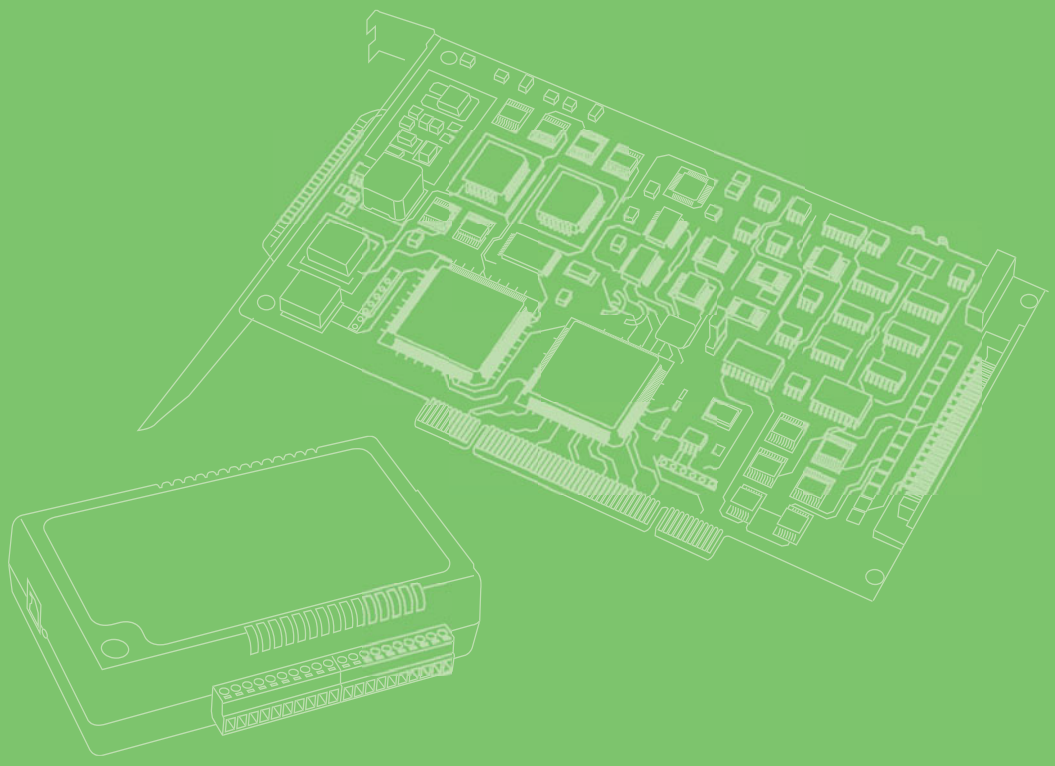

User Manual

PCIE-1840

4-ch 16Bit 125 MS/s High-Speed Data Acquisition PCI Express Card

ADVANTECH

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This warranty does not apply to any products which have been repaired or altered by persons other than repair personnel authorized by Advantech, or which have been subject to misuse, abuse, accident or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events.

Because of Advantech's high quality-control standards and rigorous testing, most of our customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced at no charge during the warranty period. For out-of-warranty repairs, you will be billed according to the cost of replacement materials, service time and freight. Please consult your dealer for more details.

If you think you have a defective product, follow these steps:

1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any onscreen messages you get when the problem occurs.
2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, obtain an RMA (return merchandize authorization) number from your dealer. This allows us to process your return more quickly.
4. Carefully pack the defective product, a fully-completed Repair and Replacement Order Card and a photocopy proof of purchase date (such as your sales receipt) in a shippable container. A product returned without proof of the purchase date is not eligible for warranty service.
5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

Part No. 2003184000 Edition 1

Printed in Taiwan October 2015

Declaration of Conformity

CE

This product has passed the CE test for environmental specifications when shielded cables are used for external wiring. We recommend the use of shielded cables. This kind of cable is available from Advantech. Please contact your local supplier for ordering information.

Technical Support and Assistance

1. Visit the Advantech web site at http://support.advantech.com where you can find the latest information about the product.
2. Contact your distributor, sales representative, or Advantech's customer service center for technical support if you need additional assistance. Please have the following information ready before you call:
   - Product name and serial number
   - Description of your peripheral attachments
   - Description of your software (operating system, version, application software, etc.)
   - A complete description of the problem
   - The exact wording of any error messages

Packing List

Before setting up the system, check that the items listed below are included and in good condition. If any item does not accord with the table, please contact your dealer immediately.

- PCIE-1840 DA&C card
- Startup or User Manual
- PCLD-8841 Calibration Board
- Companion DVD-ROM with DAQNavi drivers included

Safety Precaution - Static Electricity

Follow these simple precautions to protect yourself from harm and the products from damage.

- To avoid electrical shock, always disconnect the power from your PC chassis before you work on it. Don't touch any components on the CPU card or other cards while the PC is on.
- Disconnect power before making any configuration changes. The sudden rush of power as you connect a jumper or install a card may damage sensitive electronic components.

Contents

Chapter 1

Introduction

This chapter will provide information on the features of the PCIE-1840 cards, a quick installation guide, together with some brief information on software and accessories.

Sections include:

- **Features**
- **Applications**
- **Installation Guide**
- **Software Overview**
- **Device Drivers Programming Roadmap**
- **Accessories**

1.1 Introduction

The PCIE-1840 high-speed digitizer features four 125 MS/s simultaneous data acquisition channels with 16-bit resolution, up to 2 GB buffer in a PCIE device. It is design for applications such as PSU (power supply unit) testing, LIDAR testing, and radar signal acquisition.

1.2 Features

The PCIE-1840 offers the following main features:

- 4 simultaneous analog input channels
- 16-bit resolution A/D converter
- 125 MS/s maximum sampling rate
- 4-Order 20 MHz filter
- 2 GB onboard storage memory

Some of the features are described in detail on the following pages.

1.2.1 Auto Calibration

The PCIE-1840 card features software auto calibration. It provides a convenient method for user calibration processing.

1.2.2 BoardID Switch

The PCIE-1840 has a built-in DIP switch that helps define each card's ID when multiple PCIE-1840 cards have been installed on the same PC chassis. The BoardID setting function is very useful when building a system with multiple PCIE-1840 cards. With the correct BoardID settings, you can easily identify and access each card during hardware configuration and software programming.

Note! *For detailed specifications of the PCIE-1840 card, refer to Appendix A, Specifications.*

1.3 Applications

The following are some of the possible applications of PCIE-1840 cards:

- Radar signal acquisition
- Power supply unit (PSU) testing
- Non-destructive testing
- Motor quality inspection
- Light Detection and Ranging

1.4 Installation Guide

Before you install your PCIE-1840 card, please make sure you have the following components:

- PCIE-1840 DA&C card
- PCIE-1840 Startup Manual
- Driver software
  Advantech DAQNavi SDK and drivers (included in the companion CD-ROM)
- Auto-Calibration Board
  PCLD-8841
- PCL-10119-1E (optional)
- Wiring board
  PCLD-8840 (optional)
- Personal computer or workstation with a PCI Express interface (running Windows8 (desktop mode), 7 and XP)

Some optional components are also available for enhanced operation: After you get the necessary components and maybe some of the accessories for enhanced operation of your Multifunction card, you can then begin the installation procedures. Figure 1.1 on the next page provides a concise flow chart for a broad picture of the software and hardware installation procedure:

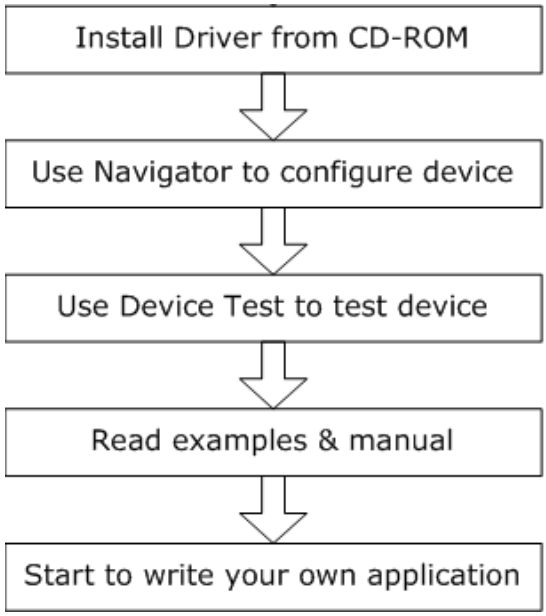

Figure 1.1 Installation Flow Chart

1.5 Software Overview

Advantech offers a rich set of APIs, third-party driver supports and application software to help fully utilize the functions of your PCIE-1840 cards:

- Device Drivers (on the companion DVD-ROM)
- DAQNavi SDK

1.5.1 Device Drivers

Advantech Device Driver software is included on the companion CD-ROM. It also comes with all Advantech DA&C cards. Advantech's device drivers feature a complete I/O function library to help boost your application performance. The Advantech Device Drivers for Windows 2000, XP, Vista or Windows 7 works seamlessly with development tools such as Visual C++, Visual C#, Visual Basic.NET, Borland C++ Builder and Borland Delphi.

1.6 DAQNavi Device Driver Programming Roadmap

This section will provide you with a roadmap to demonstrate how to build an application from scratch using Advantech DAQNavi Device Driver with your favorite development tools such as Visual Studio.Net, Visual C++, Visual Basic, Delphi and C++ Builder. The step-by-step instructions on how to build your own applications using each development tool will be given in the Device Drivers Manual. Moreover, a rich set of example source code is also given for your reference.

1.6.1 Programming Tools

Programmers can develop application programs with their favorite development tools:

- Visual Studio.Net
- Visual C++ and Visual Basic
- Delphi
- C++ Builder

For instructions on how to begin programming works in each development tool, Advantech offers a Tutorial Chapter in the *DAQNavi SDK Manual* for your reference.

Refer to the corresponding sections in this chapter on the *DAQNavi SDK Manual* to begin your programming efforts. You can also look at the example source code provided for each programming tool, since they can get you very well oriented.

The *DAQNavi SDK Manual* can be found on the companion DVD-ROM. Alternatively, if you have already installed the Device Drivers on your system, The *DAQNavi SDK Manual* can be readily accessed through the Start button:

Start/Programs/Advantech Automation/DAQNavi/DAQNavi Manuals/DAQNavi SDK Manual

The example source codes can be found under the corresponding installation folder such as the default installation path:

C:\Advantech\DAQNavi\Examples

For information about using other function groups or other evelopment tools, please refer to the Using DAQNavi SDK chapter in the *DAQNavi SDK Manual*, or the video tutorials in the Advantech Navigator.

1.6.2 Programming with DAQNavi Device Drivers Function Library

Advantech DAQNavi Device Drivers offer a rich function library that can be utilized in various application programs. This function library consists of numerous APIs that support many development tools, such as Visual Studio.Net, Visual C++, Visual Basic, Delphi and C++ Builder.

According to their specific functions or services, APIs can be categorized into several function groups:

- Analog Input Function Group
- Digital Input/Output Function Group
- Event Function Group

For the usage and parameters of each function, please refer to the Using DAQNavi SDK chapter in the *DAQNavi SDK Manual.*

1.6.3 Troubleshooting Device Drivers Error

Driver functions will return a status code when they are called to perform a certain task for the application. When a function returns a code that is not zero, it means the function has failed to perform its designated function. See Device Driver Manual for detailed information about Error Code.

1.7 Accessories

Advantech offers a complete set of accessory products to support PCIE-1840 cards. These accessories include:

1.7.1 Wiring Cables

PCL-10119-1E

HDMI Cable, 1 m

1.7.2 Wiring Boards

PCLD-8840-AE

20-pin DIN-rail HDMI Cable Wiring Board for PCIE-1802 and PCIE-1840.

Chapter 2

Installation

2.1 Unpacking

After receiving your PCIE-1840 package, inspect its contents first.

The package should contain the following items:

- PCIE-1840 card
- Auto-Calibration Board
- Companion CD-ROM (DLL driver included)
- Startup Manual

The PCIE-1840 cards harbors certain electronic components vulnerable to electrostatic discharge (ESD). ESD could easily damage the integrated circuits and certain components if preventive measures are not carefully paid attention to.

Before removing the card from the antistatic plastic bag, you should take following precautions to prevent ESD damage:

- Touch a metal part of your computer chassis with your hand to discharge static electricity accumulated on your body. Or use a grounding strap.
- Touch the anti-static bag to a metal part of your computer chassis before opening the bag.
- Hold the card only by the metal bracket when removing it from the bag.

After taking out the card, you should first inspect the card for any possible signs of external damage (loose or damaged components, etc.). If the card is visibly damaged, please notify our service department or the local sales representative immediately. Avoid installing a damaged card into your system. Also, pay extra caution to the following aspects to ensure proper installation:

- Avoid physical contact with materials that could hold static electricity such as plastic, vinyl and Styrofoam.
- Whenever you handle the card, grasp it only by its edges. DO NOT TOUCH the exposed metal pins of the connector or the electronic components.

Note! *Keep the anti-static bag for future use. You may need the original bag to store the card if you have to remove the card from the PC or transport it elsewhere.*

2.2 Driver Installation

We recommend you install the driver before you install the PCIE-1840 card into your system, since this will guarantee a smooth installation process.

The Advantech DAQNavi Device Drivers Setup program for the PCIE-1840 card is included in the companion DVD-ROM that is shipped with your DA&C card package. Please follow the steps below to install the driver software:

1. Insert the companion DVD-ROM into your DVD-ROM drive.
2. The Setup program will be launched automatically if you have the auto play function enabled on your system. When the Setup Program is launched, you can follow the installation guide to correctly install the driver step by step.

2.2.1 Device Auto Installation (Recommended)

You can install the PCIE-1840 module in any PCI Express slot on your computer. Follow the steps below to install the module on your system.

1. Turn off your computer and unplug the power cord and cables. TURN OFF your computer before installing or removing any components on the computer.
2. Remove the cover of the computer.
3. Remove the slot cover on the back panel of your computer.
4. Touch the metal part on the surface of your computer to neutralize the static electricity that might be on your body.
5. Insert the PCIE-1840 card into a PCI Express slot. Hold the card only by its edges and carefully align it with the slot. Insert the card firmly into place. Use of excessive force must be avoided, otherwise the card might be damaged.
6. Fasten the bracket of the PCI card on the back panel rail of the computer with screws.
7. Plug in the power cord and turn on the computer.

2.3 Device Setup & Configuration

The *Advantech Navigator* program is a utility that allows you to set up, configure and test your device, and later stores your settings on the system registry. These settings will be used when you call the APIs of Advantech Device Drivers.

Setting Up the Device

1. To install the I/O device for your card, you must first run the Advantech Navigator program (by accessing Start/Programs/Advantech Automation/DAQNavi/Advantech Navigator).
2. You can then view the device(s) already installed on your system (if any) on the Installed Devices list box. If the software and hardware installation are completed, you will see PCIE-1840 card in the Installed Devices list.

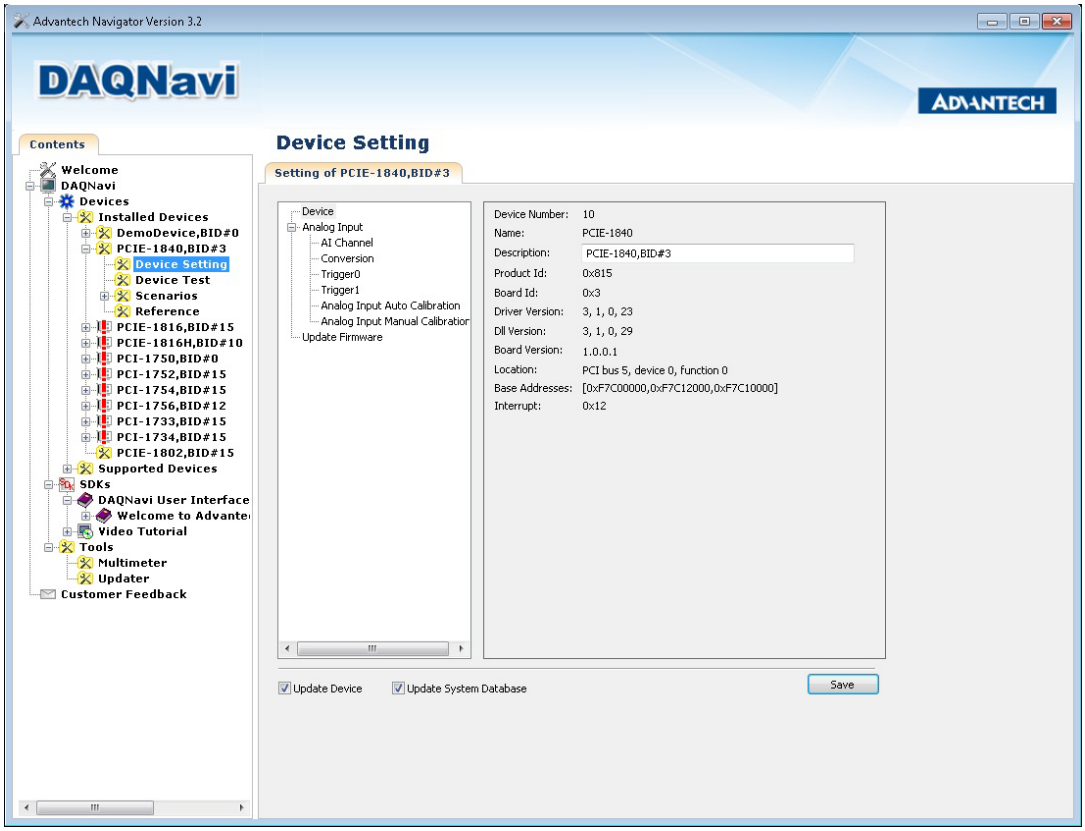

Figure 2.1 The Device Setting of PCIE-1840

Configuring the Device

Go to the Device Setting to configure your device. Here you can configure not only the Analog Input of PCIE-1840 but also Digital Input/Output.

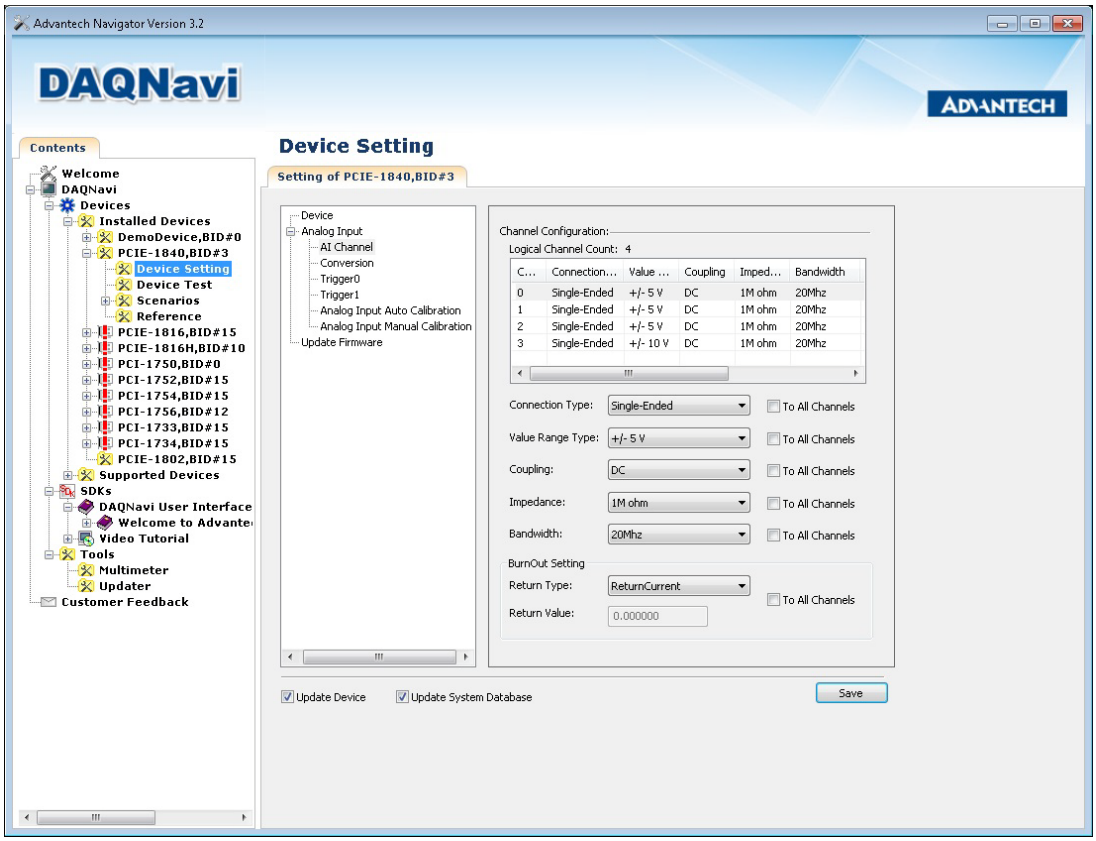

Figure 2.2 The Device Setting page

After your card is properly installed and configured, you can go to the Device Test page to test your hardware by using the testing utility supplied.

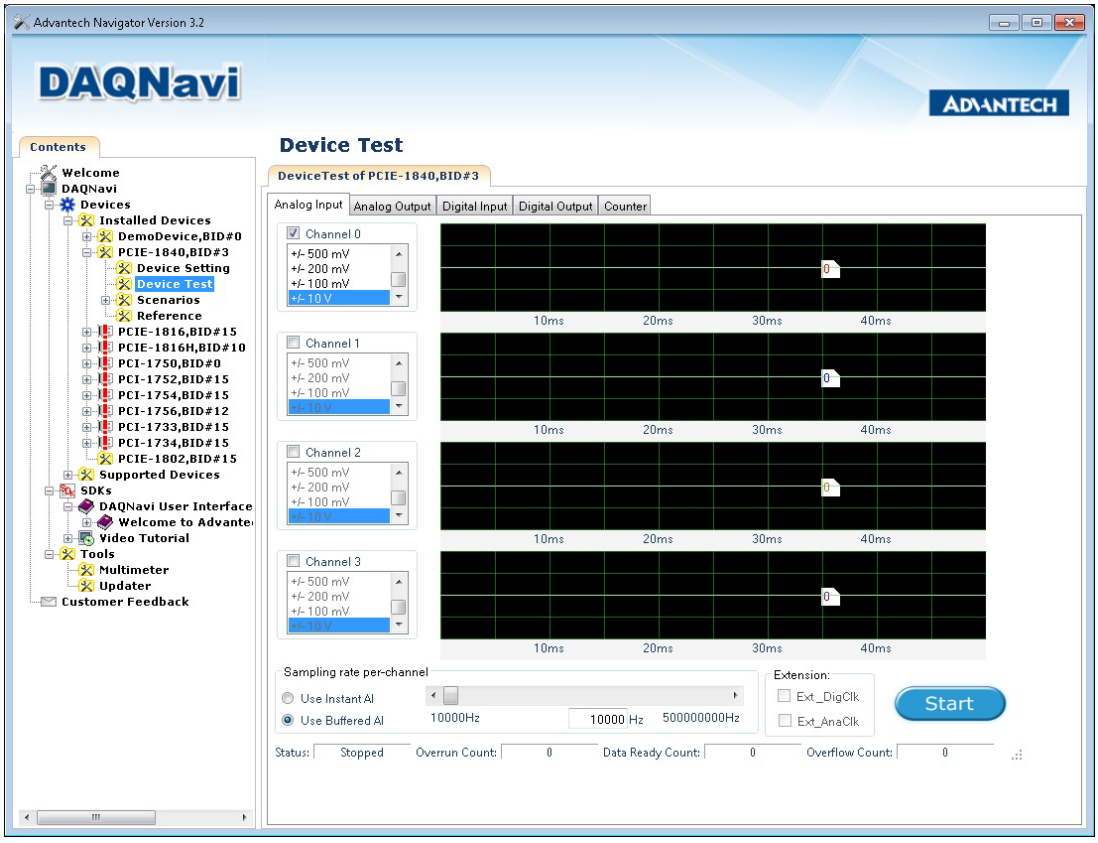

Figure 2.3 The Device Testing of PCIE-1840

For more detailed information, refer to the DAQNavi SDK Manual or the User Interface Manual in the Advantech Navigator.

Chapter 3

Signal Connections

This chapter provides useful information about how to connect input and output signals to the PCIE-1840 cards via the I/O connector.

Sections include:

- **Overview**
- **Switch Settings**
- **Signal Connections**
- **Field Wiring Considerations**

3.1 Overview

Maintaining signal connections is one of the most important factors in ensuring that your application system is sending and receiving data correctly. A good signal connection can avoid unnecessary and costly damage to your PC and other hardware devices. This chapter provides useful information about how to connect input and output signals to the PCIE-1840 cards via the I/O connector.

3.2 Jumper Settings

Setting the BoardID Switch (SW1)

The PCIE-1840 has a built-in DIP switch (SW1), which is used to define each card's board ID. You can determine the board ID on the register as shown in Table 3.1. When there are multiple cards on the same chassis, this board ID setting function is useful for identifying each card's device number through board ID. We set the PCIE-1840 board ID as 0 at the factory. If you need to adjust it to other board ID, set the SW1 by referring to DIP switch setting.

Table 3.1: Board ID Settings

SW1	3	2	1	0
BoardID	ID3	ID2	ID1	ID0
0*	ON	ON	ON	ON
1	ON	ON	ON	OFF
2	ON	ON	OFF	ON
3	ON	ON	OFF	OFF
4	ON	OFF	ON	ON
5	ON	OFF	ON	OFF
6	ON	OFF	OFF	ON
7	ON	OFF	OFF	OFF
8	OFF	ON	ON	ON
9	OFF	ON	ON	OFF
10	OFF	ON	OFF	ON
11	OFF	ON	OFF	OFF
12	OFF	OFF	ON	ON
13	OFF	OFF	ON	OFF
14	OFF	OFF	OFF	ON
15	OFF	OFF	OFF	OFF

* Default Setting

3.3 Signal Connections

Pin Assignment

There are four BNC and one 19-pin connectors on the PCIE-1840, which connects to BNC and PCL-10119 HDMI cables. Figure 3.1 and Figure 3.2 show the pin assignments for the BNC and 19-pin I/O connector separately, and Table 3.1 shows its I/O connector signal description.

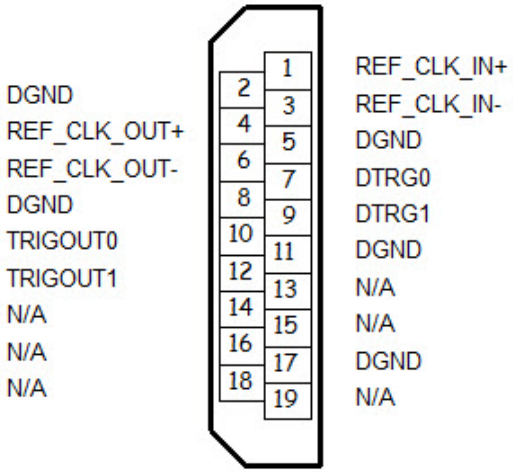

Figure 3.1 19-pin I/O Connector Pin Assignments

3.3.1 I/O Connector Signal Description

Signal Name	Reference	Direction	Description
REF_CLK_IN+/-	DGND	Input	10 MHz differential reference clock input
REF_CLK_OUT+/-	DGND	Output	10 MHz differential reference clock output
DTRG<0..1>	DGND	Input	Digital trigger inputs
TRIGOUT<0..1>	DGND	Output	Trigger outputs
DGND	----	----	Digital ground

Signal Name	Reference	Direction	Description
AICH<0..3>	AGND	Input	Analog input channels 0 through 3

3.3.2 Trigger Type

The PCIE-1840 supports two types of triggers: start triggers and stop triggers.

The returned data consists of samples acquired between a start trigger and a stop trigger. That is, only data acquired after the start trigger occurred and before the stop trigger occurred are returned.

Both start triggers and stop triggers can be delayed. When the delay number is applied to a trigger, the trigger is effective only when the number of samples has reached after the trigger occurs. For example, if delay number of 5 is applied to the start trigger, the returned data will consist of samples acquired after the start trigger occurred except the first 5 samples. If delay number of 3 is applied to the stop trigger, the returned data will consist of samples acquired before the stop trigger occurred plus 3 samples acquired after the stop trigger.

Both triggers can be configured independently, and can be set to use a variety of sources, both analog and digital. Triggers can be configured to occur on either the rising or falling edge of a signal. Moreover, analog triggers support other modes of operation, including triggering on edges with hysteresis, and triggering when a signal enters or leaves a predefined window. Since all three types of triggers are configured independently, alternate edges of a signal can be used for different types of triggers.

During repetitive triggering on a waveform, you might observe jitter because of the uncertainty of where a trigger level falls compared to the actual digitized data. Although this trigger jitter is never greater than one sample period, it might be significant when the sample rate is only twice the bandwidth of interest. This jitter usually has no effect on data processing, and you can decrease this jitter by sampling at a higher rate.

3.3.2.1 Digital Trigger Connections

You can configure the PCIE-1840 to trigger in response to digital signals on DTRG0 or DTRG1 pin of the HDMI connector, located on the device front panel. The trigger circuit can respond either to a rising or a falling edge. The trigger signal must comply to 3.3 V or 5 V TTL voltage levels.

A diagram showing the DRTG input configuration of the PCIE-1840 is shown below with a signal source.

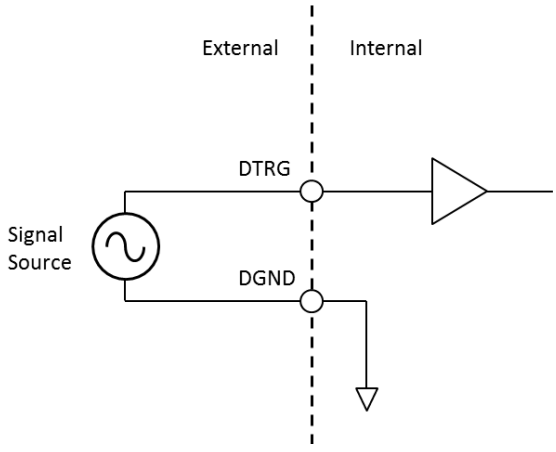

Figure 3.2 Digital Trigger Signal Connection

3.3.2.2 Analog Trigger

You can configure the PCIE-1840 analog trigger circuitry to monitor any input channel from which you acquire data. Choosing an input channel as the trigger channel does not influence the input channel acquisition capabilities.

The trigger circuit generates an internal digital trigger based on the input signal and the defined trigger levels. For example, you can configure the device to start acquiring samples after the input signal crosses a specific threshold. PCIE-1840 offers several analog triggering modes, including analog edge, analog edge with hysteresis, and window triggering.

Analog trigger connections are the same as ***Analog Input Connections***, please refer to differential input (Figure 3.3) or pseudo-differential input (Figure 3.4).

Analog Trigger- Rising Edge

For rising edge trigger, ±10 V input range, +2 V trigger level, 0.1% trigger hysteresis (equivalent to 20 V × 0.1% = 0.02 V).

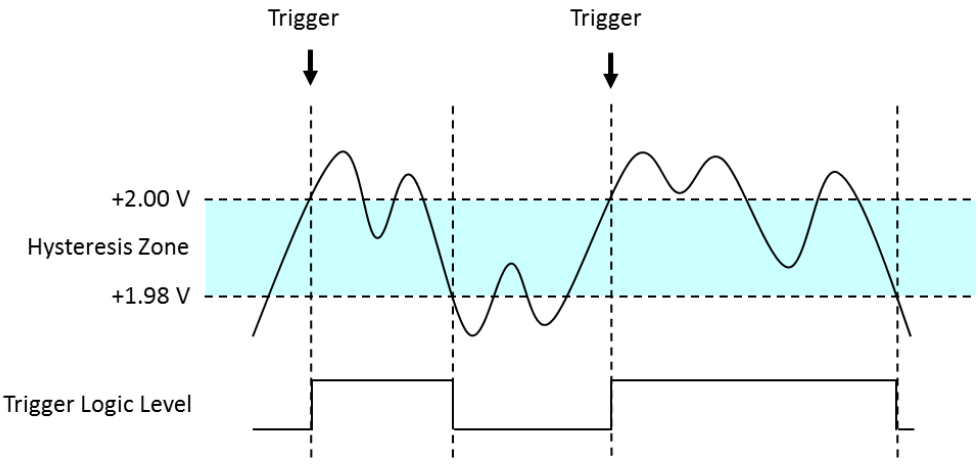

Figure 3.3 Analog Trigger - Rising Edge

Analog Trigger- Falling Edge

For falling edge trigger, ±10 V input range, +2 V trigger level, 0.1% trigger hysteresis (equivalent to 20 V × 0.1% = 0.02 V).

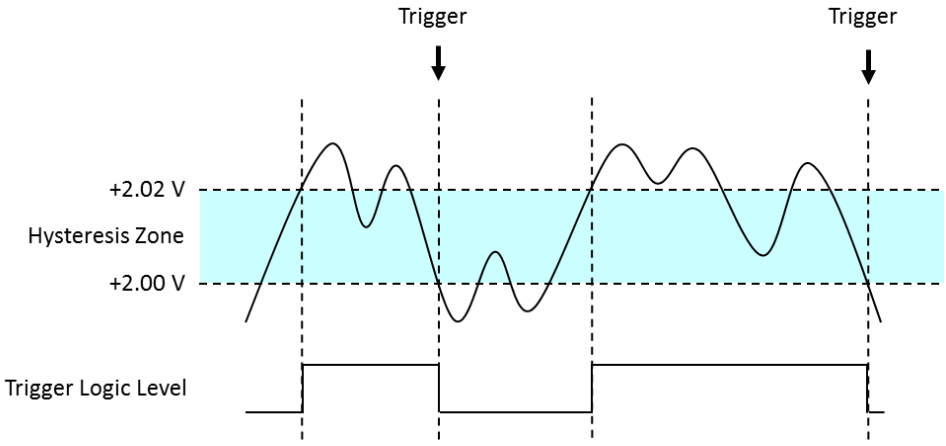

Figure 3.4 Analog Trigger - Falling Edge

3.3.3 PCLD-8841 Signal Connection

To ensure the accuracy of PCIE-1840 would not drift by time, periodical calibrations are necessary to make the performance match its specification. PCIE-1840 provides two methods for calibration, manual-calibration and self-calibration with PCLD-8841. By manual calibration, PCIE-1840 could achieve higher accuracy but it takes more time and is suitable for the users who require a single channel calibration. Self-calibration with PCLD-8841 provides a convenient way for user to calibrate all input ranges. Both calibrations are required to be done after ambient temperature is stable. Twenty minutes warm-up after PCIE-1840 begins running is necessary. Doing calibration periodically can ensure the accuracy is the same over time.

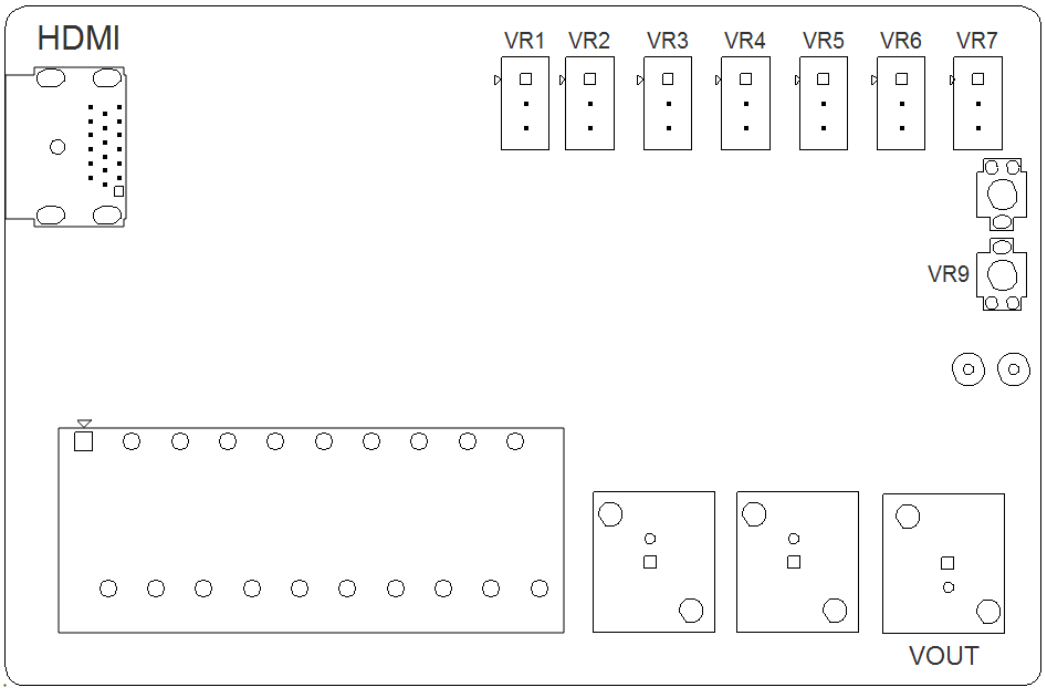

Figure 3.5 PCLD-8841 board diagram for Auto-calibration

3.3.3.1 Self-Calibration

Self-calibration provides a convenient way to calibrate all input ranges with the assistance of PCLD-8841. Before starting self-calibration, users need to fine-tune PCLD-8841 output to make sure the reference voltage is accuracy. Users should connect VOUT to a high precision multi-meter, at least 6-1/2 digital meter, and tune the eight on-board variable resistors to the dedicated voltages. The following table lists the functions of these variable resistors.

Table 3.2: PCLD-8841 Reference Voltage Output Tunning

Variable Resistor #	Dedicated Voltage (after tuning)	Corresponding Calibration
VR1	9.9 V	20 Vp-p, Gain Error
VR2	4.95 V	10 Vp-p, Gain Error
VR3	1.98 V	4 Vp-p, Gain Error
VR4	0.99 V	2 Vp-p, Gain Error
VR5	0.495 V	1 Vp-p, Gain Error
VR6	0.198 V	0.4 Vp-p, Gain Error
VR7	0.099 V	0.2 Vp-p, Gain Error
VR9	0V (GND)	ALL, Offset Error

3.4 Field Wiring Considerations

When you use PCIE-1840 cards to acquire data from outside, noises in the environment might significantly affect the accuracy of your measurements if due cautions are not taken. The following measures will be helpful to reduce possible interference running signal wires between signal sources and the PCIE-1840 card.

- The signal cables must be kept away from strong electromagnetic sources such as power lines, large electric motors, circuit breakers or welding machines, since they may cause strong electromagnetic interference.Keep the analog signal cables away from any video monitor, since it can significantly affect a data acquisition system.
- If the cable travels through an area with significant electromagnetic interference, you should adopt individually shielded, twisted-pair wires as the analog input cable. This type of cable has its signal wires twisted together and shielded with a metal mesh. The metal mesh should only be connected to one point at the signal source ground.
- Avoid running the signal cables through any conduit that might have power lines in it.
- If you have to place your signal cable parallel to a power line that has a high voltage or high current running through it, try to keep a safe distance between them. Alternatively, you can place the signal cable at a right angle to the power line to minimize the undesirable effect.
- The signals transmitted on the cable will be directly affected by the quality of the cable. In order to ensure better signal quality, we recommend that you use the PCL-108BNC-0.5E shielded cable.

Appendix A

Specifications

A.1 General Specifications

A.1.1 Bus Interface

- **Form factor:** x4 PCI Express, specification v1.1 compliant
- **Slot compatibility:** x4, x8, and x16 PCI Express slots
- **DMA channel:** 1, analog input

A.1.2 Power Requirements

- **Typical:** +3.3 V @ 1.75 A, +12 V @ 1.1 A
- **Maximum:** +3.3 V @ 2A, +12 V @ 1.4 A

A.1.3 Physical

- **Printed circuits board dimensions:** 9.9 × 16.8 cm (3.9 × 6.6 in.)
- **I/O connector:** 4 x BNC, and 1 × HDMI

A.1.4 Environmental

- **Operating temperature:** 0 to 50°C
- **Storage temperature:** 20 to 70°C
- **Operating humidity:** 10 to 90% RH, non-condensing
- **Storage humidity:** 5 to 95% RH, non-condensing

Indoor use only.

A.2 Analog Input

Number of Channels	4 single-ended, simultaneously							
Connector	BNC							
Resolution	16-bit							
Sampling Rate	125 MS/s per channel							
On-Board buffer	2G DDR3 memory							
Input impedance	50 Ohm or 1M Ohm, software selectable							
Input Coupling	50 Ohm: DC Coupling 1 M Ohm: DC/AC Coupling, AC-Coupling cutoff: 10.6 Hz							
Input Range (Vpk-pk)	0.2/ 0.4/ 1/ 2/ 4/ 10/ 20 (only available in 1M Ohm input impedance)							
Gain Error* (Manual Calibration)	Vpk-pk	0.2	0.4	1	2	4	10	20
	% of FS	±0.5 %	±0.2 %	±0.2 %	±0.1 %	±0.2 %	±0.2 %	±0.1 %
Offset Error* (Manual Calibration)	Vpk-pk	0.2	0.4	1	2	4	10	20
	mV	± 1	± 1	± 1	± 2	± 2	± 2	± 5
Bandwidth (-3 dB)	Noise Filter Enable				Filter Disable			
	20 MHz				40 MHz for 0.2 Vpk-pk, 65 MHz for others			
Max. Input Voltage	± 15 V							
Over-voltage protection	2 x FS (Full-Scale) voltage							

Time Interleaved Sampling (TIS) Rate	4 channels combined, 500 MS/s 2 channels combined, 250 MS/s
* Noise filter ON and Within ±5 °C of calibration temperature	

A.3 Trigger

Trigger Input Source	Analog input Channels, External Digital inputs
Trigger Input Mode	Start Trigger, Delay-to-Start Trigger Stop Trigger, Delay-to-Stop Trigger Index Trigger
Analog Trigger Level	Full-scale, programmable
Analog Trigger resolution	16-bit
Analog Trigger Hysteresis Range	2.5% Full-Scale, programmable
Analog Trigger Accuracy	±2% Full-Scale
Analog Trigger Slope	Positive (rising) or Negative (falling), software selectable
Analog Trigger Filter	50 KHz Low-Pass filter, software selectable
Digital Trigger Level	3.3 V COMS compatible Low: 0.8 V max.; High: 2.0V min
Digital Trigger pulse width	50 ns min.
Digital Trigger Polarity	Rising or Falling edge, software selectable
Number of Digital Trigger Output	2
Digital Trigger Output Source	Analog Trigger Input, Digital Trigger input, or Software Trigger
Digital Trigger Output Level	3.3 V COMS compatible Low: 0.8 V max. ; High: 2.0 V min

A.4 Reference Clock

Reference Clock Source	Internal on-board oscillator, External reference clock input
Reference Clock Frequency	10 MHz
External Reference Clock input impedance	50 Ohm
External Reference Clock input Coupling	AC
External Reference Clock Output Compatible	LVPECL
External Reference Clock Output Impedance	200 Ohm, Differential
Reference Clock output Frequency	10 MHz

External Reference Clock Output Swing	Min. 1.0 Vpp; Max. 1.9 Vpp, 100 Ohm load line-to-line
External Reference Clock Output common mode voltage	1.8 ~ 2.1 V, typically

A.5 Dynamic Characteristics

A.5.1 Signal-to-Noise Ratio (SNR)

Signal-to-Noise Ratio (dB)*	**Input Impedance: 50**		**Input Impedance: 1M**	
Input Range	Filter ON	Filter OFF	Filter ON	Filter OFF
±10.0 V	N/A	N/A	72.5	65
±5.0 V	71	64	70	63.5
±2.0 V	67	61.5	65	61.5
±1.0 V	71.5	64.5	71	64
±0.5 V	70	63.5	69.5	63
±0.2 V	66	61	64	60.5
±0.1 V	61	58.5	58.5	57

* 100 kHz input tone, input amplitude is -1 dBFS.

A.5.2 Signal-to-Interference and Noise Ratio (SINAD)

Signal-to-Interference and Noise Ratio (dB)*	**Input Impedance: 50**		**Input Impedance: 1M**	
Input Range	Filter ON	Filter OFF	Filter ON	Filter OFF
±10.0 V	N/A	N/A	69	64
±5.0 V	71	64	68.5	63.5
±2.0 V	67	61.5	65	61.5
±1.0 V	71.5	64	71	64
±0.5 V	69.5	63.5	69	63
±0.2 V	65.5	61	64	60
±0.1 V	61	58.5	58.5	57

* 100 kHz input tone, input amplitude is -1 dBFS.

A.5.3 Total Harmonic Distortion (THD)

Total Harmonic Distortion (dB)*	**Input Impedance: 50**		**Input Impedance: 1M**	
Input Range	Filter ON	Filter OFF	Filter ON	Filter OFF
±10.0 V	N/A	N/A	-71.5	-71.5
±5.0 V	-85	-83.5	-74	-75
±2.0 V	-84	-82.5	-80	-83
±1.0 V	-83	-82	-84	-82.5
±0.5 V	-83	-82.5	-85	-84
±0.2 V	-83	-83.5	-83	-83

±0.1 V	-81	-83	-80.5	-82

* 100 kHz input tone, input amplitude is -1 dBFS.

A.5.4 Total Harmonic Distortion Plus Noise (THD+N)

Total Harmonic Distortion Plus Noise (dB)*	**Input Impedance: 50**		**Input Impedance: 1M**	
Input Range	Filter ON	Filter OFF	Filter ON	Filter OFF
±10.0 V	N/A	N/A	-69	-64
±5.0 V	-71	-64	-68.5	-63.5
±2.0 V	-67	-61.5	-65	-61.5
±1.0 V	-71.5	-64	-71	-64
±0.5 V	-69.5	-63.5	-69	-63
±0.2 V	-65.5	-61	-64	-60
±0.1 V	-61	-58.5	-58.5	-57

* 100 kHz input tone, input amplitude is -1 dBFS.

A.5.5 Spurious Free Dynamic Range (SFDR)

Spurious Free Dynamic Range (dB)*	**Input Impedance: 50**		**Input Impedance: 1M**	
Input Range	Filter ON	Filter OFF	Filter ON	Filter OFF
±10.0 V	N/A	N/A	72	75
±5.0 V	87	87	74.5	76
±2.0 V	86.5	82	78	84
±1.0 V	85	83	86	84.5
±0.5 V	85	84	86	85.5
±0.2 V	84.5	85	78	79.5
±0.1 V	79	78	71	73.5

* 100 kHz input tone, input amplitude is -1 dBFS.

A.5.6 Passband Flatness

	Filter ON	**Filter OFF**
Flatness* ** (dB)	±0.8	±0.4

* DC to 10 MHz
** Referenced to 100 kHz.

A.5.7 Crosstalk

	Filter ON	Filter OFF
Crosstalk* ** (dBc)	<= 80	<= 68

* CH1 to CH0 at 10 MHz
** Input Amplitude: -1 dBFS

A.5.8 AC Coupling

- **-3 dB cutoff frequency :** 10.6 HZ (1M Ohm input impedance only)

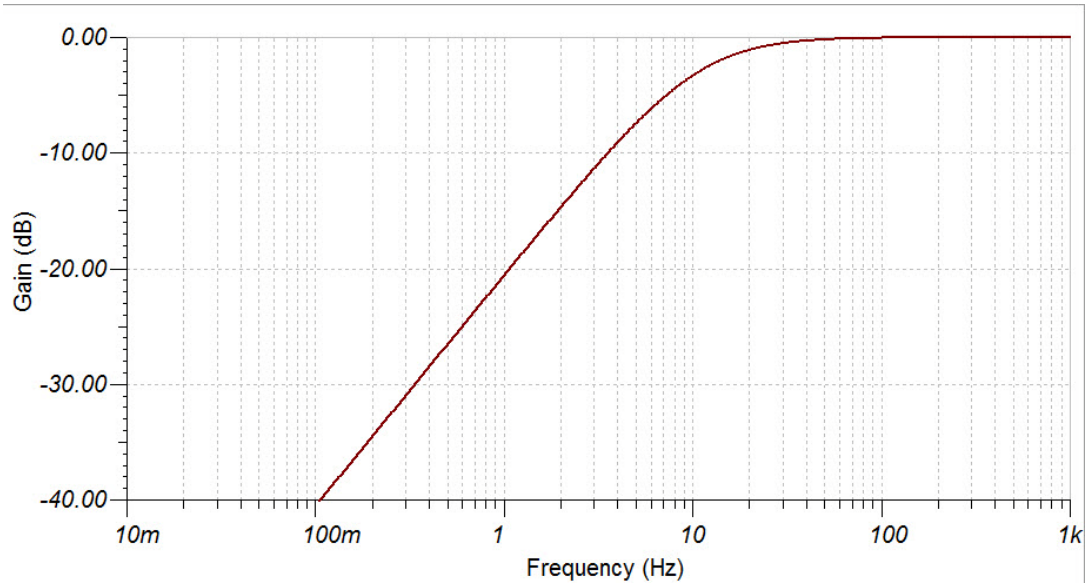

Figure A.1 Magnitude response of AC coupling circuit

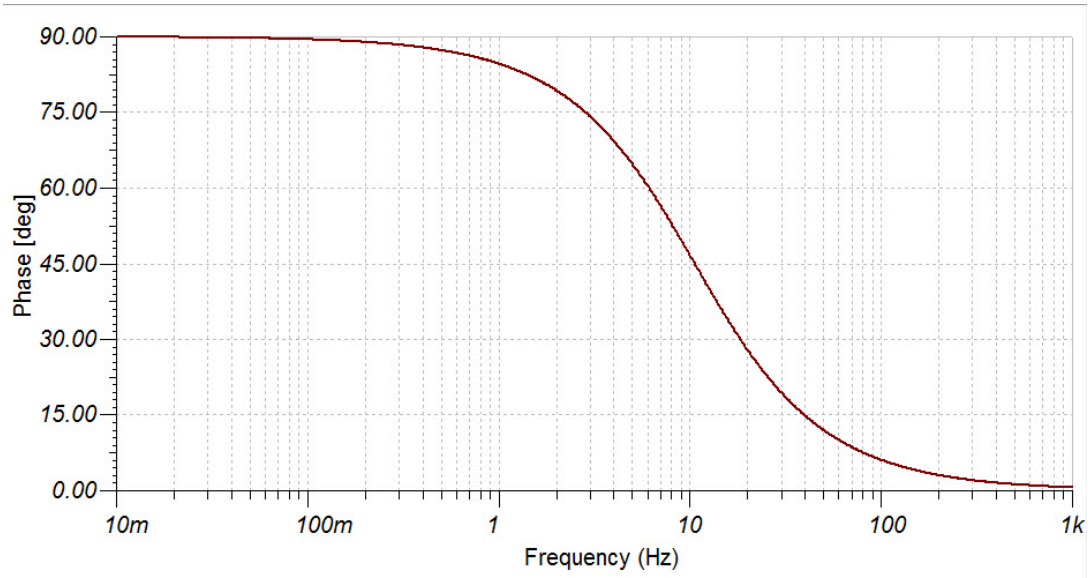

Figure A.2 Phase response of AC coupling circuit

A.6 AI Input Bandwidth and Settling

Input bandwidth issue for ±20, ±10, ±4 input ranges with 1 M Ohm input impedance.

A.6.1 Tunable Capacitor for One-tenth Voltage Divider in 1Mohm

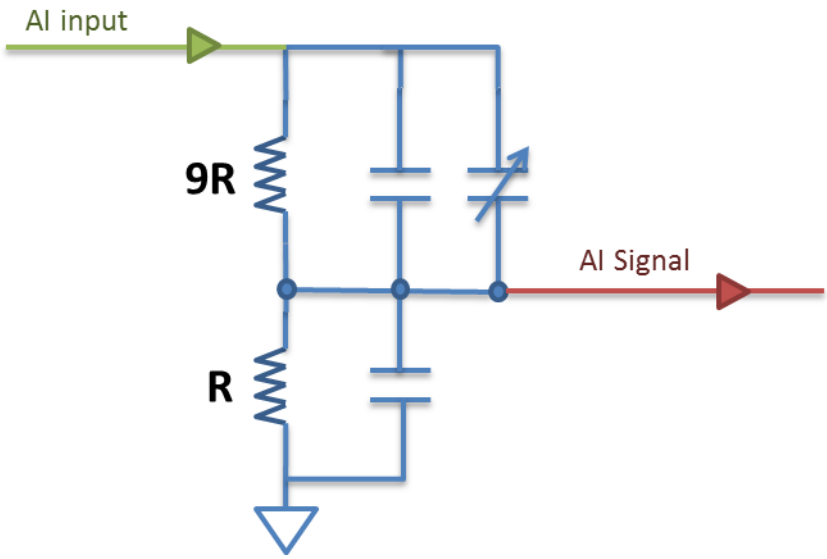

Figure A.3 PCIE-1840 one-tenth divider Circuit

PCIE-1840 provides tunable capacitors beside each BNC connector to help compensate the input bandwidth of 20Vpp, 10Vpp, and 4Vpp input ranges with 1M Ohm input impedance. With large 1M Ohm input impedance, any small parasitic capacitance could seriously affect the input impedance. To compensate the loss, tunable capacitors are added along the one-tenth divider. Users can get the better performance by fine-tuning the tunable capacitor. Here are the figures to describe the issue.

Trim. Capacitor	Function (1M input impedance only)
TC400	Analog input channel 0 bandwidth compensation*
TC500	Analog input channel 1 bandwidth compensation*
TC600	Analog input channel 2 bandwidth compensation*
TC700	Analog input channel 3 bandwidth compensation*
*Only workable in 20 Vpp, 10 Vpp, 4 Vpp input range.	

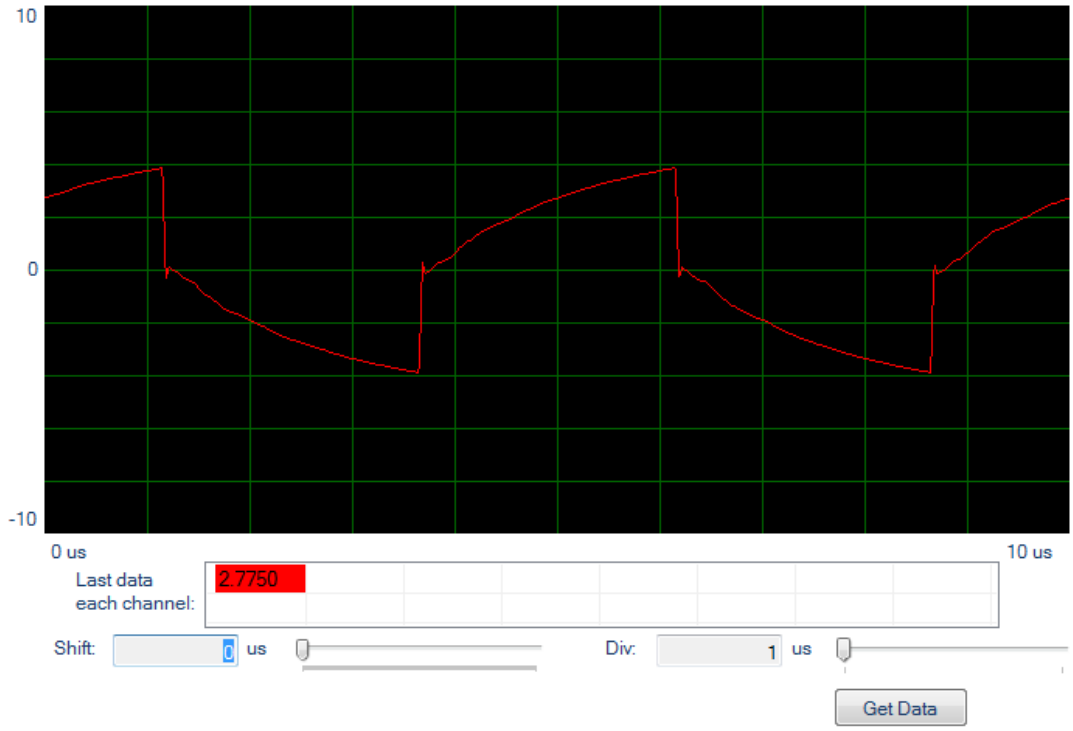

Figure A.4 Without capacitors compensation, the settling time is quite slow

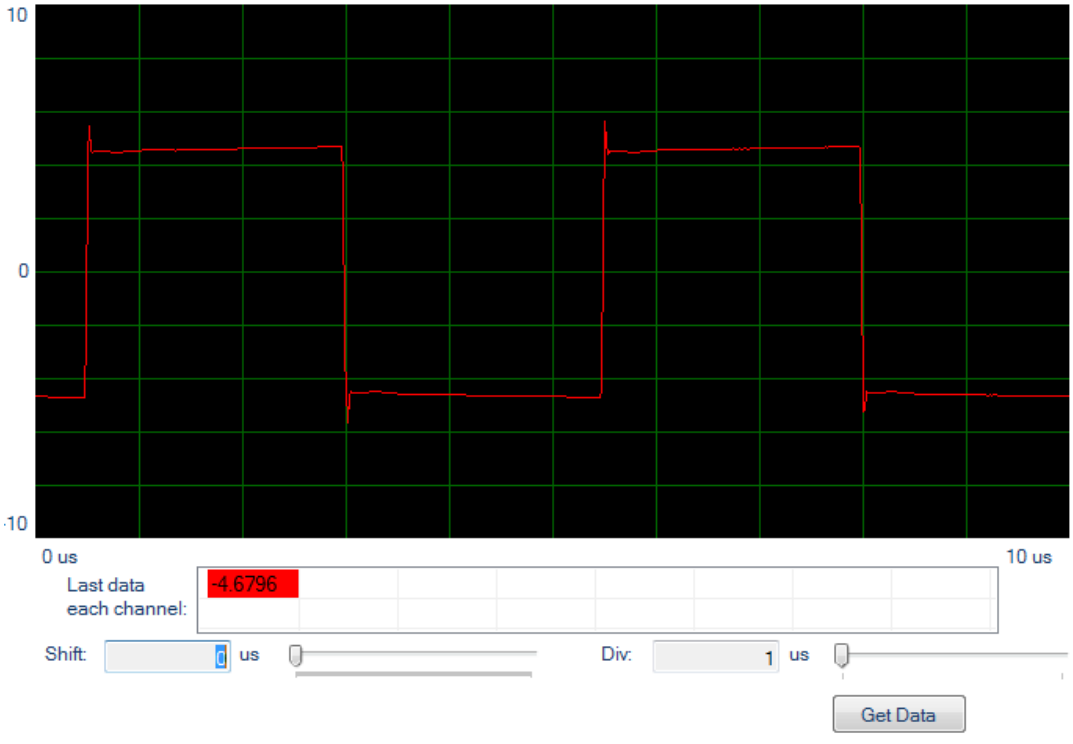

Figure A.5 With compensation, settling time is much faster

For the users requiring high frequency applications, it's highly recommended to select 50 Ohm input impedance to ease the known overshoot and parasitic capacitance issue.

Appendix B

Block Diagram

B.1 Overview

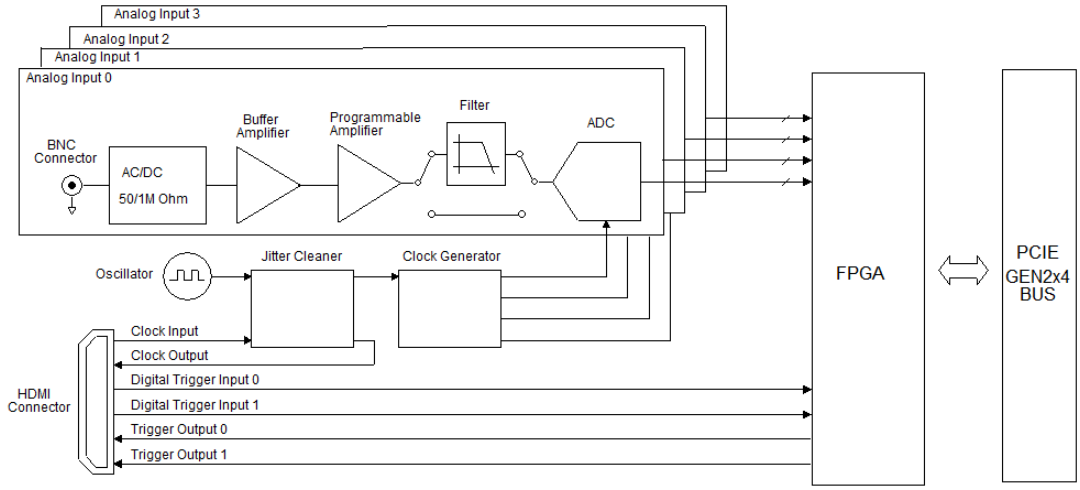

Figure B.1 Function block diagram - overview

B.2 Analog Input TIS Function

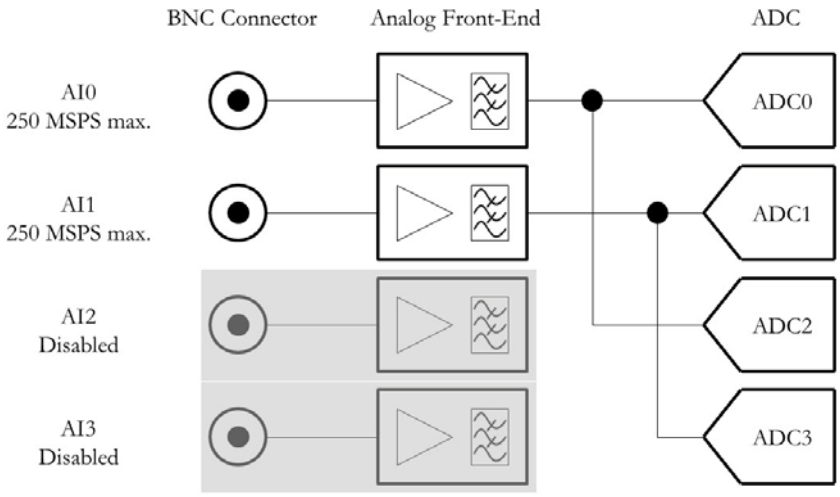

Figure B.2 Dual ADCs combination architecture in TIS mode

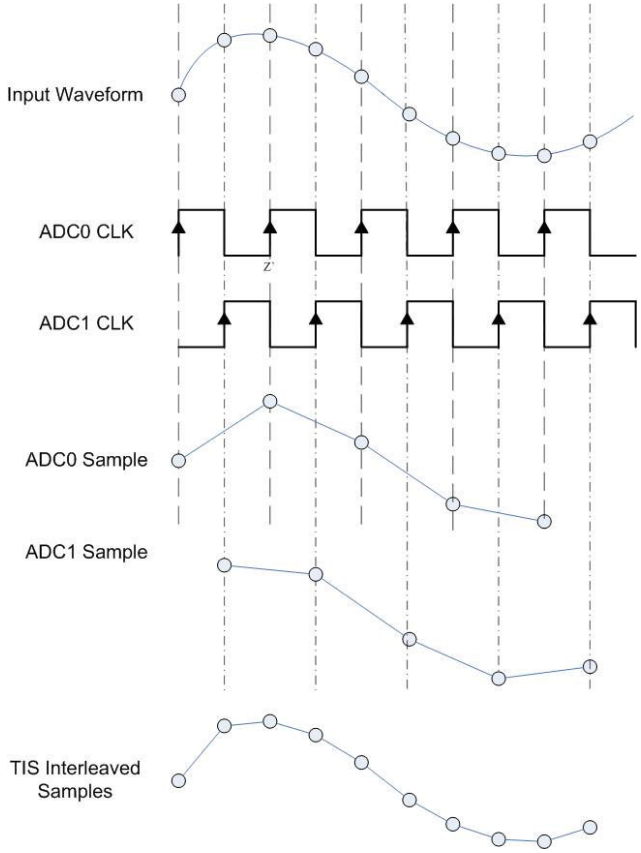

Figure B.3 Dual ADCs data composition under TIS mode

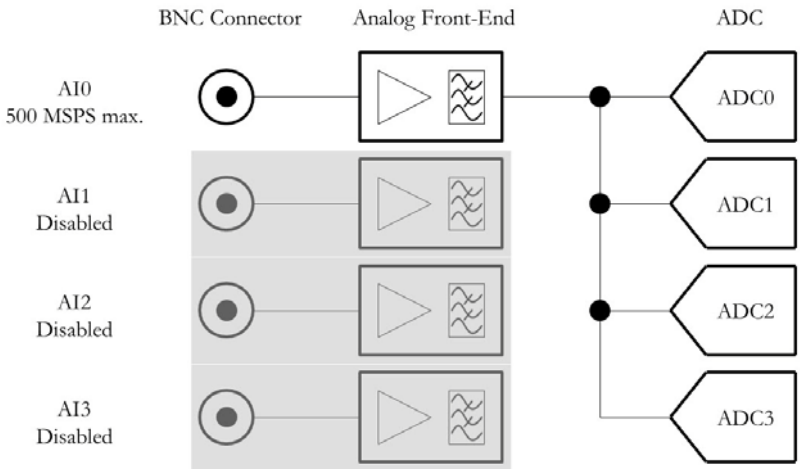

Figure B.4 Quad ADCs combination architecture in TIS mode

Time Interleaved Sampling (TIS) is a function to increase the sampling rate of PCIE-1840. It combines multiple ADCs to sample a single input signal. The ADCs in TIS have the same sampling rate but different clock phase shift. And the acquisition data from each ADC are interleaved to construct a waveform as like a single ADC dose. The following figures describe how TIS works.

The mismatches between multiple ADCs will degrade the performance of PCIE-1840. They will lead to voltage swings in time domain and unexpected spurs in frequency domain. These mismatches include offset mismatch, gain mismatch, and clock phase mismatch. Though PCIE-1840 is capable to calibrate the gain error under TIS, the non-perfectly matched ADCs would still degrade the SNR ratio. Users should take this unavoidable degradation into consideration, especially in frequency domain applications.

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