UNIVERSAL LIBRARY

User's Guide

OMEGA Engineering

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1 Introduction

Congratulations and thank you for selecting Universal Library (UL). We believe it is the most comprehensive and easiest to use data acquisition software interface available anywhere. As easy as Universal Library is to use, significant documentation and explanation is still required to help new users get going, and to allow previous users to take advantage of all the package's powerful features.

The fast changing nature of the software industry makes it very difficult to provide a totally up to date user guide in written form. Adding to this complexity are the new features and functions that are constantly being added to the library. To provide the most complete information possible, and at the same time keep the information current, the Universal Library documentation is offered in four parts. They are:

1. **Universal Library User's Guide:** The user's guide provides a general description of the UL and offers an overview of the various features and functions and how they can be used in different operating systems and languages.

2. **Universal Library Function Reference:** The Function Reference has complete details on all the Universal Library functions, usage, and options.

3. **Example Programs:** These are perhaps the most valuable and easiest of all the tools to use. We provide example programs in all the popular languages that include many of the popular functions. All of the example programs are fully functional and provided an ideal starting place for your own programming efforts. It is easier to learn by cutting-and-pasting pieces from a known, working program than it is to start writing from scratch.

4. **Read Me Files:** The best way to get the latest, most up to date information is through Read Me files. We incorporate new information into our mainstream documentation as quickly as possible, but for the very latest information, please take time to read the various read me files.

1.1 Universal Library Description

The Universal Library is the software that you need to write your own programs for use with OMEGA's data acquisition and control boards. The library is universal in three ways:

Universal across boards: The library contains high level functions for all of the common operations for all boards. Each of the boards has different hardware but the Universal Library hides these differences from your program. So, for example, a program written for use with one A/D board will work "as is" with a different A/D board.

Universal across languages: The Universal Library provides the identical set of functions and arguments for each supported language. If you switch languages, you will not have to learn a new library, with new syntax, and different features.

If you are a SoftWIRE® user, and are using data acquisition control blocks, specific support components of applicable UL functions are required and used by SoftWIRE. Refer to Section 2.4 for more information.

Languages supported by the Universal Library, at the time this manual was published, are listed in the following table. Both 16- and 32-bit versions are supported where applicable.

Microsoft Windows Languages	**Borland Windows Languages**	**Watcom**
Visual Basic	Borland C++	C++
Visual C/C++	Borland C++ Builder	
Quick C for Windows	Delphi	
Microsoft C		
		Hewlett Packard
Microsoft DOS Languages	**Borland DOS Languages**	**(Now Agilent)**
QuickBasic 4.5	Turbo C	HP VEE
Professional Basic 7.0	Turbo C++	
Visual Basic for DOS	Borland C++	
Quick C		

Universal across platforms: The Universal Library provides the same sets of functions for DOS, Windows 3.x and 32-bit Windows(95/98/ME/NT/2000).

1.2 Installation Overview

InstaCal™ is a powerful installation, test, and calibration software package that is shipped free with every board. It is also provided as part of the Universal Library package.

In addition to the information provided here, please refer to the *Software Installation Manual* provided with your disks or CD. In addition, be sure to check the read me files on the disk/CD you receive for the latest, most up-to-date information.

Please use the *Software Installation Manual* as a guide for installing the Universal Library and InstaCal. Where possible, use the default for all options presented. It will be easier to assist you if you have a problem when the default options are selected.

Windows 95, 98 and ME users are given the option to install the 32-bit library, the 16-bit library, or both. Unless you have a specific reason to choose otherwise, we recommend you install the 32-bit library (the default setting).

NOTE: If you are going to be using SoftWIRE for data acquisition, you may need to load the latest version of Universal Library. See Section 1.4 for installation instructions.

1.3 The CB.CFG File and InstaCal

All board specific information, including current installed options, are stored in the file CB.CFG which is read by Universal Library. InstaCal creates and/or modifies this file when board configuration information is added or updated. The Universal Library will not function without the CB.CFG file.

For this reason, you must use InstaCal to modify all board setups and configurations as well as to install or remove boards from your system.

1.4 Installation – SoftWIRE Support

There are three major software packages to load in your computer if you are going to use SoftWIRE. and will be using the data acquisition controls of SoftWIRE* They are:

- SoftWIRE
- Universal Library
- Additional UL SoftWIRE components on the UL CD, entitled *Install SoftWIRE UL Support* on the opening menu.

*UL is *not* required by SoftWIRE if you are *not* going to be using SoftWIRE's data acquisition controls. (Obviously, UL would still be necessary if you are doing data acquisition and control *outside* of SoftWIRE.)

NOTE: If you have upgraded to SoftWIRE 3.1 from a previous version, and installed the Data Acquisition controls when you installed the previous version, these controls are still available to you. If so, you need not upgrade your UL to Ver. 5.2 or higher.

The required loading sequence is as follows:

1. Load either SoftWIRE or Universal Library main package into the computer first, from their respective CD, followed by the other (do ***not*** load the SoftWIRE UL Support files yet).

2. Load *Install SoftWIRE UL Support* files from the UL disk (Ver. 5.2 or later) ***LAST***.

1.5 Installation - HP VEE Support

Please use the Software Installation Manual as a guide for installing the Universal Library and InstaCal. Where possible, use the default for all options presented as it will be easier to assist you in the event of a problem if the default options are selected.

The modifications made to your system when installing HP VEE Support is identical to the modifications made when installing the Universal Library with the following exceptions:

- In the directory where VEE resides, the menu bar program VEE.MNU is written (or CBI.MNN, depending on version).

NOTE: If you are using a custom VEE.MNU, such as the one shipped with DT-VEE, it may be overwritten by the install program. Please call technical support for information on handling multiple custom menu bars.

- In the directory where the VEE programs (examples and your programs) reside, examples are added. The Universal Library examples for VEE use OMEGA's standard names for examples (see the chart in the section on examples) with the .VEE extension.

Although you are finished installing HP VEE and the drivers to link VEE to OMEGA I/O boards, there is one more step to complete before you can use VEE with an I/O board. You must run the program InstaCal.Exe and configure the driver. The program InstaCal is an installation, calibration and test program which creates a required configuration file describing the specifics of the hardware installed.

2 Universal Library Description & Use

The Universal Library consists of a set of functions that are callable from your program. These functions are grouped according to their purpose. All of the groups except for Miscellaneous are based on which type of devices they are used with.

VERY IMPORTANT NOTE

In order to understand the functions, please read the board-specific information section found elsewhere in this manual and in the readme files supplied on the Universal Library Disk. We also urge you to examine and run one or more of the example programs supplied prior to attempting any programming of your own. Following this advice can save you hours of frustration and wasted time.

2.1 How to Use the Library

The Universal Library is callable from many languages and environments including Visual Basic, Visual C++, Borland C++ Builder, and Delphi. This chapter describes how to use the library from each of the languages, as well as several 16-bit environments. The first section of the chapter describes details of the library that apply to all languages. The following sections describe the differences for each language.

Before you start, be sure to:

1. Set up and test your boards with InstaCal. The library will not function until InstaCal has created a configuration file.
2. Use the example programs for the language you program in. This manual explains functions and has other necessary information, but it is incomplete without reference to and review of the examples.

2.2 General UL Language Interface Description

The interface to all languages is a set of function calls and a set of constants. The list of function calls and constants are identical for each language. All of the functions and constants are defined in a "header" file for each language. Refer to the sections below and especially to the example programs for each language. This manual is brief with respect to details of language use and syntax. You must examine the examples for this information.

Each library function takes a list of arguments and most return an error code. Some functions also return data via their arguments. For example one of the arguments to `cbAIn()` is the name of a variable in which the analog input value will be stored. All function arguments that return data are listed in the “*Returns*”.

Constants

Many functions take arguments that must be set to one of a small number of choices. These choices are all given symbolic constant names. So for example, cbTIn() takes an argument called Scale that must be set to CELSIUS, FAHRENHEIT, or KELVIN. These constant names are defined and assigned a value in the "header" file for each language. Although it is possible to use the numbers rather than the symbolic constant names, we strongly recommend that you use the names. This will make your programs more readable and more compatible with future versions of the library. The numbers may change in future versions but the symbolic names will always remain the same.

Options Arguments

Some library functions have an argument called Options and all options have a default. Some options have an alternative, such as, DTCONNECT and NODTCONNECT, one of which is the default value. Other options do not have a stated alternative. The alternative is the absence of that option. The options argument is used to turn on and off various optional features associated with the function. If you set Options = 0, the function will set all of these options to the default value, or OFF.

Individual options can be turned on by adding them to the Options argument. So, for example, Options = BACKGROUND will turn on the "background execution" feature. Options = BACKGROUND+CONTINUOUS will select both the "background execution" and the "continuous execution" feature.

Error Handling

Almost all library functions return an error code. If no error occurred during that library call then the error code will be set to 0, otherwise it will be set to one of the codes listed in the Function Reference chapter titled *Error Codes*.

The cbGetErrMsg() function can be used to convert the error code to a specific error message. As an alternative to checking the error code after each function call you can choose to turn on the library's internal error handling with cbErrHandling().

16-bit Values Using Signed Integer Data Type (Basic, Visual Basic, etc.)

When using functions that require 16-bit values, the data is normally in the range 0 to 65535. Using signed integers (as you are forced to do when using Basic and Visual Basic), reading values above (32767) can be confusing.

(32767) is equivalent to (0111 1111 1111 1111) binary. The next increment, (1000 0000 0000 0000) binary has a decimal value of (–32768). The maximum value (0111 1111 1111 1111) binary translates to (–1) decimal. Keep this in mind if you are using Basic, Visual Basic (up to version 6) or other languages that don’t support unsigned integers.

There is additional information on this topic in the Universal Library Function Reference. Also, refer to the documentation supplied with your language compiler.

2.3 Using Universal Library in Windows

All 32-bit applications (including console applications) access the 32-bit Windows Dynamic Link Library(DLL) version of the Universal Library(CBW32.DLL). Example programs are provided for MS Visual C++, MS Visual Basic, Borland C++, and Borland Delphi in the Sample32 subdirectories of the installation to illustrate the use of CBW32.DLL.

For 16-bit Windows applications, or Windows applications running in Windows 3.x, the 16-bit Windows DLL version of the Universal Library (CBW.DLL) should be used. Example programs in the Sample16 subdirectories for Visual Basic and both Borland and MS C illustrate the use of CBW.DLL.

Due to the differences in memory management among various operating systems, the scan commands have slightly different argument lists. In DOS libraries, all scan commands take a pointer to a data array as one of their arguments. In the Windows 3.x library, these functions take a handle to a Windows Global Memory buffer instead of a pointer to an array. In the 32-bit Windows version, these functions take a pointer (a 32-bit virtual address) or a handle returned from `cbWinBufAlloc()`. The affected functions are:

```
cbAInScan()
cbAOutScan()
cbAPretrig()
cbDInScan()
cbDOutScan()
cbStoreOnInt()
```

The Windows library also contains four functions for managing these Windows global memory buffers. The functions are:

```
cbWinBufAlloc()
cbWinBufFree()
cbWinArrayToBuf()
cbWinBufToArray()
```

Real Time Operation Under Windows

Real time operation is available from Windows. To operate at full speed under Windows, the A/D board must have a FIFO buffer. All of our advanced designs have FIFO buffers. These include the CIO-DAS80x, CIO-DAS160x, CIO-DAS140x, CIO-DAS16/330x and PCM-DAS16x. All these data acquisition boards will operate at full speed in real time under Windows. See the note on real time software calibration and the function `cbACalibrateData()`.

Processor Speed

Processor speed remains a factor for DMA transfers and for real time software calibration. Processors of less than 150MHz Pentium class may impose speed limits below the capability of the board. See the board specific information and the notes on real time software calibration.

2.4 Using Universal Library with SoftWIRE

The Universal Library program CD contains various components that load separately to support SoftWIRE's Data Acquisition controls. These SoftWIRE controls do not operate without the UL *added* components.

To understand how SoftWIRE interacts with DAQ I/O boards, study both this manual and the example programs supplied with SoftWIRE. It is very important that you read the entire manual for information that relates to usability and performance. Remember, SoftWIRE uses the Universal Library as the interface to the I/O boards. Library performance factors are reflected in SoftWIRE controls that use the library.

Each SoftWIRE control is implemented as a graphic block. You can access all arguments and properties on the screen. You connect constants, variables, or objects by dragging a "wire" from "pin-to-pin." In large projects, the ability to easily supply an argument with a control variable that acquires its value elsewhere is especially powerful. See the SoftWIRE Help topic for each control for detailed information on how to do this.

SoftWIRE Data Acquisition Controls

SoftWIRE is a simple and efficient way to build application programs. Read the Help file, start with simple examples, and then begin working up your own projects. Please call us with any suggestions or questions you may have. The following table lists the data acquisition controls in SoftWIRE that require the UL software support components:

SoftWIRE Control	Description
Analog In	The Analog In control reads the data from an analog input channel.
Analog In Scan	The Analog In Scan control scans a range of analog input channels and transfers the samples in the form of an array
Analog In Trigger	The Analog In Trigger control outputs an analog input value when it goes above or below a specified trigger value.
Analog In PreTrigger	The Analog In PreTrigger control causes an analog input board to wait for a trigger to occur and then returns a set number of analog samples before and after the trigger occurred.
Set Trigger	The Set Trigger control allows you to specify and set up a trigger source that starts a scan function using certain Data Acquisition controls.
Analog Out	The Analog Out control writes data to an analog output channel.
Analog Out Scan	The Analog Out Scan control sends a specified number of analog output data samples to a specific board over a range of analog output channels.

Digital In	The Digital In control reads a value from a specified board and digital input port.
Digital Bit In	The Digital Bit In control reads the value, or state, of a single digital input bit.
Digital Out	The Digital Out control sets the digital output value for a specified board and port.

2.5 Using the Library with DOS Basic

Each of the supported versions of BASIC consists of two distinct systems. Programs can be loaded into the BASIC editor and run from within the integrated BASIC environment. Programs can also be compiled by a command line compiler into stand-alone executable programs that can be run on their own without the help of the integrated BASIC environment. The Universal Library provides the tools for both methods.

BASIC Header File

Every BASIC program that uses the Universal Library must have a line which includes the BASIC Universal Library header file - CB.BI. The following line should appear near the start of every program, before the first library call is made.

```
'$INCLUDE: 'CB.BI'
```

Using Universal Library Within The Integrated BASIC Environment

When you start up BASIC, specify that you want to load the "quick library" version of Universal Library. For Quick BASIC type:

```
qb /l cbqb
```

For Professional BASIC type:

```
qbx /l cbpb
```

For Visual Basic for DOS, type:

```
vbdos /l cbvb
```

Using The Library With The BASIC Command Line Compiler

To build stand-alone executable files with the command line compiler, you must link your compiled BASIC program with the stand-alone version of the Universal Library. To do this, you must supply the linker with the library name.

The names of the .lib files are:

- QuickBasic CBQB.LIB
- Professional Basic CBPB.LIB
- Visual Basic for DOS CBVB.LIB

Sample Basic Programs

The sample BASIC programs included demonstrate how to call each function in the Universal Library. These programs can be run from within the integrated BASIC environment. They can also be compiled using the command line compiler with the batch file supplied. The names of the batch files are:

- QuickBasic MAKEQB.BAT
- Professional BASIC MAKEPB.BAT
- Visual Basic for DOS MAKEVB.BAT

Passing Arguments to Universal Library

All of the functions in the library require that arguments be passed to them. The file CB.BI contains the definition of all the argument types that are passed. In general, there are two classes of arguments, inputs and outputs.

Input Arguments

All arguments that are only used as inputs to a library function are listed in the CB.BI file definition as BYVAL. For these arguments, you can pass either a variable or a constant. So for example, both of these versions are acceptable:

```
BoardNum% = 0
cbStopBackground (BoardNum%)
```

or

```
cbStopBackground (0)
```

Output Arguments

Some arguments are used by the library to pass information back to the caller. For example, the value from an A/D is returned by cbAIn() to the DataValue% argument. Others are used as both inputs and outputs. For example, the Rate& argument specifies the requested sampling rate for cbAInScan() (Input).

The actual sampling rate can vary from the requested sampling rate so the actual rate is returned by cbAInScan() to the Rate& argument (Output).

Output and Input/Output arguments are defined in the CB.BI function definitions as SEG. All SEG arguments can only be passed via a variable. For example:

```
Count& = 1000
Rate& = 15000
cbAInScan (0, 0, 1, Count&, Rate&, BIP5VOLTS, DataArray(0), 0)
```

is correct, but,

```
cbAInScan (0, 0, 1, 1000, 15000, BIP5VOLTS,DataArray(0), 0)
```

is NOT correct.

DataArray Argument with Multiple Channels

Various functions have a DataArray argument. The DataArray either receives the data from an input function such as cbAInScan(), or contains the data to be sent to an output function such as cbAOutScan().

The DataArray must be dimensioned to be large enough to contain all of the data. The array can either be dimensioned with a single dimension or two dimensions. When sampling more than one channel, it is often more straightforward to use a multiple dimensioned array. The code below shows both methods:

```
DIM DataBuffer (1999) 'One-dimensional array. 0 to 1,999
(2,000) elements.
```

or

```
DIM DataBuffer (1, 999) 'Two-dimensional array. 0 & 1 with 0-
999 (1,000) elements each.
LowChan% = 2
HighChan% = 3
Count& = 2000
Rate& = 1000
cbAInScan (0, LowChan%, HighChan%, Count&, Rate&, BIP5VOLTS,
DataBuffer(0), 0)
```

or

```
cbAInScan (0, LowChan%, HighChan%, Count&, Rate&, BIP5VOLTS,
DataBuffer(0, 0), 0)
```

The advantage of using the multi-dimensioned array is that you can directly address the data in the array by channel. Therefore, in the example above, DataBuffer (0, 99) addresses the 100th sample for channel 2 (channel 2 was the first element in the array; LowChan%).

Using String Arguments

cbGetErrMsg() requires that a string variable be passed as an argument. This string variable must have been previously allocated to be large enough to hold the longest error message. To do this use Quick BASIC's space$ function as it is done in the example program.

```
ErrStr$ = space$ (ERRSTRLEN)
```

Integer Arguments

BASIC does not support unsigned integers (0 to 65,535). Values for the integer data type range from –32,768 to 32,767. When using functions that require unsigned integers, the data must be converted. See section 2.2.

BACKGROUND operation

If you use the BACKGROUND option with any function, you must declare the associated data array as '$STATIC.

Unless you declare an array as '$STATIC, BASIC may move the array around in memory as the program is executing. Whenever you use the BACKGROUND option, the I/O function reads/writes from the data array in the background while the BASIC program continues executing in the "foreground." If BASIC moves the array while the I/O function is reading/writing to it, it will cause intermittent and unpredictable problems.

cbStopBackground() should be executed after normal termination of all background functions to clear variables and flags.

2.6 Using the Library with Visual Basic for DOS

Compiling Stand Alone EXE files

Due to a quirk in Visual Basic for DOS, if you compile a stand-alone EXE file from within the IDE and you set the EXE type to "Stand alone EXE file", you will get the following message:

```
"fixup overflow at 334 in the segment -TEXT target external
'B$CEND'".
```

The compiled program will run without error. It appears that the error message is an error.

2.7 Using the Library with C for DOS

The C libraries included with the system can be used with either the Microsoft or Borland C compilers.

C Header File

Every C program that uses the Universal Library must have a line which includes the Universal Library C header file, CB.H. The following line should appear near the start of every program, before the first library call is made.

```
#include "cb.h"
```

Memory Models

Both Borland and Microsoft C compilers support different memory models. The Universal Library comes with the following four versions of the library.

CBCC.LIB - For use with compact model

CBCS.LIB - For use with small model

CBCM.LIB - For use with medium model

CBCL.LIB - For use with large and huge model

Large Data Arrays

The Universal Library supports input and output from very large (>64K) amounts of data. If your program requires storage and transfer of large single data sets, you must compile it for the "huge" model and use the CBCL.LIB library. If you declare an array to hold the data, it should be declared `__huge`.

If you allocate memory (as is done in the example programs using `malloc`) it should be allocated using `_halloc` (Microsoft) or `halloc` (Borland), the pointer declared as `__huge` and memory freed using `_hfree` (Microsoft) or `hfree` (Borland). Note that you must also include the `malloc.h` header.

Compiling The Sample C Programs

The example programs demonstrate how to call each of the Universal Library functions from a C program. Two batch files are provided that show how to compile and link the sample programs using the Microsoft and Borland compilers.

MAKEMC16.BAT - compile and link with Microsoft C

MAKETC16.BAT - compile and link with Borland C

2.8 Using the Library with HP VEE

The Universal Library For HP VEE includes a complete interface to HP VEE providing a DataAcq specific menu bar addition and functions as well as complete example of all the library functions.

To understand how the interface to HP VEE interacts with I/O boards, you need to study both this manual and the example programs. This manual is written for symbolic programming languages such as BASIC and C. VEE is a graphical programming language.

It is very important that you scan the entire manual for information that relates to general performance. Remember, VEE is using the Universal Library as the interface to the I/O boards; the entire library. Limitations and performance factors in the library are reflected in VEE programs that use the library. The manual contains much related information, like most manuals, scattered throughout. We encourage you to review the entire manual.

The Universal Library interface to VEE follows the structure of the library as it is used with all other languages. The arguments presented here in symbolic format are the same arguments you will need to specify when using VEE to control an I/O board. The manual

explains the functions and each of the arguments. The VEE examples show how the function is interfaced to VEE and show how to use the function to control the I/O boards.

There is one exception to this rule. The programming argument `MemHandle` is replaced in VEE with the argument `DataArray`. VEE allocates data arrays directly. Windows programming languages use another method of pointing to data arrays. In addition to a name change, there is some VEE programming logic done to dimension a two-dimensional data array for all multichannel operations. This logic can be seen by examining the design view of the function.

Each function is implemented as a panel. All the arguments are accessible on the panel and require a value. In the example programs and in simple projects this method of presenting the functions is easiest to use. Each value is hard-coded into the panel.

If more complex projects are undertaken, open the design view of the function and drag certain arguments outside the panel. Dragging an object outside the panel will create a 'pin' to which you can connect constants, variables, or objects such as slider bars. In large projects the ability to supply an argument with a variable that acquires its value elsewhere is especially useful. See the VEE manual for information on how to do this.

See the example ULAI06.VEE for an example of multiple use of several arguments where it is better to specify the argument values globally. In this example, we have brought several arguments out of the panel

Remember, if you drag an argument outside a panel you must reconnect the program flow (top and bottom pins) of the remaining arguments; the one above to the one below the argument you removed.

New HP VEE Functions

Several new functions have been added strictly for use with HP VEE. These functions are listed separately in a section devoted to the VEE specific functions. All VEE specific functions begin with the name cbv, rather than cb . The new functions add VEE style data and array handling to the library.

Using the HP VEE interface is simple and a great way to connect your VEE programs to the real world. Read the manual, start with the examples, then begin working up your own projects. Remember to call us with suggestions!

Must Install Universal Library in Default Directory

The HP VEE library import block CBI_UL contains an exact path specification for the library CBV.DLL and its header file CBV.H. If you do not install these files into the default directory suggested by the install program you will have to edit the library import block CBI_UL to point to the directory where the files are installed.

To edit the library import block, click on the DataAcq menu item then click on its cbLibrary sub-menu item. Place the mouse cursor at the desired location for the library import block

and press the left mouse button once. Double click the library import block object. A detailed CBI_UL library block will be displayed. Within the CBI_UL library block, click on the button to the right of File Name. Enter the new path with the file name and click OK. Next click on the button to the right of Definition File. Enter the new path with the file name and click OK.

Using VEE 3.2 or Later

If you are using VEE 3.2 or later, please edit the library import block and change the library name from CBV.DLL to CBV32.DLL. Be sure to include the proper path.

2.9 File Functions Overview

One of the features of the Universal Library is the ability to collect very large amounts of data to a "streamer" file. The amount of data that can be collected is limited only by the size of your hard disk.

After all of the data has been streamed to a file, your program can read it back into arrays and process it in chunks. This feature is particularly useful with Universal Library from DOS, where memory is limited.

The library contains four functions that are used with "streamer" files. `cbFileAInScan()` and `cbFilePretrig()` read the A/D and store the data in a "streamer" file. `cbFileGetInfo()` returns information about the streamer file. `cbFileRead()` reads data from a "streamer" file to an array.

In addition to these library functions, the library comes with three utility programs for use with the 16-bit version of the library; MAKESTRM.EXE, FRAGTEST.EXE and RDSTREAM.EXE. These utilities are not compatible with the 32-bit version of the library.

MAKESTRM creates a "streamer" file. This program should be run to allocate a file large enough to hold all of the data that will be later collected with `cbFileAInScan()` or `cbFilePretrig()`. The syntax is:

```
C:\MAKESTRM filename # <enter>
```

FRAGTEST checks an existing disk file to see if it is fragmented. In order to run at the faster sampling rates, the "streamer" file must not be fragmented. Refer to "Speeding up Disk Files" below for more information. The syntax is:

```
C:\FRAGTEST filename <enter>
```

RDSTREAM reads a "streamer" file and prints its contents on the screen. The syntax is:

```
C:\RDSTREAM filename <enter>
```

2.10 Hard Disk VS RAM Disk Files

The simplest type of file to use is a standard DOS file on a hard disk. The advantage of hard disk files is that they can be very large. The file size is only limited by the amount of free space on the disk. Hard disk files have the disadvantage of being slower than RAM disks. RAM disk (or virtual disk) files are faster but they are limited in size by the amount of available memory in your computer.

2.11 Maximum Sampling Speed

The maximum sustainable sampling rate that can be specified with the `cbFile` functions is very hard to predict. It depends on the speed of the CPU and the speed of the disk.

In addition to the variation in sampling speed from machine to machine, there can also be variations on the same machine between consecutive operations of the same program. When reading an A/D to memory (non-streaming modes) there is a hard and fast maximum sampling speed that cannot be exceeded. When using the streaming modes the maximum rate is much fuzzier and must be arrived at by trial and error.

A rough guideline of attainable speeds are that on a 33 MHz 80386 machine with a fast hard disk it should be possible to collect a megabyte of data at 200 kHz sampling rate to a disk file. It should also be possible to collect a megabyte of data to a RAM disk at 330 kHz.

In general the maximum sustainable speed for `cbFilePretrig()` will be somewhat less than for `cbFileAInScan()`.

Another characteristic of these "streaming" modes is that the more data you collect the lower the maximum speed will be. On any machine with any speed disk, you can collect 32000 samples to a disk file at the maximum A/D speed of 330 kHz. If you are pushing the upper limits of speed you will find that you can collect 100K samples at a faster rate than you can collect 500K samples, etc.

2.12 How To Determine Maximum Sampling Speed

The only way to determine the maximum safe speed is to try it repeatedly. Remember, if it works the first time it will not necessarily work the next time. Therefore, the only way to be sure that you can reliably run at a particular speed is to try it numerous times. Another method is to increase the speed to the point where it begins to fail every time so that you get some sense of whether or not you are pushing the speed limit on your computer.

To test it, write a program that calls `cbFileAInScan()` or `cbFilePretrig()` (depending on whether you need pre-trigger data). Check the returned error code. If you get an `OVERRUN` error (error code of 29), it means that the sampling rate is too high. Whenever you get `OVERRUN` error, some data was collected but not all of it. It is often useful to check how much data was collected to find out whether it was almost fast enough or not even close.

2.13 Speeding Up Disk Files (De-fragmenting)

Because of the way that disks work, the time that it takes to write to them can vary tremendously. A large disk file is made up of many small pieces that are written individually to the disk. If the file is contiguous (each piece is side by side) the speed is very fast. If the file is fragmented (pieces are in different places on the disk) the speed is much slower. If you create a large disk file, the odds are overwhelming that it will be fragmented to some degree and the maximum sampling speed will be much lower than it would be for an unfragmented file.

To get around this problem you should use a Disk Optimizer or De-Fragmenter program immediately before creating the streamer file with MAKESTRM. After you create the streamer file, it will remain unfragmented so long as you do not erase and recreate it.

Probably the most widely known Disk Optimizer program comes as part of the Norton Utilities, it is called Speed Disk or SD. To run it type:

```
SD /Q
```

This will execute the "Quick" optimize, which for these purposes works as well as the Full Optimization.

After de-fragmenting the disk create a streamer file that is large enough to hold as much data as you plan to collect with `cbFileAInScan()` or `cbFilePretrig()`. To create the disk file run the standalone MAKESTRM.EXE program. This will create a streamer file of the required size.

After the file is created, run FRAGTEST.EXE to see whether or not the file is fragmented. It is possible that the file may be fragmented even though you just de-fragmented the disk. The reason for this is that the disk may contain some bad sectors which could not be moved when the disk was optimized. When you create the new file if it hits one of these bad sectors it has to skip over it, hence fragmentized.

If FRAGTEST reports that the file is fragmented, create a second file and test that with FRAGTEST. Repeat this until FRAGTEST reports that the file is OK. After you have an unfragmented disk file you can try using it with `cbFileAInScan()` or `cbFilePretrig()` to collect data. If the maximum sampling speed is still too slow, you should probably switch to a RAM disk.

2.14 What is a RAM Disk?

A RAM disk is not really a disk. It is a device driver that sets aside some of the computer's memory and makes it appear to DOS as a disk drive. When you install a RAM disk on your computer it appears exactly as if you have another VERY fast hard disk drive. For example, if you have one hard disk (drive C:) then when you install the RAM disk it will appear as if you have another hard disk, drive D.

After the RAM disk is installed, all DOS commands work exactly the same on the RAM disk as on the hard disk. For example you can COPY, DEL, MKDIR, CD just as you would on a hard disk.

2.15 Installing a RAM Disk

The RAM disk driver comes with DOS. Refer to your DOS manual for more information. In older versions of DOS it is called either RAMDRIVE.SYS or VDISK.SYS. To install it you must add one line to your \CONFIG.SYS file. Find which directory the DOS files are installed in on your machine. CD to that directory and look for a file called RAMDRIVE.SYS or VDISK.SYS. If it is not there look at the other .SYS files in the directory and refer to your DOS manual to find out if any of them are a RAM Disk driver. After you have located the file add an entry to the \CONFIG.SYS file.

If the RAMDRIVE.SYS file was in a directory called DOS then you would add the following line to the \CONFIG.SYS file.

```
device=c:\dos\ramdrive.sys
```

The default size for the RAM disk is usually 64K. You will almost certainly want to make it larger than that. The larger you make it the more data you can collect but the less memory will be available for other programs.

To set up a 4 megabyte RAM disk you would add the following line to your CONFIG.SYS file:

```
device=c:\dos\ramdrive.sys 4000
```

If your computer is an 80x86 then you should install the RAM disk in extended memory (above 1M) by specifying the /e option:

```
device=c:\dos\ramdrive.sys 4000 /e
```

After you add the new line to the \CONFIG.SYS file, reboot the computer (Press *CTRL-ALT-DEL*) to install the RAM disk. When the machine reboots it should print a message on the screen describing the RAM disk.

2.16 Using the RAM Disk

To use the RAM disk you just specify the drive letter in the FileName argument of `cbFileAInScan()` or `cbFilePretrig()`. For example if the RAM disk is drive D: on your system then you could set the name of the "streamer" file in your program to "D:TEST.DAT"

This file can be created with the MAKESTRM.EXE program supplied with the Universal Library.

To set up a file large enough to hold 1 million samples, include this line in your AUTOEXEC.BAT file:

```
C:\CB\MAKESTRM D:\TEST.DAT 1000000
```

The name TEST.DAT is an example. Use the name of your preference.

When you execute `cbFileAInScan()` or `cbFilePreTrig()` it will fill up the file on your RAM drive. This file will be lost as soon as the power is switched off so if you wish to keep the data you must copy it to the hard disk before turning the computer off.

3 Analog Input Boards

3.1 Introduction

All boards that have analog input support the cbAIn() and cbAInScan() functions (except expansion boards which support cbAIn() only). Boards released after the printing of this manual are described in readme files on the Universal Library disk.

In cases where hardware-paced A/D conversion is not supported, cbAInScan() loops through software paced conversions. The scan will execute at the maximum speed possible. This speed will vary with CPU speed. The only valid option in this case is CONVERTDATA.

If trigger support is 'Polled gate' (as opposed to 'Hardware'), this indicates that the 'trigger' is implemented by disabling the on-board pacer by gating it. The trigger input is then polled continuously until the trigger occurs. When that happens, the software disables the gate input so that when the trigger returns to its original state, it does not affect the pacer and acquisition continues until the requested number of samples has been acquired. There are two 'side effects' to this type of trigger:

1) The polling portion of the function does not occur in the background even if the BACKGROUND option was specified (although the actual data acquisition does).

2) The trigger does not necessarily occur on the rising edge. Acquisition can start at any time after the function is called if the trigger input is at 'active' level. For this reason, it is best to use a trigger that goes active for a much shorter time than inactive.

Similar to ‘Polled gate’ triggering is ‘Polled digital input’ triggering. For this trigger type, the pacer is disabled while the state of a digital input is polled. When the state changes to active, the pacer is enabled by the software. The polled digital input trigger type limitations are very similar to the polled gate type described above.

Sampling rate using SINGLEIO

When using this mode of data transfer, the maximum analog sampling rate is dependent on the speed of the computer in which the board is installed. In general, it is somewhere in the range of 5 to 50 kHz. If the speed you request cannot be sustained, an overrun error will occur. Data will be returned, but likely there will be gaps. Some boards, such as the **CIO-DAS08**, support only this mode. Thus, the maximum rate attainable with these boards is system-dependent.

3.2 PCI-DAS6000 Series

❑ Analog Input

Analog Input Functions Supported

cbAIn(), cbAInScan(), cbATrig(), cbAPretrig(), cbFileAInScan(), cbFilePretrig(), cbALoadQueue()

Analog Input Argument Values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, BLOCKIO, BURSTMODE, EXTTRIGGER
HighChan	0 to 15 in single-ended mode, 0 to 7 in differential mode
Rate	Up to 200000
Range	**PCI-DAS6023, PCI-DAS6025, PCI-DAS6034, PCI-DAS6035** BIP10VOLTS BIP5VOLTS BIPPT5VOLTS BIPPT05VOLTS

❑ Analog Output PCI-DAS6025, PCI-DAS6035 only

Analog Output Functions Supported

cbAOut(), cbAOutScan()

Analog Output Argument Ranges

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, SIMULTANEOUS
HighChan	0 to 1
Rate	Up to 10000
Range	BIP10VOLTS
DataValue	0 to 4095

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigBit(), cbDConfigPort()

Digital I/O Argument Values

PortNum	AUXPORT
DataValue	0 to 255
BitNum	0 to 7

For **PCI-DAS6025,** the following additional argument values are also valid

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH
DataValue	0 to 15 for PORTCL or PORTCH; 0 to 255 for PORTA or PORTB
BitNum	0 to 23 for FIRSTPORTA

❑ Counter I/O

Counter Functions Supported

cbC8254Config(), cbCIn(), cbCLoad()

Counter Argument Values

CounterNum	1 to 2
Config	HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE
LoadValue	0 to 65535 (see notes on unsigned integers in Section 2.2.)

❑ Triggering

Trigger Functions Supported

cbSetTrigger()

Trigger Argument Values

TrigType	GATE_HIGH, GATE_LOW, TRIG_POS_EDGE, TRIG_NEG_EDGE

❑ Event Notification

Event Notification Functions Supported

cbEnableEvent(), cbDisableEvent()

Event Notification Argument Values

EventType	ON_SCAN_ERROR, ON_PRETRIGGER*, ON_DATA_AVAILABLE, ON_END_AI_SCAN For **PCI-DAS6025, PCI-DAS6035**, the following additional argument value is also valid ON_END_OF_AO_SCAN

❑ Hardware Considerations

Pacing Analog Input

Hardware pacing, external or internal clock supported. When using EXTTRIGGER, the clock edge is selectable through InstaCal.

When using EXTCLOCK and BURSTMODE together, do not use the A/D External Pacer to supply the clock. Use the A/D Start Trigger input instead. Since BURSTMODE is actually paced by the internal burst clock, specifying EXTCLOCK when using BURSTMODE is equivalent to specifying EXTTRIGGER.

The clock edge used to trigger acquisition for the external pacer may be rising or falling and is selectable using InstaCal.

The packet size is 512 samples.

Analog Input Configuration

The analog input mode may be 8 channel differential, 16 channel single-ended referenced to ground or 16 channel single-ended non-referenced and may be selected using InstaCal.

Triggering & Gating

Digital (TTL) hardware triggering is supported for the entire series.

When using cbAPretrig() or cbFilePretrig() , use the A/D Stop Trigger input to supply the trigger.

Gain queue

When using cbALoadQueue(), up to 8k elements may be loaded into the queue.

Pacing Analog Output

Hardware pacing, external or internal clock supported.

Digital Input/Output Configuration

AUXPORT is bitwise configurable for these boards, and must be configured using cbDConfigBit() or cbDConfigPort() before use.

Counters

The source for counters 1 and 2 may be internal 10MHz, internal 100kHz or external and is selectable using InstaCal.

Event Notification

Note that the EventData for ON_PRETRIGGER events may not be accurate. In general, this value will be below the actual number of pretrigger samples available in the buffer.

3.3 PCI-DAS4020 Series

❑ Analog Input

Analog Input Functions Supported

`cbAIn(), cbAInScan(), cbATrig(), cbAPretrig(), cbFileAInScan(), cbFilePretrig()`

Analog Input Argument Values

`Options`	`BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, DMAIO, BLOCKIO, EXTTRIGGER`
`HighChan`	3 max (when scanning multiple channels, the number of channels scanned must be even)
`Rate`	Up to 20000000 (Contiguous memory may be required to achieve maximum performance. See details below.)
`Range`	`BIP5VOLTS` `BIP1VOLTS`

❑ Analog Output

Analog Output Functions Supported

`cbAOut(), cbAOutScan()`

Analog Output Argument Ranges

`Options`	NONE
`HighChan`	1 max
`Count`	2
`Rate`	Ignored
`Range`	`BIP10VOLTS` `BIP5VOLTS`
`DataValue`	0 to 4095

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()

Digital I/O Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH
DataValue	0 to 15 for PORTCL or PORTCH 0 to 255 for PORTA or PORTB
BitNum	0 to 23 for FIRSTPORTA

❑ Counter I/O

Counter Functions Supported

None

❑ Triggering

Trigger Functions Supported

cbSetTrigger()

Trigger Argument Values

TrigType	TRIG_POS_EDGE, TRIG_NEG_EDGE, TRIGABOVE, TRIGBELOW, GATEHIGH, GATELOW, GATENEGHYST, GATEPOSHYST, GATEABOVE, GATEBELOW, GATEINWINDOW, GATEOUTWINDOW
Threshold	0 to 4095

❑ Event Notification

Event Notification Functions Supported

cbEnableEvent(), cbDisableEvent()

Event Notification Argument Values

EventType	ON_SCAN_ERROR, ON_PRETRIGGER, ON_DATA_AVAILABLE, ON_END_OF_AI_SCAN

❑ Hardware Considerations

Pacing Analog Input

Hardware pacing, external or internal clock supported. The clock source can be set via InstaCal to either the "Trig/Ext Clk" BNC input or the "A/D External Clock" input on the 40 pin connector (P3). Configuring for the BNC clock input will disable the clock input (pin 10) on the 40-pin connector.

When EXTCLOCK option is used, the clock signal presented to the "Trig/Ext Clk" BNC input or the "A/D External Clock" input is divided by 2 by the prescaler. This value is currently fixed at 2 in the Universal Library. If both EXTCLOCK and EXTTRIGGER are used, both the Trigger BNC and pin 10 on the 40-pin connector require signals. This is further explained in the Triggering section following. When using EXTCLOCK, the Rate argument IS USED by the Universal Library to calculate the appropriate chain size; please set the Rate argument to the approximate rate that the external clock will be pacing acquisitions.

The packet size varies. See Memory Configuration below.

Triggering & Gating

Digital (TTL) hardware triggering supported. The trigger source can be set via InstaCal to either the "Trig/Ext Clk" BNC input, the "A/D Start Trigger" input on the 40-pin connector (P3) or the "A/D Stop Trigger" input on the 40-pin connector (P3). Use the A/D Start Trigger input for cbAInScan() and cbFileAInScan() functions. For cbAPretrig() or cbFilePretrig() functions, use the A/D Stop Trigger input.

When using both EXTCLOCK and EXTTRIGGER options, one of the signals (either clock or trigger) must be assigned to the Trig/Ext Clk BNC input. The function of the Trigger BNC is determined by the setting of "Trig/Ext Clock Mode" in InstaCal. The Trig/Ext Clock BNC can be set to function as either the trigger ("A/D Start Trigger") or the clock ("A/D External Clock"). Pin 10 on the 40-pin connector then assumes the opposite function.

Analog hardware triggering supported. The trigger source can be set via InstaCal to any of the analog BNC inputs. cbSetTrigger() is supported for TRIGBELOW and TRIGABOVE trigger types. Analog thresholds are set relative to the voltage range set in the scan. For example, using a range of BIP1VOLTS during a cbAInScan(), (0) corresponds to –1V and 4095 corresponds to +1V.

When using the cbAPretrig() function, use either the TRIGGER BNC or Pin 8 of the 40 pin connector. To use the BNC, set InstaCal "Trig/Ext Clock Mode" to A/D Stop Trigger; otherwise, if not set to this selection, Pin 8 of the 40-pin connector is used.

When using cbAPretrig() with EXTCLOCK, the two inputs are required. The TRIGGER BNC can be set to function as either the pacer clock or the trigger. For the BNC to be setup as the pacer clock, set InstaCal "Trig/Ext Clk Mode" to A/D External Clock. To use the BNC as the trigger, set this InstaCal option to A/D Stop Trigger. If neither of these selections are used, the 40-pin connector will be used for both inputs; Pin 8 will be input for A/D Stop Trigger, and Pin 10 will be input for the pacer clock signal.

Digital (TTL) hardware gating supported. The gate source can be set via InstaCal to either the "Trig/Ext Clk" BNC input or the "A/D Pacer Gate" input on the 40-pin connector (P3).

Analog hardware gating supported. Analog thresholds are set relative to the voltage range set in the scan. For example, using a range of BIP1VOLTS during a cbAInScan(), (0) corresponds to (–1V) and 4095 corresponds to +1V.

The gate must be in the active (enabled) state before starting an acquisition.

For EXTCLOCK or EXTTRIGGER (digital triggering) using the BNC connector, InstaCal provides a configuration setting for thresholds. The selections available are either 0 Volts or 2.5 Volts. Use 0 Volts if the incoming signal is BIPOLAR. Use the 2.5 Volts option if the signal is UNIPOLAR, i.e., standard TTL.

Memory Configuration

In order to achieve the maximum sample rate under some conditions, a contiguous area of memory must be set up. The following is a guide that can be used to determine whether or not you need to set up this memory and how to accomplish it using InstaCal.

If the number of samples you are acquiring is less than 2K (2,048) samples then you do NOT need to set up contiguous memory (the "Contiguous Mem" edit box in InstaCal can be left at zero).

If you are acquiring more than 2048 samples, contiguous memory may be required depending on sample rate. Use the table below to determine if contiguous memory is required.

# of Channels	Rate Requiring Contiguous Memory (when sample count > 2048)
1	> 4 MHz
2	>2 MHz
4	>1 MHz

If Contiguous Memory is required, follow the InstaCal procedures below:

1.) Run InstaCal, select the **PCI-DAS4020** board and click the "Configure" tab.

2.) In the "Memory Size" edit box for the Contiguous Memory Settings, type in the amount of memory in kilobytes that you need for the acquisition. To calculate the number of kilobytes required use the following formula:

(# of KB) = {(# of samples) x (2 bytes/sample) x (1 KB/1024 bytes)},

or

(# of KB) = {(# of samples)/512} .

Note that memory is allocated in blocks of 4 KB. As a consequence, InstaCal will adjust the amount entered upward to the nearest integer multiple of 4 KB.

For example, the contiguous memory requirements for a 10,000 sample acquisition would be:

(10,000/512) = 19.5 rounded up to multiple of 4 kBytes = 20 KB.

Note that the maximum number of samples allowed for the given contiguous memory size is displayed as the "Sample Count" below the "Memory Size" edit box.

3) Reboot the machine. The Universal Library will attempt to reserve the contiguous memory at bootup time. If it is unable to reserve all the memory requested, the amount successfully reserved will be displayed in the Memory Size entry when InstaCal is run again.

4) After rebooting your PC, please run InstaCal to verify the size of the Contiguous Memory that was successfully reserved.

5) To change or free the contiguous memory, repeat step 1 through 4 specifying the new size.

Note that the size of the block shown in InstaCal is the TOTAL CONTIGUOUS MEMORY available to ALL BOARDS INSTALLED. Other boards in the PC using the Universal Library's `cbWinBufAlloc()`

function will also use this contiguous memory, so plan the size of the contiguous memory buffer accordingly.

There are two special cases where you need to be aware of packet size and adjust the number of samples acquired accordingly:

1.) `cbAPretrig()`

2.) `cbAInScan` with the `CONTINUOUS` scan option

These functions use a circular buffer. The data must be aligned in the buffer by packets for these functions. For both cases, the total number of samples must be greater than one packet (listed in the table below) and must be an integer multiple of packet size. In addition, contiguous memory must be used if noted in the table below. The minimum value for contiguous memory is calculated using the formula in step 2 above:

(# of KB) = {(# of samples) / 512}

As an example, to run cbAInScan on one channel at 18MHz with the `CONTINUOUS` option set, determine the minimum sample size from the chart to be 262,144 (since the Rate is between 14 and 20MHz). The minimum contiguous memory is calculated as follows:

(262,144 / 512) = 512 KB

Number of Channels	Rate in MHz	Packet Size in Samples	Minimum Sample Size (two packets)	Contiguous Memory	Min Contiguous Memory (based on Min Sample Size)
1	20 >= Rate >=13.3	131,072	262,144	Required	512 KB
	13.3 > Rate >= 4	65,536	131,072	Required	256 KB
	4 > Rate >= 2	4,096	8,192	Not Required	0 KB
	2 > Rate	2,048	4,096	Not Required	0 KB
2	20 >= Rate >= 6.6	131,072	262,144	Required	512 KB
	6.6 > Rate >= 2	65,536	131,072	Required	256 KB
	2 > Rate >= 1	4,096	8,192	Not Required	0 KB
	1 > Rate	2,048	4,096	Not Required	0 KB
4	20 >= Rate >= 3.3	131,072	262,144	Required	512 KB
	3.3 > Rate >= 1	65,536	131,072	Required	256 KB
	1 > Rate >= 0.5	4,096	8,192	Not Required	0 KB
	0.5 > Rate	2,048	4,096	Not Required	0 KB

*Note that the EventData for ON_PRETRIGGER events may not be accurate. In general, this value will be below the actual number of pretrigger samples available in the buffer.

❑ Notes for SoftWIRE Users

Memory Configuration

The Analog In Scan control may require more contiguous memory than listed in the prior table When the CONTINUOUS option is set for the Analog In Scan control, the control allocates a buffer large enough to hold four times as much data as required for a single scan. As a consequence, if you will be running CONTINUOUS scans with the Analog In Scan control, you will need to allocate a minimum of four times that shown in the table above. For example, using the Analog In Scan control to run a CONTINUOUS scan of one channel at 18 MHz will require a minimum scan Count Per Channel of 262,144 samples, but will require at least 2048 KB (= 4*262144/512 KB) of contiguous memory.

The Analog In PreTrigger control may require more contiguous memory than listed in the prior table. When the Analog In PreTrigger control is run, it allocates a buffer that will hold 512 samples larger than requested by the user. As a consequence, when contiguous memory is required for the scan, the Analog In PreTrigger control will require an extra 4 KB worth of contiguous memory be allocated. For example, using the Analog In PreTrigger control to run a scan with one channel at 18 MHz will require a minimum Count Per Channel of 262,144 samples, but will require at least 516 KB (= 512 KB + 4KB) of contiguous memory.

3.4 PCI-DAS64/Mx/16 Series

❑ Analog Input

Analog Input Functions Supported

cbAIn(), cbAInScan(), cbATrig(), cbAPretrig(), cbFileAInScan(), cbFilePretrig(), cbALoadQueue()

Analog Input Argument Values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, BLOCKIO, BURSTMODE, EXTTRIGGER	
HighChan	0 to 63 in single-ended mode, 0 to 31 in differential mode	
Rate	**PCI-DAS64/M3/16** Up to 3000000 **PCI-DAS64/M2/16** Up to 2000000 **PCI-DAS64/M1/16** Up to 1000000	
Range	BIP5VOLTS BIP2PT5VOLTS BIP1PT25VOLTS BIPPT625VOLTS	UNI10VOLTS UNI5VOLTS UNI2PT5VOLTS UNI1PT25VOLTS

❑ Analog Output

Analog Output Functions Supported

cbAOut(), cbAOutScan()

Analog Output Argument Ranges

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, SIMULTANEOUS
HighChan	1 max
Rate	Up to 100000
Range	BIP10VOLTS BIP5VOLTS
DataValue	0 to 65535 (See notes on using signed integers in section 2.2)

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()

Digital I/O Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH, AUXPORT
DataValue	0 to 15 for PORTCL or PORTCH or AUXPORT 0 to 255 for PORTA or PORTB
BitNum	0 to 23 for FIRSTPORTA 0 to 3 for AUXPORT

❑ Counter I/O

Counter Functions Supported

cbC8254Config(), cbCIn(), cbCLoad()

Counter Argument Values

CounterNum	1
Config	HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE
LoadValue	0 to 65535 (see notes on unsigned integers in Section 2.2.)

❑ Triggering

Trigger Functions Supported

cbSetTrigger()

Trigger Argument Values

TrigType	TRIG_POS_EDGE, TRIG_NEG_EDGE, TRIGABOVE, TRIGBELOW, GATEHIGH, GATELOW, GATENEGHYST, GATEPOSHYST, GATEABOVE, GATEBELOW, GATEINWINDOW, GATEOUTWINDOW
Threshold	0 to 65535 (See

❑ Event Notification

Event Notification Functions Supported

cbEnableEvent(), cbDisableEvent()

Event Notification Argument Values

EventType	ON_SCAN_ERROR, ON_PRETRIGGER, ON_DATA_AVAILABLE, ON_END_OF_AI_SCAN, ON_END_OF_AO_SCAN

❑ Hardware Considerations

Pacing Analog Input

Hardware pacing, external or internal clock supported.

The clock edge used to trigger acquisition for the external pacer may be rising or falling and is selectable using InstaCal.

The packet size is 512 samples.

Analog Input Configuration

The analog input mode may be 32 channel differential or 64 channel single-ended and may be selected using InstaCal.

Triggering & Gating

Digital (TTL) hardware triggering supported. Use the A/D Start Trigger Input (pin 55) for triggering and gating with cbAInScan() and cbFileAInScan(). Use the A/D Stop Trigger Input (pin 54) for cbAPretrig() and cbFilePretrig().

Analog hardware triggering and gating are supported. Use the Analog Trigger Input (pin 56) for analog triggering. Analog thresholds are set relative to the ±10V range. For example: a threshold of (0) equates to (–10Volts), a threshold of 65535 equates to +9.999695 Volts.

When running BURSTMODE scans with the EXTCLOCK option for cbAInScan(), connect the clock source to the A/D Start Trigger Input (pin 55). Since the trigger input is used as the clock signal, the EXTTRIGGER option cannot be combined with EXTCLOCK BURSTMODE scans. Since BURSTMODE is actually paced by the internal burst clock, specifying EXTCLOCK when using BURSTMODE is equivalent to specifying EXTTRIGGER.

When using analog trigger feature, one or both of the DACs are used to set the threshold and are unavailable for other functions. If the trigger

function requires a single reference (GATEABOVE, GATEBELOW, TRIGABOVE, TRIGBELOW) then DAC0 is available. If the trigger function requires two references (GATEINWINDOW, GATE OUTWINDOW, GATENEGHYS, GATEPOSHYS) then neither DAC is available for other functions.

Warning: Gating should NOT be used with BURSTMODE scans.

Pacing Analog Output

Hardware pacing, external or internal clock supported.

The clock edge used to trigger analog output updates for the external pacer may be rising or falling and is selectable using InstaCal.

EventData for ON_PRETRIGGER events may not be accurate. In general, this value will be below the actual number of pretrigger samples available in the buffer.

These boards support concurrent analog input and output scans. That is, these boards allow for operations of analog input functions (cbAInScan() and cbAPretrig()) and analog output functions (cbAOutScan()) to overlap without having to call cbStopBackground() between the start of input and output scans.

Output Pin 59 Configuration

Pin 59 may be configured as the DAC Pacer Output, SSH Output with hold configured as high level or SSH Output with hold configured as low level.

3.5 PCI- and CIO-DAS6402 and DAS3202 Series

❑ Analog Input

Analog Input Functions Supported

cbAIn(), cbAInScan(), cbATrig(), cbAPretrig(), cbFileAInScan(), cbFilePretrig(), cbALoadQueue()

Analog Input Argument Values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, BLOCKIO, BURSTMODE, EXTTRIGGER		
HighChan	**PCI-DAS6402 & CIO-DAS6402** 0 to 63 in single-ended mode, 0 to 31 in differential mode		
	PCI-DAS3202 0 to 31		
Rate	**CIO- DAS6402/12** Up to 330000	**CIO- DAS6402/16** Up to 100000	**All others** Up to 200000
Range	BIP10VOLTS BIP5VOLTS BIP2PT5VOLTS BIP1PT25VOLTS	UNI10VOLTS UNI5VOLTS UNI2PT5VOLTS UNI1PT25VOLTS	

❑ Analog Output

Analog Output Functions Supported

cbAOut(), cbAOutScan()

Analog Output Argument Ranges

Options	SIMULTANEOUS For **PCI Versions**, the following argument values are also valid BACKGROUND, EXTCLOCK, CONTINUOUS	
HighChan	1 max	
Rate	**PCI Versions** Up to 100000	**CIO Versions** Ignored
Range	**PCI Versions** BIP10VOLTS BIP5VOLTS	**CIO Versions** Ignored

DataValue	0 to 4095 For **PCI-DAS6402/16, PCI-DAS3202/16, CIO-DAS6402/16**, the following additional function is also valid 0 to 65535 (See notes on using signed integers in section 2.2)

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()

For **PCI- Versions**, the following additional function is also valid

cbDConfigPort()

Digital I/O Argument Values

PortNum	AUXPORT*
DataValue	0 to 255
BitNum	0 to 7

For **PCI- Versions**, the following additional argument values are also valid

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH
DataValue	0 to 15 for PORTCL or PORTCH; 0 to 255 for PORTA or PORTB
BitNum	0 to 23 for FIRSTPORTA

❑ Counter I/O

Counter Functions Supported

cbC8254Config(), cbCIn(), cbCLoad()

Counter Argument Values

CounterNum	1
Config	HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE
LoadValue	0 to 65535 (see notes on unsigned integers in Section 2.2)

❑ Triggering

Trigger Functions Supported

`cbSetTrigger()`

Trigger Argument Values

`TrigType`	`TRIG_POS_EDGE, TRIG_NEG_EDGE, GATEHIGH, GATELOW`
	
	For **PCI- Versions**, the following additional argument values are also valid
	`TRIGABOVE, TRIGBELOW, GATENEGHYST, GATEPOSHYST, GATEABOVE, GATEBELOW, GATEINWINDOW, GATEOUTWINDOW`

`Threshold`	0 to 4095 For **/16 versions** the following argument values are also valid 0 to 65535 (see notes on unsigned integers in Section 2.2)

❑ Event Notification

Event Notification Functions Supported
PCI Versions Only

`cbEnableEvent(), cbDisableEvent()`

Event Notification Argument Values

`EventType`	`ON_SCAN_ERROR, ON_PRETRIGGER, ON_DATA_AVAILABLE, ON_END_OF_AI_SCAN, ON_END_OF_AO_SCAN`

❑ Hardware Considerations

Pacing Analog Input

Hardware pacing, external or internal clock supported.

The packet size is 512 samples for **CIO- versions** and 2048 for **PCI versions**.

Triggering & Gating

Digital (TTL) hardware triggering supported.

PCI version also supports analog hardware triggering. Analog thresholds are set relative to the ±10V range. For example, a threshold of 0 equates to (–10)Volts, a threshold of 65535 equates to +9.999695 Volts.

When using cbAPretrig() or cbFilePretrig() on the **PCI-DAS6402/16** or **PCI-DAS3202/16**, use the A/D Stop Trigger In (pin 47) input to supply the trigger.

When using both EXTCLOCK and BURSTMODE on the **PCI-DAS6402/16** or **PCI-DAS3202/16**, do not use the A/D External Pacer (pin 42) to supply the clock. Use the A/D Start Trigger In (pin 45) input instead. Since BURSTMODE is actually paced by the internal burst clock, specifying EXTCLOCK when using BURSTMODE is equivalent to specifying EXTTRIGGER.

When using analog trigger feature, one or both of the DACs are used to set the threshold and are unavailable for other functions. If the trigger function requires a single reference (GATEABOVE, GATEBELOW, TRIGABOVE, TRIGBELOW) then DAC0 is available. If the trigger function requires two references (GATEINWINDOW, GATE OUTWINDOW, GATENEGHYS, GATEPOSHYS) then neither DAC is available for other functions.

Warning: Gating should NOT be used with BURSTMODE scans.

Gain queue

When using cbALoadQueue() with the **PCI version**, up to 8k elements can be loaded into the queue.

Pacing Analog Output

CIO Version Software only

PCI Version Hardware pacing, external or internal clock supported.

Event Notification

The **PCI-** version of these boards support concurrent analog input and output scans. That is, these boards allow for operations of analog input functions (cbAInScan() and cbAPretrig()) and analog output functions (cbAOutScan()) to overlap without having to call cbStopBackground() between the start of input and output scans.

3.6 PCI-DAS1602, PCI-DAS1200 & PCI-DAS1000 Series

❑ Analog Input

Analog Input Functions Supported

cbAIn(), cbAInScan(), cbATrig(), cbAPretrig(), cbFileAInScan(), cbFilePretrig()

Analog Input Argument Values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, BLOCKIO, BURSTMODE, EXTTRIGGER
HighChan	0 to 15 in single-ended mode, 0 to 7 in differential mode
Rate	**PCI- DAS1602/12, PCI- DAS1200, PCI- DAS1200Jr** Up to 330000 **PCI- DAS1000** Up to 250000 **PCI- DAS1602/16, PCI- DAS1002** Up to 200000 **PCI- DAS1001** Up to 150000
Range	**PCI-DAS1602/12, PCI-DAS1602/16, PCI-DAS1200, PCI-DAS1200Jr, PCI-DAS1002, PCI-DAS1000** BIP10VOLTS UNI10VOLTS BIP5VOLTS UNI5VOLTS BIP2PT5VOLTS UNI2PT5VOLTS BIP1PT25VOLTS UNI1PT25VOLTS **PCI-DAS1001** BIP10VOLTS UNI10VOLTS BIP1VOLTS UNI1VOLTS BIPPT1VOLTS UNIPT1VOLTS BIPPT01VOLTS UNIPT01VOLTS

❑ Analog Output
Excludes PCI-DAS1200Jr

Analog Output Functions Supported

cbAOut(), cbAOutScan()

Analog Output Argument Ranges

Options	SIMULTANEOUS		
	For **PCI-DAS1602 Series**, the following argument values are also valid BACKGROUND, CONTINUOUS, EXTCLOCK		
HighChan	0 to 1		
Rate	**PCI-DAS1602/16** Up to 100000	**PCI-DAS1602/12** Up to 250000	**All others** Ignored
Range	BIP10VOLTS BIP5VOLTS	UNI10VOLTS UNI5VOLTS	
DataValue	0 to 4095		
	For **PCI-DAS1602/16**, the following argument values are also valid 0 to 65535 (See notes on using signed integers in section 2.2)		

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()

Digital I/O Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH
DataValue	0 to 15 for PORTCL or PORTCH 0 to 255 for PORTA or PORTB
BitNum	0 to 23 for FIRSTPORTA

❑ Counter I/O

Counter Functions Supported

cbC8254Config(), cbCIn(), cbCLoad()

Counter Argument Values

CounterNum	4 to 6
Config	HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE
LoadValue	0 to 65535 (see notes on unsigned integers in Section 2.2.)

❑ Triggering
PCI-DAS1602/16 and PCI-DAS1602/12 Only

Trigger Functions Supported

cbSetTrigger()

Trigger Argument Values

TrigType	TRIG_POS_EDGE, TRIG_NEG_EDGE, TRIGABOVE, TRIGBELOW, GATEHIGH, GATELOW, GATENEGHYST, GATEPOSHYST, GATEABOVE, GATEBELOW, GATEINWINDOW, GATEOUTWINDOW
Threshold	0 to 4095

❑ Event Notification

Event Notification Functions Supported
PCI Versions Only

cbEnableEvent(), cbDisableEvent()

Event Notification Argument Values

EventType	ON_SCAN_ERROR, ON_PRETRIGGER, ON_DATA_AVAILABLE, ON_END_OF_AI_SCAN For **PCI-DAS1602/16** and **PCI-DAS1602/12** the following argument values are also valid ON_END_OF_AO_SCAN

❑ Hardware Considerations

Pacing Analog Input

Hardware pacing, external or internal clock supported.

The clock edge used to trigger acquisition for the external pacer may be rising or falling and is selectable using InstaCal.

For the **PCI-DAS1602/16**, the packet size is 256 samples. All others in this series have a packet size of 512 samples.

Analog Input Configuration

The analog input mode may be 8 channel differential or 16 channel single-ended and may be selected using InstaCal.

Triggering & Gating

PCI-DAS1602 Series

Digital (TTL) and analog hardware triggering supported.

Analog thresholds are set relative to the ±10V range. For example: a threshold of 0 equates to (−10)Volts, a threshold of 65535 and a threshold of 4095 correspond to +9.999695 and +9.995116 Volts for the 16-bit and 12-bit boards, respectively.

When using analog trigger feature, one or both of the DACs are unavailable for other functions. If the trigger function requires a single reference (`GATE_ABOVE, GATE_BELOW, TRIGABOVE, TRIGBELOW`), DAC0 is available. If the trigger function requires two references (`GATE_IN_WINDOW, GATE_ OUT_WINDOW, GATE_NEG_HYS, GATE_ POS_HYS`), neither DAC is available for other functions.

PCI-DAS1200, PCI-DAS1000 Series

Digital (TTL) hardware triggering supported.

The **PCI-DAS1602** boards support concurrent analog input and output scans. That is, these boards allow for operations of analog input functions (`cbAInScan()` and `cbAPretrig()`) and analog output functions (`cbAOutScan()`) to overlap without having to call `cbStopBackground()` between the start of input and output scans.

Pacing Analog Output

PCI-DAS1602 Series

Hardware pacing, external or internal clock supported.

The clock edge used to trigger analog output updates for the external pacer may be rising or falling and is selectable using InstaCal.

Counters

The source for counter 4 may be internal or external and is selectable using InstaCal.

Although counters 4, 5 and 6 are programmable through the counter functions, the primary purpose for some of these counters may conflict with these functions.

Following is a list of potential conflicts:

PCI-DAS1200, PCI-DAS1000 Series

Counters 5 and 6 are always available to the user. Counter 4 is used as a residual counter by some of the analog input functions.

PCI-DAS1602 Series

Counters 5 and 6 are used as DAC pacers by some analog output functions. Counter 4 is used as a residual counter by some of the analog input functions.

3.7 PCIM-DAS1602 Series

❑ Analog Input

Analog Input Functions Supported

cbAIn(), cbAInScan(), cbATrig()

Analog Input Argument Values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO,BLOCKIO, BURSTMODE, EXTTRIGGER.	
HighChan	0 to 15 in single-ended mode, 0 to 7 in differential mode	
Rate	100000	
Range	BIP10VOLTS	UNI10VOLTS
	BIP5VOLTS	UNI5VOLTS
	BIP2PT5VOLTS	UNI2PT5VOLTS
	BIP1PT25VOLTS	UNI1PT25VOLTS

❑ Analog Output

Analog Output Functions Supported

cbAOut(), cbAOutScan()

Analog Output Argument Ranges

Options	Ignored
HighChan	1 max
Count	2
Rate	Ignored
Range	Ignored
DataValue	0 to 4095

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(),cbDConfigPort()

Digital I/O Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH, AUXPORT
DataValue	0 to 15 for PORTCL, PORTCH or AUXPORT 0 to 255 for PORTA or PORTB
BitNum	0 to 23 for FIRSTPORTA 0 to 3 for AUXPORT

❑ Counter I/O

Counter Functions Supported

cbC8254Config(), cbCIn(), cbCLoad()

Counter Argument Values

CounterNum	1 to 3

❑ Event Notification

Event Notification Functions Supported

cbEnableEvent(), cbDisableEvent()

Event Notification Argument Values

EventType	ON_SCAN_ERROR, ON_DATA_AVAILABLE, ON_END_OF_AI_SCAN

❑ Triggering

Trigger Functions Supported

cbSetTrigger()

Trigger Argument Values

TrigType	TRIG_POS_EDGE, TRIG_NEG_EDGE, GATEHIGH, GATELOW
Threshold	0 to 65535 (see notes on unsigned integers in Section 2.2)

❑ Hardware Considerations

Pacing Analog Input

Hardware pacing, external or internal clock supported.

Analog Input Ranges

The A/D ranges are configured with a combination of a switch (Unipolar / Bipolar) and a programmable gain code. The state of this switch is set in the configuration file using InstaCal. After the UNI/BIP switch setting is selected, only matching ranges can be used in Universal Library programs.

Triggering & Gating

Digital (TTL) hardware triggering supported.

Pacing Analog Output

Software pacing only

3.8 CIO-DAS800 Series

❑ Analog Input

Analog Input Functions Supported

`cbAIn(),cbAInScan(),cbATrig(),cbFileAInScan()`

Analog Input Argument Values

`Options` `BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, BLOCKIO, EXTTRIGGER`

`HighChan` 0 to 7

`Rate`

CIO-DAS802/16
100000

All others in series
50,000

`Range`

CIO-DAS800
Range is not programmable so the Range argument is ignored.

CIO-DAS801 supports the following A/D ranges

BIP10VOLTS	UNI10VOLTS
BIP5VOLTS	UNI1VOLTS
BIP1VOLTS	UNIPT1VOLTS
BIPPT5VOLTS	UNIPT01VOLTS
BIPPT05VOLTS	
BIPPT01VOLTS	

CIO-DAS802 supports the following A/D ranges

BIP10VOLTS	UNI10VOLTS
BIP5VOLTS	UNI5VOLTS
BIP2PT5VOLTS	UNI2PT5VOLTS
BIP1PT25VOLTS	UNI1PT25VOLTS
BIPPT625VOLTS	

CIO-DAS802/16 supports the following A/D ranges

BIP10VOLTS	UNI10VOLTS
BIP5VOLTS	UNI5VOLTS
BIP2PT5VOLTS	UNI2PT5VOLTS
BIP1PT25VOLTS	UNI1PT25VOLTS

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()

Digital I/O Argument Values

PortNum	AUXPORT	
DataValue	cbDOut() 0 to 15	cbDIn() 0 to 7
BitNum	cbDOut() 0 to 3	cbDIn() 0 to 2

❑ Counter I/O

Counter Functions Supported

cbC8254Config(), cbCIn(), cbCLoad()

Counter Argument Values

CounterNum	1 to 3
Config	HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE
LoadValue	0 to 65535 (see notes on unsigned integers in Section 2.2.)

❑ Hardware Considerations

Pacing Analog Input

Hardware pacing, external or internal clock supported.

The packet size is 128 samples.

Note that digital output is not compatible with concurrent cbAInScan() operation, since the channel multiplexer control shares the register with the digital output control. Writing to this register during a scan may adversely affect the scan.

Triggering & Gating

Digital hardware triggering supported.

3.9 CIO-, PCI-, and PC104- DAS08 Series

❑ Analog Input

Analog Input Functions Supported

cbAIn(),cbAInScan(),cbATrig(),cbFileAInScan()

Analog Input Argument Values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, EXTTRIGGER
HighChan	0 to 7
Rate	50000 (See **Notes:** Analog Input Boards regarding SINGLEIO scans).
Range	**DAS08 series** Since the **DAS08** series does not have programmable gain, the Range arguments for the analog input functions are ignored. **PCI-DAS08** BIP5VOLTS (±5 volts) **CIO-DAS08** and **PC104-DAS08** BIP10VOLTS UNI10VOLTS BIP5VOLTS **CIO-DAS08-PGH** and **CIO-DAS08-AOH** BIP10VOLTS UNI10VOLTS BIP5VOLTS UNI1VOLTS BIP1VOLTS UNIPT1VOLTS BIPPT5VOLTS UNIPT01VOLTS BIPPT1VOLTS BIPPT01VOLTS BIPPT05VOLTS BIPPT005VOLTS **CIO-DAS08-PGL** and **CIO-DAS08-AOL** BIP10VOLTS UNI10VOLTS BIP5VOLTS UNI5VOLTS BIP2PT5VOLTS UNI2PT5VOLTS BIP1PT25VOLTS UNI1PT25VOLTS BIPPT625VOLTS **CIO-DAS08-PGM** and **CIO-DAS08-AOM** BIP10VOLTS UNI10VOLTS BIP5VOLTS UNI1VOLTS BIPPT5VOLTS UNIPT1VOLTS BIPPT1VOLTS UNIPT01VOLTS BIPPT05VOLTS

❑ Analog Output -AO, -AOH, -AOM, -AOL versions only

Analog Output Functions Supported

cbAOut(),cbAOutScan()

Analog Output Argument Ranges

Options	SIMULTANEOUS
HighChan	1 max
Rate	Ignored
Count	2 max
Range	Ignored
DataValue	0 to 4095

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()

For **CIO-DAS08** and **CIO-DAS08-AOx**, the following function is also supported:

cbDConfigPort()

Digital I/O Argument Values

PortNum	AUXPORT	
DataValue	cbDOut() 0 to 15	cbDIn() 0 to 7
BitNum	cbDOut() 0 to 3	cbDIn() 0 to 2

For **CIO-DAS08** and **CIO-DAS08-AOx** the following additional argument values are also valid

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH
DataValue	0 to 15 for PORTCL or PORTCH; 0 to 255 for PORTA or PORTB
BitNum	0 to 23 for FIRSTPORTA

❑ Counter I/O

Counter Functions Supported

cbC8254Config(), cbCIn(), cbCLoad()

Counter Argument Values

CounterNum	1 to 3
Config	HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE
LoadValue	0 to 65535 (see notes on unsigned integers in Section 2.2.)

❑ Hardware Considerations

Pacing Analog Input

Hardware pacing, external or internal clock supported.

Before using the timed analog input function cbAInScan() with a **CIO-** or **PC104-** series board, the output of counter 1 must be wired to the Interrupt input; if you have a **CIO-DAS08** board revision 3 or higher, a jumper is provided on the board to accomplish this. An interrupt level must have been selected in InstaCal and the CB.CFG file saved.

Triggering & Gating

Digital (TTL) polled digital input triggering supported. (See **Notes:** Analog Input Boards regarding polled gate trigger support).

Pacing Analog Output

Software pacing only

3.10 CIO-DAS08/Jr and CIO-DAS08/Jr/16 Series

❑ Analog Input

Analog Input Functions Supported

`cbAIn(),cbAInScan(),cbATrig()`

Analog Input Argument Values

`Options`	`CONVERTDATA`
`HighChan`	0 to 7
`Rate`	Ignored
`Range`	Since the **DAS08/Jr** series does not have programmable gain, the Range arguments for the analog input functions are ignored.

❑ Analog Output
If optional D/A converters are installed

Analog Output Functions Supported

cbAOut(),cbAOutScan()

Analog Output Argument Ranges

`Options`	`SIMULTANEOUS`
`HighChan`	1 max
`Rate`	Ignored
`Count`	2 max
`Range`	Ignored
`DataValue`	0 to 4095 For **CIO-DAS08/Jr/16-AO**, the following argument values are also valid 0 to 65535 (See notes on using signed integers in section 2.2)

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()

Digital I/O Argument Values

PortNum	AUXPORT
DataValue	0 to 255
BitNum	0 to 7

❑ Counter I/O

Counter Functions Supported

None

❑ Hardware Considerations

Pacing Analog Input

Software pacing only

3.11 PCM-DAS08

❑ Analog Input

Analog Input Functions Supported

cbAIn(), cbAInScan(), cbATrig()

Analog Input Argument Values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, NOTODINTS, EXTTRIGGER, NOCALIBRATEDATA
HighChan	0 to 7
Rate	24000 max (see hardware manual for other restrictions)
Range	This board does not have programmable gain so the Range argument to analog input functions is ignored.

❑ Digital I/O

Digital I/O Functions Supported

cbDIn(), cbDOut(), cbDBitIn(), cbDBitOut()

Digital I/O Argument Values

PortNum	AUXPORT
DataValue	0 to 7
BitNum	0 to 2

❑ Hardware Considerations

Pacing Analog Input

Internal or external clock

MAXIMIZING SAMPLING RATES

Although the **PCM-DAS08** is capable of 25KHz analog to digital conversions, not all computers in all configurations can transfer the converted samples fast enough to sustain a 25 kHz sample and transfer rate without missing some samples. This is especially true in a windows type environment. Unfortunately, there isn't much you can do to improve sampling rates in windows, but in DOS, where you have more control over process, you may be able to attain the full 25 kHz sampling rate.

Determining Maximum Sampling Rates in DOS

If you have installed the DOS version of the Universal Library, a utility program called MAXRATE will have been installed in the UL directory (C:\CB by default).

MAXRATE will test your computer and advise you of the maximum sustainable convert and transfer rate.

The maximum rate for your computer will be reported for two conditions. The first is with all interrupts enabled, the second is with the time of day interrupt disabled (TOD). The convert and transfer rate with TOD disabled will usually be faster.

What has the Time of Day interrupt got to do with A/D conversions?

Many TSR's and device drivers "hook" into the TOD interrupt. Using the TOD clock tick guarantees that every 1/18th of a second the routine will be woken up and can check status or do whatever the routine is designed to do. Unfortunately this can create considerable overhead in the TOD interrupt service routine and will introduce gaps in your sample data at high rates.

Using the cbAInScan() option argument to turn off the TOD interrupt will increase the speed you can maintain with your **PCM-DAS08**. Turning off the TOD will also prevent your computer's clock from incrementing while cbAInScan() is running. Your clock will lose time.

At what speed might there be a concern with my computer's transfer rate?

Any rate below 5KHz is sustainable with or without TOD interrupt enabled if your maximum required rate is less than 5KHz then your computer can do that.

If your required rate is greater that 10K you should run MAXRATE.

Remember, we are discussing the TOTAL rate, not the per channel rate. If you want 3 channels at 5KHz, the total rate is 15KHz and you should run MAXRATE to see if your computer is up to the task.

What about background operation?

MAXRATE tests your computer using the cbAInScan() routine in the foreground. If you choose background operation it may not sustain the maximum rate returned by MAXRATE.

For the fastest performance, use cbAInScan() in the foreground with the TOD interrupt disabled.

3.12 PPIO-AI08

❑ Analog Input

Analog Input Functions Supported

cbAIn(),cbAInScan(),cbATrig()

Analog Input Argument Values

Options	CONVERTDATA
HighChan	0 to 7
Rate	Ignored
Range	Since the **PPIO-AI08** does not have programmable gain, the Range arguments for the analog input functions are ignored.

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()

Digital I/O Argument Values

PortNum	AUXPORT	
DataValue	cbDOut() 0 to 15	cbDIn() 0 to 7
BitNum	cbDOut() 0 to 3	cbDIn() 0 to 2

❑ Hardware Considerations

Pacing Analog Input

Software pacing only

3.13 CIO- and PC104- DAS16

❑ Analog Input

Analog Input Functions Supported

`cbAIn(),cbAInScan(),cbATrig()`

The **DAS16/330**, **DAS16/330i**, **DAS16/M1** and **DAS16/M1/16** also support the following

`cbAPretrig(), cbFileAInScan(), cbFilePretrig()`

For **DAS16/330i** and **DAS16/M1**, the following function is also supported:

`cbALoadQueue()`

Analog Input Argument Values

`Options` `BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, EXTTRIGGER`

For **DAS16/330, DAS16/330i, DAS16/M1** and **DAS16/M1/16**, the following argument values are also valid:
`DTCONNECT, BLOCKIO, EXTMEMORY`

For **DAS16, DAS16/F, DAS16/Jr, DAS16/Jr/16** and **PC104-DAS16Jr** series, the following argument values are also valid:
`SINGLEIO, DMAIO`

For **DAS16/M1/16**, the following argument value is also valid:
`BURSTMODE`

`HighChan`

DAS16/M1 and **DAS16/M1/16**
0 to 7

All others
0 to 15 in single-ended mode, 0 to 7 in differential mode

`Rate`

DAS16/M1 & **DAS16/M1/16**
Up to 1000000

DAS16/330 & **330i**
Up to 330000

PC104-DAS16Jr/12 **CIO-DAS16Jr**
Up to 160000

Up to 130000

DAS16/F & **DAS16Jr/16**
Up to 100000

CIO-DAS16
Up to 50000

Range

CIO-DAS16 & CIO-DAS16/F
These boards do not have programmable gain so the Range argument to analog input functions is ignored.

All other boards in this series support the following ranges

BIP5VOLTS	UNI10VOLTS
BIP2PT5VOLTS	UNI5VOLTS
BIP1PT25VOLTS	UNI2PT5VOLTS
	UNI1PT25VOLTS

For all programmable gain boards in this series **except** the **DAS16/M1/16**, the following argument value is also valid:
BIP10VOLTS

For all programmable gain boards in this series **except** the **CIO-DAS16Jr/16** and **PC104-DAS16Jr/16**, the following argument value is also valid:
BIPPT625VOLTS

❑ Analog Output CIO-DAS16 & CIO-DAS16/F only

Analog Output Functions Supported

cbAOut(),cbAOutScan()

Analog Output Argument Ranges

Options	SIMULTANEOUS
HighChan	1 max
Rate	Ignored
Count	2 max
Range	Ignored
DataValue	0 to 4095

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()

For **CIO-DAS16 & 16/F**, **CIO-DAS16/M1** and **CIO-DAS16/M1/16**, the following function is also supported:

cbDConfigPort()

Digital I/O Argument Values

PortNum	AUXPORT
DataValue	0 to 15
BitNum	0 to 3

For **CIO-DAS16 & 16/F, CIO-DAS16/M1** and **CIO-DAS16/M1/16** the following additional argument values are also valid

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH
DataValue	0 to 15 for PORTCL or PORTCH; 0 to 255 for PORTA or PORTB
BitNum	0 to 23 for FIRSTPORTA

❑ Counter I/O

Counter Functions Supported

cbC8254Config(), cbCIn(), cbCLoad()

Counter Argument Values

CounterNum	1 to 3 For **CIO-DAS16/M1/16** the following additional argument values are also valid 4 to 6
Config	HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE
LoadValue	0 to 65535 (see notes on unsigned integers in Section 2.2.)

❑ Triggering
CIO-DAS16/M1/16 Only

Trigger Functions Supported

`cbSetTrigger()`

Trigger Argument Values

`TrigType`	`TRIG_POS_EDGE, TRIG_NEG_EDGE, GATEHIGH, GATELOW`
`Threshold`	0 to 65535 (see notes on unsigned integers in Section 2.2)

❑ Hardware Considerations

Pacing Analog Input

Hardware pacing, external or internal clock supported.

The packet size is 512 samples

The `DMAIO` option can not be used while using the chan/gain queue on the **DAS-330i** board.

CIO-DAS16/M1
The full 1MHz rate may not be achievable on some systems when using the timed analog functions with CIO-DAS16/M1 to acquire more than 2048 data points. On slow machines, these functions may hang if scan rate is fast (generally in the range of 500 to 700 kHz). The maximum rate can be determined by passing in different high rates until the maximum rate is achieved without hanging the system. If the full 1.0 MHz rate is required, consider adding a **MEGA FIFO** memory board and specifying the `EXTMEMORY` option on the call to `cbAInScan()`.

CIO-DAS16/M1/16 also supports counter numbers 4 through 6 with counter 4 being the only independent user counter.

Triggering & Gating

For the **CIO-DAS16/M1/16**, Digital (TTL) and analog hardware triggering is supported.

For **all others in this series**, digital (TTL) polled gate triggering is supported.

Pacing Analog Output

Software only

3.14 PCM- and PC-CARD- DAS16 Series

❑ Analog Input

Analog Input Functions Supported

cbAIn(),cbAInScan(),cbATrig(),cbFileAInScan()

Analog Input Argument Values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, BLOCKIO, EXTTRIGGER, NOTODINTS, NOCALIBRATEDATA
HighChan	**DAS16/S and DAS16/330** 0 to 15 **DAS16/D** 0 to 7
Rate	**DAS16/330** 330000 **PC-CARD-DAS16/16** 200000 **All others in series** 100000
Range	For **DAS16x/12**, the following A/D ranges are valid: BIP10VOLTS UNI10VOLTS BIP5VOLTS UNI5VOLTS BIP2PT5VOLTS UNI2PT5VOLTS BIP1PT25VOLTS UNI1PT25VOLTS For **DAS16x/16**, the following A/D ranges are valid: BIP10VOLTS BIP5VOLTS BIP2PT5VOLTS BIP1PT25VOLTS For **DAS16/330**, the following A/D ranges are valid: BIP10VOLTS BIP5VOLTS

❑ Analog Output
PCM-DAS16D/12AO and PC-CARD-DAS16/xx-AO only

Analog Output Functions Supported

cbAOut(),cbAOutScan()

Analog Output Argument Ranges

Options	SIMULTANEOUS (**PCM** version only)
HighChan	1 max
Rate	Ignored
Count	2 max
Range	BIP10VOLTS For **PC-CARD-DAS16/12-AO & PCM-DAS16D/12AO**, the following argument values are also valid BIP10VOLTS BIP5VOLTS
DataValue	0 to 4095 For **PC-CARD-DAS16/16-AO**, the following argument values are also valid 0 to 65535 (See notes on using signed integers in section 2.2)

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()

Digital I/O Argument Values

PortNum	**PC-CARD-DAS16/xx-AO** FIRSTPORTA **All others** in this series FIRSTPORTA, FIRSTPORTB
DataValue	0 to 7 for PORTA or PORTB
BitNum	**PC-CARD-DAS16/xx-AO** 0 to 3 for FIRSTPORTA **All others** in this series 0 to 7 for FIRSTPORTA

❑ Counter I/O

Counter Functions Supported

`cbC8254Config(), cbCIn(), cbCLoad()`

Counter Argument Values

`CounterNum`	1 to 3
`Config`	`HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE`
`LoadValue`	0 to 65535 (see notes on unsigned integers in Section 2.2.)

❑ Hardware Considerations

Pacing Analog Input

Internal or external clock

The packet size is 256 samples for **PCM-** boards; 2048 samples for **PC-CARD-** boards.

For `CONTINUOUS` mode scans, the sample count should be at least one packet size(>=2048 samples) for the **PC-CARD-** boards.

Note that these cards do not have residual counters. As a consequence, `BLOCKIO` transfers must acquire integer multiples of the packet size before completing the scan. This can be lengthy for the **PC-CARD**s which must acquire 2048 samples between interrupts for `BLOCKIO` transfers. In general, it is best to allow the library to determine the best transfer mode (`SINGLEIO` vs. `BLOCKIO`) for these boards.

Triggering & Gating

External digital (TTL) polled gate trigger supported on **PCM** versions.

External digital (TTL) hardware trigger supported on **PC-CARD** versions.

3.15 CIO-DAS1400 and CIO-DAS1600 Series

❑ Analog Input

Analog Input Functions Supported

cbAIn(),cbAInScan(),cbATrig()

Analog Input Argument Values

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, CONVERTDATA, SINGLEIO, DMAIO, BURSTMODE, EXTTRIGGER. For **CIO-DAS1600**, the following argument values are also valid DTCONNECT & EXTMEMORY.
HighChan	0 to 15 in single-ended mode, 0 to 7 in differential mode
Rate	**DAS1401/12, DAS1402/12, DAS1601/12, DAS1602/12** 160000 **DAS1602/16, DAS1402/16** 100000 **DAS1401/12, DAS1402/12, DAS1601/12, DAS1602/12** to external memory 330000
Range	**CIO-DAS1402, CIO-DAS1602, CIO-DAS1402/16** and **CIO-DAS1602/16** BIP10VOLTS UNI10VOLTS BIP5VOLTS UNI5VOLTS BIP2PT5VOLTS UNI2PT5VOLTS BIP1PT25VOLTS UNI1PT25VOLTS **CIO-DAS1401** and **CIO-DAS1601** BIP10VOLTS UNI10VOLTS BIP1VOLTS UNI1VOLTS BIPPT1VOLTS UNIPT1VOLTS BIPPT01VOLTS UNIPT01VOLTS

❑ Analog Output CIO-DAS1600 series only

Analog Output Functions Supported

cbAOut(),cbAOutScan()

Analog Output Argument Ranges

Options	SIMULTANEOUS
HighChan	1 max
Rate	Ignored
Count	2 max
Range	Analog output gain is not programmable so Range argument is ignored.
DataValue	0 to 4095

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()

For **DAS1600**, the following additional function is also valid

cbDConfigPort()

Digital I/O Argument Values

PortNum	AUXPORT*
DataValue	0 to 15
BitNum	0 to 3

For **DAS1600**, the following additional argument values are also valid

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH
DataValue	0 to 15 for PORTCL or PORTCH; 0 to 255 for PORTA or PORTB
BitNum	0 to 23 for FIRSTPORTA

❑ Counter I/O

Counter Functions Supported

cbC8254Config(), cbCIn(), cbCLoad()

Counter Argument Values

CounterNum	1 to 3
Config	HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE
LoadValue	0 to 65535 (see notes on unsigned integers in Section 2.2.)

❑ Hardware Considerations

Pacing Analog Input

Hardware pacing, external or internal clock supported.

Specifying SINGLEIO while also specifying BURSTMODE is not recommended.

When EXTMEMORY is used with the **CIO-DAS1600** the cbGetStatus function will not return the current count and current index. This is a limitation imposed by maintaining identical registers to the KM-DAS1600.

Triggering & Gating

External digital (TTL) polled gate trigger supported.

Range

The **CIO-DAS1400** and **CIO-DAS1600** A/D ranges are configured with a combination of a switch (Unipolar / Bipolar) and a programmable gain code. The state of this switch is set in the configuration file using InstaCal. After the UNI/BIP switch setting is selected, only matching ranges can be used in Universal Library programs.

3.16 CIO-DAS48/PGA

❑ Analog Input

Analog Input Functions Supported

`cbAIn(), cbAInScan(), cbATrig()`

Analog Input Argument Values

`Options`	`CONVERTDATA`
`HighChan`	47 (23 differential)
`Rate`	This board does not have a timer so the Rate argument to the analog scanning functions is ignored.

`Range`	**In voltage mode**
	`BIP10VOLTS` `UNI10VOLTS`
	`BIP5VOLTS` `UNI5VOLTS`
	`BIP2PT5VOLTS` `UNI2PT5VOLTS`
	`BIP1PT25VOLTS` `UNI1PT25VOLTS`
	`BIPPT625VOLTS`
	In current mode
	`MA4TO20` `MA2TO10`
	`MA1TO5` `MAPT5TO2PT5`

❑ Analog Output

Analog Output Functions Supported

The **CIO-DAS48/PGA** board does not support the analog output functions.

❑ Digital I/O

Digital I/O Functions Supported

The **CIO-DAS48/PGA** does not support any of the digital I/O functions.

❑ Counter I/O

Counter Functions Supported

The **CIO-DAS48/PGA** does not support any of the counter I/O functions.

3.17 DAS-TC Series

❑ Temperature Input

Temperature Input Functions Supported

cbTIn(), cbTInScan()

Temperature Input Argument Values

Options	NOFILTER
Scale	CELSIUS, FAHRENHEIT, KELVIN, VOLTS
HighChan	0 to 15

❑ Hardware Considerations

Pacing Input

The rate of measurement is fixed at approximately 25 samples per second.

Selecting Thermocouples

J, K, E, T, R, S or B type thermocouples may be selected using InstaCal.

Open Thermocouples

When using **cbTInScan()** with the **DAS-TC**, an open thermocouple error (OPENCONNECTION) on any of the channels will cause all data to be returned as –9999.0. This is a hardware limitation. If your application requires isolating channels with defective thermocouples attached and returning valid data for the remainder of the channels, use the cbTIn() function instead.

To read the voltage input of the thermocouple, use VOLTS for the Scale parameter in cbTIn() and cbTInScan().

3.18 CIO-DAS-TEMP

❑ Temperature Input

Temperature Input Functions Supported

cbTIn(), cbTInScan()

Temperature Input Argument Values

Options	NOFILTER
Scale	CELSIUS, FAHRENHEIT, KELVIN, VOLTS
HighChan	0 to 31

❑ Hardware Considerations

Pacing Input

The rate of measurement is fixed at approximately 25 samples per second.

Selecting Thermocouples

J, K, E, T, R, S or B type thermocouples may be selected using InstaCal.

4 Analog Output Boards

4.1 Introduction

All boards with analog outputs support the cbAOut() and cbAOutScan() functions. Boards released after the printing of this manual are described in readme files on the Universal Library disk.

cbAOutScan() is designed primarily for boards that support hardware-paced analog output but it is also useful when simultaneous update of all channels is desired. If the hardware is configured for simultaneous update, this function loads each DAC channel with the appropriate value before issuing the update command.

4.2 DAC04 HS Series

❑ Analog Output

Analog Output Functions Supported

cbAOut(),cbAOutScan()

Analog Output Argument Ranges

Options	BACKGROUND, CONTINUOUS, EXTCLOCK, SIMULTANEOUS
HighChan	0 to 3
Rate	500000
DataValue	0 to 4095

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()

Digital I/O Argument Values

PortNum	AUXPORT*
DataValue	0 to 255
BitNum	0 to 7

❑ Hardware Considerations

Pacing Analog Output

Hardware pacing, external or internal clock supported.

The external clock is hardwired to the DAC pacer. If an internal clock is to be used, do not connect a signal to the ExtPacer input.

4.3 DAC Series (Excluding HS Series)

❑ Analog Output

Analog Output Functions Supported

cbAOut(),cbAOutScan()

Analog Output Argument Ranges

Options	SIMULTANEOUS	
HighChan	**DAC02** 0 to 1	**DAC08** 0 to 7
	DAC06 0 to 5	**DAC16** 0 to 15
Rate	Ignored	
Count	HighChan - LowChan + 1 max	
Range	Ignored	
DataValue	0 to 4095	
	For the **/16 series**, the following argument values are also valid 0 to 65535 (See notes on using signed integers in section 2.2)	

❑ Hardware Considerations

Pacing Analog Output

Software only

4.4 PCM- and PC-CARD- DAC Series

❑ Analog Output

Analog Output Functions Supported

cbAOut(),cbAOutScan()

Analog Output Argument Ranges

Options	SIMULTANEOUS	
HighChan	**DAC02** 0 to 1	**DAC08** 0 to 7
Rate	Ignored	
Count	HighChan - LowChan + 1 max	
Range	**PCM-DAC08** and **PC-CARD-DAC08** Ignored	
	PCM-DAC02 BIP10VOLTS UNI10VOLTS	 BIP5VOLTS UNI5VOLTS
DataValue	0 to 4095	

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()

Digital I/O Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB
DataValue	0 to 15 for PORTA or PORTB
BitNum	0 to 7 using FIRSTPORTA

❑ Hardware Considerations

Pacing Analog Output

Software only

Digital Configuration

Supports two, configurable 4-bit ports, FIRSTPORTA and FIRSTPORTB. Each can be independently configured as either inputs or outputs via cbDConfigPort().

4.5 CIO-DDA06 Series

❑ Analog Output

Analog Output Functions Supported

cbAOut(),cbAOutScan()

Analog Output Argument Ranges

Options	SIMULTANEOUS
HighChan	0 to 5
Rate	Ignored
Count	HighChan - LowChan + 1 max
Range	Ignored
DataValue	0 to 4095 For the **/16 series**, the following argument values are also valid 0 to 65535 (See notes on using signed integers in section 2.2)

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()

Digital I/O Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH
DataValue	0 to 15 for PORTC 0 to 255 for PORTA or PORTB
BitNum	0 to 23 using FIRSTPORTA

❑ Hardware Considerations

Pacing Analog Output

Software only

Initializing 'Zero Power-Up' State

When using the **CIO-DDA06** "zero power-up state" hardware option, use cbAOutScan() to set the desired output value and enable the DAC outputs.

4.6 PCI- and CPCI- DDA Series

❑ Analog Output

Analog Output Functions Supported

cbAOut(),cbAOutScan()

Analog Output Argument Ranges

Options	SIMULTANEOUS		
HighChan	**DDA02** 0 to 1	**DDA04** 0 to 3	**DDA08** 0 to 7
Rate	Ignored		
Count	HighChan - LowChan + 1 max		
Range	BIP10VOLTS BIP5VOLTS BIP2PT5VOLTS	UNI10VOLTS UNI5VOLTS UNI2PT5VOLTS	
DataValue	0 to 4095 For the /**16 series**, the following argument values are also valid 0 to 65535 (See notes on using signed integers in section 2.2)		

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()

Digital I/O Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH, SECONDPORTA, SECONDPORTB, SECONDPORTCL, SECONDPORTCH
DataValue	0 to 15 for PORTC 0 to 255 for PORTA or PORTB
BitNum	0 to 47 using FIRSTPORTA

❑ Hardware Considerations

Pacing Analog Output

Software only

5 Digital Input / Output

5.1 Introduction

This section has details on using digital I/O boards in conjunction with the Universal Library. Boards released after the printing of this manual will be described in readme files on the Universal Library disk.

Note on Basic signed integers

When reading or writing ports that are 16 bits wide, you should be aware of the following issues using signed integers (as you are forced to do when using Basic):

On some boards (the **PDISO16** for example) the AUXPORT digital ports are set up as one, 16-bit port. When using cbDOut(), the digital values are written as a single, 16-bit word. Using signed integers, writing values above 0111 1111 1111 1111 (32767 decimal) can be confusing. The next increment, 1000 0000 0000 0000, has a decimal value of (–32768). Using signed integers, this is the value that you would use for turning on the MSB only. The value for all bits on is (–1). Keep this in mind if you are using Basic, since Basic does not supply unsigned integers (values from 0 to 65536).

Note on boards using 8255 architecture

To fully utilize the performance of this and other Digital I/O function calls, we recommend that you refer to the 82C55 data sheet. Contact OMEGA for a copy.

5.2 AC5 Series

❑ Digital I/O

Digital I/O Functions Supported

`cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()`

Digital I/O Argument Values

`PortNum`	`FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH`
	
	For **DUAL-AC5** and **QUAD-AC5**, the following argument values are also valid
	`SECONDPORTA, SECONDPORTB, SECONDPORTCL, SECONDPORTCH`
	
	For **QUAD-AC5**, the following argument values are also valid
	`THIRDPORTA, THIRDPORTB, THIRDPORTCL, THIRDPORTCH,`
	`FOURTHPORTA, FOURTHPORTB, FOURTHPORTCL, FOURTHPORTCH`

`DataValue`	0 to 15 for `PORTC` 0 to 255 for `PORTA` or `PORTB`
`BitNum`	0 to 23 using `FIRSTPORTA` For **DUAL-AC5** and **QUAD-AC5**, the following argument values are also valid 24 to 47 using `FIRSTPORTA` For **QUAD-AC5**, the following argument values are also valid 48 to 95 using `FIRSTPORTA`

5.3 DIO Series

❑ Digital I/O

Digital I/O Functions Supported

`cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()`

Digital I/O Argument Values

`PortNum`	`FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH`
	
	For **DIO48, DIO48H, DIO96**, and **DIO192**, the following argument values are also valid
	`SECONDPORTA, SECONDPORTB, SECONDPORTCL, SECONDPORTCH`
	
	For **DIO96**, and **DIO192**, the following argument values are also valid
	`THIRDPORTA, THIRDPORTB, THIRDPORTCL, THIRDPORTCH, FOURTHPORTA, FOURTHPORTB, FOURTHPORTCL, FOURTHPORTCH`
	
	For **DIO192**, the following argument values are also valid
	`FIFTHPORTA` through `EIGHTHPORTCH`

`DataValue`	0 to 15 for `PORTC` 0 to 255 for `PORTA` or `PORTB`
`BitNum`	0 to 23 using `FIRSTPORTA` For **DIO48, DIO48H, DIO96**, and **DIO192**, the following argument values are also valid 24 to 47 using `FIRSTPORTA` For **DIO96**, and **DIO192**, the following argument values are also valid 48 to 95 using `FIRSTPORTA` For **DIO192**, the following argument values are also valid 96 to 191

❑ Event Notification
CIO- and PCI- DIO24 and DIO24H Only

Event Notification Functions Supported

`cbEnableEvent(), cbDisableEvent()`

Event Notification Argument Values

EventType	ON_EXTERNAL_INTERRUPT

5.4 DIO24/CTR3 and D24/CTR3 Series

❑ Digital I/O

Digital I/O Functions Supported

`cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()`

Digital I/O Argument Values

`PortNum`	`FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH`
`DataValue`	0 to 15 for `PORTC` 0 to 255 for `PORTA` or `PORTB`
`BitNum`	0 to 23 using `FIRSTPORTA`

❑ Counter I/O

Counter Functions Supported

`cbC8254Config(), cbCIn(), cbCLoad()`

Counter Argument Values

`CounterNum`	1 to 3
`Config`	`HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE`
`LoadValue`	0 to 65535 (see notes on unsigned integers in Section 2.2.)

❑ Event Notification
CIO-DOI24/CTR3 and PCI-DIO24/CTR3

Event Notification Functions Supported

`cbEnableEvent(), cbDisableEvent()`

Event Notification Argument Values

`EventType`	`ON_EXTERNAL_INTERRUPT`

❑ Hardware Considerations

Counter Configuration

On the **PCM** board, the counter source functions are programmable using InstaCal.

5.5 PCI-DIO48/CTR15

❑ Digital I/O

Digital I/O Functions Supported

cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()

Digital I/O Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, FIRSTPORTCH, SECONDPORTA, SECONDPORTB, SECONDPORTCL, SECONDPORTCH
DataValue	0 to 15 for PORTC 0 to 255 for PORTA or PORTB
BitNum	0 to 47 using FIRSTPORTA

❑ Counter I/O

Counter Functions Supported

cbC8254Config(), cbCIn(), cbCLoad()

Counter Argument Values

CounterNum	1 to 15
Config	HIGHONLASTCOUNT, ONESHOT, RATEGENERATOR, SQUAREWAVE, SOFTWARESTROBE, HARDWARESTROBE
LoadValue	0 to 65535 (see notes on unsigned integers in Section 2.2.)

❑ Event Notification

Event Notification Functions Supported

cbEnableEvent(), cbDisableEvent()

Event Notification Argument Values

EventType	ON_EXTERNAL_INTERRUPT

5.6 PDISO8 and PDISO16 Series

❑ Digital I/O

Digital I/O Functions Supported

`cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()`

Digital I/O Argument Values

`PortNum`	`AUXPORT`	
`DataValue`	**PDISO8** 0 to 255	
	PDISO16 0 to 65535 (See note on 16-bit values using unsigned integers in section 2.2)	
`BitNum`	**PDISO8** 0 to 7	**PDISO16** 0 to 15

5.7 CIO-PDMA16 and CIO-PDMA32

❑ Digital I/O

Digital I/O Functions Supported

cbDOutScan(), cbDInScam(), cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut(), cbDConfigPort()

Digital I/O Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB, AUXPORT
DataValue	0 to 7 using AUXPORT (cbDOut() only supported), 0 to 255 using PORTA and PORTB, 0 to 65535 using WORDXFER PORTA.
BitNum	0 to 2 using AUXPORT (cbDBitOut() only supported), 0 to 15 using PORTA.
Rate	**CIO-PDMA16**: 125 Kwords **CIO-PDMA32**: 750 Kwords
Options	BACKGROUND, CONTINUOUS, EXTCLOCK, WORDXFER

❑ Hardware Considerations

Digital I/O Pacing

Hardware pacing, external or internal clock supported.

6 Digital Input

6.1 Introduction

This section provides details on using digital input boards in conjunction with the Universal Library. Boards released after the printing of this document will be described in readme files on the Universal Library disk.

6.2 CIO- and PC104- DI Series

❑ Digital I/O

Digital Input Functions Supported

cbDIn, cbDBitIn()

Digital Input Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL and FIRSTPORTCH. For **DI48, DI96**, and **DI192**, the following argument values are also valid SECONDPORTA, SECONDPORTB, SECONDPORTCL, SECONDPORTCH For **DI96**, and **DI192**, the following argument values are also valid THIRDPORTA, THIRDPORTB, THIRDPORTCL, THIRDPORTCH, FOURTHPORTA, FOURTHPORTB, FOURTHPORTCL, FOURTHPORTCH For **DI192**, the following argument values are also valid FIFTHPORTA through EIGHTHPORTCH
DataValue	0 to 255 for PORTA or PORTB, 0 to 15 for PORTCL or PORTCH
BitNum	0 to 23 for FIRSTPORTA For **DI48, DI96**, and **DI192**, the following argument values are also valid 24 to 47 using FIRSTPORTA For **DI96**, and **DI192**, the following argument values are also valid 48 to 95 using FIRSTPORTA For **DI192**, the following argument values are also valid 96 to 191

6.3 CIO-DISO48

❑ Digital I/O

Digital Input Functions Supported

cbDIn, cbDBitIn()

Digital Input Argument Values

PortNum	FIRSTPORTA, SECONDPORTA, THIRDPORTA, FOURTHPORTA, FIFTHPORTA, SIXTHPORTA
DataValue	0 to 255
BitNum	0 to 47 using FIRSTPORTA

7 Digital Output

7.1 Introduction

This chapter provides details on using digital output boards in conjunction with the Universal Library. Boards released after the printing of this document will be described in readme files on the Universal Library disk.

7.2 CIO-RELAY Series

❑ Digital I/O

Digital Output Functions Supported

`cbDOut, cbDBitOut()`

Digital Output Argument Values

`PortNum`	`FIRSTPORTA`
	
	For **CIO-RELAY16 & 16/M**, the following argument values are also valid
	`FIRSTPORTB`
	
	For **CIO-RELAY24**, the following argument values are also valid
	`SECONDPORTA`
	
	For **CIO-RELAY32**, the following argument values are also valid
	`SECONDPORTB`

`DataValue`	0 to 255
`BitNum`	0 to 7 using `FIRSTPORTA` For **CIO-RELAY16 & 16/M**, the following argument values are also valid 0 to 15 using `FIRSTPORTA` For **CIO-RELAY24**, the following argument values are also valid 0 to 23 using `FIRSTPORTA` For **CIO-RELAY32**, the following argument values are also valid 0 to 31 using `FIRSTPORTA`

7.3 CIO- and PC104- DO Series

❑ Digital I/O

Digital Output Functions Supported

cbDOut, cbDBitOut()

Digital Output Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL and FIRSTPORTCH. For **DO48H, DO48DD, DO96H** and **DO192H**, the following argument values are also valid SECONDPORTA, SECONDPORTB, SECONDPORTCL, SECONDPORTCH For **DO96H** and **DO192H**, the following argument values are also valid THIRDPORTA, THIRDPORTB, THIRDPORTCL, THIRDPORTCH, FOURTHPORTA, FOURTHPORTB, FOURTHPORTCL, FOURTHPORTCH For **DO192H**, the following argument values are also valid FIFTHPORTA through EIGHTHPORTCH
DataValue	0 to 255 for PORTA or PORTB, 0 to 15 for PORTCL or PORTCH
BitNum	0 to 23 for FIRSTPORTA For **DO48H, DO48DD, DO96H** and **DO192H**, the following argument values are also valid 24 to 47 using FIRSTPORTA For **DO96H** and **DO192H**, the following argument values are also valid 48 to 95 using FIRSTPORTA For **DO192H**, the following argument values are also valid 96 to 191

8 Counter Boards

8.1 Introduction

This chapter provides details on using counter/timer boards in conjunction with the Universal Library. Boards released after the printing of this user's guide will be described in readme files on the Universal Library disk.

Note on Basic signed integers

Since most counters use 16-bit values, using signed integers to read and write counters can be confusing. Please see the note in section 2.2 for information of this subject.

Universal Library provides functions for initialization and configuration of counter chips. It is important to note what this means:

1. Universal Library can configure a counter for any of the counter operations.

2. Counter configuration does not include USE of counters such as event counting and pulse width. Counter use is accomplished by programs which use the counter functions.

3. Some counter USE functions may be available. A function `cbCFreqIn()` is provided (Revision 1 on). Others may be added to later revisions.

For you to use a counter for any but the simplest counting function, you must read, understand and employ the information contained in the chip manufacturer's data sheet. Technical support of the Universal Library does not include providing, interpreting or explaining the counter data sheet.

To fully understand and maximize the performance of the counter/timer boards and their related function calls, we strongly recommend that you read and understand the related data sheet(s).

82C54	82C54.pdf located in the Documents subdirectory of the installation.
AM9513	9513A.pdf located in the Documents subdirectory of the installation.
Z8536	The only manufacturers product that employs the Z8536 is the **CIO-INT32**. The data book for the chip is included with the **CIO-INT32**.
LS7266	LS7266R1.pdf located in the Documents subdirectory of the installation

8.2 CTR Series

❑ Counter I/O

Counter Functions Supported

`cbC9513Config(), cbC9513Init(), cbCStoreOnInt(), cbCFreqIn(), cbCIn(), cbCLoad()`

Counter Argument Values

CounterNum	1 to 5
	For **CTR10 & CTR10-HD**, the following argument values are also valid 6 through 10
	For **CTR20-HD**, the following argument values are also valid 11 through 20

❑ Digital I/O

Digital I/O Functions Supported

`cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()`

Digital I/O Argument Values

`PortNum`	`AUXPORT`
`DataValue`	0 to 255
	For **CTR10**, the following argument values are also valid 0 to 65535 (See note on 16-bit values using unsigned integers in section 2.2)
`BitNum`	0 to 7
	For **CTR10**, the following argument values are also valid 0 to 15

❑ Event Notification PCI-CTR05 Only

Event Notification Functions Supported

`cbEnableEvent(), cbDisableEvent()`

Event Notification Argument Values

`EventType`	`ON_EXTERNAL_INTERRUPT`

❑ Hardware Considerations

Event Notification

Note that `ON_EXTERNAL_INTERRUPT` cannot be used in conjunction with `cbCStoreOnInt()`.

8.3 INT32 Series

❑ Counter I/O

Counter Functions Supported

cbC8536Config(),cbC8536Init(), cbCIn(), **cbCLoad()**

Counter Argument Values

CounterNum	1 to 6
ChipNum	1 or 2
RegName	LOADREG1 through LOADREG6
LoadValue	Values up to 65,535 (2^{16}–1) can be used. (See note on Basic signed integers at the beginning of the COUNTER BOARDS section.)

❑ Digital I/O

Digital I/O Functions Supported

cbDIn(), cbDOut(), cbDBitIn(), cbDBitOut()

Digital I/O Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB, FIRSTPORTCL, SECONDPORTA, SECONDPORTB and SECONDPORTCL.
DataValue	0 to 255 using PORTA or PORTB 0 to 15 using PORTCL
BitNum	0 to 39 using FIRSTPORTA

❑ Hardware Considerations

Argument Value vs. Configuration

These boards have two 8536 chips, which have both counter and digital I/O and interrupt vectoring capabilities. The numbers stated for Digital I/O apply when both chips are configured for the maximum number of digital devices. The numbers stated for Counter I/O apply when both chips are configured for the maximum number of counter devices.

8.4 PPIO-CTR06

❑ Counter I/O

Counter Functions Supported

`cbC8254Config(), cbCIn(), cbCLoad()`

Counter Argument Values

CounterNum	1 to 6

❑ Digital I/O

Digital I/O Functions Supported

`cbDIn(), cbDOut(), cbDBitIn(), cbDBitOut()`

Digital I/O Argument Values

`PortNum`	`AUXPORT`
`DataValue`	0 to 15 or 0 to 255, depending on jumper setting
`BitNum`	0 to 3 or 0 to 7, depending on jumper setting

8.5 QUAD Series

❑ Counter I/O

Counter Functions Supported

`cbC7266Config(), cbCIn(), cbCIn32(), cbCLoad(), cbCLoad32(), cbCStatus()`

Counter Argument Values

`CounterNum`	1 to 2 For **CIO-QUAD04**, **PCI-QUAD04**, the following argument values are also valid 3 to 4

`RegName`	`COUNT1, COUNT2, PRESET1, PRESET2, PRESCALER1 , PRESCALER2`
	
	For **CIO-QUAD04**, **PCI-QUAD04**, the following argument values are also valid
	`COUNT3, COUNT4, PRESET3, PRESET4, PRESCALER3, PRESCALER4`

`LoadValue`	When using `cbCLoad32()` to load the `COUNT#` or `PRESET#` registers, values up to 16.78 million (2^{24}–1) can be loaded. Values using `cbCLoad()` are limited to 65,535 (2^{16}–1). (See note on Basic signed integers at the beginning of the COUNTER BOARDS section.) When loading the `PRESCALER#` register, values can be from 0 to 255. (Digital Filter Clock frequency = 10 MHz/LoadValue+1.)

❑ Hardware Considerations

Loading and Reading 24-bit values

Note: The **QUAD** series boards feature a 24-bit counter. You can use the `cbCIn()` and `cbCLoad()` for counts less than 16 bits (65535), or you can use `cbCIn32()` and `cbCLoad32()` for any number supported by the LS7266 counter (24 bits = 16777216).

Cascading Counters

The **PCI- QUAD04** can be set up for cascading counters. By setting the appropriate registers, the user can have 4- 24 bit counters, 2 – 48 bit counters, 1-24 and 1 72 bit counters, or 1 96 bit counter. The OUTPUT pins of a counter are directed to the next counter by setting the `FLG1` to

CARRY/BORROW and the FLG2 to UP/DOWN. Bits 3 and 4 of the IOR Register control are set to 1,0 to accomplish this.

Using the Universal Library, the user can set these bits by using the following function

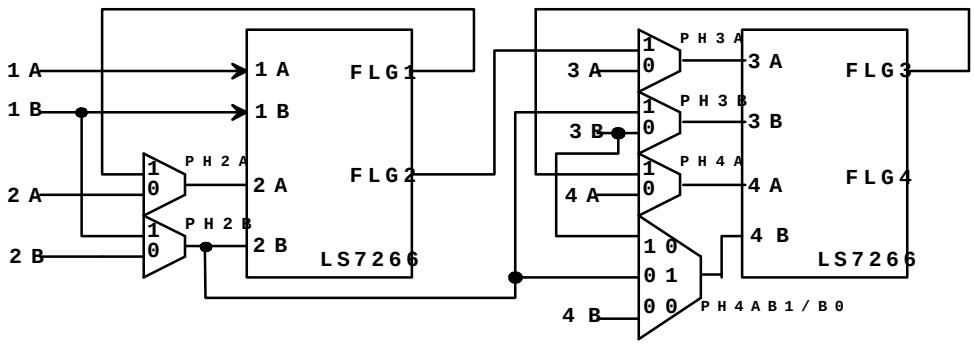
```
cbC7266Config(BoardNum, CounterNum, Quadrature,
CountingMode, DataEncoding, IndexMode, InvertIndex,
FlagPins, GateEnable)
```

The constant CARRYBORROW_UPDOWN (value of 3) is used for the parameter **FlagPins**.

The IOR register can not be read, however, the user could read the values of the Base2+9 register. The value for Base 2 can be determined by looking at the resources used by the board. The 8-bit region is Base2.

The base +9 register contains values for PhxA and PhxB, for x = 1 to 4 to identify counters. The diagram below indicates the routing of the FLG pins depending on the value of PhxA and PhxB. The actual values of the Base2+9 register are shown below:

Counter Cascading Functional Diagram



Register BADR2 + 9 D0-D6

	PH2A	PH2B	PH3A	PH3B	PH4A	PH4B1/PH4B0	Value
Case1							
(4) 24-bit counters (1/2/3/4)	0	0	0	0	0	0,0	00
Case2							
(2) 48-bit counters (1-2/3-4)	1	1	0	0	1	1,0	53
Case3							
(1) 24-bit/1 – 72-bit (1/2-3-4)	0	0	1	1	1	0,1	3C
Case4							
(1) 96-bit counter (1-2-3-4)	1	1	1	1	1	0,1	3F

Defaults to 0x00 (no inter-counter connections).

Examples

Case 1) (4) – 24 bit counters

```
cbC7266Config(0,1,0,0,2,0,0,1,0)
cbC7266Config(0,2,0,0,2,0,0,1,0)
cbC7266Config(0,3,0,0,2,0,0,1,0)
cbC7266Config(0,4,0,0,2,0,0,1,0)
```

Case 2) (2) 48-bit counters (1-2/3-4)

```
cbC7266Config(0,1,0,0,2,0,0,3,0)
cbC7266Config(0,2,0,0,2,0,0,1,0)
cbC7266Config(0,3,0,0,2,0,0,3,0)
cbC7266Config(0,4,0,0,2,0,0,1,0)
```

Case 3) (1) 24-bit & (1) - 72bit (1/2-3-4) counter

```
cbC7266Config(0,1,0,0,2,0,0,1,0)
cbC7266Config(0,2,0,0,2,0,0,3,0)
cbC7266Config(0,3,0,0,2,0,0,3,0)
cbC7266Config(0,4,0,0,2,0,0,1,0)
```

Case 4) (1) 96-bit counter (1-2-3-4)

```
cbC7266Config(0,1,0,0,2,0,0,3,0)
cbC7266Config(0,2,0,0,2,0,0,3,0)
cbC7266Config(0,3,0,0,2,0,0,3,0)
cbC7266Config(0,4,0,0,2,0,0,1,0)
```

The actual value of the Base+9 register will not be set until the `cbCLoad()` command is called.

NOTE: Setting Counter4 to CARRYBORROW-UPDOWN is NOT VALID

9 MetraBus

9.1 Introduction

This section provides details on using all **METRABUS** boards in conjunction with the Universal Library. Boards released after the printing of this user's guide will be described in readme files on the Universal Library disk.

It is important to note that to use any **METRABUS** I/O board, you must have a **METRABUS** interface board such as the **ISA-MDB64, PCI-MDB64** or a **CPCI-MDB64**. These boards, with the addition of a **METRABUS** cable, interface between the PC bus (**ISA-, PC104-, PCI-, or CPCI-**) and the **METRABUS** I/O Boards. Only then will the Universal Library functions operate correctly.

A MetraBus system is made up of at least one controller board that communicates with real world interface boards via a data bus (ribbon cable). Thus, there will always be two or more boards in the system.

9.2 MDB64 Series

This series makes up the controller portion of the MetraBus system. The Universal Library contains no function to communicate specifically with this board. The functions in the library are directed to the devices on the bus instead. For example, if this board was installed in InstaCal as board 0, and an **MII-32** was installed as board 1, the communication would be directed to board 1. If you wanted to read digital bits from this configuration, the function would be `cbDBitIn()`. The value of the BoardNum argument would be 1.

9.3 MIO and MII Digital I/O

Note: All METRABUS boards require a cable and an Interface board (such as an **ISA-, PC104-**, or **PCI- MDB64**) to interface to the host computer system.

❑ Digital In
MII-32 Only

Digital Input Functions Supported

`cbDIn, cbDBitIn()`

Digital Input Argument Values

`PortNum`	`FIRSTPORTA`, `FIRSTPORTB`, `SECONDPORTA`, `SECONDPORTB`
`DataValue`	0 to 255 for `PORTA` or `PORTB`
`BitNum`	0 to 31 for `FIRSTPORTA`

❑ Digital Out
MIO-32 Only

Digital Output Functions Supported

`cbDOut, cbDBitOut(), cbDbitIn(), cbDIn()`

Digital Output Argument Values

`PortNum`	`FIRSTPORTA, FIRSTPORTB, SECONDPORTA, SECONDPORTB`
`DataValue`	0 to 255 for `PORTA` or `PORTB`
`BitNum`	0 to 31 for `FIRSTPORTA`

Although the **MIO-32** is a digital output only board, the state of the outputs can be read back using the `cbDIn()` and `cbDBitIn()` functions.

9.4 MEM Series Relay

All **METRABUS** boards require a cable and an Interface board (such as an **ISA-, PC104-**, or **PCI- MDB64**) to interface to the host computer system.

❑ Digital I/O

Digital I/O Functions Supported

`cbDOut(), cbDIn(), cbDBitIn(), cbDBitOut()`

Digital I/O Argument Values

`PortNum`	`FIRSTPORTA`
	For **MEM-32**, the following argument values are also valid
	`FIRSTPORTB, SECONDPORTA, SECONDPORTB`

`DataValue`	0 to 255 for `PORTA` or `PORTB`
`BitNum`	0 to 7 for `FIRSTPORTA` For **MEM-32**, the following argument values are also valid 0 to 31 for `FIRSTPORTA`

Note: Although this is a digital output only board, the state of the outputs can be read back using the `cbDIn()` and `cbDBitIn()` functions.

9.5 MSSR-24 SSR

All METRABUS boards require a cable and an Interface board (such as an **ISA-, PC104-,** or **PCI- MDB64**) to interface to the host computer system.

❑ Digital I/O

Digital I/O Functions Supported

`cbDIn, cbDBitIn(), cbDOut, cbDBitOut`

Digital I/O Argument Values

`PortNum`	`FIRSTPORTA, FIRSTPORTB, SECONDPORTA`
`DataValue`	0 to 255
`BitNum`	0 to 24 using `FIRSTPORTA`

10 Expansion Boards

10.1 Introduction

This chapter provides details on using expansion boards in conjunction with the Universal Library. Boards released after the printing of this user's guide will be described in readme files on the Universal Library disk.

EXP boards are used only in combination with an A/D board. Channel numbers for accessing the EXPansion boards begin at 16.

To calculate the channel number for access to **EXP** channels, use the following formula:

```
Chan = (ADChan+1) x 16+EXPChan
```

where EXPChan is a number ranging from 0 to 15 that describes the channel number on a particular bank of the expansion board. An **EXP32** has two banks so the channel numbers for one **EXP32** connected to an A/D board would range from 16 to 47.

If all A/D channels are not used for **EXP** output, direct input to the A/D board is still available at these channels (using channel numbers below 16).

When expansion boards are used for temperature input, the gain of the A/D board must be set to a specific range. When using A/D boards with programmable gain, the Universal Library takes care of this detail. However, when using boards with switch-selectable gains, they should be set by the user to a range that determined by the temperature sensor in use. Generally, thermocouple measurements require the A/D board to be set to 5V bipolar, if available (or 10V bipolar if not). RTD sensors require a setting of 10V unipolar, if available. These checks are made when you are configuring the system for temperature measurement using InstaCal.

10.2 CIO-EXP Series

❑ Temperature Input

Temperature Input Functions Supported

cbTIn(), cbTInScan()

Temperature Input Argument Values

Options	NOFILTER
Scale	CELSIUS, FAHRENHEIT, KELVIN, VOLTS
HighChan	From 16 up to 255, depending on the number of boards connected and the application.

❑ Analog Input

Analog Input Functions Supported

cbAIn()

Analog Input Argument Values

HighChan	From 16 up to 255, depending on the number of boards connected and the application.
Range	This argument applies to the A/D board to which the **EXP** board is connected. It is ignored if the A/D board does not have programmable gain (see ANALOG INPUT BOARDS section).

10.3 MEGA-FIFO

❑ Memory I/O (Used only in combination with a board which has DT-Connect.)

Memory Functions Supported

`cbMemSetDTMode(), cbMemReset(), cbMemRead(), cbMemWrite(), cbMemReadPretrig()`

Some of these functions are integrated into the `cbAInScan()` function. For example, if the **MEGA-FIFO** is used with an A/D board and the `EXTMEMORY` option is selected then the functions `cbMemSetDTMode()` and `cbMemWrite()` would not have to be called. Continuous mode cannot be used with the `EXTMEMORY` option.

11 Other Functions

11.1 Introduction

This chapter provides details on using miscellaneous hardware such as communications boards in conjunction with the Universal Library. Boards released after the printing of this user's guide will be described in readme files on the Universal Library disk.

11.2 COM422 Series

No library functions are supported for these boards, but InstaCal can be used to configure the serial protocol in conjunction with the Set422.exe utility. All other serial communications are handled by DOS or Windows standard serial communications handlers.

11.3 COM485 Series

Supports `cbRS485()` for controlling the transmit and receive enable register. All other serial communications are handled by DOS or Windows standard serial communications handlers.

11.4 Demo-Board

The **DEMO-BOARD** is a software simulation of a data acquisition board. It simulates analog input and digital I/O.

❑ Analog Input

Analog Input Functions Supported

cbAIn(), cbAInScan(), cbATrig(), cbFileAInScan()

Analog Input Argument Values

Options	BACKGROUND, CONTINUOUS, SINGLEIO, DMAIO
HighChan	7 max
Rate	300000

❑ Digital I/O

Digital I/O Functions Supported

cbDIn(), cbDBitIn(), cbDInScan(), cbDOut(), cbDBitOut(), cbDOutScan(), cbDConfigPort()

Digital I/O Argument Values

PortNum	FIRSTPORTA, FIRSTPORTB, AUXPORT
DataValue	0 to 255 using PORTA, PORTB, or AUXPORT
BitNum	0 to 15 FIRSTPORTA

❑ Using the Demo Board

Analog Input

The **DEMO-BOARD** simulates eight channels of 16-bit analog input. InstaCal is used to configure the waveforms on the analog input channels. Choices are: sine wave, square wave, saw-tooth, ramp, damped sine wave, and input from a data file.

The data file is a streamer file, so any data that has been previously saved in a streamer file can be used as a source of demo data by the board. Data files are named DEMO0.DAT through DEMO7.DAT. When a data file is assigned to a channel the library will try to extract data for that channel from the streamer file. If data for that channel does not exist, then the first (and possibly only) channel data in the streamer is extracted and used.

For example, if DEMO2.DAT is assigned as the data source for the demo board's channel 5, the library will try to extract data from the file corresponding to channel 5. DEMO2.DAT can have scan data corresponding to channels 0 through 15, and if so then channel 5 is extracted. Alternatively, DEMO2.DAT may have data for a single channel, say 3. If so, then that data is used for the demo board's channel 5.

Digital I/O

The **DEMO-BOARD** can simulate one 8-bit AUXPORT non-configurable digital input port. Each bit of the AUXPORT generates a square wave with a different period.

The **DEMO-BOARD** can simulate one 8-bit AUXPORT non-configurable digital output port.

The **DEMO-BOARD** can simulate two 8-bit configurable digital I/O ports - FIRSTPORTA, FIRSTPORTB, which can be used for high speed scanning. FIRSTPORTA functions like AUXPORT in that it generates square waves. Each bit of FIRSTPORTB generates a pulse with a different frequency.

12 Appendix

BoardType Codes

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PCI_PDISO16	13
CPCI_GPIB	14
PCI_DAS1200	15
PCI_DAS1602_12	16
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CIO_PDMA32	18
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PCI_DIO24H_CTR3	21
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PCI_CTR05	24
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PCI_DAS1002	27
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PCI_DDA02_12	32
PCI_DDA04_12	33
PCI_DDA08_12	34
PCI_DDA02_16	35
PCI_DDA04_16	36
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CIO_DAC08_16	1796
CIO_DAC16_16	1797
CIO_DDA06_JR16	1798
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CIO_CTR10	2050
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CIO_DAS801	24578
CIO_DAS802	24579
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