Adrienne Electronics Corporation

PCI-TC Board User Guide

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INTRODUCTION

Adrienne Electronics Corporation (AEC) developed the PCI-TC family of PCI bus plug-in boards to provide effective, fast, and low cost ways of reading and/or generating time codes via personal computers. Some of these boards are also capable of reading NTSC line 21 data, including closed caption data, generating an On-Screen Display (OSD) of the time code data, and interfacing with RS-232 and RS-422 serial devices.

This booklet has been prepared to assist the average user with installing and successfully using a PCI-TC board in their computer. We have a separate "PCI-TC Board Reference Manual" for more advanced users who need to write software at the register level for our PCI-TC boards.

You probably ordered something other than a "PCI-TC" board, and are at this point wondering why we sent you a "PCI-TC" user guide to accompany your PCI-LTC/RDR board, for example. The simple answer is that we use the term "PCI-TC" to refer to all of our PCI-21, PCI-LTC, PCI-VITC, and PCI-VLTC boards. There are about 40 different board models in all here, and it is much easier for us to write one generic "PCI-TC" manual than it is to write 40 different manuals. All PCI-TC boards use the same basic hardware and software interface inside your PC, so a single manual works well here, and application software written for one board model will usually work with all PCI-TC board models.

Most of you will only need to read the INSTALLATION section starting on page 5, plug the board into your PC, attach external cables and signal sources, then fire up the test/demo program to make sure that everything is working OK. You may also need to install Windows software drivers before you can begin using the desired application program.

LEGAL NOTICES

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WHAT IS TIME CODE?

Time Code assigns to each video frame (picture) a unique number, having the format Hours:Minutes:Seconds:Frames. This number may then be used for editing and/or control purposes. Time code standards have been around for many years, and are sponsored by both SMPTE (for NTSC) and the EBU (for PAL and SECAM). Time code is also used in the 24fps FILM environment, and in some audio only applications.

There are actually two different kinds of time code commonly used in the television business. Vertical Interval Time Code (VITC) is encoded in the vertical interval (non visible portion) of a video signal. Longitudinal Time Code (LTC) is a specialized audio signal which is usually recorded on an audio track of a video tape, next to its associated video signal.

Use of VITC frees up one audio track for other purposes, such as stereo audio. It also allows time code to be read at very low (including still) tape speeds, where fine positioning is important. However VITC cannot usually be read at tape speeds much above play speed.

LTC is commonly used because it is usually lower cost than VITC, can be added to a video tape after the initial video recording, and it can be read during high shuttle speeds (fast forward and rewind). However, due to record/playback limitations of tape machines, LTC cannot be read reliably at very low tape speeds.

In many cases LTC and VITC will be used at the same time, because of the advantages each has to offer.

WHAT IS NTSC LINE 21 DATA ?

NTSC Line 21 Data includes the customary closed caption data for the hearing impaired, plus text, V-chip, clock, and other data services. This is a specially encoded signal, similar to VITC in some respects, which carries 2 bytes of useful information per video field, even in the presence of noise and severe bandwidth limiting (like VHS VCR's). All of our PCI-21 boards can read this data from properly encoded NTSC video signals.

PCI BUS TYPES

The original PCI bus standard called for a 32-bit 33MHz bus using 5.0V signaling (logic levels). The original PCI-TC boards were designed to operate in this 5.0V-only bus environment, and will only plug into and operate with PCI motherboards which use this 5.0V signaling.

The PCI bus standard keeps evolving as chips and personal computers become faster. The PCI bus has been expanded to include an optional 64-bit data path, and has been modified to allow operations at up to 66MHz. Faster bus speeds (133MHz, etc.) are currently in development. Because of the increased design complexity and cost to implement these changes, and because there is no need for a PCI-TC board to operate any faster than it already does, we have not yet developed a faster PCI-TC board, and we will put off doing so for as long as possible.

To support increased PCI bus speeds, the PCI bus signaling voltages were reduced from 5.0V to 3.3V. In January 2003 we introduced a new "Universal" PCI-TC board which will automatically adapt to and operate properly in either a 5.0V or a 3.3V PCI motherboard. The new "Universal" board has two(2) notches in its gold plated edge connector, whereas the "original" PCI-TC board only has one(1) notch in its connector, which prevents it from getting plugged into a 3.3V motherboard by mistake.

It is important to note that both your PCI-TC board and the PCI standard require that the system power supply provide 5.0VDC to your board, even if it is operating in a 3.3V signaling environment (otherwise it won't work).

Your PCI-TC board, whether an original "5.0V-only" design or the newer "Universal 5.0V/3.3V" design, only runs at 33MHz. It will still operate properly if plugged into a higher speed bus, but only because the entire bus automatically gets slowed down to 33MHz to accommodate the slowest device. If your computer has more than one PCI bus, consider plugging your PCI-TC board and other "slow" boards into one bus, and use a different bus for high speed operations. PCI bus numbers are displayed by the PCI-TC board test/demo program (on the diskette), and usually by BIOS whenever power is turned on to your computer.

The PCI-TC board test/demo program has a "hardware information" diagnostic which can tell you the PCI bus signaling voltage, and whether you have an original 5.0V board or a universal 5.0V/3.3V board installed.

INSTALLATION

Here is how to properly install a PCI-TC board into a PCI-bus personal computer. One very nice feature of the PCI bus design is that there aren't any address or interrupt jumpers to worry about. Just plug and play. Be sure to follow all of the following steps, in the order given, to avoid damaging either your PCI-TC board or your computer:
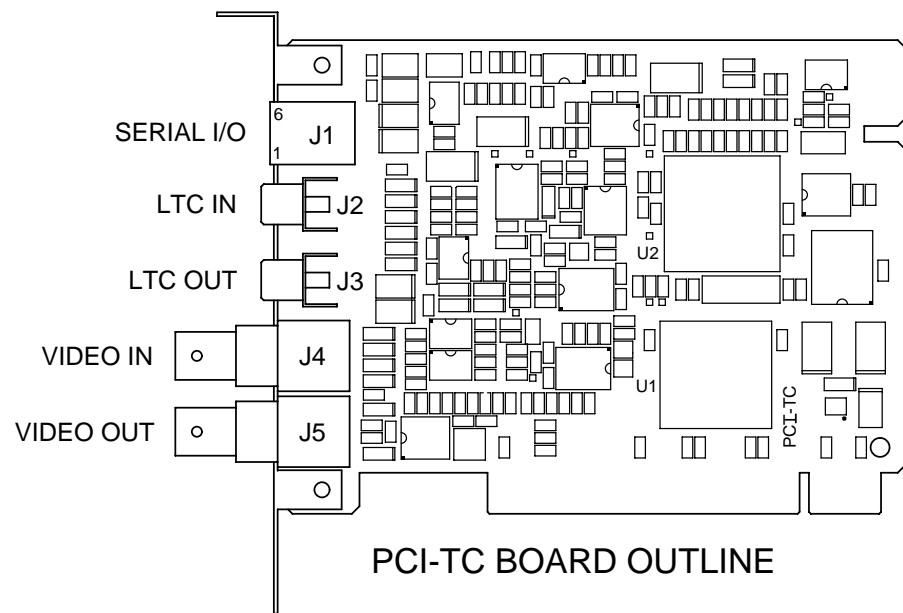
1) Turn off power to your computer.
2) Carefully remove the computer's cover (and save the screws).
3) Your PCI-TC board and your computer can both be easily damaged by electrostatic discharge (ESD). These are tiny sparks such as those you may see, hear, or feel on dry days when you scuff your feet on a carpet, for example. Electronic parts can be fatally weakened or destroyed by sparks so small that you cannot detect them. To avoid ESD problems, always discharge yourself before handling any electronic parts. For example, touch the chassis (metal parts) of a computer for about a second with your bare hand or finger(s) before touching anything inside.
4) Carefully remove the PCI-TC board from its pink shipping bag. Do not set the board down anywhere or plug it into a computer slot without first having touched that object with your other hand to eliminate possible ESD problems. Similarly, do not hand the PCI-TC board to any other person without first having touched that person with your other hand, and make sure that the other person strictly observes ESD handling procedures.
5) Decide which PCI slot inside the computer will receive the PCI-TC board. Any PCI slot will do (they are all the same). Remember that a 5.0V-only (1-notch) PCI-TC board cannot be installed into a 3.3V motherboard (a physical lockout tab keeps you from doing this by mistake). A universal 5.0V/3.3V (2-notch) PCI-TC board can be installed in either a 5.0V motherboard or a 3.3V motherboard.
6) If needed, remove the blank bracket held in place by a small bracket retainer screw. Be sure to save the screw for the next step.
7) Carefully plug the PCI-TC board into the PCI-bus slot which you have selected. Use firm but gentle pressure until it snaps into place. If you have to get a hammer (DON'T!), you may be attempting to install a 5.0V PCI-TC board into a 3.3V motherboard, and that simply will not work. You will have to order a new "Universal" PCI-TC board. Secure your board in place with the small screw which you should have saved from step #6. This little screw is VERY important.
8) Carefully install the computer's cover, and properly secure with screws.
9) Proceed to the next page to test your installation.

INSTALLATION
(continued)

Now that the physical installation described on the previous page is complete, you should verify that everything is OK by using the test/demo program located on the "PCI-TC Test/Demo/Support Disk". Insert this bootable diskette into your computer's "A:" drive (probably the only floppy drive in your computer), then turn on your computer. It will boot up using a DOS-like program which we designed. When prompted to do so, press the "1" key to select the test/demo program, wait a bit, then press the "1" key again to select the "normal test/demo program" (not diagnostics).

If you get some kind of error message when you do this, refer to the TROUBLESHOOTING section on page 26 for assistance. Otherwise the board is installed and working properly, and it is time to start installing software drivers and/or hooking up external cables and signal sources to the board, as described on the following pages.

Here is an outline drawing of a fully stuffed PCI-TC board. This will help you locate the various input and output connectors:

SERIAL I/O — J1

6
1

LTC IN — J2

LTC OUT — J3

VIDEO IN — J4

VIDEO OUT — J5

U2

U1

PCI-TC

PCI-TC BOARD OUTLINE

INSTALLATION
(continued)

SOFTWARE INSTALLATION:
If you have not already done so, run the PCI-TC board test/demo program (as described on the previous page) to make sure that your PCI-TC board is installed and working properly. There is no point to proceeding any further unless your board is operating exactly as it should. You will also quickly get acquainted with your PCI-TC board and see what it can do.

In some operating systems, such as the various editions of Windows by Microsoft, it is necessary to install "driver software" before your application program will work properly. Because most versions of Windows are incompatible with each other, a different software driver and driver installation procedure is often required for each version of Windows. On the PCI-TC test/demo/support diskette, just find the subdirectory which applies to your operating system and follow the instructions. In some cases a separate test/demo program is included to verify that the Windows (or other OS) driver has been installed properly.

After this step is completed, your application program may have further instructions. Because our boards are used in lots of different kinds of applications, most of which we have never seen before, you will have to refer to the documentation which came with your application software to see if any additional software installation work needs to be done.

The following pages tell you how to connect signals and cables to your PCI-TC board so that it can perform its intended tasks for you.

INSTALLATION
(continued)

RS232/RS422 SERIAL OPTION CONNECTIONS (J1):
Refer to the board outline drawing on page 6. J1 is the RS232/RS422 SERIAL option connector. It is a 6-position 6-conductor (6P6C) (square shaped) RJ-12 modular telephone jack connector. You can skip the rest of this section if your board does not have the SERIAL option installed.

For space reasons this connector has nonstandard RS232 and RS422 pinouts. We strongly suggest that you purchase the desired length cable and adapter from us. We don't make much profit on these cables, and we can deliver one which is already tested and guaranteed to work for you.

If you insist on building your own serial cable and 9D adapter, then modular telephone wire, plugs, crimping tools, and accessories are readily available at most electronic supply stores and are relatively inexpensive. Be sure to obtain 6-conductor cable, 6-position 6-conductor (6P6C) crimp connectors, and a crimping tool which can properly handle those items.

The pinout of this connector is as follows:

Pin 1	=> TX422-	(white wire)
Pin 2	=> TX422+	(black wire)
Pin 3	=> RX422- and RX232	(red wire)
Pin 4	=> RX422+	(green wire)
Pin 5	=> Chassis Ground	(yellow wire)
Pin 6	=> TX232	(blue wire)

Note that pin 6 is closest to the top of the board, and pin 1 is closest to the bottom of the board (the gold plated board edge connector). If you are viewing the serial port connector from the outside of the PC, pin 1 is closest to the board's other audio/video connector(s). Be sure to connect the transmit pin(s) on our PCI-TC board to the corresponding receive pin(s) on the other piece of equipment, and vice-versa. For your convenience, we have included details on how to wire RJ-12 to 9-pin "D" connector adapter modules for three different cases on the next page.

When crimping plugs onto the cables, we suggest that you follow our "wire color convention" and make sure that the blue wire will always connect to pin 6 on our board. This is a bit difficult to describe unambiguously, but if the modular cable is coming into the plug from the left, and if the plug's tab is facing you, then the blue wire should be on top.

INSTALLATION
(continued)

9-PIN RS232 ADAPTER MODULE WIRING
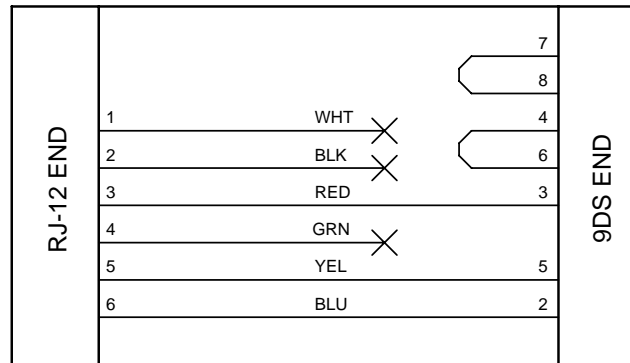
ESBUS CONTROLLER ADAPTER MODULE WIRING
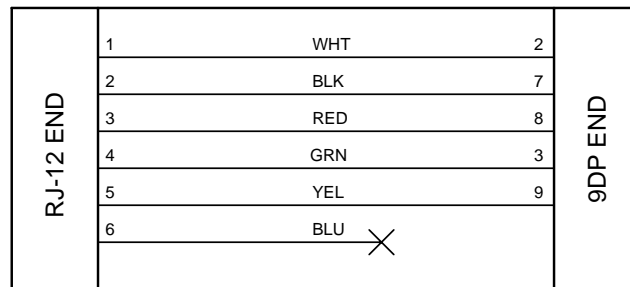
ESBUS TRIBUTARY ADAPTER MODULE WIRING

INSTALLATION
(continued)

LTC INPUT CONNECTION (J2):
Refer to the board outline on page 6. J2 is the LTC input connector. In most cases (if you look carefully) you can see the text "LTC IN" stamped onto the bracket next to this connector. If your PCI-TC board has the RS2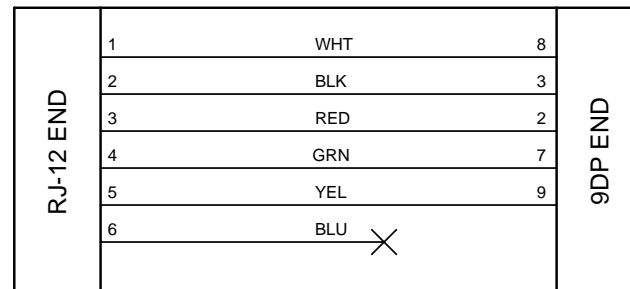32/RS422 SERIAL option installed, the LTC input connector will be adjacent to the 6P6C (square shaped) modular telephone jack connector (J1). The LTC input connector can be either an RCA jack (standard equipment), a Mini-XLR(m), or an isolated BNC(f). You can skip the rest of this section if your board does not have an LTC reader installed.

The LTC input is high impedance (20kohms typical). This differential input will reject at least 34dB of 50Hz or 60Hz hum. The input is designed to handle signals which have no more than $\pm1V$ of DC offset, and which have an amplitude of 100mVpp to 20Vpp. The maximum readable tape speed is 80x play speed. The minimum readable tape speed is tape machine dependent.

If you are using either an RCA plug or a BNC connector for the LTC input, be sure that the connector shield (outer conductor) does not contact the PCI-TC board bracket, the computer chassis, or any other connector shields. This is a differential audio input, and you normally do not want to ground the shield at the receiving end. You may choose to wrap black electrical tape around the connector body several times to make sure that such a short does not occur.

If you are using a Mini-XLR connector, refer to the EXTERNAL MINI-XLR CONNECTOR WIRING section of this manual (see page 14) for external connector wiring details. In this case you do not have to worry about accidentally grounding the connector shell.

Because LTC is a specialized type of audio signal, it may be present on any audio track. Some VTR's have a separate track dedicated to LTC, in which case you should connect the PCI-TC board's LTC input to the VTR's LTC output connector. If LTC is present on a normal audio track, keep in mind that audio channels are often muted (turned off) when the tape is operating at anything other than play speed, thus making your LTC track temporarily unreadable.

INSTALLATION
(continued)

LTC OUTPUT CONNECTION (J3):
Refer to the board outline on page 6. J3 is the LTC output connector. It is located in between the LTC input connector (J2) and the video input connector (J4). The LTC output connector can be either an RCA jack (standard equipment), a Mini-XLR(m), or a BNC(f). You can skip the rest of this section if your board does not have an LTC generator installed.

The LTC output is low impedance (100ohms typical). This is a single ended (unbalanced) output, even if you use a Mini-XLR connector. The output amplitude is about 1.5Vpp (approximately 0dBm), and nominally has zero DC offset. The LTC output waveform meets all EBU and SMPTE specifications. The rise and fall times of the output waveform are automatically adjusted depending on whether EBU or SMPTE LTC is being generated. For the case of FILM (24fps) LTC, the rise and fall times are the same as for the 25fps EBU case. The LTC output level is zero whenever the LTC generator's output is off.

The LTC output shield is connected directly to frame ground (the bracket), so you don't have to worry (as in the LTC input case) about the connector shield becoming accidentally grounded (because it is already grounded).

If you are using a Mini-XLR connector, refer to the EXTERNAL MINI-XLR CONNECTOR WIRING section of this manual (see page 14) for external connector wiring details.

Because LTC is a specialized type of audio signal, it can be recorded onto any audio track. Some VTR's have a separate track dedicated to LTC, in which case you should connect the PCI-TC board's LTC output to the VTR's LTC input connector. You can also record LTC onto a normal audio track, but keep in mind that there may be some crosstalk from the LTC track to other audio tracks (like between the left and right audio channels), and that audio channels are often muted (turned off) when the tape is operating at anything other than play speed, thus making your LTC track temporarily unreadable.

VIDEO/VITC/L21 INPUT CONNECTION (J4):
Refer to the board outline on page 6. BNC(f) connector J4 is the VIDEO/VITC/L21 input connector. For the remainder of this page, this connector will just be referred to as the VIDEO input, because L21 data and VITC data are specialized parts of the associated video signal. On some board models (if you look carefully) you should be able to see the text "VIDEO IN" stamped onto the bracket next to this connector. This input expects to see an NTSC or PAL or SECAM 1Vpp analog composite video signal. It should be connected to the VTR's "VIDEO OUT" connector or some other analog video source. You can skip the rest of this section if your board does not have a VIDEO input installed.

The VIDEO input is terminated internally with a 75ohm load, which cannot be removed. No external termination is necessary. This differential input will reject at least 60dB of common mode noise from 50Hz to 4MHz. The input is designed to handle signals which have no more than $\pm$1V of DC offset, and which have an amplitude of 0.65Vpp (the double terminated case) to 2.0Vpp. The speeds at which VITC data and L21 data can be read are highly dependent upon the type of tape machine and the video tape (video signal) quality.

For some board models, such as for PCI-LTC/RG1 boards, this input serves only as a video reference input. The LTC generator can synchronize itself to this video signal, so a standard "color black" reference signal is often a good choice. If any VITC or L21 data is present, it gets ignored.

For other board models, such as for PCI-21/RDR and PCI-VITC/RDR and PCI-VLTC/RDR boards, this input serves as the L21 data input and/or VITC data input in addition to being a video reference input.

This VIDEO input automatically adapts itself to whatever video standard (NTSC or PAL or SECAM) is present. No setup work needs to be done.

VIDEO/VITC/OSD OUTPUT CONNECTION (J5):
Refer to the board outline on page 6. BNC(f) connector J5 is the VIDEO/VITC/OSD output connector. For the remainder of this page, this connector will just be referred to as the VIDEO output, because VITC data and OSD characters (if present) are included in the associated video signal. If you look carefully you should be able to see the text "VIDEO OUT" (or just "OUT") stamped onto the bracket next to this connector. This output is designed for NTSC or PAL or SECAM 1Vpp analog composite video signals, and should look like a DC restored version of the video signal which you have supplied to the VIDEO input connector (J4). You can skip the rest of this section if your board does not have a VIDEO output installed.

The VIDEO output level is twice the VIDEO input level, so is nominally 2Vpp, source terminated in 75ohms. This will result in a standard 1Vpp video signal delivered into a standard 75ohm load. Leaving this output unterminated may lead to amplitude and phase distortion of the output signal. This output is protected against momentary shorts to ground. It is OK to leave this output floating if you will not be using it.

The VIDEO output connector shield is connected directly to frame ground (the bracket), so you don't have to worry (as in the VIDEO input case) about the connector shield becoming accidentally grounded (because it is already grounded).

For most board models, J5 serves as an active video loopthrough only. The output signal should look like a DC restored version of the input signal. The signal should be unaltered in every other respect. Please keep in mind that this is an active signal path, so this output gets turned off whenever the host computer is turned off (or the power fails).

For board models which have a VITC generator or the On-Screen Display (OSD) option installed, J5 acts in the same manner as before, except that VITC data and/or OSD information may be keyed onto the video signal. Portions of the original video signal are permanently replaced with the desired new information. Remember that this output still gets turned off whenever the host computer is turned off (or the power fails).

INSTALLATION
(continued)

<u>EXTERNAL MINI-XLR CONNECTOR WIRING:</u>
If your PCI-TC board has one or more optional Mini-XLR audio connectors installed, you should have received one mating connector for each on-board Mini-XLR connector received. The following steps explain how to properly install the mating connectors:

1) Unscrew the black plastic hood from the back of the connector, then slip it over the end of the audio cable you will be using. Make sure that the threaded end of the hood is closest to the end of the cable.
2) Pull the 4-fingered cable clamp assembly out of the Mini-XLR connector body, then slip it over the end of the audio cable. Make sure that the black plastic end of the cable clamp assembly is closest to the cable end.
3) Gently tap or push the pin block out of the Mini-XLR connector shell, then carefully fill each of the three solder cup pins with solder.
4) Being careful not to cut any of the soft copper conductors, prepare the end of your audio cable by cutting back the outer insulation and shield by 11mm (7/16”), then stripping the end of each wire back by 3mm (1/8”), then tinning the end of each wire. If this is to be an “LTC output” cable (from our board’s viewpoint), and you want to ground the cable shield at the signal source (i.e. our board), strip back the outer insulation to a total of 22mm (7/8”) from the cable’s end. This is usually not needed for LTC input cables.
5) Note the tiny pin numbers molded into the pin block face.
6) Sweat solder your ground wire to the pin 1 solder cup. Note that this pin is recessed slightly with respect to the other two pins (will always make the ground connection first).
7) Sweat solder your “LTC+” (red?) wire to the pin 2 solder cup (this is the pin farthest away from the flat side of the pin block).
8) Sweat solder your “LTC-” (black?) wire to the pin 3 solder cup (the only one left).
9) Push the pin block back into the Mini-XLR connector shell, then slide the cable clamp assembly firmly into place, then use pliers to clamp the four fingers around the cable (this keeps it from pulling out), optionally solder the four fingers to the cable shield (if this is an “LTC output” cable), then screw the black plastic hood onto the Mini-XLR connector.
10) Use a continuity tester to verify that everything is properly connected from end to end, and that there are no unintended shorts between any of the conductors (including the connector body).

SPECIFICATIONS (LTC)

<u>LTC INPUT:</u>

Connector Type:	RCA Jack (standard)
	Mini-XLR(m) (optional)
	Isolated BNC(f) (optional)
Impedance:	20kohms typical (differential)
Input Level:	100mVpp to 20Vpp
DC on Input:	±1.0V maximum
CMRR:	>34dB @ 50Hz and 60Hz
Speed Range:	1/30x to 80x play speed
	(signal quality dependent)
Bits Read:	All (time, user, and embedded)
Standards:	SMPTE and EBU and FILM
	(automatically selected)

<u>LTC OUTPUT:</u>

Connector Type:	RCA Jack (standard)
	Mini-XLR(m) (optional)
	BNC(f) (optional)
Impedance:	100ohms typical (unbalanced)
Output Level:	1.5Vpp typical (0dBm)
DC on Output:	±50mV maximum
Rise/Fall Times:	25us(SMPTE) or 50us(EBU and FILM)
	(typical, 10%-90%)
Bits Generated:	All time, user, embedded,
	and sync bits, with parity.
Standards:	SMPTE and EBU and FILM (selected
	by VIDEO or LTC reference or by software)
Freerun Error:	±0.004% (4 frames/hour)
	(after 5 minutes training)
Phasing Error:	±20us maximum
	(meets SMPTE/EBU specs)

Note that in the professional audio world, the units “dBm” are often used to indicate an audio level or signal amplitude. The 0dBm reference level is defined as the voltage required to deliver 1mW of power into a 600ohm load (a standard impedance in television audio). This corresponds to a voltage of 0.77Vrms (1.5Vpp for a square wave, 2.2Vpp for a sine wave).

SPECIFICATIONS (VIDEO)

VIDEO INPUT:
Connector Type: Isolated BNC(f)
Impedance: 75ohms (differential)
Input Level: 0.65Vpp to 2.0Vpp (1.0Vpp nominal)
DC on Input: ±1.0V maximum
CMRR: >60dB @ 50Hz to 4MHz
Video Standards: NTSC and PAL (or SECAM)
                         (automatically selected)

VIDEO OUTPUT:
Connector Type: Grounded Shield BNC(f)
Impedance: 75ohms (source terminated)
Gain Error: ±0.2dB maximum (when terminated)
DC on Output: ±50mV maximum (when terminated)
Frequency Response: +0.05dB/-0.25dB maximum, 0-4MHz

SPECIFICATIONS (SERIAL OPTION)

Connector Type: RJ-12 (6P6C) Modular Telephone Jack
                         (with custom pinout)
RS-232 Pins: Meet all RS-232
                         electrical specifications.
RS-422 Pins: Meet all RS-422
                         electrical specifications.

SPECIFICATIONS (OTHER)

POWER REQUIREMENTS:
(for a fully stuffed PCI-VLTC/RG1 board with SERIAL option):
+5V Supply: 66mA (330mW) typical
+3.3V Supply: No DC connection (bypass capacitors only)
+12V Supply: 71mA (850mW) typical
-12V Supply: 71mA (850mW) typical
Total Power: 2.0W typical
Actual power consumption depends upon the exact board type, signal levels, part tolerances, the external loads being driven, temperature, possible external short circuits, etc.. For example, the total power required for a PCI-LTC/RDR board is only 0.5W typical.

MISCELLANEOUS:
Operating Temperature: 0-50 degrees Celsius
                         (32-122 degrees Fahrenheit)
Operating Humidity: 0-95%, noncondensing
Board Dimensions: 95mm (3.75") high x 125mm (4.90") deep
Board Weight: 86 grams (0.19 pounds)
PCI Board Type: 32-bit, 33MHz, 5.0V (original board) or
                         5.0V/3.3V (universal board) signaling.

RELIABILITY:
MTBF (mean time before failure) is approximately 450 years, based on actual product return rates to date. Our previous generation of time code boards (for the ISA bus) had an actual MTBF, as measured over thousands of boards and 10 years of experience, of about 800 years. The PCI boards are new for us, so calculating MTBF numbers is a bit of a guess, but we expect them to eventually be more reliable than the ISA boards because there are fewer interconnects, and all components run very cool. Only time will tell for sure. In either case, the numbers quoted here are based on actual product return rates (for repairs), and are well in excess of the expected useful product lifetime.

DISCLAIMER:
All specifications are subject to change without notice as the product evolves.   Our legal advisor made us say this too.

VITC READER OPERATIONS

PCI-TC boards use proprietary hardware and software to read VITC from the signal present at "VIDEO IN" connector J4. Depending on the VITC signal quality, which varies greatly from one tape machine to the next, our PCI-TC boards can read VITC at tape speeds from -10x to +10x play speed, including step frame and still frame situations.

The VIDEO input signal is first passed through a differential amplifier and a DC restorer to remove DC offsets, high frequency noise, and common mode noise. The cleaned up VIDEO input signal can be viewed at the 2Vpp "DCRVID" test point on the board. This signal is then passed through a low pass filter and an analog comparator to convert the analog waveform into a digital signal, which can be viewed at the "DATA" test point on the board. The digitized VITC input signal is then analyzed using a combination of hardware and software to extract the desired time bits, user bits, and embedded bits information.

The VIDEO input automatically adapts itself to whatever video standard (NTSC or PAL or SECAM) and VITC time code standard (SMPTE or EBU) is present. No setup work needs to be done.

If you are having trouble reading VITC, first try the bootable test/demo program on the PCI-TC diskette. Be sure the cable and connectors you are using are of good quality and are wired correctly. Use a continuity tester if necessary to check them out. Connect one end of the cable to the VIDEO input on your PCI-TC board (J4), as described in the INSTALLATION section of this manual. Connect the other end of the cable to the "VIDEO OUT" connector on the VTR (or other signal source).

VITC data is normally recorded on two nonadjacent lines in the vertical interval of a video signal. Lines 10-20 are used with NTSC/SMPTE, and lines 6-22 are used with PAL/EBU. Normally the PCI-TC board will automatically select the first two lines it sees which have VITC on them. You may override this feature by writing or using custom software which tells the board which two lines to read. This is necessary in cases where there are two sets of VITC in the vertical interval, or when other VITC-like signals are present in the vertical interval and are confusing our board software. The "PCI-TC Board Reference Manual" explains how to do this.

VITC READER OPERATIONS
(continued)

The PCI-TC board can read VITC from most tape machines at speeds ranging from -1x to STILL to +3x play speed. At other than play speed, some VTR's destroy portions of vertical interval signals. Since our software has been written to ignore bad video signals, the results may not be entirely satisfactory. Please call us if the board works fine at play speed, but will not read VITC under any other conditions. A board software modification may be in order.

Most tape machines, when outputting video at other than play speed, will cause wide streaks (dark lines) to appear on the video picture. These streaks, if they happen to go through the vertical interval area, will make the VITC data unreadable. If at STILL or PAUSE, you may have to jog the tape slightly until the VITC is OK (not in a streak). If the tape is moving, VITC can usually be read OK. In general, the more streaks you see, the smaller are your chances of reading VITC reliably.

Ideally, the tops of the VITC pulses should be near +80 IRE (0.57V), and the bottoms of VITC pulses should be near +0 IRE (0.00V). Also, the horizontal and vertical sync tips should be near -40 IRE (-0.28V).

If the video signal which is carrying VITC has been low pass filtered below 4MHz, the VITC signal may become attenuated and/or distorted to the point where it is unusable, even though the sync still looks OK. This is often a problem with the VHS tape format, which usually works OK at play speed with first generation ("original") tapes, but which quickly becomes unusable if you have copied one VHS tape to another, for example.

Refer to the "PCI-TC Board Reference Manual" if you need technical information on register mapping, VITC line number selection, how to read time code from the board, etc..

LTC READER OPERATIONS

PCI-TC boards use proprietary hardware and software to read LTC from the signal present at connector J2. As described in the INSTALLATION section of this manual, the LTC input connector can be either an RCA jack (standard equipment), a Mini-XLR(m) connector, or an isolated BNC(f) connector. Depending on the LTC signal quality, which varies from one tape machine to the next, our PCI-TC boards can read LTC at tape speeds from 1/30x to 80x play speed. With most VTR outputs, reading LTC at tape speeds which are below 1/5x play speed is doubtful.

The LTC input signal is first passed through a differential amplifier and a band pass filter to remove DC offsets, high frequency noise, and common mode noise. The cleaned up LTC input signal can be viewed at the "LTC1" test point on the board. This signal is then passed through a window comparator to convert the analog waveform into a digital signal, which can be viewed at the "LTC2" test point on the board. The window comparator has a threshold which increases as the LTC signal amplitude increases, thus providing very good noise rejection for normal amplitude (1Vpp to 2Vpp) LTC input signals. The digitized LTC input signal is then analyzed using a combination of hardware and software to extract the desired time bits, user bits, and embedded bits information.

Because the SMPTE and EBU and FILM longitudinal time codes are so similar, the PCI-TC board will read any of these LTC formats interchangeably. No setup work needs to be done.

If you are having trouble reading LTC, first try the bootable test/demo program on the PCI-TC diskette. Be sure the cable and connectors you are using are of good quality and are wired correctly. Use a continuity tester if necessary to check them out. Connect one end of the cable to J2, the LTC input on your PCI-TC board, as described in the INSTALLA-TION section of this manual. Connect the other end of the cable to the "LTC OUTPUT" of the signal source. Because LTC is a specialized type of audio signal, and can thus be recorded onto any audio channel, you may have to experiment around to find out which channel has LTC on it.

Refer to the "PCI-TC Board Reference Manual" if you need technical information on register mapping, how to read time code from the board, etc..

AUTO TC READER OPERATIONS

Many PCI-TC board models are capable of reading both LTC and VITC simultaneously. The PCI-VLTC/RDR board is a good example.

Normally it is assumed that the LTC data and VITC data match each other on a frame by frame basis at play speed. Whenever it is in "Auto LTC/VITC Reader Mode", the PCI-TC board automatically selects either LTC data or VITC data to be placed into the "selected reader" area of its memory. This data area, which is exactly the same data area used by the LTC reader mode and the VITC reader mode, can then be easily read by application programs in the usual manner.

The type of time code (LTC vs. VITC) which is currently "selected" is that which "looks best" to the board's hardware and software. If the board is currently using LTC data, then that data disappears, the board will switch over to reading VITC data within a fraction of a second. If neither LTC nor VITC data is present, the board will continuously switch back and forth between the two choices until it finds a valid time code signal again.

The best way to see how the "Auto LTC/VITC Reader Mode" works is to boot up your computer using the PCI-TC test/demo/support diskette, start the test/demo program, then select "Auto LTC/VITC Reader Mode". A little status box tells you whether LTC or VITC data is currently selected. You can alternately disconnect and reconnect the LTC and VITC cables (or leave both disconnected temporarily) and see how the board responds. The algorithm used by the PCI-TC board was chosen to work well in most situations. Your application may require something a little bit different, in which case you will have to write or use some custom software to achieve the desired result.

There are some applications where the LTC data and VITC data contain two completely different sets of time code information. The board can handle this with no problem, but you will have to write or use custom software which tells the board which set of time code data is to be currently "selected", and which set of time code data is to be located in a separate area (reserved for this purpose) of the PCI-TC board's memory.

Refer to the "PCI-TC Board Reference Manual" if you need technical information on register mapping, how to read time code from the board, how to read two different time codes simultaneously, etc..

L21 READER OPERATIONS

NTSC line 21 (L21) data was initially developed for closed captioning purposes, but has recently been expanded to include time of day information (for setting VCR clocks automatically), V-chip information, and other low speed data services. Only two bytes of data are transmitted each video field. The signal is similar to VITC, but is lower amplitude, lower speed, and is always encoded onto NTSC line number 21.

Most television sets manufactured today have built-in closed caption display units. If you want to see what the closed caption data looks like, just enable the closed caption (CC) display on your TV set. Alternatively you may choose to try out the "Line 21 Data Reader" demo program on the PCI-TC test/demo diskette. If the test/demo program does not give you the option of accessing the L21 reader, then your board does not have the L21 reader installed. If this is something you really need, and if your board already has a VITC reader installed, then the L21 reader be added in the field (for a fee) via a simple software update. If your board does not already have a VITC reader installed, then the L21 reader cannot be added to your board, even if you return it to the factory. You will have to order a new board which already has the L21 reader hardware installed.

The L21 reader test/demo program uses the computer monitor to display a crude (monochrome block character) version of what you could expect to see on a regular television set. If the incoming video signal is weak and/or noisy, you may occasionally see some weird things happening on the screen. Words may be spelled incorrectly, characters may be missing, or captions may stay on the screen even after the video scene changes. You will see the same things happen on a normal television closed caption display. This is usually due to either sloppy captioning or data transmission errors. Nothing is wrong with your PCI-TC board. The L21 test/demo program does not display any of the advanced NTSC line 21 data services. It is only intended to verify that the board and signal source are both working properly.

There is a full screen of "help" information available within the Line 21 data reader demo program (on the diskette). This will hopefully answer any questions you may have regarding L21 operations. Software programming information is available in the PCI-TC reference manual. The line 21 data format is defined by other agencies, and is complicated and poorly documented in many respects. Good luck.

LTC GENERATOR OPERATIONS

The LTC generator output signal appears at connector J3. The LTC generator can be freerunning, or synchronized to the LTC reference signal at J2, or synchronized to the VIDEO reference signal at J4. With the exception of some generator-only boards, your PCI-TC board will power up with the generator(s) turned off, and you will have to run an application program or the test/demo program (on the diskette) to get it running.

The generator always remembers what mode it was in when power was turned off, and powers back up in the same mode. Thus if you were generating EBU (25fps) LTC when the power was turned off, the board will come back up in EBU mode even if the EBU reference signal (LTC or VIDEO) is no longer present. If a VIDEO reference signal changes from PAL to NTSC, for example, the board will automatically switch over to SMPTE mode. It works the other way around too, and with 24fps LTC.

The best way to see how the LTC generator works is to fire up the test/demo program (on the diskette) and select LTC generator mode. You will be able to set the time bits, the user bits, start and stop the generator, and select a sync source. Pressing the "?" key pulls up a full page LTC generator help screen which explains how to select the different sync options. If you have no sync source, and the board is generating LTC at the wrong rate for what you want to do, you can perform an "LTC standards change" via the main test/demo program menu. It is self explanatory.

The LTC generator is "smart" in that it continuously adjusts its output frequency to stay in phase with the selected LTC or VIDEO reference signal. After a 5 minute initial "learning" period, if the LTC or VIDEO reference disappears, the LTC generator will continue generating LTC with a maximum frequency error of ±0.004% (4 frames/hour). This figure assumes that the board's operating temperature and voltage remain fairly stable, and gives TV station operators (for example) plenty of time to get the reference signal hooked back up before the LTC generator's frequency drift becomes noticeable. The board remembers this calibration data even when the power is turned off, and maintains separate constants for SMPTE, EBU, and FILM, using both LTC and VIDEO references.

If the PCI-TC board is in LTC/VITC generator mode, only the VIDEO reference will be allowed, because VITC always syncs to VIDEO. Also, the LTC and VITC generators always use the exact same time code data.

VITC GENERATOR OPERATIONS

The VITC generator output signal appears at connector J5, as part of the VIDEO output signal. The VITC generator is, by definition, always synchronized to the VIDEO reference signal at J4. With the exception of some generator-only boards, your PCI-TC board will power up with the generator(s) turned off, and you will have to run an application program or the test/demo program (on the diskette) to get it running.

The generator always remembers what mode it was in when power was turned off, and powers back up in the same mode. Thus if you were generating EBU (25fps) VITC when the power was turned off, the board will come back up in EBU mode even if the PAL VIDEO reference signal is no longer present. This statement is somewhat academic, because if there is no VIDEO reference signal, there will be no VITC (and VIDEO) output from the board, but the internal clock keeps running correctly. If the VIDEO reference signal changes from PAL to NTSC, for example, the board will automatically switch over to SMPTE VITC mode, and vice-versa.

The best way to see how the VITC generator works is to fire up the test/demo program (on the diskette) and select VITC generator mode. You will be able to set the time bits, the user bits, and start and stop the generator. The VIDEO reference status is also displayed. By default, VITC is placed onto video lines 12 and 14 for all video standards. You may override this default setting by writing or using custom software.

The VITC generator is "smart" in that it continuously adjusts its internal clock to stay in phase with the VIDEO reference signal. After a 5 minute initial "learning" period, if the VIDEO reference disappears, the VITC generator will continue running (internally) with a maximum frequency error of $\pm0.004\%$ (4 frames/hour). This figure assumes that the board's operating temperature and voltage remain fairly stable, and gives TV station operators (for example) plenty of time to get the VIDEO reference signal hooked back up before the VITC generator's frequency drift becomes noticeable. The board remembers this calibration data even when the power is turned off, and maintains separate constants for NTSC(SMPTE) and PAL(EBU).

Refer to the "PCI-TC Board Reference Manual" if you need technical information on register mapping, how to control the time code generator, how to set the VITC generator line numbers, how to read time code generator data from the board, etc..

OSD OPERATIONS

In most cases you will be using an application program which controls the optional On-Screen Display (OSD) for you. Alternatively, you may wish to use the PCI-TC test/demo program (on the diskette) to play around with the OSD controls and see what it can do. If the test/demo program does not give you the option of accessing the OSD, then your board does not have the OSD option installed. If this is something you really need, and if your board already has a VITC generator installed, then the OSD option can be added in the field (for a fee) via a simple software update. If your board does not already have a VITC generator installed, then the OSD option cannot be added to your board, even if you return it to the factory. You will have to order a new board which already has the OSD hardware installed.

The OSD hardware keys the selected time bits <u>or</u> user bits data onto the visible portion of the video signal (it will appear on your video monitor). This display becomes a permanent part of the video signal. It cannot be removed later. The OSD time code information cannot be read by any time code readers that we know of (that would require expensive image recognition hardware and software).

The OSD can display either time code reader data or time code generator data. For each data source, you can also select whether time bits or user bits are to be displayed. You will need two (or more) boards to display two (or more) data fields simultaneously. For example, it would take two boards to display time bits and user bits simultaneously.

The display can be positioned anywhere (horizontally and vertically) on the screen. There are two character sizes available (large and small). Several character "colors" and background "colors" are available. Just experiment around until you find something which works well for your particular application. Note that displaying white characters on a white background (for example) just results in a big white rectangular box. The characters are still there, but you cannot distinguish them from the background. This combination could be used to cover up something.

There is a full screen of "help" information available within the OSD demo program (on the diskette). This will hopefully answer any questions you may have regarding OSD operations. Software programming information is available in the "PCI-TC Board Reference Manual".

TROUBLESHOOTING

The first step to take if you think that your PCI-TC board is not working properly is to run the bootable test/demo program which is on the diskette which came with your board. If your PCI-TC diskette has been misplaced, or if for some reason you never received one in the first place, we can e-mail you a short program which will overwrite one of your own 1.44MB diskettes to be a PCI-TC test/demo diskette.

To run the test/demo program, just place the PCI-TC diskette into your computer's "A:" drive (probably the only floppy drive in your computer), then turn on or reset your computer. The computer will boot up using a DOS-like program which we designed. When prompted to do so, press the "1" key to select the test/demo program, wait a bit, then press the "1" key again to select the "normal test/demo program" (not diagnostics).

The test/demo program will let both you and us know quickly if your board is installed and working properly inside your PC. It will say "no PCI-TC board found" or some other error message if there is something wrong with your PC or your PCI-TC board. If you do get an error message, turn off your computer's power, remove the top cover, remove the board from the PC, gently clean its gold plated edge connector contacts with a soft eraser, then plug the board back into the same slot (or better yet, a different slot). If you still get an error message, the board will probably have to be returned to the factory for repair(s). Very rarely does this happen.

Assuming that the board is working properly, you will be presented with a menu listing the available demo programs for your type of board. For example, a PCI-VLTC/RDR board has an LTC reader demo, a VITC reader demo, and an automatic LTC/VITC reader demo. The more your board is capable of doing, the more menu choices you will have. Just experiment around and make sure that everything is working OK. If you select the LTC reader demo, for example, and no LTC is being read, that could mean that the PCI-TC board's LTC input has stopped working, but that is a rare occurrence. It is much more likely that the LTC source is not working, or that a cable or connector has gone bad, or that the external LTC input connector has been wired improperly. Similar comments apply to the other board connector(s). PCI-TC boards cannot generate video signals, so if there is no video coming out of the board, perhaps it is because there is no video going into the board in the first place. Please check everything out very carefully, because historically over 90% of boards returned to us for repair have absolutely nothing wrong with them.

TROUBLESHOOTING
(continued)

If you are having trouble getting good results with one or more aspects of the demo program, refer to the corresponding section(s) of this manual. For example, if you are having trouble getting the LTC reader to work, refer to the "INSTALLATION" and "LTC READER OPERATIONS" sections of this manual. In this particular case, a mini-XLR connector could be wired incorrectly, or the LTC cable may be connected to the wrong place on a VCR, or the cable may be broken/intermittent, or there may be no LTC on the tape, or the tape speed may be too low. We can sometimes help you with such problems over the phone, but more than 90% of the time the problems are external to our board, and we cannot see what's going on via a telephone link. Please triple check everything on your end before giving us a call.

If everything is working fine with the test/demo program (on the diskette), but you cannot get your application program to work properly, at least you know by now that the board itself is OK, and that the external signal sources and cables are OK.

In some operating systems, such as the various editions of Windows by Microsoft, it is necessary to install "driver software" before your application program will work properly. This is a specialized software program which ties together your PCI-TC board, your application program, and your particular version of Windows. Because most versions of Windows are incompatible with each other, a different software driver and driver installation procedure is often required for each version of Windows. We cannot list all of the possibilities in this manual, because there are lots of differences, and they keep changing every year or two. You will need to refer to the PCI-TC test/demo/support diskette instead. It includes drivers and instructions for each supported operating system, and usually includes a separate test/demo program to verify that the Windows (or other OS) driver has been installed properly. Just find the subdirectory which applies to your operating system and follow the instructions.

Our PCI-TC boards are used in hundreds of different applications, and we have no control over and probably no experience with your particular application. If you have tried everything mentioned above, and your board is working fine, but your application still doesn't work properly, please contact the people who sold you the application program for assistance.

IN-SYSTEM SOFTWARE UPDATES

One very nice feature of our PCI-TC boards is that they can be updated in the field without having to take your computer apart. These updates can be used to fix software bugs, to add new features, or to upgrade your board to be a more expensive (but hardware compatible) model (for a fee of course). If you have just received a brand new board, you can ignore this page, because all boards are shipped from the factory fully tested and with the latest software already installed.

You will need the bootable test/demo/support diskette which came with your board. If the diskette has been misplaced, or if for some reason you never received one in the first place, we can e-mail you a short program which will overwrite one of your own 1.44MB diskettes to be a PCI-TC test/demo diskette.

Assuming that you have the PCI-TC bootable test/demo diskette in hand, put it into your computer's "A:" drive (probably the only floppy drive in your computer), then turn on or reset your computer. The computer will boot up using a DOS-like program which we designed. When prompted to do so, press the "1" key to select the test/demo program.

Once the PCI-TC board test/demo program is running, select "other diagnostic routines", then select "get software ID". Write down the 16-digit software ID code and send it to us along with an indication of who you are, how we can get ahold of you, why you need a software update, your board model number(s), and so forth. If you need to update more than one PCI-TC board, you will have to get the software ID code from each board and also remember which board has which ID code. This is very important, because each update file usually only works with one particular board.

We will e-mail you a file called "PCITCUPD.COM". Copy this file to your PCI-TC board test/demo/support diskette (you will probably have to temporarily disable the diskette's write protection to do this), close down your operating system if necessary, then reset your computer. Your computer will boot up using the diskette, just as before. Press the "2" key to select the software update mode. You will be guided through the update process automatically. Normally it takes less than 1 minute to do this. Assuming that the update is successful, remove the diskette and reboot (reset) your computer. It should now operate normally, but with better software in your PCI-TC board. Let us know if you encounter any problems.

REPAIR PROCEDURES

Please contact us before returning any PCI-TC board for repair purposes, because historically over 90% of boards returned have absolutely nothing wrong with them, and a lot of time and money gets wasted in the process. We will attempt to get you back on line via telephone or e-mail support, because that is the least expensive and fastest method. If for some reason that does not work, we will let you know where to return the board to.

There is essentially nothing on a PCI-TC board which can be repaired in the field. Very special parts, knowledge, repair equipment, and test equipment are required. We do not make any money on repair jobs. If the board is still under warranty, and hasn't been abused, the repair and re-test will cost you nothing except one-way shipping. If the board is out of warranty, we will let you know ahead of time what the repair cost will be.

You are always responsible for the full cost of shipping the board back to us, well packaged and insured. We will evaluate, repair if necessary, test, and will usually return the board within 1-2 days of receipt. We pay for shipping back to you, via a method comparable to what you used to get the board to us in the first place. If you send us a board via overnight courier, we will normally return it via overnight courier. If you send us a board via ground service, we will return the board via ground service.

It is very important that you include enough documentation with the board so that we know who you are, what's wrong with the board, where to return it to, a phone number in case we have any questions, and so forth.

WARRANTY

For the first two(2) years following the shipment of an AEC product, we will repair or replace, at our option, any such product which is found to be inoperative due to defects in materials or workmanship. Not covered is damage due to unusual electrical and/or physical abuse. Altered hardware, software, labels, or other identifying marks may also void the warranty.

EMI COMPATIBILITY

The PCI-TC board family has been tested by an independent certified testing agency and found to meet all FCC and CE-Mark requirements, including electromagnetic emissions, electromagnetic immunity, ESD protection, fast transient protection, and so forth. Do not attempt to shock the PCI-TC board to see if it survives, because these tests only apply to external connector pins after the board is securely fastened into its host PC, and such tests could shorten the useful lifetime of your PCI-TC board.

FCC NOTICE

This equipment has been tested and found to comply with the limits for a "Class A" digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a COMMERCIAL environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed in accordance with this manual, could cause harmful interference to radio communications. Operation of this equipment in a residential area could cause harmful interference, in which case the user will be required to correct the interference at his or her own expense.

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DECLARATION OF CONFORMITY

Here is all of the "CE-Mark" information, which is required for equipment being used in European Union (EU) countries. Application of Council Directive 89/336/EEC. Standards to which conformity is declared are EN55022 Class A; EN61000-3-2; EN61000-3-3; EN55024:1998; EN61000-4-2; EN61000-4-3; EN61000-4-4; EN61000-4-5; EN61000-4-6; EN61000-4-8; and EN61000-4-11. Equipment description is "PC Plug-In Board". Equipment class is "ITE Class A". Model number is "PCI-TC". Manufacturer is Adrienne Electronics Corporation, whose address and other contact information is on the inside back cover of this manual.