PLCC Packaged DAA for Europe and North America

Description

Xecom's XEV90C is a complete, multi-national DAA integrated into a compact PLCC package. The XEV90C supports analog data transfer to 56 KBPS and complies with both FCC Part 68 Rules and the Pan-European CTR21 specifications. The modified 68-Pin PLCC package permits automated, high-volume assembly.

The XEV90C does not sacrifice performance for small size and surface-mount convenience. The heart of the XEV90C 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.

The XEV90C is a complete telephone line interface. It includes the telephone line transformer, line current holding circuit, Caller ID Passthrough circuit, hookswitch and ring indicator with line connect detect. The XEV90C replaces the dozens of components found in discrete and transformerless DAA designs.

Features

* Package: Thick 68-Pin PLCC (only 18 pins used) dimensions 0.952 inches by 0.952 inches by 0.290 inches high
* Meets Total Harmonic Distortion requirements for reliable 56 Kbps modems (-85 dB typical)
* Integrated Low-Distortion Telephone Line Transformer
* Integrated Ring Detect with Line Connect Detect capability
* Integrated Caller ID Passthrough Circuit
* Operates on a single Power Supply of +5 Volts
* Solid-State Hookswitch Control with active high and active low inputs
* FCC Part 68 and CTR21 Compliant;
* Extended Temperature Range available, order part number XEV90C-ITR;

Figure 1: XEV90C BLOCK DIAGRAM

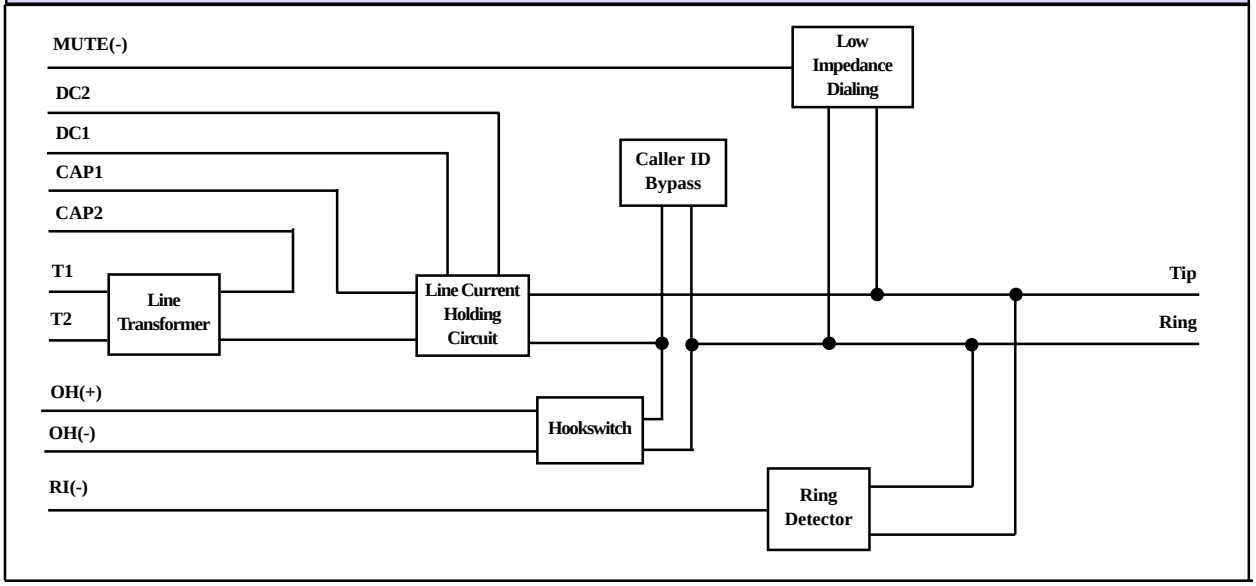
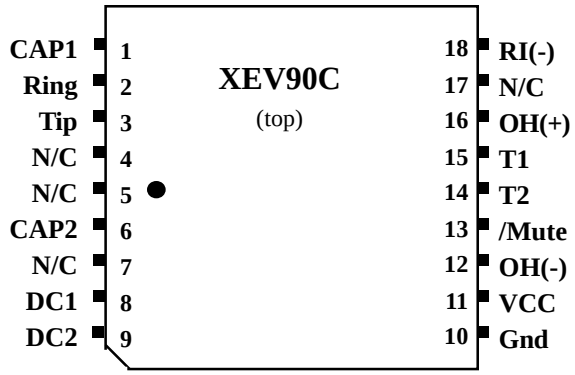


Figure 2: XEV90C Pin Configuration



XEV90C Pin Descriptions

PIN	NAME	DESCRIPTION
1	CAP1	CAP1 provides a connection point for the external blocking capacitor on the XEV90C. Two forty microfarad capacitors must be placed between the CAP1 and CAP2 pins for 56 KBPS performance. Twenty microfarad capacitors can be used for lower data rate applications. These polarized capacitors must be placed back-to-back to block line battery voltage of either polarity. These capacitors must be rated at 50 volts for CTR21 applications and 10 volts if CTR21 compliance is not required. A 5 milliHenry inductor may be placed in series with the blocking capacitors to compensate for the German billing tone filter. This filter is not addressed in CTR21 but is recommended for applications destined for Germany to prevent interference with communications.
2	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 - 5		No Connection
6	CAP2	CAP2 provides a connection point for the external blocking capacitor on the XEV90C. Two forty microfarad capacitors must be placed between the CAP1 and CAP2 pins for 56 KBPS performance. Twenty micro-farad capacitors can be used to meet lower data rate applications. These polarized capacitors must be placed back-to-back to block line battery voltage of either polarity.

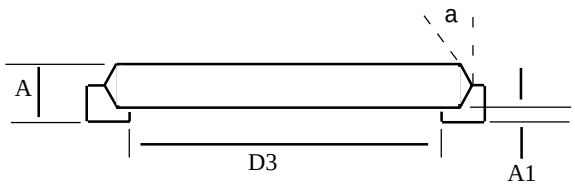
XEV90C Pin Descriptions (continued)

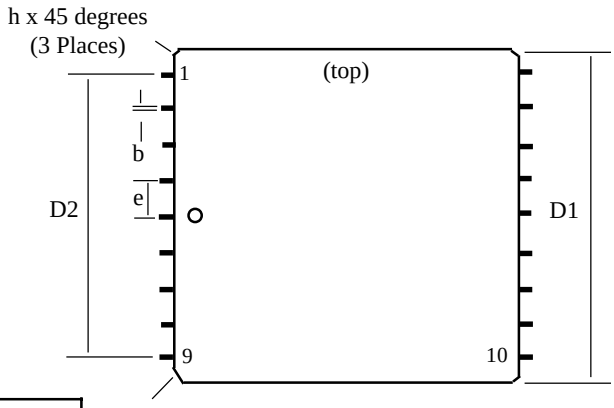
PIN	NAME	DESCRIPTION
7		No Connection
8	DC1	DC1 and DC2 control the performance of the loop current holding circuit. A jumper between DC1 and DC2 limits the DC loop current to 60 milliamps as required for CTR21. An open circuit between DC1 and DC2 allows loop currents up to 100 milliamps as required for North America and Japan. A resistor may be placed between DC1 and DC2 to adjust DC off-hook impedance to meet unique country requirements.
9:	DC2	DC1 and DC2 control the performance of the loop current holding circuit. A jumper between DC1 and DC2 limits the DC loop current to 60 milliamps as required CTR21. An open circuit between DC1 and DC2 allows loop currents up to 100 milliamps.
10	Ground	Ground provides the reference voltage for all host interface signals.
11	VCC	VCC provides operating power to the XEV90C. VCC must equal five volts plus or minus 10 percent.
12	OH(-)	OH(-) controls the switch-hook within the XEV90C with an active low input. If the user wishes to use an active high device to drive the switch-hook, Pin 16 provides the active high switch-hook control. Activating OH(-) closes the internal switch-hook and seizes the local telephone line. OH(+) must remain open when OH(-) is in use.
13	Mute(-)	Mute(-) provides an active low input for low impedance pulse dialing or for meeting the minimum transitional impedance required by CTR21. Presenting a low impedance while pulse dialing is a requirement of several European countries including, Germany, France and Italy. CTR21 does not regulate pulse dialing. European pulse dialing requirements continue to be set by the individual countries.
14	T2	T2 in conjunction with T1 provides the differential input/output for the analog signal.
15	T1	T1 in conjunction with T2 provides the differential input/output for the analog signal.
16	OH(+)	OH(+) controls the switch-hook within the XEV90C with an active high input. If the user wishes to use an active low device to drive the switch-hook, Pin 12 provides the active low switch-hook control. Activating OH(+) closes the internal switch-hook and seizes the local telephone line. OH(-) must remain open when (OH+) is in use.
17		No connection
18	RI(-)	RI(-) indicates the presence of an incoming ring (Ring Indication) or a drop in the Battery Voltage on the local telephone line (Connect Detection). RI(-) is an active low signal. RI(-) provides a square wave representation of the ring signal present on the telephone line. This permits the host to intelligently monitor the local telephone line. RI(-) also communicates the availability of the local telephone line with the Connect Detect Feature. When the Battery Voltage on Tip and Ring drops below twenty volts, RI(-) switches to high level to indicate the local telephone line is not available for use.

XEV90C Electrical Specifications *(Vcc=+5v ±10%, Ta=0 to 70 deg C)*

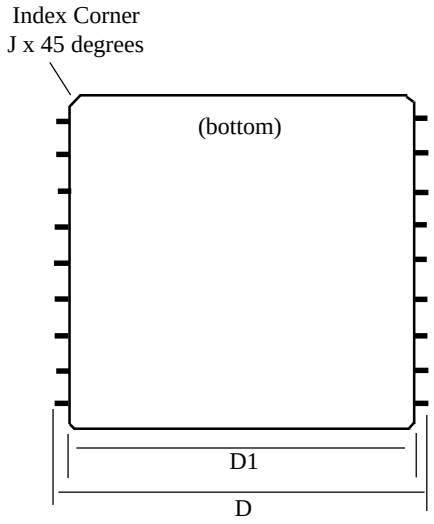
Parameter	Conditions	Min	Typ	Max	Units
Power Supply Current	Off-hook		10		mA
	On-hook		0.5		mA
Transmit Insertion loss	600 Ohm Impedance, 1800 Hz	2	3.5	5.0	dB
Receive Insertion loss	600 Ohm Impedance, 1800 Hz	3.5	5.0	6.5	dB
Caller ID Insertion Loss	Hookswitch Open	10.0	11.5	13	dB
Line Matching Impedance	Input to T1 and T2	300	340	370	ohms
Line Impedance	370 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
Hook-Switch Control	ON: (off-hook)		0.2	0.5	Volts
Voltage (active high)	OFF: (on-hook)	2.0	3.0		Volts
Hook-Switch Control	ON: (off-hook)	2.0	3.0		Volts
Voltage (active low)	OFF: (on-hook)		0.2	0.5	Volts
Hook-Switch Control	ON: (off-hook)		5	10	milliamps
Current	OFF: (on-hook)			5	microamps
Loop Current	No Connection from DC1 to DC2	0		100	mA
(current draw from line)	DC1 shorted to DC2	0		60	
DC On-Hook Impedance	Hookswitch Open	10			MOhms

XEV90C Mechanical Specifications





	Inches			Millimeters		
Dim	**Min**	**Ref**	**Max**	**Min**	**Ref**	**Max**
A	0.280		0.300	7.11		7.62
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^{O}			45^{O}	
coplanarity			0.004			0.10



XEV90C ABSOLUTE MAXIMUM RATINGS

Storage Temperature	-25^{O} C to $+85^{O}$ C
Operating Temperature Range *	0^{O} C to $+70^{O}$ C

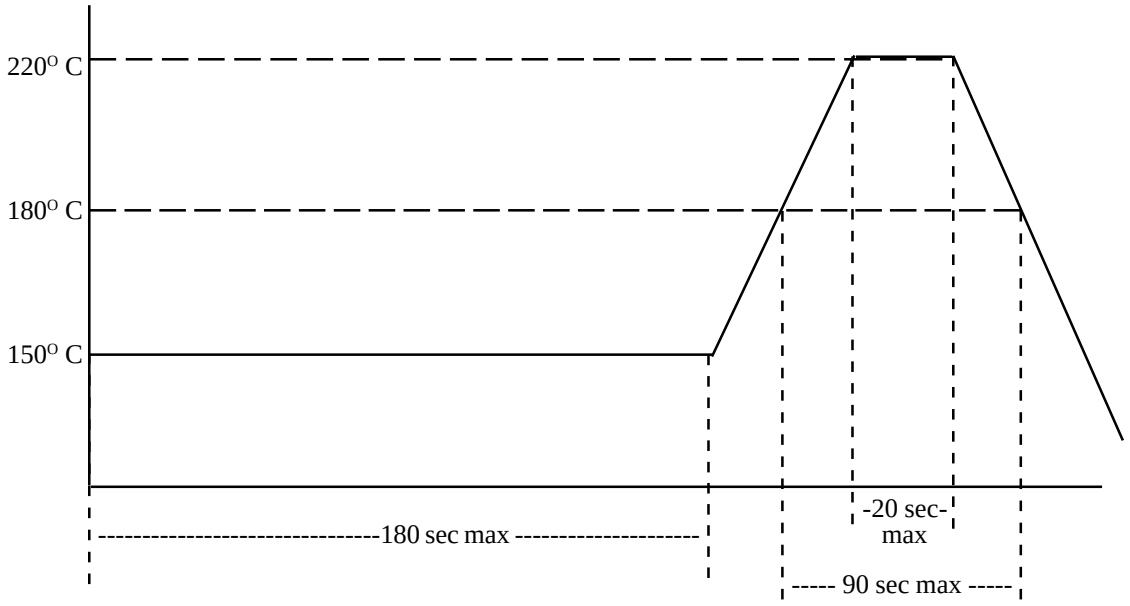
* The XEV90C can be ordered with an Operating Temperature of -40^{O} C to $+85^{O}$ C at extra cost.
Order XEV90C-ITR to specify Industrial Temperature Range (ITR).

Slim-Link® PLCC Soldering Instructions

Because of its Hybrid construction, the XEV90C DAA is subject to damage if over-exposed to heat during solder reflow operations. Following the soldering instructions below will ensure that the process of soldering the module to the board does not damage the DAA.

Maximum Temperature	220^{O} C
Maximum Time at 220^{O} C	20 Seconds
Maximum Time above Eutectic (180^{O} C)	90 Seconds
Maximum Preheat Dwell Time	180 Seconds

Maximum Recommended Solder Temperature Profile

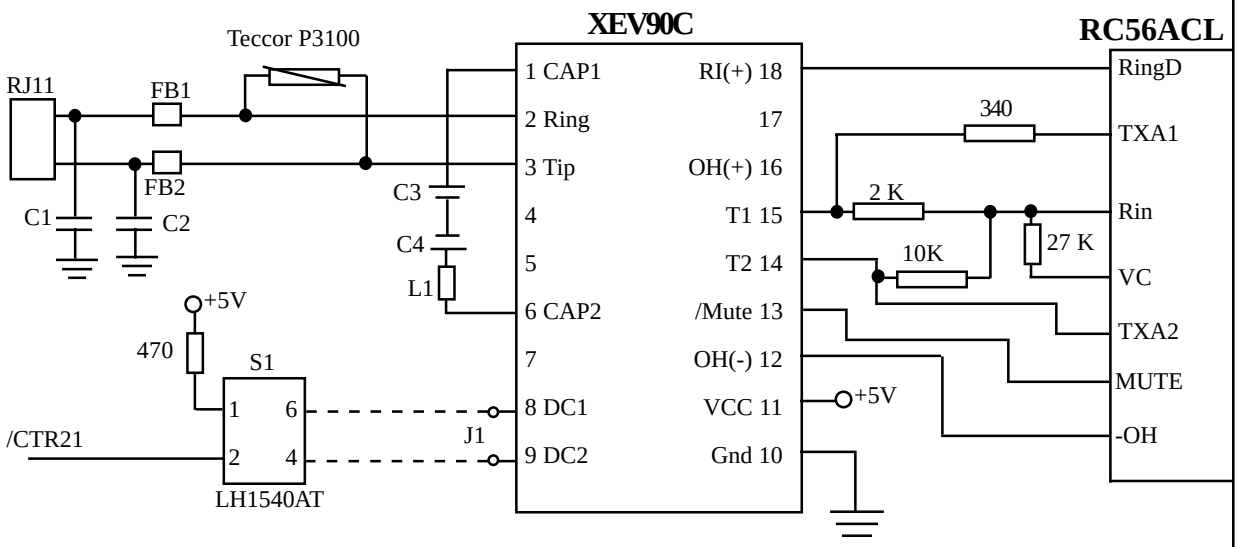


Notes:

Because of their large black bodies, Xecom's XEV90C DAA modules must not be exposed to direct Infrared (IR) heating. If your process includes direct IR heating, you must shield the PLCC DAA module from the infrared rays.

Xecom's XEV90C DAA modules should be exposed to no more than one reflow cycle.

XEV90C Typical Connection Diagram



Recommended Componants

Region	Maximum Data Rate	C1 & C2	Ferrite Beads FB1 & FB2	C3 & C4	Billing Tone Filter (Opt.) L1	J1	S1
N. America	56K	470 pfd, 1.5KV	TDK ACB2012L-120	40 ufd, 10V	OUT	OUT	OUT
Europe	56K	470 pfd, 1.5KV	TDK ACB2012L-120	40 ufd, 50V	5 mh	IN	OUT
Universal	56K	470 pfd, 1.5KV	TDK ACB2012L-120	40 ufd, 50V	5 mh	OUT	IN
N. America	33.6K	470 pfd, 1.5KV	TDK ACB2012L-120	20 ufd, 10V	OUT	OUT	OUT
Europe	33.6K	470 pfd, 1.5KV	TDK ACB2012L-120	20 ufd, 50V	5 mh	IN	OUT
Universal	33.6K	470 pfd, 1.5KV	TDK ACB2012L-120	20 ufd, 50V	5 mh	OUT	IN

Notes:

1) C1, C2, FB1, and FB2 provide filtering to meet EMI restrictions. They may be omitted if your equipment meets the appropriate EMI standards without them.
2) Some countries including Germany use billing tones which can interfere with communciations. L1 blocks the tone from reaching the receiving equipment. This filter is not required for certification but is recommended for applications to be used in Germany to prevent compromises in performance.
3) In rare instances when the CTR21 current limiting circuit is active, the XEV90C may be required to dissipate more than 2 Watts from the flow of loop current. A Heat Sink is required to dissipate the resulting heat without endangering the device. Xecom recommends an AAVID 3352 or equivalent heat sink for applications which support CTR21.
4) UL1950 requires minimum creepage and clearance distances to be maintained for telecommunications circuits. Clearance is the straight-line distance between two conductive points. Creepage is the distance along the surface between two conductive points. Consult UL1950 for the minimum creepage and clearance distances which apply to your equipment.
5) By adding an switch S1 in place of J1 it is possible to have a single DAA which is software selectable for European or North American applications.

Application Notes

Dialing:

The public switched telephone network permits tone and rotary (pulse) dialing. The XEV90C 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 XEV90C.

Pulse Dialing: The XEV90C generates dialing pulses through momentary closures of the switch-hook. Pulsing 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 XEV90C 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

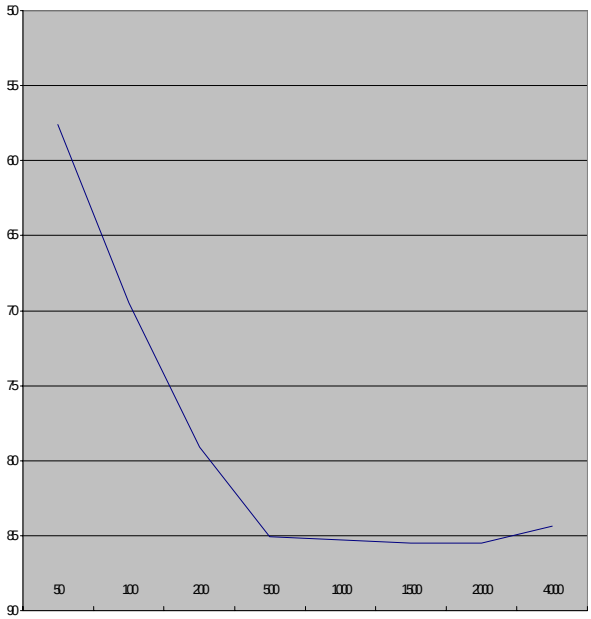
Signal Levels: FCC Part 68 Rules set the allowable signal level in the US for all signals placed on the telephone line other than live voice. Other countries have similar regulations. Signal levels are measured in dBm. Zero dBm is 1 milliwatt through a 600 ohm load.

Insertion Loss: There is some loss of signal power as the information signal passes through the XEV90C. This "insertion" loss should be taken into account when placing signals across T1 and T2 for transmission. The typical insertion loss of the XEV90C is 3.5 dBm.

Total Harmonic Distortion:

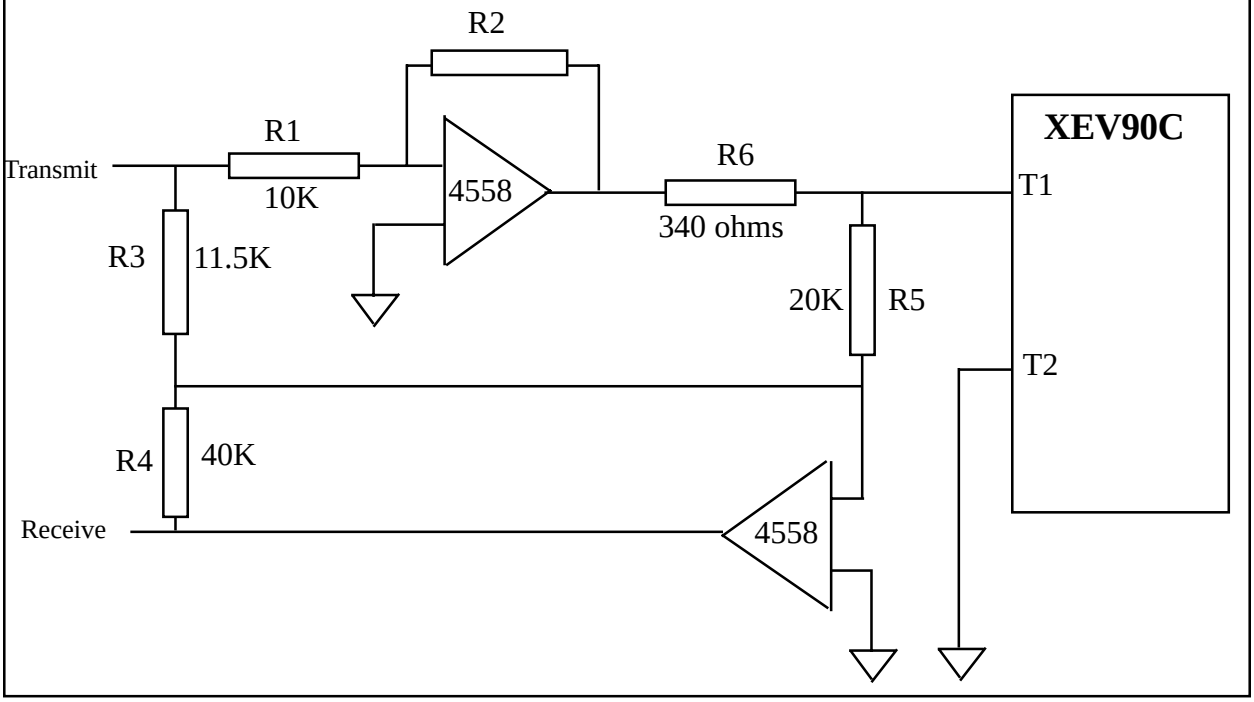
Total Harmonic Distortion is the most common measure of the signal path quality provided by the DAA. The primary sources of distortion in the DAA are the Telephone Line Transformer and the Line Current Holding Circuit, although board layout and other factors can introduce distortion.

Total Harmonic Distortion varies with frequency. The voice band provided by the telephone line is limited to less than 4000 Hz. 56KBPS modems 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



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 XEV90C 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). In Europe the CTR21 standard covers all countries in the European Union. 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 XEV90C 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 XEV90C 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 XEV90C 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 XEV90C. 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 XEV90C already complies with FCC Part 68 rules, this is a relatively simple process.

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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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