

### 2400 bps Plug-In Upgrade to CH1776

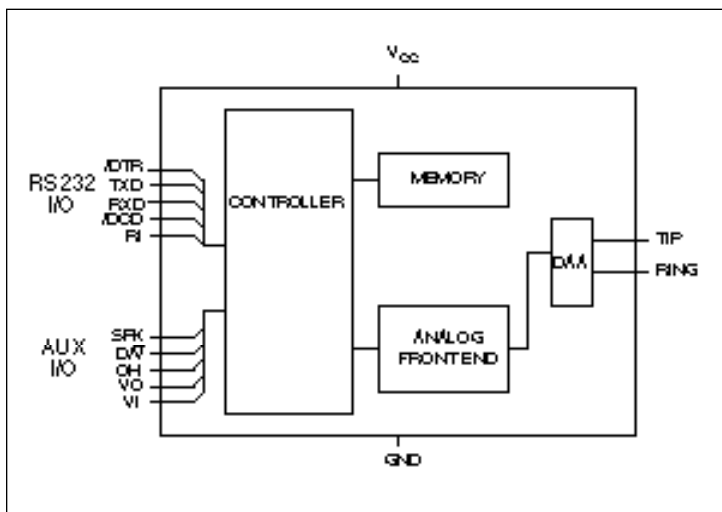
#### Description

Xecom's XE2476 is a low cost, 2400 bit per second plug-in upgrade to the 1200 bps CH1776. The XE2476 features the same pin configuration, lead spacing and case size as the CH1776. It also includes its own user transferable FCC Part 68 registration. Industry standard "AT" commands provide modem control and configuration. The XE2476 was specifically designed to provide users of the CH1776 a quick, easy and low cost upgrade to 2400 bits per second. Most OEM's currently using the CH1776 can use the XE2476 to upgrade their systems from 1200 bps to 2400 bps without altering the existing design.

#### Features

- Supported Protocols: V.22bis, V.22, V.21, Bell 212A and 103
- Pin compatible with the 1200bps CH1776
- Command set: "AT" command set for modem control and configuration.
- Identical physical dimensions to CH1776: 2.00 inches long, 1.125 inches wide, 0.44 inches high.
- Single +5V supply
- Low power CMOS:  
Operating: 250 mW (Typ.)  
Sleep mode: 50 mW (Typ.)

Block Diagram



PIN CONFIGURATION

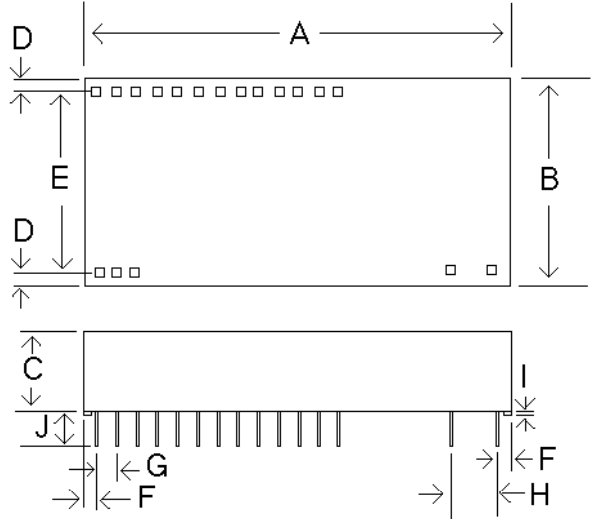
/HS	1 ●	18	RI
/CMD	2	17	GND
/AAD	3	16	VCC
/DCD	4		
/DTR	5		
D/V	6		
OHO	7		
RXD	8		
TXD	9		
TEST	10		
SPK	11		
VO	12		
VI	13		
		15	RING
		14	TIP

XE2476  
(Top View)

# XE2476 Mechanical Specifications

PIN	INCHES		METRIC(MM)	
	MIN	MAX	MIN	MAX
A	1.990	2.010	50.55	51.05
B	1.115	1.135	28.32	28.83
C	0.420	0.430	10.67	10.92
D	0.100	0.120	2.54	3.05
E	0.890	0.910	22.61	23.11
F	0.090	0.110	2.29	2.79
G	0.090	0.110	2.29	2.79
H	0.190	0.210	4.83	5.33
I	0.020	0.025	0.51	0.64
J	0.125	0.200	3.18	5.08

Pins =  $\varnothing 0.025$  square pin  
All pins tin-plated



## Pin Descriptions

PIN	NAME	I/O	DESCRIPTION
1	\HS	O	High Speed indicator, output, active LO, TTL/CMOS. Low when operating at 2400bps rate, high otherwise.
2	\CMD	-	Command Enable is not supported on the XE2476. This pin is open internally.
3	\AAD	-	The Automatic Answer Disable pin is not supported in the XE2476. Register S0 controls automatic answer operation.
4	\DCD	O	The operation of Data Carrier Detect is controlled by the &C command. DCD may be configured to remain active, DCD low, or may go low to indicate receipt of valid carrier.
5	\DTR	I	Data Terminal Ready is an active low input. The function of this pin is set by the &D command and the value in register S21. Normally, the modem ignores DTR.

PIN	NAME	I/O	DESCRIPTION
6	D $\bar{V}$	O	The Data/Voice output can be used to drive a relay to connect an auxiliary telephone handset. Data/Voice is high when the modem is off-hook.
7	OH	O	Off-hook is an active high output which indicates that the XE2476 is connected to the telephone line.
8	RXD	O	Received Data provides the serial data output from the modem. A logic "high" represents a "mark" and a logic "low" represents a "space".
9	TXD	I	Transmit data provides the serial data input from the host. A logic "high" represents a "mark" and a low represents a "space", TTL.
10	Test	-	The Test pin should be left unconnected at all times.
11	SPK	O	Audio output to the speaker. Function is determined by L & M commands. This output cannot directly drive a low impedance speaker. It can drive a 50k ohm load.
12	VO	O	The Modem Line Interface permits placement of non-modem signals on the telephone line through the modem's telephone interface. VO must be tied to VI for normal modem operation and open to place non-modem signals on the line through VI.
13	VI	I	Voice Interface provides a path for non-modem signals to be placed on the telephone line through the modem's telephone interface. VI must be tied to VO for modem operation. Non-modem signals are placed on VO to be placed on the telephone line.
14	TIP	—	Tip connection to the phone line(RJ11 pin3) from the internal DAA.
15	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>
16	Vcc	—	+5 Volt power for the modem.
17	GND	—	Ground reference for the modem.
18	RI	O	Ring Indicator provides an active high output whenever a ring signal appears on the telephone line.

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# AT Commands

The XE2476 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 used.

## Modes of Operation

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

**Data Mode:** The XE2476 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 XE2476 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.

**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 resul codes are chosen. When full word result

<b>AT Command List</b>	
<p><b>An asterisk indicates the factory default</b></p> <p><b>A - Answer Command -</b></p> <p><b>Bn - Select Communications Standard</b>            n=0 Selects CCITT standards            n=1 Selects Bell standards*</p> <p><b>D - Dial Command -</b>            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</p>	<p><b>En - Command Echo</b>            n=0 Do not echo commands            n=1 Enable command echo*</p> <p><b>Hn - Switch Hook Control -</b>            n=0 Switch hook relay closes*            n=1 The switch hook relay opens</p> <p><b>In - Modem Identification</b></p> <p><b>Ln - Speaker Volume -</b>            n=0 Low speaker volume            n=1 Low speaker volume            n=2 Moderate speaker volume*            n=3 High speaker volume</p>

## AT Command List (continued)

### **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

### **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**

### **&Ln - Line Type**

- n=0 Modem operates on dial-up lines\*
- n=1 Modem operates on leased lines

### **&Qn - Communications Format**

- n=0 Sets the modem for normal, unbuffered operation.

### **&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 Intiate a Remote Digital loopback
- n=7 Remote digital loopback w self-test
- n=8 Local analog loopback w self-test

### **&V - View Active Profile -**

### **&Wn - Store Profile -**

- n=0 Stores the current configuration in memory location 0.
- n=1 Stores the current configuration in memory location 1.

### **&Yn - Recall Profile**

- n=0 Use memory location 0.
- n=1 Use memory location 1.

### **&Zn=X- Store Number**

## 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 +100° C
LEAD TEMPERATURE (Soldering, 2 sec per wave)	260° C
OPERATING TEMPERATURE RANGE	0 TO 70° C

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

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

Symbol	Parameter	Min	Typ	Max	Units	Comments
V <sub>cc</sub>	Supply Voltage	4.75	5.0	5.25	V	
I <sub>cc</sub>	V <sub>cc</sub> Supply Current		40		mA	All outputs Disconnected
I <sub>ccpd</sub>	Power Down Current		10		mA	

**Power Management:** The XE2476 has an integrated, advanced power management capability. If no activity is detected on the RXD, DTR, or RI lines the modem will, within 5 seconds, automatically go into a smart power down mode. In this mode power consumption is typically less than 50 milliwatts.

## I/O Characteristics

Signals	Description		
<b>DIGITAL INPUTS</b>	<b>Input High</b>	<b>Input Low</b>	
/DTR, /RTS, TXD, RESET	min. 2.0 V	max. 0.8 V	
<b>DIGITAL OUTPUTS</b>	<b>Output High</b>	<b>Output Low</b>	<b>Current Drive</b>
OH, RI	min. 2.4 V	max. 0.8 V	15 ma
/DCD, RXD	min. 2.4 V	max. 0.4 V	1.6 ma

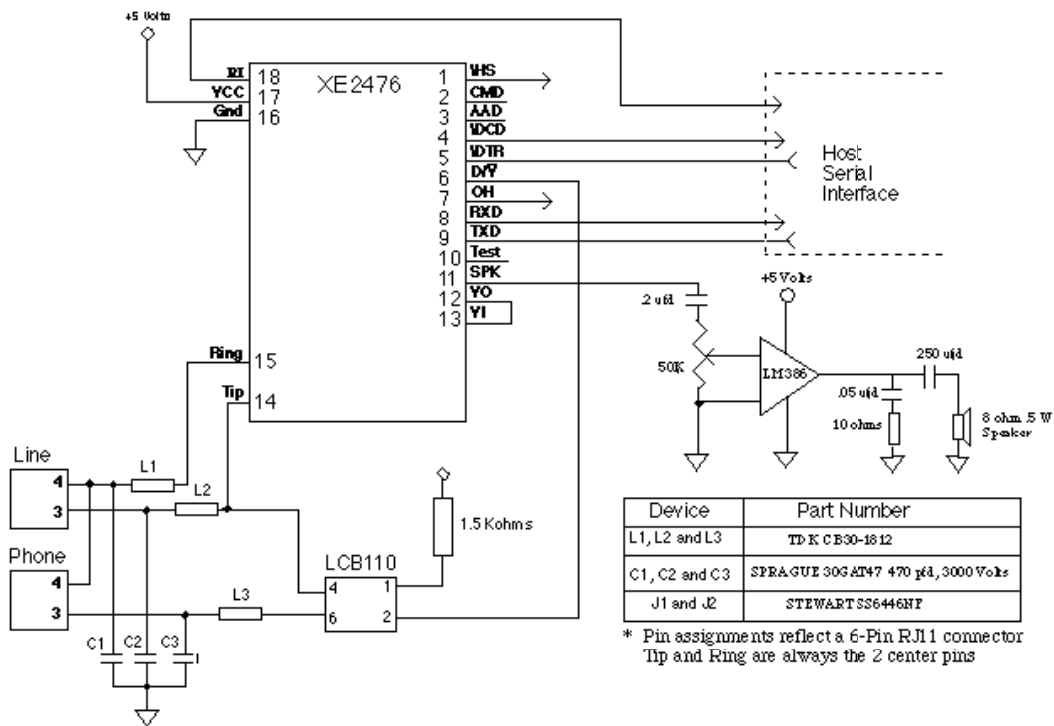


## Other Performance Specifications

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
DTMF Level		-2.2	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 on
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.
	Cadence	1.5			sec.
Busy Tone Detect	Duration	0.2			sec.
	Cadence	0.67		1.5	sec.

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

# Modem Applications Schematic



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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.

FCC Registration Number: DWEUSA-\_\_ \_\_ \_\_ \_\_-FA-E  
Ringer Equivalence: \_\_. \_\_B

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**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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