xecom®

XE056LCC
February 2005

Surface-Mount Slim-Link® DAA for 56K bps Data Transfer

Description

The XE056LCC is a complete telephone line interface or DAA supporting 56K bps data transfer in a leadless, surface-mount package. It is an alternative to discrete DAA's for high-speed dial-up communications. The XE056LCC replaces 25 to 30 discrete components.

In spite of being less than 1 inch square, the XE056LCC does not sacrifice performance for its small size and surface-mount convenience. The wide bandwidth, low distortion design supports data transfer with even V.90 and V.92 modulation.

The XE056LCC includes the telephone line transformer, loop current holding circuit, hook-switch and ring indicator. The XE056LCC complies with FCC Part 68 rules for direct connection to the telephone line.

Features

* Leadless design compatible with a 68-Pin PLCC footprint for high-volume assembly

* Meets line interface requirements for reliable voice, audio and data communications;

* Typical Total Harmonic Distortion -77 dB ;

* FCC Part 68 Compliant;

* Integrated Low-Distortion Telephone Line Transformer

* Ring Detection;

* Operates on a Single +5 Volt or + 3 Volt Power Supply;

* Solid-State Hook-switch Control;

* Internal metallic surge protection provided;
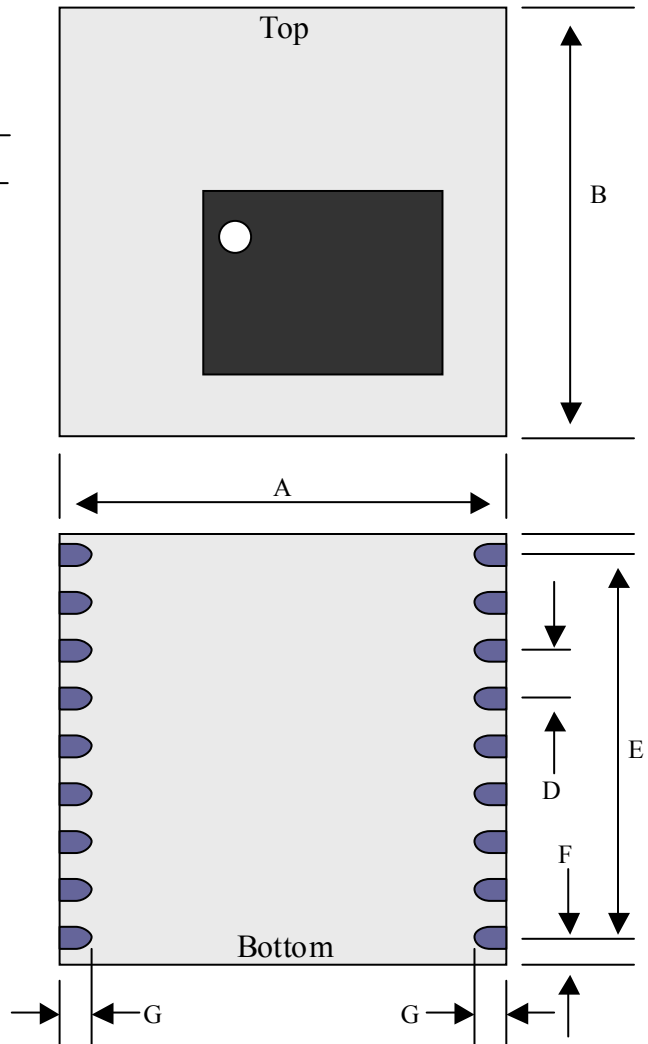
* Extended Temperature Ranges available;

## XE056LCC BLOCK DIAGRAM
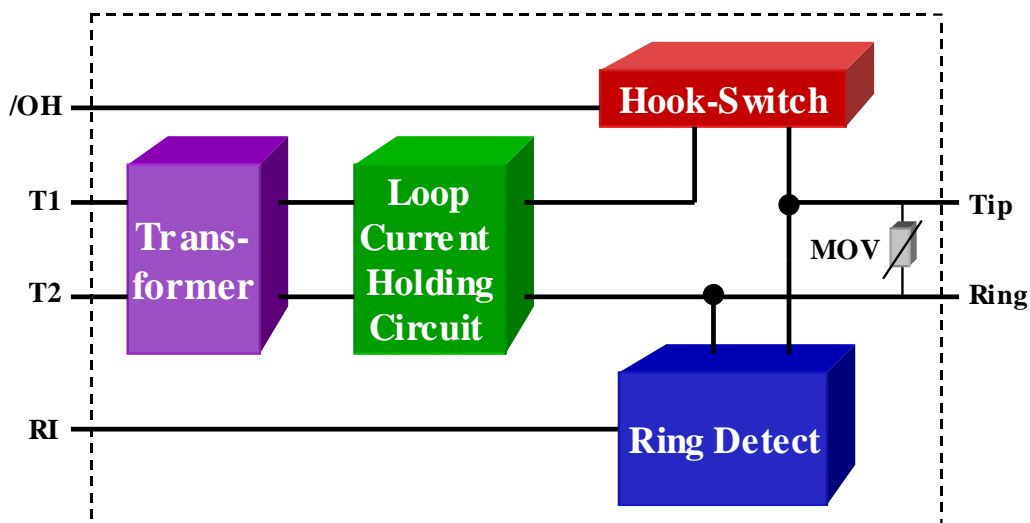
XE056LCC Mechanical Specifications

	Inches		MM	
Dim	Min	Max	Min	Max
A	0.945	0.955	24.00	24.26
B	0.945	0.955	24.00	24.26
C	0.340	0.350	8.64	8.89
D	0.095	0.105	2.41	2.67
E	0.795	0.805	20.19	20.45
F	0.070	0.080	1.90	2.03
G	0.095	0.105	2.41	2.67

Top

Bottom

XE056LCC PCB Layout Recommendations

The XE056LCC is a leadless part. The pads on your printed circuit board must align with the pads on the bottom of the DAA mdule. Below is the recommended PCB layout. Do not place trace or components under the DAA as this could compromise the network isolation.
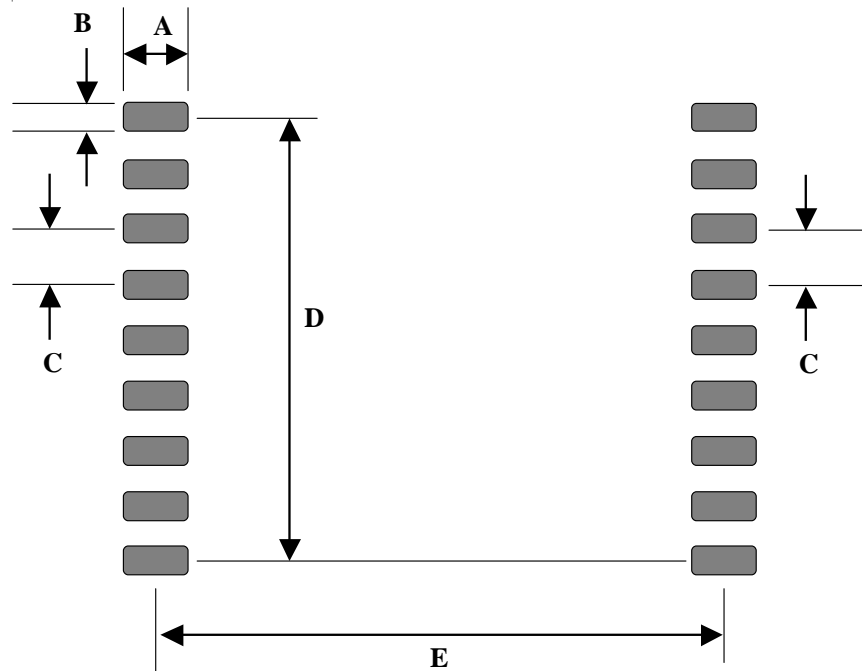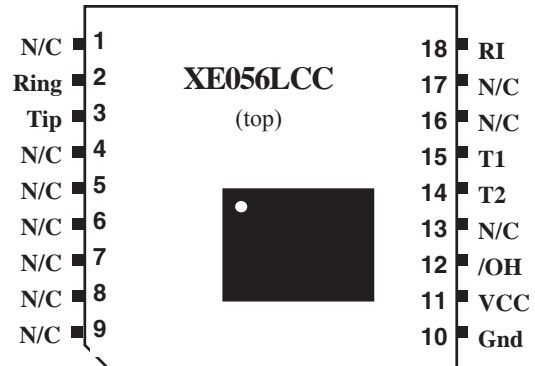
Dim	Typical (inches)	Description
A	0.100	Pad Length
B	0.045	Pad Width
C	0.100	Pad-to-Pad Spacing
D	0.800	Pin 1 to Pin 9 Spacing
E	0.950	Row-to-Row Spacing

XE056LCC Pin Descriptions

Pin	Name	Description
1	N/C	No Connection
2	Ring	Ring is half of the two-wire telephone line connection (RJ11 Pin 4). FCC Part 68 Rules require a 1500 volt isolation barrier between the phone line and all other circuits. This isolation must be preserved throughout the system. Xecom recommends 0.100 inch spacing between the Tip and Ring traces and all other conductors to preserve this isolation.

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        ┌──────────────────────────┐
N/C  ■1 │                          │ 18 ■ RI
Ring ■2 │        XE056LCC          │ 17 ■ N/C
Tip  ■3 │         (top)            │ 16 ■ N/C
N/C  ■4 │                          │ 15 ■ T1
N/C  ■5 │        ┌─────────┐       │ 14 ■ T2
N/C  ■6 │        │ ●       │       │ 13 ■ N/C
N/C  ■7 │        │         │       │ 12 ■ /OH
N/C  ■8 │        │         │       │ 11 ■ VCC
N/C  ■9 │        └─────────┘       │ 10 ■ Gnd
        └──────────────────────────┘
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XE056LCC Pin Configuration

| Pin	Name	Description
3	Tip	Tip is the other half 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 XE056LCC works regarless of the polarity of the battery voltage.
4-9	N/C	No Connection
10	GND	Ground connection to the XE056LCC. Pin 10 supplies the reference for the RI input and /OH output and should connect to the systems digital ground.
11	VCC	+5 or +3 Volt power source for the XE056LCC. VCC powers the RI and OH control lines.
12	/OH	Active low Switch-hook control. A low on /OH closes the switch-hook causing the DAA to seize the local telephone line. Raising /OH drops the telephone line connection.
		/OH can be pulsed to simulate rotary dialing. When rotary dialing, a series of pulses represents each digit. (One pulse for the digit one to ten pulses for the digit zero.) These pulses are created by a momentary closure of the hook-switch. The pulse rate in the US is 10 pulses per second. The pulses must be asymmetrical with the hook-switch closed for 31 milliseconds then open for 69 milliseconds. A delay of at least 100 milliseconds is required between digits.
13	N/C	No Connection
14	T2	T2 and T1 provide the differential analog signal input/output connecting directly to the secondary side of the XE056LCC line transformer. To match the impedance of the DAA to the 600 ohm telephone line, a 340 ohm resistor is required on T1 or T2.
15	T1	T1 and T2 provide the differential analog signal input/output connecting directly to the secondary side of the XE056LCC line transformer. To match the impedance of the DAA to the 600 ohm telephone line, a 280 ohm resistor is required on T1 or T2.
16-17	N/C	No Connection
18	RI	Active High Ring Indicate output. RI provides a square wave representation of the Ring signal present on Tip and Ring. This permits intelligent monitoring of the incoming ring.

Typical Connections Diagram
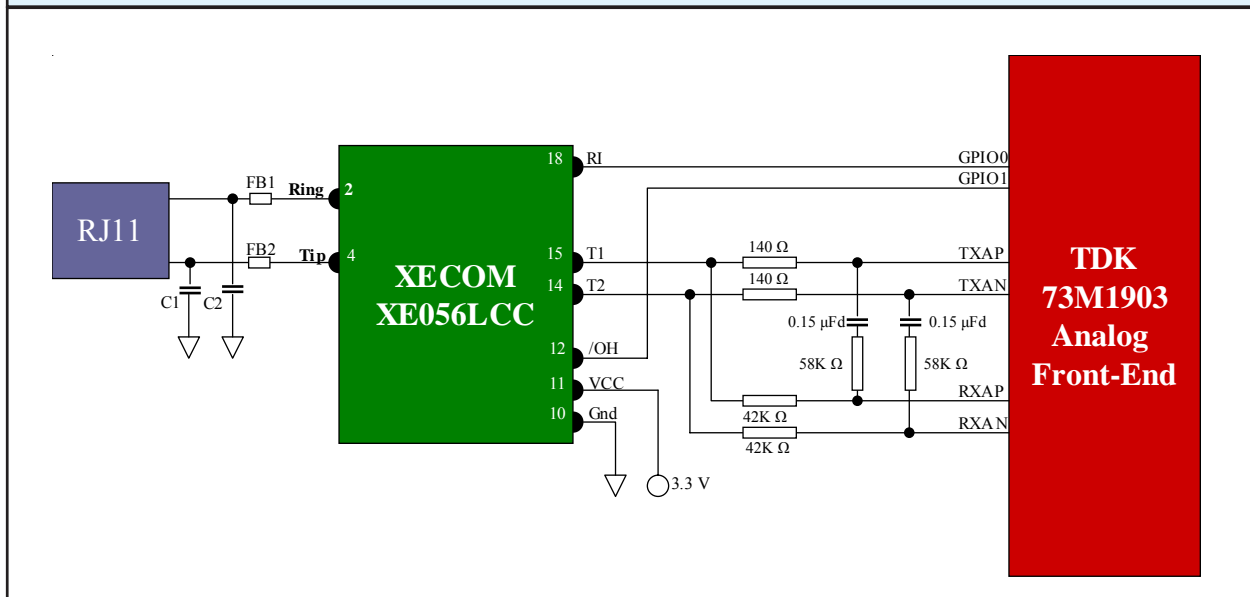

Recommended Parts

C1, C2 — 470 pFd, 1500 Volts; C1 and C2 may be required for EMI filtering to prevent unintended radiation when the telephone cable is attached to your system. These capacitors must be rated at a minimum of 1500 volts to maintain the isolation required by FCC Part 68 Rules.

FB1., FB2 — FB1 and FB2 are ferrite beads provided for EMI filtering. Xecom recommends the TDK ACB2012L-120 which provides more than 100 ohms impedance above 100 MHz.

Slim-Link® PLCC Soldering Instructions

Because of its Hybrid construction, the XE056LCC 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$^{\mathrm{O}}$ C
Maximum Time at 220$^{\mathrm{O}}$ C	20 Seconds
Maximum Time above Eutectic (180$^{\mathrm{O}}$ C)	90 Seconds
Maximum Preheat Dwell Time	180 Seconds

Maximum Recommended Solder Temperature Profile
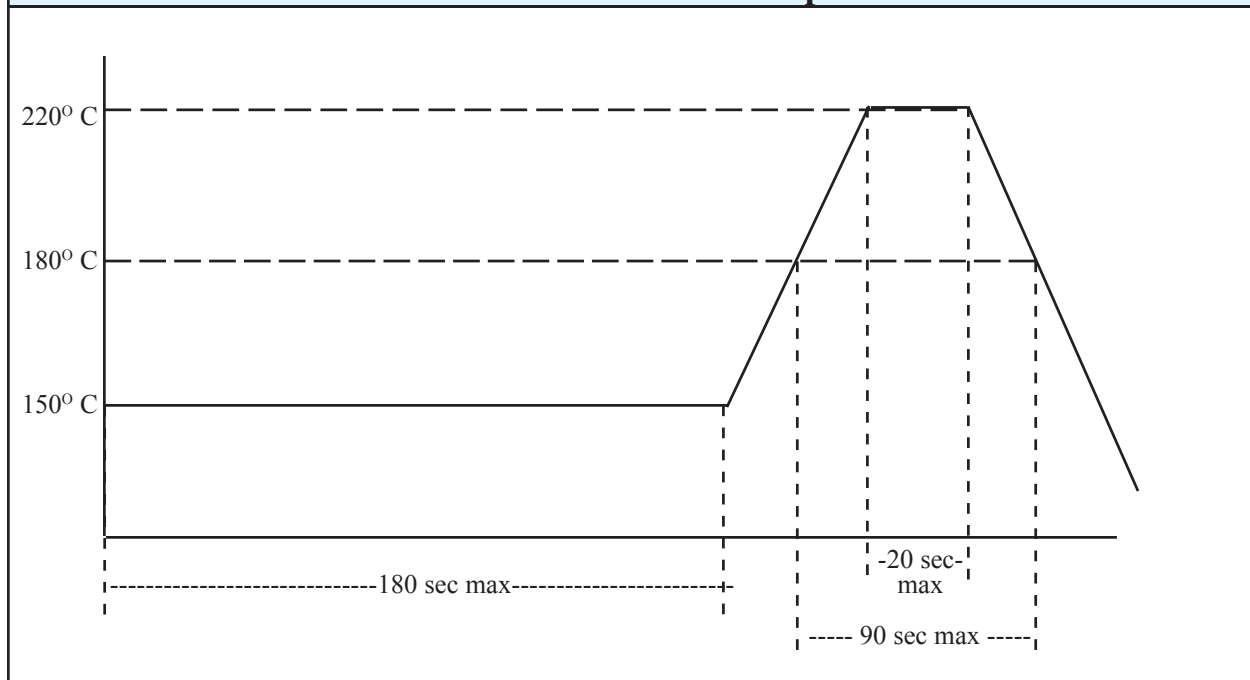
Notes:

Do not expose the XE056LCC DAA module to direct Infrared (IR) heating. If your process includes direct IR heating, you must shield the DAA module from the infrared radiation.

Xecom's XE056LCC DAA modules should be exposed to no more than one reflow cycle.

XE056LCC Applications Notes

Dialing:
The XE056LCC supports both tone and rotary (pulse) dialing. Tone dialing requires an external signal source to generate the dialing tones. Rotary dialing is accomplished by pulsing the /OH line.

Pulse Dialing: Dialing pulses are created by momentarily closing the switch-hook. Each digit is represented as a series of pulses; one pulse for the digit one, two pulses for a two, up to ten pulses for a zero. The pulse rate is ten pulses per second. These dialing pulses are asymmetrical. For the correct duty cycle consult with the local country regulations. An inter-digit delay of at least one hundred milliseconds separates the digits.

Tone Dialing: To permit tone dialing the /OH line msut be activated to seize the line. Dialing tones can then be presented on T1 and T2. Each digit consists of a unique DTMF, Dual Tone Multiple Frequency, tone pair. Transmit teh tones for a minimum of 70 milliseconds with a minimum of 70 milliseconds between digits.

Below is a list of the DTMF signal frequencies.

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 maximum level of all signals on the telephone line other than live voice. Signal levels are measured in dBm; 0 dBm is 1 milliwatt through a 600 ohm load. Dialing tones may have a combined signal level of up to 0 dBm; all other signals are limited to a maximum of -9 dBm.

Insertion Loss: There is some loss of signal strength as the signal passes through the DAA. This "insertion" loss should be considered when placing signals across T1 and T2 for transmission. The typical insertion loss of the XE056LCC is 6 dB.

Total Harmonic Distortion:
Total harmonic distortion measures the quality of the DAA signal path quality. The primary sources of distortion 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 telephone line provides a frequency band of 100 to 4000 Hz. High speed modems using V.90 and V.92 protocols require virtually all of this bandwidth. Even if the total harmonic distortion is very good in the center of the spectrum, distortion elsewhere will adversely affect data transmission.

2/4 Wire Conversion:

Two-way communications over a two-wire telephone line requires that the transmit and receive signal share the available bandwidth. The 2/4 wire convertor separates these signals at the host interface. Most modem analog front end chips incorporate an internal 2/4 wire convertor.

If you are using the XE056LCC for an application other than a modem, such as audio, 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. Figure 12 shows a simple 2/4 wire convertor circuit.
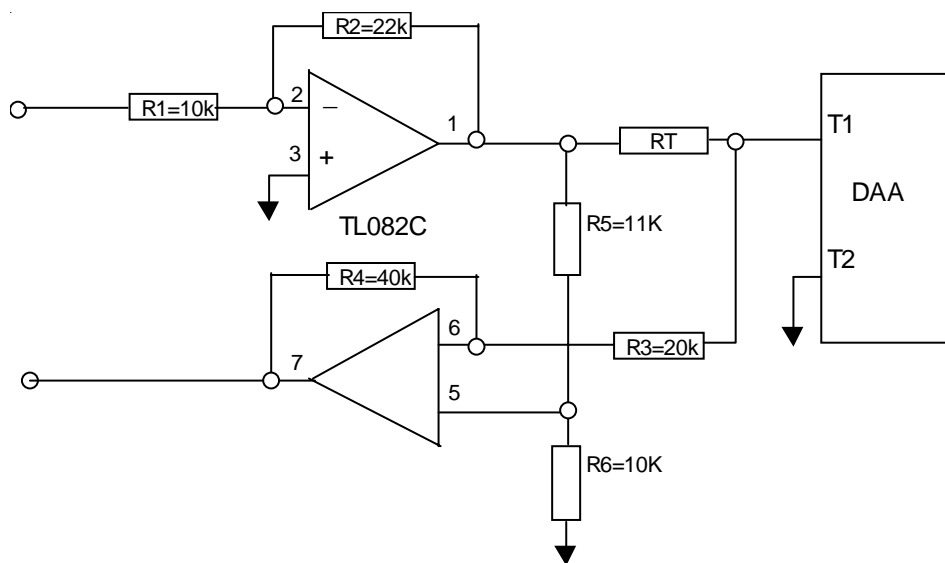
The performance of the 2/4 wire convertor is measured by its Transhybrid Loss. The Transhybrid Loss shows how much the 2/4 wire convertor attenuates the transmit signal on the received data path. The circuit above provides a typical Transhybrid Loss of 20 dB. The value of R3 can be changed to improve the Transhybrid Loss.

The Transhybrid Loss will vary with the quality of the impedance match to the telephone line. The impedance presented to the telephone line isa a funciton of the impedance matching resistor, RT. Variations from line to line mean that a perfect impedance match is rarely achieved.

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.

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	4.5	6.0	7.0	dB
Receive Insertion loss	600 Ohm Impedance, 1800 Hz	4.5	6.0	7.0	dB
Matching Impedance	Input to T1 and T2	266	280	294	ohms
Line Impedance	RT equals 340 ohms	540	600	660	ohms
Total Harmonic Distortion	600 Ohm Impedance, 200 to 4000 Hz	-72	-77		dB
Ring Detect Sensitivity	Tip & Ring voltage; Type B ringer	38		150	Vrms
Ring Frequencies Range		16		68	Hz
RI Output Voltage (active high)	No Ring signal, Low output		0.2	0.5	Volts
	Ring signal present, High output	2.0		5.0	Volts
Hook-Switch Control Voltage (active low)	ON: (off-hook)		0.2	0.5	Volts
	OFF: (on-hook)	2.0	3.0		Volts
Hook-Switch Control Current	ON: (off-hook)		5	10	milliamps
	OFF: (on-hook)			5	uamps
Loop Current	Off-Hook	20		100	mA
DC On-Hook Impedance	Hook-switch Open	10			MOhms

XE056LCC Absolute Maximum Ratings

Storage Temperature	-25° C to +85° C
Operating Temperature Range *	0° C to +70° C

* The XE056LCC can be ordered with an Operating Temperature of -40° C to +85° C at extra cost.
Order Model Number XE056LCC-ITR

XE056LCC FCC Part 68 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 XE056LCC 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 XE056LCC 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.

The user of the XE056LCC 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 XE056LCC. 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 XE056LCC 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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