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DAQCard-500

DAQCard™-500
User Manual

Multifunction I/O Card for Type II PCMCIA Bus

January 1996 Edition

Part Number 371918A-01

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WARNING REGARDING MEDICAL AND CLINICAL USE
OF NATIONAL INSTRUMENTS PRODUCTS

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About This Manual

This manual describes the mechanical and electrical aspects of the DAQCard-500 and contains information concerning its installation and operation. The DAQCard-500 is a compact, low-cost, low-power analog input, digital I/O, and timing I/O board for computers that are equipped with a Type II PCMCIA socket.

Organization of This Manual

The *DAQCard-500 User Manual* is organized as follows:

- Chapter 1, Introduction, describes the DAQCard-500, lists what you need to get started, your software programming choices, and explains how to unpack the DAQCard-500.

- Chapter 2, Installation and Configuration, describes how to install and software configure the DAQCard-500.

- Chapter 3, Signal Connections, describes the signals on the PR27-30F I/O connector and the CB-27 connector block, optional accessories available from National Instruments.

- Chapter 4, Theory of Operation, includes an overview of the DAQCard-500 and explains the operation of each functional unit making up the DAQCard-500.

- Appendix A, Specifications, lists the specifications of the DAQCard-500.

- Appendix B, Differences between the DAQCard-700 and the DAQCard-500, contains a summary of differences between the DAQCard-700 and the DAQCard-500 that may be relevant to you if you are a current DAQCard-700 user.

- Appendix C, Custom Cable Design, describes the pin connections on the DAQCard-500, which you will need to use only if you are designing your own cable.

- Appendix D, PC Card Questions and Answers, contains a list of common questions and answers relating to PC Card (PCMCIA) operation.

- Appendix E, Power-Management Modes, describes the power-management modes of the DAQCard-500.

- Appendix F, PSH27-50F Signal Connections, gives the pin assignments for the CB-50 I/O connector block when using the PSH27-50F-D1 cable with the DAQCard-500.

- Appendix G, Customer Communication, contains forms you can use to request help from National Instruments or to comment on our products.

- The Glossary contains an alphabetical list and description of terms used in this manual, including acronyms, abbreviations, metric prefixes, mnemonics, and symbols.

- The Index alphabetically lists topics covered in this manual, including the page number where you can find the topic.

Conventions Used in This Manual

The following conventions are used in this manual:

bold italic	Bold italic text denotes a note, caution, or warning.
italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
NI-DAQ	NI-DAQ refers to the NI-DAQ software.
< >	Angle brackets, < >, containing numbers separated by an ellipsis represent a range of values associated with a bit or signal name (for example, ACH<0..7> stands for the signals ACH0 through ACH7).

Abbreviations, acronyms, metric prefixes, mnemonics, symbols, and terms are listed in the Glossary.

National Instruments Documentation

The DAQCard-500 User Manual is one piece of the documentation set for your data acquisition system. You could have any of several types of manuals, depending on the hardware and software in your system. Use the manuals you have as follows:

- Getting Started with SCXI—If you are using SCXI, this is the first manual you should read. It gives an overview of the SCXI system and contains the most commonly needed information for the modules, chassis, and software.

- Your SCXI user manuals—If you are using SCXI, read these manuals next for detailed information about signal connections and module configuration. They also explain in greater detail how the module works and contain application hints.

- Your DAQ hardware user manuals—These manuals have detailed information about the DAQ hardware that plugs into or is connected to your computer. Use these manuals for hardware installation and configuration instructions, specification information about your DAQ hardware, and application hints.

- Software documentation—Examples of software documentation you may have are the LabVIEW and LabWindows/CVI manual sets and the NI-DAQ documentation. After you set up your hardware system, use either the application software (LabVIEW or LabWindows/CVI) manuals or the NI-DAQ documentation to help you write your application. If you have a large and complicated system, it is worthwhile to look through the software documentation before you configure your hardware.

- Accessory manuals—If you are using accessory products, read the terminal block and cable assembly installation guides. They explain how to physically connect the relevant pieces of the system. Consult these guides when you are making your connections.

- SCXI chassis manuals—If you are using SCXI, read these manuals for maintenance information on the chassis, installation instructions, and information about making custom modules.

Related Documentation

The following documents contain information that you may find helpful as you read this manual:

- Your NI-DAQ software documentation

- Your computer operating manual, which explains how to insert cards into the PCMCIA slot

The following National Instruments manual contains detailed information for the register-level programmer:

- DAQCard-500 Register-Level Programmer Manual

This manual is available from National Instruments by request. If you are using NI-DAQ, LabVIEW, or LabWindows/CVI, you should not need the register-level programmer manual. Using NI-DAQ, LabVIEW, or LabWindows/CVI is as easy and as flexible as using the low-level programming described in the register-level programmer manual. Refer to Software Programming Choices in Chapter 1, Introduction, of this manual to learn more about your programming options.

Customer Communication

National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you to complete. These forms are in Appendix G, Customer Communication, at the end of this manual.

Chapter 1
Introduction

This chapter describes the DAQCard-500, lists what you need to get started, your software programming choices, and explains how to unpack the DAQCard-500.

About the DAQCard-500

Thank you for purchasing the National Instruments DAQCard-500. The DAQCard-500 is a low-cost, low-power analog input, digital I/O, and timing I/O board for computers equipped with a Type II PCMCIA slot. The board contains a 12-bit, successive-approximation ADC with eight single-ended analog inputs, four lines of TTL-compatible digital input, and four lines of digital output. The optional 27-pin I/O connector for the DAQCard-500 enables you to easily connect all your signals directly to the card. The DAQCard-500 is fully software configurable and calibrated so that you can easily install the card and begin your acquisition without having to spend time calibrating the card.

The DAQCard-500 ships with NI-DAQ, National Instruments' complete DAQ driver that handles every function listed on the data sheet for our DAQ hardware. Using NI-DAQ you can quickly and easily start your application without having to program the card on the register level.

The small size and weight of the DAQCard-500 coupled with its low-power consumption make this board ideal for use in portable computers, making remote data acquisition practical. The board requires very little power when operating and has a standby mode that uses even less power, thus extending the life of your computer batteries.

In addition, the low cost of a system based on the DAQCard-500 makes it ideal for laboratory work in industrial and academic environments. The multichannel analog input is useful in signal analysis and data logging. The 12-bit ADC is useful in high-resolution applications such as chromatography, temperature measurement, and DC voltage measurement. The eight TTL-compatible digital I/O lines can be used for switching external devices such as transistors and solid-state relays, and for reading the status of external digital logic. The DAQCard-500, used in conjunction with your computer, is a versatile, cost-effective platform for laboratory test, measurement, and control.

Detailed specifications for the DAQCard-500 are in Appendix A, *Specifications*.

What You Need to Get Started

To set up and use your DAQCard-500, you will need the following:

❑ DAQCard-500

❑ PR27-30F I/O connector with cable (must be purchased separately)

❑ *DAQCard-500 User Manual*

❑ One of the following software packages and documentation:
  NI-DAQ for PC compatibles
  NI-DAQ for NEC PC-9800 Series
  NI-DAQ for Macintosh
  LabVIEW for Windows
  LabWindows/CVI for Windows

❑ Your computer

Software Programming Choices

There are several options to choose from when programming your National Instruments DAQ and SCXI hardware. You can use LabVIEW, LabWindows/CVI, or NI-DAQ.

LabVIEW and LabWindows/CVI Application Software

LabVIEW and LabWindows/CVI are innovative program development software packages for data acquisition and control applications. LabVIEW uses graphical programming, whereas LabWindows/CVI enhances traditional programming languages. Both packages include extensive libraries for data acquisition, instrument control, data analysis, and graphical data presentation.

LabVIEW features interactive graphics, a state-of-the-art user interface, and a powerful graphical programming language. The LabVIEW Data Acquisition VI Library, a series of VIs for using LabVIEW with National Instruments DAQ hardware, is included with LabVIEW. The LabVIEW Data Acquisition VI Libraries are functionally equivalent to the NI-DAQ software.

LabWindows/CVI features interactive graphics, a state-of-the-art user interface, and uses the ANSI standard C programming language. The LabWindows/CVI Data Acquisition Library, a series of functions for using LabWindows/CVI with National Instruments DAQ hardware, is included with the NI-DAQ software kit. The LabWindows/CVI Data Acquisition libraries are functionally equivalent to the NI-DAQ software.

Using LabVIEW or LabWindows/CVI software will greatly reduce the development time for your data acquisition and control application.

NI-DAQ Driver Software

The NI-DAQ driver software is included at no charge with all National Instruments DAQ hardware. NI-DAQ is not packaged with SCXI or accessory products, except for the SCXI-1200. NI-DAQ has an extensive library of functions that you can call from your application programming environment. These functions include routines for analog input (A/D conversion), buffered data acquisition (high-speed A/D conversion), analog output (D/A conversion), waveform generation, digital I/O, counter/timer operations, SCXI, RTSI, self-calibration, messaging, and acquiring data to extended memory.

NI-DAQ has both high-level DAQ I/O functions for maximum ease of use and low-level DAQ I/O functions for maximum flexibility and performance. Examples of high-level functions are streaming data to disk or acquiring a certain number of data points. An example of a low-level function is writing directly to registers on the DAQ device. NI-DAQ does not sacrifice the performance of National Instruments DAQ devices because it lets multiple devices operate at their peak performance.

NI-DAQ also internally addresses many of the complex issues between the computer and the DAQ hardware such as programming interrupts and DMA controllers. NI-DAQ maintains a consistent software interface among its different versions so that you can change platforms with minimal modifications to your code. Figure 1-1 illustrates the relationship between NI-DAQ and LabVIEW and LabWindows/CVI.
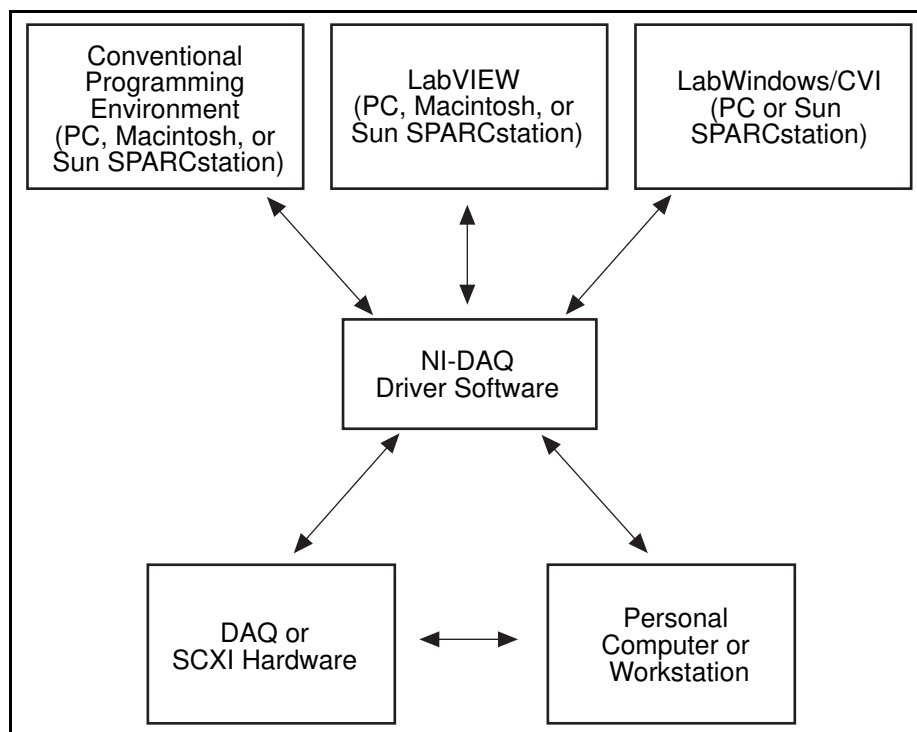
Figure 1-1. The Relationship between the Programming Environment, NI-DAQ, and Your Hardware

Register-Level Programming

The final option for programming any National Instruments DAQ hardware is to write register-level software. Writing register-level programming software can be very time-consuming and inefficient and is not recommended for most users.

Even if you are an experienced register-level programmer, consider using NI-DAQ, LabVIEW, or LabWindows/CVI to program your National Instruments DAQ hardware. Using the NI-DAQ, LabVIEW, or LabWindows/CVI software is as easy and as flexible as register-level programming and can save weeks of development time.

Optional Equipment

Listed below are some of the optional accessories that work with the DAQCard-500. New accessories are always being added to our product family. See your National Instruments catalog or call the National Instruments office nearest you for more information about optional equipment.

• PR27-30F I/O connector with .5 m or 1 m connector cable

• CB-27 I/O connector block

Unpacking

The DAQCard-500 is shipped in an antistatic vinyl case; when you are not using the DAQCard-500, you should store it in this case. Because the DAQCard-500 is enclosed in a fully shielded case, no additional electrostatic precautions are necessary. However, for your own safety and to protect the DAQCard-500, never attempt to touch the pins of the connectors.

Chapter 2
Installation and Configuration

This chapter describes how to install and software configure the DAQCard-500.

Installation

Your computer should be equipped with Card and Socket Services 2.0 or later. The DAQCard-500 requires a 32-byte I/O address window and one interrupt level.

This manual assumes that you are using the optional PR27-30F cable from National Instruments. Notice that the cable is keyed so that you can insert it only one way.

Insert the DAQCard-500 and attach the I/O cable.

Your DAQCard-500 kit includes a label for the CB-27 terminal block, which is available from National Instruments. If you are using the CB-27, attach the label to the inside cover. This label identifies the DAQCard-500 signal connections for the CB-27.

The DAQCard-500 has two connectors–a 68-pin PCMCIA bus connector on one end and a 27-pin I/O connector on the other end. Insert the PCMCIA bus connector into any available Type II PCMCIA slot until the connector is seated firmly. Notice that the card is keyed so that it can be inserted only one way. If your computer supports hot insertion, you may insert or remove the DAQCard-500 at any time, whether your computer is powered on or off.

Be very careful not to put strain on the I/O cable when inserting it into and removing it from the DAQCard-500. Always grasp the cable by the connector you are plugging or unplugging. *Never* pull directly on the I/O cable to unplug it from the DAQCard-500.

Figure 2-1 shows an example of a typical configuration.
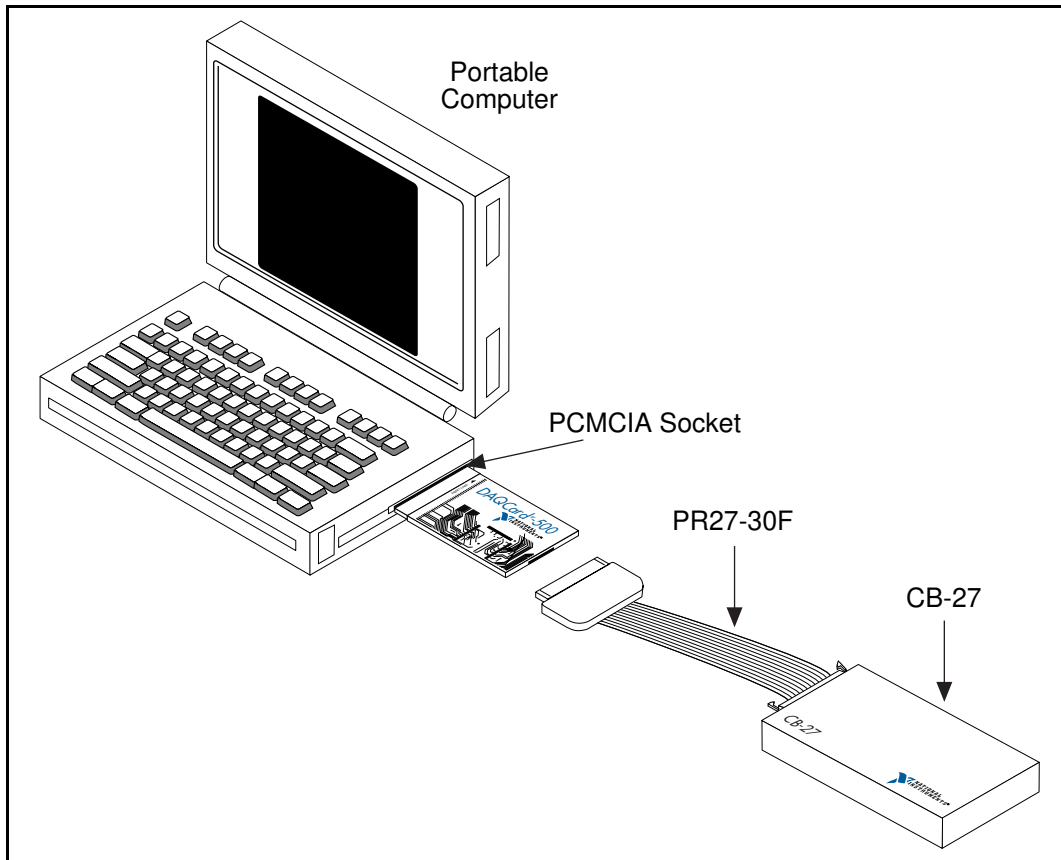
Figure 2-1. A Typical Configuration for the DAQCard-500

The DAQCard-500 is now installed. You are ready to make the appropriate connections to the I/O connector cable as described in Chapter 3, *Signal Connections,* and to install and configure your software.

Configuration

The DAQCard-500 is completely software configurable; refer to your software documentation to install and configure the software.

If you are using NI-DAQ for PC compatibles or NI-DAQ for NEC PC-9800 Series computers, refer to your NI-DAQ release notes. Find the installation and system configuration section for your operating system and follow the instructions given there.

If you are using NI-DAQ for Macintosh, refer to the NI-DAQ documentation. Find the installation and system configuration section for your operating system and follow the instructions given there.

If you are using LabVIEW, the software installation instructions are in your LabVIEW release notes. After you have installed LabVIEW, refer to the *Configuring LabVIEW* section of Chapter 1 of your LabVIEW user manual for software configuration instructions.

If you are using LabWindows/CVI, the software installation instructions are in Part 1, *Introduction to LabWindows/CVI*, of the *Getting Started with LabWindows/CVI* manual. After you have installed LabWindows/CVI, refer to Chapter 1, *Configuring LabWindows/CVI*, of the *LabWindows/CVI User Manual* for software configuration instructions.

If you are a register-level programmer, refer to the *DAQCard-500 Register-Level Programmer Manual.*

Analog Input Configuration

The DAQCard-500 is always configured as follows:

•   Single-ended input mode referenced to analog ground

•   ±5 V analog input range

Digital I/O Configuration

The DAQCard-500 always uses one 4-bit digital output port and one 4-bit digital input port.

Counter Configuration

You can use the MSM82C54 counter/timers for general-purpose applications, such as pulse and square wave generation, event counting, and pulsewidth, time-lapse, and frequency measurement. For information about configuring the MSM82C54, see the *Timing Connections* section of Chapter 3, *Signal Connections*.

Chapter 3
Signal Connections

This chapter describes the signals on the PR27-30F I/O connector and the CB-27 connector block, optional accessories available from National Instruments. Appendix C, *Custom Cable Design*, contains information and guidelines for the design of custom cables. Appendix F, PSH27-50F Signal Connections, contains information for using the the PSH27-50F and the CB-50 connector block, optional accessories available from National Instruments.

I/O Connectors

Figure 3-1 shows the pin assignments for the PR27-30F I/O connector and CB-27 connector block. Although the pin arrangements on these connectors differ, notice that the signal names and pin numbers are the same.

Warning: *Connections that exceed any of the maximum ratings of input or output signals on the DAQCard-500 can damage the DAQCard-500 and your computer. This includes connecting any power signals to ground and vice versa. National Instruments is NOT liable for any damages resulting from such signal connections.*

DIN1	13	27	DGND		ACH0	2	1	AIGND
DIN0	12	26	OUT2		ACH2	4	3	ACH1
EXTCONV*	11	25	CLK2		ACH4	6	5	ACH3
+5 V	10	24	GATE2		ACH6	8	7	ACH5
ACH7	9	23	OUT1		+5 V	10	9	ACH7
ACH6	8	22	CLK1		DIN0	12	11	EXTCONV*
ACH5	7	21	DGND		DIN2	14	13	DIN1
ACH4	6	20	1 MHz		DOUT0	16	15	DIN3
ACH3	5	19	DOUT3		DOUT2	18	17	DOUT1
ACH2	4	18	DOUT2		1MHz	20	19	DOUT3
ACH1	3	17	DOUT1		CLK1	22	21	DGND
ACH0	2	16	DOUT0		GATE2	24	23	OUT1
AIGND	1	15	DIN3		OUT2	26	25	CLK2
AIGND	1	14	DIN2		NC	28	27	DGND
					NC	30	29	NC

(key) between pins 15 and 16 of PR27-30F Cable

| a. CB-27 Connector Block | b. PR27-30F Cable |

Figure 3-1. I/O Connector Pin Assignments

Signal Connection Descriptions

Pin	Signal Name	Description
1	AIGND	Analog Input Ground—This signal is the common ground tie-in point for all analog signals.
2–9	ACH<0..7>	Analog Input Channels 0 through 7—These signals are the single-ended analog input signals.
10	+5 V	+5 Volts—This pin provides +5 VDC. The +5 V supply is fused at 1 A, which is the maximum current available.
11	EXTCONV*	External Convert Signal—This input signal externally initiates an A/D conversion.
12–15	DIN<0..3>	Digital Input Data Lines—These signals are TTL-compatible, digital input lines. DIN3 is the MSB; DIN0 is the LSB
16–19	DOUT<0..3>	Digital Output Data Lines—These signals are TTL-compatible digital output lines. DOUT3 is the MSB; DOUT0 is the LSB.
20	1 MHz	1 MHz Square Wave Output of Oscillator—This signal is a 1 MHz square wave for use with the internal counter or external timing needs.
21, 27	DGND	Digital Ground—This is the common ground tie-in point for all digital signals.
22	CLK1	Clock Input of Counter 1—This signal is the clock input of counter 1.
23	OUT1	Output of Counter 1—This signal outputs the programmed waveform of counter 1.
24	GATE2	Gate Input of Counter 2—This signal controls the starting, interruption, and restarting of counter 2.
25	CLK2	Clock Input of Counter 2—This signal is the clock input of counter 2.
26	OUT2	Output of Counter 2—This signal outputs the programmed waveform of counter 2.
28–30	NC	Not Connected—These signals are not connected.

Note: *An asterisk (*) indicates that the signal is active low.*

The connector pins are grouped into analog input signal pins, digital I/O signal pins, and timing I/O signal pins. Signal connection guidelines for each of these groups are included in the following pages.

Analog Input Signal Connections

Pins 1 through 9 are analog input signal pins for the ADC. Pin 1, AIGND, is an analog common signal. You can use these pins for a general analog power ground tie to the DAQCard-500. Pins 2 through 9 are the ACH<0..7> signal pins. These pins are tied to the analog input channels of the DAQCard-500 through 4.7 k series resistors. These resistors limit the input current

to the multiplexer. The following input range and maximum ratings apply to inputs ACH<0..7>:

- Input signal range   ±5 V

- Maximum input voltage rating   ±25 V powered on or off

Warning: ***Exceeding the input signal range distorts input signals. Exceeding the maximum input voltage rating may damage the DAQCard-500 card and the computer. National Instruments is NOT liable for any damages resulting from any such signal connections.***

Analog Input Signal Connection Considerations

When making analog signal connections to the DAQCard-500, you should first determine whether the signal source and the measurement system are floating or ground referenced. The two types of signal sources are described as follows, and the types of measurement systems are described in later sections.

Types of Signal Sources

Ground-Referenced Signal Sources

A ground-referenced signal source is one that is connected in some way to the building system ground. Nonisolated outputs of instruments and devices that plug into the building power system fall into this category.

The difference in ground potential between two instruments connected to the same building power system is typically between 1 and 100 mV but can be much higher if power distribution circuits are not properly connected.

Floating Signal Sources

A floating signal source is one that is not connected in any way to the building ground system but rather has an isolated ground-reference point. Some examples of floating signal sources are outputs of transformers, thermocouples, battery-powered devices, optical isolator outputs, and isolation amplifiers. The ground reference of a floating signal must be tied to the DAQCard-500 analog input ground to establish a local or onboard reference for the signal. Otherwise, the measured input signal varies or appears to float. An instrument or device that provides an isolated output falls into the floating signal source category.

Types of Measurement Systems

In addition to determining the type of signal source, you also need to determine whether your measurement system is floating or ground referenced. These two types of measurement systems

are described below. Depending on the power connection, a portable computer can represent either a floating or ground-referenced measurement system. If a portable computer is entirely battery powered, it is a floating system. If it is operated from an AC/DC wall adapter, it may or may not be ground referenced, depending on the connection. You should determine from your computer documentation whether any of the power connections are tied to the building power system ground.

Ground-Referenced Measurement System

A ground-referenced measurement system is one that is connected in some way to the building system ground. Instruments that plug into the building power system fall into this category.

Floating Measurement System

A floating measurement system is one that is not connected in any way to the building ground system but rather has an isolated ground-reference point. Some examples of floating measurement systems are battery-powered instruments, instruments powered with a nonground-referenced power adapter, and instruments with differential inputs. A floating measurement system will float to the level of the signals being measured.

Analog Input Connections

The analog input connections on the DAQCard-500 are single ended. They are measured with respect to one common ground. The input signals are tied to the positive input of an operational amplifier that is referenced to this common ground. Figure 3-2 shows how to connect single-ended analog input signals to the DAQCard-500. Table 3-1 summarizes this information.

Table 3-1. Recommended Input Configurations for Ground-Referenced and Floating
Measurement Systems

| System Type	Type of Signal	Considerations
Floating system such as a battery-powered computer	Floating, not referenced (batteries, thermocouples, isolated outputs)	Signal ground (negative side of signal) should be connected to AIGND of the DAQCard-500.
	Grounded, referenced (nonisolated outputs, plug-in instruments)	Signal ground (negative side of signal) should be connected to AIGND of the DAQCard-500.
Ground-referenced system such as a desktop computer	Floating, not referenced (batteries, thermocouples, isolated outputs)	Signal ground (negative side of signal) should be connected to AIGND of the DAQCard-500.
	Grounded, referenced (nonisolated outputs, plug-in instruments)	Not recommended due to noise caused by ground currents
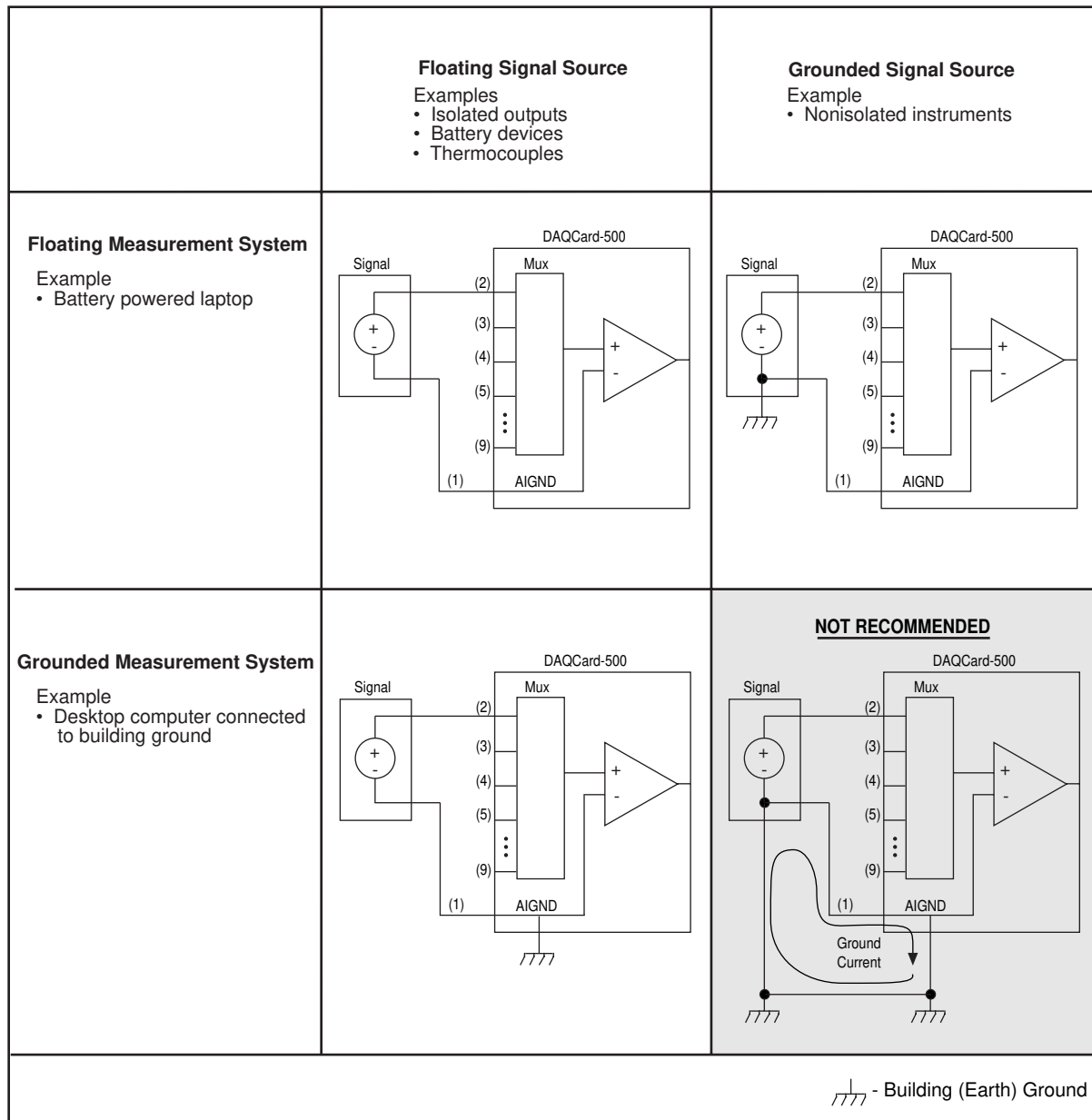
Figure 3-2. DAQCard-500 Analog Input Connections

Digital I/O Signal Connections

Pins 12 through 19 of the I/O connector are digital I/O signal pins. Pins 12 through 15 are digital input pins. Pins 16 through 19 are digital output pins. Pin 27 is the digital ground pin.

The following specifications and ratings apply to the digital I/O lines.

* Absolute maximum voltage input rating   +5.5 V with respect to DGND

* Absolute minimum voltage input rating   -0.5 V with respect to DGND

- Digital input compatibility   TTL-compatible

- Input current (high or low level)   1 µA

- Digital output compatibility   TTL-compatible

- Output current source capability   4 mA, at $V_{OH} = 3.3$ V

- Output current sink capability   4 mA, at $V_{OL} = 0.9$ V

Figure 3-3 shows an example of connections to the digital input and output ports. Digital input applications include receiving TTL signals and sensing external device states such as the switch in Figure 3-3. Digital output applications include sending TTL signals and driving external devices such as the LED shown in Figure 3-3.
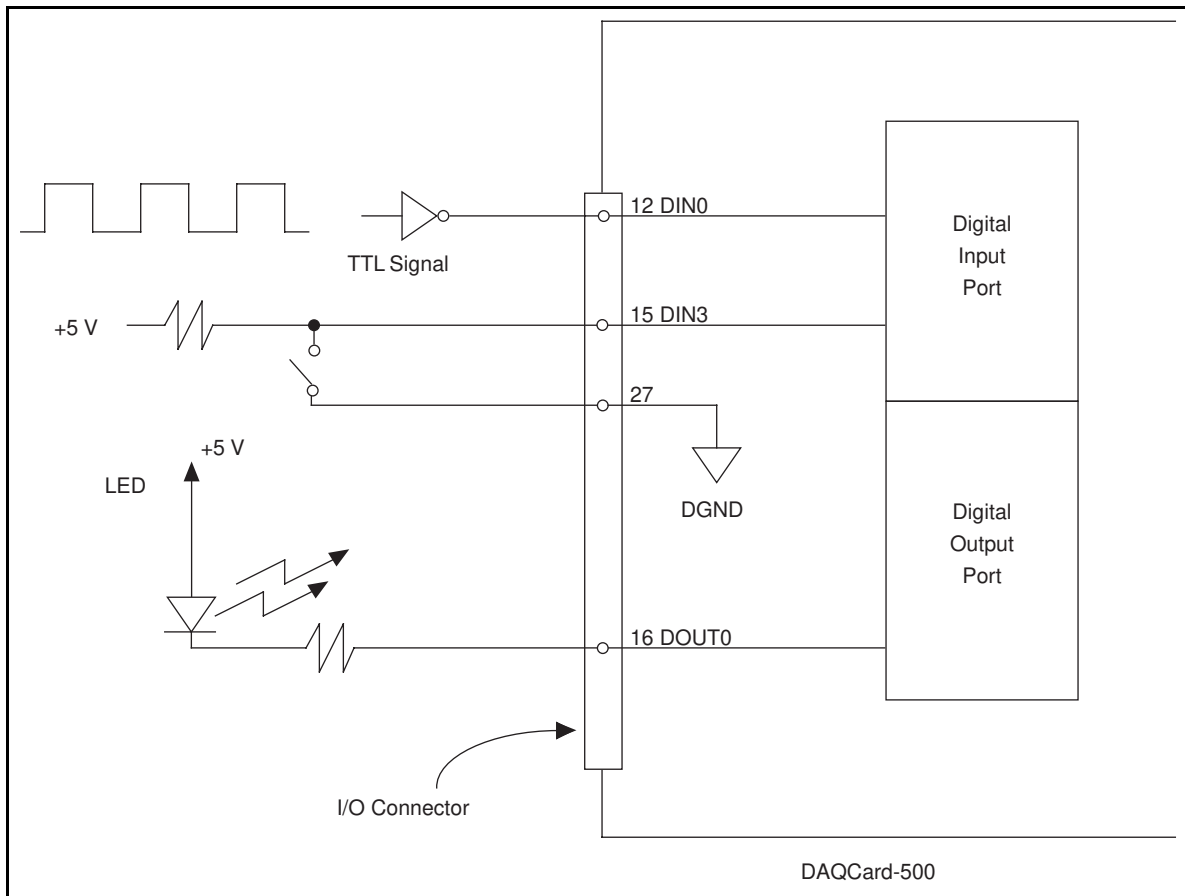

Figure 3-3. Digital I/O Signal Connections

Note: Pin numbers in this figure refer only to the PR27-30F cable.

Timing Connections

Pins 20 through 26 and pin 11 of the I/O connector are for timing I/O signals. The DAQCard-500 uses an MSM82C54 counter/timer integrated circuit. Counters 1 and 2 are available at the I/O connector. Counter 0 is dedicated for data acquisition timing. Pin 11 carries an external signal, EXTCONV*, that can be used for data acquisition timing in place of counter 0 of the MSM82C54. This signal is explained in the *Data Acquisition Counter and Timing Connections* section of this chapter. Pin 20 carries the 1 MHz square-wave oscillator signal. This signal can be used as a timebase for the counter clock inputs. Pins 22 through 26 carry general-purpose timing signals from the MSM82C54. These signals are explained under *General-Purpose Counter and Timing Signal Connections* later in this chapter.

Data Acquisition Counter and Timing Connections

Counter 0 on the MSM82C54 counter/timer is used as a sample-interval counter in timed A/D conversions. In addition to counter 0, you can use pin 11, EXTCONV*, to externally time conversions. If you need to program this chip directly, refer to the optional *DAQCard-500 Register-Level Programmer Manual* for the programming sequence needed to enable this input. Figure 3-4 shows the timing requirements for the EXTCONV* input. An A/D conversion is initiated by a rising edge on the EXTCONV*. The data from this conversion is latched into the FIFO memory within 20 μs. The EXTCONV* input is a TTL-compatible signal.
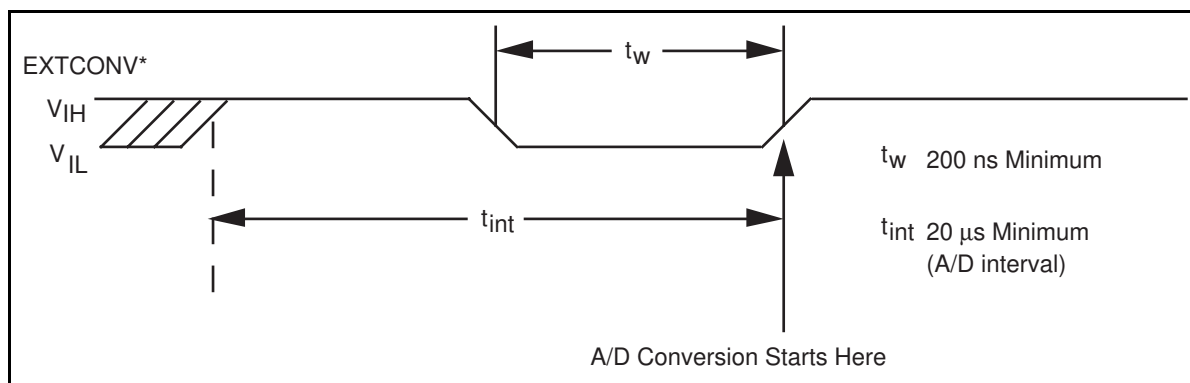

Figure 3-4. EXTCONV* Signal Timing

Notice that EXTCONV* can only cause conversions to occur; you cannot use it as a monitor to detect conversions caused by the onboard sample-interval timer.

General-Purpose Counter and Timing Signal Connections

The general-purpose timing signals include CLK and OUT signals for counter 1 and GATE, CLK, and OUT signals for counter 2 of the MSM82C54. Counter 0 is not available on the I/O connector. You can use the MSM82C54 counter/timers for general-purpose applications such as pulse and square wave measurement. For these applications, CLK and GATE signals are sent to the counters and the counters are programmed for various operations. The only exceptions are counter 0, which has an internal 1 MHz clock and its gate is always enabled, and counter 1, which has its gate always enabled.

The MSM82C54 counter/timer is described briefly in Chapter 4, *Theory of Operation.* For more detailed programming information, consult the *MSM82C54 Data Sheet* in the optional *DAQCard-500 Register-Level Programmer Manual*.

To perform pulse and square wave generation, program a counter to generate a timing signal at its OUT output pin.

To count events, program a counter to count rising or falling edges applied to any of the MSM82C54 CLK inputs. You can then read the counter value to determine the number of edges that have occurred. You can gate counter operation on and off during event counting. Figure 3-5 shows connections for a typical event-counting operation in which a switch is used to gate counter 2 on and off.
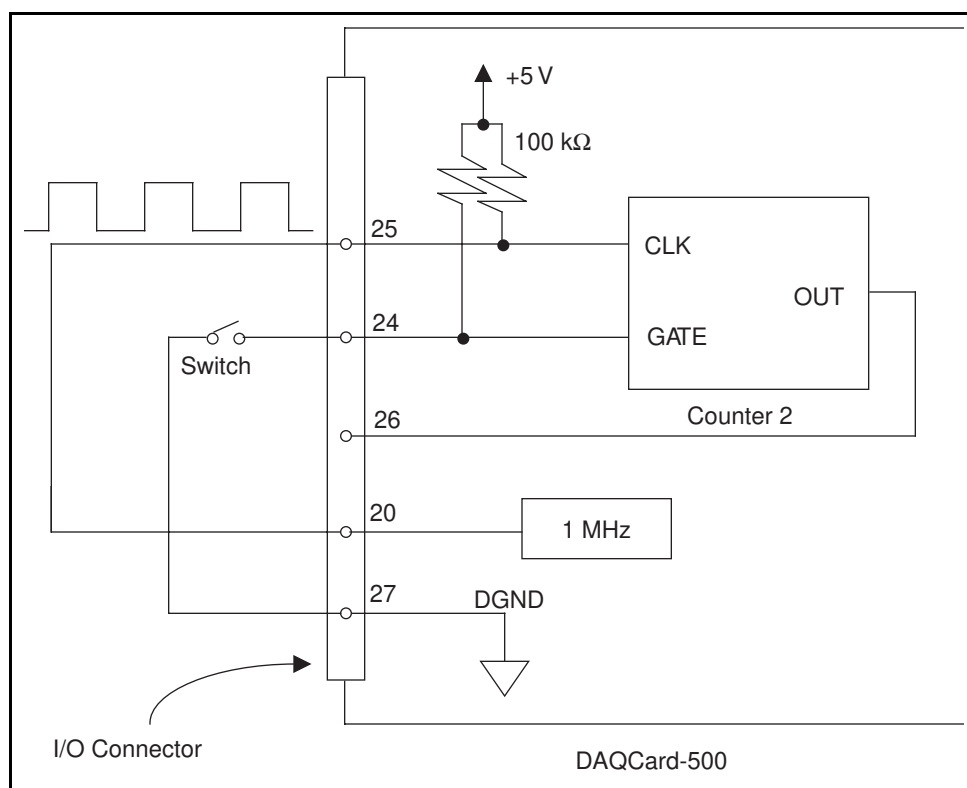

Figure 3-5. Event-Counting Application with External Switch Gating

Use level gating to measure pulse width. Apply the pulse to be measured to the GATE2 input. Load the counter with the known count and program the counter to count down while the signal at the GATE2 input is high. The pulse width equals the counter difference (loaded value minus read value) multiplied by the CLK2 period.

To measure time lapse, program counter 2 to be edge gated. Apply an edge to the GATE2 input to start the counter. Program counter 2 to start counting after receiving a low-to-high edge. The time lapse since receiving the edge equals the counter value difference (loaded value minus the read value) multiplied by the CLK2 period.

To measure frequency, program counter 2 to be level gated and count the number of falling edges in a signal applied to the CLK2 input. The gate signal you applied to the GATE2 input is of a known duration. In this case, program counter 2 to count falling edges at the CLK2 input while the gate is applied. The frequency of the input signal then equals the count value divided by the gate period. Figure 3-6 shows the connections for a frequency measurement application. You could also use counter 1 to generate the gate signal in this application.
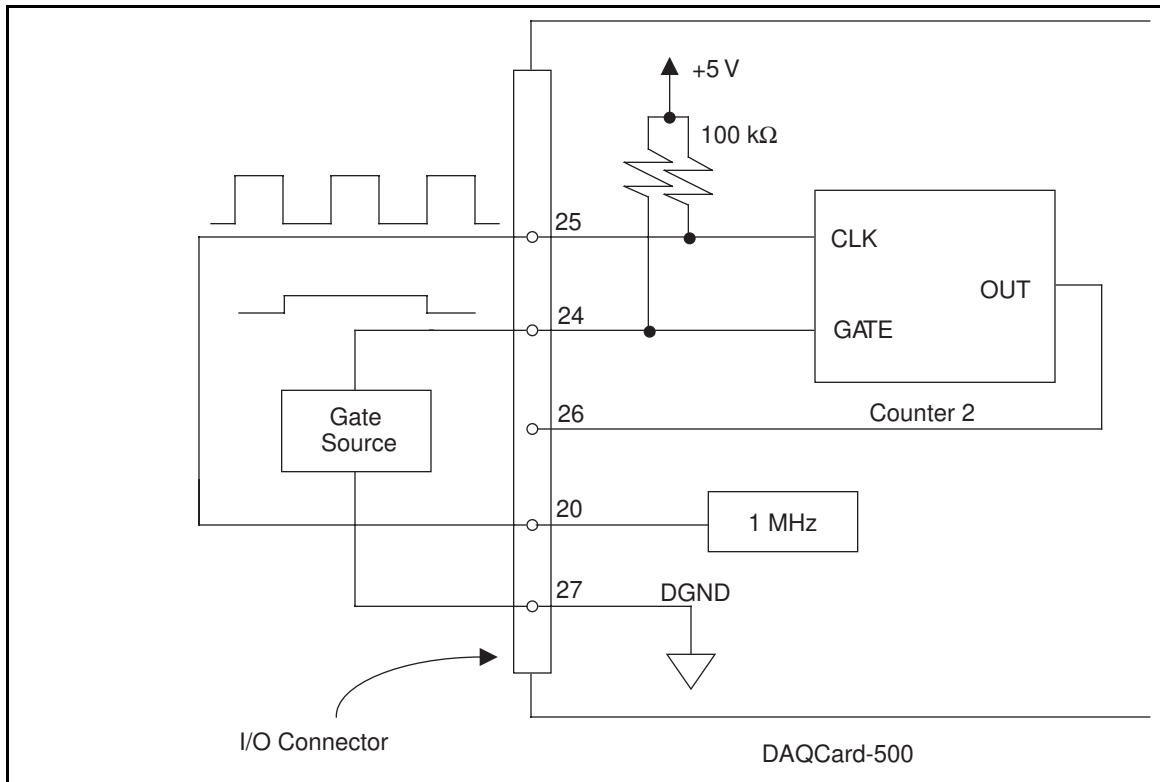

Figure 3-6. Frequency Measurement Application

The CLK and OUT signals for counter 1 are available at the I/O connector. The GATE, CLK, and OUT signals for counter 2 are available at the I/O connector. In addition, the GATE and CLK pins are pulled up to +5 V through a 100 k resistor.

Figure 3-7 shows the timing requirements for the GATE and CLK input signals and the timing specifications for the OUT output signals of the MSM82C54.

- Absolute maximum voltage input rating   -0.5 to 5.0 V with respect to DGND

- MSM82C54 digital input specifications (referenced to DGND):

  - V_{IH} input logic high voltage   2.2 V minimum

  - V_{IL} input logic low voltage   0.8 V maximum

  - Input load current   ±10.0 μA maximum

- MSM82C54 digital output specifications (referenced to DGND):

  - V_{OH} output logic high voltage   3.0 V minimum

  - V_{OL} output logic low voltage   0.40 V maximum

  - I_{OH} output source current, at V_{OH} 2.5 mA maximum

  - I_{OL} output sink current, at V_{OL} 2.5 mA maximum

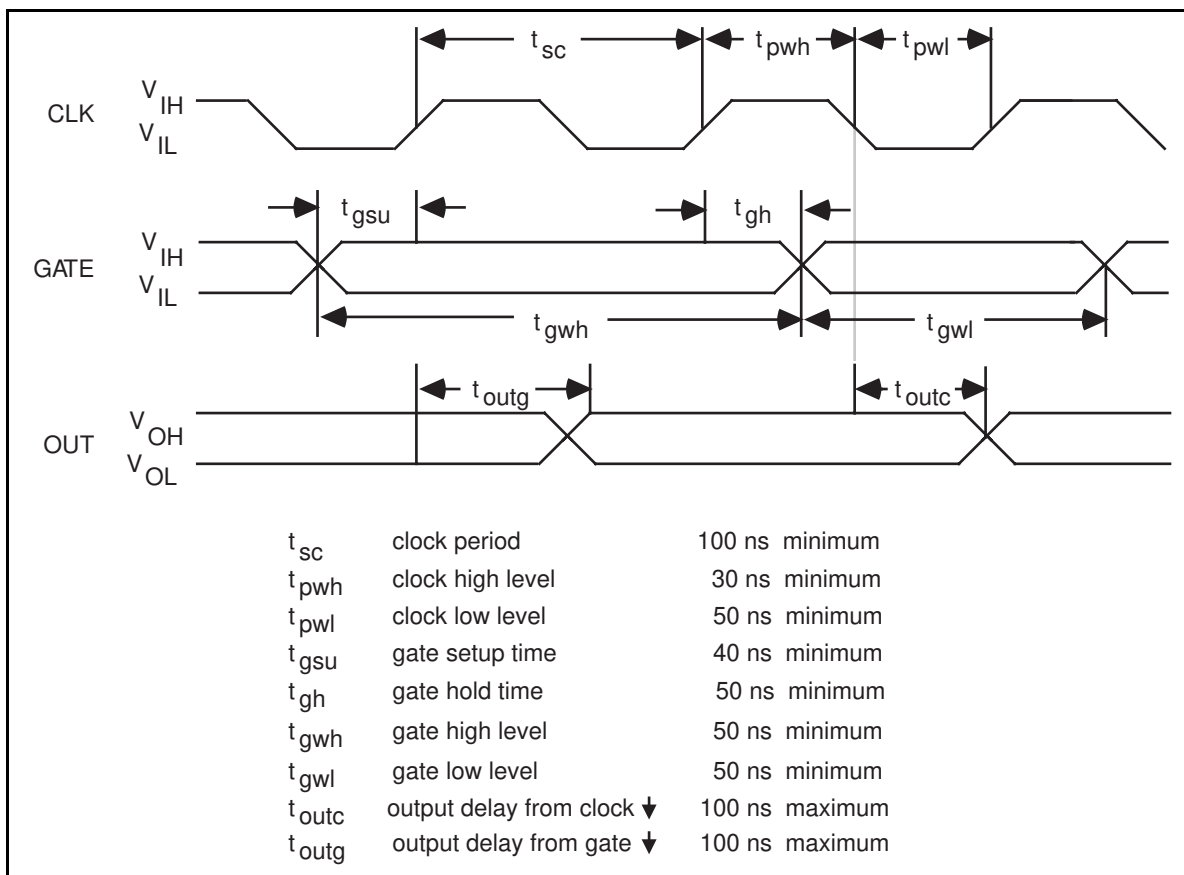| t_{sc}	clock period	100 ns minimum
t_{pwh}	clock high level	30 ns minimum
t_{pwl}	clock low level	50 ns minimum
t_{gsu}	gate setup time	40 ns minimum
t_{gh}	gate hold time	50 ns minimum
t_{gwh}	gate high level	50 ns minimum
t_{gwl}	gate low level	50 ns minimum
t_{outc}	output delay from clock ↓	100 ns maximum
t_{outg}	output delay from gate ↓	100 ns maximum

Figure 3-7. General-Purpose Timing Signals

The GATE and OUT signals in Figure 3-7 are referenced to the rising edge of the CLK signal.

Cabling

National Instruments currently offers a cable termination accessory, the CB-27, for use with the DAQCard-500. You can attach signal input and output wires to screw terminals on the connector block and, therefore, to the DAQCard-500 I/O connector.

The CB-27 is useful for the initial prototyping of an application or in situations in which the DAQCard-500 interconnections are frequently changed. After you develop a final field wiring scheme, however, you may want to develop your own cable. Refer to Appendix C, *Custom Cable Design*, for information and guidelines for the design of custom cables.

Chapter 4
Theory of Operation

This chapter includes an overview of the DAQCard-500 and explains the operation of each functional unit making up the DAQCard-500.

Functional Overview

The block diagram in Figure 4-1 shows a functional overview of the DAQCard-500.
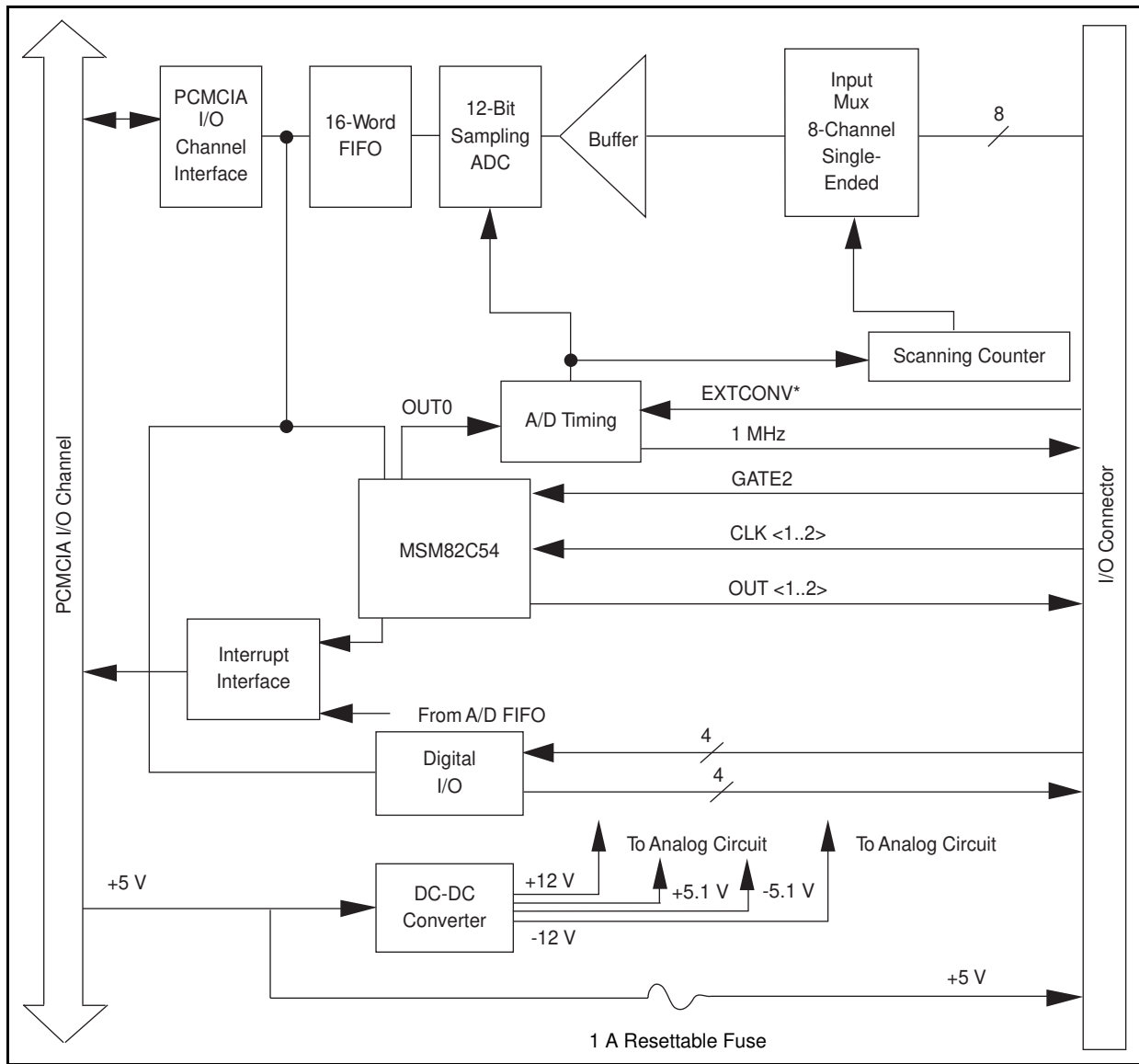
Figure 4-1. DAQCard-500 Block Diagram

The following are the major components making up the DAQCard-500:

- PCMCIA I/O channel interface circuitry

- Analog input circuitry

- Digital I/O circuitry

- Timing I/O circuitry

You can execute data acquisition functions by using the analog input circuitry and some of the timing I/O circuitry. The internal data and control buses interconnect the components. The theory of operation for each of these components is explained in the remainder of this chapter. The theory of operation for the data acquisition circuitry is included with the discussion of the analog input circuitry.

PCMCIA I/O Channel Interface Circuitry

The PCMCIA I/O channel interface circuitry consists of an address bus, a data bus, interrupt lines, and several control and support signals. The components making up the DAQCard-500 PCMCIA I/O channel interface circuitry are shown in Figure 4-2.
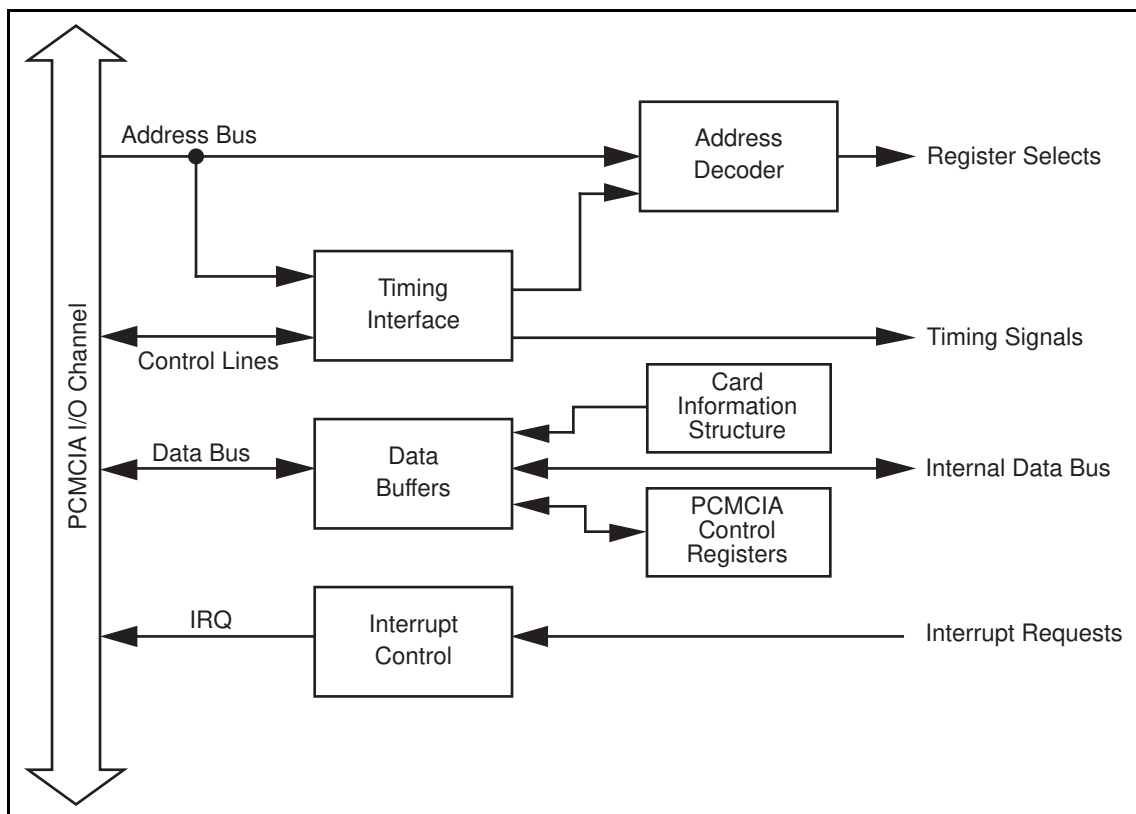
Figure 4-2. PCMCIA I/O Interface Circuitry Block Diagram

When you first insert the card, the system examines information stored in the DAQCard-500 Card Information Structure. This data is used to configure the card appropriately for the system in which it is used. When the system has assigned the card to a section of memory, it updates the PCMCIA control registers and initializes the card.

Analog Input and Data Acquisition Circuitry

The DAQCard-500 has 8 channels of analog input with 12-bit A/D conversion. Using the timing circuitry, the DAQCard-500 can also automatically time multiple A/D conversions. Figure 4-3 shows a block diagram of the analog input and data acquisition circuitry.
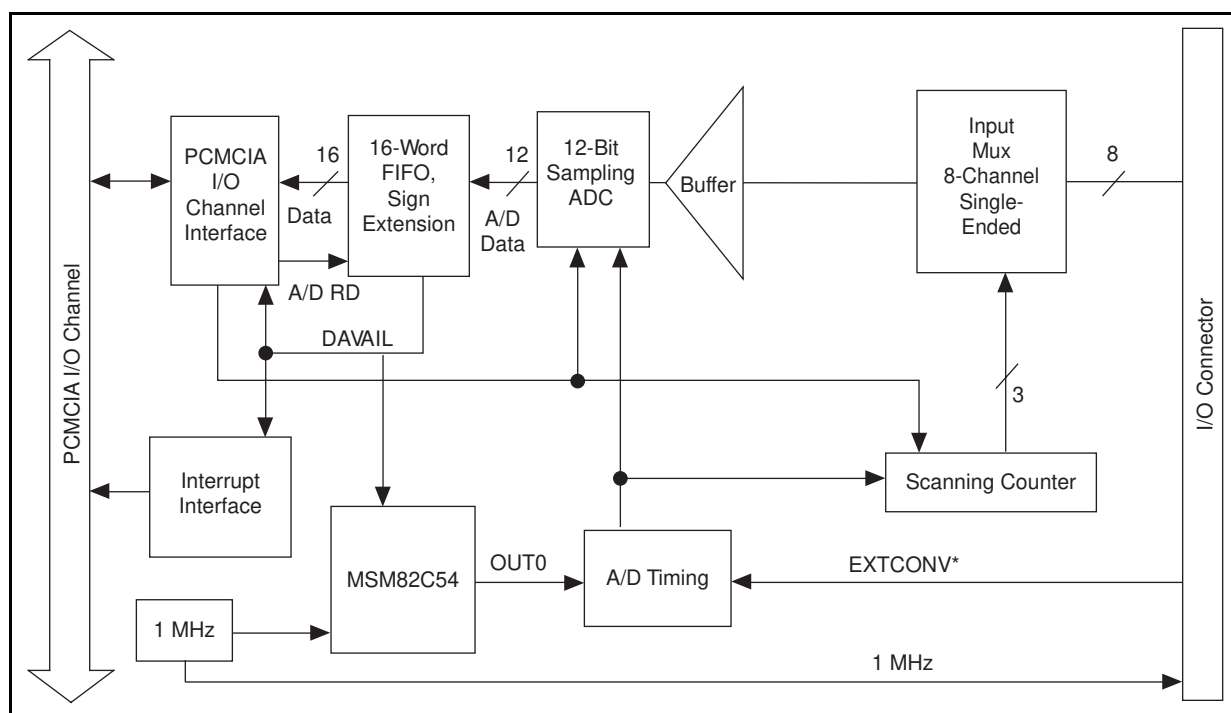
Figure 4-3. Analog Input and Data Acquisition Circuitry Block Diagram

Analog Input Circuitry

The analog input circuitry consists of an input multiplexer, a buffer, and a 12-bit sampling ADC. The 12-bit output is sign-extended to 16 bits, then stored in a 16-word-deep FIFO memory.

The input multiplexer is an 8-channel CMOS analog input multiplexer. The input multiplexer selects one of 8 analog input channels (channels 0 through 7). With the input multiplexer stage, input overvoltage protection of ± 25 V is available, powered on or off.

The DAQCard-500 uses a 12-bit successive-approximation ADC. The ADC has a fixed input range of ±5 V.

When an A/D conversion is complete, the ADC clocks the result into the A/D FIFO. The A/D FIFO is 16 bits wide and 16 words deep. This FIFO serves as a buffer to the ADC and has two

benefits. First, when an A/D conversion is complete, the value is saved in the A/D FIFO for later reading, and the ADC is free to start a new conversion. Secondly, the A/D FIFO can collect up to 16 A/D conversion values before any information is lost, thus giving the software some extra time (16 times the sample interval) to catch up with the hardware. If more than 16 values are stored in the A/D FIFO without the A/D FIFO being read from, an error condition called A/D FIFO overflow occurs and A/D conversion information is lost.

The A/D FIFO generates a signal that indicates when it contains A/D conversion data. The state of this signal can be read from the Status Register.

The output from the ADC is a two's complement number ranging from -2,048 to 2,047. The output from the 12-bit ADC is always sign-extended to 16 bits by the board circuitry so that data values read from the FIFO are 16 bits wide.

Data Acquisition Timing Circuitry

A data acquisition operation refers to the process of obtaining a series of successive A/D conversions at a carefully timed interval. This interval is called the sample interval. The data acquisition timing circuitry consists of various clocks and timing signals that perform this timing. The DAQCard-500 can perform two types of data acquisition—single-channel data acquisition and multichannel (scanned) data acquisition. Scanned data acquisition uses a counter to automatically switch between analog input channels during data acquisition.

Data acquisition timing consists of signals that initiate a data acquisition operation and generate scanning clocks. One of the three counters of the onboard MSM82C54 is reserved for this purpose.

An A/D conversion can be initiated during data acquisition by a low-to-high transition on the counter 0 output (OUT0) of the MSM82C54 onboard counter/timer chip on the DAQCard-500, or by a low-to-high transition on EXTCONV* input.

The sample-interval timer is a 16-bit down counter that uses the onboard 1 MHz clock to generate sample intervals from 2 µs to 65,535 µs (see *Timing I/O Circuitry* later in this chapter). Each time the sample-interval timer reaches zero, it generates a pulse and reloads with the programmed sample-interval count. This operation continues until the counter is reprogrammed.

Notice that only counter 0 is required for data acquisition operations. The software must track the number of conversions that have occurred and turn off counter 0 after the required number has been obtained.

Single-Channel Data Acquisition

During single-channel data acquisition, a control register is set to select the analog input channel before data acquisition is initiated. This multiplexer setting remains constant during the entire data acquisition process; therefore, all A/D conversion data is read from a single channel.

Multichannel (Scanned) Data Acquisition

You can perform multichannel data acquisition by enabling scanning during data acquisition. Multichannel scanning is controlled by a scan counter.

For scanning operations, the DAQCard-500 decrements from the highest numbered channel (selected by the user) through channel 0 and then repeats the sequence. Any number of channels from 2 to 8 can be scanned.

Data Acquisition Rates

The maximum data acquisition rate (number of samples per second) is determined by the conversion period of the ADC plus the acquisition time of its track-and-hold stage. During multichannel scanning, the data acquisition rate is further limited by the settling time of the input multiplexer and operational amplifier. After the input multiplexer is switched, the amplifier must be able to settle to the new input signal value to within 12-bit accuracy before an A/D conversion is performed, or 12-bit accuracy cannot not be achieved.

If your chosen data acquisition rate does not allow the specified settling time, the analog input circuitry may not perform at 12-bit accuracy. Furthermore, if the maximum data acquisition rate is exceeded, A/D conversions may be lost. The maximum data acquisition rate and settling time specifications are listed in Appendix A, *Specifications*.

These settling time specifications assume that voltage levels on all the channels included in the scan sequence are within range and are driven by low-impedance sources. Signal levels outside the ranges on the channels included in the scan sequence adversely affect the input settling time. Similarly, greater settling time may be required for channels driven by high-impedance signal sources.

Digital I/O Circuitry

The DAQCard-500 has eight digital I/O lines that are TTL-compatible. Pins DIN<0..3> of the I/O connector are digital input lines, and pins DOUT<0..3> are digital output lines. These lines are monitored or driven by the Digital Input Register or the Digital Output Register, respectively. Reading the Digital Input Register returns the current state of DIN<0..3> lines. Writing to the Digital Output Register drives the new value onto the DOUT<0..3> lines. Figure 4-4 shows a diagram of this circuitry.
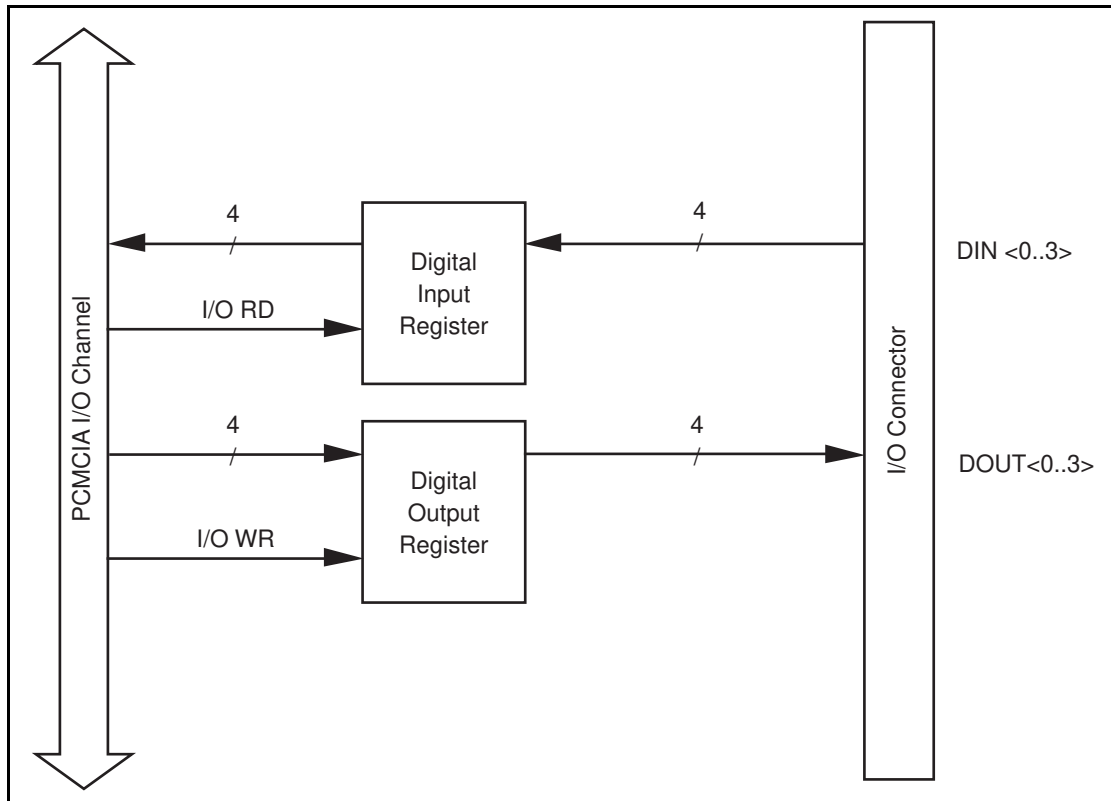
Figure 4-4. Digital I/O Circuitry Block Diagram

Timing I/O Circuitry

The DAQCard-500 uses an MSM82C54 counter/timer integrated circuit for data acquisition timing and for general-purpose timing I/O functions. Counters 1 and 2 of the MSM82C54 are available for general use, but counter 0 is used internally for data acquisition timing. The gate signal of counter 1 is internally pulled up and is always active. Figure 4-5 shows a block diagram of both groups of timing I/O circuitry.
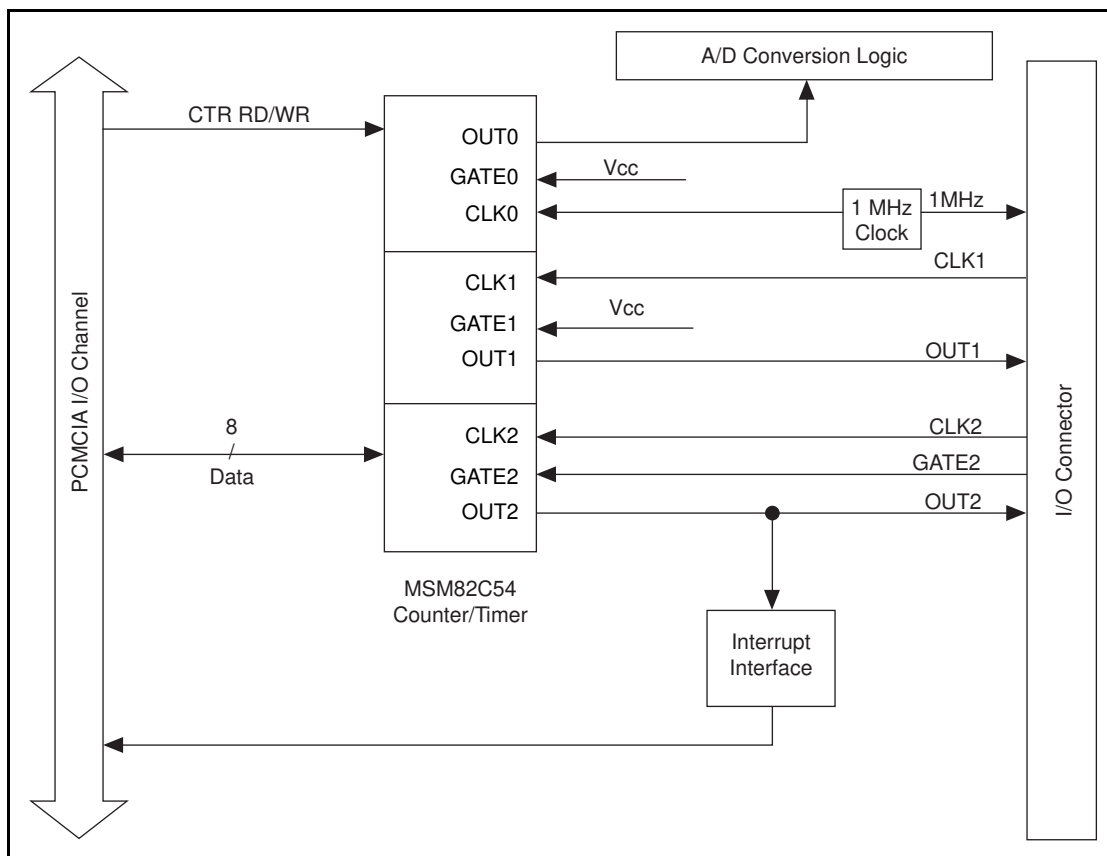
Figure 4-5. Timing I/O Circuitry Block Diagram

The MSM82C54 contains three independent 16-bit counter/timers and one 8-bit Mode Register.
As shown in Figure 4-5, counter 0 is used for data acquisition timing, and counters 1 and 2 are
free for general use. All three counter/timers can be programmed to operate in several useful
timing modes. The programming and operation of the MSM82C54 is presented in detail in the
optional *DAQCard-500 Register-Level Programmer Manual*.

The MSM82C54 for counter 0 uses a 1 MHz clock generated from the onboard oscillator. This
1 MHz clock is also available on the cable I/O connector, which can be used as a timebase for
counters 1 and 2. The 16-bit counters in the MSM82C54 can be diagrammed as shown in
Figure 4-6.
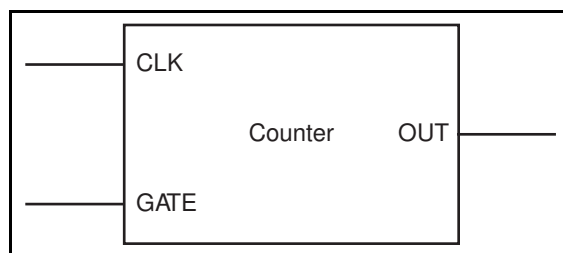
Figure 4-6. Counter Block Diagram

Each counter has a clock input pin, a gate input pin, and an output pin labeled CLK, GATE, and OUT, respectively. The MSM82C54 counters are numbered zero through two, and their GATE, CLK, and OUT pins are labeled GATE *N*, CLK *N*, and OUT *N*, where *N* is the counter number.

Appendix A
Specifications

This appendix lists the specifications of the DAQCard-500. These specifications are typical at 25° C unless otherwise specified. The operating temperature range is 0° to 70° C.

Analog Input

Input Characteristics
Number of channels .... 8 single-ended
Type of ADC .... Successive approximation
Resolution .... 12 bits, worst-case code range -2,021 to +2,020 (due to software calibration)

Maximum sampling rate .... 50 kS/s, 25 kS/s sustained under DOS, 10 kS/s sustained under Windows 3.*x*
Input signal ranges .... ±5 V
Input coupling .... DC
Overvoltage protection .... ±25 V powered on, ±25 V powered off
    Inputs protected .... ACH<0..7>
FIFO buffer size .... 16 samples
Data transfers .... Interrupts, programmed I/O

Transfer Characteristics
Relative accuracy .... ±1.5 LSB typ, ±2.5 LSB max
DNL .... ±0.7 LSB typ, ±1 LSB max
INL .... ±0.7 LSB typ, ±1 LSB max
No missing codes .... 12 bits, guaranteed
Offset error
    After software calibration .... ±1 LSB
    Before software calibration .... ±8 LSB typ, ±12 LSB max
Gain error (relative to calibration reference)
    After software calibration .... ±0.045% of reading typ, ±0.09% max
    Before software calibration .... ±0.87% of reading typ, ±1.5% max

Amplifier Characteristics
Input impedance .... 1 G in parallel with 40 pF

Dynamic Characteristics
Settling time to ±0.024% (±1 LSB) for
full-scale step .... 20 µs

System noise .... 0.5 LSBrms

Stability
Recommended warm-up time .... 15 min
Offset temperature coefficient .... 10 ppm/° C max
Gain temperature coefficient .... 15 ppm/° C max

Digital I/O

Number of channels .... 4 input and 4 output
Compatibility .... TTL
Digital logic levels ....

Level	Min	Max
Input low voltage	0 V	0.8 V
Input high voltage	2 V	5 V
Input low current (V_{in} = 0 V)	—	-50 µA
Input high current (V_{in} = 5 V)	—	1 µA
Output low voltage (I_{OUT} = 4 mA)	—	0.9 V
Output high voltage (I_{OUT} = 4 mA)	3.3 V	—

Timing I/O

Number of channels .... 3 counter/timers (1 dedicated to analog input)
Resolution... 16 bits
Compatibility .... TTL, gate and source pulled high with 100 k resistors
Base clocks available .... 1 MHz
Base clock accuracy .... ±0.01%
Max source frequency .... 10 MHz
Min source pulse duration .... 50 ns
Min gate pulse duration.. 50 ns
Data transfers .... Programmed I/O

Bus Interface

Type .... Slave

Power Requirement

+5 VDC (±5%).. 60 mA in operational mode
20 mA in power-down mode

Note: These power usage figures do not include the power used by external devices that you have connected to the fused supply present on the I/O connector.

Physical

PC Card type .... Type II
I/O connector.. 27-pin male

Environment

Operating temperature... 0° to 70° C
Storage temperature .... -55° to 150° C
Relative humidity.. 5% to 90% noncondensing

Appendix B
Differences between the DAQCard-700 and the DAQCard-500

This appendix contains a summary of differences between the DAQCard-700 and the DAQCard-500 that may be relevant to you if you are a current DAQCard-700 user. For a summary of programming differences, refer to the *DAQCard-500 Register-Level Programmer Manual*.

Functionality	DAQCard-700	DAQCard-500
FIFO read	One, 16-bit word	Two, 8-bit words
FIFO buffer size	512 samples	16 samples
Maximum sample rate	100 kS/s	25 kS/s
Maximum input voltage rating	±30 V	±25 V
ADC calibration	Software calibration	Software calibration
Timer chip	MSM82C54	MSM82C54
Maximum timer source frequency	10 MHz	10 MHz
Input modes	Single ended, differential	Single ended
Input ranges	±10 V, ±5 V, ±2.5 V, Software selectable	±5 V, fixed

Appendix C
Custom Cable Design

This appendix describes the pin connections on the DAQCard-500, which you will need to use only if you are designing your own cable.

The recommended cable for the DAQCard-500 is the National Instruments PR27-30F. This cable has a 27-pin male connector that mates with the 27-pin female connector on the DAQCard-500. Figure C-1 shows the pin assignment for the 27-pin female connector on the DAQCard-500. You should use the pin assignment in Figure C-1 only for custom cable design.

If you are using the National Instruments 27-30F cable, you should use the pin assignment shown in Figure 3-1.

The other end of the cable uses a 30-pin, insulation displacement, male ribbon-cable header connector. National Instruments uses a polarized (keyed) connector to prevent inadvertent upside-down connection to the CB-27. Recommended manufacturer part number for this mating connector is as follows:

- AMP Manufacturing (part number 746288-7)

The following are the standard ribbon cables (30-conductor, 28 AWG, stranded) that work with the 30-pin connectors:

- Electronic Products Division/3M (part number 3365-30)

- T&B/Ansley Corporation (part number 171-30)

DGND	26
OUT2	1
CLK2	2
GATE2	3
OUT1	4
CLK1	5
DGND	6
1MHZ	7
DOUT3	8
DOUT2	9
DOUT1	10
DOUT0	11
DIN3	12
DIN2	13	key
DIN1	14
DIN0	15
EXTCONV*	16
+5 V	17
ACH7	18
ACH6	19
ACH5	20
ACH4	21
ACH3	22
ACH2	23
ACH1	24
ACH0	25
AIGND	27

Figure C-1. DAQCard-500 I/O Connector Pin Assignments

Note: Use this pin assignment figure ONLY if you are designing custom-made cables for your
DAQCard-500.

Appendix D
PC Card Questions and Answers

This appendix contains a list of common questions and answers relating to PC Card (PCMCIA) operation. The questions are grouped according to the type of information requested. You may find this information useful if you are having difficulty with the PCMCIA system software configuration.

Configuration

1. **Do I need to use my PCMCIA configuration utility to configure the National Instruments PC Cards?**

   No. We recommend that you do not configure our PC Cards using PC Card Control or an equivalent PC Card configuration utility. Use the configuration utilities included with the NI-DAQ driver software to properly configure your card. The appropriate utilities are WDAQCONF for Windows users or DAQCONF for DOS users.

2. **What should I do if my computer does not have Card and Socket Services version 2.0 or later?**

   Contact the manufacturer of your computer or of your PCMCIA adapter and request the latest Card and Socket PCMCIA driver. Our NI-DAQ software will work with any Card and Socket Service driver that is compliant to version 2.0 or later.

Operation

1. **My PC Card works when inserted before power-on time, but it does not work when hot inserted. What is wrong?**

   You may have an interrupt conflict. If you have a utility such as MSD.EXE, run it to determine the allocated interrupts, then refer to question 5 in the *Resources* section. MSD.EXE is usually shipped with Microsoft Windows.

2. **My computer locks up when I use a PC Card. What should I do?**

   This usually happens because Card Services allocated an unusable interrupt level to the PC Card. For example, on some computers, interrupt level 11 is not routed to PC Cards. If Card Services is not aware of this, it may assign interrupt 11 to a PC Card even though the interrupt is not usable. When a call uses the interrupt, the interrupt never occurs, and the computer locks up waiting for a response. For information about how to locate an interrupt that is free to be used, refer to question 4 in the *Resources* section.

3. **Is there a way I can conserve power on my PC Card when it is not in use?**

Yes. If you are using NI-DAQ for PC compatibles version 4.8.0 or later, a DOS utility called DAQPOWER_EXE will switch all National Instruments PC Cards between normal mode and power-down mode. Power-up and power-down icons are also installed for Windows users to access either of these two power-management modes.

Resources

1. How do I determine if I have a memory conflict?

If no PC Cards are working at all, it is probably because a memory window is not usable. Card Services uses a 4 KB memory window for its own internal use. If the memory cannot be used, then Card Services cannot read the Card Information Structure (CIS) from the card's EPROM, which means it cannot identify cards.

There are two different methods you can use when Card Services has a problem reading the CIS. First, you can determine which memory window Card Services is using, and then exclude that window from use by Card Services and/or the memory manager. Second, you can attempt to determine all of the memory that Card Services can possibly use and then exclude all but that memory from use by Card Services.

2. How do I determine all of the memory that Card Services can use?

One way to find out which memory addresses Card Services can use is to run a utility such as `MSD.EXE` that scans the system and tells you how the system memory is being used. For example, if you run such a memory utility and it tells you that physical addresses C0000 to C9FFF are being used for ROM access, then you know that C8000–D3FFF is an invalid range for Card Services and should be changed to CA000–D3FFF.

3. How can I find usable I/O addresses?

Finding usable I/O addresses is done by trial and error. Of the three resources used— memory, I/O, interrupts—I/O conflicts will be low. You can use either `DAQCONF.EXE` in DOS or `WDAQCONF` in Windows to diagnose I/O space conflicts. When you have configured `DAQCONF` or `WDAQCONF` for a particular I/O space, save the configuration. If there is a conflict, the configuration utility will report an error describing the conflict.

4. How do I find usable interrupt levels?

Some utilities, such as `MSD.EXE`, will scan the system and display information about what is using hardware interrupts. If you have such a utility, you can run it to determine what interrupts Card Services can use. Card Services needs an interrupt for itself as well as one interrupt for each PCMCIA socket in the system. For example, in a system with two PCMCIA sockets, at least three interrupts should be allocated for use by Card Services. Keep in mind that utilities such as `MSD.EXE` will sometimes report that an interrupt is in use when it really is not. For example, if the computer has one serial port, COM1, and one parallel port, LPT1, you know that IRQs 4 and 7 are probably in use. In general, IRQ5 is used for LPT2, but if the computer does not have two parallel ports, IRQ5 should be usable. IRQ3 is used for COM2, but if the computer has only has one serial port, IRQ3 should be usable.

5. I run a memory utility, and it appears there is no memory available for Card Services. What should I do?

You should remove your memory manager by commenting it out of the CONFIG.SYS file. Next, you can rerun the memory utility. Memory managers often consume an enormous amount of memory, and you will need to determine what memory is really usable by Card Services. When you have determined what memory is available for Card Services, reinstall your memory manager and make the necessary changes to provide Card Services with the memory needed. We suggest that you use the minimum amount of memory for Card Services, namely 4 to 12 KB, which frees more memory for the memory manager.

Resource Conflicts

1. How do I resolve conflicts between my memory manager and Card Services?

Card Services can usually use memory space that is not being used for real RAM on the system. Even when this is the case, you should still exclude the memory addresses used by Card Services from use by any memory manager that may be installed.

Appendix E
Power-Management Modes

This appendix describes the power-management modes of the DAQCard-500.

- Normal Mode—This is the normal operating mode of the DAQCard-500 in which all the circuits are fully functional. This mode draws about 60 mA from the 5 V supply (about 300 mW).

- Power-Down Mode—In this mode, the digital circuitry is powered on and is functional. The analog input is powered down by setting the PWRDOWN bit in the PC Card Configuration and Status Register. You can set the PWRDOWN bit by using the `DAQPOWER` utility that is shipped with NI-DAQ. Use `DAQPOWER-D` to power down and `DAQPOWER-U` to power up the DAQCard-500. This utility is also available in Windows and is installed whenever you install NI-DAQ. Typically, the analog supplies are not reduced to zero; negligible power is supplied to the analog circuits. This mode draws about 20 mA from the 5 V supply (about 100 mW).

Table E-1 shows the effects of different power-management modes on the DAQCard-500 circuits.

Table E-1. DAQCard-500 Power-Management Modes

	Normal Mode	**Power-Down Mode**
Analog Input	Functional. Protected to ±25 V. Impedance > 1 G.	Nonfunctional. Draws negligible power. Protected to ±25 V. Impedance = 4.7 k, which is the input protection resistance.
Digital I/O	Functional. Protected from -0.5 to 5.5 V.	Functional. Protected from -0.5 to 5.5 V.
Counters	Functional. Initialize to undefined states. Individual counters of the 82C54 must be fully programmed before use. Protected from -0.5 to 5.5 V.	Functional. Initialize to undefined states. Individual counters of the 82C54 must be fully programmed before use. Protected from -0.5 to 5.5 V.

Appendix F
PSH27-50F Signal Connections

This appendix gives the pin assignments for the CB-50 I/O connector block when using the PSH27-50F-D1 cable with the DAQCard-500.

If you are using the CB-50 I/O connector block and the PSH27-50F-D1 cable with the DAQCard-500, signals will not map to the same pin numbers as the pin numbers shown for the CB-27 I/O connector block. For the correct pin numbers, refer to Figure F-1.

Note: Use of the PSH27-50F-D1 cable with the DAQCard-500 is not recommended because the PSH27-50F-D1 design is optimized for use with the DAQCard-DIO-24.

Signal	Pin	Pin	Signal
OUT2	1	2	AGND
CLK2	3	4	AGND
GATE2	5	6	AGND
OUT1	7	8	AGND
CLK1	9	10	AGND
DGND	11	12	AGND
1 MHz	13	14	AGND
DOUT3	15	16	AGND
DOUT2	17	18	AGND
DOUT1	19	20	AGND
DOUT0	21	22	AGND
DIN3	23	24	AGND
DIN2	25	26	AGND
DIN1	27	28	AGND
DIN0	29	30	AGND
EXTCONV*	31	32	AGND
+5 V	33	34	AGND
ACH7	35	36	AGND
ACH6	37	38	AGND
ACH5	39	40	AGND
ACH4	41	42	AGND
ACH3	43	44	AGND
ACH2	45	46	AGND
ACH1	47	48	AGND
ACH0	49	50	AGND

Figure F-1. CB-50 Pin Assignments Using the PSH27-50F-D1 Cable

Appendix G
Customer Communication

_____

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve technical problems you might have as well as a form you can use to comment on the product documentation. Filling out a copy of the *Technical Support Form* before contacting National Instruments helps us help you better and faster.

National Instruments provides comprehensive technical assistance around the world. In the U.S. and Canada, applications engineers are available Monday through Friday from 8:00 a.m. to 6:00 p.m. (central time). In other countries, contact the nearest branch office. You may fax questions to us at any time.

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Japan	03 5472 2970	03 5472 2977
Korea	02 596 7456	02 596 7455
Mexico	95 800 010 0793	5 520 3282
Netherlands	0348 433466	0348 430673
Norway	32 84 84 00	32 84 86 00
Singapore	2265886	2265887
Spain	91 640 0085	91 640 0533
Sweden	08 730 49 70	08 730 43 70
Switzerland	056 200 51 51	056 200 51 55
Taiwan	02 377 1200	02 737 4644
U.K.	01635 523545	01635 523154

Technical Support Form

Photocopy this form and update it each time you make changes to your software or hardware, and use the completed copy of this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

If you are using any National Instruments hardware or software products related to this problem, include the configuration forms from their user manuals. Include additional pages if necessary.

Name _____

Company _____

Address _____

_____

Fax (___)_____   Phone (___)_____

Computer brand _____ Model _____ Processor _____

Operating system _____

Speed _____MHz   RAM _____MB   Display adapter _____

Mouse _____yes _____no   Other adapters installed _____

Hard disk capacity _____MB   Brand _____

Instruments used _____

National Instruments hardware product model _____   Revision _____

Configuration _____

National Instruments software product _____   Version _____

Configuration _____

The problem is _____

_____

_____

_____

_____

List any error messages _____

_____

_____

_____

_____

The following steps will reproduce the problem _____

_____

_____

DAQCard-500 Hardware and Software Configuration Form

_____

Record the settings and revisions of your hardware and software on the line to the right of each item. Complete a new copy of this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

National Instruments Products

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*   Clock Frequency   _____

*   Type of Video Board Installed

*   Operating System

*   Operating System Version   _____

*   PCMCIA Software   _____

*   PCMCIA Software Version   _____

*   Programming Language   _____

*   Programming Language Version   _____

*   Other Boards in System   _____

*   Base I/O Address of Other Boards   _____

*   DMA Channels of Other Boards   _____

*   Interrupt Level of Other Boards   _____

Documentation Comment Form

National Instruments encourages you to comment on the documentation supplied with our products. This information helps us provide quality products to meet your needs.

Title: **DAQCard™-500 User Manual**

Edition Date: **January 1996**

Part Number: **371918A-01**

Please comment on the completeness, clarity, and organization of the manual.

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If you find errors in the manual, please record the page numbers and describe the errors.

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Thank you for your help.

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Glossary

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Prefix	Meaning	Value
p-	pico-	10^{-12}
n-	nano-	10^{-9}
μ-	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^{3}
M-	mega-	10^{6}
G-	giga-	10^{12}

°	degrees
Ω	ohms
%	percent
1 MHz	1 MHz square wave oscillator signal
A	amperes
AC	alternating current
ACH	analog input channel signal
A/D	analog-to-digital
ADC	A/D converter
AIGND	analog input ground signal
AWG	American Wire Gauge
C	Celsius
CE	card enable signal
CLK	clock input signal
CMOS	complementary metallic oxide semiconductor
CMRR	common-mode rejection ratio
CTR	counter
D/A	digital-to-analog
DAQ	data acquisition
DAVAIL	data available signal
DC	direct current
DGND	digital ground signal
DIN	digital input signal
DOUT	digital output signal
EISA	Extended Industry Standard Architecture
EXTCONV	external convert signal to trigger A/D conversions
FIFO	first-in-first-out
GATE	gate input signal
Hz	hertz
I/O	input/output
I_{OH}	current, output high
I_{OL}	current, output low
I_{OUT}	output current
ISA	Industry Standard Architecture
LED	light-emitting diode

LSB	least significant bit
MB	megabytes of memory
MSB	most significant bit
mux	multiplexer
NC	not connected (signal)
OUT	output signal
PCMCIA	Personal Computer Memory Card International Association
RD	read
rms	root mean square
S	samples
s	seconds
SCXI	Signal Conditioning eXtensions for Instrumentation
TTL	transistor-transistor logic
V	volts
VCC	positive supply voltage from the PCMCIA bus (usually +5V)
VDC	volts, direct current
V_{IH}	volts, input high
V_{IL}	volts, input low
V_{in}	volts in
V_{OH}	volts, output high
V_{OL}	volts, output low
WR	write

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