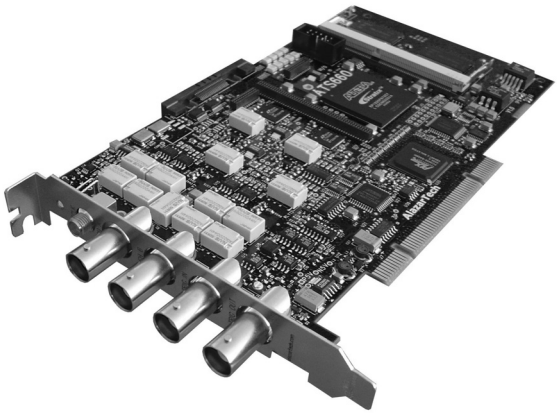
PCI Digitizers
BY ALAZARTECH

ATS660 User Manual

16 Bit, 125 MS/s
Waveform Digitizer for PCI Bus



Written for Hardware Version 1.1
October 2006 Edition
Part Number: 660-USR-1

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Information required when contacting AlazarTech for technical support:

Owned by: _____

Serial Number: _____

Purchase Date: _____

Purchased From: _____

Software Driver Version: _____

SDK Version: _____

API Panel Version: _____

AlazarDSO Version: _____

Operating System: _____

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The ATS660 is warranted against defects in materials and workmanship for a period of one year from the date of shipment, as evidenced by receipts or other documentation. AlazarTech, Inc. will, at its option, repair or replace equipment that proves to be defective during the warranty period. This warranty includes parts and labor.

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Compliance

FCC/Canada Radio Frequency Interference Compliance*

Determining FCC Class

The Federal Communications Commission (FCC) has rules to protect wireless communications from interference. The FCC places digital electronics into two classes. These classes are known as Class A (for use in industrial-commercial locations only) or Class B (for use in residential or commercial locations). Depending on where it is operated, this product could be subject to restrictions in the FCC rules. (In Canada, the Department of communications (DOC), of Industry Canada, regulates wireless interference in much the same way.)

Digital electronics emit weak signals during normal operation that can affect radio, television, or other wireless products. By examining the product you purchased, you can determine the FCC Class and therefore which of the two FCC/DOC Warnings apply in the following sections. (Some products may not be labeled at all for FCC; if so, the reader should then assume these are Class A devices.)

FCC Class A products only display a simple warning statement of one paragraph in length regarding interference and undesired operation. Most of our products are FCC Class A. The FCC rules have restrictions regarding the locations where FCC Class A products can be operated.

FCC Class B products display either a FCC ID code, starting with the letters **EXN**, or the FCC Class B compliance mark.

Consult the FCC web site http://www.fcc.gov for more information.

FCC/DOC Warnings

This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual and the CE Mark Declaration of Conformity**, may cause interference to radio and television reception. Classification requirements are the same for the Federal Communications Commission (FCC) and the Canadian Department of Communications (DOC).

Changes or modifications not expressly approved by AlazarTech Inc. could void the user's authority to operate the equipment under the FCC Rules.

Class A

Federal Communications Commission

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 and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Department of Communications

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*.

Compliance to EU Directives

Readers in the European Union (EU) must refer to the Manufacturer's Declaration of Conformity (DoC) for information** pertaining to the CE Mark compliance scheme. The Manufacturer includes a DoC for most every hardware product except for those bought for OEMs, if also available from an original manufacturer that also markets in the EU, or where compliance is not required as for electrically benign apparatus or cables.

To obtain the DoC for this product, click **Declaration of Conformity** at http://www.alazartech.com/support/documents.htm. This web page lists all DoCs by product family. Select the appropriate product to download or read the DoC.

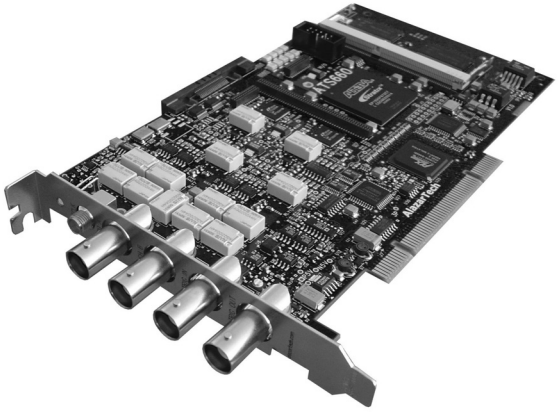
* Certain exemptions may apply in the USA, see FCC Rules §15.103 **Exempted devices**, and §15.105(c). Also available in sections of CFR 47.

** The CE Mark Declaration of Conformity will contain important supplementary information and instructions for the user or installer.

Table of Contents

Chapter 1 - Introduction

This chapter describes the ATS660 and lists additional equipment.



About Your ATS660

Thank you for your purchase of an ATS660. The ATS660 PCI based waveform digitizer has the following features:

- Two 16-bit resolution analog input channels
- Real-time sampling rate of 125 MS/s to 1 KS/s
- 8 Million samples of onboard memory per channel, standard
- Optional 128 Million samples of on-board memory per channel
- 65 MHz analog input bandwidth
- DIP switch selectable Amplifier Bypass Mode for optimum signal integrity
- Dual-Port Memory
- Half length PCI bus card
- Analog trigger channel with software-selectable level and slope
- Software-selectable AC/DC coupling and 1MΩ/50Ω input impedance
- Software-selectable bandwidth limit switch, independent for each channel
- Pre-trigger and Post-Trigger Capture with Multiple Record capability
- NIST traceable calibration

All ATS660 digitizers follow industry-standard Plug and Play specifications on all platforms and offer seamless integration with compliant systems. If your application requires more than two channels for data acquisition, you can synchronize multiple digitizers on all platforms using a Master/Slave SyncBoard 460.

Detailed specifications of the ATS660 digitizers are listed in Appendix A, Specifications.

Acquiring Data with Your ATS660

You can acquire data either programmatically by writing an application for your ATS660 or interactively with the API Panel software.

If you want to integrate the ATS660 in your test and measurement or embedded OEM application, you can program the digitizer using C/C++, Visual BASIC or LabVIEW for Win32 (Windows 98SE, Windows 2000 and Windows XP) operating systems or C for Linux operating systems.

For programming in C/C++ or Visual BASIC, you must purchase the ATS-SDK software development kit that comes with sample programs and a reference manual describing the API.

For programming in LabVIEW, you must purchase the ATS-VI virtual instrument library that comes with a high-level, easy-to-use VI that makes integrating the ATS660 into your own system very simple.

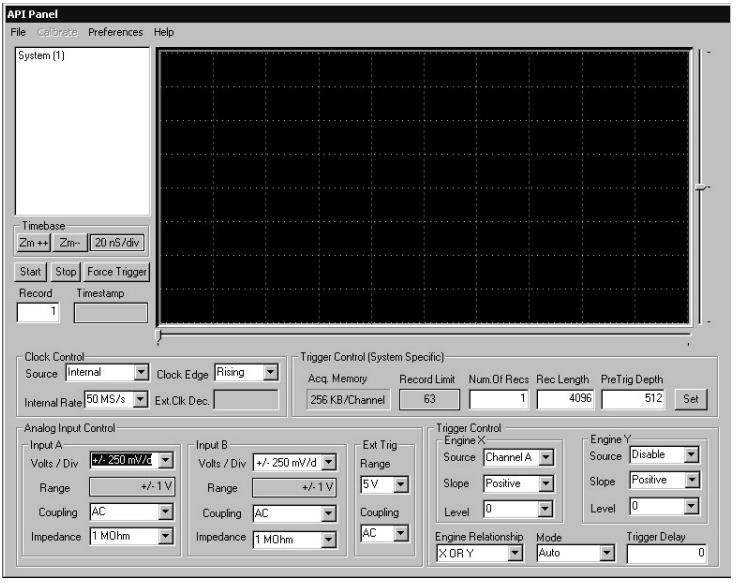
It is also possible to program your ATS660 under Linux operating system. You will need to purchase the ATS-Linux software development kit that comes with binary files for the driver (kernel 2.6) and C source code for a sample program. Also supplied is the AlazarDSO graphical user interface for the ATS660.

If you need to operate the ATS660 under Windows XP x64, please contact the factory for 64-bit Windows drivers.

Interactively Controlling your ATS660 with API Panel
The API Panel Soft Front Panel allows you to interactively control your ATS660 as you would a desktop oscilloscope. To launch the Scope Soft Front Panel, select

Start » Programs » AlazarTech » API Panel

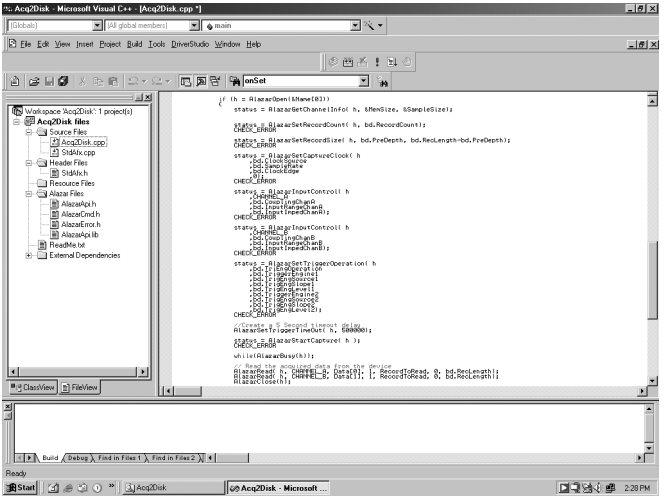
The following screen will be displayed. If you connect the input to a signal generator and click on **Start** button, you should see the signal on the screen.



API Panel has been designed to be very intuitive and uses a user interface similar to most of today's digital oscilloscopes.

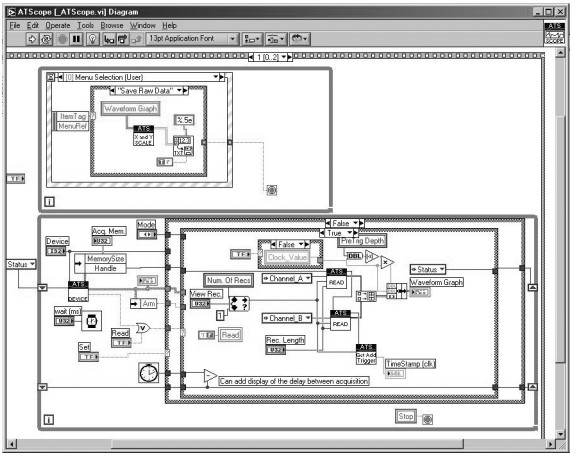
ATS-SDK API

The ATS-SDK API is used for programming the ATS660 in C/C++ or Visual BASIC. It provides the exact same API that is used for writing API Panel software. To help you get started, ATS-SDK comes with examples you can use or modify.



ATS-VI LabVIEW VI

ATS-VI allows you to integrate the ATS660 into your own LabVIEW program. A high level VI is supplied that requires very few controls to get started.



ATS-Linux for ATS660

The ATS-Linux for ATS660 can be used for programming the ATS660 under Linux operating system. A binary driver is supplied that has been compiled for Kernel 2.6 running on an i386 platform. Sample program is supplied in C. The API is identical to the Windows API.

Optional Upgrades

AlazarTech offers the following upgrades and accessories for use with your ATS660 digitizer:

- ATS660: External Clock Upgrade
- ATS660: Master/Slave SyncBoard 2 position
- ATS660: Master/Slave SyncBoard 4 position
- ATS660: Master/Slave SyncBoard 8 position
- ATS660: 8M to 128M Memory Upgrade

Chapter 2 - Installation and Configuration

This chapter describes how to unpack, install, and configure your ATS660.

What You Need to Get Started

To set up and use your ATS660, you will need the following:

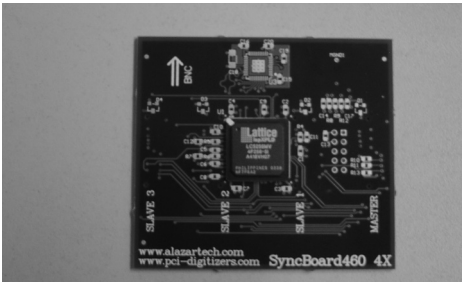
- One or more ATS660 digitizers

- ATS660 Install Disk

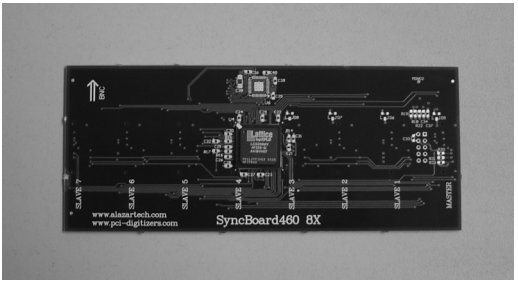
- For Master/Slave operation only:
  SyncBoard of appropriate width

SyncBoard 2X for up to 2 digitizers

SyncBoard 4X for up to 4 digitizers



SyncBoard 8X for up to 8 digitizers



Unpacking

Your digitizer is shipped in an antistatic package to prevent electrostatic damage to the digitizer. Electrostatic discharge can damage several components on the digitizer. To avoid such damage in handling the digitizer, take the following precautions:

- Ground yourself via a grounding strap or by holding a grounded object.
- Touch the antistatic package to a metal part of your computer chassis before removing the digitizer from the package.
- Remove the digitizer from the package and inspect the digitizer for loose components or any other sign of damage. Notify AlazarTech if the digitizer appears damaged in any way. Do *not* install a damaged digitizer into your computer.
- *Never* touch the exposed pins of the connectors.

Installing the ATS660

There are four main steps involved in installation:

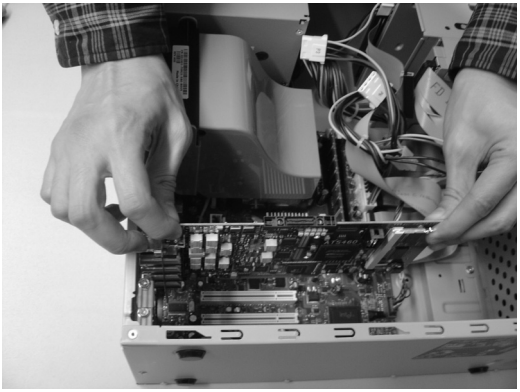
1. Physically install the digitizer(s) and SyncBoard, if any, in your computer
2. Install ATS660 software driver, when prompted by the operating system
3. Install API Panel software that allows you to setup the hardware, acquire signals and view and archive them
4. Optionally, install the ATS-SDK software development kit or ATS-VI LabVIEW VI or ATS-Linux Linux drivers, which enable you to programmatically control the ATS660

The following paragraphs will guide you through this process in a step-by-step manner.

1. **Physically install the digitizer in your computer**

   Make sure that your computer is powered off before you attempt to insert the ATS660 digitizer in one of the free PCI slots.

   For best noise performance, leave as much room as possible between your ATS660 and other hardware.

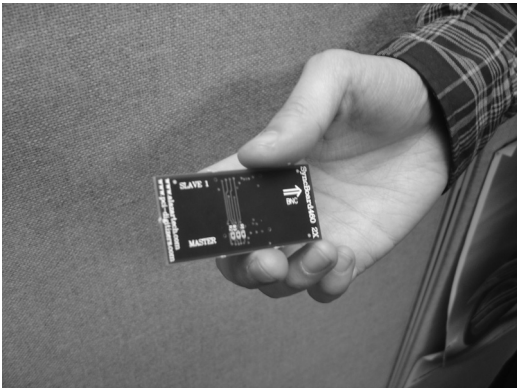


   Always screw the digitizer bracket to the chassis in order to create a stable and robust connection to chassis ground.

   In the absence of such a connection, ATS660 is not guaranteed to operate within the specifications listed elsewhere in this manual.

For Master/Slave Installation
If you are installing multiple ATS660 digitizers that will be configured as a Master/Slave system, make sure that you insert all cards in adjacent slots.

The connector on the SyncBoard that is labeled as “M” (Master), must be inserted into the Master/Slave connector of the left-most digitizer, if you are facing the BNC connectors of the ATS660 digitizers.



If you are installing fewer than the maximum number of digitizers supported by your SyncBoard, the unused SyncBoard connectors must be on the right-hand side of the digitizers, if you are facing the BNC connectors of the ATS660 digitizers.

Once you have completed this step, you should power the computer on.

2. **Install ATS660 software driver, when prompted**

The following instructions guide you through the process of installing the ATS660 in a computer running Windows XP, Windows 2000 or Windows 98SE operating systems. Other operating systems, such as Windows NT, are not covered here.

Installation of Multiple ATS660 Digitizers
If you are installing multiple ATS660 digitizers, the operating system will detect one card at a time and you will have to go through the driver installation setup as many times as you have cards.

If you are installing multiple ATS660 digitizers under Windows 98SE, you will be prompted to reboot the computer after each installation. You should only reboot the computer after having installed the last ATS660 digitizer.

Installing ATS660 Driver In Windows 98SE

When you first plug in an ATS660 digitizer into a computer, the plug-n-play Windows 98SE operating system will detect the presence of a new PCI card and ask you to provide the device driver.

a) Operating System will display the **Welcome to the Found New Hardware Wizard**

   Click **Next**.

b) Operating system will display the **Install Hardware Device Driver** dialog box

   Select the radio button next to the text *Display a list of the known drivers for this device so that I can choose a specific driver.* Click **Next**.

c) Operating system will display the **Hardware Type** dialog box

   Select **System devices**

d) Operating system will display the **Select a Device Driver** dialog box

   Click on **Have Disk**

e) Operating system will display the **Install from Disk** dialog box

   Make sure the path points to **D:**, or wherever the ATS660.INF file resides. If you are using a floppy disk or a CD, make sure the disk is inserted in the drive.

   Select the ATS660.INF file and click **Open**

   The operating system may display **Install from Disk** dialog box again. If it does, Click **OK**, otherwise continue to the next step

f) Operating system will display the **Select a Device Driver** dialog box again.

Make sure the **AlazarTech ATS660 PCI Digitizer** is selected. Then click **Next**.

g) Operating system will display the **Update Driver Warning**. This warning is meant to tell you that Windows does not recognize the hardware.

Click **Yes**.

h) Operating system will display the **Start Device Driver Installation** dialog box.

Click **Next**. System will copy all necessary files to the appropriate folders.

i) Operating system will display the **Completing the Found New Hardware Wizard** message.

Click **Finish**.

Installing ATS660 Driver in Windows 2000

Before proceeding, make sure that you have sufficient administrative rights to install device drivers on your computer. Typically, you should be the Administrator for the computer you are installing device drivers on.

When you first plug in an ATS660 digitizer into a computer, the plug-n-play Windows 2000 operating system will detect the presence of a new PCI card and ask you to provide the device driver.

a) Operating System will display the **Welcome to the Found New Hardware Wizard**

Click **Next**.

b) Operating system will display the **Install Hardware Device Driver** dialog box

Select the radio button next to the text *Display a list of the known drivers for this device so that I can choose a specific driver.* Click **Next**.

c) Operating system will display the **Hardware Type** dialog box

Select **System devices**

d) Operating system will display the **Select a Device Driver** dialog box

Click on **Have Disk**

e) Operating system will display the **Install from Disk** dialog box

Make sure the path points to **D:**, or wherever the ATS660.INF file resides. If you are using a floppy disk or a CD, make sure the disk is inserted in the appropriate drive.

f) Select the ATS660.INF file and click **Open**

The operating system may display **Install from Disk** dialog box again. If it does, Click **OK**, otherwise continue to the next step

g) Operating system will display the **Select a Device Driver** dialog box again.

Make sure the **AlazarTech ATS660 PCI Digitizer** is selected. Then click **Next**.

h) Operating system will display the **Update Driver Warning**. This warning is meant to tell you that Windows does not recognize the hardware.

Click **Yes**.

i) Operating system will display the **Start Device Driver Installation** dialog box.

Click **Next**. System will copy all necessary files to the appropriate folders.

j) Operating system will display the **Completing the Found New Hardware Wizard** message.

Click **Finish**.

Installing ATS660 Driver In Windows XP

Before proceeding, make sure that you have sufficient administrative rights to install device drivers on your computer. Typically, you should be the Administrator for the computer you are installing device drivers on.

When you first plug in an ATS660 digitizer into a computer, the plug-n-play Windows XP operating system will detect the presence of a new PCI card and ask you to provide the device driver.

a) Operating System will display the **Welcome to the Found New Hardware Wizard**

   Click on the radio button next to the text *Install from a list or specific location (Advanced)*.

   Click **Next**.

b) Operating System will display the **Please choose your search and installation options** dialog box.

   Click on the radio button next to the text *Don't search. I will choose the driver to install*.

   Click **Next**.

c) Operating system will display the **Hardware Type** dialog box

   Select **System devices**

d) Operating system will display the **Select the device driver you want to install for this hardware** dialog box

   Click on **Have Disk**

e) Operating system will display the **Install from Disk** dialog box

Make sure the path points to **D:**, or wherever the ATS660.INF file resides. If you are using a floppy disk or a CD, make sure the disk is inserted in the drive.

Click **OK**.

f) Operating system will display the **Select the device driver you want to install for this hardware** dialog box again.

Make sure the **AlazarTech ATS660 PCI Digitizer** is selected (highlighted).

Click **Next**.

g) Operating system will display the **Update Driver Warning**. This warning is meant to tell you that Windows does not recognize the hardware.

Click **Yes**.

h) System will copy all necessary files to the appropriate folders.

i) Operating system will display the **Completing the Found New Hardware Wizard** message.

Click **Finish**.

3. **Install API Panel software that allows you to setup the hardware, acquire signals and view and archive them**

   If you are installing from the CD shipped with the ATS660 digitizer:

   - Insert the ATS660 Install disk
   - Use Windows Explorer to navigate to the API Panel folder on the ATS660 Install Disk. Run Setup.exe program
   - Follow the instructions on the screen.

   If you are installing API Panel after having downloaded the installation file from AlazarTech web site:

   - Download API Panel installation file from www.alazartech.com/support/downloads.htm
   - Unzip the file downloaded in the previous step.
   - Browse to the folder that contains the unzipped file, say API_Panel_V_4_2_0.exe
   - Run this executable file and follow the instructions on the screen.

4. **Optionally, install the ATS-SDK software development kit or ATS-VI LabVIEW VI, which enables you to programmatically control the ATS660**

   Insert the ATS-SDK or ATS-VI CD. Software installation will start automatically.

   If, for any reason, installation does not start automatically, run the SETUP.EXE program.

   Follow the instructions on the screen.

   Note that you must have already installed the ATS660 drivers for any of the sample programs included with the ATS-SDK or ATS-VI to work properly.

Installing the ATS660 in a Linux System

ATS660 is fully compatible with the popular Linux operating system.

AlazarTech supplies binary Linux drivers that have been compiled for Fedora Core 4 (kernel 2.6).

Customers who require drivers for another version of Linux must contact the factory to obtain source code for the drivers (requires a Non-Disclosure Agreement). AlazarTech will not provide software support for compiling drivers for other versions of Linux, i.e. customers will be fully responsible for compiling drivers for their own Linux operating system.

To install Linux drivers in a Fedora Core 4 system, follow the instructions listed below:

1. Copy the supplied RPM file to the target machine
2. Double-click on the RPM icon. This will install the driver as well as associated applications.
3. Reboot the PC.
   Note that if you do not reboot the PC, the driver will not be loaded.

The RPM file will also install an application called AlazarDSO. This is a Graphical User Interface (GUI) using which you can setup and acquire data from the ATS660.

> Note that AlazarDSO has been compiled using GTK 2.4 libraries. If you intend to use an operating system other than Fedora Core 4, make sure that the GTK 2.4 libraries have been installed on your machine.

Compiling the ATS660 Linux Driver

If you need to compile the ATS660 driver for a version of Linux other than Fedora Core 4, follow the following steps:

1. Install the Linux kernel header files.
2. Extract the driver sources using the command "tar xvfz PlxLinux-2006.01.10.tgz". This will create a folder named "PlxLinux" with the driver files inside.
3. Set the shell environment variable PLX_SDK_DIR to the root location where the "PlxLinux" directory was created. For example, if using bash and the PlxLinux directory is in your home directory, then add the following line to the ~/.bashrc :

   declare -x PLX_SDK_DIR=$HOME/PlxLinux

4. To build the ATS660 driver, type

   ```
   cd PlxLinux/linux/driver
   ./builddriver 660
   ```

   This will create the file Pci9056/ATS660.ko, the loadable driver file. You can change build defines in PlxLinux/linux/makefiles/Gcc.def. Copy the driver to /usr/local/AlazarTech/bin.

5. Load the driver by rebooting the computer or typing:

   ```
   cd /usr/local/AlazarTech/bin
   ATS660.rc start
   ```

   The customer should be able to run the AlazarDSO application or Acq2Disk sample in /usr/local/AlazarTech/samples/ATS660.

6. If it is necessary to rebuild the library, type

   ```
   cd PlxLinux/linux/api
   make
   ```

This will create SharedLibrary/libPlxApi.so.0.0. Copy the file to /usr/local/AlazarTech/lib and then run ldconf

Configuring Internet Security and Virus Protection Software to Allow Proper Operation of ATS Class Digitizers

Some of the recent releases of internet security and virus protection software packages, such as Norton Anti-Virus, disable any unused parallel or serial ports as well as any PCI devices that have not been assigned to a software application by the user. Users of AlazarTech PCI digitizers must configure their security software to allow access to the PCI digitizers.

The problem exhibits itself as a blue-screen crash and a "STOP Error".

Typically, this error message is:

```
STOP:   0x0000000A
        (0x00000016, 0x0000001C, 0x00000000, 0x804E5DEB)
```

For more details on this problem with anti-virus software packages, refer to the technical note on Microsoft's support site :

http://support.microsoft.com/kb/892000/EN-US

Also refer to the knowledgebase article on Symantec's web site:

http://service1.symantec.com/SUPPORT/sharedtech.nsf/0/2671ef6e5d72d3cd88256d26006699d5?OpenDocument

This article explains that the root of the problem is one of the files updated by the Symantec anti-virus software.

Symantec suggests that users should upgrade their internet security software using Live Update, but our customers' experience has been that this does not always work.

The solution that always works is:

- Remove Norton Anti-Virus software
- Reboot the PC after removing Norton Anti-Virus.
- Make sure AlazarTech hardware and software are fully functional
- Re-install Norton Anti-Virus software

AlazarTech PCI digitizer products are fully compatible with all internet security and anti-virus software. Users must make sure that their security software has been updated and configured properly..

Updating ATS660 Driver

From time to time, AlazarTech updates the device drivers for its products. These updates may be required for product enhancements or for bug fixes.

This section of the manual takes you through the steps required to update the device driver for the ATS660 PCI digitizer.

In other words, this section shows you how to install a newer version of the driver, when you already have a previous version of the driver installed on your machine.

1. Run Device Manager. To do so:
    a. Run **Control Panel** by opening **Start » Settings » Control Panel**
    b. Open **System Properties** dialog box by selecting or double-clicking on the **System** menu
    c. Click on **Hardware** tab in the dialog box
    d. Click on **Device Manager** button
2. **Device Manager** lists all hardware devices in your computer. AlazarTech PCI digitizers are listed within **System Devices**
3. Expand the **System Devices** list
4. Double-click on the **AlazarTech ATS660 PCI Digitizer** device.

    If more than one such devices are present, choose the first one in the list
5. This will open up the **AlazarTech ATS660 PCI Digitizer Properties** page
6. Click on the **Driver** tab
7. Click on **Update Driver** button near the bottom-right corner of the page
8. This will cause the **Upgrade Device Driver Wizard** to be started

9. To complete the installation, follow the instructions provided in the section labeled:

    a. *Installing ATS660 Driver in Windows 98SE*

    Or

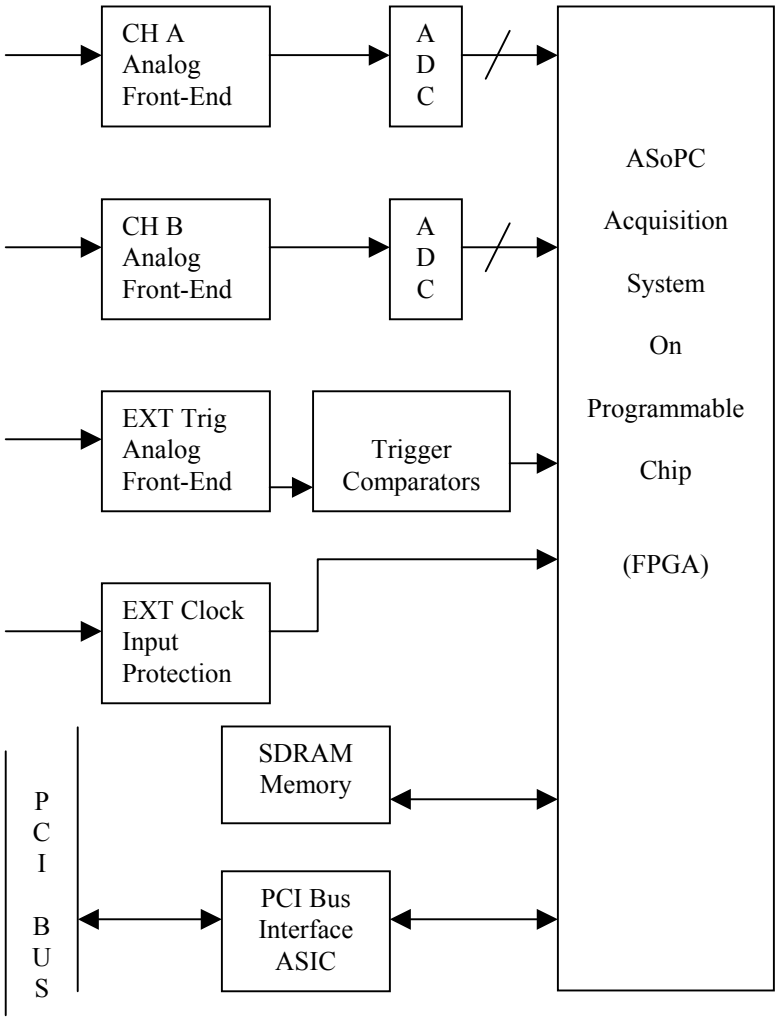
    b. *Installing ATS660 Driver in Windows 2000*

    Or

    c. *Installing ATS660 Driver in Windows XP*

Chapter 3 - Hardware Overview

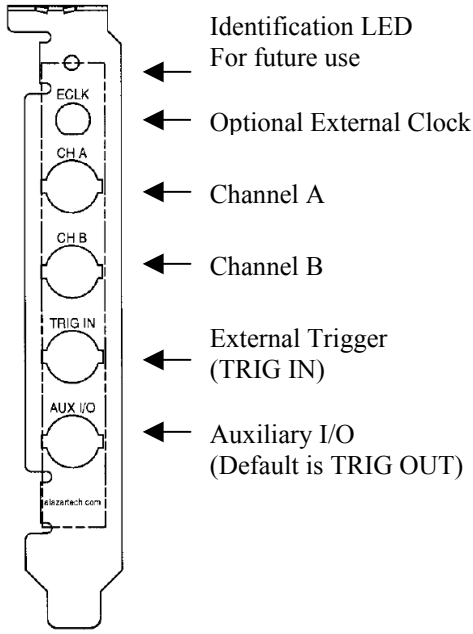
This chapter includes an overview of the ATS660, explains the operation of each functional unit making up your ATS660, and describes the signal connections. Following is a high-level block diagram of ATS660.



Input Connectors

ATS660 digitizers have one SMA connector for ECLK (External Clock) Input, two standard BNC female connectors for CH A and CH B analog input connections, one standard BNC female connector for the TRIG IN (External Trigger) input and one standard BNC female connector for AUX I/O (Auxiliary Input or Output).

The following pictorial shows the various connectors available on the digitizer bracket.



Signal Connections

You can use CH A and CH B to digitize data as well as to trigger an acquisition.

Use the EXT input for an external analog trigger only; data on the TRIG channel cannot be digitized.

If External Clock Upgrade is installed on your ATS660, use the ECLK input for clocking the ATS660 in applications that require an external clock. Consult the chapter Optional External Clock for details on various types of clocking schemes available.

AUX I/O connector can be used for outputting TRIG OUT signal, a 5 V TTL signal synchronous with the on-board trigger signal and the sampling clock.

- Note that the Trigger Output connector can also be configured as a Trigger Enable Input through a software command. Contact factory for details.

Analog Input

The two analog input channels are referenced to common ground in bipolar mode. These settings are fixed; therefore, neither the reference nor the polarity of input channels can be changed. You cannot use CH A or CH B to make differential measurements or measure floating signals unless you subtract the digital waveforms in software.

For accurate measurements, make sure the signal being measured is referenced to the same ground as your ATS660 by attaching the probe's ground clip to the signal ground.

The EXTernal Trigger input (labeled TRIG IN) has a programmable input range of ±5 V or ±1 V.

The CH A, CH B, and EXT inputs have a software-programmable coupling selection between AC and DC. Use AC coupling when your AC signal contains a large DC component. Without AC coupling, it is difficult to view details of the AC component with a large DC offset and a small AC component, such as switching noise on a DC supply. If you enable AC coupling, you remove the large DC offset for the input amplifier and amplify only the AC component. This technique makes effective use of dynamic range to digitize the signal of interest.

The *low-frequency corner* in an AC-coupled circuit is the frequency below which signals are attenuated by at least 3 dB. The low-frequency corner is approximately 10 Hz with 1 MΩ input impedance and 100 KHz with 50Ω input impedance.

Pipelined ADC
Each of the two ADCs on the ATS660 is a pipelined flash converter with a maximum conversion rate of 130 MS/s.

If you use an external clock, you must provide a free-running clock to ensure reliable operation. You also must follow all the timing specifications on the external clock as described in Appendix A, Specifications.

Pre-Trigger Multiple Record Acquisition
The ATS660 allows the capture of multiple records into the on-board memory. This allows you to capture rapidly occurring triggers in lightning test, ultrasound or radar applications.

Unlike other digitizers on the market, users are allowed to acquire both pre- and post-trigger data when acquiring more than one record in an acquisition session. This feature can be very useful in lightning test, power line monitoring and other applications that feature rapidly occurring transient signals.

Specifying Record Length
Record Length is specified in number of sample points. It must be a minimum of 128 points and can be specified with a 16-sample resolution up to a maximum of the per-channel on-board memory.

Record Length thus specified determines the maximum number of records you can capture in one acquisition session. The relationship is given by:

Max. Records = (Per-Channel Memory) / (Record Length + 16)

Note that, unlike other products in its class, ATS660 allows you to capture multiple records into the on-board memory without requiring software-assisted re-arming of the digitizer.

Specifying Pretrigger Depth
ATS660 acquires a certain number of samples, called the pretrigger depth, *before* it allows the trigger circuitry to operate, thereby guaranteeing that the required number of sample points will be captured before trigger occurs.

User is allowed to set pretrigger depth for an acquisition session. Same values are used for all records captured in that session.

Pretrigger depth can be a minimum of 0 points and can be specified with a 16 sample resolution up to a maximum of (Record Length – 64).

Specifying Record Count
User can specify the number of records that must be captured into on-board acquisition memory in one acquisition session. The minimum value must be 1 and the maximum value is given by:

Max. Records = (Per-Channel Memory) / (Record Length + 16)

- Note that this limit does not apply if you are using dual port memory and AutoDMA to transfer data to PC host memory while you are acquiring data. In that case, you can capture an infinite number of records.

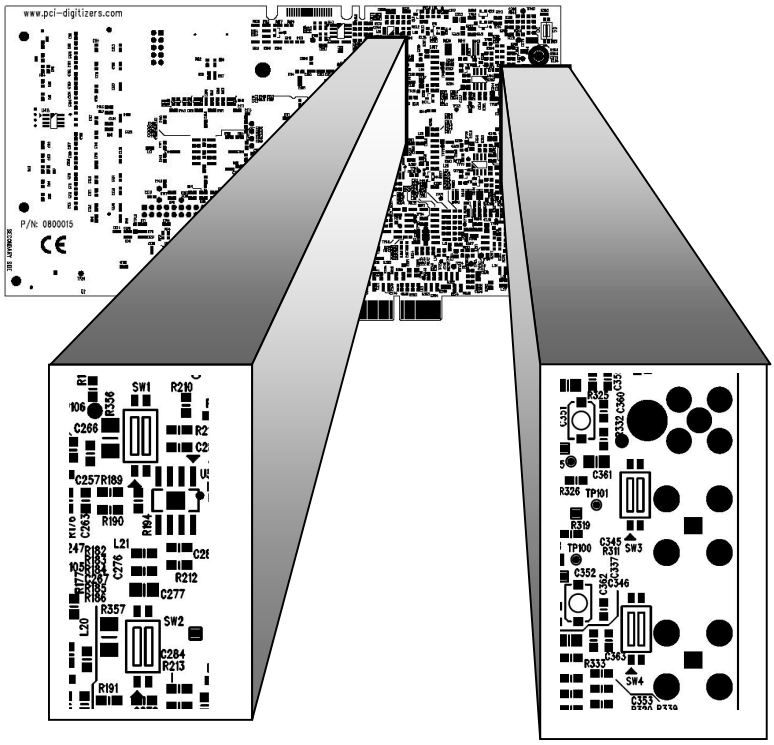
Amplifier Bypass Option

ATS660 includes the capability to bypass the input amplifier in order to maximize dynamic performance.

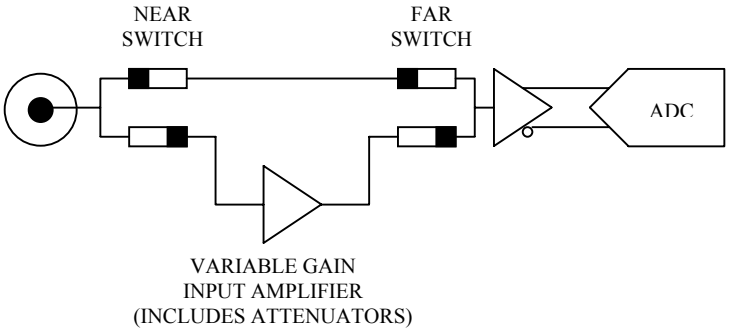
ATS660 allows the user to set and reset the Amplifier Bypass Option using on-board DIP switches.

The user can bypass the amplifier on any one, or both, channels of ATS660.

The following picture of the secondary side of ATS660 board shows the location of four DIP switches used for this purpose (2 DIP switches per channel):



The concept behind Amplifier Bypass Option is very simple, as shown below:



There are two DIP switches per channel: the one closest to the input BNC connectors is called the “Near Switch” and the one closest to the ADC IC is called the “Far Switch”.

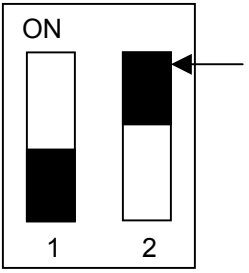
Each DIP switch, in turn, has two individual switches, called Switch 1 and Switch 2.

Under normal operating conditions, Switch 1 is always OFF (disconnected) and Switch 2 is always ON (connected). Thus, the input signal travels through the input amplifier and attenuator circuitry before being digitized by the ADC IC.

To select “Amplifier Bypass Mode”, the switch settings must be changed such that Switch 1 is always ON (connected) and Switch 2 is always OFF (disconnected). This would bypass all input amplifier circuitry and inject the signal directly into the driving amplifier of the ADC.

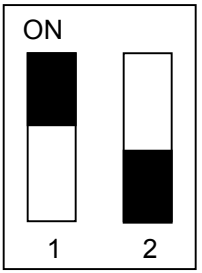
It is very important that the user set both the “Near Switch” and “Far Switch” with the same settings. Failure to do so can cause measurement errors.

The default setting of all four of the DIP switches is shown below:

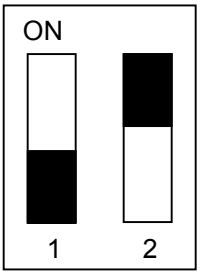


The black square represents the plastic tab for the switch. Note that the actual tab may not be black. It may, in fact, be white.

To set Amplifier Bypass Option for a channel, change the DIP Switch setting of the Near and Far switches for that particular channel to be as shown below:



To re-insert the input amplifier in the signal path, i.e. to remove Amplifier Bypass Option, change the DIP Switch setting of the Near and Far switches for that particular channel to be the same as the factory-set default:



NOTE THAT ANY SETTINGS OTHER THAN THE ONES SHOWN ABOVE ARE ILLEGAL, AND MAY CAUSE DAMAGE TO THE ATS660 ANALOG CIRCUITRY

Calibration

Calibration is the process of minimizing measurement errors by making small circuit adjustments.

All ATS660 digitizers come factory calibrated to the levels indicated in Appendix A, Specifications. Note that AlazarTech calibration is fully NIST traceable.

However, your digitizer needs to be periodically recalibrated in order to maintain its specified accuracy. This calibration due date is listed on the CALIBRATION sticker affixed to your ATS660 digitizer.

Externally recalibrate the ATS660 when this calibration interval has expired.

This requires three very simple steps:

1. Verify whether or not ATS660 is still within its specifications. If it is, then your calibration can be extended by another one-year period
2. If not, perform calibration, i.e. make adjustments to the circuit until it is within specifications again
3. If any adjustments have been made, verify if the ATS660 is within specifications

Verification and Calibration procedures are available to all registered users of ATS660 upon request.

Master/Slave Operation

You can use two or more ATS660 digitizers in one system to increase the number of channels for your application by synchronizing digitizers using the appropriate SyncBoard.

Currently, up to 16 channel (8 board) systems are supported for ATS660. For higher channel counts, contact the factory for special system configuration.

Unlike other products on the market, ATS660 does not suffer from clock jitter between master and slave digitizers.

The unique design of the ATS660 clock circuit provides a buffered copy of the Master digitizer's clock to itself and all the slave digitizers, thereby maintaining a very low skew between Master and Slave digitizer clocks.

Note that an ATS660 Master/Slave system is capable of triggering from any one of its input channels. This is valuable in multi-channel detector applications that cannot predict the input channel that is going to receive the first pulse.

With fully synchronous A/D conversion, arming and triggering, an ATS660 based Master/Slave system is an ideal multi-channel transient analyzer.

Restrictions
To ensure proper master/slave operation of your ATS660 digitizers, you must observe the following restrictions:

- All Master/Slave digitizers must be installed in adjacent slots, i.e. there should be no gap between the digitizers that are to be configured as a Master/Slave system

Good Installation

Bad Installation

- You must connect the appropriate SyncBoard to all of the ATS660 digitizers in your system. Note that all SyncBoards are polarized, so you cannot make a mistake in inserting them

- If you are using fewer than the maximum number of digitizers allowed by the SyncBoard, make sure that the connector labeled “M” (Master) on the SyncBoard is connected to one of the ATS660 digitizers. Any over-hang of the SyncBoard should be beyond the last slave board in your system

The presence of a SyncBoard is detected by the ATS660 driver when the ATSApi DLL is loaded. This DLL gets loaded when you run any application program written for ATS660. Examples of such application programs are API Panel, one of the sample programs supplied with ATS-SDK or ATS-VI or any custom software written using ATS-SDK or ATS-VI.

If you run API Panel or your own software that loads the ATSApi DLL, after having installed a SyncBoard, the ATS660 driver will automatically recognize that the digitizers are now configured as Master/Slave.

As such, there is no need to have your hardware upgraded or modified in any way to go from a set of independent boards to Master/Slave and vice-versa.

HyperDisP® Display Technology

ATS660 uses proprietary HyperDisP® technology to allow the user to display datasets as long as 128 Million points in a few seconds. This provides the user with instantaneous feedback on the screen, compared to many tens of seconds or even minutes it may take with other product on the market.

Displaying large datasets under Windows is difficult, to say the least. The first problem is that Windows does not like to allocate large data buffers. This implies that a large data buffer will inevitably thrash to disk, slowing down display processing.

Secondly, standard Windows draw routines are not optimized for large datasets and slow down the display even if the data does not thrash to disk.

HyperDisP® is a proprietary hardware technology contained in the ATS660 that reduces large datasets to a more manageable size, without losing any of the information contained in the signal.

In other words, HyperDisP® enables fast screen updates not by simply “skipping” data points, but by doing data processing on every captured point and mapping it to one of the screen pixels.

Optional External Clock

ATS660 PCI Digitizer optionally allows you to supply the ADC clock. This option is extremely important in many RF applications in which phase measurements must be made between the inputs themselves or between the inputs and an external event.

Driving high performance ADCs must be done carefully, as any injection of phase jitter through ADC clocks will result in reduction in data conversion quality.

Aside from phase noise, the clock signal for a pipelined ADC must also have a duty cycle close to 50%. This maximizes the dynamic performance of the ADC. See Fast External Clock section below for more details.

External clock input impedance is fixed at 50 Ohms.

External clock input coupling can be set to AC or DC, under software control.

There are three types of External Clock supported by ATS660:

- Fast External Clock
- Slow External Clock
- 10 MHz Clock Reference

The following paragraphs describe the three types of External Clock input and outline the restrictions on each of them.

Fast External Clock
This setting must be used when the external clock frequency is in the range of 1 MHz to 125 MHz. The frequency can change from one cycle to the next, as long as it stays within this range.

It is highly recommended that the external clock signal have a duty cycle of 50% +/- 5%.

If the External Clock supplied is lower than 1 MHz, measurement quality will be compromised. Measurement errors may include gain errors, signal discontinuities and general signal distortion.

If you want to clock slower than the lower limit of Fast External Clock, you must use the Slow External Clock range.

Slow External Clock
This setting must be used when the external clock frequency is slower than the lower limit of Fast External Clock.

In this range, the input clock is tracked by the 125 MHz internal clock and a sample is taken on every rising or falling clock edge. As such, there will be a timing error of 0 to 8 nanoseconds. For low bandwidth signals, this error can be considered to be negligible.

Note that if you use Slow External Clock and your clock frequency is higher than 10 MHz, you may see significant signal distortion.

10 MHz Clock Reference
ATS660 allows the user to synchronize the sampling clock to an external 10 MHz reference signal. This is useful in many RF applications.

Reference clock frequency must be 10 MHz +/- 0.5 MHz.

It should be noted that the user can set the sampling frequency from 100 MHz to 130 MHz, with 1 MHz resolution.

Optional Dual-Port Memory & AutoDMA

One of the most unique features of the ATS660 is its dual-port memory and the associated AutoDMA mechanism of transferring data to host PC memory without any appreciable "in-process" software involvement.

These features are particularly useful for applications that require:

a) Continuous, gapless data capture. Also known as "Data Streaming" to PC host memory or hard disk

or

b) Data capture from rapidly occurring triggers, also known as Pulse Repeat Frequency Captures or PRF Captures.

In order to understand these sophisticated features, let us first review some of the issues involved in transferring data under Windows or Linux operating systems.

The Effects of the Operating System

Windows and Linux are not real-time operating systems, i.e. the operating system cannot guarantee a deterministic response time to an event, such as an interrupt or a software generated event.

This means that if software has to play any appreciable part in data transfer, then the data throughput cannot be guaranteed, as the operating system will have the last say as to when the data collection application will get the CPU cycles to execute the necessary commands.

Note that the above is true even if the digitizer claims to use Direct Memory Access (DMA) to do the actual transfer, but uses software commands to re-arm the digitizer. It is the re-arm command that will determine the overall data throughput.

For example, it is very common for PCI digitizers that boast very fast throughput to slow down considerably when capturing pulsed radar or ultrasonic signals at Pulse Repeat

Frequency (PRF) of 1 KHz or so, even though each capture is only 2048 bytes (requiring a throughput of only 2 MB/s).

In other words, digitizers that specify raw data throughput of 100 MB/s can hardly handle 2MB/s effective throughput due to the operating system related delays in issuing re-arm commands.

Real-Time Operating Systems
Some vendors claim that switching to a real-time operating system (RTOS) can solve the problems involved in PRF data capture.

Before switching to an expensive RTOS (such as VxWorks, QNX or PharLap ETS), ask the vendor of the operating system, the supplier of your PC system and manufacturer of the digitizer board if they are all guaranteed to be 100% compatible and interoperable with each other with deterministic interrupt latencies and if you will get your money back if the system does not work at your PRF rates with your software.

Here is an excerpt from a FAQ section of one such supplier of RTOS:

> Question: How do system configuration and CPU selection impact the interrupt latency?
>
> Answer: Hardware platforms and the configuration of the associated drivers that use the hardware do impact response times. Some of the common issues include:
>
> Video cards - some of the higher-end cards lock-out (or busy-wait) the bus for extended periods of time to improve their performance.
>
> DMA devices - devices which burst DMA for lengthy period.
>
> Power management which cycles off the CPU during IDLE CPU periods.
>
> Memory speeds, processor speeds, etc.

A PCI digitizer being used in a PRF application is, by definition, doing “burst DMA for lengthy period”, and is a type of product that can negatively impact response times of the RTOS.

As such, the claim that an RTOS can remove all timing uncertainties in PRF application is suspect, to say the least.

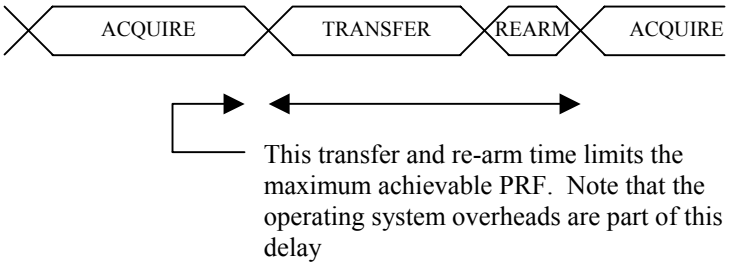
Furthermore, you may not be able to get software drivers for the selected RTOS for all the hardware components you need for your system.

In summary, moving to a real-time operating system will not guarantee data throughput, but will surely increase the overall system cost, increase the cost of software development and maintenance and limit the number of suppliers for other hardware components.

Dual Port Memory

The basic throughput problem faced by digitizers is that almost all of them use single-port memory, i.e. if you are reading data from the acquisition memory, you cannot capture into it and vice-versa.

This requires a software handshake which is heavily dependent on the operating system response time.



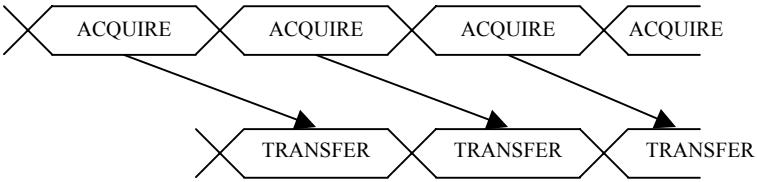
ATS660 solves this problem by providing dual-port memory. When operated in Multiple Record mode (Record Count > 1), a new record is being captured even while you read the previous one from the on-board memory.

Or in the case of continuous capture, or Data Streaming, ATS660 acquires a specific number of samples, say 1 Megasample, and initiates a DMA while capturing the next Megasample of data, thereby guaranteeing that there is no break in data storage.

In both cases, the system does not have to wait until the end of data capture to read the acquired data.

AutoDMA for PRF Captures and Streaming Applications
Just having dual-ported memory, on its own, does not solve the problem of PRF captures or streaming applications. Software still has to get involved in re-arming the hardware after every capture and again for reading the data from on-board acquisition memory.

ATS660's proprietary AutoDMA feature allows the acquisition system to be re-armed by a hardware command and data transfer to be initiated by the hardware itself, thus removing virtually all "in-process" software involvement.



Of course, software still has to set up the DMA when one of the buffers fills up, but that can be done fairly quickly and the on-board memory acts as a very deep FIFO to accommodate this latency. The maximum latency that can be handled by the ATS660 is given by:

$$Latency_{max} = \text{On-Board Memory / PCI Transfer Rate}$$

Where "PCI Transfer Rate" is the effective rate at which data is being transferred across PCI bus. For example, if the trigger repeat rate is 8 KHz and Record Length is 4096 samples and only one channel is being captured, then PCI Transfer Rate is (8 KHz * 4096) = approximately 32 MS/s or 64 MB/s.

For streaming applications, PCI Transfer Rate is equal to the sample rate set by the user.

An ATS660-8M transferring across the bus at 5 MS/s (10 MB/s) provides latency protection of (8MS / 5MS/s) = 1.6 seconds. This is usually sufficient for most Windows related latencies, including disk accesses, screen updates etc.

An ATS660-8M transferring across the bus at 50 MS/s (100 MB/s) provides latency protection of only (8MS / 50MS/s) = 160 milliseconds. Testing has shown that this latency protection is insufficient for screen updates and disk accesses.

An ATS660-128M transferring across the bus at 50 MS/s (100 MB/s) provides latency protection of (128MS / 50 MS/s) = 2.5 seconds.

- If very fast PCI transfer rates are required, e.g. 100 MB/s, it is highly recommended that ATS660-128M be used, as it would give 2.5 seconds of latency protection even in the worst case.

Note that if the PCI Transfer Rate is too high for AutoDMA to keep up, a DMA_OVERFLOW flag gets set and is available to the programmer.

Consumption of the captured data is, of course, under the control of user-created software, and it is this that will determine the maximum PRF instead of the bus throughput.

Chapter 4 – Using API Panel Software

This chapter provides a Quick Start Guide to the **API Panel** software supplied with your ATS660.

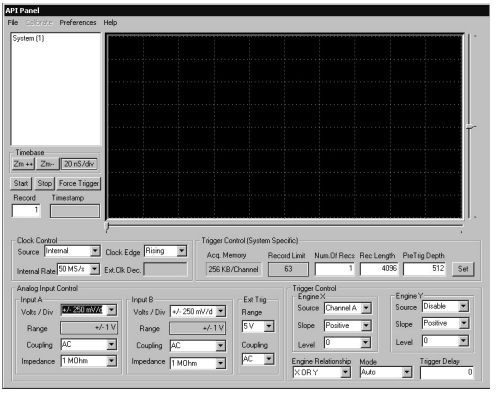
API Panel Installation
For installing API Panel software, refer to the installation section of this manual.

Launching API Panel
You can launch API Panel by the following two methods:

1. By double-clicking on the API Panel desktop icon

2. By running **Start » Programs » AlazarTech » API Panel**

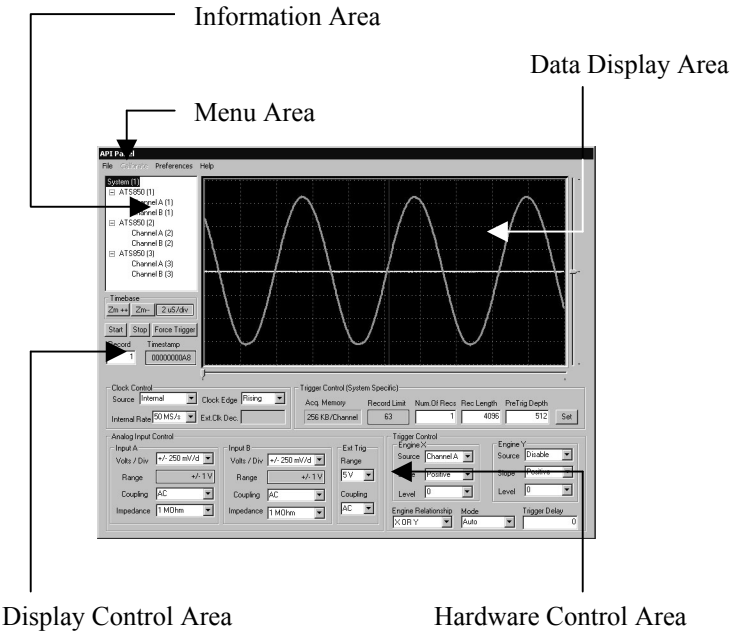
You will hear the clicking of some on-board relays, as API Panel initializes the hardware and places it in a known state. Then, the API Panel screen will be displayed. Note that no signals will be displayed until you click on the **Start** button.



Exiting API Panel
Open the File menu and click on **Exit**.

API Panel screen is divided into five sections:

1. Data Display Area
2. Hardware Control Area
3. Display Control Area
4. Information Area
5. Menu Area



Data Display Area is an oscilloscope style grid of 8 vertical and 10 horizontal divisions.

By default, all signals are overlapped, with the zero-level being the vertical mid-point of the area.

Hardware Control Area provides the user complete control over the hardware parameters of the ATS660. API Panel also performs complete error checking on all user selections to make sure that only valid settings are passed on to the hardware.

The following controls are included in this area:

Sampling Clock Control

This control is not available on Slave digitizers.

The Clock Source drop-down selection allows the user to select between the internal clock oscillator and the optional ECLK input.

The Sample Rate field selects the specified sampling rate when Internal Clock is selected.

Note that If External Clock is selected, the Sample Rate field causes the digitized data to be decimated based on the ratio of the sample rate to 100 MHz, i.e. if user selects 20 MS/s sample rate after having selected External Clock, API Panel will decimate the digitized data by a factor of (100 MS/s divided by 20 MS/s) = 5.

Clock Edge field allows the user to specify either the rising or the falling edge of the clock for sampling. While it has very little meaning for Internal Clock, this can be a very useful feature if External Clock is selected.

Decimation Ratio field is reserved for future use.

Channel A Input Control

API Panel allows the user to set the vertical scale, input coupling and input impedance for Channel A. Note that the full-scale input range is defined as being +/- 4 divisions. Therefore, a vertical scale of 250 mV/div results in full scale input range of +/- 1V.

Further note that API Panel does not allow the user to set a vertical scale greater than 1 V/div (+/- 4 V full scale) if 50Ω input impedance is selected for Channel A.

Channel B Input Control

API Panel allows the user to set the vertical scale, input coupling and input impedance for Channel B. Note that the full-scale input range is defined as being +/- 4 divisions. Therefore, a vertical scale of 250 mV/div results in full scale input range of +/- 1V.

Further note that API Panel does not allow the user to set a vertical scale greater than 1 V/div (+/- 4 V full scale) if 50Ω input impedance is selected for Channel B.

External Trigger Input Control

API Panel allows the user to select the input coupling and full scale input range of the External Trigger input.

Trigger Control

API Panel supports the dual-engine triggering featured on the ATS660. These trigger engines are called Engine X and Engine Y.

For each engine, the user can select a trigger source, a trigger level and the trigger slope. User is allowed to set the same source on both engines for Windowed triggering applications.

User can also select the Trigger Mode. The default mode is Auto, but the user can also select Normal and Single-Shot. The definitions of these terms are exactly the same as on most digital oscilloscopes, except that ATS660 supports each trigger mode in

Multiple Record captures as well as Single Record captures:

In Auto-Trigger mode, the trigger system generates a software trigger after waiting a pre-determined amount of time. In Multiple Record captures, each record can generate its own timeout. This mode is usually employed during the part of experimentation in which you are not aware of what exact signals you are trying to capture.

In Normal Trigger mode, the trigger system waits indefinitely for trigger to occur. No software triggers are generated. Once the required number of trigger events has occurred, data is displayed and the ATS660 is re-armed to capture data again. This mode is usually employed for capturing transient signals that occur repeatedly.

In Single-Shot mode, the trigger system waits indefinitely for one (single-record capture) or more (multiple record capture) trigger events. Once all triggers have occurred, data is captured and displayed and no further acquisitions are allowed.

Acquisition Memory Control

This control is not available on Slave digitizers.

API Panel allows the user to set Record Length, Pre-Trigger Depth and Number of Records to Capture. If the Modify button is clicked, a dialog box appears that lets the user set Record Length, Pre-Trigger Depth and Number of Records to Capture. API Panel checks for all dependencies between these three settings and then sets them on the hardware.

Verification of the settings is done based on the following dependencies:

- Record Length must be a minimum of 128 points

- Record length must not exceed 8,000,000 points for the 8M model or 128,000,000 points for the 128M model
- Record length must be a multiple of 64 points
- Pre-Trigger Depth must not exceed (Record Length – 64)
- Number of Records to Capture must not exceed the lower of 256,000 or (8,000,000 / (Record Length + 16)) or for the 8M version and lower of 256,000 or (128,000,000 / (Record Length + 16)) for the 128M model

If any settings are found to be illegal, an error message is generated and the user is asked to enter the selections again.

Display Control Area allows the user to select the View Record and the display timebase. It also displays the 40-bit timestamp for the record selected. This area also includes the Start, Stop and Force Trigger command buttons. A Trigger indicator is also included in this area.

The user is not allowed to set View Record to be greater than the number of records captured. Note that API Panel checks View Records against the number of records captured in the last capture and not the current selection of Number of Records to Capture field in the Acquisition Memory Control section. This feature is very useful if you are capturing signals using One-Shot trigger mode.

The minimum setting of the timebase depends on the sampling clock frequency. The timebase limits are given by:

Minimum Timebase = $1 / f_s$,
where f_s is the frequency of the sampling clock

Maximum Timebase = $2 * \text{Record Length} * (1 / f_s) / 10$

In other words, the user is not allowed to set a timebase that results in displaying less than 10 points or more than 200% of record length.

The 40-bit timestamp is displayed as a 40-bit hexadecimal number. Each count of the timestamp corresponds to 2 sample clocks. This count is initialized to zero when the software instructs the ATS660 to start acquiring data and start looking for a trigger.

Information Area displays all the AlazarTech systems installed on the computer.

This information is displayed in an Explorer-like tree structure. By expanding any System, users can check how many digitizers are included in the system and whether they are ATS660 or another type of digitizer.

Users can also expand each digitizer to see how many input channels that digitizer provides.

When one of the channels is selected (by clicking the left button of the mouse on the channel name), the vertical scrolling slider is activated for that channel.

User can also enable or disable the displaying of a particular channel by right-clicking on that channel.

Menu Area provides the standard Windows menus.

File menu allows the user to save acquired signals as comma separated ASCII values or FlexPro compatible ASCII files.

Select Exit command from the file menu to terminate API Panel.

Preferences menu allows the user to select whether the individual points should be displayed as circles or they should be connected by a straight line.

A “Find Trigger” command is also provided to make it easy to scroll back to the trigger point.

Help menu allows the user to check which version of API Panel, ATS660 driver and SDK are being used. This feature is very useful for technical support.

Appendix A - Specifications

This appendix lists the specifications of the ATS660. These specifications are typical at 25 °C unless otherwise stated. The operating temperature range is 0 to 50 °C.

System Requirements

Pentium based computer with at least one free PCI slot, 128 MB RAM, 20 MB of free hard disk space, SVGA display adaptor and monitor with at least an 800 x 600 resolution. API Panel requires Internet Explorer 5.0 or higher.

Power Requirements

+5V	2.5 A, typical for ATS660-8M 3.0 A, typical for ATS660-128M +5V voltage level must remain between the range of 4.75V to 5.20V at all times after power-on

Physical

Size	Single slot, half-length PCI card (4.2 inches x 7.2 inches)
Weight	500 g

I/O Connectors

ECLK	SMA female connector
CH A, CH B, TRIG IN, AUX I/O	BNC female connectors

Environmental

Operating temperature	0 to 55 °C
Storage temperature	-20 to 70 °C
Relative humidity	5 to 95%, non-condensing

Acquisition System

Resolution	16 bits
Bandwidth (-3dB)	
DC-coupled, 1MΩ	DC - 65 MHz
DC-coupled, 50Ω	DC - 65 MHz
AC-coupled, 1MΩ	10 Hz - 65 MHz
AC-coupled, 50Ω	100KHz - 65 MHz
Bandwidth flatness:	± 1dB, from DC to 10 MHz with DC coupling ± 1dB, from 50Hz to 10 MHz with AC, 1 MΩ ± 1dB, from 200 KHz to 10 MHz with AC, 50Ω
Bandwidth Limit	20 MHz, typical. Software selectable for each input channel independently
Number of channels	2 simultaneously sampled
Maximum Sample Rate	125 MS/s single shot (internal clock) 130 MS/s single shot (external clock)
Minimum Sample Rate	1 KS/s single shot (internal clock) 1 MS/s single shot (Fast External Clock)
Full Scale Input ranges	
1 MΩ:	±200mV, ±400mV, ±800mV, ±2V, ±4V, ±8V and ±16V, software selectable
50 Ω:	±200mV, ±400mV, ±800mV, ±2V and ±4V, software selectable
DC accuracy	±2% of full scale in all input ranges
Input coupling	AC or DC, software selectable
Input impedance	50Ω or 1MΩ ±1% in parallel with 30 pF ±10pF, software selectable
Input protection	
1MΩ	±28V (DC + peak AC for CH A, CH B and EXT only without external attenuation)
50Ω	±5V (DC + peak AC for CH A, CH B and EXT only without external attenuation)

Amplifier Bypass Mode

DIP Switch Selectable	Yes, independently for each channel
Input Range	Approximately 550 mV rms
Input Coupling	DC, irrespective of input coupling setting for the channel
Input Impedance	50 Ω, irrespective of input impedance setting for the channel
Input Bandwidth (-3dB)	85 MHz

Acquisition Memory System

Acquisition Memory/channel	For ATS660-8M: Up to 8,000,000 samples per channel standard For ATS660-128M: Up to 128,000,000 samples per channel standard
Record Length	Software selectable with 16-point resolution. Record length must be a minimum of 128 points. Maximum record length is limited by the acquisition memory per channel.
Number of Records	Software selectable from a minimum of 1 to a maximum of 256,000 or (Acquisition Memory Per Channel / (Record Length+16)), whichever is lower
Pre-trigger depth	0 to (Record Length-64), software selectable with 16 point resolution
Post-trigger depth	Record Length - Pre-trigger depth

Timebase System

Timebase options	Internal Clock or External Clock (Optional)
Internal Sample Rates	125 MS/s, 100 MS/s, 50 MS/s, 20 MS/s, 10 MS/s, 5 MS/s, 2 MS/s, 1 MS/s, 500 KS/s, 200 KS/s, 100KS/s, 50 KS/s, 20KS/s, 10KS/s, 5 KS/s, 2 KS/s, 1 KS/s
Internal Clock accuracy	±25 ppm

Dynamic Parameters

Typical values measured using a randomly selected ATS660 with Amplifier Bypass Mode. Input was provided by a HP8656A signal generator, followed by a 9-pole, 1 MHz band-pass filter (TTE Q36T-1M-100K-50-720B). Input frequency was set at 1 MHz and output amplitude was 520 mV rms, which is approximately 95% of the 550 mVrms full scale input in Amplifier Bypass Mode.

SNR	72.9 dB
SINAD	72.3 dB
THD	-83.2 dB
SFDR	-82.7 dB

Note that these measurements were made using raw data: no signal averaging was used to artificially improve the results.

Further note that these dynamic parameters may vary from one unit to another, with input frequency and with the full-scale input range selected.

Optional ECLK (External Clock) Input

Signal Level	LVTTL levels or 200 mV sine wave
Input impedance	50Ω
Input Coupling	AC or DC, software selectable
Maximum frequency	
Fast External Clock:	125 MHz with 50% ±5% duty cycle
Slow External Clock:	10 MHz with minimum positive or negative pulse width of 10 ns
10 MHz Clock Reference:	10.5 MHz
Minimum frequency	
Fast External Clock:	1 MHz with 50% ±5% duty cycle
Slow External Clock:	DC
10 MHz Clock Reference:	9.5 MHz
Decimation factor	Software selectable from 1 to 100,000 Fixed to 1 for Slow External Clock
Sampling Edge	Rising or Falling, software selectable
Sample Rates Available With 10 MHz Clock Reference:	100 MS/s, 101 MS/s, 102 MS/s, 103 MS/s, 104 MS/s, 105 MS/s, 106 MS/s, 107 MS/s, 108 MS/s, 109 MS/s, 110 MS/s, 111 MS/s, 112 MS/s, 113 MS/s, 114 MS/s, 115 MS/s, 116 MS/s, 117 MS/s, 118 MS/s, 119 MS/s, 120 MS/s, 121 MS/s, 122 MS/s, 123 MS/s, 124 MS/s, 125 MS/s, 126 MS/s, 127 MS/s, 128 MS/s, 129 MS/s, 130 MS/s Note that the accuracy and stability of these sampling frequencies is dependent on the accuracy and stability of the 10 MHz Clock Referece input supplied by the user

Triggering System

Mode	Edge triggering with fixed hysteresis
Number of Trigger Engines	2
Trigger Engine Combination	OR, AND, XOR, software selectable
Trigger Engine Source	CH A, CH B, EXT, Software or None, independently software selectable for each of the two Trigger Engines
Hysteresis	±5% of full-scale input, typical
Trigger sensitivity	±10% of full scale input range. This implies that the trigger system may not trigger reliably if the input has an amplitude less than ±10% of full-scale input range selected
Trigger level accuracy	±10%, typical, of full-scale input range of the selected trigger source

Bandwidth	65 MHz
Trigger Delay	Software selectable from 0 to 9,999,999 sampling clock cycles
Trigger Timeout	Software selectable with a 10 us resolution. Maximum settable value is 3,600 seconds. Can also be disabled to wait indefinitely for a trigger event

EXT (External Trigger) Input

Input impedance	1 MΩ in parallel with 30pF ±10pF
Bandwidth (-3dB)	
DC-coupled	DC - 25 MHz
AC-coupled	10 Hz - 25 MHz
Input range	±5V or ±1V, software selectable
DC accuracy	±10% of full-scale input
Input protection	±28V (DC + peak AC without external attenuation)
Coupling	AC or DC, software selectable

Auxiliary I/O (AUX I/O)

Signal Direction	Input or Output, software selectable Output by default
Output Types:	Trigger Output Busy Output Software controlled Digital Output
Input Types:	Trigger Enable Software readable Digital Input

Output		
	Amplitude:	5 Volt TTL
	Synchronization:	Synchronized to rising edge of sampling clock
Input		
	Amplitude:	5 Volt TTL or 3.3 Volt TTL

Certification and Compliances

CE Mark Compliance

Materials Supplied

One ATS660 Digitizer

One ATS660 Install Disk (CD)

One ATS660 User Manual

All specifications are subject to change without notice

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