56 KBPS DAA in a PLCC Package

Description

Xecom's XEV90 is a complete DAA integrated into a compact PLCC package. The XEV90 supports analog data transfer to 56 KBPS. The 68-Pin PLCC package permits automated, high-volume assembly.
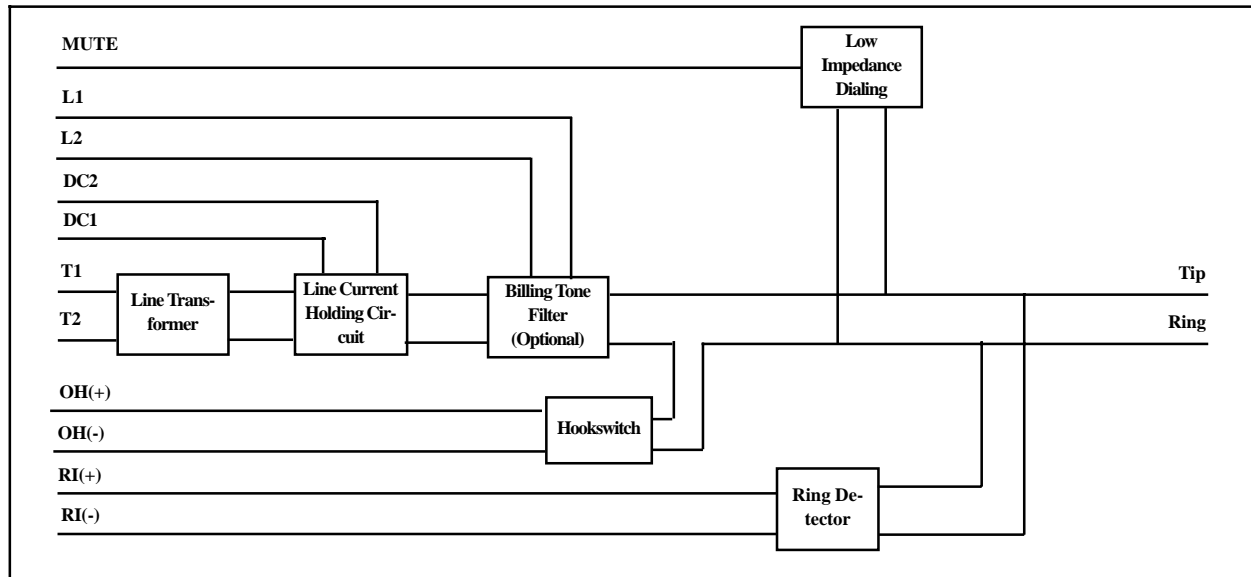
The XEV90 does not sacrifice performance for small size and surface-mount convenience. The heart of the XEV90 is a proprietary, low profile, low distortion transformer. This wide bandwidth, low distortion device provides the clear signal path required for 56 KBPS analog data transfer.

Like all Xecom DAA's the XEV90 is a complete telephone line interface. It includes the telephone line transformer, line current holding circuit, hookswitch and ring indicator. The XEV90 replaces the dozens of components found in a discrete DAA design.
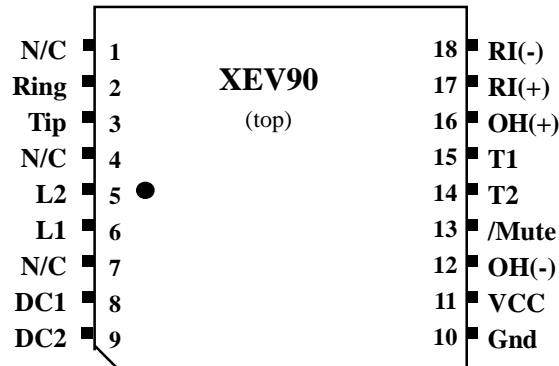
Features

* Package: 68-Pin PLCC (only 18 pins used) dimensions 0.952 inches by 0.952 inches by 0.170 inches high

* Meets Total Harmonic Distortion requirements for reliable 56 Kbps modems (-85 dB typical);

* Integrated Low-Distortion Telephone Line Transformer

* Integrated Ring Detection with active high and active low ouput signals

* Operates on either a single Power Supply of +5 or + 3 Volts;

* Solid-State Hookswitch Control with active high and active low inputs;

* FCC Part 68 Compliant;

* Extended Temperature Range available;

Figure 1: XEV90 BLOCK DIAGRAM

Figure 2: XEV90 Pin Configuration

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      N/C ■ 1              18 ■ RI(-)
     Ring ■ 2    XEV90     17 ■ RI(+)
      Tip ■ 3    (top)     16 ■ OH(+)
      N/C ■ 4              15 ■ T1
       L2 ■ 5 ●            14 ■ T2
       L1 ■ 6              13 ■ /Mute
      N/C ■ 7              12 ■ OH(-)
      DC1 ■ 8              11 ■ VCC
      DC2 ■ 9              10 ■ Gnd
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Pin Descriptions

| PIN	NAME	DESCRIPTION
1	N/C	No Connection
2	Ring	Ring is one wire of the two-wire telephone line connection (RJ11 Pin 4). 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. Xecom recommends 0.100 inch spacing between traces connected to Ring and all other conductors to preserve this isolation.
3	Tip	Tip is one wire of the two-wire telephone line connection (RJ11 Pin 3). The telephone company places a DC "Battery" voltage across Tip and Ring on all public switched telephone lines. The XEV90 accepts this line battery voltage without regard to its polarity.
4	N/C	No Connection
5, 6	L1 & L2	L1 and L2 provide the connective points for a billing tone filter when required.
7	N/C	No Connection
8, 9	DC1 & DC2	DC1 and DC2 control performance of the line current holding circuit. A jumper from DC1 to DC2 limits DC loop current to 60 milliamps. An open circuit between DC1 and DC2 permits loop currents up to 100 milliamps as required for North America. A resistor may be placed between DC1 and DC2 to alter the off-hook impedence to meet unique country requirements.
10	GND	Ground connection to the XEV90. This signal provides the reference for the OH output and RI input. This pin should be connected to the systems digital ground.
11	VCC	+5 Volt power source for the XEV90. VCC powers the RI and OH control lines.
12	OH(-)	Modem switch-hook control: OH(-), an active low input, for controls the switch hook in the XEV90. When the host activates pin 12, the switch-hook closes and the XEV90 seizes the local telephone line. Pin 16 provides an active high switch-hook control. OH(-) should remian open when using OH(+). The host can pulse OH(-) line to perform rotary dialing. The normal pulse rate is ten pulses per second. Closing the switch-hook creates a series of pulses. Dial one pulse for the digit one to ten pulses for the digit zero. The pulses on OH(-) must be asymmetrical, active for thirty-one milliseconds, inactive for sixty-nine milliseconds. An inter-digit delay of at least one hundred milliseconds is required.

Pin Descriptions

PIN	NAME	DESCRIPTION
13	Mute	The Mute signal can be used for pulse (rotary) dialing. The host must toggle the Mute signal to generate the dialing pulses.
14	T2	T2 in conjunction with T1 provides the differential input/output for the analog signal. T2 connects directly to the secondary side of the miniature line transformer embedded into the XEV90. To match the impedance of the DAA to the 600 ohm telephone line, a 320 ohm resistor must be connected in series with T1 or T2.
15	T1	T1 in conjunction with T2 provides the differential input/output for the analog signal. T1 connects directly to the secondary side of the miniature line transformer embedded into the XEV90. To match the impedance of the DAA to the 600 ohm telephone line, a 320 ohm resistor must be connected in series with T1 or T2.
16	OH(+)	Switch-hook control to the modem. OH(+) provides an active high input for controlling the switch hook. When pin 16 is active, the switch-hook closes and the XEV90 seizes the local telephone line. OH(+) should remain open when using OH(-).
		The host can pulse OH(+) line to perform rotary dialing. The normal pulse rate is ten pulses per second. Closing the switch-hook creates these pulses. Dial one pulse for the digit one to ten pulses for the digit zero. The pulses on OH(+) must be asymmetrical, active for thirty-one milliseconds, inactive for sixty-nine milliseconds. An inter-digit delay of at least one hundred milliseconds is required.
17	RI(+)	Ring Indicate output from the modem. RI(+) is an active high, open-emmitter output. RI(+) provides a square wave representation of the Ring signal present across Tip and Ring. This permits intelligent monitoring of the incoming ring. The XEV90 recognizes ring voltages of thirty-eight to one hundred fifty volts RMS in the frequency range of sixteen to sixty-eight Hertz. When using the RI(+) output, a 20 Kohm pull-down resistor must be added to RI(+); RI(-) must be tied to VCC.
18	RI(-)	Ring Indicate output from the modem. RI(-) is an active low, open collector output. RI(-) provides a square wave representation of the Ring signal present across Tip and Ring. This permits intelligent monitoring of the incoming ring. The XEV90 recognizes ring voltages of thirty-eight to one hundred fifty volts RMS in the frequency range of sixteen to sixty-eight Hertz. Pin 17 provides an active high ring indication. When using the RI(-) output, a 20 Kohm pull-up resistor must be added to RI(-); RI(+) must be tied to ground.

Electrical Specification *(Vcc=+5v ±10%, Ta=0 to 70 deg C)*

Parameter	Conditions	Min	Typ	Max	Units
Power Supply Current	Off-hook		10		mA
	On-hook		0.5		mA
Transmit Insertion loss	600 Ohm Impedance, 1800 Hz	4.5	6.0	7.0	dB
Receive Insertion loss	600 Ohm Impedance, 1800 Hz	4.5	6.0	7.0	dB
Line Matching Impedance	Input to T1 and T2	300	320	340	ohms
Line Impedance	320 ohm matching impedance resistor	540	600	660	ohms
Total Harmonic Distortion	600 Ohm Impedance, 100 to 4000 Hz	-80	-85		dB
Ring Detect Sensitivity	Min. AC voltage between Tip & Ring Type B ringer	20		150	Vrms
Ring Frequencies Detected		16		68	Hz
RI Output Voltage	Ring signal present, Active low		0.2	0.5	Volts
	Ring signal present, Active High	2.0		5.0	Volts
Hook-Switch Control Voltage (active high)	ON: (off-hook)		0.2	0.5	Volts
	OFF: (on-hook)	2.0	3.0		Volts
Hook-Switch Control Voltage (active low)	ON: (off-hook)	2.0	3.0		Volts
	OFF: (on-hook)		0.2	0.5	Volts
Hook-Switch Control Current	ON: (off-hook)		5	10	milliamps
	OFF: (on-hook)			5	microamps
Loop Current (current draw from line)	No Connection from DC1 to DC2	20		100	mA
	DC1 shorted to DC2	10		60	
DC On-Hook Impedance	Hookswitch Open	10			MOhms

Mechanical Specifications
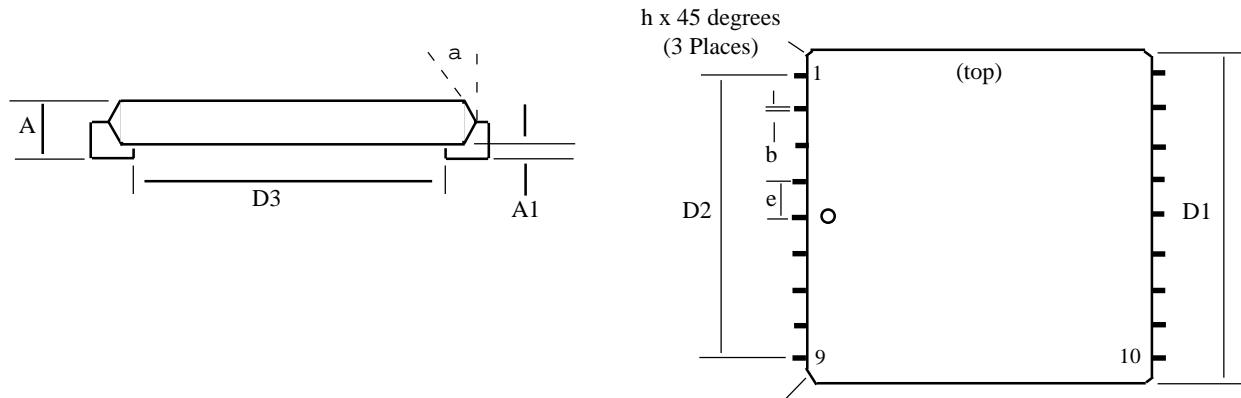
	Inches			**Millimeters**		
Dim	**Min**	**Ref**	**Max**	**Min**	**Ref**	**Max**
A		0.170			4.32	
A1	0.020			0.51		
b	0.017		0.021	4.32		5.33
D	0.985		0.995	25.0		25.27
D1		0.952			24.18	
D2		0.800			20.32	
D3	0.910		0.930	23.1		23.62
e		0.100			2.54	
h		0.010			0.25	
J		0.045			1.15	
a		45°			45°	
coplanarity			0.004			0.10

XEV90 ABSOLUTE MAXIMUM RATINGS	
Storage Temperature	-25° C to +85° C
Operating Temperature Range *	0° C to +70° C
Maximum Solder Temperature	220° C
Maximum Time Above Eutectic (183° C)	90 seconds
Preheat Dwell Time	120 to 180 seconds

* The XEV90 can be ordered with an Operating Temperature of -40° C to +85° C at extra cost.
   Order XEV90-ITR to specify Industrial Temperature Range (ITR).

Typical Connection Diagram
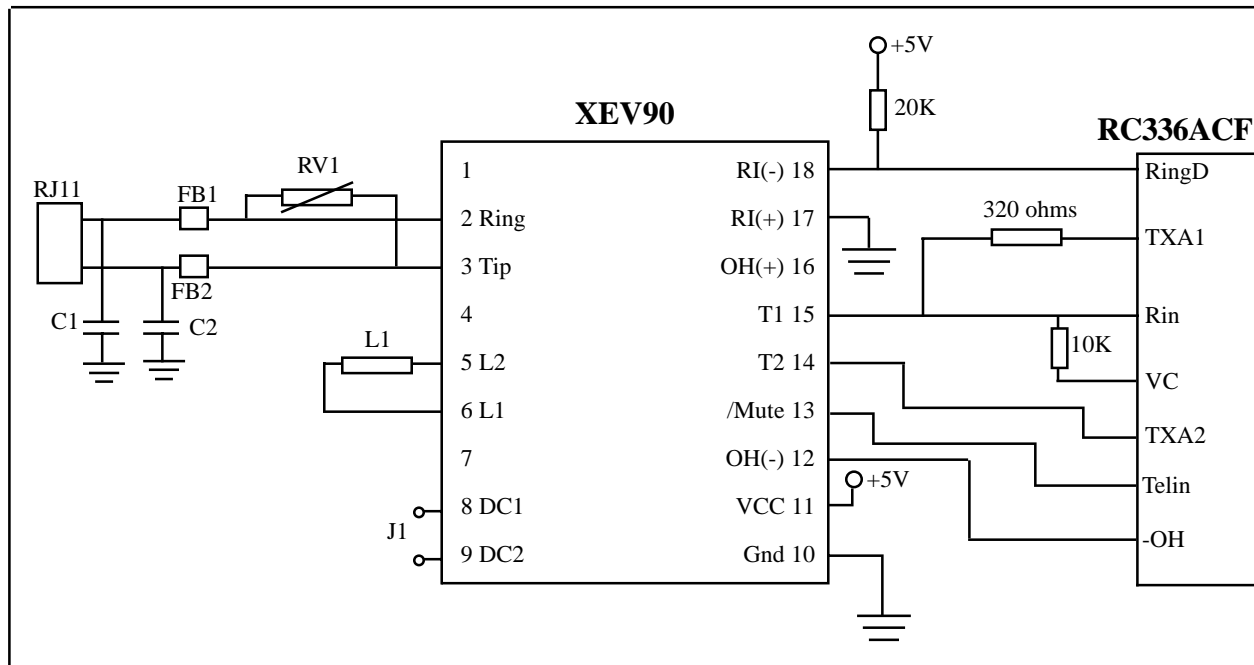
Notes on Application Schematic:

The Schematic above shows connections to support North American regulations. Use in North America requires compliance with FCC Part 68 Rules.

When jumper J1 is installed loop current is limited to just 60 milliamps. J1 must be removed for FCC Part 68 compliance.

L1 provides the Billing Tone Filter required in some countries.

C1 and C2 are 47 picofarad 1500 Volt Capacitors provided for EMI filtering. High voltage capacitors are required to maintain the isolation barrier between the telephone line and the host equipment.

FB1 and FB2 are Ferrite beads. They provide EMI filtering. They should present an impedance of at least 100 ohms at 100 MHz.

RV1 protects the XEV90 from voltage surges generated by near lightning strikes. Xecom recommends a Teccor Electronics P3100BA70 Sidactor. This device has a typical breakover voltage of 300 volts.

The 320 ohm resistor between T1 and TXA1 provides the optimal resistance for the XEV90 to match the impedance of a standard 600 ohm line.

The Mute signal can be used to provide low-impedance pulse dialing.

Application Notes

Dialing:

The public switched telephone network permits tone and rotary (pulse) dialing. The XEV90 supports both types of dialing. Tone dialing requires an external signal source to provide the dialing tones. Rotary dialing is accomplished by pulsing the OH or Mute line on the XEV90.

Pulse Dialing: The XEV90 generates dialing pulses through momentary closures of the switch-hook. (pulsing of the MUTE signal can also be used to generate dialing pules) Each digit is represented as a series of pulses, one pulse for a one to ten pulses for a zero. The pulse rate in normally ten pulses per second. (Some European countries require 20 pulses per second.) The dialing pulses are asymmetrical. Consult with the local country regulations for the required duty cycle. An interdigit delay of at least one hundred milliseconds separates the digits.

Tone Dialing: To tone dial the XEV90 seizes the line, OH active. For each digit a unique DTMF, Dual Tone Multiple Frequency, tone pair is placed across T1 and T2. The higher frequency tone is always of greater magnitude than the lower frequency tone. Transmit the tones for a minimum of 70 milliseconds, and leave a minimum of 70 milliseconds between digits.

The table below shows the correct DTMF signal frequencies for each digit.

| Digit	Lower Tone	Upper Tone
1	697	1209
2	697	1336
3	697	1477
4	770	1209
5	770	1336
6	770	1477
7	852	1209
8	852	1336
9	852	1477
0	941	1336
*	941	1209
#	941	1477

Signal Levels: FCC Part 68 Rules set the allowable signal level in the US for all signals placed on the telephone line other than live voice. Other countries have similar regulations. Signal levels are measured in dBm. Zero dBm is 1 milliwatt through a 600 ohm load.

Insertion Loss: There is some loss of signal power as the information signal passes through the XEV90. This "insertion" loss should be taken into account when placing signals across T1 and T2 for transmission. The typical insertion loss of the XEV90 is 6 dBm.

Total Harmonic Distortion:

Total Harmonic Distortion is the most common measure of the signal path quality provided by the DAA. The primary sources of distortion in the DAA are the Telephone Line Transformer and the Line Current Holding Circuit, although board layout and other factors can introduce distortion.

Total Harmonic Distortion varies with frequency. The voice band provided by the telephone line is limited to less than 4000 Hz. High speed modems such as 33.6 KBPS and 56KBPS require virtually all of this bandwidth for signal transmission. Even if the Total Harmonic Distortion of a device is very good in the center portion of the spectrum, signal quality is compromised if distortion greatly increases at the outer limits of the voice band.
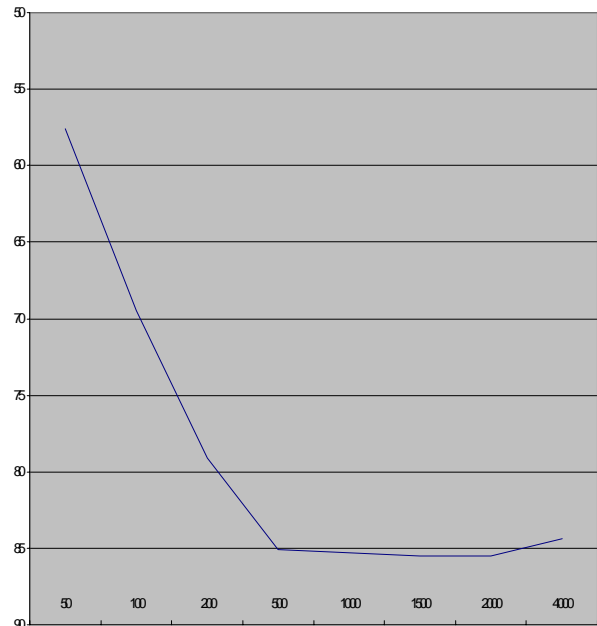
Note: This chart represents the total harmonic distortion of the complete DAA not just the telephone line transformer. Distortion measurements of the transformer only will show much lower distortion but do not account for distortion from other sources.

2/4 Wire Convertor

R2

R1

10K

Transmit

4558

R3   11.5K

R6

320 ohms

XEV90

T1

20K   R5

T2

R4   40K

Receive

4558
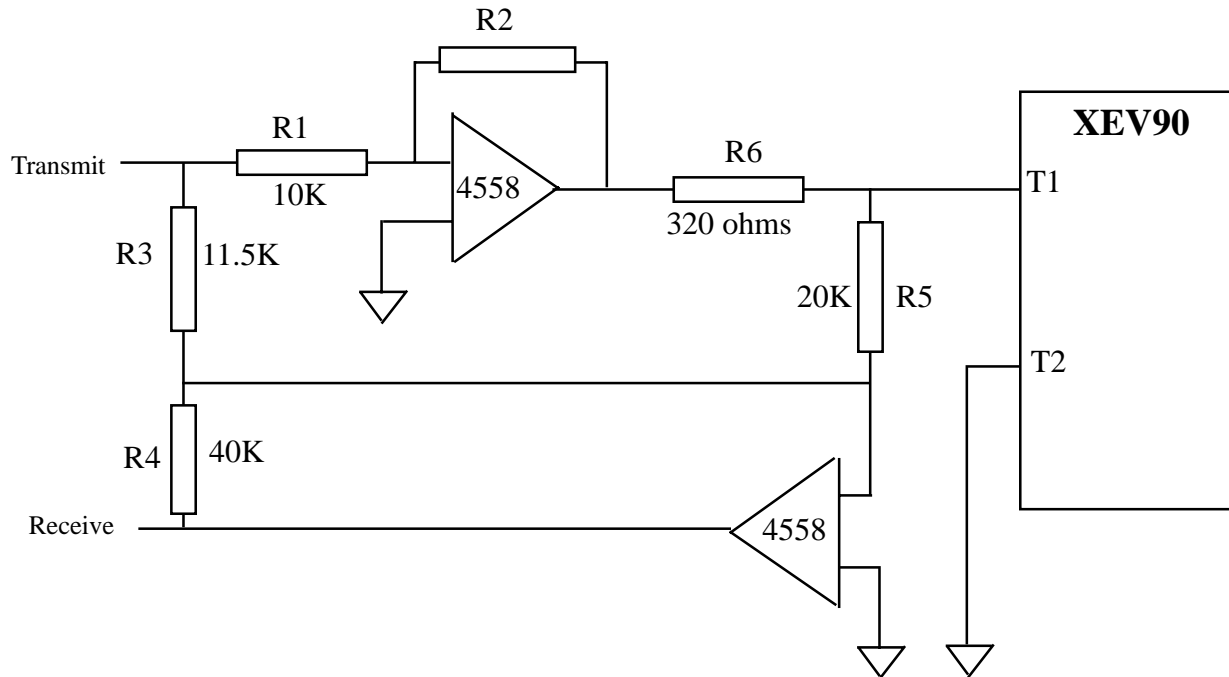
2/4 Wire Conversion:

Full Duplex communications over a two-wire telephone line requires that transmit and receive signal share the available bandwidth. The two-to-four wire convertor separates these signals at the host interface. Most modem analog front end chips incorporate an internal 2/4 wire convertor making it unnecessary to provide one in the DAA.

If you are using the XEV90 for an application other than a modem, such as voice processing, or your modem analog front end does not provide the 2/4 wire convertor, you will need to provide a discrete 2/4 wire convertor. The schematic on this page shows a simple 2/4 wire convertor circuit.

The performance of the 2/4wire convertor is measured by its Transhybrid Loss. The Transhybrid Loss shows how much the 2/4 wire convertor attenuates the transmit signal on the received data line. The circuit above provides a typical Transhybrid Loss of 20 dB.

The Transhybrid Loss will vary with the quality of the impedance match to the telephone line. Even when the

recommended value for the impedance matching resistor, R6, is used variations from line to line alter the impedance match. The value of R3 can be changed to improve the Transhybrid Loss.

The 2/4 wire convertor also amplifies the transmit and receive signals to compensate for the insertion loss of the DAA. This circuit provides 6 dB gain of both the transmit and receive signals. The values of R1 and R2 set the transmit gain. The values of R4 and R5 set the receive gain.

Telephone Line Connection Information

When developing a product to be connected to the telephone line, it is necessary to use a circuit known as a Data Access Arrangement (DAA) approved by the appropriate governmental agency. In the US this agency is the Federal Communications Commission (FCC), while in Canada it is Industry Canada (IC). These agencies test and approve the product to ensure that it meets their specifications, thereby protecting the telephone system from damage and protecting the user from high voltage transients (such as lightning strikes) which may come down the telephone line.

The XEV90 has been designed to meet all FCC Part 68 requirements for hazardous voltage, line impedance and leakage current. If the system transmits data, synthesized voice, or DTMF tones on the telephone line, the user must certify that the signals transmitted meet basic FCC requirements for maximum transmission levels, out of band energy and billing delay. Full details may be obtained from the FCC under Part 68 of the FCC Rules and Regulations, or in Title 47 of the Code of Federal Regulations, however the basic requirements are as follows:

1. Maximum Transmit Level
For the normal "permissive" (standard) telephone line, equipment which transmits data (such as a modem) must not exceed a transmission level of -9 dBm.

2. Out of Band Energy
Data equipment must not transmit "out of band" energy on the telephone line which exceeds the following limits:

Frequency		Range	Max. Power
3995 Hz	to	4005 Hz	-27 dBm
4005 Hz	to	12 kHz	-20 dBm
12 kHz	to	90 kHz	-55 dBm
90 kHz	to	270 kHz	-55 dBm
270 kHz	to	6 MHz	-15 dBm

3. DTMF Transmission Level
If the system is capable of DTMF dialing, the maximum DTMF transmission level must be less than 0 dBm averaged over a 3 second interval.

4. Billing Delay
A delay of 2 seconds or greater is required after the time the XEV90 is taken "off hook" and before any information is transmitted. This is required to ensure that billing information may be exchanged between telephone company central offices without interference.

OEM's using the XEV90 must certify to the FCC that the final system meets the requirements of Part 68 which include the criteria above as well as the high voltage protection provided by the XEV90. This is generally accomplished through an independent testing lab which tests the System and submits the proper paperwork to the FCC for approval. Since the XEV90 already complies with FCC Part 68 rules, this is a relatively simple process.

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