

Aculab E1/T1 PCI card

Installation guide

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Document Revision

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2.2.5	Dec 2005	DJL	Further H.100 usage clarification added
2.2.6	11.07.06	DJL	Change to Australia approvals certificate holder reference

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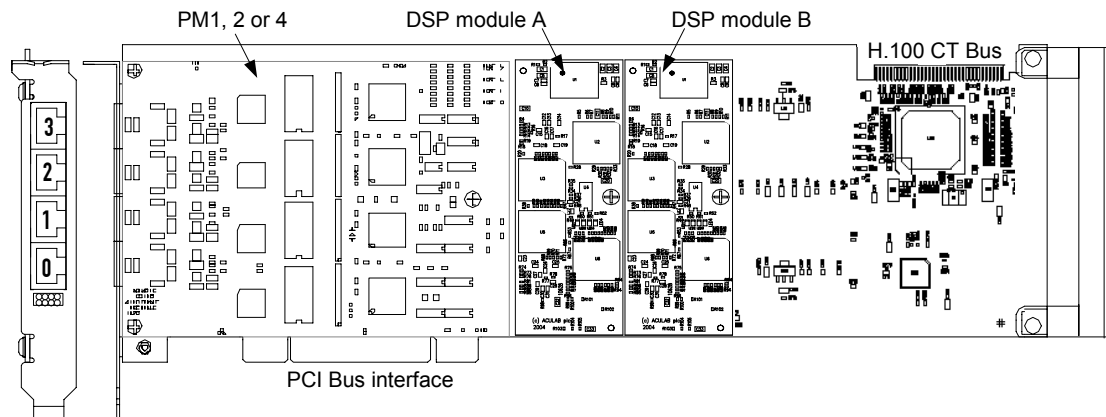
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1 Introduction

This introductory section of this document provides a general description of the E1/T1 PCI card, its features and facilities.

1.1 General

This document is the installation and user guide for the Aculab E1/T1 PCI card. There are three variants of the E1/T1 PCI card, with one (PM1), two (PM2) or four (PM4) Primary Rate Line Interfaces (ports) on an interchangeable Line Interface Module (LIM). Up to two optional signalling DSP modules can be added when additional resources are needed, for example, to support CAS protocols, DTMF and call progress tones, etc.



The Aculab E1/T1 PCI card shown with line interface unit (LIM) and optional digital signal processor (DSP) modules

This product is referred to as the 'E1/T1 PCI card' in this document unless the context requires a more specific term.

The serial number of the E1/T1 PCI card is used when configuring the device driver to uniquely identify the E1/T1 PCI card in the system. The serial number of the card is located on the reverse of the card (no components) on the top edge and has the format P/N ACXXXX S/N XXXX WONXXX. Only the 'number' following S/N is used during driver configuration, the other numbers are for Aculab use.

DSPs

When using the DSP 65 for tone based CAS protocols, the following DSP firmware file needs to be downloaded to the DSP65:

acasa.b65 for a-law
 acasu.b65 for u-law

For all other functions, such as with tone detection, the file name suffix denotes the firmware file to be used. For example:

cpdtmfu.b65 for u-law tone detection on a DSP65

See the Aculab Call switch and speech driver guide for further details on using the DSP resources.

The **Card Installation & Connection** section refers to installation of the E1/T1 PCI card into a host computer, hardware control and configuration information, and subsequent connection to the network.

The **Approval Information** section, in conjunction with the country-specific appendices, gives the conditions of the Approval for connection to the telephone network, requirements for installation and safety, and other regulatory matters. This section and the appropriate country-specific appendices contain statements regarding the use of the E1/T1 PCI card that are legal requirements for connection to the public network. Failure to use the E1/T1 PCI card in accordance with any of these instructions for use may invalidate the approval for connection.

Call and Switch control functions are provided via one of several device drivers that are described in separate specific publications.

The card is not a complete product, and only has usable functionality when associated with a host computer and an application program.

These instructions for use assume that these various elements are being assembled and integrated by someone competent in such matters. Please contact Aculab support if you are unsure of any issues arising from the use of the Aculab PCI card. Contact details may be found on the company web site at www.aculab.com

1.2 Uses of the E1/T1 PCI card

The E1/T1 PCI card is a plug-in card suitable for use in many different types of PCI compatible computer. Up to four E1/T1 primary rate ports are installed on a plug-in Line Interface Module (LIM) providing a means of connection to a digital telephone network. The four port LIM is referred to as the PM4 (Primary rate Module 4 port), the two port LIM is referred to as the PM2 and the single port LIM is referred to as the PM1.

The E1/T1 PCI card provides an ECTF H.100 CTBus port that allows interconnection with a very wide range of third-party products. The E1/T1 PCI card contains a digital switch matrix that allows arbitrarily switched interconnection between up to 120 channels on the E1-network or 92 channels on the T1-network or 4096 speech paths (timeslots or channels) on the H.100 CTBus.

Control of the E1/T1 PCI card is via a low-level interface ported to the PCI bus. The card is essentially operating system independent, and may be used in a Windows NT/2000, Linux, or indeed any other operating system environment using a suitable device driver. Please contact Aculab plc for information on current device driver availability.

1.3 Telephone Network Attachment

Each port on an Aculab E1/T1 cPCI card, fitted with revision 2 E1/T1 PM 4 line interface modules, attaches to either an E1 (2Mbit) or T1 (1.544Mbit) digital system. It is available with 4 or 8 primary rate ports and subject to each port configuration may make or receive between 92 and 240 separate calls at a time. Each individual ports driver is software configurable for either T1 or E1 (75 or 120 Ohms).

An E1 port attaches to the 2Mbit digital system or Primary Rate (2.048 Mbit/s) Integrated Services Digital Network (ISDN). Network attachment is via a service provision often used to connect digital PBXs to the telephone network (NT1). Each E1 primary rate ISDN ports may make or receive 30 separate calls at a time.

A T1 port attaches to the 1.544Mbit digital system via a Channel Service Unit (FCC, IC or UL Listed CSU). Each T1 ports may make or receive 23/24* separate calls at a time.

** T1 capacity is signalling system dependent.*

CAUTION When making a network connection, to reduce the risk of fire, only telecommunications line cord of 26 AWG or larger may be used.

Please refer to the **Country Specific Information** appendices for more details of the various international connections.

1.4 Call Control

Processors on the PM Line Interface Module daughter-card (one processor per E1/T1 port) control all of the call signalling (set-up, acceptance, clearing, etc.) in response to commands from an application program running on the host computer.

The call control interface to the PM Line Interface Module is at a low level (in signalling terms), and this provides maximum information and control over the various stages of call progress. This interface is accessed via a device driver that has been prepared for the operating system in use. The PM Line Interface Module processor checks each outgoing message provided by the application program for syntax, validity of content and context. If errors are found, the call is automatically cleared. The software on the PM Line Interface Module therefore forms an effective barrier between the application program and the telephone network, and protects the network from incorrect call signalling.

Several elements of call signalling related information are available to the application program, although in some cases this depends upon provision by the Public Switched Telephone Network (PSTN) of this information along with each call. One such information element is the number used by the caller on calling into the card, (the DDI number); this is only available when the service obtained from the PSTN is of the appropriate type. Another such information element, which may be available, according to the protocol and PSTN, is Calling Line Identity (CLI), which on incoming calls makes the telephone number of the calling party available to the application program.

Full details on the control of calls using the E1/T1 PCI card are available in a separate publication, the **Aculab Call Control API Guide**. This guide can be downloaded from the company web site at www.aculab.com

1.5 Speech and Data Paths

Speech and data associated with telephone calls are not terminated on the card, but are always switched without modification to other cards, or on-board modules, for processing. The card maintains bit integrity within timeslots between ports on the card. The card is configured to operate with one of these expansion bus types; simultaneous use of multiple expansion bus types is not currently supported.

There are three broad categories of Multi-channel path provided by the card;

1. E1 (G703) ports – 30, 60 or 120 calls (2Mbit system or ISDN)
or
2. T1 (G703) ports - 23/24, 46/48 or 92/96 calls (1.554Mbit T1 system or T1 PRI)
3. The H.100 CTBus

Additionally, any one source of speech or data may be distributed to a number of separate sinks, but it is not possible via switching on the card alone for more than one source to feed a single sink. This conferencing function is only possible with the use of extra processing power of Aculab Signalling DSP modules or with third party conferencing cards.

Full details on the switching of calls using the E1/T1 PCI card are available in a separate publication, the **Aculab Switch Control API Guide**. This guide can be downloaded from the company web site at www.aculab.com

1.6 H.100 CTBus termination

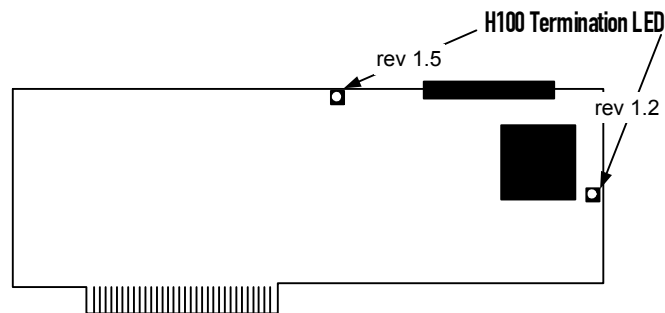
The E1/T1 PCI card can occupy any position in a 'chain' of H.100 CTBus devices interconnected with a suitable ribbon cable.

The H.100 CTBus ribbon cable may consist of no more than 20 connectors, with a typical distance between each connector of one inch, and a maximum bus cable length of 20 inches (including connector terminations).

In addition, in order to assure that the interleaved grounds on the ribbon cable act as effective grounds, The distance between populated CTBus cards should be as short as possible and **MUST BE** less than 7 inches. It is also recommended that the ribbon cable be no longer than required to interconnect the chain of H.100 CTBus devices.

If the E1/T1 PCI card is the first or last device, at either end of a 'chain' then the termination function (-ht) of the device driver configuration switches must be set. See the '**Aculab Call, Switch & Speech Driver Installation Guide**'. If the E1/T1 PCI card is in the middle of a 'chain' of H.100 CTBus devices, then the termination function is not used.

See the following diagram for the position of the H.100 CTBus termination indicator LED. The LED is on when ever the card is terminated and as such can be used to identify the terminated cards in a system. For easier visibility, the LED is located on the top edge of the card on hardware revisions 1.5 and later.



1.7 H.100 CTBus loading

The E1/T1 PCI card has a loading factor of 1 on the H.100 CTBus. The maximum loading allowed on the H.100 CTBus is 20. The total loading is calculated by adding the loading factor of all the devices on a single H.100 CTBus. The loading limit of H.100 means that no more than 20 E1/T1 PCI cards can be used in the same host.

1.8 E1/T1 PCI card - Host Interface

A device driver program, running on the host computer, controls the behaviour of the E1/T1 PCI card.

The driver accesses the card via a control space within an area of shared RAM. This shared area is a block of memory physically resident on the card that appears as a normal area of memory in the memory map of the host computer.

For information on device driver installation and configuration, please refer to the Aculab publication '**Call, Switch and Speech Driver Installation Guide**'. This guide can be downloaded from <http://www.aculab.com>

2 Card Installation

2.1 Installing the Card

The installation procedure for expansion cards will vary from one type of host computer to another, and the exact details of the installation procedures for expansion cards must be sought in the user guide supplied by the host computer manufacturer. However, in general:

- Do not attempt to install or remove the E1/T1 PCI card unless the mains power supply is completely removed from the host computer and any network ports are disconnected from the network.
- To ensure safety, any covers removed from the host computer in order to install the E1/T1 PCI card must be replaced before the mains power supply is reconnected.
- Do not connect the E1/T1 PCI card to the 2.048/1.554 Mbit/s digital service or Primary Rate ISDN network termination port until this document, and in particular the sections marked 'Installation and Safety', have been read in full and understood.
- Proper ESD (electrostatic discharge) procedures should be maintained throughout.

2.2 Installation der Karte

Die Installationsprozedur für Erweiterungskarten wird sich je nach Hostcomputertyp ändern. Die genaue Einzelheiten bezüglich der Installationsprozedur für Erweiterungskarten soll im Benutzerhandbuch, welches vom Hersteller zur Verfügung gestellt wird, erklärt sein. Jedoch, im Allgemeinen:

- Versuchen Sie nicht die E1/T1 Karte zu installieren bzw. entfernen, es sei denn, die Stromversorgung ganz ausgeschaltet und vom Hostcomputer entfernt wurde und die Verbindung des Netzwerkports vom Netzwerk unterbrochen wurde.
- Für Ihre Sicherheit, entfernen Sie alle Schutzkappen vom Hostcomputer und installieren Sie die E1/T1 Karte bevor die Stromversorgung wieder angeschlossen ist.
- Verbinden Sie die E1/T1 Karte nicht mit 2.048/1.554 Mbits/s Service bzw. Primary Rate ISDN Netzwerkbeendigungsport bis dieses Dokument insbesondere der Abschnitt versehen mit "Network Connection" gelesen und verstanden wurde.

2.3 Installation de la carte

La procédure d'installation des cartes d'expansion varie d'un type de serveur à l'autre. Le détail des procédures d'installation pour les cartes d'expansion se trouve dans le guide d'utilisateur fourni par le fabricant du serveur. Cependant, en général:

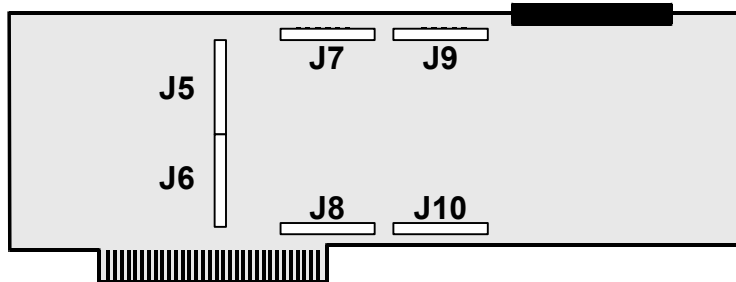
- N'essayez jamais d'installer ou de démonter la carte E1/T1 avant d'avoir débranché l'alimentation principale du serveur et déconnecté le port réseau du réseau.
- Pour votre sécurité, avant de rebrancher l'alimentation, remettez en place tous les boîtiers de protection que vous avez préalablement ôtés pour pouvoir installer la carte E1/T1.
- Ne branchez pas la carte E1/T1 au service 2.048/1.554 Mbits/s ou le port réseau terminal Primary Rate ISDN avant d'avoir entièrement lu et compris ce document, et en particulier les parties comportant "Connexion du Réseau".

2.4 Installing/upgrading modules

Available modules:

- Primary rate line interface modules (PM) 1, 2 or 4 port E1 or T1 modules are available, these modules plug into connectors J5 - J6.
- Signalling DSP modules for tone signaling (CAS) and basic signal processing functions can be fitted to positions J7 - J8 & J9 - J10.

If a card has been purchased which has limited ports or no optional modules fitted, the capability of the card may be increased by upgrading the PM or fitting additional Aculab modules to the expansion ports. Normally this would be accomplished by returning the card to Aculab for upgrade. The process is relatively straightforward and can be carried out by competent personnel by using the following instructions.



Expansion ports on the E1/T1 PCI card

2.4.1 Removing an existing card:

1. Remove the power from the host computer and disconnect the mains leads.
2. Remove the covers from the host computer.
3. Ensuring that the appropriate ESD (Electrostatic Discharge) measures are taken, remove any bus cables from the card then remove the PCI card from the PCI slot.

2.4.2 Removing an existing module:

1. Remove the existing module retaining screws and washers.
2. Gently remove the module from the board taking care not to use any undue force that may damage components.

2.4.3 Installing modules:

Only expansion modules designed for this PCI card are suitable for use. Any attempt to use different modules may cause damage, will invalidate warranty and may invalidate approvals.

Revision 2 PM modules (PM2 or PM4 only) can simultaneously support both E1 and T1, depending on the driver firmware downloaded to each port.

Note All T1 connections are 100ohm by default; E1 connections are 120ohms by default. Subject to the signalling protocol being used, an E1 port can also support 75ohm network connections.

Each port, whether E1 or T1, is associated with a specific firmware which must be downloaded to the PM module. Refer to the **Call, Switch and Speech Driver Installation Guide** for further details.

To install modules:

1. Fit the first module to its connectors, ensuring correct orientation and mating of the connectors. (see the above diagram and the documentation supplied with the expansion kit)
2. Secure the module to the card using 8mm spacers and appropriate screws and washers. (Supplied with the module when purchased as an expansion kit.)
3. Repeat steps 1 and 2 for any additional modules.

2.4.4 Installing a card into a host:

1. Remove power and disconnect any mains leads
2. Remove the host computer covers.
3. Locate a vacant full-length PCI slot and if required, remove the blanking plate.
4. Fit the card to the PCI slot and screw the bracket to the chassis.
5. Fit the H.100 ribbon cables between the E1/T1 PCI card connectors and any other cards that are required.
6. Replace the covers on the host computer.
7. Attach the mains leads and apply power.

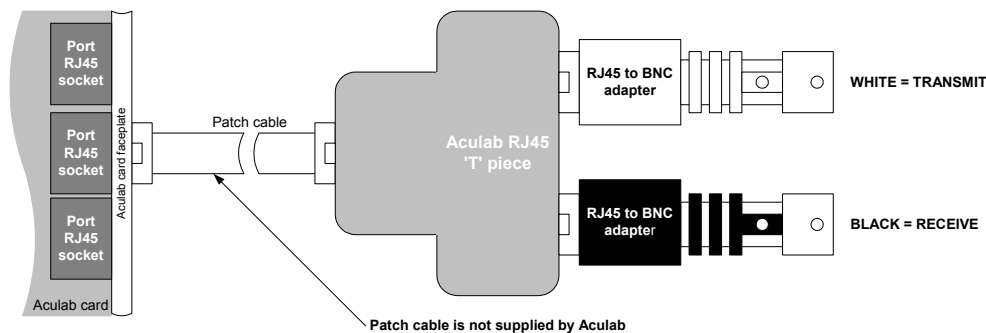
Following installation, the device driver will automatically detect the presence of the additional modules.

2.5 75 ohm network connection

- Different impedance can be supported on the same E1 variant module;
- The revision 2 module can simultaneously support both E1 and T1 ports.
- Besides E1 and T1 ports requiring different firmware, E1 firmware also needs to support both 75 and 120ohms.

The default impedance is 120 ohms, changing the impedance to 75ohms is achieved through changes to the firmware/firmware switches. For example, ETS300 firmware uses a switch `-s61,1` for 75ohms, but E1 DASS requires the firmware DASS75. Refer to the Call, Switch and Speech Driver Installation Guide for further details

To connect to 75ohm E1 networks, RJ45 to BNC adapters are needed. The correct configuration of these adapters is shown below:



Grounding option

Extending ground from the Aculab card to both BNC connectors is possible using a screened RJ45 to RJ45 patch cable and an Aculab screened RJ45 T piece.

The RJ45 T piece is only screened if specifically requested.

An Aculab screened RJ45 T piece has internal connections from the outer screening to both the transmit ring and receive ring pins.

CAUTION An Aculab screened RJ45 T piece must always be grounded through a screened patch cable connecting to the Aculab card; failure to do so could affect signal integrity on the trunk.

2.6 Prosody PCI card endplate LED usage

The endplate of the Prosody PCI card displays a block of eight LED's.

The red LED's correspond to the network ports. With the exception of ISUP firmware, the LEDs will be on until firmware has been successfully downloaded to the corresponding port. For ISUP, the LEDs will be on until an active E1 link has been connected to the port. Activity on a port may cause the LEDs to flash momentarily.

The green LED's indicate the Prosody SHARC processor state, however their operation is firmware dependent. As a general guide, the LED's will flash to indicate activity. Error states are normally indicated by either a permanent on or off state. Should you be experiencing problems, contact Aculab Support for further clarification.

2.7 PM module LED usage

There are up to 12 surface mount LEDs mounted on the PM module. These are difficult to see after the card has been installed. The LEDs are arranged in 4 rows, one for each port.

```
LED A, LED B, LED C, PORT 3
LED A, LED B, LED C, PORT 2
LED A, LED B, LED C, PORT 1
LED A, LED B, LED C, PORT 0
```

Current production is LED A red, LEDs B & C green.

While a microprocessor is in the reset state the LED A is on. It will go out when firmware is downloaded to the port. LED B turns on briefly during firmware download.

ISDN protocols

LED B flashes when layer 1 transmits a frame. LED C flashes when layer 1 receives a frame. The quiescent state of LEDs B & C indicates the state of layer 1.

When both LEDs are off, layer 1 is inactive, and the LEDs will flash on to indicate frames.

When both LEDs are on, layer 1 is active (F1 or F2 state), and the LEDs will flash off to indicate frames.

CAS protocols

The state of LEDs B & C indicate Line State.

When both LEDs are off, there is a line problem (for example, no signal or loss of sync).

When both LEDs are on, the line is active. LED B/LED C will flash off when a digit is transmitted/received.

Note If the power supply voltage goes outside of tolerance, the board will go into the reset state. This is indicated by all four of the A (Red) LEDs being on.

3 Approval Information

This section provides information on the approval of the E1/T1 PCI card, and information that may affect the approval status of the card in use. Failure to use the E1/T1 PCI card in accordance with any of these instructions may invalidate the approval for connection.

3.1 Safety Warnings

If you are unsure about installation and connection to the network, seek advice from a competent telecommunication engineer before proceeding.

The network ports on the E1/T1 PCI cards are only suitable for connection to TNV (Telecom Network Voltage) circuits operating as SELV (Safety Extra Low Voltage) TNV class 1.

The ports have the following safety status:

Type of Circuit	Port Description
SELV	Host Bus Interface (PCI)
SELV	H.100 Telecommunications Bus
SELV (TNV class1)	RJ45 Network Interface ports

CAUTION When making a network connection, to reduce the risk of fire, only telecommunications line cord of 26 AWG or larger may be used.

See the appendices following this **General Approvals Information** for additional country specific safety related information.

3.2 EMC Compliance

The card has been tested for compliance with EMC regulations in the USA, Canada, the UK, Europe and Australia in conjunction with a compliant system. This does not guarantee that every EMC compliant system will remain compliant when used with the card. In extreme cases, high frequency energy within the system may be conducted out of the system and re-radiated via the network cables. In this case, the network cables may require additional treatment (such as clamp-on ferrite rings), and system-grounding provisions may require modification.

Good quality shielded cables must be used for the network connections in all cases.

If there is doubt regarding the overall EMC performance of a particular system, the user is advised to obtain competent advice, and local systems testing for EMC. Should local testing identify that additional EMC protection is required in the form of E1/T1 trunk cable clamping, you can refer to Appendix F: for guidance on the retrofit of Aculab Ferrite Clamps.

3.3 Approval Details

The Approval Number and Approval Holder details are included in the **Country Specific Information** appendices.

3.4 Usage and Type

The usage and type of connections supported by the E1/T1 PCI cards are detailed in the **Country Specific Information** appendices.

3.5 Environmental

The E1/T1 PCI card is specified to operate within the following operating conditions:

- Temperature 0 deg to 50 deg Celsius
- Relative Humidity 10% to 95% non-condensing
- Altitude 0 to 2,500 metres

3.6 Network Timing

The E1/T1 PCI card has been tested for compliance with the pulse and jitter requirements of CCITT G703, I431, ETS300-011 and in some cases additional national or international service requirements.

The E1/T1 PCI card usually derives the timing for its network output ports from one of the network receive ports.

Alternatively, the E1/T1 PCI card may be configured to derive the timing for network output ports from the H.100 CTBus clock. **The jitter performance required to maintain the card's approval status is only guaranteed if an external clock is derived from another Aculab E1/T1 Digital Access card that is connected to the network.** Other clock configurations may require further testing to ensure compliance.

3.7 Power Supply

The E1/T1 PCI card takes its power from the host computer expansion bus and has the following power requirements:

5 Amps Max at +5V (DC) +/- 5%

It is the user's responsibility to ensure that the host computer is able to safely supply the power required by the card in addition to any other auxiliary apparatus that draw power from it.

The card is specified to operate correctly with a tolerance (plus or minus) of 5% on the nominal DC power supply voltage.

3.8 Regulatory Warnings.

The CE Marking has been applied to the Aculab GroomerII to demonstrate compliance with the following European standards.

EN55022 and EN55024 for electromagnetic compatibility.
EN60950 for electrical safety.

3.9 Approved Functionality & Label

Details of the approved functionality are included in the country specific appendices.

Users are reminded that when the card has been installed in a host computer it is still only the card that is approved so the Approval label must not be attached to the host.

3.10 Documentation Release

To ensure operation of the E1/T1 PCI card consistent with the terms of approval, it is essential to ensure that the card is accompanied by the correct release of the instructions for use, and is used in conjunction with appropriate device drivers.

If an application developer, by virtue of an application program, reduces the functionality of the E1/T1 PCI card before delivery, then the instructions for use may be rewritten so that only the functionality implemented is described, provided that all of the sections regarding approval, installation and connection are retained.

3.11 Software Release

To ensure correct operation of the PCI card, it is necessary that application programs be built using the correct release of software files for the particular revision of the E1/T1 PCI card. To aid this process it is recommended that the application program read the major revision level from the device driver, and compares it with the major revision value for which their application was built and tested. The minor revision level is essentially a documentary indicator, but the major revision level value indicates a change that may impact the Host application.

The control software supplied to run on the card (downloaded to RAM) has been tested for compliance with the requirements of the Approval Authority referred to in the **Country Specific Information** appendices for connection to the digital network. The Approval label on the card is

only valid and applicable if the card is used with the Aculab supplied signalling software appropriate for the Approval label.

Use of any other control software on a port connected to the PSTN is not covered by the approval and reference must be made to the Approvals Authority before any connection to the network is made.

3.12 User Responsibilities

There may be configurations of the E1/T1 PCI card along with other equipment that may require additional approval testing by an accredited test laboratory.

In particular, in producing the approval certificate for the card, the Approval Authority did not place any specific restriction on the use of the card apart from any restrictions listed in the **Country Specific Information** appendices.

It is the responsibility of the user to ensure that all of the legal requirements for attachment are met, thus the user is advised to seek competent advice regarding any particular equipment configuration or use.

3.13 Speech Calls

If the E1/T1 PCI card is used in an application that makes or answers calls with a service code that indicates a speech or telephony call, or any call that may use a partly analogue route, the Approval Authority may place requirements on the audio signals transmitted. Please refer to the **Country Specific Information** appendices for more details.

Many of the speech and FAX resource cards that may be used with the E1/T1 PCI card may comply with Approval Authority requirements, but it is the responsibility of the user to ensure that Approval requirements are complied with, by confirmation via the manufacturer of the card, or by any other suitable means such as independent testing.

Signal sources that do not in themselves guarantee compliance with Approval requirements must be conditioned by appropriate circuitry before transmission.

Appendix A: Country Specific Information

This appendix lists the country-specific information to supplement the Installation Guide for the E1/T1 PCI card. These appendices should always be read in conjunction with the sections on 'Instructions for Use'.

The appendices are arranged in separate sections detailing regulatory requirements for the following countries:

- Appendix B - USA & Canada
- Appendix C - European Union Countries
- Appendix D - Japan
- Appendix E - Australia

Appendix B: USA/Canada Approval Details

This section applies only to the 100 Ohm T1 version of the PM1/2/4 Line Interface Module.

FCC Connection Requirements

This equipment complies with Part 68 of the FCC rules and the requirements adopted by the ACTA. On the exterior of the cabinet of this equipment is a label that contains, among other information, a product identifier in the format **US:AAAEQ##TXXXX**. If requested, this number must be provided to the telephone company.

ACTA Registration Number:	US: 5TC XD NA N PM4MODT1
Ringer Equivalence Number (REN):	NAN
Facility Interface Code (FIC):	04DU9.1SN
Service Order Code (SOC):	6.0N
USOC Jack Type:	NA

A FCC compliant telephone cord and modular plug is provided with this equipment. This equipment is designed for connection to the telephone network or premises wiring using a compatible modular jack that is Part 68 compliant. See Installation Instructions for details.

The REN is used to determine the quantity of devices that may be connected to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to an incoming call. Typically, the sum of RENs should not exceed five (5.0). To be certain of the number of devices that may be connected to a line (as determined by the total RENs) contact the local telephone company.

If this equipment E1/T1 PCI causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes to its facilities, equipment, operations or procedures that could affect the operation of the equipment. If this happens the telephone company will provide advance notice so you can make the necessary modifications to maintain uninterrupted service.

If trouble is experienced with this equipment E1/T1 PCI, for repair or warranty information, please contact Aculab INC, Customer Service, 197 First Avenue, Suite 130, Needham, MA 02494 +1 781 433 6000, (There are no user serviceable components on the card). If the equipment is causing harm to the telephone network, the telephone company may request that you disconnect the equipment until the problem is resolved.

Connection to party line service is subject to state tariffs. (Contact the state public utility commission, public service commission or corporation commission for information.)

This equipment is hearing aid compatible.

Customer Owned Coin/Credit Card Phones

To comply with state tariffs, the telephone company must be given notification prior to connection. In some states, the state public utility commission, public service commission or corporation commission must give prior approval of connection.

Data Equipment

The table below shows which jacks are associated with which modes of operation:

Mode of Operation	USOC Jack
Programmable	RJ45

Systems

Facility Interface Codes (FIC), Service Order Codes (SOC), USOC Jack Codes and Ringer Equivalence Numbers (REN) are shown in the table below:

Before connecting the card to the public network, you must inform the local telephone company of this information:

Service Type	SOC	FIC	USOC	REN
T1	6.0N	04DU9-1SN	NA	NAN
ISDN (PRI)	6.0N	04DU9-1SN	NA	NAN

UL Requirement

This card has been assessed against UL60950-1 and is a listed accessory component under UL file number E178354. The E1/T1 PCI card may only be installed in a UL listed PCI bus, based computer system.

Industry Canada Warnings

The Industry Canada Label identifies certified equipment. This certification means that the equipment meets telecommunications network protective, operational and safety requirements as prescribed in the appropriate Terminal Equipment Technical Requirements document(s). The Department does not guarantee the equipment will operate to the users satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local Telecommunications Company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

A representative designated by the supplier should co-ordinate repairs to certified equipment. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together (bonded). This precaution may be particularly important in rural areas.

CAUTION Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

Service Requirements

In case of equipment malfunction, Aculab Plc should carry out repairs. It is the responsibility of users requiring service to report the need for service to our company.

Contact details for the USA and Canada offices, (Aculab USA Inc) are available from the Aculab company web site at <http://www.aculab.com>.

Approval Number USA

Approval Type	FCC part 68 XD Component Registration
Approval Number	US:5TC XD NA N PM4MODT1
Approval holder	Aculab Plc, Lakeside, Bramley Road, Mount Farm, Milton Keynes MK1 1PT, UK

FCC approves the apparatus for connection to public T1 services as specified in the approval certificate, this appendix, and the 'Instructions for Use' subject to the conditions set out in these documents.

Approval Number Canada

Approval Type	Industry Canada CS-03 Issue 8
Approval Number	2789A – 12217 (rev 2)

FCC EMC Requirements

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 the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area may cause harmful interference, in which case the user will be required to correct the interference at his own expense.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

No changes or modification to the E1/T1 PCI card is allowed without explicit written permission from Aculab as these could void the end user's authority to operate the device.

The card is only intended for use in commercial applications and should not be operated in a domestic environment. It must only be installed by a professional engineer and good quality shielded cables must be used between the network ports and the Channel Service Unit (FCC, IC or UL Listed CSU) to ensure continued compliance to EMC regulations.

Canadian EMC Requirements

This Class A digital apparatus meets all requirements of the Canadian interference-causing equipment regulations.

Cet appareil numérique de la Classe A respecte toutes les exigences du règlement sur le matériel brouilleur du Canada.

Usage and Type

The E1/T1 PCI card is principally designed for use connected to a 1.544 Mbps T1 digital service configured for primary rate ISDN (PRI) with National ISDN 2 signalling. Other types of private circuit use are also appropriate, and other signalling systems are available or planned.

Examples of the files to be loaded into RAM for signalling software to connect with the network are:

<code>ni2_net.upr</code>	(for NI-2 T1 PRI – network to user)
<code>ni2_usr.upr</code>	(for NI-2 T1 PRI – user to network)
<code>att_tnet.upr</code>	(for AT&T, TR41459, T1 PRI – network to user)
<code>att_tusr.upr</code>	(for AT&T, TR41459, T1 PRI – user to network)

Functionality

- Call initiation
- Call clearing
- Call answering
- B-channel switching
- Host independent installation
- Application program generated by the user
- Independent Operation of the network ports (one or more ports attached to the public network)
- Operational code running from RAM

Speech Calls

If the E1/T1 card is used in an application that makes or answers calls with a service code that indicates a speech or telephony call, or any call that may use a partly analogue route, there is a requirement that audio signals transmitted are encoded using CCITT μ -law PCM.

Many of the speech and FAX resource cards that may be used with the E1/T1 card comply with this requirement. It is the responsibility of the user to ensure that this requirement is complied with, by confirmation via the manufacturer of the card, or by any other suitable means such as independent testing.

Signal sources that do not in themselves guarantee compliance with this requirement must be conditioned by appropriate circuitry before transmission.

Card Installation & Connection

Safety Warnings

Interconnection circuits should be such that the equipment continues to comply with the requirements of UL60950-1/CSA C22 for SELV circuits, after making connections between circuits using any of the internal ports.

Refer to a competent telecommunications engineer before installation and connection to the network is made.

L'avertissements concernant la sécurité

Quel que soit le matériel qui est raccordé aux port le système doit respecter les exigence de la norme CSA C22 au sujet des circuits SELV.

Il conviendra de rechercher l'avis d'un technicien de télécommunications avant l'installation de la carte et sa connexion au réseau.

Line Interface

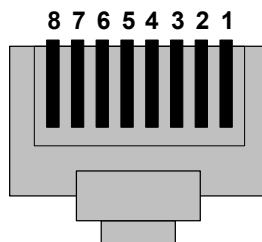
Each network port on the card carries one service connection via a screened twisted pair cable of 100 ohm characteristic impedance. There is one transmit pair and one receive pair. A T1 digital service will normally carry 24 channels and a T1-PRI service will carry 23 channels. The card is designed to connect to an FCC or IC registered Channel Service Unit (FCC, IC or UL Listed CSU), which is not supplied by Aculab. The default line build out setting is suitable for cables up to 133 feet between the card and the FCC, IC or UL Listed CSU.

Network Cable Pinout

The 8-contact RJ48 (RJ45) Telephone Modular Plug on the cable between the card and the network must be wired as follows:

Pin	Signal	Function	Direction
4	LTT	Transmit (tip)	output
5	LTR	Transmit (ring)	output
1	LRT	Receive (tip)	input
2	LRR	Receive (ring)	input

**RJ48 (RJ45) connector
(Front view)**



The cable and plug must be shielded to ensure EMC compliance.

If a cable is to be produced to wire into a network connection, the connector on the network end of the cable must be wired as appropriate for the network terminating unit or Channel Service Unit (FCC, IC or UL Listed CSU) provided.

A 'cross-over' cable is required to connect two T1 ports 'back-to-back', for example, when one port is to run an exchange end emulation and the other port a user end application. The cable should be wired as follows.

User End		Exchange End
4	to	1
5	to	2
1	to	4
2	to	5

Appendix C: Approval Details For European Union Countries & UK

This section applies only to the 120 Ohm and 75 Ohm E1 version of the PM 1/2/4 module.



Declaration of Conformity

We

Aculab PLC

of

**Lakeside
Bramley Road
Mount Farm
Milton Keynes MK1 1PT
United Kingdom.**

Declare under our sole responsibility that the product

Aculab E1/T1 PCI Card with Rev2 PM Module

Models

PM4- 4 port Module

PM2- 2 port Module

PM1- 1 port Module

To which this declaration relates, is in conformity with the Radio and Telecommunication Terminal Equipment (RTTE) Directive 1999/5/EC

Signed: 
Location: Milton Keynes
Date: 7th October 2002

Position: Managing Director

Speech Calls

If the E1/T1 PCI card is used in an application that makes or answers calls with a service code that indicates a speech or telephony call, or any call that may use a partly analogue route, there is a requirement that audio signals transmitted are encoded using CCITT A-law PCM, and do not exceed a 1 minute mean power level of -9dBm.

Many of the speech and FAX resource cards that may be used with the E1/T1 PCI card comply with this requirement. It is the responsibility of the user to ensure that this requirement is complied with, by confirmation via the manufacturer of the card, or by any other suitable means such as independent testing.

Signal sources that do not guarantee compliance with this requirement must be conditioned by appropriate circuitry before transmission.

Card Installation & Connection

Safety Warnings

Interconnection circuits should be such that the equipment continues to comply with the requirements of 2.3 of EN 60950 for SELV circuits, after making connections between circuits using any of the internal ports.

The host system into which the E1/T1 PCI card is fitted is classed as an indirect attachment. The PCI bus connector provides an interconnection circuit between the host system and the E1/T1 PCI card. Similarly, equipment connected to the E1/T1 PCI card H.100 CTBus ports are also classed as indirect attachments.

Installation and Safety

The card must be installed such that, with the exception of the PCI, H.100 bus connections, clearance and creepage distances shown in the table below are maintained between the E1/T1 PCI card and any parts of the host system or other expansion cards which use or generate a voltage, shown in the following table below.

Clearance mm	Creepage mm	Voltage present on other parts of the host or on expansion cards.
2.0	2.4 (3.8)	Up to 50V rms or dc
2.6	3.0 (4.8)	Up to 125V rms or dc
4.0	5.0 (8.0)	Up to 250V rms or dc
4.0	6.4 (10.0)	Up to 300V rms or dc

WARNING ADVICE FROM A COMPETENT TELECOMMUNICATIONS SAFETY ENGINEER MUST BE OBTAINED BEFORE INSTALLATION OF THE RELEVANT EQUIPMENT USING OR GENERATING VOLTAGES GREATER THAN 300V (RMS OR DC).

Clearance distances refer to the shortest distance between parts, measured through air. Creepage distances refer to total distances measured across surfaces when installed in a normal office environment. The creepage distances in parenthesis apply where the local environment within the PC is subject to conductive pollution or dry non-conductive pollution that could become conductive due to condensation.

If in doubt seek advice from a competent telecommunications safety engineer.

In order to maintain the host independent approval of the E1/T1 PCI card, it is essential that, when other expansion cards are introduced which use or generate a hazardous voltage, the minimum creepage and clearances specified above are also maintained. A hazardous voltage is one that exceeds 42.4V ac peak or 60V dc. If you have any doubt, seek advice from a competent engineer before installing other adapters into the host equipment.

Failure to install the E1/T1 PCI card in accordance with these instructions will invalidate the Approval.

75 ohm Line Interface

Each network port on the card carries one 30-channel digital service connection. For 75 ohm characteristic impedance coaxial cables connections, an RJ45 to BNC adapter is required. Each adapter contains a pair of BNC coaxial connections, one for the transmit cable that is colour coded white, and one for the receive cable that is colour coded black.

The coaxial adapter is fitted after the card is installed in the host PC. The adapters are only push fit so some form of strain relief is recommended.

75 Ohm Network Connection

The connection of the network input and output ports on the E1 card to the network termination port (NTP) must be via coaxial cables with a nominal impedance of 75 ohms terminated with a 75 ohm BNC plug.

Note There may be maximum cable lengths imposed by the PTO.

The correct identification of the input and output of the network termination ports is the responsibility of installation personnel.

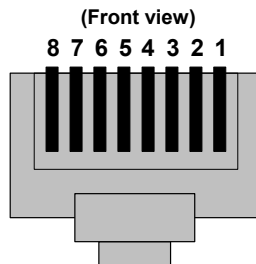
120 Ohm Line Interface

Each network port on the card carries one 30-channel digital service connection via a screened twisted pair cable of 120 ohm characteristic impedance. There is one transmit pair and one receive pair.

120 Ohm Network Connection

The 8-contact RJ45 Telephone Modular Plug on the cable between the card and the network must be wired as follows:

Pin	Signal	Function	Direction
4	LTT	Transmit (tip)	output
5	LTR	Transmit (ring)	output
1	LRT	Receive (tip)	input
2	LRR	Receive (ring)	input



The cable and plug must be a shielded type to ensure EMC compliance. If a cable is to be produced to wire into a network trunk connection, the connector on the network end of the cable must be wired as appropriate for the network-terminating unit provided.

A 'cross-over' cable is required to connect two E1 cards 'back-to-back', for example, when one card is to run an exchange end emulation and the other card a user end application. The cable should be wired as follows.

User End		Exchange End
4	to	1
5	to	2
1	to	4
2	to	5

Network Connection via Other Apparatus

If other apparatus, including cable or wiring, is to be connected between the E1 card and the point of connection to the network, then all of that apparatus must comply with the following:

- The overall transmission characteristic of all the other apparatus, upon electrical conditions presented to one another by the apparatus and the network connection, shall be such as to introduce degradation no greater than the requirement for direct connection. The attenuation shall be assumed to follow the \sqrt{f} law, and the loss at a frequency of 1024KHz shall not exceed 6dB.
- All that other apparatus shall comprise only apparatus approved for the purpose of connection between the apparatus and the network. Cable, wire and wiring accessories shall comply with Approval No: NS/G/1235/M/100009 Section 22, Telecommunications Act 1984 Approval of cable, wire and wiring accessories for connection between certain digital telecommunication apparatus, published by OFTEL.

The installation should comply with the Wiring Code Part 2, published by OFTEL.

The MEF Watchdog

Once running, the DASS-2 port processors enable an internal 'watchdog' timer that they must persistently and regularly update. Any error condition that causes processing to falter will cause the watchdog to generate a processor reset. This is the 'Major Equipment Failure' (MEF) condition, and will result in a 'no signal' being presented at the particular G703 output port, which is the required behaviour under these conditions.

Service Requirements

In case of equipment malfunction, repairs should be carried out by Aculab plc. It is the responsibility of users requiring service to report the need for service to our company.

Contact details are available from the Aculab company web site at <http://www.aculab.com>.

EN55022 declaration

This is a class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

No changes or modification to the E1/T1 PCI card are allowed without explicit written permission from Aculab, as these could void the end user's authority to operate the device.

Appendix D: Approval details for Australia

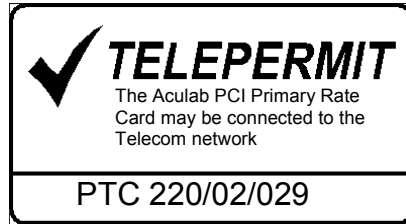
Approval Type



C-Tick Mark
(EMC Australia)



A-Tick Mark
(Telecom Australia)



Telepermit
(Telecom New Zealand)

Supplier Identification **N4292 PTC 220 / 02 / 029**
 Approval Holder Aculab Australia
 Aculab NZ Representative - via Aculab Australia

The current contact details for the Australia offices, are available from the Aculab company web site at www.aculab.com.

Approval by the ACA for connection to primary rate ISDN is held by the local subsidiary of Aculab Plc, as specified in this document and subject to the conditions set out in this appendix. The Telepermit approval is issued to the Aculab New Zealand representative who may be contacted through the Aculab Australian office. The rev 2 PM4 module has the NZ approval PTC220/02/029.

Usage and Type

The E1/T1 PCI card is principally designed for use connected to a 2048 Kbps integrated services digital network (primary rate ISDN) with TS038 signalling including the New Zealand primary rate ISDN network

Other types of private circuit use are also appropriate, and other signalling systems are available or planned.

The Australian and NZ approvals are only applicable when the E1/T1 PCI card is used with Aculab supplied signalling software appropriate for use in the country covered by the Approval.

A typical example of the software filenames to be loaded into RAM for signalling software to connect to the network is:

`ets_supn.upr` (ETS300 – network to user), `ets_supu.upr` (ETS300 – user to network)

Approved Functionality

- Call initiation
- Call clearing
- Call answering
- Application program generated by the user
- Independent Operation of the network ports (one or more ports attached to the network)
- Operational code running from RAM

Speech Calls

If the E1/T1 PCI card is used in an application that makes or answers calls with a service code that indicates a speech or telephony call, or any call that may use a partly analogue route, there is a requirement that audio signals transmitted are encoded using CCITT A-law PCM, and do not exceed a 1 minute mean power level of -9dBm.

Many of the speech and FAX resource cards that may be used with the E1/T1 PCI card comply with this requirement. It is the responsibility of the user to ensure that this requirement is complied with, by confirmation via the manufacturer of the card, or by any other suitable means such as independent testing.

Signal sources that do not guarantee compliance with this requirement must be conditioned by appropriate circuitry before transmission.

Card installation & connection

Safety warnings

The primary rate E1 ISDN interface is a TNV interface as detailed in section 6 of AS/NZ 3260.

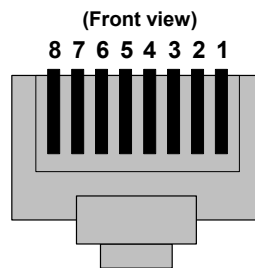
Where equipment is intended to be electrically connected to other equipment, interconnection circuits shall be selected to provide continued conformance with the requirements of section 2.3 for SELV circuits and with the requirements of clause 6 for TNV circuits.

Make sure that the integrity of the SELV system is maintained when connection is made through any other interface port within the system. If in any doubt, seek competent advice.

All host equipment incorporating the E1 ISDN interface must be earthed.

Network Cable Pinout

The 8-contact RJ45 Telephone Modular Plug on the cable between the card and the network must be wired as follows:



Pin	Signal	Function	Direction
4	LTT	Transmit +ve (tip)	output
5	LTR	Transmit -ve (ring)	output
1	LRT	Receive +ve (tip)	input
2	LRR	Receive -ve (ring)	input

If a cable is to be produced to wire into a network trunk connection, the connector on the network end of the cable must be wired as appropriate for the network-terminating unit provided.

If a 'cross-over' cable is to be produced to connect two E1/T1 PCI cards 'back-to-back', for example, when one card is to run an exchange end emulation and the other card a user end application, the cable may be wired as follows.

User End		Exchange End
4	to	1
5	to	2
1	to	4
2	to	5

Appendix E: Technical Specifications

Connectors

- PM 4, 2 or 1 modules— 8 way RJ45/RJ48 balanced (120R/100R)

Line interface

- E1 2Mbit to G703/G704/I431
- Doubleframe, CRC4 multiframe and CAS multiframe supported
- HDB3 line encoding
- T1 1.544Mb to G703/G704/ANSI T1.403
- D4 and ESF support
- AMI or B8ZS line encoding

TDM interfaces

- H.100 compliant interface supporting connection to any of the 4096 timeslots

Switching

- 256 full duplex channel switching between the local resources and the H.100 bus
- PM4 - Quad trunk 120/96 or 92 channels between network and TDM interface (E1, T1 or T1 PRI)
- PM2 - Dual trunk 60/48 or 46 channels between network and TDM interface (E1, T1 or T1 PRI)
- PM1 - Single trunk 30/24 or 23 channels between network and TDM interface (E1, T1 or T1 PRI)
- Local switching of 120 channels to optional signalling DSP modules

Clocking

- CT bus slave
- CT bus master supporting clock fallback

Embedded processors

- AM188 @ 20MHz - One per network port

Signalling DSP modules (DSP32)

- MF/DTMF tone signalling support. Conferencing, A-law/ μ -law conversion, Attenuation, Fax and Bit Error rate testing
- 1 or 2 DSP32 modules providing up to 2 DSPs per network port

Power supply (+5V DC +/- 5%)

- | | |
|---|-----|
| • Pre revision 1.4 PCI card with standard PM4 | 17W |
| • Revision 1.5 and later PCI card with standard PM4 | 12W |
| • Plus for each DSP32 module fitted (maximum 2) | 4W |

Physical dimensions

- All Aculab PCI products conform to PCI local bus specification revision 2.1
- Overall dimensions (excluding face plate):

Height 106.68mm +/- 0.127mm

Depth (including retainer) 340.74mm +/- 1.57mm

Depth (excluding retainer) 312mm +/- 0.127mm

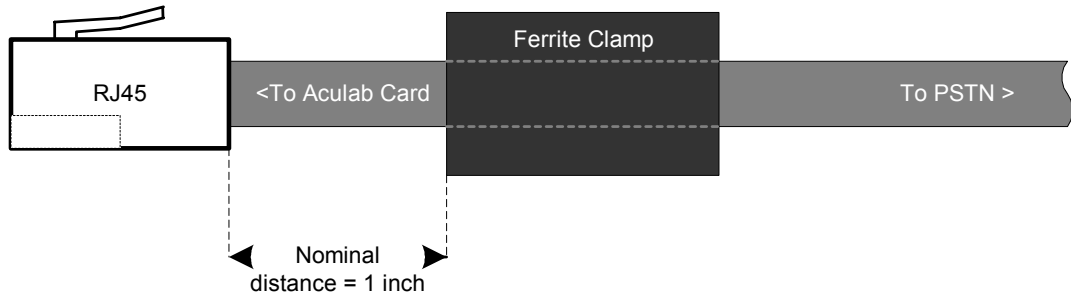
Each PCI card fits into a single card slot without impinging any adjacent slots

- For further details on PCI standards, please contact the PCI Special Interest Group at <http://www.pcisig.com/home>.

Appendix F: Aculab Ferrite Clamp fitting instructions

The following diagram depicts the correct fitting of Aculab part number AC0440 Ferrite clamps. These may be fitted as required, for example, when local EMC testing of a system identifies the need for E1/T1 trunk cable clamping.

Europe & USA/Canada



The Ferrite clamp consists of two halves of a ferrite core encased in a hinged plastic holder that is closed and latched around a cable up to 6mm in diameter

Please contact Aculab should you require further clarification on obtaining and using Ferrite Clamps.

Glossary of abbreviations:

ACA	Australian Communications Authority
A-Law	The PCM coding and companding standard in Europe
BNC	Bayonet Neill Concelman (Locking bayonet co-axial connector)
CAS	Channel Associated Signalling
CCITT	Committee on International Telegraphy and Telephony
CCS	Common Channel Signalling
CLI	Calling Line Identifier
CSA	Canadian Standards Authority
CSU	Channel Service Unit
CTBus	Computer Telephony Bus
DASS	Digital Access Signalling System
DC	Direct Current
DDI	Direct Dial In
DPNSS	Digital Private Network Signalling System
DSU	Digital Service Unit
DTMF	Dual Tone Multi Frequency (2 out of 5 or 8 tone signals representing single digits)
E1	Alternative title for the CEPT digital telephony format carrying data at a rate of 2.048 Mbps. E1 is the rate used by European CEPT carriers to transmit 32 64 Kb/s channel, 30 of them used for voice and data calls. A PCM system, E1 is used throughout the world with the exception of North America and Japan. Also known as 120R. The E1 link complies with the ITU-T recommendations G.703/G704. It is the interface between the ITS and the backhaul network (switch).
EC	Echo Cancellation
ECTF	Enterprise Computer Telephony Forum
EMC	ElectroMagnetic Compatability
EN	European Norme
ESD	ElectroStatic Discharge
ETS	European Telecommunications Standards
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
G.703	ITU Standard for physical/electrical characteristics of hierarchical digital interfaces
H.100	Standard for PCI bus operability
IC	Integrated Circuit
IEC	International Electrotechnical Commission
ISDN	Integrated Services Digital Network
ITU	International Telecommunications Union
J1	Japan variant of the American T1 (1.55Mbps/s) standard
JATE	Japan Approvals institute for Telecommunications Equipment
LED	Light Emitting Diode
LIM	Line Interface Module
LIU	Line Interface Unit
MEF	Major Equipment Failure
μ-Law	The PCM coding and companding standard in Japan and North America
MVIP	Multi-Vendor Integration Protocol
NSAI	National Standards Authority Ireland
NT (1)	Network Termination (type 1)
NT	New Technology
NTP	Network Termination Port
NTT	Nippon Telephone and Telegraph
PC	Personal Computer
PCI	Peripheral Component Interconnect
PCM	Pulse Code Modulation
PM	Primary rate Module
POTS	Plain Old Telephone System
Pri	Primary Rate Interface (23B + 1D T1 or 30B + 1D E1)

PSTN	Public Switched Telephone Network
PTO	Public Telephone Operator
RAM	Random Access Memory
REN	Ringer Equivalence Number
RJ	Registered Jacks (RJ11=6 position, RJ45=8 position)
SELV	Safety Extra Low Voltage
SCBus	Dialogic specific version of MVIP bus
T1	American 1.55Mbits/s 24 channel standard
TDM	Time Division Multiplex
TE	Terminal Equipment
TNV	Telecom Network Voltage
UL	Underwriters Laboratories