threshold		-35			dBm	into 600 ohms
Dial Tone Detect Duration		3.0			sec.	
Ringback Tone Detect	Duration	0.75			sec.	OFF/ON Ratio
	Cadence	1.5			sec.	
Busy Tone Detect	Duration	0.2			sec.	OFF/ON Ratio
	Cadence	0.67		1.5	sec.	

## 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	0	20	100	mA

## Modem Application Circuit



# Engineering Notes

Capacitors C1, C2 and C3 and Ferrite Beads FB1, FB2, and FB3 prevent radiated emissions from entering or leaving through the modem's telephone cable. They may be needed for your system to meet FCC Part 15 Rules. These components should be mounted as close to the RJ11 jack as possible.

The relay, K1, switches the telephone line to the auxilliary phone jack, J2, so that the phone line can be used by a telephone handset when the modem is not active.

The XE2401L includes user transferrable FCC Part 68 Registration; however, your system design must not introduce any characteristics which cause the Part 68 rules to be violated. Follow design rules carefully to ensure full compliance with FCC Part 68 rules. Xecom recommends a minimum of 0.100" clearance for tip and ring traces. Use PCB materials with a minimum rating of 94V0. This will ensure compliance with FCC 1500V isolation requirements. If this is a problem in your design consult with Xecom's Customer Service engineers for assistance.

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# FCC Instructions

This product 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.

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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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