HP SICL User's Guide for Windows

Edition 5

4. Programming with HP SICL

5. Using HP SICL with HP-IB

HP Standard Instrument Control Library

User's Guide for Windows

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This is the fifth edition of the *HP Standard Insrtument Control Library User's Guide for Windows*. Note: on previous editions the Reference section was actually a separate manual.

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Introduction

Introduction

Welcome to the *HP Standard Instrument Control Library (SICL) User's Guide for Windows*. This guide explains how to use SICL to develop I/O applications on Microsoft® Windows 95®, and Windows NT®. A getting started chapter is provided to help you write and run your first SICL program. Then this guide explains how to build and program SICL applications. Later chapters are interface-specific, describing how to use SICL with the HP-IB, GPIO, VXI, RS-232, and LAN interfaces.

See the *HP I/O Libraries Installation and Configuration Guide for Windows* for detailed information on SICL installation and configuration.

This first chapter provides an overview of SICL. In addition, this guide contains the following chapters:

- **Chapter 2 - Getting Started with HP SICL** steps you through building and running a simple example program in C/C++ and in Visual BASIC. This is a good place to start if you are a first-time SICL user.
- **Chapter 3 - Building an HP SICL Application** explains how to build a SICL application in a Windows environment.
- **Chapter 4 - Programming with HP SICL** provides some detailed example programs and considerations to remember when programming in a Windows environment. You can find information on communications sessions, addressing, error handling, locking, and more.
- **Chapter 5 - Using HP SICL with HP-IB** describes how to communicate over the HP-IB interface. Example programs are also provided.
- **Chapter 6 - Using HP SICL with GPIO** describes how to communicate over the GPIO interface. Example programs are also provided.
- **Chapter 7 - Using HP SICL with VXI** describes how to communicate over the VXIbus. Example programs are also provided.
- **Chapter 8 - Using HP SICL with RS-232** describes how to communicate over the RS-232 interface. Example programs are also provided.

- **Chapter 9 - Using HP SICL with LAN** describes how to communicate over a Local Area Network (LAN). Example programs are also provided.
- **Chapter 10 - Troubleshooting Your HP SICL Program** describes some of the most common SICL programming problems and provides troubleshooting procedures to help you solve the problems.
- **Chapter 11 - More HP SICL Example Programs** contains additional example programs to help you develop your SICL applications.
- **Chapter 12 - HP SICL Reference** provides the function syntax and description of each SICL function.

This guide also contains the following appendices:

- **Appendix A - HP SICL System Information** provides information on SICL software files and system interaction.
- **Appendix B - Porting from the HP 82335 Command Library** provides tips for moving from the HP-IB Command Library products to SICL.
- **Appendix C - Porting to Visual BASIC 4.0** explains how to move SICL applications from earlier versions of Visual BASIC (such as version 3.0) to Visual BASIC version 4.0.
- **Appendix D - HP SICL Error Codes** provides a list of error codes andf error strings along with a brief description.
- **Appendix E - HP SICL Function Summary** summarizes the supported features for each SICL function.
- **Appendix F - RS-232 Cables** lists and shows the wiring diagram for many HP RS-232 cabels.

This guide also contains a **Glossary** of terms and their definitions, as well as an **Index**.

HP SICL Overview

SICL is a modular instrument communications library that works with a variety of computer architectures, I/O interfaces, and operating systems. Applications written in C/C++ or Visual BASIC using this library can be ported at the source code level from one system to another without, or with very few, changes.

SICL uses standard, commonly used functions to communicate over a wide variety of interfaces. For example, a program written to communicate with a particular instrument on a given interface can also communicate with an equivalent instrument on a different type of interface. This is possible because the commands are independent of the specific communications interface. SICL also provides commands to take advantage of the unique features of each type of interface, thus giving you, the programmer, complete control over I/O communications.

Support

There is a 32-bit version of SICL on both Windows 95 and Windows NT, and a 16-bit version of SICL on Windows 95. Note that you can use one or both versions of SICL (32-bit and/or 16-bit) on your 32-bit computer when running Windows 95. The following two tables summarize the support for the 32-bit and 16-bit versions of SICL.

Support for 32-bit SICL on Windows 95 and Windows NT

Interfaces	Programming Languages
HP-IB, GPIO, VXI[1], RS-232, LAN	C, C++, Visual BASIC[2]

Support for 16-bit SICL on Windows 95

Interfaces	Programming Languages
HP-IB, GPIO, VXI[a], RS-232	C, C++, Visual BASIC[b]

a. SICL for the VXI interface on Windows 95 is supported with the HP VXI Pentium® Controller, VXI Embedded PC Controller, and VXLink products. SICL for the VXI interface on Windows NT (version 4.0 or later) is supported with the HP VXI Pentium Controller product only.

b. This edition of this manual supports and shows how to program SICL applications in Visual BASIC version 4.0 or later only.

Note If you have existing SICL applications written in an earlier Visual BASIC version than version 4.0 (for example, version 3.0), you can easily port your SICL applications to Visual BASIC version 4.0. See Appendix C, "Porting to Visual BASIC 4.0," in this manual.

Users

SICL is intended for instrument I/O and C/C++ or Visual BASIC programmers who are familiar with Windows 95 or Windows NT. If you will be performing the SICL installation and configuration on Windows NT, you must also have system administration privileges on your Windows NT system.

Other Documentation

The following documentation is also helpful when using SICL:

- *HP I/O Libraries Installation and Configuration Guide for Windows* explains how to install and configure the HP SICL and HP VISA (Virtual Instrument Software Architecture) libraries on Windows.
- *HP SICL Quick Reference Guide for C Programmers* helps you find SICL function syntax information quickly if you are programming in C/C++.
- *HP SICL Quick Reference Guide for Visual BASIC Programmers* helps you find SICL function syntax information quickly if you are programming in Visual BASIC.
- *HP SICL Online Help* is provided in the form of Windows Help.
- *HP SICL Example Programs* are provided in the `C\SAMPLES` (for C/C++) subdirectory and in the `VB\SAMPLES` subdirectory (for Visual BASIC) under the base directory where SICL is installed (for example, under the `C:\SICL95` or `C:\SICLNT` base directory if the default installation directory was used). These examples are designed to help you develop your SICL applications more easily.

The following VXIbus Consortium specifications may also be helpful when using SICL over LAN:

- *TCP/IP Instrument Protocol Specification* - VXI-11, Rev. 1.0
- *TCP/IP-VXIbus Interface Specification* - VXI-11.1, Rev. 1.0
- *TCP/IP-IEEE 488.1 Interface Specification* - VXI-11.2, Rev. 1.0
- *TCP/IP-IEEE 488.2 Instrument Interface Specification* - VXI-11.3, Rev. 1.0

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Getting Started with HP SICL

Getting Started with HP SICL

This chapter will help you to get started programming with SICL. This chapter steps through a simple example to let you verify your configuration and introduce you to some of SICL's basic features.

This chapter is divided into two sections: the first is for C programmers, and the second is for Visual BASIC programmers. Please go to the appropriate section depending on whether you will use SICL with the C/C++ programming language, or SICL with the Visual BASIC programming language.

You may also want to look through Chapter 12, "HP SICL Language Reference," to familiarize yourself with SICL's functionality. Note that this reference information is also available as online help. To get the reference information online, simply double-click on the `Help` icon in the `HP I/O Libraries` program group for Windows 95 or Windows NT, or in the `HP SICL` program group for Windows 3.1.

Getting Started Using C

In this section, you will first review a simple example program called `IDN` that queries an HP-IB instrument for its identification string. This example either uses the QuickWin or EasyWin feature of Microsoft and Borland C compilers for WIN16 programs (that is, for 16-bit SICL programs on Windows 95 or Windows 3.1 environment), or it builds a console application for WIN32 programs (that is, for 32-bit SICL programs on Windows 95 or Windows NT). Once you have reviewed the program, you will then learn how to compile and run the example program.

Reviewing an HP SICL Program

All files used to develop SICL applications in C or C++ are located in the `C` subdirectory of the base SICL directory (for example, `C:\SICL95\C` or `C:\SICLNT\C` if you installed SICL in the default location). Sample C/C++ programs are located in the `C\SAMPLES` subdirectory of the base SICL directory (for example, `C:\SICL95\C\SAMPLES` or `C:\SICLNT\C\SAMPLES`). Each sample program subdirectory contains makefiles or project files that you can use to build each sample C program. Note that you must first compile the sample C/C++ programs before you can execute them.

The `IDN` example files are located in the `C\SAMPLES\IDN` subdirectory under the SICL base directory. This subdirectory contains the source program, `IDN.C`.

The source file `IDN.C` is listed on the following pages. An explanation of the various function calls in the example is provided directly after the program listing for your review.

```
////////////////////////////////////////////////////////////////////
//
// The following simple demonstration program uses the Standard
// Instrument Control Library to query an HP-IB instrument for
// an identification string and then prints the result.
//
// Edit the DEVICE_ADDRESS line below to specify the address of the
// device you want to talk to.  For example:
//
//     hpib7,0    - refers to an HP-IB device at bus address 0
//                  connected to an interface named “hpib7” by the
//                  I/O Config utility.
//
//     hpib7,9,0  - refers to an HP-IB device at bus address 9,
//                  secondary address 0, connected to an interface
//                  named “hpib7” by the I/O Config utility.
//
// Note that this program is meant to be built either as a WIN16
// QuickWin or EasyWin program on 16 bit Windows 95, or as a WIN32
// console application on 32 bit Windows 95 or Windows NT.  Also
// note that WIN16 programs must be compiled with the Large memory
// model.
//
////////////////////////////////////////////////////////////////////
#include <stdio.h>    // for printf()
#include “sicl.h”     // Standard Instrument Control Library routines

#define DEVICE_ADDRESS “hpib7,0” // Modify this line to match your setup

void main(void)
{
  INST id;                  // device session id
  char buf[256] = { 0 };    // read buffer for idn string

  #if defined(__BORLANDC__) && !defined(__WIN32__)
    _InitEasyWin();// required for Borland EasyWin programs.
  #endif
  // Install a default SICL error handler that logs an error message
  // and exits. On Windows 95 or Windows 3.1 view messages with the
  // SICL Message Viewer,and on Windows NT use the Event Viewer.
  ionerror(I_ERROR_EXIT);
```

```
    // Open a device session using the DEVICE_ADDRESS
    id = iopen(DEVICE_ADDRESS);

    // Set the I/O timeout value for this session to 1 second
    itimeout(id, 1000);

    // Write the *RST string (and send an EOI indicator) to put the
    // instrument in a known state.
    iprintf(id, "*RST\n");

    // Write the *IDN? string and send an EOI indicator, then read
    // the response into buf.
    // For WIN16 programs, this will only work with the Large memory model
    // since ipromptf expects to receive far pointers to the format
    // strings.

    ipromptf(id, "*IDN?\n", "%t", buf);
    printf("%s\n", buf);

    iclose(id);

    // For WIN16 programs, call _siclcleanup before exiting to release
    // resources allocated by SICL for this application.  This call is a
    // no-op for WIN32 programs.
    _siclcleanup();
}
```

The SICL example C program includes the following:

sicl.h The `sicl.h` file is included at the beginning of the file to provide the function prototypes and constants defined by SICL.

INST Notice the declaration of `INST id` at the beginning of `main`. The type `INST` is defined by SICL and is used to represent a unique identifier that will describe the specific device or interface that you are communicating with. The `id` is set by the return value of the SICL `iopen` call, and will be set to 0 if `iopen` fails for any reason.

ionerror The first SICL call, `ionerror`, installs a default error handling routine that is automatically called if any of the subsequent SICL calls result in an error. `I_ERROR_EXIT` specifies a built-in error handler that will print out a message about the error and then exit the program. If desired, a custom error handling routine could be specified instead. On Windows 95 and Windows 3.1, the error messages may be viewed by executing the `Message Viewer` utility in the `HP I/O Libraries` program group. On Windows NT, these messages may be viewed with the Windows NT `Event Viewer` utility in the `Administrative Tools` group.

iopen Then an `iopen` call is made. The parameter string `"hpib7,0"` passed to `iopen` specifies the HP-IB interface, followed by the bus address of the instrument. The interface name, `"hpib7"`, is the name given to the interface during execution of the `I/O Config` utility. The bus (primary) address of the instrument follows, in this case `"0"`, and is typically set with switches on the instrument, or from the front panel of the instrument.

You may wish to modify the program to set the interface name and instrument address to those applicable for your setup. Refer to the section titled "Opening a Communications Session" in Chapter 4, "Programming with HP SICL," for a complete description of how to use SICL's addressing capabilities.

itimeout Next, `itimeout` is called to set the length of time (in milliseconds) that SICL will wait for an instrument to respond. The specified value will depend on the needs of your configuration. Different timeout values can be set for different sessions as needed.

iprintf and ipromptf

SICL provides formatted I/O functions that are patterned after those used in the C programming language. These SICL functions support the standard ANSI C format strings, plus additional formats defined specifically for instrument I/O.

The SICL `iprintf` call sends the Standard Commands for Programmable Instruments (SCPI) command "`*RST`" to the instrument that puts it in a known state. Then `ipromptf` is used to query the instrument for its identification string. The string is read back into `buf` and then printed to the screen. (Separate `iprintf` and `iscanf` calls could have been used to perform this operation.) The `%t` read format string specifies that an ASCII string is to be read back, with end indicator termination. SICL automatically handles all addressing and HP-IB bus management necessary to perform these reads and writes to instrument.

iclose and _siclcleanup

The `iclose` function closes the device session to this instrument (`id` is no longer valid after this point). Finally, for WIN16 programs, a call to `_siclcleanup` tells Windows 95 or Windows 3.1 that the WIN16 program is done and that the SICL I/O resources are no longer needed. WIN32 programs on
Windows 95 or Windows NT do not require the `_siclcleanup` call.

Refer to Chapter 12, "HP SICL Language Reference" or the SICL online `Help` for more detailed information on these SICL function calls and to learn about all of the functions provided by SICL.

Compiling an HP SICL Program

In this subsection, you will learn how to compile the `IDN` example.

The `C\SAMPLES\IDN` subdirectory (under the SICL base directory) contains a number of files to help you build the example with specific compilers. You will have a subset of the following files depending on which Windows environment you are using.

`IDN.C`	Example program source file.
`IDN.DEF`	Module definition file for the IDN example program.
`MSCIDN.MAK`	Windows 3.1 makefile for Microsoft C and Microsoft SDK compilers.
`VCIDN.MAK`	Windows 3.1 project file for Microsoft Visual C++.
`VCIDN32.MAK`	Windows 95 or Windows NT (32-bit) project file for Microsoft Visual C++.
`VCIDN16.MAK`	Windows 95 (16-bit) project file for Microsoft Visual C++.
`QCIDN.MAK`	Windows 3.1 project file for Microsoft QuickC for Windows.
`BCIDN.IDE`	Windows 3.1 project file for Borland C Integrated Development Environment.
`BCIDN32.IDE`	Windows 95 or Windows NT (32-bit) project file for Borland C Integrated Development Environment.
`BCIDN16.IDE`	Windows 95 (16-bit) project file for Borland C Integrated Development Environment.

Follow these steps to compile the `IDN` example program:

1. Connect an instrument to your HP 82341 or 82335 HP-IB interface that is compatible with IEEE 488.2 directives.

2. Change directories to the location of the example (for example, `CD \SICL95\C\SAMPLES\IDN` or `CD \SICLNT\C\SAMPLES\IDN`).

3. The program assumes that the HP-IB interface name is `hpib7` (set using `I/O Config`) and that the instrument is at bus address `0`. If necessary, use an editor to modify the interface name and instrument address on the `DEVICE_ADDRESS` definition line in the `IDN.C` source file.

4. Compile the program as follows:

   -- If you use the command line interface for your compiler (for Windows 3.1 only), compile the program using the makefile from the command prompt as follows:
      - For Borland compilers, type : `MAKE BCIDN.MAK`.
      - For Microsoft compilers, type: `NMAKE MSCIDN.MAK`.

      Now go on to the next subsection, “Running an HP SICL Program.”

   -- If you use the Windows interface for your compiler, select and load the appropriate project or make file. Then compile the program as follows:
      - For Borland compilers, use `Project | Open Project`. Then select `Project | Build All`.
      - For Microsoft compilers, use `Project | Open`. Then set the include file path by selecting `Options | Directories`. In the Include File Path box, add a semicolon followed by the full path to the `C` subdirectory (for example, `C:\SICL95\C` or `C:\SICLNT\C` if you installed SICL in the default location). Then select `Project | Re-build All`.

Running an HP SICL Program

To run the `IDN` example program, do the following. Note that if you are using Windows 95 or Windows NT, you should execute the program from a console command prompt.

- If you use the command line interface (Windows 3.1 only):

  Select `FILE | RUN` from the Windows Program Manager menu. (For example, type `C:\SICL\C\SAMPLES\IDN\IDN` in the input box. Then click on `OK`.)

- If you use the Windows interface:
  -- For Borland, select `Run | Run`.
  -- For Microsoft, select `Project | Execute` or `Run | Go`.

If the program runs correctly, the following is an example of the output if connected to an HP 54601A oscilloscope:

```
HEWLETT-PACKARD,54601A,0,1.7
```

If the program does not run, refer to the message logger for a list of run-time errors, and see Chapter 10, "Troubleshooting Your HP SICL Program," for assistance in correcting the problem.

Where to Go Next

Now that you understand some basics of programming with SICL, continue on to Chapter 3, "Building an HP SICL Application," and Chapter 4, "Programming with HP SICL." Chapter 4 provides detailed example programs and some considerations for programming in the Windows environment. It also contains information on communications sessions, addressing, error handling, and so forth.

Additionally, you should look at the chapter(s) that describe how to use SICL with your particular interface(s):

- Chapter 5 - "Using HP SICL with HP-IB"
- Chapter 6 - "Using HP SICL with GPIO"
- Chapter 7 - "Using HP SICL with VXI"
- Chapter 8 - "Using HP SICL with RS-232"
- Chapter 9 - "Using HP SICL with LAN"

You might also want to familiarize yourself with all the SICL functions, which are defined in Chapter 12, "HP SICL Language Reference" and in the reference information that is provided in the SICL online `Help`.

If you have any problems, see Chapter 10 in this guide, "Troubleshooting Your HP SICL Program."

Loading and Running an HP SICL Program

In this subsection, you will learn how to load and run the `IOCMD` Visual BASIC example program.

The `VB\SAMPLES\IOCMD` subdirectory (under the SICL base directory) contains the following files:

`IOCMD.FRM`	Visual BASIC source for the `IOCMD` example program.
`IOCMD.MAK`	Visual BASIC project file for the `IOCMD` example program.

Follow these steps to load and run the `IOCMD` sample program:

1. Connect an instrument to your interface that is compatible with Standard Commands for Programmable Instruments (SCPI) directives.

2. Run Visual BASIC.

3. Open the project file `IOCMD.MAK` by selecting `File | Open Project` from the Visual BASIC menu.

4. Run the program by pressing **F5**, or by pressing the `Run` button on the Visual BASIC Toolbar.

5. Type in the address of the instrument in the Text box labeled `Interface Address`. Note that the default address that appears in this Text box is `"hpib7,7"`. This refers to an HP-IB instrument at bus address `7` connected to the interface named `hpib7`. You should type in the interface name you assigned to your interface (with the `I/O Config` utility) and the bus address of your instrument (if applicable). Make sure to separate the interface name and bus address with a comma, and do not include space characters.

6. Type the command you want to send in the Text box labeled `Command:`. Note that the default command in this Text box is `*IDN?`. This command requests an identification string for the instrument.

7. Press the `Output Command` button to send the command to the instrument at the specified address.

Note that after performing the previous steps, you can create a standalone executable (`.EXE`) version of this program by selecting `File | Make EXE File` from the Visual BASIC menu.

Where to Go Next

Now that you understand the basics of programming with SICL, continue on to Chapter 3, "Building an HP SICL Application," and Chapter 4, "Programming with HP SICL." Chapter 4 provides detailed example programs and some considerations for programming in the Windows environment. It also contains information on communications sessions, addressing, error handling, and so forth.

Additionally, you should look at the chapter(s) that describe how to use SICL with your particular interface(s):

- Chapter 5 - "Using HP SICL with HP-IB"
- Chapter 6 - "Using HP SICL with GPIO"
- Chapter 7 - "Using HP SICL with VXI"
- Chapter 8 - "Using HP SICL with RS-232"
- Chapter 9 - "Using HP SICL with LAN"

You might also want to familiarize yourself with all the SICL functions, which are defined in Chapter 12, "HP SICL Language Reference" and in the reference information that is provided in the SICL online `Help`.

If you have any problems, see Chapter 10 in this guide, "Troubleshooting Your HP SICL Program."

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Building an HP SICL Application

Building an HP SICL Application

This chapter explains how to build a SICL application in a Windows environment. This chapter contains the following sections:

- Including the HP SICL Declaration File
- Memory Models for 16-bit Windows Applications
- Libraries for C Applications and DLLs
- Compiling and Linking C Applications
- Loading and Running Visual BASIC Applications
- Thread Support for 32-bit Windows Applications
- Avoiding Nested I/O in 16-bit Windows Applications
- Application Cleanup

Including the HP SICL Declaration File

For C and C++ programs, you must include the `sicl.h` header file at the beginning of every file that contains SICL function calls. This header file contains the SICL function prototypes and the definitions for all SICL constants and error codes.

```
#include "sicl.h"
```

For Visual BASIC version 3.0 or earlier programs, you must add the `SICL.BAS` file to each project that calls SICL. For Visual BASIC Version 4.0 or later programs, you must add the `SICL4.BAS` file to each project that calls SICL.

Memory Models for 16-bit Windows Applications

We strongly recommend that you use the Large memory model when designing WIN16 applications that call SICL functions. This is because SICL requires all pointer parameters to be “far” pointers. Most SICL function prototypes in the `sicl.h` header file explicitly declare all pointer parameters to be far. However, there is no way to declare pointer types for functions that take a variable number of arguments (such as SICL’s formatted I/O functions), and your compiler will not be able to properly check or cast types for these functions.

Libraries for C Applications and DLLs

32-bit Windows

All WIN32 applications and DLLs that use SICL must link to the `SICL32.LIB` import library. (Borland compilers use `BCSICL32.DLL`.)

The SICL libraries are located in the `C` directory under the SICL base directory (for example, `C:\SICL95\C` or `C:\SICLNT\C` if you installed SICL in the default location). You may wish to add this directory to the library file path used by your language tools.

Use the DLL version of the C run-time libraries, because the run-time libraries contain global variables that must be shared between your application and the SICL DLL.

If you use the static version of the C run-time libraries, these global variables will not be shared, and unpredictable results could occur. For example, if you use `isscanf` with the `%F` format, an application error will occur. The following sections describe how to use the DLL versions of the run-time libraries.

16-bit Windows

All WIN16 applications that use SICL must link to the `SICL16.LIB` import library and to one additional import library that is compiler-dependent. Selecting the proper library depends on the compiler you are using and whether you are calling SICL functions from another dynamic link library (DLL), or from an application program.

`MSAPP16.LIB`	Link to this library if you are developing an application with a Microsoft compiler.
`BCAPP16.LIB`	Link to this library if you are developing an application with a Borland compiler.
`MSDLL16.LIB`	Link to this library if you are developing a DLL with a Microsoft compiler.
`BCDLL16.LIB`	Link to this library if you are developing a DLL with a Borland compiler.

All SICL libraries are located in the `C` directory under the SICL base directory (for example, `C:\SICL95\C` if you installed SICL in the default location).

Compiling and Linking C Applications

32-bit Windows

The following is a summary of important compiler-specific considerations for several C/C++ compiler products when developing WIN32 applications.

Note If you are using another version of the Microsoft or Borland compilers than those listed in this subsection, note that the menu structure and selections may be different than indicated here. However, the equivalent functionality exists in your particular version.

For Microsoft Visual C++ compilers:

- Select `Project | Settings` or `Build | Settings` from the menu (depending on the version of your compiler). Click on the `C/C++` button. Then select `Code Generation` from the `Category` list box and select `Multithreaded Using DLL` from the `Use Run-Time Library` list box. Click on `OK` to close the dialog box.

- Select `Project | Settings` or `Build | Settings` from the menu. Click on the `Link` button. Then add `sicl32.lib` to the `Object/Library Modules` list box. Click on `OK` to close the dialog box.

- You may wish to add the SICL `C` directory (for example, `C:\SICL95\C` or `C:\SICLNT\C`) to the include file and library file search paths. They are set by selecting `Tools | Options` from the menu and clicking on the `Directories` button. Then do the following:

  -- To set the include file path, select `Include Files` from the `Show Directories for:` list box. Then click on the `Add` button and type in either `C:\SICL95\C` if on Windows 95, or `C:\SICLNT\C` if on Windows NT. Click on `OK`.

  -- To set the library file path, select `Library Files` from the `Show Directories for:` list box. Then click on the `Add` button and type in either `C:\SICL95\C` or `C:\SICLNT\C`. Click on `OK`.

For Borland C++ version 4.0 compilers:

- Link your programs with `BCSICL32.LIB`, *not* `SICL32.LIB`. `BCSICL32.LIB` is located in the `C` subdirectory under the SICL base directory (for example, `C:\SICL95\C` or `C:\SICLNT\C` if SICL is installed in the default location).

- Edit the `BCC32.CFG` and `TLINK32.CFG` files, which are located in the `BIN` subdirectory of the Borland C installation directory.

  -- Add the following line to `BCC32.CFG` so the compiler can find the `sicl.h` file:

  `-IC:\`*`SICL_base_dir`*`\C`

where *SICL_base_dir* is the SICL base directory on your system.

  -- Add the following line to both files so the compiler and linker can find `BCSICL32.LIB`:

  `-LC:\`*`SICL_base_dir`*`\C`

where *SICL_base_dir* is the SICL base directory on your system.

- As an example, to create `MYPROG.EXE` from `MYPROG.C`, you would type:

```
BCC32 MYPROG.C BCSICL32.LIB
```

16-bit Windows

The following is a summary of important compiler-specific considerations for several C/C++ compiler products when developing WIN16 applications.

For Microsoft compilers on Windows 3.1 only, such as Microsoft C 7.0 or SDK compilers:

- Make sure the Large Memory Model is selected using `/AL`.
- Be sure to compile with an option that adds prolog code for exported functions (`/GA` or `/GSW` for applications, `/GD` for DLLs). This causes the application's data segment to be loaded correctly at the beginning of an exported function. It is also required for SICL error and interrupt handlers to work correctly.
- You may wish to add the SICL C directory (for example `C:\SICL\C`) to the include file and library file search paths. These are typically set suing the `LIB` and `INCLUDE` environment variables in the `AUTOEXEC.BAT` file in the root directory. Otherwise, the library and include files and paths should be explicitly specified in the makefile.

For the Microsoft Visual C++ version 1.52 compiler:

- To set the memory model, do the following:

1. Select `Options | Project`.
2. Click on the `Compiler` button, then select `Memory Model` from the `Category` list box.
3. Click on the `Model` list arrow to display the model options, and select `Large`.
4. Click on `OK` to close the `Compiler` dialog box.

- You may wish to add the SICL `C` directory (for example, `C:\SICL95\C`) to the include file and library file search paths. They are set under the `Options | Directories` menu selection. Otherwise, the library and include files and paths should be explicitly specified in the project file.

For Borland C 4.0 compilers:

- Make sure the Large memory model is selected:

  1. Select `Options | Project`.
  2. Double-click on `16-bit Compiler` in the `Topics` list box, then click on `Memory Model`.
  3. Click on the radio button next to `Large` in the `Mixed Model Override` box.
  4. Click on `OK` to close the dialog box.

  You can do this from the command line environment by specifying the `/ml` option to the compiler.

- The Borland C linker defaults to being case-insensitive when resolving references. To link to the SICL libraries, you will need to tell the linker to be case-sensitive.

  To do this from Borland's Integrated Environment:

  1. Select `Options | Project`.
  2. Double-click on `Linker` in the `Topics` list box, then click on `General`.
  3. Click on the checkbox next to `Case Sensitive Exports and Imports`.
  4. Click on `OK` to close the dialog box.

  You can do this from the command line environment by specifying the `/C` option to TLINK.

Loading and Running Visual BASIC Applications

To load and run an existing Visual BASIC application, first run Visual BASIC. Then open the project file for the program you want to run by selecting `File | Open Project` from the Visual BASIC menu. Visual BASIC project files have a `.MAK` file extension. Once you have opened the application's project file, you can run the application by pressing either **F5** or the `Run` button on the Visual BASIC Toolbar.

Note that you can create a standalone executable (`.EXE`) version of this program by selecting `File | Make EXE File` from the Visual BASIC menu. Once this is done, your application can be run stand-alone just like any other `.EXE` file without having to run Visual BASIC.

Thread Support for 32-bit Windows Applications

SICL can be used in multi-threaded designs, and SICL calls can be made from multiple threads, in WIN32 applications. However, there are a few important points to remember:

- SICL error handlers (installed with `ionerror`) are *per process*, not per thread, but are called in the context of the thread that caused the error to occur. Calling `ionerror` from one thread will overwrite any error handler presently installed by another thread.
- The `igeterrno` is per thread, and returns the last SICL error that occurred in the current thread.
- You may wish to make use of the SICL session locking functions (`ilock` and `iunlock`) to help coordinate common instrument accesses from more than one thread.

Also see the “LAN Client and Threads” section in Chapter 9, “Using HP SICL with LAN,” for thread information specific to the use of SICL with LAN.

Avoiding Nested I/O in 16-bit Windows Applications

In WIN16 applications, the `I_ERR_NESTED_IO` error is generated by SICL whenever an attempt is made to call a SICL function before a previous call to another SICL function is complete. This error can occur in event-driven WIN16 programs where SICL functions are called in response to events such as menu selections or button clicks.

To avoid this problem, you should disable menu items, buttons, or other controls that cause SICL calls to be made before previous SICL function calls are complete. Note that all of the sample programs that make SICL calls in response to events do this. In particular, the oscilloscope example in Chapter 11 shows one design method to prevent this WIN16 problem.

Application Cleanup

16-bit Windows and C

Note WIN32 SICL applications on Windows 95 or Windows NT do *not* require the `_siclcleanup` call.

SICL has a special function, `_siclcleanup()`, to ensure that Windows performs the necessary clean-up required when a WIN16 SICL program written in C completes execution. Each WIN16 SICL application written in C should call `_siclcleanup()` before exiting or posting a `WM_QUIT` message in order to release resources allocated for the application by the SICL library. Without this call, you may experience difficulty in executing your application, especially from within debuggers.

Note that the `I_ERROR_EXIT` handler calls `_siclcleanup()` automatically before it exits.

16-bit Windows and Visual BASIC

SICL has a special function, `siclcleanup`, to ensure that Windows performs the necessary cleanup required when a 16-bit SICL program written in Visual BASIC completes execution. Each 16-bit SICL application written in Visual BASIC should call `siclcleanup` before exiting.

The best place to call `siclcleanup` is in the `Form_Unload` routine of the Start Up form in a Visual BASIC program. This is where `siclcleanup` is called in all of the SICL example programs that are written in Visual BASIC throughout this manual.

4

Programming with HP SICL

Programming with HP SICL

This chapter first describes what you need to know to build a SICL application. Then some of the basic features of SICL, such as formatted I/O, error handling, and locking are described.

Detailed example programs are also provided to help you develop your SICL applications more easily. Copies of the example programs are located in the `C\SAMPLES\MISC` subdirectory (for C/C++) and in the `VB\SAMPLES\MISC` subdirectory (for Visual BASIC) under the SICL base directory (for example, under the `C:\SICL95` or `C:\SICLNT` base directory, if SICL was installed in the default location).

This chapter contains the following sections:

- Opening a Communications Session
- Sending I/O Commands
- Handling Asynchronous Events in C Applications
- Logging HP SICL Error Messages
- Using Error Handlers
- Using Locks

For specific details on the SICL functions, see Chapter 12, "HP SICL Language Reference" or the SICL online `Help`.

Opening a Communications Session

A communications session is a channel of communication with a particular device, interface, or commander:

- A **device session** is used to communicate with a device on an interface. A device is a unit that receives commands from a controller. Typically a device is an instrument but could be a computer, a plotter, or a printer.
- An **interface session** is used to communicate with a specified interface. Interface sessions allow you to use interface-specific functions (for example, `igpibsendcmd`).
- A **commander session** is used to communicate with the interface's commander. Typically a commander session is used when a computer is acting like a device.

There are two parts to opening a communications session with a specific device, interface, or commander. First, you must declare a variable for the SICL session identifier. C and C++ programs should declare the session variable to be of type `INST`. Visual BASIC programs should declare the session variable to be of type `Integer`. Once the variable is declared, you can open the communication channel by using the SICL `iopen` function, as shown in the following examples.

C example:

```
INST id;
id = iopen (addr);
```

Visual BASIC example:

```
Dim id As Integer
id = iopen (addr)
```

Where *id* is the session identifier used to communicate to a device, interface, or commander. The *addr* parameter specifies a device or interface address, or the term `cmdr` for a commander session. See the sections that follow for details on creating the different types of communications sessions.

Your program may have several sessions open at the same time by creating multiple session identifiers with the `iopen` function. Use the SICL `iclose` function to close a channel of communication.

Device Sessions

A device session allows you direct access to a device without worrying about the type of interface to which it is connected. On GPIB, for example, you do not have to address a device to listen before sending data to it. This insulation makes applications more robust and portable across interfaces, and is recommended for most applications.

Device sessions are the recommended way of communicating using SICL. They provide the highest level programming method, best overall performance, and best portability.

Addressing Device Sessions

To create a device session, specify the interface logical unit or symbolic name and a particular device logical address in the *addr* parameter of the `iopen` function. The interface logical unit and symbolic name are set by running the `I/O Config` utility from the `HP I/O Libraries` program group for Windows 95 or Windows NT, or from the `HP SICL` program group for Windows 3.1. See Chapter 2, “Installing and Configuring the HP I/O Libraries,” in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on the `I/O Config` utility.

The logical unit is an integer corresponding to the interface. The device address generally consists of an integer that corresponds to the device’s bus address. It may also include a secondary address which is an integer.

Note Secondary addressing is not supported on RS-232 interfaces.

The following are valid device addresses:

`7,23`	Device at address 23 connected to an interface card at logical unit 7.
`7,23,1`	Device at address 23, secondary address 1, connected to an interface card at logical unit 7.
`hpib,23`	HP-IB device at address 23.
`hpib2,23,1`	HP-IB device at address 23, secondary address 1, connected to a second HP-IB interface card.
`com1,488`	RS-232 device

The following are examples of opening a device session with the HP-IB device at address 23.

C example:

```
INST dmm;
dmm = iopen (“hpib,23”);
```

Visual BASIC example:

```
Dim dmm As Integer
dmm = iopen (“hpib,23”)
```

More on addressing specific devices can be found in the interface-specific chapter (for example, “Using HP SICL with HP-IB”) later in this manual.

Interface Sessions

An interface session allows direct, low-level control of the specified interface. There is a full set of interface-specific SICL functions for programming features that are specific to a particular interface type (GPIB, Serial, and so forth). This gives you full control of the activities on a given interface, but does make for less portable code.

Addressing Interface Sessions

To create an interface session, specify the particular interface logical unit or symbolic name in the *addr* parameter of the `iopen` function. The interface logical unit and symbolic name are set by running the `I/O Config` utility from the `HP I/O Libraries` program group for Windows 95 or Windows NT, or from the `HP SICL` program group for Windows 3.1. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on the `I/O Config` utility.

The logical unit is an integer that corresponds to a specific interface. The symbolic name is a string which uniquely describes the interface.

The following are valid interface addresses:

`7`	Interface card at logical unit 7
`hpib`	HP-IB interface card.
`hpib2`	Second HP-IB interface card.
`com1`	RS-232 interface card.

The following examples open an interface session with an RS-232 interface.

C example:

```
INST com1;
com1 = iopen (“com1”);
```

Visual BASIC example:

```
Dim com1 As Integer
com1 = iopen (“com1”)
```

More on addressing specific interfaces can be found in the interface-specific chapter (for example, "Using HP SICL with HP-IB") later in this manual.

Commander Sessions

The commander session allows you to talk to the interface controller. Typically, the controller is the computer used to communicate with devices on the interface. When your computer is not active controller, commander sessions can be used to talk to the computer which is active controller. In this mode, your computer is acting like a device on the interface.

Addressing Commander Sessions

To create a commander session, specify a valid interface address followed by a comma and then the string `cmdr` in the `iopen` function. The following are valid commander addresses:

`hpib,cmdr`	HP-IB commander session.
`7,cmdr`	Commander session on interface at logical unit 7.

The following are examples of creating a commander session with the HP-IB interface.

C example:

```
INST cmdr;
cmdr = iopen(“hpib,cmdr”);
```

Visual BASIC example:

```
Dim cmdr As Integer
cmdr = iopen (“hpib,cmdr”)
```

The above function calls will open a session of communication with the commander on the HP-IB interface.

Sending I/O Commands

Once you have established a communications session with a device, interface, or commander, you can start communicating with that session using SICL's I/O routines. SICL provides both formatted I/O and non-formatted I/O routines:

- **Formatted I/O** converts mixed types of data under the control of a format string. The data is buffered, thus optimizing interface traffic. The formatted I/O routines are geared towards instruments, and reduce the amount of I/O code.

- **Non-formatted I/O** sends or receives raw data to a device, interface, or commander. With non-formatted I/O, no format or conversion of the data is performed. Thus, if formatted data is required, it must be done by the user.

See the following sections for a complete description and examples of using formatted I/O (for C applications and for Visual BASIC applications) and non-formatted I/O.

Formatted I/O in C Applications

The SICL formatted I/O mechanism is similar to the C `stdio` mechanism. SICL formatted I/O, however, is designed specifically for instrument communication and is optimized for IEEE 488.2 compatible instruments. The three main functions for formatted I/O in C applications are as follows:

- The `iprintf` function formats according to the format string and sends data to a device:
  `iprintf(`*id, format [,arg1][,arg2][,...]*`);`
- The `iscanf` function receives and converts data according to the format string:

  `iscanf(`*id, format [,arg1][,arg2][,...]*`);`
- The `ipromptf` function formats and sends data to a device and then immediately receives and converts the response data:

  `ipromptf(`*id, writefmt, readfmt [,arg1][,arg2][,...]*`);`

The formatted I/O functions are buffered. There are two non-buffered and non-formatted I/O functions called `iread` and `iwrite`. See "Non-Formatted I/O" later in this chapter. These are raw I/O functions and do not intermix with the formatted I/O functions.

If raw I/O must be mixed, use the `ifread`/`ifwrite` functions. They have the same parameters as `iread` and `iwrite`, but read or write raw output data to the formatted I/O buffers. Refer to the "Formatted I/O Buffers" subsection later in this section for more details.

Formatted I/O Conversion

The formatted I/O functions convert data under the control of the format string. The format string specifies how the argument is converted before it is input or output. The typical format string syntax is as follows:

%[format flags][field width][. precision][, array size][argument modifier]conversion character

See `iprintf`, `ipromptf`, and `iscanf` in Chapter 12, "HP SICL Language Reference" for more information on how data is converted under the control of the format string

Format Flags. Zero or more flags may be used to modify the meaning of the conversion character. The format flags are only used when sending formatted I/O (`iprintf` and `ipromptf`). The following are supported format flags:

Format Flags for `iprintf` and `ipromptf` in C Applications

Format Flag	Description
`@1`	Converts to a 488.2 NR1 number.
`@2`	Converts to a 488.2 NR2 number.
`@3`	Converts to a 488.2 NR3 number.
`@H`	Converts to a 488.2 hexadecimal number.
`@Q`	Converts to a 488.2 octal number.
`@B`	Converts to a 488.2 binary number.
`+`	Prefixes number with sign (+ or –).
`–`	Left justifies result.
`space`	Prefixes number with blank space if positive or with – if negative.
`#`	Uses alternate form. For o conversion, it prints a leading zero. For x or X, a nonzero will have 0x or 0X as a prefix. For e, E, f, g, or G, the result will always have one digit on the right of the decimal point.
`0`	Causes left pad character to be a zero for all numeric conversion types.

The following example converts `numb` into a 488.2 floating point number and sends it to the session specified by *id*:

```
int numb = 61;
iprintf (id, "%@2d&\n", numb);
```

Sends: `61.000000`

Field Width. Field width is an optional integer that specifies how many characters are in the field. If the formatted data has fewer characters than specified in the field width, it will be padded. The padded character is dependent on various flags. You can use an asterisk (`*`) in place of the integer to indicate that the integer is taken from the next argument.

The following example pads `numb` to six characters and sends it to the session specified by *id*:

```
long numb = 61;
iprintf (id, "%6ld&\n", numb);
```

Pads to six characters: `61`

. Precision. Precision is an optional integer preceded by a period. When used with conversion characters `e, E`, and `f`, the number of digits to the right of the decimal point are specified. For the `d, i, o, u, x,` and `X` conversion characters, the minimum number of digits to appear is specified. For the `s` and `S` conversion characters, the precision specifies the maximum number of characters to be read from the argument. This field is only used when sending formatted I/O (`iprintf` and `ipromptf`). You can use an asterisk (`*`) in place of the integer to indicate that the integer is taken from the next argument.

The following example converts `numb` so that there are only two digits to the right of the decimal point and sends it to the session specified by *id*:

```
float numb = 26.9345;
iprintf (id, ".2f\n", numb);
```

Sends : `26.93`

, Array Size. The comma operator is a format modifier which allows you to read or write a comma-separated list of numbers (only valid with `%d` and `%f` conversion characters). It is a comma followed by an integer. The integer indicates the number of elements in the array. The comma operator has the format of `,`*dd* where *dd* is the number of elements to read or write.

The following example specifies a comma separated list to be sent to the session specified by *id*:

```
int list[5]={101,102,103,104,105};
iprintf (id, "%,5d\n", list);
```

Sends: `101,102,103,104,105`

Argument Modifier. The meaning of the optional argument modifier `h, l, w, z,` or `Z` is dependent on the conversion character.

Argument Modifiers in C Applications

Argument Modifier	Conversion Character	Description
`h`	`d,i`	Corresponding argument is a short integer.
`h`	`f`	Corresponding argument is a float for `iprintf` or a pointer to a float for `iscanf`.
`l`	`d,i`	Corresponding argument is a long integer.
`l`	`b,B`	Corresponding argument is a pointer to a block of long integers.
`l`	`f`	Corresponding argument is a double for `iprintf` or a pointer to a double for `iscanf`.
`w`	`b,B`	Corresponding argument is a pointer to a block of short integers.
`z`	`b,B`	Corresponding argument is a pointer to a block of floats.
`Z`	`b,B`	Corresponding argument is a pointer to a block of doubles.

Conversion Characters. The conversion characters for sending and receiving formatted I/O are different. The following tables summarize the conversion characters for each:

`iprintf` **and** `ipromptf` **Conversion Characters in C Applications**

Conversion Character	Description
`d,i`	Corresponding argument is an integer.
`f`	Corresponding argument is a float.
`b,B`	Corresponding argument is a pointer to an arbitrary block of data.
`c,C`	Corresponding argument is a character.
`t`	Controls whether the END indicator is sent with each LF character in the format string.
`s,S`	Corresponding argument is a pointer to a null terminated string.
`%`	Sends an ASCII percent (%) character.
`o,u,x,X`	Corresponding argument will be treated as an unsigned integer.
`e,E,g,G`	Corresponding argument is a double.
`n`	Corresponding argument is a pointer to an integer.
`F`	Corresponding argument is a pointer to a FILE descriptor opened for reading.

The following example sends an arbitrary block of data to the session specified by the *id* parameter. The asterisk (`*`) is used to indicate that the number is taken from the next argument:

```
int size = 1024;
char data [1024];
.
.
iprintf (id, "%*b&\n", size, data);
```

Sends 1024 characters of block data.

`iscanf` and `ipromptf` Conversion Characters in C Applications

Conversion Character	Description
`d,i,n`	Corresponding argument must be a pointer to an integer.
`e,f,g`	Corresponding argument must be a pointer to a float.
`c`	Corresponding argument is a pointer to a character.
`s,S,t`	Corresponding argument is a pointer to a string.
`o,u,x`	Corresponding argument must be a pointer to an unsigned integer.
`[`	Corresponding argument must be a character pointer.
`F`	Corresponding argument is a pointer to a FILE descriptor opened for writing.

The following example receives data from the session specified by the *id* parameter and converts the data to a string:

```
char data[180];
iscanf (id, "%s", data);
```

Formatted I/O C Example

The following C program example shows sending and receiving formatted I/O. This example opens an HP-IB communications session with a multimeter and uses a comma operator to send a comma separated list to the multimeter. The *lf* conversion characters are then used to receive a double from the multimeter.

```
/* formatio.c
   This example program makes a multimeter measurement
   with a comma separated list passed with formatted I/O
   and prints the results */
#include <sicl.h>
#include <stdio.h>
main()
{
   INST dvm;
   double res;
   double list[2] = {1,0.001};

#if defined(__BORLANDC__) && !defined(__WIN32__)
_InitEasyWin(); /*Required for Borland EasyWin programs*/
#endif

   /* Log message and terminate on error */
   ionerror (I_ERROR_EXIT);

   /* Open the multimeter session */
   dvm = iopen (“hpib7,16”);
   itimeout (dvm, 10000);

   /*Initialize dvm*/
   iprintf (dvm, “*RST\n”);

   /*Set up multimeter and send comma separated list*/
   iprintf (dvm, “CALC:DBM:REF 50\n”);
   iprintf (dvm, “MEAS:VOLT:AC? %,2lf\n”, list);

   /* Read the results */
   iscanf (dvm,”%lf”,&res);

   /* Print the results */
   printf (“Result is %f\n”,res);

   /* Close the multimeter session */
   iclose (dvm);

/* For WIN16 programs, call _siclcleanup before exiting
   to release resources allocated by SICL for this
   application. This call is a no-op for WIN32 programs.*/
   _siclcleanup();
    return 0;
}
```

Format String

The format string for `iprintf` puts a special meaning on the newline character (`\n`). The newline character in the format string flushes the output buffer to the device. All characters in the output buffer will be written to the device with an END indicator included with the last byte (the newline character). This means that you can control at what point you want the data written to the device. If no newline character is included in the format string for an `iprintf` call, then the characters converted are stored in the output buffer. It will require another call to `iprintf` or a call to `iflush` to have those characters written to the device.

This can be very useful in queuing up data to send to a device. It can also raise I/O performance by doing a few large writes instead of several smaller writes. This behavior can be changed by the `isetbuf` and `isetubuf` functions. See the following subsection on "Formatted I/O Buffers."

The format string for `iscanf` ignores most white-space characters. Two white-space characters that it does not ignore are newlines (`\n`) and carriage returns (`\r`). These characters are treated just like normal characters in the format string, which *must* match the next non-white-space character read from the device.

Formatted I/O Buffers

The SICL software maintains both a read and write buffer for formatted I/O operations. Occasionally, you may want to control the actions of these buffers.

The write buffer is maintained by the `iprintf` and the write portion of the `ipromptf` functions. It queues characters to send to the device so that they are sent in large blocks, thus increasing performance. The write buffer automatically flushes when it sends a newline character from the format string (see the `%t` conversion character to change this feature). It also flushes immediately after the write portion of the `ipromptf` function. It may occasionally be flushed at other non-deterministic times, such as when the buffer fills. When the write buffer flushes, it sends its contents to the device.

The read buffer is maintained by the `iscanf` and the read portion of the `ipromptf` functions. It queues the data received from a device until it is needed by the format string. The read buffer is automatically flushed before the write portion of an `ipromptf`. Flushing the read buffer destroys the data in the buffer and guarantees that the next call to `iscanf` or `ipromptf` reads data directly from the device rather than data that was previously queued.

Note Flushing the read buffer also includes reading all pending response data from a device. If the device is still sending data, the flush process will continue to read data from the device until it receives an `END` indicator from the device.

See the `isetbuf` function for other options for buffering data.

Related Formatted I/O Functions

The following is a set of functions that are related to formatted I/O:

`ifread`	Obtains raw data directly from the read formatted I/O buffer. This is the same buffer that `iscanf` uses.
`ifwrite`	Writes raw data directly to the write formatted I/O buffer. This is the same buffer that `iprintf` uses.
`iprintf`	Converts data via a format string and writes the arguments appropriately.
`iscanf`	Reads data from a device/interface, converts this data via a format string, and assigns the values to your arguments.
`ipromptf`	Sends, then receives, data from a device/instrument. It also converts data via format strings that are identical to `iprintf` and `iscanf`.
`iflush`	Flushes the formatted I/O read and write buffers. A flush of the read buffer means that any data in the buffer is lost. A flush of the write buffer means that any data in the buffer is written to the session's target address.
`isetbuf`	Sets the size of the formatted I/O read and the write buffers. A size of zero (0) means no buffering. Note that if no buffering is used, performance can be severely affected.
`isetubuf`	Sets the read or the write buffer to your allocated buffer. The same buffer cannot be used for both reading and writing. Also you should be careful when using buffers that are automatically allocated.

Formatted I/O in Visual BASIC Applications

SICL formatted I/O is designed specifically for instrument communication and is optimized for IEEE 488.2 compatible instruments. The two main functions for formatted I/O in Visual BASIC applications are as follows:

- The `ivprintf` function formats according to the format string and sends data to a device:

```
Function ivprintf(id As Integer, fmt As String,
                  ap As Any) As Integer
```

- The `ivscanf` function receives and converts data according to the format string:

```
Function ivscanf(id As Integer, fmt As String,
                 ap As Any) As Integer
```

Note There are certain restrictions when using `ivprintf` and `ivscanf` with Visual BASIC. For details about these restrictions, see either the "Restrictions Using `ivprintf` in Visual BASIC" section under the `iprintf` function, or the "Restrictions Using `ivscanf` in Visual BASIC" section under the `iscanf` function, in Chapter 12, "HP SICL Language Reference".

The formatted I/O functions are buffered. There are two non-buffered and non-formatted I/O functions called `iread` and `iwrite`. See "Non-Formatted I/O" later in this chapter. These are raw I/O functions and do not intermix with the formatted I/O functions.

If raw I/O must be mixed, use the `ifread`/`ifwrite` functions. They have the same parameters as `iread` and `iwrite`, but read or write raw output data to the formatted I/O buffers. Refer to the "Formatted I/O Buffers" subsection later in this section for more details.

Formatted I/O Conversion

The formatted I/O functions convert data under the control of the format string. The format string specifies how the argument is converted before it is input or output. The typical format string syntax is as follows:

```
%[format flags][field width][. precision][, array size][argument modifier]conversion character
```

See `iprintf` and `iscanf` in Chapter 12, "HP SICL Language Reference" for more information on how data is converted under the control of the format string.

Format Flags. Zero or more flags may be used to modify the meaning of the conversion character. The format flags are only used when sending formatted I/O (`ivprintf`). The following are supported format flags:

Format Flags for `ivprintf` in Visual BASIC Applications

Format Flag	Description
`@1`	Converts to a 488.2 NR1 number.
`@2`	Converts to a 488.2 NR2 number.
`@3`	Converts to a 488.2 NR3 number.
`@H`	Converts to a 488.2 hexadecimal number.
`@Q`	Converts to a 488.2 octal number.
`@B`	Converts to a 488.2 binary number.
`+`	Prefixes number with sign (+ or –).
`–`	Left justifies result.
`space`	Prefixes number with blank space if positive or with – if negative.
`#`	Uses alternate form. For o conversion, it prints a leading zero. For x or X, a nonzero will have 0x or 0X as a prefix. For e, E, f, g, or G, the result will always have one digit on the right of the decimal point.
`0`	Causes left pad character to be a zero for all numeric conversion types.

The following example converts `numb` into a 488.2 floating point number to the session specified by *id*. Note how the function return values must be assigned to variables for all Visual BASIC function calls. Also note that `+ Chr$(10)` adds the newline character to the format string to indicate that the formatted I/O write buffer should be flushed. (This is equivalent to the `\n` character sequence used for C/C++ programs.

```
Dim numb As Integer
Dim ret_val As Integer

numb = 61
ret_val = ivprintf(id, "%@2d" + Chr$(10), numb)
```

Sends: `61.000000`

Field Width. Field width is an optional integer that specifies how many characters are in the field. If the formatted data has fewer characters than specified in the field width, it will be padded. The padded character is dependent on various flags.

The following example pads `numb` to six characters and sends it to the session specified by *id*:

```
Dim numb As Integer
Dim ret_val As Integer

numb = 61
ret_val = ivprintf(id, "%6d" + Chr$(10), numb)
```

Pads to six characters: `61`

. Precision. Precision is an optional integer preceded by a period. When used with conversion characters `e, E`, and `f`, the number of digits to the right of the decimal point are specified. For the `d, i, o, u, x,` and `X` conversion characters, the minimum number of digits to appear is specified. This field is only used when sending formatted I/O (`ivprintf`).

The following example converts *numb* so that there are only two digits to the right of the decimal point and sends it to the session specified by *id*:

```
Dim numb As Double
Dim ret_val As Integer
numb = 26.9345
ret_val = ivprintf(id, "%.2lf" + Chr$(10), numb)
```

Sends : `26.93`

, Array Size. The comma operator is a format modifier which allows you to read or write a comma-separated list of numbers (only valid with `%d` and `%f` conversion characters). It is a comma followed by an integer. The integer indicates the number of elements in the array. The comma operator has the format of `,`*dd* where *dd* is the number of elements to read or write.

The following example specifies a comma separated list to be sent to the session specified by *id*:

```
Dim list(4) As Integer
Dim ret_val As Integer

list(0) = 101
list(1) = 102
list(2) = 103
list(3) = 104
list(4) = 105

ret_val = ivprintf(id, "%,5d" + Chr$(10), list(0))
```

Sends: `101,102,103,104,105`

Argument Modifier. The meaning of the optional argument modifier `h, l, w, z,` or `Z` is dependent on the conversion character.

Argument Modifiers in Visual BASIC Application

Argument Modifier	Conversion Character	Description
`h`	`d,i`	Corresponding argument is an Integer.
`h`	`f`	Corresponding argument is a Single.
`l`	`d,i`	Corresponding argument is a Long.
`l`	`d,B`	Corresponding argument is an array of Long.
`l`	`f`	Corresponding argument is a Double.
`w`	`d,B`	Corresponding argument is an array of Integer.
`z`	`d,B`	Corresponding argument is an array of Single.
`Z`	`d,B`	Corresponding argument is an array of Double.

Conversion Characters. The conversion characters for sending and receiving formatted I/O are different. The following tables summarize the conversion characters for each:

`ivprintf` **Conversion Characters in Visual BASIC Applications**

Conversion Character	Description
`d, i`	Corresponding argument is an Integer.
`b, B`	Not supported on Visual BASIC.
`c,C`	Not supported on Visual BASIC.
`t`	Not supported on Visual BASIC.
`s,S`	Not supported on Visual BASIC.
`%`	Sends an ASCII percent (%) character.
`o,u,x,X`	Corresponding argument will be treated as an Integer.
`f,e,E,g,G`	Corresponding argument is a Double.
`n`	Corresponding argument is an Integer.
`F`	Corresponding *arg* is a pointer to a FILE descriptor.

`ivscanf` **Conversion Characters in Visual BASIC Applications**

Conversion Character	Description
`d,i,n`	Corresponding argument must be an Integer.
`e,f,g`	Corresponding argument must be a Single.
`c`	Corresponding argument is a fixed length String.
`s,S,t`	Corresponding argument is a fixed length String.
`o,u,x`	Corresponding argument must be an Integer.
`[`	Corresponding argument must be a fixed length character String.
`F`	Not supported on Visual BASIC.

The following example receives data from the session specified by the *id* parameter and converts the data to a string:

```
   Dim ret_val As Integer
   Dim data As String * 180

ret_val = ivscanf(id, "%180s", data)
```

Formatted I/O Visual BASIC Example

The following Visual BASIC program example shows sending and receiving formatted I/O. This example opens an HP-IB communications session with a multimeter and uses a comma operator to send a comma separated list to the multimeter. The `lf` conversion characters are then used to receive a Double from the multimeter.

```
''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
'  formatio.bas
'  The following subroutine makes a multimeter measurement with a comma
'  separated list passed with formatted I/O and prints the results.
''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
Sub main()
   Dim dvm As Integer
   Dim res As Double
   ReDim list(2) As Double
   Dim nRetVal As Integer

   On Error GoTo ErrorHandler

   ' Initialize values in list
   list(0) = 1
   list(1) = 0.001

   ' Open the multimeter session
   dvm = iopen("hpib7,0")
   Call itimeout(dvm, 10000)

   ' Initialize dvm.
   nRetVal = ivprintf(dvm, "*RST" + Chr$(10), 0&)

   ' Set up multimeter and send comma separated list
   nRetVal = ivprintf(dvm, "CALC:DBM:REF 50" + Chr$(10))
   nRetVal = ivprintf(dvm, "MEAS:VOLT:AC? %,2lf" + Chr$(10), list())

   ' Read the results.
   nRetVal = ivscanf(dvm, "%lf", res)

   ' Display the results
   MsgBox "Result is " + Format$(res)

   ' Close the multimeter session
   Call iclose(dvm)

   ' Tell SICL to cleanup for this task
   Call siclcleanup
   End

ErrorHandler:
   ' Display the error message
   MsgBox "*** Error : " + Error$, MB_ICON_EXCLAMATION
   ' Tell SICL to cleanup for this task
   Call siclcleanup
   End
End Sub
```

Format String

In the format string for `ivprintf`, when the special characters `Chr$(10)` is used, the output buffer to the device is flushed. All characters in the output buffer will be written to the device with an END indicator included with the last byte. This means that you can control at what point you want the data written to the device. If no `Chr$(10)` is included in the format string for an `ivprintf` call, then the characters converted are stored in the output buffer. It will require another call to `ivprintf` or a call to `iflush` to have those characters written to the device.

This can be very useful in queuing up data to send to a device. It can also raise I/O performance by doing a few large writes instead of several smaller writes.

The format string for `ivscanf` ignores most white-space characters. Two white-space characters that it does not ignore are newlines (`Chr$(10)`) and carriage returns (`Chr$(13)`). These characters are treated just like normal characters in the format string, which *must* match the next non-white-space character read from the device.

Formatted I/O Buffers

The SICL software maintains both a read and write buffer for formatted I/O operations. Occasionally, you may want to control the actions of these buffers.

The write buffer is maintained by the `ivprintf` function. It queues characters to send to the device so that they are sent in large blocks, thus increasing performance. The write buffer automatically flushes when it sends a newline character from the format string. It may occasionally be flushed at other non-deterministic times, such as when the buffer fills. When the write buffer flushes, it sends its contents to the device.

The read buffer is maintained by the `ivscanf` function. It queues the data received from a device until it is needed by the format string. Flushing the read buffer destroys the data in the buffer and guarantees that the next call to `ivscanf` reads data directly from the device rather than data that was previously queued.

Note Flushing the read buffer also includes reading all pending response data from a device. If the device is still sending data, the flush process will continue to read data from the device until it receives an `END` indicator from the device.

Related Formatted I/O Functions

The following is a set of functions that are related to formatted I/O in Visual BASIC:

`ifread`	Obtains raw data directly from the read formatted I/O buffer. This is the same buffer that **`ivscanf`** uses.
`ifwrite`	Writes raw data directly to the write formatted I/O buffer. This is the same buffer that **`ivprintf`** uses.
`ivprintf`	Converts data via a format string and converts the arguments appropriately.
`ivscanf`	Reads data from a device/interface, converts this data via a format string, and assigns the value to your arguments.
`iflush`	Flushes the formatted I/O read and write buffers. A flush of the read buffer means that any data in the buffer is lost. A flush of the write buffer means that any data in the buffer is written to the session's target address.

Non-Formatted I/O

There are two non-buffered, non-formatted I/O functions called `iread` and `iwrite`. These are raw I/O functions and do not intermix with the formatted I/O functions. If raw I/O must be mixed, use the `ifread` and `ifwrite` functions. They have the same parameters as `iread` and `iwrite`, but read/write raw data from/to the formatted I/O buffers.

The non-formatted I/O functions are described as follows:

- The `iread` function reads raw data from the device or interface specified by the *id* parameter and stores the results in the location where *buf* is pointing.

C example:

```
iread(id, buf, bufsize, reason, actualcnt);
```

Visual BASIC example:

```
Call iread(id, buf, bufsize, reason, actualcnt)
```

- The `iwrite` function sends the data pointed to by *buf* to the interface or device specified by *id*:

C example:

```
iwrite(id, buf, datalen, end, actualcnt);
```

Visual BASIC example:

```
Call iwrite(id, buf, datalen, end, actualcnt)
```

Non-Formatted I/O Examples

The following program examples illustrate using non-formatted I/O to communicate with a multimeter over the HP-IB interface. The SICL non-formatted I/O functions `iwrite` and `iread` are used for the communication. A similar example was used to illustrate formatted I/O earlier in this chapter.

C example:

```
/* nonfmt.c
   This example program measures AC voltage on a
   multimeter and prints out the results*/

#include <sicl.h>
#include <stdio.h>

main()
{
   INST dvm;
   char strres[20];
   unsigned long actual;

   #if defined(__BORLANDC__) && !defined(__WIN32__)
   _InitEasyWin(); /*required for Borland EasyWin programs*/
   #endif

   /* Log message and terminate on error */
   ionerror (I_ERROR_EXIT);

   /* Open the multimeter session */
   dvm = iopen ("hpib7,16");
   itimeout (dvm, 10000);

   /*Initialize dvm*/
   iwrite (dvm, "*RST\n", 5, 1, NULL);

   /*Set up multimeter and take measurements*/
   iwrite (dvm,"CALC:DBM:REF 50\n",16,1,NULL);
   iwrite (dvm,"MEAS:VOLT:AC? 1, 0.001\n",23,1,NULL);

   /* Read measurements */
   iread (dvm, strres, 20, NULL, &actual);

   /* NULL terminate result string and print the results*/
   /* This technique assumes the last byte sent was a line-feed */
   if (actual){
      strres[actual - 1] = (char) 0;
      printf("Result is %s\n", strres);
   }
  /* Close the multimeter session */
   iclose(dvm);
```

```
   /* For WIN16 programs, call _siclcleanup before exiting
      to release resources allocated by SICL for this
      application. This call is a no-op for WIN32 programs.*/
   _siclcleanup();
return 0; }
```

Visual BASIC example:

```
''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
'  nonfmt.bas
'  The following subroutine measures AC voltage on a
'  multimeter and prints out the results.
''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
Sub Main ()
   Dim dvm As Integer
   Dim strres As String * 20
   Dim actual As Long

'  Open the multimeter session
   dvm = iopen("hpib7,16")
   Call itimeout(dvm, 10000)

'  Initialize dvm
   Call iwrite(dvm,ByVal "*RST" + Chr$(10), 5, 1, 0&)

'  Set up multimeter and take measurements
   Call iwrite(dvm,ByVal "CALC:DBM:REF 50" + Chr$(10),16,1, 0&)

   Call iwrite(dvm,ByVal "MEAS:VOLT:AC? 1, 0.001" + Chr$(10),23,1, 0&)

'  Read measurements
   Call iread(dvm,ByVal strres, 20, 0&, actual)

'  Print the results
   Print "Result is " + Left$(strres, actual)

'  Close the multimeter session
   Call iclose(dvm)

'  Tell SICL to cleanup for this task
   Call siclcleanup

   Exit Sub

End Sub
```

Handling Asynchronous Events in C Applications

Asynchronous events are events that happen outside the control of your application. These events include Service ReQuests (**SRQ**s) and **interrupt**s. An SRQ is a notification that a device requires service. Both devices and interfaces can generate SRQs and interrupts.

Note SICL allows you to install SRQ and interrupt handlers in C programs, but does not support them in Visual BASIC programs.

By default, asynchronous events are enabled. However, the library will not generate any events until the appropriate handlers are installed in your program.

Note If an application is using asynchronous events (`ionsrq`, `ionintr`), be aware that a callback thread is created by the underlying SICL implementation to service the asynchronous event. This thread will not be terminated until some other thread of the application performs an `ExitProcess` on Windows 95, or calls `iclose` on Windows NT.

Note For WIN16 programs, custom SRQ and interrupt handler (callback) functions installed using SICL's `ionsrq` and `ionintr` functions should be declared using the SICL modifier `SICLCALLBACK`, which is defined as "`_export _far _pascal`" in `sicl.h`. Failure to do this usually causes a "General Protection Fault" error at the time the handler is called in 16-bit Windows.

Example declarations:

```
void SICLCALLBACK my_int_handler(INST id, int reason, long sec) {
   /* your code here */
}

void SICLCALLBACK my_srq_handler(INST id) {
   /* your code here */
}
```

Additionally, if you are developing a 16-bit application using the QuickWin feature provided with Microsoft compilers and are installing a custom handler, you must also use the `_loadds` modifier with your handler declaration.

Example declaration for QuickWin applications:

```
void SICLCALLBACK _loadds my_srq_handler(INST id) {
   /* your code here */
}
```

SRQ Handlers

The `ionsrq` function installs an SRQ handler. The currently installed SRQ handler is called any time its corresponding device generates an SRQ. If an interface is unable to determine which device on the interface generated the SRQ, all SRQ handlers assigned to that interface will be called.

Therefore, an SRQ handler cannot assume that its corresponding device generated an SRQ. The SRQ handler should use the `ireadstb` function to determine whether its device generated an SRQ. If two or more sessions refer to the same device, the handlers for each of the sessions are called.

Interrupt Handlers

Two distinct steps are required for an interrupt handler to be called. First, the interrupt handler must be installed. Second, the interrupt event or events need to be enabled. The `ionintr` function installs an interrupt handler. The `isetintr` function enables the interrupt event or events.

An interrupt handler can be installed with no events enabled. Conversely, interrupt events can be enabled with no interrupt handler installed. Only when both an interrupt handler is installed and interrupt events are enabled will the interrupt handler be called.

Temporarily Disabling/Enabling Asynchronous Events

To temporarily prevent *all* SRQ and interrupt handlers from executing, use the `iintroff` function. This disables all asynchronous handlers for all sessions in the process.

To re-enable asynchronous SRQ and interrupt handlers previously disabled by `iintroff`, use the `iintron` function. This enables all asynchronous handlers for all sessions in the process, that had been previously enabled.

Note These functions do not affect the `isetintr` values or the handlers (`ionsrq` or `ionintr`) in any way. See `ionintr` and `ionsrq` in Chapter 12, "HP SICL Language Reference".

Default is `on`.

On operating systems that support multiple threads such as Windows 95 and Windows NT, SRQ and interrupt handlers execute on a separate thread (a thread created and managed by SICL). This means that a handler can be executing when the `iintroff` call is made. If this occurs, the handler will continue to execute until it has completed. An implication of this is that the SRQ or interrupt handler may need to synchronize its operation with the application's primary thread. This could be accomplished via WIN32 synchronization methods, or by using SICL locks, where the handler uses a separate session to perform its work.

Calls to `iintroff`/`iintron` may be nested, meaning that there must be an equal number of on's and off's. This means that calling the `iintron` function may not actually re-enable interrupts.

Occasionally, you may want to suspend a process and wait until an event occurs that causes a handler to execute. The `iwaithdlr` function causes the process to suspend until either an enabled SRQ or interrupt condition occurs and the related handler executes. Once the handler completes its operation, this function returns and processing continues.

For this function to work properly, your application *must* turn interrupts off (that is, use `iintroff`). The `iwaithdlr` function behaves as if interrupts are enabled. Interrupts are still disabled after the `iwaithdlr` function has completed.

Note Interrupts must be disabled if you are using `iwaithdlr`. Use `iintroff` to disable interrupts.

The reason for disabling interrupts is because there may be a race condition between the `isetintr` and `iwaithdlr` and, if you only expect one interrupt, it might come before the `iwaithdlr`. This may or may not be the effect you desire.

For example:

```
...
ionintr (hpib, act_isr);
isetintr (hpib, I_INTR_INTFACT, 1);
...
iintroff ();
igpibpassctl (hpib, ba);
while (!done)
   iwaithdlr (0);
iintron ();
...
```

Logging HP SICL Error Messages

Windows NT

SICL logs internal messages as Windows NT events. This includes error messages logged by the `I_ERROR_EXIT` and `I_ERROR_NOEXIT` error handlers. While developing your SICL application or tracking down problems, you may wish to view these messages. You can do so by starting the `Event Viewer` utility in the `Administrative Tools` group. Both system and application messages can be logged to the `Event Viewer` from SICL. SICL messages are identified either by `SICL LOG`, or by the driver name (for example, `hp341i32`).

Windows 95 and Windows 3.1

While developing your SICL application or tracking down problems in either Windows 95 or Windows 3.1, you may wish to use the `Message Viewer` utility. This utility provides a debug window to which SICL logs internal messages during application execution, including those logged by the `I_ERROR_EXIT` and `I_ERROR_NOEXIT` error handlers. The `Message Viewer` utility provides menu selections for saving the logged messages to a file, and to clear the message buffer.

To start the utility, double-click on the `Message Viewer` icon in the `HP I/O Libraries` program group for Windows 95, or in the `HP SICL` program group for Windows 3.1. The utility must be started before execution of the SICL application. It will receive messages while minimized, however.

Using Error Handlers

Error handling is supported in C and Visual BASIC. Refer to the following subsection that applies to your programming language.

Error Handlers in C

When a SICL function call in a C/C++ program results in an error, it typically returns a special value such as a NULL pointer or a non-zero error code. SICL provides a convenient mechanism for handling errors. SICL allows you to install an error handler for all SICL functions within a C/C++ application.

This allows your application to ignore the return value, and simply permits the error procedure to detect errors and recover. The error handler is called before the function that generated the error completes. It is important to note that error handlers are per process (*not* per session or per thread).

The function `ionerror` is used to install an error handler. It is defined as follows:

```
int ionerror (proc);
void (*proc)();
```

Where:

```
void SICLCALLBACK proc (id, error);
INST id;
int error;
```

The routine *proc* is the error handler and is called whenever a SICL error occurs. Two special reserved values of *proc* may be passed to the `ionerror` function:

`I_ERROR_EXIT`	This value installs a special error handler which will log a diagnostic message and then terminate the process.
`I_ERROR_NOEXIT`	This value installs a special error handler which will log a diagnostic message and then allow the process to continue execution.

This mechanism has substantial advantages over other I/O libraries, because error handling code is located away from the center of your application. This makes the application easier to read and understand.

Note Custom error handler (callback) functions installed using SICL's `ionerror` function in WIN16 applications should be declared using the SICL modifier `SICLCALLBACK`, which is defined as "`_export _far _pascal`" in the `sicl.h` file. Failure to do this usually causes a "General Protection Fault" error at the time the handler is called in 16-bit Windows.

Example declarations:

```
void SICLCALLBACK my_err_handler(INST id, int error) {
     /* your code here */
}
```

Additionally, if you are developing a WIN16 application using the QuickWin feature provided with Microsoft compilers and are installing a custom handler, you must also use the `_loadds` modifier with your handler declaration.

Example declaration for QuickWin applications:

```
void SICLCALLBACK _loadds my_err_handler(INST id, int error) {
   /* your code here */
}
```

Error Handlers in C Example

Typically in an application, error handling code is intermixed with the I/O code. However, with SICL error handling routines, no special error handling code is inserted between the I/O calls.

Instead, a single line at the top (calling `ionerror`) installs an error handler that gets called any time an error occurs. In this example, a standard, system-defined error handler is installed that logs a diagnostic message and exits.

```
/* errhand.c
   This example demonstrates how a SICL error handler
   can be installed. */

#include <sicl.h>
#include <stdio.h>

main ()
{
   INST dvm;
   double res;

    #if defined(__BORLANDC__) && !defined(__WIN32__)
   _InitEasyWin(); /* Required for Borland EasyWin programs */
   #endif

   ionerror (I_ERROR_EXIT);
   dvm = iopen ("hpib7,16");
   itimeout (dvm, 10000);
   iprintf (dvm, "%s\n", "MEAS:VOLT:DC?");
   iscanf (dvm, "%lf", &res);
   printf ("Result is %lf\n", res);
   iclose (dvm);

   /* For WIN16 programs, call _siclcleanup before exiting
      to release resources allocated by SICL for this
      application. This call is a no-op for WIN32
      programs.*/
   _siclcleanup();

   return 0;
}
```

The following is an example of writing and implementing your own error handler.

```
/* errhand2.c
   This program shows how you can install your own error
    handler*/
#include <sicl.h>
#include <stdio.h>
#include <stdlib.h>

void SICLCALLBACK err_handler (INST id, int error) {
   fprintf (stderr, "Error: %s\n", igeterrstr (error));
   exit (1);
}
main () {
   INST dvm;
   double res;

   #if defined(__BORLANDC__) && !defined(__WIN32__)
   _InitEasyWin(); /* Required for Borland EasyWin programs */
   #endif

   ionerror (err_handler);
   dvm = iopen ("hpib7,16");
   itimeout (dvm, 10000);
   iprintf (dvm, "%s\n", "MEAS:VOLT:DC?");
   iscanf (dvm, "%lf", &res);
   printf ("Result is %lf\n", res);
   iclose (dvm);

   /* For WIN16 programs, call _siclcleanup before exiting
      to release resources allocated by SICL for this
      application. This call is a no-op for WIN32 programs*/
   _siclcleanup();

    return 0;
 }
```

Note If an error occurs in `iopen`, the *id* that is passed to the error handler may not be valid.

Error Handlers in Visual BASIC

Typically in an application, error handling code is intermixed with the I/O code. However, by using Visual BASIC's error handling capabilities, no special error handling code needs to be inserted between the I/O calls.

Instead, a single line at the top (`On Error GoTo`) installs an error handler in the subroutine that gets called any time a SICL or Visual BASIC error occurs.

When a SICL call results in an error, the error is communicated to Visual BASIC by setting Visual BASIC's `Err` variable to the SICL error code, and `Error$` is set to a human-readable string that corresponds to `Err`. This allows SICL to be integrated with Visual BASIC's built-in error handling capabilities. SICL programs written in Visual BASIC can set up error handlers with the Visual BASIC `On Error` statement.

The SICL `ionerror` function for C programs is not used with Visual BASIC. Similarly, the `I_ERROR_EXIT` and `I_ERROR_NOEXIT` default handlers used in C programs are not defined for Visual BASIC.

When an error occurs within a Visual BASIC program, the default behavior is to display a dialog box indicating the error and then halt the program. If you want your program to intercept errors and keep executing, you will need to install an error handler with the `On Error` statement. For example:

```
On Error GoTo MyErrorHandler
```

This will cause your program to jump to code at the label `MyErrorHandler` when an error occurs. Note that the error handling code must exist within the subroutine or function where the error handler was declared.

If you don't want to call an error handler or have your application terminate when an error occurs, you can use the `On Error` statement to tell Visual BASIC to ignore errors. For example:

```
On Error Resume Next
```

This tells Visual BASIC to proceed to the statement following the statement in which an error occurs. In this case, you could call the Visual BASIC `Err` function in subsequent lines to find out which error occurred.

Visual BASIC error handlers are only active within the scope of the subroutine or function in which they are declared. Each Visual BASIC subroutine or function that wants an error handler must declare its own error handler. Note that this is different than the way SICL error handlers installed with `ionerror` work in C programs. An error handler installed with `ionerror` remains active within the scope of the whole C program.

For more information on Visual BASIC error handlers, see the section "Handling Run-Time Errors" in the *Visual BASIC Programmer's Guide.*

Error Handlers in Visual BASIC Example

In the following Visual BASIC example, the error handler displays the error message in a dialog box and then terminates the program. When an error occurs, the Visual BASIC `Err` variable is set to the error code, and the `Error$` variable is set to the error message string for the error that occurred.

```
‘  errhand.bas
Sub Main()
   Dim dvm As Integer
   Dim res As Double

   On Error GoTo ErrorHandler

   dvm = iopen(“hpib7,16”)
   Call itimeout(dvm, 10000)
   argcount = ivprintf(dvm, “MEAS:VOLT:DC?” + Chr$(10))
   argcount = ivscanf(dvm, “%lf”, res)
   MsgBox “Result is “ + Format(res)
   iclose (dvm)

    ‘ Tell SICL to cleanup for this task
   Call siclcleanup
   End

ErrorHandler:
   ‘  Display the error message
      MsgBox “*** Error : “ + Error$, MB_ICON_EXCLAMATION
   ‘  Tell SICL to cleanup for this task
   Call siclcleanup
   End
End Sub
```

Using Locks

Because SICL allows multiple sessions on the same device or interface, the action of opening does not mean you have exclusive use. In some cases this is not an issue, but should be a consideration if you are concerned with program portability.

The SICL `ilock` function is used to **lock** an interface or device. The SICL `iunlock` function is used to unlock an interface or device.

Locks are performed on a per-session (device, interface, or commander) basis. Also, locks can be nested. The device or interface only becomes unlocked when the same number of unlocks are done as the number of locks. Doing an unlock without a lock returns the error `I_ERR_NOLOCK`.

What does it mean to lock? Locking an interface (from an interface session) restricts other device and interface sessions from accessing this interface. Locking a device restricts other device sessions from accessing this device; however, other interface sessions may continue to access the interface for this device. Locking a commander (from a commander session) restricts other commander sessions from accessing this commander.

Caution

It is possible for an interface session to access a device locked from a device session. In such a case, data may be lost from the device session that was underway.

In particular, be aware that HP Visual Engineering Environment (HP VEE) applications use SICL interface sessions. Hence, I/O operations from these applications can supercede any device session that has a lock on a particular device.

Not all SICL routines are affected by locks. Some routines that simply set or return session parameters never touch the interface hardware and therefore work without locks.

For information on using locks in multi-threaded SICL applications over LAN, see the section, “Using Locks and Multiple Threads over LAN,” in Chapter 9, “Using HP SICL with LAN.”

Lock Actions

If a session tries to perform any SICL function that obeys locks on an interface or device that is currently locked by another session, the default action is to suspend the call until the lock is released or, if a timeout is set, until it times out.

This action can be changed with the `isetlockwait` function (see Chapter 12, "HP SICL Language Reference" for a full description). If the `isetlockwait` function is called with the *flag* parameter set to 0 (zero), the default action is changed. Rather than causing SICL functions to suspend, an error will be returned immediately.

To return to the default action, to suspend and wait for an unlock, call the `isetlockwait` function with the *flag* set to any non-zero value.

Locking in a Multi-User Environment

In a multi-user/multi-process environment where devices are being shared, it is a good idea to use locking to ensure exclusive use of a particular device or set of devices. (However, as explained in the previous section, "Using Locks," remember that an interface session can access a device locked from a device session.) In general, it is not friendly behavior to lock a device at the beginning of an application and unlock it at the end. This can result in deadlock or long waits by others who want to use the resource.

The recommended way to use locking is per transaction. Per transaction means that you lock before you setup the device, then unlock after all the desired data has been acquired. When sharing a device, you cannot assume the state of the device, so the beginning of each transaction should have any setup needed to configure the device or devices to be used.

Locking Examples

The following C and Visual BASIC examples show how device locking can be used to grant exclusive access to a device by an application.

C example:

```
/* locking.c
   This example shows how device locking can be
   used to gain exclusive access to a device*/

#include <sicl.h>
#include <stdio.h>

main()
{
   INST dvm;

   char strres[20];
   unsigned long actual;

   #if defined(__BORLANDC__) && !defined(__WIN32__)
   _InitEasyWin();  // required for Borland EasyWin programs
   #endif

   /* Log message and terminate on error */
   ionerror (I_ERROR_EXIT);

   /* Open the multimeter session */
   dvm = iopen ("hpib7,16");
   itimeout (dvm, 10000);

   /* Lock the multimeter device to prevent access from
        other applications*/
   ilock(dvm);

   /* Take a measurement  */
   iwrite (dvm, "MEAS:VOLT:DC?\n", 14, 1, NULL);

   /* Read the results */
   iread (dvm, strres, 20, NULL, &actual);

   /* Release the multimeter device for use by others */
   iunlock(dvm);
```

```
    /* NULL terminate result string and print the results */
    /* This technique assumes the last byte sent was a line-feed */
    if (actual) {
       strres[actual - 1] = (char) 0;
       printf("Result is %s\n", strres);
    }

    /* Close the multimeter session */
    iclose(dvm);

  // For WIN16 programs, call _siclcleanup before exiting to release
  // resources allocated by SICL for this application.  This call
  // is a no-op for WIN32 programs.
  _siclcleanup();

  return 0;
}
```

Visual BASIC example:

```
'  locking.bas
Sub Main ()
  Dim dvm As Integer
  Dim strres As String * 20
  Dim actual As Long

'  Install an error handler
  On Error GoTo ErrorHandler

'  Open the multimeter session
  dvm = iopen("hpib7,16")
  Call itimeout(dvm, 10000)

' Lock the multimeter device to prevent access from other applications
  Call ilock(dvm)

'  Take a measurement
  Call iwrite(dvm,ByVal "MEAS:VOLT:DC?" + Chr$(10), 14, 1, 0&)

'  Read the results
  Call iread(dvm,ByVal strres, 20, 0&, actual)

'  Release the multimeter device for use by others
  Call iunlock(dvm)
```

```
‘  Display the results
   MsgBox “Result is “ + Left$(strres, actual)

‘  Close the multimeter session
   Call iclose(dvm)

‘  Tell SICL to cleanup for this task
   Call siclcleanup

   End

ErrorHandler:
   ‘  Display the error message.
      MsgBox “*** Error : “ + Error$
   ‘  Tell SICL to cleanup for this task
      Call siclcleanup

   End

End Sub
```

5

Using HP SICL with HP-IB

Using HP SICL with HP-IB

The HP-IB interface (Hewlett-Packard Interface Bus) is Hewlett-Packard Company's implementation of the IEEE 488.1 Bus. Other IEEE 488 versions include GPIB (General Purpose Interface Bus) and IEEE Bus. GPIB and HP-IB are both used synonymously in the discussions and examples in this chapter.

This chapter describes in detail how to open a communications session and communicate with HP-IB devices, interfaces, or controllers. The example programs shown in this chapter are also provided in the `C\SAMPLES\MISC` (for C/C++) and `VB\SAMPLES\MISC` (for Visual BASIC) subdirectories under the SICL base directory (for example, under `C:\SICL95` or `C:\SICLNT` if the default installation directory was used).

This chapter contains the following sections:

- Creating a Communications Session with HP-IB
- Communicating with HP-IB Devices
- Communicating with HP-IB Interfaces
- Communicating with HP-IB Commanders
- Writing HP-IB Interrupt Handlers
- Summary of HP-IB Specific Functions

Note Using the HP 82335 HP-IB interface with both SICL and the HP-IB Command Library at the same time on the same interface is *not* supported. No error will be reported, but unexpected results could occur.

Creating a Communications Session with HP-IB

Once you have determined that your HP-IB system is setup and operating correctly, you may want to start programming with the SICL functions. First you must determine what type of communications session you need. The three types of communications sessions are device, interface, and commander.

Communicating with HP-IB Devices

The device session allows you direct access to a device without worrying about the type of interface to which it is connected. The specifics of the interface are hidden from the user.

Addressing HP-IB Devices

To create a device session, specify the interface logical unit or symbolic name and a particular device logical address in the *addr* parameter of the `iopen` function. The interface logical unit and symbolic name are set by running the `I/O Config` utility from the `HP I/O Libraries` program group for Windows 95 or Windows NT, or from the `HP SICL` program group for Windows 3.1. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on the `I/O Config` utility.

The following are example HP-IB addresses for device sessions:

`GPIB,7`	A device address corresponding to the device at primary address 7
`hpib,3,2`	A device address corresponding to the device at primary address 3, secondary address 2

SICL supports both primary and secondary addressing on GPIB interfaces.

Remember that the primary address must be between 0 and 30 and that the secondary address must be between 0 and 30. The primary and secondary addresses correspond to the HP-IB primary and secondary addresses.

Note If you are connecting to a VXI card cage through an HP E1405/06 Command Module or equivalent, the primary address passed to `iopen` corresponds to the address of the Command Module, and the secondary address must be specified to select a specific instrument in the card cage. Secondary addresses of 0, 1, 2, ... 30 correspond to VXI instruments at logical addresses of 0, 8, 16, ... 240, respectively. See "HP-IB Device Session Examples" later in this chapter for an example program of communicating with a VXI card cage over the HP-IB interface.

The following are examples of opening a device session with an HP-IB device at bus address 16.

C example:

```
INST dmm;
dmm = iopen ("hpib,16");
```

Visual BASIC example:

```
Dim dmm As Integer
dmm = iopen ("hpib,16")
```

HP SICL Function Support with HP-IB Device Sessions

The following describes how some SICL functions are implemented for HP-IB device sessions. The data transfer functions work only when the HP-IB interface is the Active Controller. Passing control to another HP-IB device causes this device to lose active control.

`iwrite`	Causes all devices to untalk and unlisten. It sends this controller's talk address followed by unlisten, and then the listen address of the corresponding device session. Then it sends the data over the bus.
`iread`	Causes all devices to untalk and unlisten. It sends an unlisten, then sends this controller's listen address followed by the talk address of the corresponding device session. Then it reads the data from the bus.
`ireadstb`	Performs a GPIB serial poll (SPOLL).
`itrigger`	Performs an addressed GPIB group execute trigger (GET).
`iclear`	Performs a GPIB selected device clear (SDC) on the device corresponding to this session.

HP-IB Device Session Interrupts

There are no device-specific interrupts for the HP-IB interface.

HP-IB Device Sessions and Service Requests

HP-IB device sessions support Service Requests (SRQs). On the HP-IB interface, when one device issues an SRQ, the library will inform *all* HP-IB device sessions that have SRQ handlers installed (see `ionsrq` in Chapter 12, "HP SICL Language Reference"). This is an artifact of how HP-IB handles the SRQ line. The interface cannot distinguish which device requested service; therefore, the library acts as if all devices require service. Your SRQ handler can retrieve the device's **status byte** by using the `ireadstb` function. For more information, see the section "Writing HP-IB Interrupt Handlers" later in this chapter.

HP-IB Device Session Examples

The following examples illustrate communicating with an HP-IB device session. These examples open two HP-IB communications sessions with VXI devices (through a VXI Command Module). Then a scan list is sent to a switch, and measurements are taken by the multimeter every time a switch is closed.

C example:

```
/* hpibdev.c
   This example program sends a scan list to a switch and
   while looping closes channels and takes measurements. */

#include <sicl.h>
#include <stdio.h>

main()
{
   INST dvm;
   INST sw;

double res;
int i;

#if defined(__BORLANDC__) && !defined(__WIN32__)
_InitEasyWin();/* Required for Borland EasyWin programs */
#endif

/* Log message and terminate on error */
ionerror (I_ERROR_EXIT);

/* Open the multimeter and switch sessions*/
dvm = iopen (“hpib7,9,3”);
sw = iopen (“hpib7,9,14”);
itimeout (dvm, 10000);
itimeout (sw, 10000);

/*Set up trigger*/
iprintf (sw, “TRIG:SOUR BUS\n”);
```

```
/*Set up scan list*/
iprintf (sw,"SCAN (@100:103)\n");
iprintf (sw,"INIT\n");

for (i=1;i<=4;i++)
{
   /* Take a measurement */
   iprintf (dvm,"MEAS:VOLT:DC?\n");

   /* Read the results */
   iscanf (dvm,"%lf",&res);

   /* Print the results */
   printf ("Result is %lf\n",res);

   /* Trigger to close channel */
   iprintf (sw, "TRIG\n");
}
/* Close the multimeter and switch sessions */
iclose (dvm);
iclose (sw);

/* For WIN16 programs, call _siclcleanup before exiting
   to release resources allocated by SICL for this
   application. This callis a no-op for WIN32
   programs*/
_siclcleanup();

   return 0;
}
```

Visual BASIC example:

```
'hpibdev.bas
'  This example program sends a scan list to a switch and
'  while looping closes channels and takes measurements.

Sub Main ()
   Dim dvm As Integer
   Dim sw As Integer
   Dim res As Double
   Dim i As Integer
   Dim argcount As Integer

   ' Open the multimeter and switch sessions
   dvm = iopen("hpib7,9,3")
   sw = iopen("hpib7,9,14")
   Call itimeout(dvm, 10000)
   Call itimeout(sw, 10000)

   ' Set up trigger
   argcount = ivprintf(sw, "TRIG:SOUR BUS" + Chr$(10))

   ' Set up scan list
   argcount = ivprintf(sw, "SCAN (@100:103)" + Chr$(10))

   argcount = ivprintf(sw, "INIT" + Chr$(10))

   ' Display form1 and print voltage measurements
   form1.Show

   For i = 1 To 4
      ' Take a measurement
      argcount = ivprintf(dvm, "MEAS:VOLT:DC?" + Chr$(10))

      ' Read the results
      argcount = ivscanf(dvm, "%lf", res)

      ' Print the results
      form1.Print "Result is " + Format(res)

      ' Trigger to close channel
      argcount = ivprintf(sw, "TRIG" + Chr$(10))
   Next i
```

```
' Close the voltmeter session
Call iclose(dvm)

' Close the switch session
Call iclose(sw)

' Tell SICL to cleanup for this task
Call siclcleanup

End Sub
```

Communicating with HP-IB Interfaces

Interface sessions allow you direct, low-level control of the specified interface. You must do all the bus maintenance for the interface. This also implies that you know a lot about the interface. Additionally, when using interface sessions, you need to use interface-specific functions. The use of these functions means that the program can not be used on other interfaces and, therefore, becomes less portable.

Addressing HP-IB Interfaces

To create an interface session on your HP-IB system, specify the particular interface logical unit or symbolic name in the *addr* parameter of the `iopen` function. The interface logical unit and symbolic name are set by running the `I/O Config` utility from the `HP I/O Libraries` program group for Windows 95 or Windows NT, or from the `HP SICL` program group for Windows 3.1. See Chapter 2, “Installing and Configuring the HP I/O Libaries,” in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on the `I/O Config` utility.

The following are example interface addresses:

`GPIB`	An interface symbolic name.
`hpib`	An interface symbolic name.
`gpib2`	An interface symbolic name.
`IEEE488`	An interface symbolic name.
`7`	An interface logical unit.

The following are examples that open an interface session with the HP-IB interface.

C example:

```
INST hpib;
hpib = iopen (“hpib”);
```

Visual BASIC example:

```
Dim hpib As Integer
hpib = iopen (“hpib”)
```

HP SICL Function Support with HP-IB Interface Sessions

The following describes how some SICL functions are implemented for HP-IB interface sessions.

`iwrite`	Sends the specified bytes directly to the interface without performing any bus addressing. The `iwrite` function always clears the ATN line before sending any bytes, thus ensuring that the GPIB interface sends the bytes as data, not command bytes.
`iread`	Reads the data directly from the interface without performing any bus addressing.
`itrigger`	Performs a broadcast GPIB group execute trigger (GET) without additional addressing. Use this function with `igpibsendcmd` to send a `UNL` followed by the appropriate device addresses. This will allow the `itrigger` function to be used to trigger multiple GPIB devices simultaneously. Passing the `I_TRIG_STD` value to the ixtrig function also causes a broadcast GPIB group execute trigger (GET). There are no other valid values for the `ixtrig` function.
`iclear`	Performs a GPIB interface clear (pulses IFC), which resets the interface.

HP-IB Interface Session Interrupts

There are specific interface session interrupts that can be used. See `isetintr` in Chapter 12, “HP SICL Language Reference” for information on the interface session interrupts for HP-IB. Also see the section “Writing HP-IB Interrupt Handlers” later in this chapter for more information.

HP-IB Interface Sessions and Service Requests

HP-IB interface sessions support Service Requests (SRQs). On the HP-IB interface, when one device issues an SRQ, the library will inform *all* HP-IB interface sessions that have SRQ handlers installed (see `ionsrq` in Chapter 12, "HP SICL Language Reference"). For more information, see the section "Writing HP-IB Interrupt Handlers" later in this chapter.

HP-IB Interface Session Examples

The following example programs retrieve the HP-IB interface bus status information and displays it for the user.

C example:

```
/* hpibstat.c
   The following example retrieves and displays
   HP-IB bus status information.  */

#include <stdio.h>
#include <sicl.h>

main()
{
   INST id;       /* session id        */
   int rem;       /* remote enable     */
   int srq;       /* service request   */
   int ndac;      /* not data accepted */
   int sysctlr;   /* system controller */
   int actctlr;   /* active controller */
   int talker;    /* talker            */
   int listener;  /* listener          */
   int addr;      /* bus address       */

   #if defined(__BORLANDC__) && !defined(__WIN32__)
       _InitEasyWin(); /* Required for Borland EasyWin programs */
   #endif

   /* exit process if SICL error detected */
   ionerror(I_ERROR_EXIT);

   /* open HP-IB interface session */
   id = iopen("hpib");
itimeout (id, 10000);
```

```
    /* retrieve HP-IB bus status */
    igpibbusstatus(id, I_GPIB_BUS_REM,      &rem);
    igpibbusstatus(id, I_GPIB_BUS_SRQ,      &srq);
    igpibbusstatus(id, I_GPIB_BUS_NDAC,     &ndac);
    igpibbusstatus(id, I_GPIB_BUS_SYSCTLR,  &sysctlr);
    igpibbusstatus(id, I_GPIB_BUS_ACTCTLR,  &actctlr);
    igpibbusstatus(id, I_GPIB_BUS_TALKER,   &talker);
    igpibbusstatus(id, I_GPIB_BUS_LISTENER, &listener);
    igpibbusstatus(id, I_GPIB_BUS_ADDR,     &addr);

    /* display bus status */
    printf("%-5s%-5s%-5s%-5s%-5s%-5s%-5s%-5s\n", "REM", "SRQ",
       "NDC", "SYS", "ACT", "TLK", "LTN", "ADDR");
    printf("%2d%5d%5d%5d%5d%5d%5d%6d\n", rem, srq, ndac,
       sysctlr, actctlr, talker, listener, addr);

  /* For WIN16 programs, call _siclcleanup before exiting
   to release resources allocated by SICL for this
   application. This call is no-op for WIN32 programs.*/

  _siclcleanup();

  return 0;
}
```

Visual BASIC example:

```
'hpibstat.bas
'  The following example retrieves and displays
'  HP-IB bus status information.
Sub main ()
   Dim id As Integer   ' session id
   Dim remen As Integer  ' remote enable
   Dim srq As Integer    ' service request
   Dim ndac As Integer   ' not data accepted
   Dim sysctlr As Integer' system controller
   Dim actctlr As Integer' active controller
   Dim talker As Integer ' talker
   Dim listener As Integer' listener
   Dim addr As Integer   ' bus address
   Dim header As String  ' report header
   Dim values As String  ' report output

' Open HP-IB interface session
   id = iopen("hpib7")
   Call itimeout(id, 10000)

' Retrieve HP-IB bus status
   Call igpibbusstatus(id, I_GPIB_BUS_REM, remen)
   Call igpibbusstatus(id, I_GPIB_BUS_SRQ, srq)
   Call igpibbusstatus(id, I_GPIB_BUS_NDAC, ndac)
   Call igpibbusstatus(id, I_GPIB_BUS_SYSCTLR, sysctlr)
   Call igpibbusstatus(id, I_GPIB_BUS_ACTCTLR, actctlr)
   Call igpibbusstatus(id, I_GPIB_BUS_TALKER, talker)
   Call igpibbusstatus(id, I_GPIB_BUS_LISTENER, listener)
   Call igpibbusstatus(id, I_GPIB_BUS_ADDR, addr)

' Display form1 and print results
   form1.Show
   form1.Print "REM"; Tab(7); "SRQ"; Tab(14); "NDC"; Tab(21);
   "SYS"; Tab(28); "ACT"; Tab(35); "TLK"; Tab(42); "LTN"; Tab(49);
   "ADDR"
   form1.Print remen; Tab(7); srq; Tab(14); ndac; Tab(21);
   sysctlr; Tab(28); actctlr; Tab(35); talker; Tab(42); listener;
   Tab(49); addr

   ' Tell SICL to cleanup for this task
   Call siclcleanup

End Sub
```

Communicating with HP-IB Commanders

Commander sessions are intended for use on HP-IB interfaces that are not active controller. In this mode, a computer that is not the controller is acting like a device on the HP-IB bus. In a commander session, the data transfer routines only work when the GPIB interface is not active controller.

Addressing HP-IB Commanders

To create a commander session on your HP-IB interface, specify the particular interface logical unit or symbolic name in the *addr* parameter followed by a comma and the string `cmdr` in the `iopen` function. The interface logical unit and symbolic name are set by running the `I/O Config` utility from the `HP I/O Libraries` program group for Windows 95 or Windows NT, or from the `HP SICL` program group for Windows 3.1. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on the `I/O Config` utility.

The following are example HP-IB addresses for commander sessions:

`GPIB,cmdr`	A commander session with the GPIB interface.
`hpib2,cmdr`	A commander session with the hpib2 interface.
`7,cmdr`	A commander session with the interface at logical unit 7.

The following are examples that open a commander session with the HP-IB interface.

C example:

```
INST hpib;
hpib = iopen ("hpib,cmdr");
```

Visual BASIC example:

```
Dim hpib As Integer
hpib = iopen ("hpib,cmdr")
```

HP SICL Function Support with HP-IB Commander Sessions

The following describes how some SICL functions are implemented for HP-IB commander sessions.

`iwrite`	If the interface has been addressed to talk, the data is written directly to the interface. If the interface has not been addressed to talk, it will wait to be addressed to talk before writing the data.
`iread`	If the interface has been addressed to listen, the data is read directly from the interface. If the interface has not been addressed to listen, it will wait to be addressed to listen before reading the data.
`isetstb`	Sets the status value that will be returned on a `ireadstb` call (that is, when this device is SPOLLed). Bit 6 of the status byte has a special meaning. If bit 6 is set, the SRQ line will be set. If bit 6 is clear, the SRQ line will be cleared.

HP-IB Commander Session Interrupts

There are specific commander session interrupts that can be used. See `isetintr` in Chapter 12, "HP SICL Language Reference" for information on the commander session interrupts. Also see the following section, "Writing
HP-IB Interrupt Handlers," for more information.

Writing HP-IB Interrupt Handlers

This section provides some additional information you should be aware of when writing interrupt handlers for HP-IB applications in SICL.

Multiple `I_INTR_GPIB_TLAC` Interrupts

This interrupt occurs whenever a device has been addressed to talk or untalk, or a device has been addressed to listen or unlisten. Due to hardware limitations, your SICL interrupt handler may be called twice in response to any of these events.

Your HP-IB application should be written to handle this situation gracefully. This can be done by keeping track of the current talk/listen state of the interface card, and ignoring the interrupt if the state does not change. For more information, see the *secval* parameter definition of the `isetintr` function in Chapter 12, "HP SICL Language Reference".

Handling SRQs from Multiple HP-IB Instruments

HP-IB is a multiple-device bus, and SICL allows multiple device sessions open at the same time. On the HP-IB interface, when one device issues a Service Request (SRQ), the library will inform *all* HP-IB device sessions that have SRQ handlers installed (see `ionsrq` in Chapter 12, "HP SICL Language Reference"). This is an artifact of how HP-IB handles the SRQ line; the underlying HP-IB hardware does not support session-specific interrupts like VXI does. Therefore, your application must reflect the nature of the HP-IB hardware if you expect to reliably service SRQs from multiple devices on the same HP-IB interface.

It is vital that you never exit an SRQ handler without first clearing the SRQ line. If the multiple devices are all controlled by the same process, the easiest technique is to service all devices from one handler. The pseudo-code for this is:

```
while (srq_asserted) {
   serial_poll (device1)
   if (needs_service) service_device1
   serial_poll (device2)
   if (needs_service) service_device2
   ...
   check_SRQ_line
}
```

This algorithm loops through all the device sessions and does not exit until the SRQ line is released (not asserted). The following example shows a SICL program segment which implements this algorithm. Checking the state of the SRQ line requires an interface session. Only one device session needs to execute `ionsrq` because that handler is invoked regardless of which instrument asserted the SRQ line. Assuming IEEE 488 compliance, an `ireadstb` is all that is needed to clear the device's SRQ.

```
/* Must be global */
INST id1, id2, bus;

void handler (dummy)
INST dummy;
{
   int srq_asserted = 1;
   unsigned char statusbyte;

/* Service all sessions in turn until no one is
    requesting service */
while (srq_asserted) {
   ireadstb(id1, &statusbyte);
   if (statusbyte & SRQ_BIT) {
      /* Actual service actions depend upon application */
      iscanf(id1, “%f”, &data1);
   }
   ireadstb(id2, &statusbyte);
   if (statusbyte & SRQ_BIT){
   iscanf(id2, “%f”, &data2);
   }
   igpibbusstatus(bus, I_GPIB_BUS_SRQ, &srq_asserted);
   }
}

main() {
   .
   .
   /* Device sessions for instruments */
   id1 = iopen(“hpib, 17”);
   id2 = iopen(“hpib, 18”);

   /* Interface session for SRQ test */
   bus = iopen(“hpib”);

   /* Only one handler needs to be installed */
   ionsrq(id1, handler);
   .
   .
```

Since the program cannot leave the handler until all devices have released SRQ, it is recommended that the handler do as little as possible for each device. The previous example assumed that only one `iscanf` was needed to service the SRQ. If lengthy operations are needed, a better technique is simply to perform the `ireadstb` and set a flag in the handler. Then the main program can test the flags for each device and perform the more lengthy service.

Even if the different device sessions are in different processes, it is still important to stay in the SRQ handler until the SRQ line is released. However, it is not likely that a process which only knows about Device A can do anything to make Device B release the SRQ line. In such a configuration, a single unserviced instrument can effectively disable SRQs for all processes attempting to use that interface. Again, this is a hardware characteristic of HP-IB. The only way to ensure true independence of multiple HP-IB processes is to use multiple HP-IB interfaces.

Summary of HP-IB Specific Functions

Table 5-1. SICL GPIB Functions

Function Name	Action
`igpibatnctl`	Sets or clears the ATN line
`igpibbusaddr`	Changes bus address
`igpibbusstatus`	Returns requested bus data
`igpibgett1delay`	Returns the current T1 setting for the interface
`igpibllo`	Sets bus in Local Lockout Mode
`igpibpassctl`	Passes active control to specified address
`igpibppoll`	Performs a parallel poll on the bus
`igpibppollconfig`	Configures device for PPOLL response
`igpibppollresp`	Sets PPOLL state
`igpibrenctl`	Sets or clears the REN line
`igpibsendcmd`	Sends data with ATN line set
`igpibsett1delay`	Sets the T1 delay value for this interface

6

Using HP SICL with GPIO

Using HP SICL with GPIO

GPIO is a parallel interface that is flexible and allows a variety of custom connections. Although GPIO typically requires more time to configure than HP-IB, its speed and versatility make it the perfect choice for many tasks.

Note GPIO is *only* supported with SICL on Windows 95 and Windows NT.

GPIO is *not* supported with SICL over LAN.

This chapter describes in detail how to open a communications session and communicate with an instrument over a GPIO connection. The example programs shown in this chapter are also provided in the `C\SAMPLES\MISC''` (for C/C++) and `VB\SAMPLES\MISC''` (for Visual BASIC) subdirectories under the SICL base directory (for example, under `C:\SICL95''` or `C:\SICLNT` if the default installation directory was used).

This chapter contains the following sections:

- Creating a Communications Session with GPIO
- Communicating with GPIO Interfaces
- Summary of GPIO Specific Functions

Creating a Communications Session with GPIO

Once you have configured your system for GPIO communications, you can start programming with the SICL functions. If you have programmed GPIO before, you will probably want to open the interface and start sending commands.

With HP-IB, there can be multiple devices on a single interface. These interfaces support a connection called a **device session**. With GPIO, only one device is connected to the interface. Therefore, you communicate with GPIO devices using an **interface session**.

Communicating with GPIO Interfaces

Interface sessions are used for GPIO data transfer, interrupt, status, and control operations. When communicating with a GPIO interface session, you specify the interface name.

Addressing GPIO Interfaces

To create an interface session on GPIO, specify the interface logical unit or symbolic name in the *addr* parameter of the `iopen` function. The interface logical unit and symbolic name are defined by running the `I/O Config` utility from the `HP I/O Libraries` program group. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on the `I/O Config` utility.

The following are example addresses for GPIO interface sessions:

`gpio`	An interface symbolic name
`12`	An interface logical unit

The following example opens an interface session with the GPIO interface:

```
INST intf;
intf = iopen ("gpio");
```

HP SICL Function Support with GPIO Interface Sessions

The following describes how some SICL functions are implemented for GPIO interface sessions.

`iwrite`, `iread`	The *size* parameters for non-formatted I/O functions are always byte counts, regardless of the current data width of the interface.
`iprintf`, `iscanf`	All formatted I/O functions work with GPIO. When formatted I/O is used with 16-bit data widths, the formatting buffers re-assemble the data as a stream of bytes. On Windows 95, these bytes are ordered: high-low-high-low... Because of this "unpacking" operation, 16-bit data widths may not be appropriate for formatted I/O operations. For `iscanf` termination, an END value must be specified using `igpioctrl`. See Chapter 12, "HP SICL Language Reference" for details.
`itermchr`	With 16-bit data widths, only the low (least-significant) byte is used.
`ixtrig`	Provides a method of triggering using either the CTL0 or CTL1 control lines. This function pulses the specified control line for approximately 1 or 2 microseconds. The following constants are defined: `I_TRIG_STD` Pulse CTL0 line `I_TRIG_GPIO_CTL0` Pulse CTL0 line `I_TRIG_GPIO_CTL1` Pulse CTL1 line
`itrigger`	Same as `ixtrig` (`I_TRIG_STD`). Pulses the CTL0 control line.
`iclear`	Pulses the P_RESET line for at least 12 microseconds, aborts any pending writes, discards any data in the receive buffer, and resets any error conditions. Optionally clears the Data Out port, depending upon the configuration specified via the I/O Config utility.

`ionsrq`	Installs a service request handler for this session. The concept of service request (SRQ) originates from HP-IB. On an HP-IB interface, a device can request service from the controller by asserting a line on the interface bus. On GPIO, the EIR line is assumed to be the service request line.
`ireadstb`	Chapter 12, "HP SICL Language Reference" says that `ireadstb` is for device sessions only. Since GPIO has no device sessions, `ireadstb` is allowed with GPIO interface sessions. The interface status byte has bit 6 set if EIR is asserted; otherwise, the status byte is 0 (zero). This allows normal SRQ programming techniques in GPIO SRQ handlers.

GPIO Interface Session Interrupts

There are specific interface session interrupts that can be used. See `isetintr` in Chapter 12, "HP SICL Language Reference" for information on the interface session interrupts for GPIO.

GPIO Interface Session Examples

C example:

```
/* gpiomeas.c
This program does the following:
- Creates a GPIO session with timeout and error checking
- Signals the device with a CTL0 pulse
- Reads the device's response using formatted I/O */

#include <sicl.h>

main()
{
   INST id;       /* interface session id */
   float result;  /* data from device */

#if defined (__BORLANDC__) && !defined (__WIN32__)
_InitEasyWin();  /* required for Borland EasyWin programs */
#endif

/* log message and exit program on error */
ionerror(I_ERROR_EXIT);

/* open GPIO interface session, with 3-second timeout*/
id = iopen("gpio");
itimeout(id, 3000);

/* setup formatted I/O configuration */
igpiosetwidth(id, 8);
igpioctrl(id, I_GPIO_READ_EOI, '\n');

/* monitor the device's PSTS line */
igpioctrl(id, I_GPIO_CHK_PSTS, 1);

/* signal the device to take a measurement */
itrigger(id);

/* get the data */
iscanf(id, "%f%*t", &result);
printf("Result = %f\n", result);
```

```
   /* For WIN16 applications, call _siclcleanup before
   exiting to release resources allocated by SICL for this
   application. This call is a no-op for WIN32 applications.*/

   _siclcleanup();

   /* close session */
   iclose (id);
}
```

Visual BASIC example:

```
''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
'  This program does the following:
'  - Creates a GPIO session with timeout and error checking
'  - Signals the device with a CTL0 pulse
'  - Reads the device's response using formatted I/O
''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
Sub cmdMeas_Click ()
   Dim id As Integer              ' device session id
   Dim retval As Integer          ' function return value
   Dim buf As String              ' buffer for displaying
   Dim real_data As Double           ' data from device

'  Set up an error handler within this subroutine that will
'  be called if a SICL error occurs.
   On Error GoTo ErrorHandler

'  Disable the button used to initiate I/O while I/O is
'  being performed.
   cmdMeas.Enabled = False

'  Open an interface session using a known symbolic name
   id = iopen("gpio12")

'  Set the I/O timeout value for this session to 3 seconds
   Call itimeout(id, 3000)

'  Setup formatted I/O configuration
   Call igpiosetwidth(id, 8)
   Call igpioctrl(id, I_GPIO_READ_EOI, 10)

'  Signal the device to take a measurement
   Call itrigger(id)

'  Get the data
   retval = ivscanf(id, "%lf%*t", real_data)

'  Display the response as string in a Message Box
   buf = Str$(real_data)
   retval = MsgBox(buf, MB_OK, "GPIO Data")

'  Close the device session.
   Call iclose(id)
```

```
‘  Enable the button used to initiate I/O
   cmdMeas.Enabled = True

   Exit Sub

ErrorHandler:
‘  Display the error message string in a Message Box
   retval = MsgBox(Error$, MB_ICONEXCLAMATION, “SICL Error”)

‘  Close the device session if iopen was successful.
   If id <> 0 Then
     iclose (id)
   End If

‘  Enable the button used to initiate I/O
   cmdMeas.Enabled = True
   Exit Sub

End Sub

’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’
‘  The following routine is called when the application’s
‘  Start Up form is unloaded.  It calls siclcleanup to
‘  release resources allocated by SICL for this
‘  application.
’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’
Sub Form_Unload (Cancel As Integer)
   Call siclcleanup ‘ Tell SICL to clean up for this task
End Sub
```

GPIO Interrupts Example

```
/* gpiointr.c
   This program does the following:
   - Creates a GPIO session with error checking
   - Installs an interrupt handler and enables EIR interrupts
   - Waits for EIR; invokes the handler for each interrupt
*/

#include <sicl.h>

void SICLCALLBACK handler(id, reason, sec)
INST id;
int reason, sec;
{
   if (reason == I_INTR_GPIO_EIR) {
      printf("EIR interrupt detected\n");

      /* Proper protocol is for the peripheral device to hold
       * EIR asserted until the controller "acknowledges" the
       * interrupt.  The method for acknowledging and/or responding
       * to EIR is very device-dependent.  Perhaps a CTLx line is
       * pulsed, or data is read, etc.  The response should be
       * executed at this point in the program.
       */
   }
   else
      printf("Unexpected Interrupt; reason=%d\n", reason);
}

main()
{
   INST intf;     /* interface session id */

   #if defined (__BORLANDC__) && !defined (__WIN32__)
   _InitEasyWin();  /* required for Borland EasyWin programs */
   #endif

   /* log message and exit program on error */
   ionerror(I_ERROR_EXIT);
```

```
   /* open GPIO interface session */
   intf = iopen("gpio");

   /* suspend interrupts until configured */
   iintroff();

   /* configure interrupts */
   ionintr(intf, handler);
   isetintr(intf, I_INTR_GPIO_EIR, 1);

   /* wait for interrupts */
   printf("Ready for interrupts\n");
   while (1) {
      iwaithdlr(0);  /* optional timeout can be specified here*/
   }

   /* iwaithdlr performs an automatic iintron().  If your  program
    * does concurrent processing, instead of waiting, then you need
    * to execute iintron() when you are ready for interrupts.
    */

   /* This simplified example loops forever.  Most real applications
    * would have termination conditions that cause the loop to exit.
    */
   iclose(id);

   /* For WIN16 applications, call _siclcleanup before
      exiting to release resources allocated by SICL for
      this application.  This call is a no-op for WIN32
      applications. */

   _siclcleanup();
}
```

Summary of GPIO Specific Functions

Function Name	Action
`igpioctrl`	Sets the following characteristics of the GPIO interface:

Request	Characteristic	Settings
`I_GPIO_AUTO_HDSK`	Auto-Handshake mode	1 or 0
`I_GPIO_AUX`	Auxiliary Control lines	16-bit mask
`I_GPIO_CHK_PSTS`	Check PSTS before read/ write	1 or 0
`I_GPIO_CTRL`	Control lines	`I_GPIO_CTRL_CTL0` `I_GPIO_CTRL_CTL1`
`I_GPIO_DATA`	Data Output lines	8-bit or 16-bit mask
`I_GPIO_PCTL_DELAY`	PCTL delay time	0-7
`I_GPIO_POLARITY`	Logical polarity	0-31
`I_GPIO_READ_CLK`	Data input latching	(See *HP SICL Reference Manual*)
`I_GPIO_READ_EOI`	END termination pattern	`I_GPIO_EOI_NONE` or 8-bit or 16-bit mask
`I_GPIO_SET_PCTL`	Start PCTL handshake	1

`igpiogetwidth`	Returns the current width (in bits) of the GPIO data ports.
`igpiosetwidth`	Sets the width (in bits) of the GPIO data ports. Either 8 or 16.

Function Name	Action
`igpiostat`	Gets the following information about the GPIO interface:

Request	Characteristic	Value
`I_GPIO_CTRL`	Control Lines	`I_GPIO_CTRL_CTL0` `I_GPIO_CTRL_CTL1`
`I_GPIO_DATA`	Data In lines	16-bit mask

`I_GPIO_INFO`	GPIO information	`I_GPIO_AUTO_HDSK`
		`I_GPIO_CHK_PSTS`
		`I_GPIO_EIR`
		`I_GPIO_ENH_MODE`
		`I_GPIO_PSTS`
		`I_GPIO_READY`

`I_GPIO_READ_EOI`	END termination pattern	`I_GPIO_EOI_NONE` or 8-bit or 16-bit mask
`I_GPIO_STAT`	Status lines	`I_GPIO_STAT_STI0` `I_GPIO_STAT_STI1`

7

Using HP SICL with VXI

Using HP SICL with VXI

This chapter explains how to use SICL to communicate over the VXIbus. The example programs shown in this chapter are also provided in the `C\SAMPLES\MISC` subdirectory under the SICL base directory (for example, under `C:\SICL95` or `C:\SICLNT` if the default installation directory was used).

This chapter contains the following sections:

- Creating a Communications Session with VXI
- Communicating with VXI Devices
- Communicating with VXI Interfaces
- Communicating with VME Devices
- Looking at HP SICL Function Support with VXI
- Considering VXI Backplane Memory I/O Performance
- Using VXI Specific Interrupts
- Summary of VXI Specific Functions

Creating a Communications Session with VXI

Before you start programming your VXI system, ensure that the system is set up and operating correctly.

To begin programming your VXI system, you must determine what type of communication session you need. The two supported VXI communication sessions are as follows:

Device Session	The device session allows you direct access to a device without worrying about the type of interface to which it is connected.
Interface Session	An interface session allows direct low-level control of the specified interface. This gives you full control of the activities on a given interface, such as VXI.

Device sessions are the recommended method for communicating while using SICL. They provide the highest level of programming, best overall performance, and best portability.

Note Commander Sessions are *not* supported with VXI interfaces.

Communicating with VXI Devices

If you are going to use SICL functions to communicate directly with VXI devices, you must first be aware of the two different types of VXI devices:

Message-Based	Message-based devices have their own processors which allow them to interpret the high-level SCPI (Standard Commands for Programmable Instruments) commands. While using SICL, you simply place the SCPI command within your SICL output function call, and the message-based device interprets the SCPI command.
Register-Based	The register-based device typically does not have a processor to interpret high-level commands; and therefore, only accepts binary data. Use the following methods to program register-based instruments: • **Interpreted SCPI** - Use the SICL `iscpi` interface and program using high-level SCPI commands. I-SCPI interprets the high-level SCPI commands and sends the data to the instrument. • **Register programming** - Do register peeks and pokes and program directly to the device's registers with the `vxi` interface.

Note Interpreted SCPI (I-SCPI) is supported over LAN. However, register programming (`imap`, `ipeek`, `ipoke`, and so forth) is *not* supported over LAN.

I-SCPI runs on the LAN server if used in a LAN-based system.

Other HP Products:

- **HP Compiled SCPI** - Use the C-SCPI product and program with high-level SCPI commands (achieve higher throughput as well).
- **HP Command Module** - Use a Command Module to interpret the high-level SCPI commands. The `hpib` interface is used with a Command Module. A Command Module may also be accessed over a LAN using a LAN-to-HPIB gateway, such as the HP E2050 LAN/HP-IB Gateway.

Programming with register-based and message-based devices is discussed in further detail later in this section.

Note You can program a VXIbus system that is mixed with both message-based and register-based devices. To do this, open a communications session for each device in your system and program as shown in the following sections.

Message-Based Devices

Message-based devices have their own processors which allow them to interpret the high-level SCPI commands. While using SICL, you simply place the SCPI command within your SICL output function call and the message-based device interprets the SCPI command. SICL functions used for programming message-based devices include `iread`, `iwrite`, `iprintf`, `iscanf`, and so forth.

Note If your message-based device has shared memory, you can access the device's shared memory by doing register peeks and pokes. See "Register-Based Devices" later in this chapter for information on register programming.

Addressing VXI Message-Based Devices

To create a device session, specify either the interface symbolic name or logical unit and a particular device's address in the *addr* parameter of the `iopen` function. The interface symbolic name and logical unit are set by running the `I/O Config` utility from the `HP I/O Libraries` program group. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Instalation and Configuration Guide for Windows* for information on the `I/O Config` utility.

The following are example addresses for VXI device sessions:

`vxi,24`	A device address corresponding to the device at primary address 24 on the vxi interface.
`vxi,128`	A device address corresponding to the device at primary address 128 on the vxi interface.

Remember that the primary address must be between 0 and 255. The primary address corresponds to the VXI logical address and specifies the address in A16 space of the VXI device.

Note The previous examples use the default symbolic name specified during the system configuration. If you want to change the name listed above, you must also change the symbolic name or logical unit specified during the configuration. The name used in your SICL program must match the logical unit or symbolic name specified in the system configuration. Other possible interface names are `VXI`, `vxi`, and so forth.

SICL supports only primary addressing on the VXI device sessions. Specifying a secondary address causes an error.

The following is an example of opening a device session with the VXI device at logical address 64:

```
INST dmm;
dmm = iopen (“vxi,64”);
```

Message-Based Device Session Example

The following example program opens a communication session with a VXI message-based device and measures the AC voltage. The measurement results are then printed.

```
/* vximdev.c
   This example program measures AC voltage on a
   multimeter andprints out the results */
#include <sicl.h>
#include <stdio.h>

main()
{
   INST dvm;
   char strres[20];

   /* Print message and terminate on error */
   ionerror (I_ERROR_EXIT);

   /* Open the multimeter session */
   dvm = iopen (“vxi,24”);
   itimeout (dvm, 10000);

   /* Initialize dvm */
   iwrite (dvm, “*RST\n”, 5, 1, NULL);

   /* Take measurement */
   iwrite (dvm,”MEAS:VOLT:AC? 1, 0.001\n”, 23, 1, NULL);

   /* Read measurements */
   iread (dvm, strres, 20, NULL, NULL);

   /* Print the results */
   printf(“Result is %s\n”, strres);

   /* Close the multimeter session */
iclose(dvm);

}
```

Register-Based Devices

There are several methods that can be used for communicating with register-based devices:

`iscpi` interface	Use the SICL `iscpi` interface and program using SCPI commands. The `iscpi` interface interprets the SCPI commands and allows you to communicate directly with register-based devices. This method is supported over LAN.
Register Programming	Use the `vxi` interface to program directly to the device's registers with a series of register peeks and pokes. This method can be very time consuming and difficult. This method is not supported over LAN.

Other HP Products:

HP Compiled SCPI	The HP Compiled SCPI product is another programming language that can be used with SICL to program register-based instruments with SCPI commands. Because this product interprets the SCPI commands at compile time, it can be used to achieve high throughput of register-based devices.
HP Command Module	When you use an HP Command Module to communicate with VXI devices, you are actually communicating over HP-IB. The Command Module interprets the high-level SCPI commands for register-based instruments and then sends out low-level commands over the VXIbus backplane to the instruments. See the "Using HP SICL with HP-IB" chapter for more details on communicating through a Command Module.

If you currently have a SICL application that accesses VXI devices by using HP-IB and the HP E1405/06 Command Module, you can port your application to use the `iscpi` interface and directly access the VXI backplane without the use of the Command Module. This can be done by changing the `iopen` function to use the `iscpi` interface followed by the device logical address.

See "Addressing VXI Register-Based Devices" later in this chapter for more details on addressing rules. Since I-SCPI was designed to simulate control of register-based instruments using HP-IB and the Command Module, you usually will not need to change anything else in your application.

Note There are also other applications that use SICL as their I/O library but have their own methods of communicating with the instruments. These applications hide most of the I/O complexity behind the user interface.

Contact your local sales representative for information on other HP products that might interpret the high-level SCPI commands for register-based devices.

Addressing VXI Register-Based Devices

To create a device session, specify either the interface symbolic name or logical unit and a particular device's address in the *addr* parameter of the `iopen` function. The interface symbolic name and logical unit are set by running the `I/O Config` utility from the `HP I/O Libraries` program group. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on the `I/O Config` utility.

The following are example addresses for VXI device sessions:

`iscpi,32`	A register-based device address corresponding to the device at primary address 32 on the `iscpi` interface.
`vxi,24`	A device address corresponding to the device at primary address 24 on the vxi interface.
`vxi,128`	A device address corresponding to the device at primary address 128 on the vxi interface.

Remember that the primary address must be between 0 and 255. The primary address corresponds to the VXI logical address.

Note The previous examples use the default symbolic name specified during the system configuration. If you want to change the name listed above, you must also change the symbolic name or logical unit specified during the configuration. The name used in your SICL program must match the logical unit or symbolic name specified in the system configuration. Other possible interface names are `VXI`, `vxi`, and so forth.

SICL supports only primary addressing on the VXI device sessions. Specifying a secondary address causes an error.

The following is an example of opening a device session with the VXI device at logical address 64:

```
INST dmm;
dmm = iopen (“vxi,64”);
```

Interpreted SCPI (`iscpi`) Addressing Rules

The simplest way to address a register-based device using the `iscpi` interface is to use the same rules described in the last section: Specify the interface logical unit or symbolic name and a particular device logical address in the *addr* parameter of the `iopen` function. For example:

```
dmm=iopen (“iscpi,24”);
```

In most cases this is sufficient and additional addressing is not needed. I-SCPI automatically configures your system according to specific combining rules that determine how the instruments are set up relative to other VXI instruments.

Generally, when an `iopen` is performed, an instrument is formed consisting of all devices at logical addresses contiguous to the base logical address passed in the address string. Let’s say, for example, that you open an instrument at logical address 24 and the next logical address is 25. The `iscpi` interface will search for an instrument driver that supports the combined instruments found.

If you wish to specify how instruments are combined or what instrument driver to use, see the following sections for details on specifying this information.

Defining an Instrument. There may be times you would like to have control over which logical addresses are used to form a particular instrument. In this case you can use an explicit list in the logical address portion of the `iopen` call. Define the instrument by adding a colon after the interface symbolic name followed by the backplane name as was specified in the `I/O Config` utility (backplane is the *symname* of the VXI backplane SICL driver, usually `vxi`). Then add the instrument logical addresses enclosed within parentheses separated by commas. For example:

```
dmm=iopen ("iscpi:vxi,(24,25)");
```

The above example combines instruments at logical address 24 and 25 to form one instrument. Note that the logical addresses of these instruments do not have to be contiguous.

Defining an Instrument Driver. There may be times when you would like to specify an instrument driver to use for a particular set of logical addresses. This allows you to create your own instrument drivers or you can form unique virtual instrument combinations. This can be done by adding the instrument driver name within brackets. For example:

```
dmm=iopen ("iscpi,24[E1326]");
```

If you would like to specify the instrument driver plus which instruments are grouped together to form the instrument, use the following form:

```
dmm=iopen ("iscpi[E1326]:vxi,(24,25)");
```

The directory location specified during the SICL installation (default is `C:\HPVXI\BIN` for 16-bit, and `C:\SICLXX\DRIVERS\ISCPI` for 32-bit) is searched for a matching instrument driver.

Note The `iopen` call will run faster if you specify an instrument driver name since it does not have to search through all the instrument drivers for a match.

Programming with Interpreted SCPI (the `iscpi` Interface)

The `iscpi` interface allows you to program register-based instruments with high-level SCPI commands. To program using the `iscpi` interface, open a device session with a specific register-based instrument and then program using the SICL functions such as `iprintf`, `iscanf`, and `ireadstb`.

When opening the device session, you need to specify `iscpi` as the interface type in the SICL `iopen` call. See "Interpreted SCPI (`iscpi`) Addressing Rules" earlier in this chapter for information addressing with the `iscpi` interface.

The `iscpi` interface was designed to closely simulate control of register-based instruments using the HP Command Module over HP-IB. When an `iopen` is performed, I-SCPI searches for an instrument driver consisting of all the devices at logical addresses contiguous to the base logical address. If no instrument driver will support the list of contiguous logical addresses, the device with the highest logical address will be removed and the search process repeated. This will continue until the driver is found or this list is exhausted. If no instrument driver is found the `iopen` call will fail.

Once an `iopen` is successful, I-SCPI runs in an infinite loop waiting to parse SCPI commands for the instrument. A separate process is created for each instrument that is opened.

In order to use the `iscpi` interface, you must have configured the system to include `iscpi` as an interface. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on the `I/O Config` utility.

Register-Based Instrument Drivers. `iscpi` includes drivers for most Hewlett-Packard register-based devices. These drivers are located in the directory specified during the HP I/O Libraries installation (default is `C:\HPVXI\BIN` for 16-bit, and `C:\SICLXX\DRIVERS\ISCPI` for 32-bit). Additionally, you can see either the `C:\HPVXI\BIN\README.TXT` file for 16-bit, or the `C:\SICLXX\DRIVERS\ISCPI\README32.TXT` file for 32-bit, for a list of currently supported, register-based devices.

`iscpi` Device Session Example

The following example program opens a communication session with a VXI register-based device with the `iscpi` interface. This example then uses SCPI commands to measure the AC voltage and print out the results.

```
/* vxiiscpi.c
   This example program measures AC voltage on a
   multimeter and prints out the results */
#include <sicl.h>
#include <stdio.h>

main()
{
   INST dvm;
   char strres[20];

   /* Print message and terminate on error */
   ionerror (I_ERROR_EXIT);

   /* Open the multimeter session */
   dvm = iopen (“iscpi,24”);
   itimeout (dvm, 10000);

   /* Initialize dvm */
   iwrite (dvm, “*RST\n”, 5, 1, NULL);

   /* Take measurement */
   iwrite (dvm,”MEAS:VOLT:AC? 1, 0.001\n”, 23, 1, NULL);

   /* Read measurements */
   iread (dvm, strres, 20, NULL, NULL);

   /* Print the results */
   printf(“Result is %s\n”, strres);

   /* Close the multimeter session */
   iclose(dvm);
}
```

Programming Directly to the Registers

When communicating with register-based devices, you either have to send a series of peeks and pokes directly to the device's registers, or you have to have a command interpreter to interpret the high-level SCPI commands. Command interpreters include the `iscpi` interface, HP C-Size Command Module, HP B-Size card cage (built-in Command Module), or HP Compiled SCPI (C-SCPI).

When sending a series of peeks and pokes to the device's registers, use the following process:

- Map memory space into your process space.
- Read the register's contents using `i?peek`.
- Write to the device registers using `i?poke`.
- Unmap the memory space.

Note Note that the above procedure is only used on register-based devices that are not using the `iscpi` interface.

Note that programming directly to the registers is not supported over LAN.

Mapping Memory Space for Register-Based Devices. When using SICL to communicate directly to the device's registers, you must map a memory space into your process space. This can be done by using the SICL `imap` function:

`imap (`*id, map_space, pagestart, pagecnt, suggested*`);`

This function maps space for the interface or device specified by the *id* parameter. *pagestart*, *pagecnt*, and *suggested* are used to indicate the page number, how many pages, and a suggested starting location respectively. *map_space* determines which memory location to map the space. The following are valid *map_space* choices:

- `I_MAP_A16` Maps in VXI A16 address space (device or interface sessions, 64K byte pages).
- `I_MAP_A24` Maps in VXI A24 address space (device or interface sessions, 64K byte pages).

- `I_MAP_A32` Maps in VXI A32 address space (device or interface sessions, 64K byte pages).
- `I_MAP_VXIDEV` Maps in VXI A16 device registers (device session only, 64 bytes).
- `I_MAP_EXTEND` Maps in VXI device extended memory address space in A24 or A32 address space (device sessions only).
- `I_MAP_SHARED` Maps in VXI A24/A32 memory that is physically located on the computer (sometimes called local shared memory, interface sessions only).
- `I_MAP_AM` | *address modifer* Maps in the specified region (*address modifer*) of VME address space. See the "Communicating with VME Devices" section later in this chapter for more information on this map space argument.

The following are example `imap` function calls:

```
/* Map to the VXI device vm starting at pagenumber 0 for 1 page */
base_address = imap (vm, I_MAP_VXIDEV, 0, 1, NULL);

/* Map to A32 address space (16 Mbytes) */
ptr = imap (id, I_MAP_A32, 0x000, 0x100, NULL);

/* Map to a device's A24 or A32 extended memory */
ptr=imap (id, I_MAP_EXTEND, 0, 1, 0);

/* Map to a computer's A24 or A32 shared memory */
ptr=imap (id, I_MAP_SHARED, 0, 1, 0);
```

Note Due to hardware constraints on given devices or interfaces, not all address spaces may be implemented. In addition, there may be a maximum number of pages that can be simultaneously mapped.

If a request is made that cannot be granted due to hardware constraints, the process will hang until the desired resources become available. To avoid this, use the `isetlockwait` with the *flag* parameter set to 0, and thus generate an error instead of waiting for the resources to become available. You may also use the `imapinfo` function to determine hardware constraints before making an `imap` call.

Use the following table to determine which *map-space* argument to use with your SICL `imap/iunmap` function.

`imap`/`iunmap` (*map-space* **argument)**	**Widths**	**VME Data Access Mode**
I_MAP_A16	D8,D16	Supervisory
I_MAP_A24	D8,D16	Supervisory
I_MAP_A32	D8,D16	Supervisory
I_MAP_A16_D32	D32	Supervisory
I_MAP_A24_D32	D32	Supervisory
I_MAP_A32_D32	D32	Supervisory

However, all accesses through the *_D32 map windows can *only* be 32-bit transfers. The application software must do a 32-bit assignment to generate the access, and only accesses on 32-bit boundaries are allowed. If 8- or 16-bit accesses to the device are also necessary, a normal `I_MAP_A16/24/32` map must also be requested.

Reading and Writing to the Device Registers. Once you have mapped the memory space, use the SICL `i?peek` and `i?poke` functions to communicate with the register-based instruments. With these functions, you need to know which register you want to communicate with and the register's offset. See the instrument's user's manual for a description of the registers and register locations.

The following is an example of using `iwpeek`:

```
id = iopen ("vxi,24");
addr = imap (id, I_MAP_VXIDEV, 0, 1, 0);
reg_data = iwpeek (addr + 4);
```

See Chapter 12, "HP SICL Language Reference" for a complete description of the `i?peek` and `i?poke` functions.

Unmapping Memory Space. Make sure you use the `iunmap` function to unmap the memory space when it is no longer needed. This frees the mapping hardware so it can be used by other processes.

Register-Based Programming Example

The following example program opens a communication session with the register-based device connected to the address entered by the user. The program then reads the Id and Device Type registers. The register contents are then printed.

```
/* vxirdev.c
The following example prompts the user for an instrument
address and then reads the id register and device type
register. The contents of the register are displayed.*/

#include <stdio.h>
#include <stdlib.h>
#include <sicl.h>

void main (){
   char inst_addr[80];
   char *base_addr;
   unsigned short id_reg, devtype_reg;
   INST id;

   /* get instrument address */
   puts ("Please enter the logical address of the
register-based instrument, for example, vxi,24 :  \n");
   gets (inst_addr);

   /* install error handler */
   ionerror (I_ERROR_EXIT);

   /* open communications session with instrument */
   id  =  iopen (inst_addr);
   itimeout (id, 10000);

   /* map into user memory space */
   base_addr = imap (id, I_MAP_VXIDEV, 0, 1, NULL);

   /* read registers */
   id_reg = iwpeek ((unsigned short *)(base_addr + 0x00));
   devtype_reg = iwpeek ((unsigned short *)(base_addr + 0x02));

   /* print results */
   printf ("Instrument at address %s\n", inst_addr); printf ("ID
   Register = 0x%4X\n  Device Type Register = 0x%4X\n", id_reg,
      devtype_reg);

   /* unmap memory space */
   iunmap (id, base_addr, I_MAP_VXIDEV, 0, 1);

  /* close session */
   iclose (id);
}
```

Communicating with VXI Interfaces

Interface sessions allow you direct low-level control of the interface. You must do all the bus maintenance for the interface. This also implies that you have considerable knowledge of the interface. Additionally, when using interface sessions, you need to use interface specific functions. The use of these functions means that the program can not be used on other interfaces, and therefore, becomes less portable.

Addressing VXI Interface Sessions

To create an interface session on your VXI system, specify either the interface symbolic name or logical unit in the *addr* parameter of the `iopen` function. The interface symbolic name and logical unit are set by running the `I/O Config` utility from the `HP I/O Libraries` program group. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on the `I/O Config` utility.

The following are example addresses for VXI interface sessions:

`vxi`	An interface symbolic name.
`iscpi`	An interface symbolic name.

Note The above examples use the default symbolic name specified during the system configuration. If you want to change the name listed above, you must also change the symbolic name or logical unit specified during the configuration. The name used in your SICL program must match the logical unit or symbolic name specified in the system configuration. Other possible interface names are `VXI`, `vxi`, and so forth.

The following example opens a interface session with the VXI interface:

```
INST vxi;
vxi = iopen (“vxi”);
```

Note The only interface session operations supported by I-SCPI are service requests and locking.

VXI Interface Session Example

The following example program opens a communication session with the VXI interface and uses the SICL interface specific `ivxirminfo` function to get information about a specific VXI device. This information comes from the VXI resource manager and is only valid as of the last time the VXI resource manager was run.

```
 /* vxiintr.c
   The following example gets information about a specific
   vxi device and prints it out. */
#include <stdio.h>
#include <sicl.h>

void main () {
   int laddr;
   struct vxiinfo info;
   INST id;

   /* get instrument logical address */
   printf ("Please enter the logical address of the
      register-based instrument, for example, 24 : \n");
   scanf ("%d", &laddr);

   /* install error handler */
   ionerror (I_ERROR_EXIT);

   /* open a vxi interface session */
   id  =  iopen ("vxi");
   itimeout (id, 10000);

   /*read VXI resource manager information for specified device*/
   ivxirminfo (id, laddr, &info);

   /* print results */
   printf ("Instrument at address %d\n", laddr);
   printf ("Manufacturer's Id = %s\n  Model = %s\n",
            info.manuf_name, info.model_name);

  /* close session */
   iclose (id);
}
```

Communicating with VME Devices

Note Not supported over LAN.

Many people assume that since VXI is an extension of VME that VME should be easy to use in a VXI system. Unfortunately, this is not true. Since the VXI standard defines specific functionality that would be a custom design in VME, some of the resources required for VME custom design are actually used by VXI. Therefore, there are certain limitation and requirements when using VME in a VXI system. Note that VME is not an officially supported interface for SICL.

Use the following process when using VME devices in a VXI mainframe:

- Declaring Resources
- Mapping VME Memory
- Reading and Writing to Device Registers
- Unmapping Memory

Each of the above items are described in further detail in the following subsections. An example program is also provided.

Declaring Resources

The VXI Resource Manager does not reserve resources for VME devices. Instead, a configuration file is used to reserve resources for VME devices in a VXI system. Use the VXI Device Configurator to edit the `DEVICES` file, or edit the file directly, to reserve resources for VME devices. The VXI Resource Manager reads this file to reserve the VME address space and VME IRQ lines. The VXI Resource Manager then assigns the VXI devices around the already reserved VME resources.

For VME devices requiring A16 address space, the device's address space should be defined in the lower 75% of A16 address space (addresses below 0xC000). This is necessary because the upper 25% of A16 address space is reserved for VXI devices.

For VME devices using A24 or A32 address space, use A24 or A32 address ranges just higher than those used by your VXI devices. This will prevent the Resource Manager from assigning the address range used by the VME device to any VXI device. (The A24 and A32 address range is software programmable for VXI devices.)

Mapping VME Memory

SICL defaults to byte, word, and longword supervisory access to simplify programming VXI systems. However, some VME cards use other modes of access which are not supported in SICL. Therefore, SICL provides a map parameter that allows you to use the access modes defined in the VME Specification. See the VME Specification for information on these access modes.

Note Use care when mixing VXI and VME devices. You *MUST* know what VME address space and offset within that address space that VME devices use. VME devices cannot use the upper 16K of the A16 address space since this area is reserved for VXI instruments.

Use the `I_MAP_AM` | *address modifer* map space argument in the `imap` function to specify the map space region (*address modifer*) of VME address space. See the VMEbus Specifications for information on what value to use as the address modifier. Note that if the controller doesn't support specified address mode, then the `imap` call will fail (see table in the next section).

The following maps A24 non-privileged data access mode:

```
prt = imap (id, (I_MAP_AM | 0x39), 0x20, 0x4, 0);
```

The following maps A32 non-privileged data access mode:

```
prt = imap (id, (I_MAP_AM | 0x09), 0x20, 0x40, 0);
```

Note When accessing VME or VXI devices via an embedded controller such as an HP E6232/33 VXI Pentium Controller, current versions of SICL use the "supervisory data" address modifiers 0x2D, 0x3D, and 0x0D for A16, A24, and A32 accesses, respectively. (Some older versions of SICL use the "non-privileged data" address modifiers.)

Supported Access Modes

The following table lists VME access modes supported on HP controllers.

VME Mapping Support

	A16			A24			A32		
	D08	D16	D32	D08	D16	D32	D08	D16	D32
Supervisory data	X	X	X	X	X	X	X	X	X
Non-Privilege data									

Reading and Writing to the Device Registers

Once you have mapped the memory space, use the SICL `i?peek` and `i?poke` functions to communicate with the VME devices. With these functions, you needed to know which register you want to communicate with and the register's offset. See the instrument's user's manual for a description on the registers and register locations.

The following is an example of using `iwpeek`:

```
id = iopen ("vxi");
addr = imap (id, (I_MAP_AM | 0x39), 0x20, 0x4, 0);
reg_data = iwpeek ((unsigned short *)(addr + 0x00));
```

See Chapter 12, "HP SICL Language Reference" for a complete description of the `i?peek` and `i?poke` functions.

Unmapping Memory Space

Make sure you use the `iunmap` function to unmap the memory space when it is no longer needed. This frees the mapping hardware so it can be used by other processes.

VME Interrupts

There are seven VME interrupt lines that can be used. By default, VXI processing of the IACK value will be used. However, if you configure VME IRQ lines and `VME Only`, no VXI processing of the IACK value will be done. That is the IACK value will be passed to a SICL interrupt handler directly. See `isetintr` in Chapter 12, "HP SICL Language Reference" for information on the VME interrupts.

VME Example

The following ANSI C example program opens a VXI interface session and sets up an interrupt handler. When the `I_INTR_VME_IRQ1` interrupt occurs, the function defined in the interrupt handler will be called. The program then writes to the registers, causing the `I_INTR_VME_IRQ1` interrupt to occur. Note that you must edit this program to specify the starting address and register offset of your specific VME device. This example program also requires the VME device to be using `I_INTR_VME_IRQ1` and the controller to be the handler for the VME IRQ1.

```
/* vmedev.c
 This example program opens a VXI interface session and sets
 up an interrupt handler.  When the specified interrupt occurs,
 the procedure defined in the interrupt handler is called. You
 must edit this program to specify starting address and
 register offset for your specific VME device. */
#include <stdio.h>
#include <stdlib.h>
#include <sicl.h>

#define ADDR “vxi”

void handler (INST id, long reason, long secval){
   printf (“Got the interrupt\n”);
}

void main ()
{
   unsigned short reg;
   char *base_addr;
   INST id;

   /* install error handler */
   ionerror (I_ERROR_EXIT);

   /* open an interface communications session */
   id = iopen (ADDR);
   itimeout (id, 10000);
```

```
   /* install interrupt handler */
   ionintr (id, handler);
   isetintr (id, I_INTR_VME_IRQ1, 1);

   /* turn interrupt notification off so that interrupts are
      not recognized before the iwaithdlr function is called*/
   iintroff ();

   /* map into user memory space */
   base_addr = imap (id, I_MAP_A24, 0x40, 1, NULL);

   /* read a register */
   reg = iwpeek((unsigned short *)(base_addr + 0x00));

   /* print results */
   printf ("The registers contents were as follows:
             0x%4X\n", reg);

   /* write to a register causing interrupt */
   iwpoke ((unsigned short *)(base_addr + 0x00), reg);

   /* wait for interrupt */
   iwaithdlr (10000);

   /* turn interrupt notification on */
   iintron ();

   /* unmap memory space */
   iunmap (id, base_addr, I_MAP_A24, 0x40, 1);

   /* close session */
   iclose (id);
}
```

Looking at HP SICL Function Support with VXI

This section describes how SICL functions are implemented for VXI sessions.

Device Sessions

Message-Based Device Sessions

The following describes how some SICL functions are implemented for VXI device sessions (for message-based devices):

`iwrite`	Sends the data to the (message-based) servant using the byte-serial write protocol and the *byte available* word-serial command.
`iread`	Reads the data from the (message-based) servant using the byte-serial read protocol and the *byte request* word-serial command.
`ireadstb`	(read status byte) Performs a VXI *readSTB* word-serial command.
`itrigger`	Sends a word-serial *trigger* to the specified message-based device.
`iclear`	Sends a word-serial *device clear* to the specified message-based device.
`ionsrq`	Can be used to catch SRQs from message-based devices.

Interpreted SCPI (`iscpi`) Device Sessions

The `iscpi` interface is used to program VXI register-based instruments. However, the VXI specific and register-based specific SICL functions, such as `ivxiws`, `imap`, and `ipeek` are not necessary, and therefore, are not implemented for the `iscpi` interface.

The following describes how some SICL functions are implemented for `iscpi` device sessions.

`iwrite`	Sends the SCPI commands to the register-based instrument driver's input buffer. The driver will interpret the command and do register peeks and pokes. If the command is a query, the driver will put the data into its output buffer.
`iread`	Reads the data from the register-based instrument driver's output buffer.
`ireadstb`	Performs the equivalent of a serial poll (SPOLL).
`itrigger`	Performs the equivalent of an addressed group execute trigger (GET).
`iclear`	Performs the equivalent of a device clear (DCL) on the device corresponding to this session.

Interpreted SCPI (`iscpi`) Device Session Interrupts. The `iscpi` interface does not support interrupts. Therefore, the SICL `ionintr` function is not implemented for `iscpi` device sessions. There are no device-specific interrupts for the `iscpi` interface.

Interpreted SCPI (`iscpi`) Device Session Service Request. `iscpi` device sessions support Service Requests (SRQ) in the same manner as HP-IB. When one device issues an SRQ, *all* `iscpi` device sessions that have SRQ handlers installed (see `ionsrq` in Chapter 12, "HP SICL Language Reference") will be informed. This is an emulation of how HP-IB handles the SRQ line. The interface cannot distinguish which device requested service, therefore, `iscpi` acts as if all devices require service. Your SRQ handler can retrieve the device's **status byte** by using the `ireadstb` function. The status byte can be used to determine if the instrument needs service. It is good practice to ensure that a device isn't requesting service before leaving the SRQ handler. The easiest technique for this is to service all devices from one handler.

Register-Based Device Sessions

Because *register-based* devices do not support the word serial protocol and other features of *message-based* devices, the following SICL functions are not supported with register-based device sessions (unless you're using the `iscpi` interface, see "Programming with Interpreted SCPI").

- *Non-formatted I/O:*
  - `iread`
  - `iwrite`
  - `itermchr`
- *Formatted I/O:*
  - `iprintf`
  - `iscanf`
  - `ipromptf`
  - `ifread`
  - `ifwrite`
  - `iflush`
  - `isetbuf`
  - `isetubuf`
- *Device/Interface Control:*
  - `iclear`
  - `ireadstb`
  - `isetstb`
  - `itrigger`
- *Service Requests:*
  - `igetonsrq`
  - `ionsrq`
- *Timeouts*:
  - `igettimeout`
  - `itimeout`
- *VXI Specific:*
  - `ivxiws`

All other functions will work with all VXI devices (message-based, register-based, and so forth.)

Use the `i?peek` and `i?poke` functions to communicate with register-based devices.

Interface Sessions

The following describes how some SICL functions are implemented for VXI interface sessions:

`iwrite` and `iread`	Not supported for VXI interface sessions and return the `I_ERR_NOTSUPP` error.
`iclear`	Causes the VXI interface to perform a SYSREST on interface sessions. Note that this will cause all VXI devices to reset. If the `iscpi` interface is being used, the `iscpi` instrument will be terminated. If this happens, you will get a `No Connect` error message and you need to re-open the `iscpi` communications session. All servant devices will cease to function until the VXI resource manager runs and normal operation is re-established.

Note I-SCPI interface sessions only support service requests and locking (`ionsrq`, `ilock`, and `iunlock`).

Considering VXI Backplane Memory I/O Performance

SICL supports two different memory I/O mechanisms for accessing memory on the VXI backplane:

- Single location peek/poke and direct memory dereference:
  -- `imap`
  -- `iunmap`
  -- `ibpeek, iwpeek, ilpeek`
  -- `ibpoke, iwpoke, ilpoke`
  -- *value = *pointer*
  -- **pointer = value*

- Block memory access:
  -- `imap`
  -- `iunmap`
  -- `ibblockcopy, iwblockcopy, ilblockcopy`
  -- `ibpushfifo, iwpushfifo, ilpushfifo`
  -- `ibpopfifo, iwpopfifo, ilpopfifo`

Single location peek/poke or direct memory dereference is the most efficient in programs which require repeated access to different addresses.

On many platforms, the peek/poke operations are actually macros which expand to direct memory dereferencing. The notable exception is on Microsoft Windows platforms, where `ipeek`/`ipoke` are implemented as functions. This is necessary because, under certain conditions, the compiler will attempt to optimize a direct dereference and cause a VXI memory access of the wrong size. For example, when masking the results of a 16-bit read in an expression:

```
data = iwpeek(addr) & 0xff;
```

the compiler will simplify this to an 8-bit read of the contents of the `addr` pointer. This would cause an error when attempting to read memory on a VXI card that did not support 8-bit access. When `iwpeek` is implemented as a function, the correct size memory access is guaranteed.

The block memory access functions provide the highest possible performance for transferring large blocks of data to or from the VXI backplane.

Although these calls have higher initial overhead than the `ipeek`/`ipoke` calls, they are optimized by HP on each platform to provide the fastest possible transfer rate for large blocks of data. These routines may, for example, use DMA, which is not available with `ipeek`/`ipoke`.

Note that for small blocks, the overhead associated with the block memory access functions may actually make these calls longer than an equivalent loop of `ipeek`/`ipoke` calls. The block size at which the block functions become faster depends on the particular platform and processor speed.

The following is an example of the various types of VXI memory I/O in SICL.

```
/*
   siclmem.c
   This example program demonstrates the use of
   simple and block memory I/O methods in SICL.
*/

#include <sicl.h>
#include <stdlib.h>
#include <stdio.h>

#define VXI_INST “vxi,24”

void main () {
   INST           id;
   unsigned short *memPtr16;
   unsigned short id_reg;
   unsigned short devtype_reg;
   unsigned short memArray[2];
   int            err;

   /* Open a session to our instrument */
   id = iopen(VXI_INST);
```

```
/*
=========================================================
=================== Simple memory I/O ==================
   = iwpeek()
   = direct memory dereference

   Note that on many platforms, the ipeek/ipoke operations are
   actually macros which expand to direct memory dereferencing.
   The notable exception is on Microsoft Windows platforms where
   ipeek/ipoke are implemented as functions.  This is necessary
   because under certain conditions, the compiler will attempt to
   optimize a direct dereference and cause a VXI memory access of
   the wrong size.  For example when masking the results of a 16
   bit read in a expression:
      data = iwpeek(addr) & 0xff;
   the compiler will simplify this to an 8 bit read of the
   contents of the addr pointer.  This would cause an error when
   attempting to read memory on a VXI card that did not support
   8 bit access.
=========================================================
*/

/* Map into memory space */
memPtr16 = (unsigned short *)imap(id, I_MAP_VXIDEV, 0, 1, 0);

/* ================= using peek ======================
/* Read instrument id register contents */
id_reg = iwpeek(memPtr16);

/*       Read device type register contents    */
id_reg = iwpeek(memPtr16+1);

/* Print results */
printf("   iwpeek: ID Register = 0x%4X\n", id_reg);
printf("   iwpeek: Device Type Register = 0x%4X\n",
   devtype_reg);

/* Use direct memory dereferencing */
id_reg =      *memPtr16;
devtype_reg = *(memPtr16+1);

/* Print results */
printf("dereference: ID Register = 0x%4X\n", id_reg);
printf("dereference: Device Type Register = 0x%4X\n",
        devtype_reg);
```

```
/*
============================================================
================== block memory I/O ====================
   = iwblockcopy
   = iwpushfifo
   = iwpopfifo

These commands offer the best performance for reading and writing
large data blocks on the VXI backplane.  Note that for this
example we are only moving 2 words at a time. Normally these
functions would be used to move much larger blocks of data.
============================================================
============================================================
*/

/*
============== Demonstrate block read ==================
Read the instrument id register and device type register
into an array.
*/
err = iwblockcopy(id, memPtr16, memArray, 2, 0);

/* Print results */
printf(" iwblockcopy: ID Register = 0x%4X\n", memArray[0]);
printf(" iwblockcopy: Device Type Register = 0x%4X\n",
memArray[1]);

/*
================ Demonstrate popfifo ===================
*/

/* Do a popfifo of the Id Register */
err = iwpopfifo(id, memPtr16, memArray, 2, 0);

/* Print results */
printf(" iwpopfifo: 1 ID Register = 0x%4X\n", memArray[0]);
printf(" iwpopfifo: 2 ID Register = 0x%4X\n", memArray[1]);

/*
================ Cleanup and exit ==================*/
/* Unmap memory space */
iunmap(id, (char *)memPtr16, I_MAP_VXIDEV, 0, 1);

/* Close instrument session */
iclose(id);
}
```

Using VXI Specific Interrupts

See the `isetintr` function in Chapter 12, "HP SICL Language Reference" for a list of VXI specific interrupts.

The following pseudo-code describes the actions performed by SICL when a VME interrupt arrives and/or a VXI signal register write occurs.

```
VME Interrupt arrives:
   get iack value
   send I_INTR_VME_IRQ?
   is VME IRQ line configured VME only
   if yes then
      exit
   do lower 8 bits match logical address of one of our servants?
   if yes then
      /*  iack is from one of our servants */
      call servant_signal_processing(iack)
   else
      /* iack is from non-servant VXI device or VME device*/
   send I_INTR_VXI_VME interrupt to interface sessions
Signal Register Write occurs:
   get value written to signal register
   send I_INTR_ANY_SIG
   do lower 8 bits match logical address of one of our servants?
   if yes then
      /* Signal is from one of our servants */
      call Servant_signal_processing(value)
   else
      /* Stray signal */
      send I_INTR_VXI_UKNSIG to interface sessions
servant_signal_processing (signal_value)
   /* Value is form one of our servants */
   is signal value a response signal?
   If yes then
      process response signal
      exit
   /* Signal is an event signal */
   is signal an RT or RF event?
   if yes then
      /* A request TRUE or request FALSE arrived */
      process request TRUE or request FALSE event
      generate SRQ if appropriate
      exit
```

```
is signal an undefined command event?
if yes then
   /* Undefined command event */
   process an undefined command event
   exit
/* Signal is a user-defined or undefined event */
send I_INTR_VXI_SIGNAL to device sessions for this device
exit
```

Processing VME Interrupts Example

```
/* vmeintr.c
   This example uses SICL to cause a VME interrupt from an
   HP E1361 register-based relay card at logical address 136.*/
#include <sicl.h>

static void vmeint (INST, unsigned short);
static void int_setup (INST, unsigned long);
static void int_hndlr (INST, long, long);
int intr = 0;
main() {
   int o;   INST id_intf1;
   unsigned long mask = 1;

   ionerror (I_ERROR_EXIT);
   iintroff ();
   id_intf1 = iopen (“vxi,136”);
   int_setup (id_intf1, mask);
   vmeint (id_intf1, 136);
   /* wait for SRQ or interrupt condition */
   iwaithdlr (0);

   iintron ();
   iclose (id_intf1);
}
static void int_setup(INST id, unsigned long mask) {
   ionintr(id, int_hndlr);
   isetintr(id, I_INTR_VXI_SIGNAL, mask);
}
static void vmeint (INST id, unsigned short laddr) {
   int reg;
   char *a16_ptr = 0;

   reg = 8;
   a16_ptr = imap (id, I_MAP_A16, 0, 1, 0);
```

```
  /* Cause uhf mux to interrupt: */
  iwpoke ((unsigned short *)(a16_ptr + 0xc000 + laddr *
          64 + reg),  0x0);
}
static void int_hndlr (INST id, long reason, long sec) {
  printf ("VME interrupt: reason: 0x%x, sec: 0x%x\n",
             reason,sec);
  intr = 1;
}
```

Summary of VXI Specific Functions

Note Using these VXI interface specific functions means that the program can not be used on other interfaces and, therefore, becomes less portable.

These functions will work over a LAN-gatewayed session if the server supports the operation.

SICL VXI Functions

Function Name	Action
`ivxibusstatus`	Returns requested bus status information
`ivxigettrigroute`	Returns the routing of the requested trigger line
`ivxirminfo`	Returns information about VXI devices
`ivxiservants`	Identifies active servants
`ivxitrigoff`	De-asserts VXI trigger line(s)
`ivxitrigon`	Asserts VXI trigger line(s)
`ivxitrigroute`	Routes VXI trigger lines
`ivxiwaitnormop`	Suspends until normal operation is established
`ivxiws`	Sends a word-serial command to a device

8

Using HP SICL with RS-232

Using HP SICL with RS-232

RS-232 is a serial interface that is widely used for instrumentation. Although it is slow in comparison to HP-IB or VXI, its low cost makes it an attractive solution in many situations. Because HP SICL for Windows uses the RS-232 facilities built into the Windows operating system, controlling RS-232 instruments is easy to do.

This chapter describes in detail how to open a communications session and communicate with an instrument over an RS-232 connection. The example programs shown in this chapter are also provided in the `C\SAMPLES\MISC` (for C/C++) and `VB\SAMPLES\MISC` (for Visual BASIC) subdirectories under the SICL base directory (for example, `C:\SICL95` or `C:\SICLNT` if the default installation directory was used).

This chapter contains the following sections:

- Creating a Communications Session with RS-232
- Communicating with RS-232 Devices
- Communicating with RS-232 Interfaces
- Summary of RS-232 Specific Functions

Creating a Communications Session with RS-232

Once you have configured your system for RS-232 communications, you can start programming with the SICL functions. If you have programmed RS-232 before, you will probably want to open the interface and start sending commands. With SICL, you must first determine what type of communications session you will need.

SICL is designed to provide a standard way of accessing instrumentation that is independent from the type of connection. With HP-IB, there can be multiple devices on a single interface. SICL allows you direct access to a device on an interface without worrying about the type of interface to which it is connected. To do this, you communicate with a **device session**. SICL also allows you to do interface-specific actions, such as setting up device addresses or setting other interface-specific characteristics. To do this, you communicate with an **interface session**.

With RS-232, only one device is connected to the interface. Therefore, it may seem like extra work to have device sessions and interface sessions. However, structuring your code so that interface-specific actions are isolated from actions on the device itself makes your programs easier to maintain. This is especially important if, at some point, you will want to use a program with a similar instrument on a different interface, such as HP-IB.

Using SICL to communicate with an instrument on RS-232 is similar to using SICL over HP-IB. You must first determine what type of communications session you will need. An RS-232 communications session can be either a device session or an interface session. Commander sessions are not supported on RS-232.

An RS-232 device session should be used when sending commands and receiving data from an instrument. Setting interface characteristics (such as the baud rate) must be done with an interface session.

Communicating with RS-232 Devices

The device session allows you direct access to a device without worrying about the type of interface to which it is connected. The specifics of the interface are hidden from the user.

Addressing RS-232 Devices

To create a device session, specify the interface logical unit or symbolic name, followed by a device logical address of `488`. The interface logical unit and symbolic name are defined by running the `I/O Config` utility from the `HP I/O Libraries` program group for Windows 95 or Windows NT, or from the `HP SICL` program group for Windows 3.1. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on running `I/O Config`. The device address of `488` tells SICL that you are communicating with an instrument that uses the IEEE 488.2 standard command structure.

Note If your instrument does not "speak" IEEE 488.2, you can still use SICL to communicate with it. However, some of the SICL functions that work only with device sessions may not operate correctly. See the next section, "HP SICL Function Support with RS-232 Device Sessions."

The following are example addresses for RS-232 device sessions:

```
COM1,488
serial,488
```

For other interfaces, SICL supports the concept of primary and secondary addresses. For RS-232, the only primary address supported is `488`. SICL does not support secondary addressing on RS-232 interfaces.

The following are examples of opening a device session with an RS-232 device.

C example:

```
INST dmm;
dmm = iopen ("com1,488");
```

Visual BASIC example:

```
Dim dmm As Integer
dmm = iopen ("com1,488"
```

HP SICL Function Support with RS-232 Device Sessions

The following describes how some SICL functions are implemented for RS-232 device sessions.

`iprintf`, `iscanf`, `ipromptf`	SICL's formatted I/O routines depend on the concept of an EOI indicator. Since RS-232 does not define an EOI indicator, SICL uses the newline character (`\n`) by default. You cannot change this with a device session; however, you can use the `iserialctrl` function with an interface session. See the section titled "HP SICL Function Support with RS-232 Interface Sessions" later in this chapter.
`ireadstb`	Sends the IEEE 488.2 command `*STB?` to the instrument, followed by the newline character (`\n`). It then reads the ASCII response string and converts it to an 8-bit integer. Note that this will work only if the instrument understands this command.

`itrigger`	Sends the IEEE 488.2 command `*TRG` to the instrument, followed by the newline character (`\n`). Note that this will work only if the instrument understands this command.
`iclear`	Sends a break, aborts any pending writes, discards any data in the receive buffer, resets any flow control states (such as `XON/XOFF`), and resets any error conditions. To reset the interface without sending a break, use the following function: `iserialctrl (`*id*`, I_SERIAL_RESET, 0)`
`ionsrq`	nstalls a service request handler for this session. Service requests are supported for both device sessions and interface sessions. See the section titled "HP SICL Function Support for RS-232 Interface Sessions" later in this chapter.

RS-232 Device Session Interrupts

There are specific device session interrupts that can be used. See `isetintr` in Chapter 12, "HP SICL Language Reference" for information on the device session interrupts for RS-232.

RS-232 Device Session Examples

Note The following `ser_dev` example programs were tested with an HP 34401A Digital Voltmeter. When you run the program with a serial connection to the HP 34401A, make sure that DTR/DSR flow control is set for the serial port. Otherwise, the program will appear not to work.

C example:

```
/* ser_dev.c
   This example program takes a measurement from a DVM
   using a SICL device session.
*/
#include <sicl.h>
#include <stdio.h>
#include <stdlib.h>

#if !defined(WIN32)
   #define LOADDS __loadds
#else
   #define LOADDS
#endif

void SICLCALLBACK LOADDS error_handler (INST id, int error) {

   printf ("Error: %s\n", igeterrstr (error));
   exit (1);
}

main()
{
   INST dvm;
   double res;

   #if defined(__BORLANDC__) && !defined(__WIN32__
      _InitEasyWin();  // required for Borland EasyWin
programs
   #endif
```

```
  /* Log message and terminate on error */
  ionerror (error_handler);

  /* Open the multimeter session */
  dvm = iopen (“COM1,488”);
  itimeout (dvm, 10000);

  /* Prepare the multimeter for measurements */
  iprintf (dvm,”*RST\n”);
  iprintf (dvm,”SYST:REM\n”);

  /* Take a measurement */
  iprintf (dvm,”MEAS:VOLT:DC?\n”);

  /* Read the results */
  iscanf (dvm,”%lf”,&res);

  /* Print the results */
  printf (“Result is %f\n”,res);

  /* Close the voltmeter session */
  iclose (dvm);

  // For WIN16 programs, call _siclcleanup before exiting to
  // release resources allocated by SICL for this
  // application. This call is a no-op for WIN32 programs
  _siclcleanup();

  return 0;
}
```

Visual BASIC example:

```
‘  ser_dev.bas
‘  This example program takes a measurement from a DVM
‘  using a SICL device session.
Sub Main ()
   Dim dvm As Integer
   Dim res As Double
   Dim argcount As Integer

   ‘ Open the multimeter session
   dvm = iopen(“COM1,488”)
   Call itimeout(dvm, 10000)

   ‘ Prepare the multimeter for measurements
   argcount = ivprintf(dvm, “*RST” + Chr$(10), 0&)

   argcount = ivprintf(dvm, “SYST:REM” + Chr$(10), 0&)

   ‘ Take a measurement
   argcount = ivprintf(dvm, “MEAS:VOLT:DC?” + Chr$(10))

   ‘ Read the results
   argcount = ivscanf(dvm, “%lf”, res)

   ‘ Print the results
   MsgBox “Result is “ + Format(res), MB_ICON_EXCLAMATION

   ‘ Close the multimeter session
   Call iclose(dvm)

‘  Tell SICL to cleanup for this task
   Call siclcleanup

End Sub
```

Communicating with RS-232 Interfaces

Interface sessions can be used to get or set the characteristics of the RS-232 connection. Examples of some of these characteristics are baud rate, parity, and flow control.

Addressing RS-232 Interfaces

To create an interface session on RS-232, specify the interface logical unit or symbolic name in the *addr* parameter of the `iopen` function. The interface logical unit and symbolic name are defined by running the `I/O Config` utility from the `HP I/O Libraries` program group for Windows 95 or Windows NT, or from the `HP SICL` program group for Windows 3.1. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on running `I/O Config`.

The following are example addresses for RS-232 interface sessions:

`COM1`	An interface symbolic name
`serial`	An interface symbolic name
`1`	An interface logical unit

The following examples open an interface session with the RS-232 interface.

C example:

```
INST intf;
intf = iopen ("COM1");
```

Visual BASIC example:

```
Dim intf As Integer
intf = iopen ("COM1")
```

HP SICL Function Support with RS-232 Interface Sessions

The following describes how some SICL functions are implemented for RS-232 interface sessions.

`iwrite`, `iread`	All I/O functions (non-formatted and formatted) work the same as for device sessions. However, it is recommended that all I/O be performed with device sessions to make your programs easier to maintain.
`ixtrig`	Provides a method of triggering using either the DTR or RTS modem status line. This function clears the specified modem status line, waits 10 milliseconds, then sets it again. Specifying `I_TRIG_STD` is the same as specifying `I_TRIG_SERIAL_DTR`.
`itrigger`	Pulses the DTR modem control line for 10 milliseconds.
`iclear`	Sends a break, aborts any pending writes, discards any data in the receive buffer, resets any flow control states (such as `XON/XOFF`), and resets any error conditions. To reset the interface without sending a break, use the following function: `iserialctrl (`*id*`, I_SERIAL_RESET, 0)`

`ionsrq`

Installs a service request handler for this session. The concept of service request (SRQ) originates from HP-IB. On an HP-IB interface, a device can request service from the controller by asserting a line on the interface bus. RS-232 does not have a specific line assigned as a service request line. However, you can assign one of the modem status lines (RI, DCD, CTS, or DSR) as the service request line by running the `I/O Config` utility. Any transition on the designated service request line will cause an SRQ handler in your program to be called. (Be sure not to set the SRQ line to CTS or DSR if you are also using that line for hardware flow control.)

Service requests are supported for both device sessions and interface sessions. When the designated SRQ line changes state, the RS-232 driver calls all SRQ handlers installed by either device sessions or interface sessions.

`iserialctrl`

Sets the characteristics of the serial interface. The following requests are clarified:

- `I_SERIAL_DUPLEX`: The duplex setting determines whether data can be sent and received simultaneously. Setting full duplex allows simultaneous send and receive data traffic. Setting half duplex (the default) will cause reads and writes to be interleaved, so that data is flowing in only one direction at any given time. (The exception to this is if `XON/XOFF` flow control is used.)
- `I_SERIAL_READ_BUFSZ`: The default read buffer size is 2048 bytes.
- `I_SERIAL_RESET`: Performs the same function as the `iclear` function on an interface session, except that a break is not sent.

`iserialstat`	Gets the characteristics of the serial interface. The following requests are clarified: • `I_SERIAL_MSL`: Gets the state of the modem status line. Because of the way Windows supports RS-232, the `I_SERIAL_RI` bit will never be set. However, the `I_SERIAL_TERI` bit will be set when the RI modem status line changes from high to low. • `I_SERIAL_STAT`: Gets the status of the transmit and receive buffers and the errors that have occurred since the last time this request was made. Only the error bits (`I_SERIAL_PARITY`, `I_SERIAL_OVERFLOW`, `I_SERIAL_FRAMING`, and `I_SERIAL_BREAK`) are cleared; the `I_SERIAL_READ_DAV` and `I_SERIAL_TEMT` bits reflect the status of the buffers at all times. • `I_SERIAL_READ_DAV`: Gets the current amount of data available for reading. This shows how much data is in Windows' receive buffer, not how much data is in the buffer used by the formatted input functions such as `iscanf`.
`iserial-mclctrl`	Controls the modem control lines RTS and DTR. If one of these lines is being used for flow control, you cannot set that line with this function.
`iserial-mclstat`	Determines the current state of the modem control lines. If one of these lines is being used for flow control, this function may not give the correct state of that line.

RS-232 Interface Session Interrupts

There are specific interface session interrupts that can be used. See `isetintr` in Chapter 12, "HP SICL Language Reference" for information on the interface session interrupts for RS-232.

RS-232 Interface Session Examples

C example:

```
/*ser_intf.c
   This program does the following:
   1) gets the current configuration of the serial port,
   2) sets it to 9600 baud, no parity, 8 data bits, and
      1 stop bit, and
   3) Prints the old configuration.
*/
#include <stdio.h>
#include <sicl.h>

main()
{
   INST intf;                  /* interface session id */
   unsigned long baudrate, parity, databits, stopbits;
   char *parity_str;

   #if defined(__BORLANDC__) && !defined(__WIN32__)
   _InitEasyWin();   // required for Borland EasyWin programs
   #endif

   /* Log message and exit program on error */
   ionerror (I_ERROR_EXIT);

   /* open RS-232 interface session */
   intf = iopen ("COM1");
   itimeout (intf, 10000);

   /* get baud rate, parity, data bits, and stop bits */
   iserialstat (intf, I_SERIAL_BAUD,   &baudrate);
   iserialstat (intf, I_SERIAL_PARITY, &parity);
   iserialstat (intf, I_SERIAL_WIDTH,  &databits);
   iserialstat (intf, I_SERIAL_STOP,   &stopbits);

   /* determine string to display for parity */
   if   (parity == I_SERIAL_PAR_NONE) parity_str = "NONE";
   else if (parity == I_SERIAL_PAR_ODD) parity_str = "ODD";
   else if (parity == I_SERIAL_PAR_EVEN) parity_str = "EVEN";
   else if (parity == I_SERIAL_PAR_MARK)  parity_str = "MARK";
   else  /*parity == I_SERIAL_PAR_SPACE*/ parity_str = "SPACE";
```

```
    /* set to 9600,NONE,8,1 */
    iserialctrl (intf, I_SERIAL_BAUD,   9600);
    iserialctrl (intf, I_SERIAL_PARITY, I_SERIAL_PAR_NONE);
    iserialctrl (intf, I_SERIAL_WIDTH,  I_SERIAL_CHAR_8);
    iserialctrl (intf, I_SERIAL_STOP,   I_SERIAL_STOP_1);

     /* Display previous settings */
    printf("Old settings:  %5ld,%s,%ld,%ld\n",
           baudrate, parity_str, databits, stopbits);

    /* close port */
    iclose (intf);

    // For WIN16 programs, call _siclcleanup before exiting
    // to release resources allocated by SICL for this
    // application. This call is a no-op for WIN32 programs.
    _siclcleanup();

    return 0;
}
```

Visual BASIC example:

```
‘  ser_intf.bas
‘  This program does the following:
‘  1) gets the current configuration of the serial port
‘  2) sets it to 9600 baud, no parity, 8 data bits, and
‘     1 stop bit
‘  3) prints the old configuration

Sub main ()
  Dim intf As Integer
  Dim baudrate As Long
  Dim parity As Long
  Dim databits As Long
  Dim stopbits As Long
  Dim parity_str As String
  Dim msg_str As String

  ‘ open RS-232 interface session
  intf = iopen(“COM1”)
  Call itimeout(intf, 10000)

  ‘ get baud rate, parity, data bits, and stop bits
  Call iserialstat(intf, I_SERIAL_BAUD, baudrate)
  Call iserialstat(intf, I_SERIAL_PARITY, parity)
  Call iserialstat(intf, I_SERIAL_WIDTH, databits)
  Call iserialstat(intf, I_SERIAL_STOP, stopbits)

  ‘ determine string to display for parity
  Select Case parity
  Case I_SERIAL_PAR_NONE
    parity_str = “NONE”
  Case I_SERIAL_PAR_ODD
    parity_str = “ODD”
  Case I_SERIAL_PAR_EVEN
    parity_str = “EVEN”
  Case I_SERIAL_PAR_MARK
    parity_str = “MARK”
  Case Else
    parity_str = “SPACE”
  End Select
```

```
    ‘ set to 9600,NONE,8, 1
    Call iserialctrl(intf, I_SERIAL_BAUD, 9600)
    Call iserialctrl(intf, I_SERIAL_PARITY, I_SERIAL_PAR_NONE)
    Call iserialctrl(intf, I_SERIAL_WIDTH, I_SERIAL_CHAR_8)
    Call iserialctrl(intf, I_SERIAL_STOP, I_SERIAL_STOP_1)

    ‘ display previous settings
    msg_str = “Old settings: “ + Str$(baudrate) + “,” +
         parity_str + “,” + Str$(databits) + “,” +
         Str$(stopbits)
    MsgBox msg_str, MB_ICON_EXCLAMATION

    ‘ close port
    Call iclose(intf)

    ‘  Tell SICL to cleanup for this task
    Call siclcleanup

End Sub
```

Summary of RS-232 Specific Functions

Function Name	Action
`iserialctrl`	Sets the following characteristics of the RS-232 interface:

Request	Characteristic	Settings
`I_SERIAL_BAUD`	Data rate	2400, 9600, etc.

`I_SERIAL_PARITY`	Parity	`I_SERIAL_PAR_NONE`
		`I_SERIAL_PAR_IGNORE`
		`I_SERIAL_PAR_EVEN`
		`I_SERIAL_PAR_ODD`
		`I_SERIAL_PAR_MARK`
		`I_SERIAL_PAR_SPACE`

`I_SERIAL_STOP`	Stop bits / frame	`I_SERIAL_STOP_1` `I_SERIAL_STOP_2`

`I_SERIAL_WIDTH`	Data bits / frame	`I_SERIAL_CHAR_5`
		`I_SERIAL_CHAR_6`
		`I_SERIAL_CHAR_7`
		`I_SERIAL_CHAR_8`

`I_SERIAL_READ_BUFSZ`	Receive buffer size	Number of bytes
`I_SERIAL_DUPLEX`	Data traffic	`I_SERIAL_DUPLEX_HALF` `I_SERIAL_DUPLEX_FULL`

`I_SERIAL_FLOW_CTRL`	Flow control	`I_SERIAL_FLOW_NONE`
		`I_SERIAL_FLOW_XON`
		`I_SERIAL_FLOW_RTS_CTS`
		`I_SERIAL_FLOW_DTR_DSR`

`I_SERIAL_READ_EOI`	EOI indicator for reads	`I_SERIAL_EOI_NONE`
		`I_SERIAL_EOI_BIT8`
		`I_SERIAL_EOI_CHAR` | (n)

`I_SERIAL_WRITE_EOI`	EOI indicator for writes	`I_SERIAL_EOI_NONE` `I_SERIAL_EOI_BIT8`
`I_SERIAL_RESET`	Interface state	(none)

Function Name	Action
`iserialstat`	Gets the following information about the RS-232 interface:

Request	Characteristic	Value
`I_SERIAL_BAUD`	Data rate	2400, 9600, etc.
`I_SERIAL_PARITY`	Parity	`I_SERIAL_PAR_*`
`I_SERIAL_STOP`	Stop bits / frame	`I_SERIAL_STOP_*`
`I_SERIAL_WIDTH`	Data bits / frame	`I_SERIAL_CHAR_*`
`I_SERIAL_DUPLEX`	Data traffic	`I_SERIAL_DUPLEX_*`

`I_SERIAL_MSL`	Modem status lines	`I_SERIAL_DCD`
		`I_SERIAL_DSR`
		`I_SERIAL_CTS`
		`I_SERIAL_RI`
		`I_SERIAL_TERI`
		`I_SERIAL_D_DCD`
		`I_SERIAL_D_DSR`
		`I_SERIAL_D_CTS`

`I_SERIAL_STAT`	Misc. status	`I_SERIAL_DAV`
		`I_SERIAL_TEMT`
		`I_SERIAL_PARITY`
		`I_SERIAL_OVERFLOW`
		`I_SERIAL_FRAMING`
		`I_SERIAL_BREAK`

`I_SERIAL_READ_BUFSZ`	Receive buffer size	Number of bytes
`I_SERIAL_READ_DAV`	Data available	Number of bytes
`I_SERIAL_FLOW_CTRL`	Flow control	`I_SERIAL_FLOW_*`
`I_SERIAL_READ_EOI`	EOI indicator for reads	`I_SERIAL_EOI*`
`I_SERIAL_WRITE_EOI`	EOI indicator for writes	`I_SERIAL_EOI*`

Function Name	Action
`iserialmclctrl`	Sets or Clears the modem control lines. Modem control lines are either `I_SERIAL_RTS` or `I_SERIAL_DTR`.
`iserialmclstat`	Gets the current state of the modem control lines.
`iserialbreak`	Sends a break to the instrument. Break time is 10 character times, with a minimum time of 50 milliseconds and a maximum time of 250 milliseconds.

9

Using HP SICL with LAN

Using HP SICL with LAN

This chapter explains how to use SICL over LAN (Local Area Network). LAN is a natural way to extend the control of instrumentation beyond the limits of typical instrument interfaces.

Note LAN is *only* supported with 32-bit SICL on Windows 95 and Windows NT. If you are programming in Visual BASIC, this means that LAN is *only* supported with 32-bit Visual BASIC version 4.0.

Also, the GPIO interface is *not* supported with SICL over LAN.

This chapter describes in detail how to open a communications session and communicate with devices over LAN. The example programs shown in this chapter are also provided in the `C\SAMPLES\MISC` (for C/C++) and `VB\SAMPLES\MISC` (for Visual BASIC) subdirectories under the SICL base directory (for example, under `C:\SICL95` or `C:\SICLNT` if the default installation directory was used).

This chapter contains the following sections:

- Overview of LAN with HP SICL
- Considering LAN Configuration and Performance
- Communicating with LAN Devices
- Using Locks and Multiple Threads over LAN
- Using Timeouts with LAN
- Summary of LAN Specific Functions

Note To start the LAN server on a Windows 95 or Windows NT system, see the appropriate “Starting the LAN Server” section of Chapter 2, “Installing and Configuring the HP I/O Libraries,” in the *HP I/O Libraries Installation and Configuration Guide for Windows*.

To stop the LAN server on a Windows 95 or Windows NT system, see the appropriate “Stopping the LAN Server” section of Chapter 2, “Installing and Configuring the HP I/O Libraries,” in the *HP I/O Libraries Installation and Configuration Guide for Windows*.

Overview of LAN with HP SICL

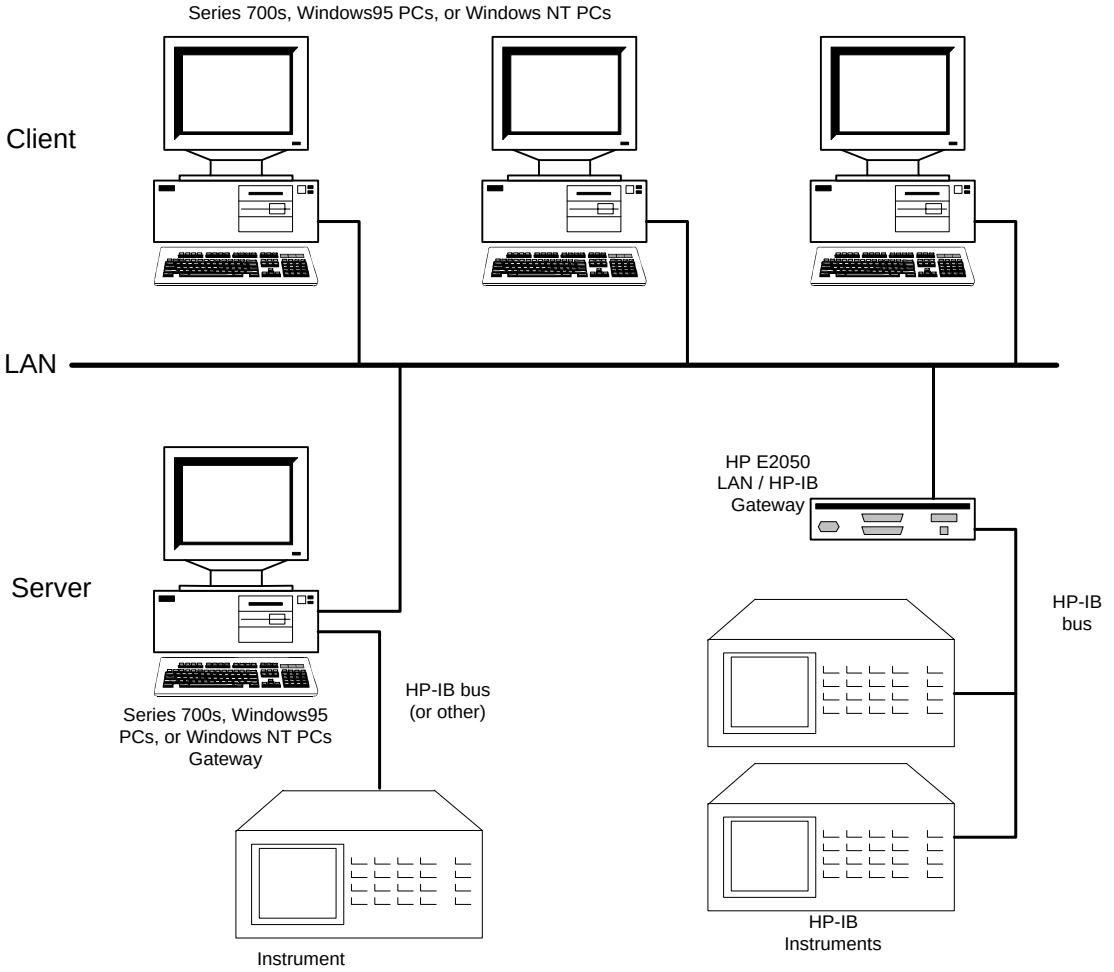
The LAN software provided with SICL allows you to control instrumentation over a LAN. LAN connections are included on many systems being sold today. By making use of these standard LAN connections, instrument control can be driven from a computer which does not have a special interface for instrument control.

The LAN software provided with SICL uses the client/server model of computing. **Client/server computing** refers to a model where an application, the **client**, does not perform all the necessary tasks of the application itself. Instead, the client makes requests of another computing device, the **server**, for certain services. Examples that you may have in your workplace include shared file servers, print servers, or database servers.

The use of LAN for instrument control also provides other advantages associated with client/server computing:

- Resource sharing by multiple applications/people within an organization.
- Distributed control, where the computer running the application controlling the devices need not be in the same room or even the same building as the devices themselves.

As shown in the following figure, a LAN client computer system (a Series 700 HP-UX workstation, a Windows 95 PC, or a Windows NT PC) makes SICL requests over the network to a LAN server (a Series 700 HP-UX workstation, a Windows 95 PC, a Windows NT PC, or an HP E2050 LAN/HP-IB Gateway). The LAN server is connected to the instrumentation or devices that must be controlled. Once the LAN server has completed the requested operation on the instrument or device, the LAN server sends a reply to the LAN client. This reply contains any requested data and status information which indicates whether the operation was successful.

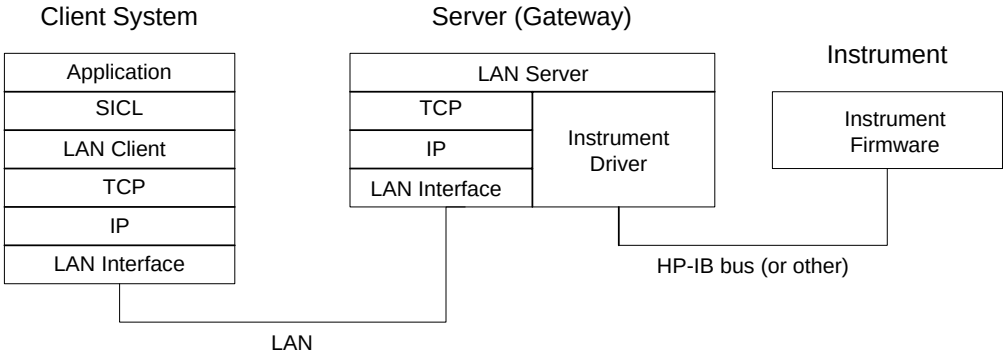


Using the LAN Client and LAN Server (Gateway)

The LAN server acts as a **gateway** between the LAN that your client system supports, and the instrument-specific interface that your device supports. Due to the LAN server's gateway functionality, we refer to devices or interfaces which are accessed via one of these LAN-to-instrument_interface gateways as being a LAN-gatewayed device or a LAN-gatewayed interface.

LAN Software Architecture

As the following figure shows, the client system contains the LAN client software and the LAN software (TCP/IP) needed to access the server (gateway). The gateway contains the LAN server software, LAN (TCP/IP) software, and the instrument driver software needed to communicate with the client and to control the instruments or devices connected to it.



LAN Software Architecture

LAN Networking Protocols

The LAN software provided with SICL is built on top of standard LAN networking protocols. There are two LAN networking protocols provided with the SICL software. You can choose one or both of these protocols when configuring your systems (via the `I/O Config` utility) to use SICL over LAN. The two protocols are as follows:

- **SICL LAN Protocol** is a networking protocol developed by HP which is compatible with all existing SICL LAN products. This LAN networking protocol is the default choice in the `I/O Config` utility when you are configuring LAN for SICL. The SICL LAN Protocol on Windows 95 and Windows NT supports SICL operations over the LAN to HP-IB/GPIB and RS-232 interfaces.

- **TCP/IP Instrument Protocol** is a networking protocol developed by the VXIbus Consortium based on the SICL LAN Protocol which permits interoperability of LAN software from different vendors that meet the VXIbus Consortium standards. Note that this LAN networking protocol may not be implemented with all the SICL LAN products at this time. The TCP/IP Instrument Protocol on Windows 95 and Windows NT supports SICL operations over the LAN to HP-IB/GPIB interfaces. Also, some SICL operations are not supported when using the TCP/IP Instrument Protocol. See the section titled "HP SICL Function Support with LAN-gatewayed Sessions" later in this chapter.

When using either of these networking protocols, the LAN software provided with SICL uses the TCP/IP protocol suite to pass messages between the LAN client and the LAN server. The server accepts device I/O requests over the network from the client and then proceeds to execute those I/O requests on a local interface, such as HP-IB.

You can use both LAN networking protocols with a LAN client. To do so, simply configure *both* the SICL LAN Protocol and the TCP/IP Instrument Protocol on the LAN client system via the `I/O Config` utility. (See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on running `I/O Config`.) Then use the name of the interface supporting the protocol you wish to use in each SICL `iopen` call of your program. (See the "Communicating with LAN Devices" section later in this chapter for details on how to create communications sessions with SICL over LAN using each of these protocols.) Note, however, that the LAN server does *not* support

simultaneous connections from LAN clients using the SICL LAN Protocol and from other LAN clients using the TCP/IP Instrument Protocol.

LAN Client and Threads

You can use multi-threaded designs (where SICL calls are made from multiple threads) in WIN32 SICL applications over LAN. However, only one thread is permitted to access the LAN driver at a time. This sequential handling of individual threads by the LAN driver prevents multiple threads from colliding or overwriting one another. Note that requests are handled sequentially even if they are intended for different LAN servers.

If you want concurrent threads to be processed simultaneously with SICL over LAN, use multiple processes. For more information on using threads in WIN32 SICL applications, refer to the section, "Thread Support for 32-bit Windows Applications," in Chapter 3, "Building an HP SICL Application." Also see the section, "Using Locks and Multiple Threads over LAN," later in this chapter for information on using locks in multi-threaded applications.

LAN Server

SICL includes the necessary software to allow a Windows 95 PC or a Windows NT PC to act as a LAN-to-instrument_interface gateway. To use this capability, the PC must have a local interface configured for I/O. The supported interfaces for this release are GPIB/HP-IB and RS-232 with the SICL LAN Protocol, and GPIB/HP-IB with the TCP/IP Instrument Protocol. (The LAN server does *not* support VXI operations with either protocol.)

Note that the timing of operations performed remotely over a network will be different from the timing of operations performed locally. The extent of the timing difference will, in part, depend on the bandwidth of and the traffic on the network being used.

Contact your local HP representative for a current list of other HP supported LAN servers.

Considering LAN Configuration and Performance

As with other client/server applications on a LAN, when deploying an application which uses SICL over LAN, consideration must be given to the performance and configuration of the network to which the client and server will be attached. If the network to be used is not a dedicated LAN or otherwise isolated via a bridge or other network device, current utilization of the LAN must be considered. Depending on the amount of data which will be transferred over the LAN via the SICL application, performance problems could be experienced by the SICL application or other network users if sufficient bandwidth is not available. This is not unique to SICL over LAN, but is simply a general design consideration when deploying any client/server application.

If you have questions concerning the ability of your network to handle SICL traffic, consult with your network administrator or network equipment providers.

Communicating with LAN Devices

There are several different types of sessions which are supported over LAN. This section describes those session types and what behavior should be expected for the various SICL calls.

LAN-gatewayed Sessions

Communicating with a device over LAN through a LAN-to-instrument_interface gateway preserves the functionality of the gatewayed-interface with only a few exceptions. (See the "HP SICL Function Support with LAN-gatewayed Sessions" section later in this chapter.) This means most operations you might request of an interface, such as HP-IB, connected directly to your controller, you can also request of a remote interface via the LAN gateway. The only portions of your application which must change are the addresses passed to the `iopen` calls (unless those addresses are stored in a configuration file, in which case no changes to the application itself are required). The address used for a local interface must have a LAN prefix added to it so that the SICL software knows to direct the request to a LAN server on the network.

Addressing Devices or Interfaces with LAN-gatewayed Sessions

To create a LAN-gatewayed session, specify the LAN's interface logical unit or interface name, the IP address or hostname of the server machine, and the address of the remote interface or device in the *addr* parameter of the `iopen` function. The interface logical unit and interface name are defined by running the `I/O Config` utility from the `HP I/O Libraries` program group. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on running `I/O Config`.

The following are examples of LAN-gatewayed addresses:

`lan[instserv]:GPIB,7`	A device address corresponding to the device at primary address 7 on the `GPIB` interface attached to the machine named `instserv`.
`lan[instserv.hp.com]:hpib,7`	A device address corresponding to the device at primary address 7 on the `hpib` interface attached to the machine named `instserv` in the `hp.com` domain. (Fully qualified domain names may be used.)
`lan1[128.10.0.3]:GPIB0,3,2`	A device address corresponding to the device at primary address 3, secondary address 2, on the `GPIB0` interface attached to the machine with IP address `128.10.0.3`
`lan1[intserv]:GPIB2`	An interface address corresponding to the `GPIB2` interface attached to the machine named `intserv`.
`30,intserv:hpib,3,2`	A device address corresponding to the device at primary address 3, secondary address 2, on the `hpib` interface attached to the machine named `intserv`. (30 is the default logical unit for LAN.)
`lan[intserv]:GPIB,cmdr`	A commander session with the `GPIB` interface attached to the machine named `intserv`. (This example assumes that the server supports GPIB commander sessions).

Note If you are using the IP address of the server machine rather than the hostname, then you cannot use the comma notation, but must use the bracket notation.

Incorrect:

```
lan,128.10.0.3:hpib
```

Correct:

```
lan[128.10.0.3]:hpib
```

The following table shows the relationship between the address passed to iopen, the session type returned by `igetsesstype`, the interface type returned by `igetintftype`, and the value returned by `igetgatewaytype`.

Address	Session Type	Interface Type	Gateway Type
lan	`I_SESS_INTF`	`I_INTF_LAN`	`I_INTF_NONE`
lan[instserv]:hpib	`I_SESS_INTF`	`I_INTF_GPIB`	`I_INTF_LAN`
lan[instserv]:hpib,7	`I_SESS_DEV`	`I_INTF_GPIB`	`I_INTF_LAN`
hpib	`I_SESS_INTF`	`I_INTF_GPIB`	`I_INTF_NONE`
hpib,7	`I_SESS_DEV`	`I_INTF_GPIB`	`I_INTF_NONE`

HP SICL Function Support with LAN-gatewayed Sessions

A gatewayed-session to a remote interface provides the same SICL function support as if the interface was local, with the following exceptions or qualifications.

The following SICL functions are *not* supported over LAN using either protocol:

- `iblockcopy`
- `imap`
- `imapinfo`
- `ipeek`
- `ipoke`
- `ipopfifo`
- `ipushfifo`
- `iunmap`

The following SICL functions, in addition to those listed above, are *not* supported with the TCP/IP Instrument Protocol:

- All RS-232/serial specific functions
- `igetlu`
- `ionintr`
- `isetintr`
- `igetintfsess`
- `igetonintr`
- `igpibgett1delay`
- `igpibppoll`
- `igpibppollconfig`
- `igpibppollresp`
- `igpibsett1delay`

For the `igetdevaddr`, `igetintftype`, and `igetsesstype` functions to be supported with the TCP/IP Instrument Protocol, the remote address strings *must* follow the TCP/IP Instrument Protocol naming conventions – `gpib0`, `gpib1`, and so forth. For example:

```
gpib0,7
gpib1,7,2
gpib2
```

However, since the interface names at the remote server may be configurable, this is not guaranteed. Also note that the correct behavior of `iremote` and `iclear` depend on the correct address strings being used.

Finally, note that when `iremote` is executed over the TCP/IP Instrument Protocol, `iremote` will also send the LLO (local lockout) message in addition to placing the device in the remote state.

Any of the following functions may timeout over LAN, even those functions which cannot timeout over local interfaces. (See the "Using Timeouts with LAN" section later in this chapter for more details.) These functions all cause a request to be sent to the server for execution.

- All GPIB/HP-IB specific functions
- All RS-232/serial specific functions
- iabort
- `iclear`
- `iclose`
- `iflush`
- `ifread`
- `ifwrite`
- `igetintfsess`
- `ilocal`
- `ilock`
- `ionintr`
- `ionsrq`
- `iopen`
- `iprintf`

- `ipromptf`
- `iread`
- `ireadstb`
- `iremote`
- `iscanf`
- `isetbuf`
- `isetintr`
- `isetstb`
- `isetubuf`
- `itrigger`
- `iunlock`
- `iversion`
- `iwrite`
- `ixtrig`

The following SICL functions perform as follows with LAN-gatewayed sessions:

`idrvrversion`	Returns the version numbers from the server.
`iwrite`, `iread`	`actualcnt` may be reported as 0 when some bytes were transferred to or from the device by the server. This can happen if the client times out while the server is in the middle of an I/O operation.

LAN-gatewayed Session Example

The following example programs open an HP-IB device session via a LAN-to-HPIB gateway. Note that these examples are the same as the first example in the "Using HP SICL with HP-IB" chapter, only the addresses passed to the `iopen` calls are modified. The addresses used in these examples assume the machine with hostname `instserv` is acting as a LAN-to-HPIB gateway.

C Example:

```
/* landev.c
This example program sends a scan list to a switch and
while looping closes channels and takes measurements.*/
#include <sicl.h>
#include <stdio.h>

main() {
   INST dvm;
   INST sw;

   double res;
   int i;
   /* Print message and terminate on error */
   ionerror (I_ERROR_EXIT);

   /* Open the multimeter and switch sessions */
   dvm = iopen ("lan[instserv]:hpib,9,3");
   sw = iopen ("lan[instserv]:hpib,9,14");
   itimeout (dvm, 10000);
   itimeout (sw, 10000);

   /*Set up trigger*/
   iprintf (sw, "TRIG:SOUR BUS\n");

   /*Set up scan list*/
   iprintf (sw,"SCAN (@100:103)\n");
   iprintf (sw,"INIT\n");

   for (i=1;i<=4;i++)   {
      /* Take a measurement */
      iprintf (dvm,"MEAS:VOLT:DC?\n");

      /* Read the results */
      iscanf (dvm,"%lf", &res);

      /* Print the results */
      printf ("Result is %f\n",res);
      /*Trigger to close channel*/
      iprintf (sw, "TRIG\n");
   }
   /* Close the multimeter and switch sessions */
   iclose (dvm);
   iclose (sw);
}
```

Visual BASIC Example:

```
‘ landev.bas
‘ This program sends a scan list to a switch and while
‘ looping closes channels and takes measurements.

Attribute VB_Name = “Module1”

Public Sub lanmain()
   Dim dvm As Integer, sw As Integer
   Dim nargs As Integer, I As Integer
   Dim res As Double
   Dim actual As Long
   Dim res1 As String

   ‘  Set up an error handler within this subroutine that
   ‘  will get called if a SICL error occurs.
   On Error GoTo ErrorHandler

   ‘Open the multimeter and switch sessions
   dvm = iopen(“lan[intserv]:hpib,9,3”)
   sw = iopen(“lan[intserv]:hpib,9,14”)

   Call itimeout(dvm, 10000)
   Call itimeout(sw, 10000)

   ‘set up the trigger
   nargs = iwrite(id, “TRIG:SOUR BUS” + Chr$(10) + Chr$(0), 14, 1, actual)

   ‘set up scan list
   nargs = iwrite(id, “SCAN (@100:103)” + Chr$(10) + Chr$(0), 15, 1, actual)
   nargs = iwrite(id, “INIT” + Chr$(10) + Chr$(0), 5, 1, actual)

For I = 1 To 4 Step 1
   nargs = iwrite(id, “MEAS:VOLT:DC?” + Chr$(10) + Chr$(0), 14, 1, actual)
   nargs = iread(id, res1, l, &H0&, actual)

   MsgBox “Result is”
   MsgBox res1

   nargs = iwrite(id, “TRIG” + Chr$(10) + Chr$(0), 5, 1, actual)
   Next I

   Dim x As Integer
```

```
   x = iclose(dvm)
   x = iclose(sw)

   Exit Sub

ErrorHandler:

‘  Display the error message in the txtResponse TextBox.
   txtResponse.Text = “*** Error : “ + Error$
   MsgBox txtResponse.Text
‘  Close the device session if iopen was successful.
   If id <> 0 Then
     iclose (id)
   End If

   Exit Sub
End Sub
```

LAN Interface Sessions

The LAN interface, unlike most other supported SICL interfaces, does not allow for direct communication with devices via interface commands. LAN interface sessions, if used at all, will typically be used only for setting the client side LAN timeout. (See the "Using Timeouts with LAN" section later in this chapter.)

Addressing LAN Interface Sessions

To create a LAN interface session, specify the interface logical unit or interface name in the *addr* parameter of the `iopen` function. The interface logical unit and interface name are defined by running the `I/O Config` utility from the `HP I/O Libraries` program group. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on running `I/O Config`.

The following are examples of LAN interface addresses:

`lan`	A LAN interface address using the interface name `lan`.
`30`	A LAN interface address using the logical unit 30. (Note that `30` is the default logical unit for LAN.)

HP SICL Function Support with LAN Interface Sessions

The following SICL functions are *not* supported over LAN interface sessions and will return `I_ERR_NOTSUPP`:

- All HP-IB specific functions
- All serial specific functions
- All formatted I/O routines
- `iwrite`
- `iread`
- `ilock`
- `iunlock`
- `isetintr`
- `itrigger`
- `ixtrig`
- `ireadstb`

- `isetstb`
- `imapinfo`
- `ilocal`
- `iremote`

The following SICL functions perform as follows with LAN interface sessions:

`iclear`	Performs no operation, returns `I_ERR_NOERROR`.
`ionsrq`	Performs no operation against LAN gateways for SICL, returns `I_ERR_NOERROR`.
`ionintr`	Performs no operation, returns `I_ERR_NOERROR`.
`igetluinfo`	This function returns information about local interfaces only. It does not return information about remote interfaces that are being accessed via a LAN-to-instrument_interface gateway.

Using Locks and Multiple Threads over LAN

If two or more threads are accessing the same device or interface using two or more different sessions over LAN, and they are using SICL locks to synchronize access, the following situations may cause timeouts to occur or may hang an application which does not use timeouts. The common idea in all of these scenarios is that all threads which are using their own sessions to access the same device or interface should use the same string to identify the device or interface in their calls to `iopen`. Hence, the following scenarios should be avoided:

- Using a hostname to identify the remote host in one call to `iopen` while using an alias or IP address to identify the same host in another call to `iopen`.
- Using a device symbolic name in one call to `iopen` (such as "`dmm`", where "`dmm`" equals "`hpib,1`") while using the fully specified device name (such as "`hpib,1`") in another call.
- Using a remote interface's logical unit (such as "`7`") in one call while using the remote interface's symbolic name (such as "`hpib`") in another.
- Using `igetintfsess` to open an interface session (which internally uses the logical unit to identify the remote interface) while opening the interface with its symbolic name for another session.

You can avoid each of the previous situations by always using the same strings to identify the same device or interface in multi-threaded applications. You can also use the `igetintfsess` function if other sessions use the logical unit to specify the interface instead of the interface's symbolic name.

Note that if any thread is using `ilock` and `iunlock` to synchronize access to a particular device or interface, all threads accessing that same device or interface using a different session must also use `ilock` and `iunlock`. WIN32 synchronization techniques may also be used to ensure that a thread does not attempt I/O (`iread/iwrite`, and so forth) to a device already

locked via a different session from a different thread within the same process.

Note that if a session has an interface locked, and if a different thread using its own session attempts to lock a device on that interface, the device lock will be held off either until the interface is unlocked by the other thread, or until a timeout occurs on the device lock. This is different from how `ilock` works on other interfaces (where a lock on a device when the device's interface is already locked will not hold off the `ilock` operation, but rather will hold off any subsequent I/O to the device).

Using Timeouts with LAN

The client/server architecture of the LAN software requires the use of two timeout values, one for the client and one for the server. The server's timeout value is the SICL timeout value specified with the `itimeout` function. The client's timeout value is the LAN timeout value, which may be specified with the `ilantimeout` function.

When the client sends an I/O request to the server, the timeout value specified with `itimeout`, or the SICL default, is passed with the request. The server will use that timeout in performing the I/O operation, just as if that timeout value had been used on a local I/O operation. If the server's operation is not completed in the specified time, then the server will send a reply to the client which indicates that a timeout occurred, and the SICL call made by the application will return `I_ERR_TIMEOUT`.

When the client sends an I/O request to the server, it starts a timer and waits for the reply from the server. If the server does not reply in the time specified, then the client stops waiting for the reply from the server and returns `I_ERR_TIMEOUT` to the application.

LAN Timeout Functions

The `ilantimeout` and `ilangettimeout` functions can be used to set or query the current LAN timeout value. They work much like the `itimeout` and `igettimeout` functions. The use of these functions is optional, however, since the software will calculate the LAN timeout based on the SICL timeout in use and the configuration values set via the `I/O Config` utility (see the next subsection). Once `ilantimeout` is called by the application, the automatic LAN timeout adjustment described in the next subsection is turned off. See Chapter 12, "HP SICL Language Reference" for details of the `ilantimeout` and `ilangettimeout` functions.

Note that a timeout value of `1` used with the `ilantimeout` function has special significance, causing the LAN client to not wait for a response from the LAN server. However, the timeout value of `1` should be used in special circumstances only and should be used with extreme caution. For more information about this timeout value, see the section, "Using the No-Wait Value," under the `ilantimeout` function in Chapter 12, "HP SICL Language Reference".

Default LAN Timeout Values

The `I/O Config` utility specifies two timeout-related configuration values for the LAN software. These values are used by the software to calculate timeout values if the application has not previously called `ilantimeout`.

Server Timeout	Timeout value passed to the server when an application either uses the SICL default timeout value of infinity or sets the SICL timeout to infinity (0). Value specifies the number of seconds the server will wait for the operation to complete before returning `I_ERR_TIMEOUT`. A value of 0 in this field will cause the server to be sent a value of infinity if the client application also uses the SICL default timeout value of infinity or sets the SICL timeout to infinity (0).
Client Timeout Delta	Value added to the SICL timeout value (server's timeout value) to determine the LAN timeout value (client's timeout value). Value specifies the number of seconds.

Note Once `ilantimeout` is called, the software no longer sends the Server Timeout value to the server and no longer attempts to determine a reasonable client-side timeout. It is assumed that the application itself wants *full* control of timeouts, both client and server.

Also note that `ilantimeout` is *per process*. That is, all sessions which are going out over the network are affected when `ilantimeout` is called.

If the application has *not* called the `ilantimeout` function, then the timeouts are adjusted via the following algorithm:

- The SICL timeout, which is sent to the server, for the current call is adjusted if it is currently infinity (0). In that case it will be set to the Server Timeout value.

- The LAN timeout is adjusted if the SICL timeout plus the Client Timeout Delta is greater than the current LAN timeout. In that case the LAN timeout will be set to the SICL timeout plus the Client Timeout Delta.

- The calculated LAN timeout only increases as necessary to meet the needs of the application, but never decreases. This avoids the overhead of readjusting the LAN timeout every time the application changes the SICL timeout.

- The first `iopen` call used to set up the server connection uses the Client Timeout Delta specified via the `I/O Config` utility for portions of the `iopen` operation. The timeout value for TCP connection establishment is not affected by the Client Timeout Delta.

To change the defaults, do the following:

1. Exit any LAN applications for SICL which you want to reconfigure.

2. Run the `I/O Config` utility. (Double-click the `I/O Config` icon in the `HP I/O Libraries` program group.) Change the Server Timeout and/or Client Timeout Delta value(s).

3. Restart the LAN applications for SICL.

Timeouts in Multi-threaded Applications

If you need to manually set the client side timeout in an application using multiple threads, note that `ilantimeout` may itself timeout due to contention for the LAN subsystem where multiple threads in an application are simultaneously using SICL over LAN. Thus, if multiple threads will be using SICL over LAN at the same time, and LAN timeouts are expected by the application, it is recommended that `ilantimeout` be called when no other LAN I/O is occurring, such as immediately after session creation (`iopen`).

Also, the use of the `ilantimeout` No-Wait Value for certain special cases is described under the `ilantimeout` function in Chapter 12, "HP SICL Language Reference". If the no-wait value is used and multiple threads are attempting I/O over the LAN, the I/O operations using the no-wait option will wait for access to the LAN for 2 minutes. If another thread is using the LAN interface for greater than 2 minutes, the no-wait operation will timeout.

Timeout Configurations to Be Avoided

The LAN timeout used by the client should always be set greater than the SICL timeout used by the server. This avoids the situation where the client times out while the server continues to attempt the request, potentially holding off subsequent operations from the same client. This also avoids having the server send unwanted replies to the client.

The SICL timeout used by the server should generally be less than infinity. Having the LAN server wait less than forever allows the LAN server to detect clients that have died abruptly or network problems and subsequently release resources associated with those clients, such as locks. Using the smallest possible value for your application will maximize the server's responsiveness to dropped connections, including the client application being terminated abnormally. Using a value less than infinity is made easy for application developers due to the Server Timeout configuration value set via the `I/O Config` utility. Even if your application uses the SICL default of infinity, or if `itimeout` is used to set the timeout to infinity, by setting the Server Timeout value to some reasonable number of seconds, the server will be allowed to timeout and detect network trouble if it has occurred and release resources.

Application Terminations and Timeouts

If an application is killed while in the middle of a SICL operation which is performed at the LAN server, the server will continue to try the operation until the server's timeout is reached. By default, the LAN server associated with an application using a timeout of infinity which is killed may not discover that the client is no longer running for 2 minutes. (If you are using a server other than the LAN server on HP-UX, Windows 95, Windows NT, or the HP E2050, check that server's documentation for its default behavior.)

If `itimeout` is used by the application to set a long timeout value, or if both the LAN client and LAN server are configured to use infinity or a long timeout value, then the server may appear "hung." If this situation is encountered, the LAN client (via the Client Timeout Delta value set via the `I/O Config` utility) or the LAN server (via its Server Timeout value) may be configured to use a shorter timeout value.

If long timeouts must be used, the server may be reset. A LAN server may be reset by logging into the server system and killing the LAN server that is running. Note that the latter procedure will affect all clients connected to the server. See the LAN section in Chapter 10, "Troubleshooting Your HP SICL Program," for more details. Also see the documentation of the server you are using for the method to be used to reset the server.

Summary of LAN Specific Functions

Function Name	Action
`ilantimeout`	Sets LAN timeout value
`ilangettimeout`	Returns LAN timeout value
`igetgatewaytype`	Indicates whether the session is via a LAN gateway

10

Troubleshooting Your HP SICL Program

Troubleshooting Your HP SICL Program

This chapter contains a description of SICL error codes. It also provides help for troubleshooting common problems with SICL and:

- Windows 95
- WIN16 Programs on Windows 95 and Windows 3.1
- Windows NT
- RS-232
- GPIO
- LAN Client and Server

HP SICL Error Codes

When you install a default SICL error handler such as `I_ERROR_EXIT` or `I_ERROR_NOEXIT` with an `ionerror` call, a SICL internal error message will be logged. To view these messages:

- **On Windows 95 or Windows 3.1**, start the `Message Viewer` utility by double-clicking on the icon in the `HP I/O Libraries` program group for Windows 95 or in the `HP SICL` program group for Windows 3.1. You may want to iconify the utility during execution of your program. However, you must always start it before you execute a program in order for messages to be logged.

- **On Windows NT**, SICL logs internal messages as Windows NT events that you can view by starting the `Event Viewer` utility in the `Administrative Tools` group. Both system and application messages can be logged to the `Event Viewer` from SICL. SICL messages are identified by `SICL LOG`, or by the driver name (such as `hp341i32` for the HP-IB driver).

If you are programming in C, you may also use `ionerror` to install your own custom error handler. Your error handler can call `igeterrstr` with the given error code, and the corresponding error message string will be returned.

See either the “Error Handlers in C” or “Error Handlers in Visual BASIC” section in Chapter 4, “Programming with HP SICL,” for more information on installing error handlers.

The following table contains an alphabetical summary of SICL error codes and messages.

SICL Error Codes and Messages

Error Code	Error String	Description
I_ERR_ABORTED	Externally aborted	A SICL call was aborted by external means.
I_ERR_BADADDR	Bad address	The device/interface address passed to iopen doesn't exist. Verify that the interface name is the one assigned with the I/O Config utility.
I_ERR_BADCONFIG	Invalid configuration	An invalid configuration was identified when calling iopen.
I_ERR_BADFMT	Invalid format	Invalid format string specified for iprintf or iscanf.
I_ERR_BADID	Invalid INST	The specified INST *id* does not have a corresponding iopen.
I_ERR_BADMAP	Invalid map request	The imap call has an invalid map request.
I_ERR_BUSY	Interface is in use by non-SICL process	The specified interface is busy.
I_ERR_DATA	Data integrity violation	The use of CRC, Checksum, and so forth imply invalid data.
I_ERR_INTERNAL	Internal error occurred	SICL internal error.
I_ERR_INTERRUPT	Process interrupt occurred	A process interrupt (signal) has occurred in your application.
I_ERR_INVLADDR	Invalid address	The address specified in iopen is not a valid address (for example, "hpib,57").
I_ERR_IO	Generic I/O error	An I/O error has occurred for this communication session.
I_ERR_LOCKED	Locked by another user	Resource is locked by another session (see isetlockwait).
I_ERR_NESTEDIO	Nested I/O	Attempt to call another SICL function when current SICL function has not completed (WIN16). More than one I/O operation is prohibited.
I_ERR_NOCMDR	Commander session is not active or available	Tried to specify a commander session when it is not active, available, or does not exist.

SICL Error Codes and Messages (Continued)

Error Code	Error String	Description
I_ERR_NOCONN	No connection	Communication session has never been established, or connection to remote has been dropped.
I_ERR_NODEV	Device is not active or available	Tried to specify a device session when it is not active, available, or does not exist.
I_ERR_NOERROR	No Error	No SICL error returned; function return value is zero (0).
I_ERR_NOINTF	Interface is not active	Tried to specify an interface session when it is not active, available, or does not exist.
I_ERR_NOLOCK	Interface not locked	An `iunlock` was specified when device wasn't locked.
I_ERR_NOPERM	Permission denied	Access rights violated.
I_ERR_NORSRC	Out of resources	No more system resources available.
I_ERR_NOTIMPL	Operation not implemented	Call not supported on this implementation. The request is valid, but not supported on this implementation.
I_ERR_NOTSUPP	Operation not supported	Operation not supported on this implementation.
I_ERR_OS	Generic O.S. error	SICL encountered an operating system error.
I_ERR_OVERFLOW	Arithmetic overflow	Arithmetic overflow. The space allocated for data may be smaller than the data read.
I_ERR_PARAM	Invalid parameter	The constant or parameter passed is not valid for this call.
I_ERR_SYMNAME	Invalid symbolic name	Symbolic name passed to `iopen` not recognized.
I_ERR_SYNTAX	Syntax error	Syntax error occurred parsing address passed to `iopen`. Make sure that you have formatted the string properly. White space is not allowed.

SICL Error Codes and Messages (Continued)

Error Code	Error String	Description
`I_ERR_TIMEOUT`	`Timeout occurred`	A timeout occurred on the read/write operation. The device may be busy, in a bad state, or you may need a longer timeout value for that device. Check also that you passed the correct address to `iopen`.
`I_ERR_VERSION`	`Version incompatibility`	The `iopen` call has encountered a SICL library that is newer than the drivers. Need to update drivers.

Common Problems with Windows 95

Subsequent Execution of SICL Application Fails

If you terminate a program using the Task Manager, or if a program has an abnormal termination, then some drivers may not unload from memory. This could cause subsequent attempts to execute your I/O program to fail. To recover from this situation, you must restart (reboot) Windows 95.

Common Problems with WIN16 Programs on Windows 95 and Windows 3.1

Subsequent Execution of SICL Application Gives Strange Behavior

Check that `_siclcleanup` for C, or `siclcleanup` for Visual BASIC, is called at the end of the program and at any other possible program exit-point (at error handlers, and so forth).

General Protection Fault Occurs When Interrupt, SRQ, or Error Handler Called

Check that the interrupt or error handler routine was declared with the `SICLCALLBACK` modifer. Also, make sure that compiler options to generate prolog code for exported functions were selected. If you are using the QuickWin feature of Microsoft compilers, you must also use the `_loadds` modifier in the handler declaration.

General Protection Fault When Calling SICL Formatted I/O Routine

Verify that all pointer parameters passed to SICL formatted I/O routines are declared as `_far`, or that the compiler large memory model option is selected.

Reference to Undefined Function or Array

Visual BASIC gives this message when a call is made to a function that is not defined in a program. If you get this message when you try to call a SICL routine, then you need to add the `SICL4.BAS` file to your Project for Visual BASIC 4.0, or the `SICL.BAS` file to your Project for Visual BASIC 3.0 or earlier.

Do this by selecting `File | Add` from the Visual BASIC menu. The `SICL4.BAS` and `SICL.BAS` files are located in the `VB` subdirectory under the SICL base directory (for example, `C:\SICL95\VB` or `C:\SICLNT\VB` if you installed SICL in the default directory).

General Protection Fault Occurs When `iwrite`, `iread`, or `ivscanf` is Called from Visual BASIC

Make sure that all strings used as buffers for `iread` and `ivscanf` are fixed length strings that are large enough to accommodate the data to be read in.

`I_ERR_NESTED_IO` Occurs

A subsequent SICL function call has been made before a previous call completed. In order to allow other WIN16 applications to execute while a SICL application is running, SICL may temporarily suspend execution in the middle of a SICL call while waiting for a slow HP-IB transaction to complete. Without this feature, your Windows system would be locked up until the transaction completes.

However, because Windows is an event-/message-driven operating system, it is possible that the SICL application would receive a message instructing it to initiate another SICL call before the first one completes. This will result in a SICL error. Your program must be designed so that this situation does not occur.

Common Problems with Windows 3.1

Unresolved SICL Externals when Building a SICL Application

Check that you are linking to the correct import libraries. Refer to Chapter 3, "Building an HP SICL Application."

Can't Find "llibxxxx" When Building a SICL Application

You probably did not load the large memory model libraries when you installed your compiler software. Re-run the setup program for your compiler and specifically request that large memory model libraries be installed.

Common Problems with Windows NT

Program Appears to Hang and Cannot Be Killed

Check that an `itimeout` value has been set for all SICL sessions in your program. Otherwise, when an instrument does not respond to a SICL read or write, SICL will wait indefinitely in the SICL kernel access routine, preventing the application from being killed.

To kill the application, click on the "toaster" button in the upper-left corner of the window and then close the window. After a few seconds, an `End Task` dialog box will appear. Press the `End Task` button. The application is now killed.

Formatted I/O Using %F Causes Application Error

Verify that you are using `$(cvarsdll)` when compiling your application, and either `$(guilibsdll)` for Windows applications or `$(conlibsdll)` for console applications when linking your application.

Also note that the `%F` format character for `iprintf` only works with languages that use either `MSVCRT.DLL`, `MSVCRT20.DLL`, or `MSVCRT40.DLL` for their run-time library. Some versions of Visual C/C++ and Borland C/C++ use their own versions of the run-time library. They cannot share global data with SICL's version of the run-time library. Therefore, they cannot use `%F` at all.

Common Problems with RS-232

Unlike HP-IB, special care must be taken to ensure that RS-232 devices are correctly connected to your computer. Verifying your configuration first can save many wasted hours of debugging time.

No Response from Instrument

Check to make sure that the RS-232 interface is configured to match the instrument. Check the Baud Rate, Parity, Data Bits, and Stop Bits.

Also make sure that you are using the correct cabling. Refer to Appendix F, "RS-232 Cables" as well as the "RS-232 Cables and HP Instruments" appendix in the *HP I/O Libraries Installation and Configuration Guide*, for more information on correct cabling.

If you are sending many commands at once, try sending them one at a time either by inserting delays, or by single-stepping your program.

Data Received from Instrument is Garbled

Check the interface configuration. Install an interrupt handler in your program that checks for communication errors.

Data Lost During Large Transfers

Check the following:

- Flow control settings match
- Full/half duplex for 3-wire connections
- Cabling is correct for hardware handshaking

Common Problems with GPIO

Because the GPIO interface has such flexibility, most initial problems come from cabling and configuration. There are many configuration fields in the `I/O Config` utility that must be configured for GPIO. For example, no data transfers will work correctly until the handshake mode and polarity have been correctly set. A GPIO cable can have up to 50 wires in it, and you often must solder your own plug to at least one end. It is important to have the hardware configuration under control before you begin troubleshooting your software.

If you are porting an existing HP 98622 application, the hardware task is simplified. The cable connections are the same, and many `I/O Config` fields closely approximate HP 98622 DIP switches. If yours is a new application, someone on the project with good hardware skills should become familiar with the HP E2075 cabling and handshake behavior. In either case, it is important to read the *HP E2074/5 GPIO Interface Installation Guide*.

The following are some GPIO-specific reasons for certain SICL errors. Keep in mind that many of these can also be caused by non-GPIO problems. (For example, “Operation not supported” will happen on any interface if you execute `igetintfsess` with an interface ID.) Such general causes are discussed earlier in this book. The following discussion highlights the causes of errors that relate directly to the HP E2075 GPIO interface.

Bad Address (for `iopen`)

This means the same thing for GPIO as for any interface. It indicates that the `iopen` did not succeed because the specified address (symbolic name) does not correspond to a correctly configured entry in `I/O Config`. This is mentioned here because the GPIO has more configuration fields (and thus more chances for mistakes) than any other interface.

If your `iopen` fails, make sure that the interface was properly configured. The `I/O Config` utility establishes an entry for the GPIO card in your Windows 95 or Windows NT registry. You are strongly encouraged to let `I/O Config` handle all registry maintenance for SICL. However, there is nothing which prohibits you from editing registry entries manually. If you manually change the registry and enter an improper configuration value, then the failed `iopen` may send a diagnostic message to the `Message Viewer` (on Windows 95) or `Event Viewer` (on Windows NT) utility. For example:

```
HPe2074: GPIO config, bad read_clk entry
ISA card in slot #0 NOT INITIALIZED (Invalid parameter)
```

In such circumstances, you need to correct the configuration data in the registry. The recommended procedure is to use `I/O Config`, remove the problematic interface name, and create a `Configured Interface` with legal values selected from the `I/O Config` utility's dialog boxes.

Operation Not Supported

The HP E2075 has several modes. Certain operations are valid in one mode, and not supported in another. Two examples are:

```
igpioctrl(id, I_GPIO_AUX, value);
```

This operation applies only to the Enhanced mode of the data port. Auxiliary control lines do not exist when the interface is in HP 98622 Compatibility mode.

```
igpioctrl(id, I_GPIO_SET_PCTL, 1);
```

This operation is allowed only in Standard-Handshake mode. When the interface is in Auto-Handshake mode (the default), explicit control of the PCTL line is not possible.

No Device

This error indicates that you wanted PSTS checks for read/write operations, and a false state of the PSTS line was detected. Enabling and disabling PSTS checks is done with the command:

```
igpioctrl(id, I_GPIO_CHK_PSTS, value);
```

If the check seems to be reporting the wrong state of the PSTS line, then correct the PSTS polarity bit via the `I/O Config` utility. If the PSTS check is functioning properly and you get this error, then some problem with the cable or the peripheral device is indicated.

Bad Parameter

This error has the same meaning for GPIO as for any interface. However, one case may be less obvious than typical parameter passing errors. If the interface is in 16-bit mode, the number of bytes requested in an `iread` or `iwrite` function must be an even number. Although you probably view 16-bit data as words, the syntax of `iread` and `iwrite` requires a length specified as bytes.

Common Problems with HP SICL over LAN (Client and Server)

Note Both the LAN client and server may log messages to the `Message Viewer` (on Windows 95) or `Event Viewer` (on Windows NT) utility under certain conditions, whether an error handler has been registered or not.

Before SICL over LAN can be expected to function, the client must be able to talk to the server over the LAN. Use the following techniques to determine whether the problem you are experiencing is a general network problem, or is specific to the LAN software provided with SICL:

- If your application is unable to open a session to the LAN server for SICL, the first diagnostic to try is the `ping` utility. This command allows you to test general network connectivity between your client and server machines. Using `ping` looks something like the following:

```
>ping instserv.hp.com
Pinging instserv.hp.com[128.10.0.3] with 32 bytes of data:
Reply from 128.10.0.3:bytes=32 time=10ms TTL=255
Reply from 128.10.0.3:bytes=32 time=10ms TTL=255
Reply from 128.10.0.3:bytes=32 time=10ms TTL=255
Reply from 128.10.0.3:bytes=32 time=10ms TTL=225
```

Where each line after the `Pinging` line is an example of a packet successfully reaching the server.

However, if `ping` is unable to reach the host, you will see a message similar to the following:

```
Pinging instserv.hp.com[128.10.0.3] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.
```

This indicates that the client was unable to contact the server. In this situation you should contact your network administrator to determine what is wrong with the LAN. Once the LAN problem has been corrected, you can then retry your SICL application over LAN.

- Another tool which can be used to determine where a problem might reside is the `rpcinfo` utility on an HP-UX workstation or other UNIX workstation. This tool tests whether a client can make an RPC call to a server. The first `rpcinfo` option to try is `-p`, which will print a list of registered programs on the server:

```
> rpcinfo -p instserv
program verses proto   port
100001    1   udp   1788  rstatd
100001    2   udp   1788  rstatd
100001    3   udp   1788  rstatd
100002    1   udp   1789  rusersd
100002    2   udp   1789  rusersd
395180    1   tcp   1138
395183    1   tcp   1038
```

Several lines of text will likely be returned, but the ones of interest are the lines for programs `395180`, which is for the SICL LAN Protocol, and `395183`, which is for the TCP/IP Instrument Protocol (the port numbers will vary). If the line for program `395180` or `395183` is not present, your LAN server is likely misconfigured. Consult your server's documentation, correct the configuration problem, and then retry your application.

- The second `rpcinfo` option which can be tried is `-t`, which will attempt to execute procedure 0 of the specified program. You should see a line similar to the following.

  For the SICL LAN Protocol:

  ```
  > rpcinfo -t instserv 395180
  program 395180 version 1 ready and waiting
  ```

  For the TCP/IP Instrument Protocol:

  ```
  > rpcinfo -t instserv 395183
  program 395183 version 1 ready and waiting
  ```

  If you do not see one of the above, your server is likely misconfigured or not running. Consult your server's documentation, correct the problem, and then retry your application. See the `rpcinfo(1M)` man page for more information.

LAN Client Problems

`iopen` Fails - Syntax Error

In this case, `iopen` fails with the error `I_ERR_SYNTAX`. If using the "lan,net_address" format, ensure that the net_address is a hostname, not an IP address. If you must use an IP address, specify the address using the bracket notation, `lan[128.10.0.3]`, rather than the comma notation `lan,128.10.0.3`.

`iopen` Fails - Bad Address

An `iopen` fails with the error `I_ERR_BADADDR`, and the error text is `core connect failed: program not registered`. This indicates that the LAN server for SICL has not registered itself on the server machine. This may also be caused by specifying an incorrect hostname. Ensure that the hostname or IP address is correct, and if so, check the LAN server's installation and configuration.

`iopen` Fails - Unrecognized Symbolic Name

The `iopen` fails with the error `I_ERR_SYMNAME`, and the error text is `bad hostname, gethostbyname() failed`. This indicates that the hostname used in the `iopen` address is unknown to the networking software. Ensure that the hostname is correct and, if so, contact your network administrator to configure your machine to recognize the hostname. The `ping` utility can be used to determine if the hostname is known to your system. If `ping` returns with the error `Bad IP address`, the hostname is not known to the system.

`iopen` Fails - Timeout

An `iopen` fails with a timeout error. Increase the Client Timeout Delta configuration value via the `I/O Config` utility. See the "Using Timeouts with LAN" section in Chapter 9, "Using HP SICL with LAN," for more information.

`iopen` Fails - Other Failures

An `iopen` fails with some error other than those already mentioned above. Try the steps mentioned at the beginning of this section to determine if the client and server can talk to one another over the LAN. If the `ping` and `rpcinfo` procedures described earlier in this chapter work, then check any server error logs which may be available for further clues. Check for possible problems such as a lack of resources at the server (memory, number of SICL sessions, and so forth).

I/O Operation Times Out

An I/O operation times out even though the timeout being used is infinity. Increase the Server Timeout configuration value via the `I/O Config` utility. Also ensure that the LAN client timeout is large enough if you used `ilantimeout`. See the "Using Timeouts with LAN" section in Chapter 9, "Using HP SICL with LAN," for more information.

Operation Following a Timed Out Operation Fails

An I/O operation following a previous timeout fails to return or takes longer than expected. Ensure that the LAN timeout being used by the system is sufficiently greater than the SICL timeout being used for the session in question. The LAN timeout should be large enough to allow for the network overhead in addition to the time that the I/O operation may take.

If you are using `ilantimeout`, you must determine and set the LAN timeout manually. Otherwise, ensure that the Client Timeout Delta configuration value is large enough (via the `I/O Config` utility). See the "Using Timeouts with LAN" section in Chapter 9, "Using HP SICL with LAN," for more information.

`iopen` Fails or Other Operations Fail Due to Locks

An `iopen` fails due to insufficient resources at the server or I/O operations fail because some other session has the device or interface locked. Old LAN server connections for SICL from previous clients may not have terminated properly. Consult your server's troubleshooting documentation and follow its instructions for cleaning-up any old server processes.

LAN Server Problems

SICL LAN Application Fails - RPC Error

After starting the LAN server, a SICL LAN application fails and returns a message similar to the following:

```
RPC_PROG_NOT_REGISTERED
```

There is a short (approximately 5 second) delay between starting the LAN server and the LAN server being registered with the Portmapper. Simply try running the SICL LAN application again.

`rpcinfo` Does Not List `395180` or `395183`

An `rpcinfo` fails to indicate that program `395180` (SICL LAN Protocol) or `395183` (TCP/IP Instrument Protocol) is available on the server. Did you start the LAN server? If not, do so. (See the "Starting the LAN Server" section of Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows.*) If so, try the `rpcinfo` query again after a few seconds to ensure that the LAN server had time to register itself.

`iopen` Fails

An `iopen` fails when you run your application, but `rpcinfo` indicates that the LAN server is ready and waiting. Ensure that the requested interface has been configured on the server. See Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows* for information on using the `I/O Config` utility to configure interfaces for SICL.

LAN Server Appears "Hung"

The LAN server appears hung (possibly due to a long timeout being set by a client on an operation which will never succeed). Login to the LAN server and stop the hung LAN server process. (To stop the LAN server, see the "Stopping the LAN Server" section of Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows*.) Note that this will affect all connected clients, even those which may still be operational. If informational logging has been enabled using the `I/O Config` utility, then connected clients can be determined by log entries in either the `Message Viewer` (on Windows 95) or `Event Viewer` (on Windows NT) utility.

`rpcinfo` Fails - can't contact portmapper

An `rpcinfo` returns the message `rpcinfo: can't contact portmapper: RPC_SYSTEM_ERROR - Connection refused`. Ensure that the LAN server is running. If not, start it. If so, stop the currently running LAN server and restart it. Use **Ctrl**-**Alt**-**Del** to get a task list. Ensure that both `LAN Server` and `Portmap` are not running before restarting the LAN server. (See the "Starting the LAN Server" and the "Stopping the LAN Server" sections of Chapter 2, "Installing and Configuring the HP I/O Libraries," in the *HP I/O Libraries Installation and Configuration Guide for Windows*.)

`rpcinfo` Fails - program 395180 is not available

An `rpcinfo -t` *server_hostname* `395180 1` returns the following message:

```
rpcinfo: RPC_SYSTEM_ERROR - Connection refused
program 395180 version 1 is not available
```

Ensure that the LAN server program is running on the server.

Mouse Hung When Stopping LAN Server

If after attempting to stop a LAN server via either **Ctrl**-**C** or the Windows 95 X-button (the "kill" button in the upper-right hand corner of a Windows 95 window), the mouse may appear to be hung. Hit any keyboard key and the LAN server will stop and the mouse will again be operational.

11

More HP SICL Example Programs

More HP SICL Example Programs

This chapter contains additional example programs that help show you how to develop your SICL applications. The example programs are:

- An example C program for oscilloscopes
- An example Visual BASIC program for oscilloscopes

Example C Program for Oscillosopes

This C example programs an oscilloscope (such as an HP 54601), uploads the measurement data, and instructs the scope to print its display to a ThinkJet printer. This example program uses many SICL features and illustrates some important C and Windows programming techniques for SICL. An overview of the program follows the sections on building the program.

The oscilloscope example files are located in the `C\SAMPLES\SCOPE` subdirectory under the SICL base directory (for example, `C:\SICL95\C\SAMPLES\SCOPE` or `C:\SICLNT\C\SAMPLES\SCOPE` if you installed SICL in the default location). The subdirectory contains the source program and a number of files to help you build the example with specific compilers, depending on which Windows environment you are using.

`SCOPE.C`	Example program source file.
`SCOPE.H`	Example program header file.
`SCOPE.RC`	Example program resource file.
`SCOPE.DEF`	Example program module definitions file.
`SCOPE.ICO`	Example program icon file.
`MSCSCOPE.MAK`	Windows 3.1 makefile for Microsoft C and Microsoft SDK compilers.
`VCSCOPE.MAK`	Windows 3.1 project file for Microsoft Visual C++.
`VCSCP32.MAK`	Windows 95 or Windows NT (32-bit) project file for Microsoft Visual C++.
`VCSCP16.MAK`	Windows 95 (16-bit) project file for Microsoft Visual C++.
`QCSCOPE.MAK`	Windows 3.1 project file for Microsfot QuickC for Windows.
`BCSCOPE.IDE`	Windows 3.1 project file for Borland C Integrated Development Environment.
`BCSCP32.IDE`	Windows 95 or Windows NT (32-bit) project file for Borland C Integrated Development Environment.
`BCSCP16.IDE`	Windows 95 (16-bit) project file for Borland C Integrated Development Environment.

Building a 16-bit C Program for Windows 95 or Windows 3.1

This section explains how to create the project file for this example using Microsoft Visual C. The following procedure summarizes many of the considerations discussed earlier in this guide. An overview of this example program is provided later in this chapter.

You may also load the makefile directly from the `C\SAMPLES\SCOPE` subdirectory, if you desire. If you are using another language tool, choose the corresponding project file or makefile from the `C\SAMPLES\SCOPE` subdirectory.

To compile and link the example program with Microsoft Visual C, follow these steps:

1. Select `Project | Open` from the menu, and enter a name (with the path of your working directory) for the project in the dialog box. Also select `Windows Application` as the project type. Click on the `OK` button.

2. The `Edit` dialog box will now be displayed. Double-click on the source file `SCOPE.C` to add it to the project. Also add `SICL16.LIB` and `MSAPP16.LIB` from the SICL `C` directory (for example, `C:\SICL95\C` or `C:\SICLNT\C` if you installed SICL in the default location). Click on the `Close` button.

3. Select `Options | Directories` from the menu and add the SICL `C` directory (for example, `C:\SICL95\C` or `C:\SICLNT\C` if you installed SICL in the default location) to the end of the paths listed in the `Include` edit box. Be sure to add a semicolon before the SICL path. Click the `OK` button.

4. Select `Options | Project`. Click on the `Compiler` button, then select `Memory Model` from the `Category` list. Click on the `Model` list arrow to display the model options, and select `Large`. Click on `OK` to close the Compiler dialog box.

5. Select `Project | Build` to build the application.

If there are no errors reported, you can execute the program by selecting `Project | Execute`. An application window will be opened. Several commands are available from the `Actions` menu, and any results or output will be printed in the program window.

To end the program, select `File | Exit` from the program menu.

Building a 32-bit C Program for Windows 95 or Windows NT

This section explains how to create the project file for this example using Microsoft Visual C. The following procedure summarizes many of the considerations discussed earlier in this guide. An overview of this example program is provided in the next section.

You may also load the makefile directly from the `C\SAMPLES\SCOPE` subdirectory, if you desire. If you are using another language tool, choose the appropriate project file or makefile from the `C\SAMPLES\SCOPE` subdirectory.

To compile and link the example program with Microsoft Visual C, follow these steps:

1. Select `File | New` from the menu and select `Project` from the list box that appears. Then click on `OK`.

2. The `New Project` dialog box is now displayed. Type the name you want for the project in the edit box labeled `Project Name`. Then select `Application` from the `Project Type` list box. Select the directory location for the project in the `Directory` list box. Then click on the `Create` button.

3. The `Project Files` dialog box is now displayed. Double-click on the source files `scope.c`, `scope.rc`, and `scope.def` to add them to the project. Also add `sicl32.lib` from the SICL `C` directory (for example, `C:\SICL95\C` or `C:\SICLNT\C` if you installed SICL in the default location). Then press the `Close` button.

4. Select `Project | Settings` from the menu and click on the `C\C++` button. Select `Code Generation` from the `Category` list box. Then select `Multithreaded Using DLL` from the `Use Run-Time Library` list box. Click on `OK`.

5. Select `Tools | Options` from the menu and click on the `Directories` button in the `Options` dialog box. Select `Include Files` from the `Show Directories for:` list box and click on the `Add` button. Then type in `\SICL\C` and click on `OK`.

6. Select `Project | Build` to build the application.

If there are no errors reported, you can execute the program by selecting `Project | Execute`. An application window will open. Several commands are available from the `Actions` menu, and any results or output will be printed in the program window.

To end the program, select `File | Exit` from the program menu.

C Program Overview

You may want to view the program with an editor as you read through this section. (The entire oscilloscope example program is not listed here because of its length.) This example program is designed to illustrate particular SICL features and programming techniques — it is not meant to be a robust Windows application.

Refer to Chapter 12, "HP SICL Language Reference" or the SICL online `Help` for more detailed information on the SICL features used in this example program.

Custom Error Handler

The oscilloscope program defines a custom error handler that will be called whenever an error occurs during a SICL call. The handler is installed using `ionerror` before any other SICL function call is made, and will be used for all SICL sessions created in the program.

```
void SICLCALLBACK my_err_handler(INST id, int error)
{
   ...
   sprintf(text_buf[num_lines++],
     "session id=%d, error = %d:%s", id, error,
       igeterrstr(error));
   sprintf(text_buf[num_lines++], "Select 'File | Exit'
       to exit program!");
   ...
// If error is from scope, disable I/O actions by
       graying out menu picks.
   if (id == scope) {
     ... code to disallow further I/O requests from user
     }
   }
```

The error number is passed to the handler, and `igeterrstr` is used to translate the error number into a more useful description string. If desired, different actions can be taken depending on the particular error or `id` that caused the error.

Locks SICL allows multiple applications to share the same interfaces and devices. Different applications may access different devices on the same interface, or may alternately access the same device (a shared resource). If your program will be executing along with other SICL applications, you may wish to prevent another application from accessing a particular interface or device during critical sections of your code. SICL provides the `ilock/iunlock` functions for this purpose.

```
void get_data (INST id)
{
   ...  non-SICL code

   // lock the device to prevent access from other applications
   ilock(scope);

   ...
   SICL I/O code to program scope and get data

   // release the scope for use by others
   iunlock(scope);

   ...  non-SICL code
}
```

Lock the interface or device with `ilock` before critical sections of code, and release the resource with `iunlock` at the end of the critical section. Using `ilock` on a device session prevents any other device session from accessing the particular device. Using `ilock` on an interface session prevents any other session from accessing the interface and any device connected to the interface. See the description of `isetlockwait` in Chapter 12, "HP SICL Language Reference" to determine what actions can be taken when a SICL call in your code attempts to access a resource that is locked by another session.

Formatted I/O SICL provides extensive formatted I/O functionality to help facilitate communication of I/O commands and data. The example program uses just a few of the capabilities of the `iprintf/iscanf/ipromptf` functions and their derivatives.

The `iprintf` function is used to send commands. As with all of the formatted I/O functions, the data is actually buffered. In this call, the `\n` at the end of the format:

```
iprintf(id,":waveform:preamble?\n");
```

causes the buffer to be flushed and the string to be output. If desired, several commands can be formatted before being sent, and then all output at once. The formatted I/O buffers are automatically flushed whenever the buffer fills (see `isetbuf`) or when an `iflush` call is made.

When reading data back from a device, the `iscanf` function is used. To read the preamble information from the scope, we use the format string "`%,20f\n`":

```
iscanf(id,"%,20f\n",pre);
```

This string expects to input 20 comma-separated floating point numbers into the `pre` array.

To upload the scope waveform data, the string "`%#wb\n`" is used. The `wb` indicates that it should read word-wide binary data. The # preceding the data modifer tells `iscanf` to get the maximum number of binary words to read from the next parameter (`&elements`):

```
iscanf(id,"%#wb\n",&elements,readings);
```

The read will continue until an EOI indicator is received, or the maximum number of words has been read.

Interface Sessions Sometimes it may be necessary to control the HP-IB bus directly instead of using SICL commands that do it for you. This is accomplished using an interface session and interface-specific commands. This example uses `igetintfsess` to get a session for the interface to which the scope is connected. (If you know which interface is being used, it is also possible to just use an `iopen` call on that interface.) Then `igpibsendcmd` is used to send some specific command bytes out on the bus to tell the printer to listen and the scope to send its data. The `igpibatnctl` function directly controls the state of the ATN signal on the bus.

```
void print_disp (INST id)
{
   INST hpibintf ;
   ...

   hpibintf = igetintfsess(id);
   ...

   // tell scope to talk and printer to listen
   // the listen command is formed by adding 32 to the
   // device address of the device to be a listener
   // the talk command is formed by adding 64 to the device
   // address ofthe device to be a talker

   cmd[0] = (unsigned char)63 ;   // 63 is unlisten
   cmd[1] = (unsigned char)(32+1) ;  // printer at addr 1,
                                        make it a listener
   cmd[2] = (unsigned char)(64+7) ;  // scope at addr 7,
                                        make it a talker
   cmd[3] = '\0';                 // terminate the string

   length = strlen (cmd) ;

   igpibsendcmd(hpibintf,cmd,length);
   igpibatnctl(hpibintf,0);

   ...
}
```

SRQs and `iwaithdlr`

Many instruments are capable of using the service request, or SRQ, signal on the HP-IB bus to signal the controller that an event has occurred. If an application wishes to respond to SRQs, an SRQ handler must be installed with the `ionsrq` call. All SRQ handlers will be called whenever an SRQ occurs.

In the example handler, the scope status is read to verify that the scope asserted SRQ, and then the SRQ is cleared and a status message is displayed. If the scope did not assert SRQ, the handler prints an error message.

```
void SICLCALLBACK my_srq_handler(INST id)
{
   unsigned char status;

   // make sure it was the scope requesting service
   ireadstb(id,&status);

   if (status &= 64) {
      // clear the status byte so the scope can assert SRQ
         again if needed.
      iprintf(id,"*CLS\n");

      sprintf(text_buf[num_lines++],
         "id = %d, SRQ received!, stat=0x%x", id,status);
   } else {
      sprintf(text_buf[num_lines++],
         "SRQ received, but not from the scope");
   }
   InvalidateRect(hWnd, NULL, TRUE);
}
```

In the routine that commands the scope to print its display, the scope is set to assert SRQ when printing is finished. While the scope is printing, the example program has the application suspend execution. SICL provides the function `iwaithndlr` that will suspend execution and wait until either an event occurs that would call a handler, or a specified timeout value is reached.

In the example, interrupt events are turned off with `iintroff` so that all interrupts are disabled while interrupts are being set up. Then the SRQ handler is installed with `ionsrq`. Code to program the scope to print and send an SRQ is next, then the call to `iwaithdlr`, with a timeout value of 30 seconds. When the scope finishes printing and sends the SRQ, the SRQ handler will be executed and then `iwaithdlr` will return. A call to `iintron` re-enables interrupt events.

```
void print_disp (INST id)
{
   ...

   iintroff();
   ionsrq(id,my_srq_handler); // Not supported on HP 82335

   // tell the scope to SRQ on 'operation complete'
   iprintf(id,"*CLS\n");
   iprintf(id,"*SRE 32 ; *ESE 1\n") ;

   // tell the scope to print
   iprintf(id,":print ; *OPC\n") ;

   ... code to tell the scope to print

   // wait for SRQ before continuing program

   iwaithdlr(30000L);
   iintron();

   sprintf (text_buf[num_lines++],"Printing complete!") ;
   ...
}
```

Nested I/O and 16-bit Windows

WIN16 programs must be designed so that a new SICL call cannot be initiated until the previous call completes. In this program, it would be possible for the user to select another action from the program menu that required a SICL call before the previous action completed. To prevent this, any action that uses SICL functions first disables all other actions by using Windows commands to gray out and disable other I/O menu items (see the `enable_io_menu_items` function). These menu items are then re-enabled after the desired SICL calls have completed.

```
   void print_disp (INST id)
   {
      ... non-SICL code

   // do this before making all SICL calls
   enable_io_menu_items(FALSE);
   ... SICL I/O code
   // do this after making all SICL calls
   enable_io_menu_items(TRUE);
}
```

Example Visual BASIC Program for Oscillosopes

This Visual BASIC example program uses 16-bit SICL to get and plot waveform data from an HP 54601A (or compatible) oscilloscope. This routine is called each time the `cmdGetWaveform` command button is clicked. This example program uses many SICL features and illustrates some important Visual BASIC and Windows programming techniques for SICL. An overview of the program follows the section on loading and running the program.

The oscilloscope example files are located in the `VB\SAMPLES\SCOPE` subdirectory under the SICL base directory (for example, `C:\SICL95\VB\SAMPLES\SCOPE` if you installed SICL in the default location). The files provided are:

`SCOPE.FRM`	Visual BASIC source for the `SCOPE` example program.
`SCOPE.MAK`	Visual BASIC project file for the `SCOPE` example program.

Loading and Running the Visual BASIC Program

Follow these steps to load and run the `SCOPE` sample program:

1. Connect an HP 54601A scope to your interface.

2. Run Visual BASIC.

3. Open the project file `SCOPE.MAK` by selecting `File | Open Project` from the Visual BASIC menu.

4. Edit the `SCOPE.FRM` file to set the `scope_address` constant to the address of your scope. To do this:

   a. Select `Window | Procedures` from the Visual BASIC menu. A View Procedure dialog box will appear.

   b. Select `SCOPE.FRM` from the Modules list box and `(declarations)` from the Procedures list box. Then click `OK`.

   c. Edit the following line so that the address is set to the address of your scope:

```
>>  Const scope_address = “hpib7,7”
```

5. Run the program by pressing either the **F5** key or the `RUN` button on the Visual BASIC Toolbar.

6. Press the `Waveform` button to get and display the waveform.

7. Press the `Integral` button to calculate and display the integral.

Note that after performing the previous steps, you can create a standalone executable (`.EXE`) version of this program by selecting `File | Make EXE File` from the Visual BASIC menu.

Visual BASIC Program Overview

You will want to view the program with an editor as you read through this section. (The oscilloscope example program is not listed here because of its length.) Refer to Chapter 12, "HP SICL Language Reference" or the SICL online `Help` for more detailed information on the SICL features used in this example program.

cmdGetWaveform_Click Subroutine that gets called when the `cmdGetWaveform` command button is pressed. The command button is labeled `Waveform`.

On Error This Visual BASIC statement enables an error handling routine within a procedure. In this example, an error handler is installed starting at label `ErrorHandler` within the `cmdOutputCmd_Click` subroutine. The error handling routine will be called any time an error occurs during the processing of the `cmdGetWaveform_Click` procedure. Note that SICL errors are handled in the same way that Visual BASIC errors are handled with the `On Error` statement.

cmdGetWaveform.Enabled Notice how the button that causes the `cmdGetWaveform_Click` routine to be called is disabled when code is executing inside `cmdOutputCmd_Click`. This is good programming style.

iopen Next, an `iopen` call is made to open a device session for the scope. The device address for the scope is contained in the `scope_address` string. Note that, in this example, the default address is "`hpib7,7`". The interface name "`hpib7`" is the name given to the interface with the `I/O Config` utility. The bus (primary) address of the scope follows, in this case 7. You will probably want to change the `scope_address` string to specify the correct address for your configuration.

igetintfsess Next, `igetintfsess` is called to return an interface session *id* for the interface to which the scope instrument is connected. This interface session will be used by the following `iclear` call to send an interface clear to reset the interface.

iclear The `iclear` function is called to reset the interface.

itimeout Next, `itimeout` is called to set the timeout value for the scope's device session to 3 seconds.

ivprintf The `ivprintf` function is called four times to set up the scope and then request the scope's preamble information. Notice in each case how `Chr$(10)` is appended to the format string passed as the second argument to `ivprintf`. This tells `ivprintf` to flush the formatted I/O write buffer after writing the string specified in the format string. Also, notice how `0&` is used to specify a NULL pointer for the third argument to `ivprintf`. A NULL pointer must be passed as the third argument since no argument conversion characters were specified in the format string for `ivprintf`.

ivscanf The `ivscanf` function is called to read the scope's preamble information into the preamble array. Note how the first element of the preamble array is passed as the third parameter to `ivscanf`. This passes the address of the first element of the preamble array to the `ivprintf` SICL function.

For more information on passing numeric arrays as arguments, see the "Arrays" section of the "Calling Procedures in DLLs" chapter of the *Visual BASIC Programmer's Guide*.

ivprintf Next `ivprintf` is called to prompt the scope for its waveform data. Again, notice how `Chr$(10)` is appended to the format string passed as the second argument to `ivprintf`. This tells `ivprintf` to flush the formatted I/O write buffer after writing the string specified in the format string. Also notice how `0&` is used to specify a NULL pointer for the third argument to `ivprintf`, since no additional arguments were specified in the format string.

ivscanf Next `ivscanf` is called to read in the scope's waveform. The waveform is read in as an arbitrary block of data. Note that the format string passed as the second parameter to `ivscanf` specifies a maximum of 4000 Integer values that can be read into the array. Also note how the first element of the waveform array is passed as the 3rd parameter to `ivscanf`. This passes the address of the first element of the waveform array to the SICL `ivscanf` function.

For more information on passing numeric arrays as arguments, see the "Arrays" section of the "Calling Procedures in DLLs" chapter of the *Visual BASIC Programmer's Guide*.

iclose The `iclose` subroutine closes the `scope_id` device session for the scope as well as the `intf_id` interface session obtained with `igetintfsess`.

cmdGetWaveform.Enabled Notice how the button that causes the `cmdGetWaveform_Click` routine to be called is re-enabled when execution inside `cmdGetWaveform_Click` is finished. This allows the program to get another waveform.

Exit Sub This Visual BASIC statement causes the `cmdGetWaveform_Click` subroutine to be exited after normal processing has completed.

errorhandler: This label specifies the beginning of the error handler that was installed for this subroutine. This handler gets called whenever a run-time error occurs.

Error$ This Visual BASIC function is called to get the error message for the error.

iclose The `iclose` subroutine is called inside the error handler to close the `scope_id` device session for the scope as well as the `intf_id` interface session obtained with `igetintfsess`.

cmdGetWaveform.Enabled This re-enables the button that causes the `cmdGetWaveform_Click` routine to be called. This allows the program to get another waveform.

Exit Sub This Visual BASIC statement causes the `cmdGetWaveform_Click` subroutine to be exited after processing an error in the subroutine's error handler.

12

HP SICL Language Reference

HP SICL Language Reference

This chapter defines all of the supported SICL functions. The functions are listed in alphabetical order to make them easier for you to look-up and reference. In this chapter, the entry for each SICL function includes:

- C syntax and Visual BASIC syntax (if the function is supported on Visual BASIC).
- Complete description.
- Return value(s).
- Related SICL functions that you may want to see, also.

Note This edition of this manual supports and shows the syntax structure for programming SICL applications in Visual BASIC version 4.0 or later.

If you have SICL applications written in an earlier Visual BASIC version than version 4.0 (for example, version 3.0), you can easily port your SICL applications to Visual BASIC version 4.0. See Appendix C, "Porting to Visual BASIC 4.0," in this manual.

Along with this chapter, you may also want to refer to:

- Appendix D, HP SICL Error Codes, which lists all the SICL error codes.
- Appendix E, HP SICL Function Summary, which summarizes the supported features of each core and interface-specific SICL function.

Session Identifiers

SICL uses session identifiers to refer to specific SICL sessions. The `iopen` function will create a SICL session and return a session identifier to you. A session identifier is needed for most SICL functions.

Note that for the C and C++ languages, SICL defines the variable type `INST`. C and C++ programs should declare session identifiers to be of type `INST`. For example:

```
INST id;
```

Visual BASIC programs should declare session identifiers to be of type `Integer`. For example:

```
DIM id As Integer
```

Device, Interface, and Commander Sessions

Some SICL functions are supported on device sessions, some on interface sessions, some on commander sessions, and some on all three. The listing for each function in this chapter indicates which sessions support that function.

Functions Affected by Locks

In addition, some functions are affected by locks (refer to the `ilock` function). This means that if the device or interface that the session refers to is locked by another process, this function will block and wait for the device or interface to be unlocked before it will succeed, or it will return immediately with the error `I_ERR_LOCKED`. Refer to the `isetlockwait` function.

Functions Affected by Timeouts

Likewise, some functions are affected by timeouts (refer to the `itimeout` function). This means that if the device or interface that the session refers to is currently busy, this function will wait for the amount of time specified by `itimeout` to succeed. If it cannot, it will return the error `I_ERR_TIMEOUT`.

Per-Process Functions

Functions that do not support sessions and are not affected by `ilock` or `itimeout` are *per-process* functions. The SICL function `ionerror` is an example of this. The `ionerror` function installs an error handler for the process. As such, it handles errors for all sessions in the process regardless of the type of session.

IABORT

Supported Sessions . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int iabort (id);
inst id;
```

Note This function is *only* supported with C/C++ on Windows 3.1 and Series 700 HP-UX. (*Not* supported with Visual BASIC, Windows 95, or Windows NT.)

This function is also not implemented for the HP 82341 HP-IB interface and will return `I_ERR_NOTIMPL`.

Also, this function has no effect over LAN for any of the LAN servers, such as the HP E2050 LAN/HP-IB Gateway.

Description The `iabort` function will abort any SICL calls currently executing with the current session *id*, regardless of what **thread** it is executing on. However, since session *ids* are only valid within a single process, only SICL calls in progress in the current process will be affected. The SICL call being aborted will return the error code `I_ERR_ABORTED`, implying that it was aborted by another **thread**. If no **thread** has any SICL calls pending on the given session *id*, this function will perform no action.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

IBLOCKCOPY

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int ibblockcopy (id, src, dest, cnt);
INST id;
unsigned char *src;
unsigned char *dest;
unsigned long cnt;

int iwblockcopy (id, src, dest, cnt, swap);
INST id;
unsigned char *src;
unsigned char *dest;
unsigned long cnt;
int swap;

int ilblockcopy (id, src, dest, cnt, swap);
INST id;
unsigned char *src;
unsigned char *dest;
unsigned long cnt;
int swap;
```

Visual BASIC Syntax

```
Function ibblockcopy
(ByVal id As Integer, ByVal src As Long,
 ByVal dest As Long, ByVal cnt As Long)

Function iwblockcopy
(ByVal id As Integer, ByVal src As Long,
 ByVal dest As Long, ByVal cnt As Long,
 ByVal swap As Integer)

Function ilblockcopy
(ByVal id As Integer, ByVal src As Long,
 ByVal dest As Long, ByVal cnt As Long,
 ByVal swap As Integer)
```

Note Not supported over LAN.

Description

The three forms of `iblockcopy` assume three different types of data: byte, word, and long word (8 bit, 16 bit, and 32 bit). The `iblockcopy` functions copy data from memory on one device to memory on another device. They can transfer entire blocks of data.

The *id* parameter, although specified, is normally ignored except to determine an interface-specific transfer mechanism such as DMA. To prevent using an interface-specific mechanism, pass a zero (`0`) for this parameter. The *src* argument is the starting memory address for the source data. The *dest* argument is the starting memory address for the destination data. The *cnt* argument is the number of transfers (bytes, words, or long words) to perform. The *swap* argument is the byte swapping flag. If swap is zero, no swapping occurs. If *swap* is non-zero the function swaps bytes (if necessary) to change byte ordering from the internal format of the controller to/from the VXI (big-endian) byte ordering.

Note If a bus error occurs, unexpected results may occur.

Return Value

For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also

"IPEEK", "IPOKE", "IPOPFIFO", "IPUSHFIFO"

IBLOCKMOVEX

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iblockmovex (id, src_handle, src_offset, src_width,
                 src_increment, dest_handle, dest_offset,
                 dest_width, dest_increment, cnt, swap);
  INST id;
  unsigned long src_handle;
  unsigned long src_offset;
  int src_width;
  int src_increment;
  unsigned long dest_handle;
  unsigned long dest_offset;
  int dest_width;
  int dest_increment;
  unsigned long cnt;
  int swap;
```

Visual BASIC Syntax

```
Function iblockmovex
(ByVal id As Integer, ByVal src_handle As Long,
ByVal src_offset as Long, ByValue src_width as Integer,
ByVal src_increment as Integer, ByVal dest_handle As Long,
ByVal dest_offset as Long, ByVal dest_width as Integer,
ByVal dest_increment as Integer, ByVal cnt As Long,
 ByVal swap As Integer)
```

Note Not supported over LAN.

Note If either the *src_handle* or the *dest_handle* is NULL, then the handle is assumed to be for local memory. In this case, the corresponding offset is a valid memory address.

Description `iblockmovex` moves data (8-bit byte, 16-bit word, and 32-bit long word). from memory on one device to memory on another device. This function allows local-to-local memory copies (both *src_handle* and *dest_handle* are zero), VXI-to-VXI memory transfers (both *src_handle* and *dest_handle* are valid handles), local-to-VXI memory transfers (*src_handle* is zero, *dest_handle* is valid handle), or VXI-to-local memory transfers (*src_handle* is valid handle, *dest_handle* is zero).

The *id* parameter is the value returned from `iopen`. If the *id* parameter is zero (0) then all handles must be zero and all offsets must be either local memory or directly dereferencable VXI pointers.

The *src_handle* argument is the starting memory address for the source data. The *dest_handle* argument is the starting memory address for the destination data. These handles must either be valid handles returned from the `imapx` function (indicating valid VXI memory), or zero (0) indicating local memory. Both *src_width* and *dest_width* must be the same value; they specify the width (in number of bits) of the data. Specify them as 8, 16, or 32. Offset values (*src_offset* and *dest_offset*) are generally used in memory transfers to specify memory locations. The increment parameters specify whether or not to increment memory addresses. The *cnt* argument is the number of transfers (bytes, words, or long words) to perform. The *swap* argument is the byte swapping flag. If swap is zero, no swapping occurs. If *swap* is non-zero the function swaps bytes (if necessary) to change byte ordering from the internal format of the controller to/from the VXI (big-endian) byte ordering.

Note If a bus error occurs, unexpected results may occur.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IPEEKX8, IPEEKX16, IPEEKX32", "IPOKEX8, IPOKEX16, IPOKEX32", "IPOPFIFO", "IPUSHFIFO", "IDEREFPTR"

ICAUSEERR

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

void icauseerr (id, errcode, flag);
INST id;
int errcode;
int flag;
```

Visual BASIC Syntax

```
Sub icauseerr
(ByVal id As Integer, ByVal errcode As Integer,
 ByVal flag As Integer)
```

Description Occasionally it is necessary for an application to simulate a SICL error. The `icauseerr` function performs that function. This function causes SICL to act as if the error specified by *errcode* (see Appendix D, HP SICL Error Codes, for a list of errors) has occurred on the session specified by *id*. If *flag* is 1, the error handler associated with this process is called (if present); otherwise it is not.

On operating systems that support multiple **threads**, the error is per-thread, and the error handler will be called in the context of this **thread**.

See Also "IONERROR", "IGETONERROR", "IGETERRNO", "IGETERRSTR"

ICLEAR

Supported sessions: . . . . . device, interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iclear (id);
INST id;
```

Visual BASIC Syntax

```
Function iclear
(ByVal id As Integer)
```

Description Use the `iclear` function to clear a device or interface. If *id* refers to a device session, this function sends a *device clear* command. If *id* refers to an interface, this function sends an *interface clear* command.

The `iclear` function also discards the data in both the read and the write formatted I/O buffers. This discard is equivalent to performing the following `iflush` call (in addition to the device or interface clear function):

```
iflush (id, I_BUF_DISCARD_READ | I_BUF_DISCARD_WRITE);
```

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IFLUSH", and the interface-specific chapter in this manual for details of implementation.

ICLOSE

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int iclose (id);
INST id;
```

Visual BASIC Syntax

```
Function iclose
(ByVal id As Integer)
```

Description Once you no longer need a session, close it using the `iclose` function. This function closes a SICL session. After calling this function, the value in the *id* parameter is no longer a valid session identifier and cannot be used again.

Note Do not call `iclose` from an SRQ or interrupt handler, because it may cause unpredictable behavior.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IOPEN"

IDEREFPTR

Supported Sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int idereptr (id, handle, *value);
   INST id;
   unsigned long handle;
   unsigned char *value;
```

Visual BASIC Syntax

```
Function iderefptr
(ByVal id as Integer, ByVal handle as Long,
  ByVal value as Integer)
```

Description This function tests the handle returned by `imapx`. The *id* is the valid SICL session id returned from the `iopen` function, *handle* is the valid SICL map handle obtained from the `imapx` function. This function sets **value* to zero (0) if `imap` or `imapx` returns a map handle that cannot be used as a memory pointer; you must use `ipeekx`*8*, `ipeekx16`, `ipeekx32`, `ipokex8`, `ipokex16`, `ipokex32`, or `iblockmovex` functions. Alternately, the function returns a non-zero value if `imapx` returns a valid memory pointer that can be directly dereferenced.

Return Value For C programs, this function returns zero (0) if successful, or it returns a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IMAPX", "IUNMAPX", "IPEEKX8, IPEEKX16, IPEEKX32", "IPOKEX8, IPOKEX16, IPOKEX32", "IBLOCKMOVEX"

IFLUSH

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iflush (id, mask);
INST id;
int mask;
```

Visual BASIC Syntax

```
Function iflush
(ByVal id As Integer, ByVal mask As Integer)
```

Description This function is used to manually flush the read and/or write buffers used by formatted I/O. The *mask* may be one or a combination of the following flags:

`I_BUF_READ`	Indicates the read buffer (`iscanf`). If data is present, it will be discarded until the end of data (that is, if the END indicator is not currently in the buffer, reads will be performed until it is read).
`I_BUF_WRITE`	Indicates the write buffer (`iprintf`). If data is present, it will be discarded.
`I_BUF_WRITE_END`	Flushes the write buffer of formatted I/O operations and sets the *END* indicator on the last byte (for example, sets EOI on HP-IB).
`I_BUF_DISCARD_READ`	Discards the read buffer (does not perform I/O to the device).
`I_BUF_DISCARD_WRITE`	Discards the write buffer (does not perform I/O to the device).

The `I_BUF_READ` and `I_BUF_WRITE` flags may be used together (by OR-ing them together), and the `I_BUF_DISCARD_READ` and

`I_BUF_DISCARD_WRITE` flags may be used together. Other combinations are invalid.

If `iclear` is called to perform either a device or interface clear, then both the read and the write buffers are discarded. Performing an `iclear` is equivalent to performing the following iflush call (in addition to the device or interface clear function):

```
iflush (id, I_BUF_DISCARD_READ | I_BUF_DISCARD_WRITE);
```

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IPRINTF", "ISCANF", "IPROMPTF", "IFWRITE", "IFREAD", "ISETBUF", "ISETUBUF", "ICLEAR"

IFREAD

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int ifread (id, buf, bufsize, reason, actualcnt);
INST id;
char *buf;
unsigned long bufsize;
int *reason;
unsigned long *actualcnt;
```

Visual BASIC Syntax

```
Function ifread
(ByVal id As Integer, buf As String,
 ByVal bufsize As Long, reason As Integer,
 actual As Long)
```

Description This function reads a block of data from the device via the formatted I/O read buffer (the same buffer used by `iscanf`). The *buf* argument is a pointer to the location where the block of data can be stored. The *bufsize* argument is an unsigned long integer containing the size, in bytes, of the buffer specified in *buf*.

The *reason* argument is a pointer to an integer that, upon exiting `ifread`, contains the reason why the read terminated. If the *reason* parameter contains a zero (`0`), then no termination reason is returned. The *reason* argument is a bit mask, and one or more reasons can be returned.

Values for *reason* include:

`I_TERM_MAXCNT`	*bufsize* characters read.
`I_TERM_END`	*END* indicator received on last character.
`I_TERM_CHR`	Termination character enabled and received.

The *actualcnt* argument is a pointer to an unsigned long integer which, upon exit, contains the actual number of bytes read from the formatted I/O read buffer.

If a termination condition occurs, the `ifread` will terminate. However, if there is nothing in the formatted I/O read buffer to terminate the read, then `ifread` will read from the device, fill the buffer again, and so forth.

This function obeys the `itermchr` termination character, if any, for the specified session. The read terminates only on one of the following conditions:

- It reads *bufsize* number of bytes.
- It finds a byte with the *END* indicator attached.
- It finds the current termination character in the read buffer (set with `itermchr`).
- An error occurs.

This function acts identically to the `iread` function, except the data is not read directly from the device. Instead the data is read from the formatted I/O read buffer. The advantage to this function over `iread` is that it can be intermixed with calls to `iscanf`, while `iread` may not.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IPRINTF", "ISCANF", "IPROMPTF", "IFWRITE", "ISETBUF", "ISETUBUF", "IFLUSH", "ITERMCHR"

IFWRITE

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int ifwrite (id, buf, datalen, end, actualcnt);
INST id;
char *buf;
unsigned long datalen;
int end;
unsigned long *actualcnt;
```

Visual BASIC Syntax

```
Function ifwrite
(ByVal id As Integer, ByVal buf As String,
 ByVal datalen As Long, ByVal endi As Integer,
 actual As Long)
```

Description

This function is used to send a block of data to the device via the formatted I/O write buffer (the same buffer used by `iprintf`). The *id* argument specifies the session to send the data to when the formatted I/O write buffer is flushed. The *buf* argument is a pointer to the data that is to be sent to the specified interface or device. The *datalen* argument is an unsigned long integer containing the length of the data block in bytes.

If the *end* argument is non-zero, this function will send the *END* indicator with the last byte of the data block. Otherwise, if *end* is set to zero, no *END* indicator will be sent.

The *actualcnt* argument is a pointer to an unsigned long integer. Upon exit, it will contain the actual number of bytes written to the specified device. A `NULL` pointer can be passed for this argument, and it will be ignored.

This function acts identically to the `iwrite` function, except the data is not written directly to the device. Instead the data is written to the formatted I/O write buffer (the same buffer used by `iprintf`). The formatted I/O write buffer is then flushed to the device at normal times, such as when the buffer is full, or when `iflush` is called. The advantage to this function over `iwrite` is that it can be intermixed with calls to `iprintf`, while `iwrite` cannot.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IPRINTF", "ISCANF", "IPROMPTF", "IFREAD", "ISETBUF", "ISETUBUF", "IFLUSH", "ITERMCHR", "IWRITE", "IREAD"

IGETADDR

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int igetaddr (id, addr);
INST id;
char * *addr;
```

Note Not supported on Visual BASIC.

Description The `igetaddr` function returns a pointer to the address string which was passed to the `iopen` call for the session id.

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "IOPEN"

IGETDATA

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int igetdata (id, data);
INST id;
void * *data;
```

Note Not supported on Visual BASIC.

Description The *igetdata* function retrieves the pointer to the data structure stored by *isetdata* associated with a session.

The *isetdata*/*igetdata* functions provide a good method of passing data to event handlers, such as error, interrupt, or SRQ handlers.

For example, you could set up a data structure in the main procedure and retrieve the same data structure in a handler routine. You could set a device command string in this structure so that an error handler could re-set the state of the device on errors.

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "ISETDATA"

IGETDEVADDR

Supported sessions: . . . . . .device

C Syntax

```
#include <sicl.h>

int igetdevaddr (id, prim, sec);
INST id;
int *prim;
int *sec;
```

Visual BASIC Syntax

```
Function igetdevaddr
(ByVal id As Integer, prim As Integer,
 sec As Integer)
```

Description

The *igetdevaddr* function returns the device address of the device associated with a given session. This function returns the primary device address in *prim*. The *sec* parameter contains the secondary address of the device or -1 if no secondary address exists.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IOPEN"

IGETERRNO

C Syntax

```
#include <sicl.h>

int igeterrno ();
```

Visual BASIC Syntax

```
Function igeterrno ()
```

Description

All functions (except a few listed below) return a zero if no error occurred (`I_ERR_NOERROR`), or a non-zero error code if an error occurs (see Appendix D, HP SICL Error Codes). This value can be used directly. The `igeterrno` function will return the last error that occurred in one of the library functions.

Also, if an error handler is installed, the library calls the error handler when an error occurs.

The following functions do not return the error code in the return value. Instead, they simply indicate whether an error occurred.

```
iopen
iprintf
isprintf
ivprintf
isvprintf
iscanf
isscanf
ivscanf
isvscanf
ipromptf
ivpromptf
imap
i?peek
i?poke
```

For these functions (and any of the other functions), when an error is indicated, read the error code by using the `igeterrno` function, or read the associated error message by using the `igeterrstr` function.

Return Value This function returns the error code from the last failed SICL call. If a SICL function is completed successfully, this function returns undefined results.

On operating systems that support multiple **threads**, the error number is per-thread. This means that the error number returned is for the last failed SICL function for this **thread** (not necessarily for the session).

See Also "IONERROR", "IGETONERROR", "IGETERRSTR", "ICAUSEERR"

IGETERRSTR

C Syntax

```
#include <sicl.h>

char *igeterrstr (errorcode);
int errorcode;
```

Visual BASIC Syntax

```
Function igeterrstr
(ByVal errcode As Integer, myerrstr As String)
```

Description SICL has a set of defined error messages that correspond to error codes (see Appendix D, HP SICL Error Codes) that can be generated in SICL functions. To get these error messages from error codes, use the `igeterrstr` function.

Return Value Pass this function the error code you want, and this function will return a human-readable string.

See Also "IONERROR", "IGETONERROR", "IGETERRNO", "ICAUSEERR"

IGETGATEWAYTYPE

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int igetgatewaytype (id, gwtype);
INST id;
int *gwtype;
```

Visual BASIC Syntax

```
Function igetgatewaytype
(ByVal id As Integer, pdata As Integer) As Integer
```

Note LAN is not supported with 16-bit SICL on Windows 95.

Description The `igetgatewaytype` function returns in *gwtype* the gateway type associated with a given session *id*.

This function returns one of the following values in *gwtype*:

`I_INTF_LAN`	The session is using a LAN gateway to access the remote interface.
`I_INTF_NONE`	The session is not using a gateway.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also The "Using HP SICL with LAN" chapter of this manual.

IGETINTFSESS

Supported sessions: . . . . . device, commander

C Syntax

```
#include <sicl.h>

INST igetintfsess (id);
INST id;
```

Visual BASIC Syntax

```
Function igetintfsess
(ByVal id As Integer)
```

Description

The `igetintfsess` function takes the device session specified by *id* and returns a new session *id* that refers to an interface session associated with the interface that the device is on.

Most SICL applications will take advantage of the benefits of device sessions and not want to bother with interface sessions. Since some functions only work on device sessions and others only work on interface sessions, occasionally it is necessary to perform functions on an interface session, when only a device session is available for use. An example is to perform an interface clear (see `iclear`) from within an SRQ handler (see `ionsrq`).

In addition, multiple calls to `igetintfsess` with the same *id* will return the same interface session each time. This makes this function useful as a filter, taking a device session in and returning an interface session.

SICL will close the interface session when the device or commander session is closed. Therefore, do *not* close this session.

Return Value

If no errors occur, this function returns a valid session *id*; otherwise it returns zero (0).

See Also

"IOPEN"

IGETINTFTYPE

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int igetintftype (id, pdata);
INST id;
int *pdata;
```

Visual BASIC Syntax

```
Function igetintftype
(ByVal id As Integer, pdata As Integer)
```

Description The `igetintftype` function returns a value indicating the type of interface associated with a session. This function returns one of the following values in *pdata*:

`I_INTF_GPIB`	This session is associated with a GPIB interface.
`I_INTF_GPIO`	This session is associated with a GPIO interface.
`I_INTF_LAN`	This session is associated with a LAN interface.
`I_INTF_RS232`	This session is associated with an RS-232 (Serial) interface.
`I_INTF_VXI`	This session is associated with a VXI interface.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IOPEN"

IGETLOCKWAIT

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int igetlockwait (id, flag);
INST id;
int *flag;
```

Visual BASIC Syntax

```
Function igetlockwait
(ByVal id As Integer, flag As Integer)
```

Description To get the current status of the lockwait flag, use the `igetlockwait` function. This function stores a one (1) in the variable pointed to by *flag* if the wait mode is enabled, or a zero (`0`) if a no-wait, error-producing mode is enabled.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "ILOCK", "IUNLOCK", "ISETLOCKWAIT"

IGETLU

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int igetlu (id, lu);
INST id;
int *lu;
```

Visual BASIC Syntax

```
Function igetlu
(ByVal id As Integer, lu As Integer)
```

Description The `igetlu` function returns in *lu* the logical unit (interface address) of the device or interface associated with a given session *id*.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IOPEN", "IGETLUINFO"

IGETLUINFO

C Syntax

```
#include <sicl.h>

int igetluinfo (lu, luinfo);
int lu;
struct lu_info *luinfo;
```

Visual BASIC Syntax

```
Function igetluinfo
(ByVal lu As Integer, result As lu_info)
```

Description The `igetluinfo` function is used to get information about the interface associated with the *lu* (logical unit). For C programs, the *lu_info* structure has the following syntax:

```
struct lu_info {
...
long logical_unit;     /* same as value passed into
igetluinfo */
char symname[32];   /* symbolic name assigned to interface
*/
char cardname[32];  /* name of interface card */
long intftype;         /* same value returned by igetintftype
*/
...
};
```

For Visual BASIC programs, the *lu_info* structure has the following syntax:

```
Type lu_info
logical_unit As Long
symname As String
cardname As String
filler1 As Long
intftype As Long
          .
          .
          .
End Type
```

Notice that, in a given implementation, the exact structure and contents of the *lu_info* structure is implementation-dependent. The structure can contain any amount of non-standard, implementation-dependent fields. However, the structure must always contain the above fields. If you are programming in C, please refer to the `sicl.h` file to get the exact *lu_info* syntax. If you are programming in Visual BASIC, please refer to the `SICL.BAS` or `SICL4.BAS` file for the exact syntax.

Note that `igetluinfo` will return information for valid local interfaces only, *not* remote interfaces being accessed via LAN.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IOPEN", "IGETLU", "IGETLULIST"

IGETLULIST

C Syntax

```
#include <sicl.h>

int igetlulist (lulist);
int * *lulist;
```

Visual BASIC Syntax

```
Function igetlulist
(list() As Integer)
```

Description The `igetlulist` function stores in lulist the logical unit (interface address) of each valid interface configured for SICL. The last element in the list is set to -1.

This function can be used with `igetluinfo` to retrieve information about all local interfaces.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IOPEN", "IGETLUINFO", "IGETLU"

IGETONERROR

C Syntax

```
#include <sicl.h>

int igetonerror (proc);
void ( * *proc)(INST, int);
```

Note Not supported on Visual BASIC.

Note For WIN16 programs on Microsoft Windows platforms, the variable used to store a handler's address must be declared `(_far _pascal * _far *proc)`.

Description The `igetonerror` function returns the current error handler setting. This function stores the address of the currently installed error handler into the variable pointed to by *proc*. If no error handler exists, it will store a zero (`0`).

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "IONERROR", "IGETERRNO", "IGETERRSTR", "ICAUSEERR"

IGETONINTR

Supported sessions: . . . . . .device, interface, commander

C Syntax

```
#include <sicl.h>

int igetonintr (id, proc);
INST id;
void ( * *proc)(INST, long, long);
```

Note Not supported on Visual BASIC.

Note For WIN16 programs on Microsoft Windows platforms, the variable used to store a handler's address must be declared `(_far _pascal * _far *proc)`.

Description The `igetonintr` function stores the address of the current interrupt handler in *proc*. If no interrupt handler is currently installed, *proc* is set to zero (`0`).

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "IONINTR", "IWAITHDLR", "IINTROFF", "IINTRON"

IGETONSRQ

Supported sessions: . . . . . .device, interface

C Syntax

```
#include <sicl.h>

int igetonsrq (id, proc);
INST id;
void ( * *proc)(INST);
```

Note Not supported on Visual BASIC.

Note For WIN16 programs on Microsoft Windows platforms, the variable used to store a handler's address must be declared `(_far _pascal * _far *proc)`.

Description The `igetonsrq` function stores the address of the current SRQ handler in *proc*. If there is no SRQ handler installed, *proc* will be set to zero (`0`).

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "IONSRQ", "IWAITHDLR", "IINTROFF", "IINTRON"

IGETSESSTYPE

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int igetsesstype (id, pdata);
INST id;
int *pdata;
```

Visual BASIC Syntax

```
Function igetsesstype
(ByVal id As Integer, pdata As Integer)
```

Description The `igetsesstype` function returns in *pdata* a value indicating the type of session associated with a given session *id*.

This function returns one of the following values in *pdata*:

`I_SESS_CMDR`	The session associated with *id* is a commander session.
`I_SESS_DEV`	The session associated with *id* is a device session.
`I_SESS_INTF`	The session associated with *id* is an interface session.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IOPEN"

IGETTERMCHR

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int igettermchr (id, tchr);
INST id;
int *tchr;
```

Visual BASIC Syntax

```
Function igettermchr
(ByVal id As Integer, tchr As Integer)
```

Description This function sets the variable referenced by tchr to the termination character for the session specified by *id*. If no termination character is enabled for the session, then the variable referenced by *tchr* is set to -1.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "ITERMCHR"

IGETTIMEOUT

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int igettimeout (id, tval);
INST id;
long *tval;
```

Visual BASIC Syntax

```
Function igettimeout
(ByVal id As Integer, tval As Long)
```

Description The `igettimeout` function stores the current timeout value in *tval*. If no timeout value has been set, *tval* will be set to zero (`0`).

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "ITIMEOUT"

IGPIBATNCTL

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpibatnctl (id, atnval);
INST id;
int atnval;
```

Visual BASIC Syntax

```
Function igpibatnctl
(ByVal id As Integer, ByVal atnval As Integer)
```

Description The `igpibatnctl` function controls the state of the ATN (Attention) line. If *atnval* is non-zero, then ATN is set. If *atnval* is 0, then ATN is cleared.

This function is used primarily to allow GPIB devices to communicate without the controller participating. For example, after addressing one device to talk and another to listen, ATN can be cleared with `igpibatnctl` to allow the two devices to transfer data.

Note This function will not work with `iwrite` to send GPIB command data onto the bus. The `iwrite` function on a GPIB interface session always clears the ATN line before sending the buffer. To send GPIB command data, use the `igpibsendcmd` function.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIBSENDCMD", "IGPIBRENCTL", "IWRITE"

IGPIBBUSADDR

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpibbusaddr (id, busaddr);
INST id;
int busaddr;
```

Visual BASIC Syntax

```
Function igpibbusaddr
(ByVal id As Integer, ByVal busaddr As Integer)
```

Description This function changes the interface bus address to *busaddr* for the GPIB interface associated with the session *id*.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIBBUSSTATUS"

IGPIBBUSSTATUS

Supported sessions: . . . . . interface

C Syntax

```
#include <sicl.h>

int igpibbusstatus (id, request, result);
INST id;
int request;
int *result;
```

Visual BASIC Syntax

```
Function igpibbusstatus
(ByVal id As Integer, ByVal request As Integer,
 result As Integer)
```

Description The `igpibbusstatus` function returns the status of the GPIB interface. This function takes one of the following parameters in the *request* parameter and returns the status in the *result* parameter.

`I_GPIB_BUS_REM`	Returns a 1 if the interface is in remote mode, 0 otherwise.
`I_GPIB_BUS_SRQ`	Returns a 1 if the SRQ line is asserted, 0 otherwise.
`I_GPIB_BUS_NDAC`	Returns a 1 if the NDAC line is asserted, 0 otherwise.
`I_GPIB_BUS_SYSCTLR`	Returns a 1 if the interface is the system controller, 0 otherwise.
`I_GPIB_BUS_ACTCTLR`	Returns a 1 if the interface is the active controller, 0 otherwise.
`I_GPIB_BUS_TALKER`	Returns a 1 if the interface is addressed to talk, 0 otherwise.
`I_GPIB_BUS_LISTENER`	Returns a 1 if the interface is addressed to listen, 0 otherwise.

`I_GPIB_BUS_ADDR`	Returns the bus address (0-30) of this interface on the GPIB bus.
`I_GPIB_BUS_LINES`	Returns the state of various GPIB lines. The result is a bit mask with the following bits being significant (bit 0 is the least-significant-bit): Bit 0: 1 if SRQ line is asserted. Bit 1: 1 if NDAC line is asserted. Bit 2: 1 if ATN line is asserted. Bit 3: 1 if DAV line is asserted. Bit 4: 1 if NRFD line is asserted. Bit 5: 1 if EOI line is asserted. Bit 6: 1 if IFC line is asserted. Bit 7: 1 if REN line is asserted. Bit 8: 1 if in REMote state. Bit 9: 1 if in LLO (local lockout) mode. Bit 10: 1 if currently the active controller. Bit 11: 1 if addressed to talk. Bit 12: 1 if addressed to listen.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIBPASSCTL", "IGPIBSENDCMD"

IGPIBGETT1DELAY

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpibgett1delay (id, delay);
INST id;
int *delay;
```

Visual BASIC Syntax

```
Function igpibgett1delay
(ByVal id As Integer, delay As Integer)
```

Description This function retrieves the current setting of t1 delay on the GPIB interface associated with session *id*. The value returned is the time of t1 delay in nanoseconds.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIBSETT1DELAY"

IGPIBLLO

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpibllo (id);
INST id;
```

Visual BASIC Syntax

```
Function igpibllo
(ByVal id As Integer)
```

Description The `igpibllo` function puts all GPIB devices on the given bus in local lockout mode. The *id* specifies a GPIB interface session. This function sends the GPIB LLO command to all devices connected to the specified GPIB interface. Local Lockout prevents you from returning to local mode by pressing a device's front panel keys.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IREMOTE", "ILOCAL"

IGPIBPASSCTL

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpibpassctl (id, busaddr);
INST id;
int busaddr;
```

Visual BASIC Syntax

```
Function igpibpassctl
(ByVal id As Integer, ByVal busaddr As Integer)
```

Description The `igpibpassctl` function passes control from this GPIB interface to another GPIB device specified in *busaddr*. The *busaddr* parameter must be between 0 and 30. Note that this will also cause an I_INTR_INTFDEACT interrupt, if enabled.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also “IONINTR”, “ISETINTR”

IGPIBPPOLL

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpibppoll (id, result);
INST id;
unsigned int *result;
```

Visual BASIC Syntax

```
Function igpibppoll
(ByVal id As Integer, result As Integer)
```

Description The `igpibppoll` function performs a parallel poll on the bus and returns the (8-bit) result in the lower byte of *result*.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIBPPOLLCONFIG", "IGPIBPPOLLRESP"

IGPIBPPOLLCONFIG

Supported sessions: . . . . . device, commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpibppollconfig (id, cval);
INST id;
unsigned int cval;
```

Visual BASIC Syntax

```
Function igpibppollconfig
(ByVal id As Integer, ByVal cval As Integer)
```

Description For device sessions, the `igpibppollconfig` function enables or disables the parallel poll responses. If *cval* is greater than or equal to 0, then the device specified by *id* is enabled in generating parallel poll responses. In this case, the lower 4 bits of *cval* correspond to:

`bit 3`	Set the sense of the PPOLL response. A 1 in this bit means that an affirmative response means service request. A 0 in this bit means that an affirmative response means no service request.
`bit 2-0`	A value from 0-7 specifying the GPIB line to respond on for PPOLL's.

If *cval* is equal to -1, then the device specified by *id* is disabled from generating parallel poll responses.

For commander sessions, the `igpibppollconfig` function enables and disables parallel poll responses for this device (that is, how we respond when our controller PPOLL's us).

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIBPPOLL", "IGPIBPPOLLRESP"

IGPIBPPOLLRESP

Supported sessions: . . . . . commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpibppollresp (id, sval);
INST id;
int sval;
```

Visual BASIC Syntax

```
Function igpibppollresp
(ByVal id As Integer, ByVal sval As Integer)
```

Description The `igpibppollresp` function sets the state of the PPOLL bit (the state of the PPOLL bit when the controller PPOLL's us).

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIBPPOLL", "IGPIBPPOLLCONFIG"

IGPIBRENCTL

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpibrenctl (id, ren);
INST id;
int ren;
```

Visual BASIC Syntax

```
Function igpibrenctl
(ByVal id As Integer, ByVal ren As Integer)
```

Description The `igpibrenctl` function controls the state of the REN (Remote Enable) line. If *ren* is non-zero, then REN is set. If *ren* is 0, then REN is cleared.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIBATNCTL"

IGPIBSENDCMD

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpibsendcmd (id, buf, length);
INST id;
char *buf;
int length;
```

Visual BASIC Syntax

```
Function igpibsendcmd
(ByVal id As Integer, ByVal buf As String,
 ByVal length As Integer)
```

Description The `igpibsendcmd` function sets the ATN line and then sends bytes to the GPIB interface. This function sends *length* number of bytes from *buf* to the GPIB interface. Note that the `igpibsendcmd` function leaves the ATN line set.

If the interface is not active controller, this function will return an error.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIBATNCTL", "IWRITE"

IGPIBSETT1DELAY

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpibsett1delay (id, delay);
INST id;
int delay;
```

Visual BASIC Syntax

```
Function igpibsett1delay
(ByVal id As Integer, ByVal delay As Integer)
```

Description This function sets the t1 delay on the GPIB interface associated with session *id*. The value is the time of t1 delay in nanoseconds, and should be no less than `I_GPIB_T1DELAY_MIN` or no greater than `I_GPIB_T1DELAY_MAX`.

Note that most GPIB interfaces only support a small number of t1 delays, so the actual value used by the interface could be different than that specified in the `igpibsett1delay` function. You can find out the actual value used by calling the `igpibgett1delay` function.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIBGETT1DELAY"

IGPIOCTRL

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpioctrl (id, request, setting);
INST id;
int request;
unsigned long setting;
```

Visual BASIC Syntax

```
Function igpioctrl
(ByVal id As Integer, ByVal request As Integer,
 ByVal setting As Long)
```

Note GPIO is *not* supported over LAN.

Description The `igpioctrl` function is used to control various lines and modes of the GPIO interface. This function takes *request* and sets the interface to the specified *setting*. The *request* parameter can be one of the following:

`I_GPIO_AUTO_HDSK`	If the *setting* parameter is non-zero, then the interface uses auto-handshake mode (the default). This gives the best performance for `iread` and iwrite operations. If the *setting* parameter is zero (`0`), then auto-handshake mode is canceled. This is *required* for programs that implement their own handshake using `I_GPIO_SET_PCTL`.
`I_GPIO_AUX`	The *setting* parameter is a mask containing the state of all auxiliary control lines. A 1 bit asserts the corresponding line; a 0 (zero) bit clears the corresponding line. When configured in Enhanced Mode, the HP E2074/5 interface has 16 auxiliary control lines. In HP 98622 Compatibility Mode, it has none. Attempting to use `I_GPIO_AUX` in HP 98622 Compatibility Mode results in the error: `Operation not supported`.
`I_GPIO_CHK_PSTS`	If the *setting* parameter is non-zero, then the PSTS line is checked before each block of data is transferred. If the *setting* parameter is zero (`0`), then the PSTS line is ignored during data transfers. If the PSTS line is checked and false, SICL reports the error: `Device not active or available`.

`I_GPIO_CTRL`

The *setting* parameter is a mask containing the state of all control lines. A 1 bit asserts the corresponding line; a 0 (zero) bit clears the corresponding line.

The HP E2074/5 interface has two control lines, so only the two least-significant bits have meaning for that interface. These can be represented by the following. All other bits in the *setting* mask are ignored.
`I_GPIO_CTRL_CTL0`The CTL0 line.
`I_GPIO_CTRL_CTL1`The CTL1 line.

`I_GPIO_DATA`

The *setting* parameter is a mask containing the state of all data out lines. A 1 bit asserts the corresponding line; a 0 (zero) bit clears the corresponding line. The HP E2074/5 interface has either 8 or 16 data out lines, depending on the setting specified by `igpiosetwidth`.

Note that this function changes the data lines asynchronously, without any type of handshake. It is intended for programs that implement their own handshake explicitly.

`I_GPIO_READ_EOI`

If the *setting* parameter is `I_GPIO_EOI_NONE`, then END pattern matching is disabled for read operations. Any other *setting* enables END pattern matching with the specified value. If the current data width is 16 bits, then the lower 16 bits of *setting* are used. If the current data width is 8 bits, then only the lower 8 bits of *setting* are used.

`I_GPIO_SET_PCTL`

If the *setting* parameter is non-zero, then a GPIO handshake is initiated by setting the PCTL line. Auto-handshake mode must be disabled to allow explicit control of the PCTL line. Attempting to use `I_GPIO_SET_PCTL` in auto-handshake mode results in the error: `Operation not supported`.

`I_GPIO_PCTL_DELAY` The *setting* parameter selects a PCTL delay value from a set of eight “click stops” numbered 0 through 7. A *setting* of 0 selects 200 ns; a *setting* of 7 selects 50 µs. For a complete list of delay values, see the *HP E2074/5 GPIO Interface Installation Guide*.

Changes made by this function can remain in the interface hardware after your program ends. On HP-UX and Windows NT, the *setting* remains until the computer is rebooted. On Windows 95, it remains until `hp074i16.dll` is reloaded.

`I_GPIO_POLARITY` The *setting* parameter determines the logical polarity of various interface lines according to the following bit map. A 0 sets active-low polarity; a 1 sets active-high polarity.

Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data Out	Data In	PSTS	PFLG	PCTL
Value=16	Value=8	Value=4	Value=2	Value=1

Changes made by this function can remain in the interface hardware after your program ends. On HP-UX and Windows NT, the *setting* remains until the computer is rebooted. On Windows 95, it remains until `hp074i16.dll` is reloaded.

`I_GPIO_READ_CLK` The *setting* parameter determines when the data input registers are latched. It is recommended that you represent *setting* as a hex number. In that representation, the first hex digit corresponds to the upper (most-significant) input byte, and the second hex digit corresponds to the lower input byte. The clocking choices are: 0=Read, 1=Busy, 2=Ready. For an explanation of the data-in clocking, see the *HP E2074/5 GPIO Interface Installation Guide*.

Changes made by this function can remain in the interface hardware after your program ends. On HP-UX and Windows NT, the *setting* remains until the computer is rebooted. On Windows 95, it remains until `hp074i16.dll` is reloaded.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIOSTAT", "IGPIOSETWIDTH"

IGPIOGETWIDTH

Supported sessions: . . . . . interface

C Syntax

```
#include <sicl.h>

int igpiogetwidth (id, width);
INST id;
int *width;
```

Visual BASIC Syntax

```
Function igpiogetwidth
(ByVal id As Integer, width As Integer)
```

Note GPIO is *not* supported over LAN.

Description The `igpiogetwidth` function returns the current data width (in bits) of a GPIO interface. For the HP E2074/5 interface, *width* will be either 8 or 16.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIOSETWIDTH"

IGPIOSETWIDTH

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int igpiosetwidth (id, width);
INST id;
int width;
```

Visual BASIC Syntax

```
Function igpiosetwidth
(ByVal id As Integer, ByVal width As Integer)
```

Note GPIO is *not* supported over LAN.

Description The `igpiosetwidth` function is used to set the data width (in bits) of a GPIO interface. For the HP E2074/5 interface, the acceptable values for *width* are 8 and 16.

While in 16-bit width mode, all `iread` calls will return an even number of bytes, and all `iwrite` calls must send an even number of bytes.

16-bit words are placed on the data lines using “big-endian” byte order (most significant bit appears on data line D_15). Data alignment is automatically adjusted for the native byte order of the computer. This is a programming concern only if your program does its own packing of bytes into words. The following program segment is an `iwrite` example. The analogous situation exists for `iread`.

```
/* System automatically handles byte order */
unsigned short words[5];

/* Programmer assumes responsibility for byte order */
unsigned char bytes[10];

/* Using the GPIO interface in 16-bit mode */
igpiosetwidth(id, 16);
```

```
/* This call is platform-independent */
iwrite(id, words, 10, ... );

/* This call is NOT platform-independent */
iwrite(id, bytes, 10, ... );

/* This sequence is platform-independent */
ibeswap(bytes, 10, 2);
iwrite(id, bytes, 10, ... );
```

There are several notable details about GPIO width. The “count” parameters for `iread` and `iwrite` always specify bytes, even when the interface has a 16-bit width. For example, to send 100 *words*, specify 200 *bytes*. The `itermchr` function always specifies an 8-bit character. If a 16-bit width is set, only the lower 8 bits are used when checking for an `itermchr` match.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also “IGPIOGETWIDTH”

IGPIOSTAT

Supported sessions: . . . . . interface

C Syntax

```
#include <sicl.h>

int igpiostat (id, request, result);
INST id;
int request;
unsigned long *result;
```

Visual BASIC Syntax

```
Function igpiostat
(ByVal id As Integer, ByVal request As Integer,
 ByVal result As Long)
```

Note GPIO is *not* supported over LAN.

Description The `igpiostat` function is used to determine the current state of various GPIO modes and lines. The *request* parameter can be one of the following:

`I_GPIO_CTRL`	The *result* is a mask representing the state of all control lines. The HP E2074/5 interface has two control lines, so only the two least-significant bits have meaning for that interface. These can be represented by the following. All other bits in the *result* mask are 0 (zero). `I_GPIO_CTRL_CTL0`The CTL0 line. `I_GPIO_CTRL_CTL1`The CTL1 line.
`I_GPIO_DATA`	The *result* is a mask representing the state of all data input latches. The HP E2074/5 interface has either 8 or 16 data in lines, depending on the setting specified by `igpiosetwidth`. Note that this function reads the data lines asynchronously, without any type of handshake. It is intended for programs that implement their own handshake explicitly. An `igpiostat` function from one process will proceed even if another process has a lock on the interface. Ordinarily, this does not alter or disrupt any hardware states. Reading the data in lines is one exception. A data read causes an “input” indication on the I/O line (pin 20). In rare cases, that change might be unexpected, or undesirable, to the session that owns the lock.
`I_GPIO_INFO`	The *result* is a mask representing the following information about the device and the HP E2074/5 interface:
`I_GPIO_PSTS`	State of the PSTS line.
`I_GPIO_EIR`	State of the EIR line.
`I_GPIO_READY`	True if ready for a handshake. (Exact meaning depends on the current handshake mode.)

`I_GPIO_AUTO_HDSK`	True if auto-handshake mode is enabled. False if auto-handshake mode is disabled.
`I_GPIO_CHK_PSTS`	True if the PSTS line is to be checked before each block of data is transferred. False if PSTS is to be ignored during data transfers.
`I_GPIO_ENH_MODE`	True if the HP E2074/5 data ports are configured in Enhanced (bi-directional) Mode. False if the ports are configured in HP 98622 Compatibility Mode.
`I_GPIO_READ_EOI`	The *result* is the value of the current END pattern being used for read operations. If the *result* is `I_GPIO_EOI_NONE`, then no END pattern matching is being used. Any other *result* is the value of the END pattern.
`I_GPIO_STAT`	The *result* is a mask representing the state of all status lines. The HP E2074/5 interface has two status lines, so only the two least-significant bits have meaning for that interface. These can be represented by the following. All other bits in the *result* mask are 0 (zero). `I_GPIO_STAT_STI0`The STI0 line. `I_GPIO_STAT_STI1`The STI1 line.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGPIOCTRL", "IGPIOSETWIDTH"

IHINT

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int ihint (id, hint);
INST id;
int hint;
```

Visual BASIC Syntax

```
Function ihint
(ByVal id As Integer, ByVal hint As Integer)
```

Description There are three common ways a driver can implement I/O communications: Direct Memory Access (DMA), Polling (POLL), and Interrupt Driven (INTR). Note, however, that some systems may not implement all of these transfer methods.

The SICL software permits you to "recommend" your preferred method of communication. To do this, use the `ihint` function. The *hint* argument can be one of the following values:

`I_HINT_DONTCARE`	No preference.
`I_HINT_USEDMA`	Use DMA if possible and feasible. Otherwise use POLL.
`I_HINT_USEPOLL`	Use POLL if possible and feasible. Otherwise use DMA or INTR.
`I_HINT_USEINTR`	Use INTR if possible and feasible. Otherwise use DMA or POLL.
`I_HINT_SYSTEM`	The driver should use whatever mechanism is best suited for improving overall system performance.
`I_HINT_IO`	The driver should use whatever mechanism is best suited for improving I/O performance.

Keep the following in mind as you make your suggestions to the driver:

- DMA tends to be very fast at sending data but requires more time to set up a transfer. It is best for sending large amounts of data in a single request. Not all architectures and interfaces support DMA.
- Polling tends to be fast at sending data and has a small set up time. However, if the interface only accepts data at a slow rate, polling wastes a lot of CPU time. Polling is best for sending smaller amounts of data to fast interfaces.
- Interrupt driven transfers tend to be slower than polling. It also has a small set up time. The advantage to interrupts is that the CPU can perform other functions while waiting for data transfers to complete. This mechanism is best for sending small to medium amounts of data to slow interfaces or interfaces with an inconsistent speed.

Note The parameter passed in `ihint` is only a suggestion to the driver software. The driver will still make its own determination of which technique it will use. The choice has no effect on the operation of any intrinsics, just on the performance characteristics of that operation.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IREAD", "IWRITE", "IFREAD", "IFWRITE", "IPRINTF", "ISCANF"

IINTROFF

C Syntax

```
#include <sicl.h>

int iintroff ();
```

Note Not supported on Visual BASIC.

Description The `iintroff` function disables SICL's asynchronous events for a process. This means that all installed handlers for any sessions in a process will be held off until the process enables them with `iintron`.

By default, asynchronous events are enabled. However, the library will not generate any events until the appropriate handlers are installed. To install handlers, refer to the `ionsrq` and `ionintr` functions.

Note The `iintroff`/`iintron` functions do not affect the *isetintr* values or the handlers in any way.

Default is on.

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "IONINTR", "IGETONINTR", "IONSRQ", "IGETONSRQ", "IWAITHDLR", "IINTRON"

IINTRON

C Syntax

```
#include <sicl.h>

int iintron ();
```

Note Not supported on Visual BASIC.

Description The `iintron` function enables all asynchronous handlers for all sessions in the process.

Note The `iintroff`/`iintron` functions do not affect the `isetintr` values or the handlers in any way.

Default is on.

Calls to `iintroff`/`iintron` can be nested, meaning that there must be an equal number of on's and off's. This means that simply calling the `iintron` function may not actually enable interrupts again. For example, note how the following code enables and disables events.

```
iintroff(); /* Events Disabled */
iintron();  /* Events Enabled */

iintroff(); /* Events Disabled */
   iintroff();    /* Events Disabled */
   iintron();     /* Events STILL Disabled */
iintron();  /* Events NOW Enabled */
```

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "IONINTR", IGETONINTR, "IONSRQ", "IGETONSRQ", "IWAITHDLR", "IINTROFF", "ISETINTR"

ILANGETTIMEOUT

Supported sessions: . . . . . interface

C Syntax

```
#include <sicl.h>

int ilangettimeout (id, tval);
INST id;
long *tval;
```

Visual BASIC Syntax

```
Function ilangettimeout
(ByVal id As Integer, tval As Long) As Integer
```

Note LAN is *not* supported with 16-bit SICL on Windows 95.

Description The `ilangettimeout` function stores the current LAN timeout value in *tval*. If the LAN timeout value has not been set via `ilantimeout`, then *tval* will contain the LAN timeout value calculated by the system.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "ILANTIMEOUT", and the "Using Timeouts with LAN" section of the "Using HP SICL with LAN" chapter of this manual.

ILANTIMEOUT

Supported sessions: . . . . . interface

C Syntax

```
#include <sicl.h>

int ilantimeout (id, tval);
INST id;
long tval;
```

Visual BASIC Syntax

```
Function ilantimeout
(ByVal id As Integer, ByVal tval As Long) As Integer
```

Note LAN is *not* supported with 16-bit SICL on Windows 95.

Description The `ilantimeout` function is used to set the length of time that the application (LAN client) will wait for a response from the LAN server. Once an application has manually set the LAN timeout via this function, the software will no longer attempt to determine the LAN timeout which should be used. Instead, the software will simply use the value set via this function.

In this function, *tval* defines the timeout in milliseconds. A value of zero (`0`) disables timeouts. The value `1` has special significance, causing the LAN client to not wait for a response from the LAN server. However, the value `1` should be used in special circumstances only and should be used with extreme caution. See the following subsection, “Using the No-Wait Value,” for more information.

Note The `ilantimeout` function is per process. Thus, when `ilantimeout` is called, all sessions which are going out over the network are affected.

Note Not all computer systems can guarantee an accuracy of one millisecond on timeouts. Some computer clock systems only provide a resolution of 1/50th or 1/60th of a second. Other computers have a resolution of only 1 second. Note that the time value is *always* rounded up to the next unit of resolution.

This function does not affect the SICL timeout value set via the `itimeout` function. The LAN server will attempt the I/O operation for the amount of time specified via `itimeout` before returning a response.

Note If the SICL timeout used by the server is greater than the LAN timeout used by the client, the client may timeout prior to the server, while the server continues to service the request. This use of the two timeout values is not recommended, since under this situation the server may send an unwanted response to the client.

Using the No-Wait Value

A *tval* value of `1` has special significance to `ilantimeout`, causing the LAN client to not wait for a response from the LAN server. For a very limited number of cases, it may make sense to use this no-wait value. One such scenario is when the performance of paired writes and reads over a wide-area network (WAN) with long latency times is critical, and losing status information from the write can be tolerated. Having the write (and only the write) call not wait for a response allows the read call to proceed immediately, potentially cutting the time required to perform the paired WAN write/read in half.

Caution This value should be used with great caution. If `ilantimeout` is set to `1` and then is not reset for a subsequent call, the system may deadlock due to responses being buffered which are never read, filling the buffers on both the LAN client and server.

To use the no-wait value, do the following:

- Prior to the `iwrite` call (or any formatted I/O call that will write data) which you do not wish to block waiting for the returned status from the server, call `ilantimeout` with a timeout value of `1`.

- Make the `iwrite` call. The `iwrite` call will return as soon as the message is sent, not waiting for a reply. The `iwrite` call's return value will be `I_ERR_TIMEOUT`, and the reported count will be `0` (even though the data will be written, assuming no errors).

  Note that the server will send a reply to the write, even though the client will simply discard it. There is no way to directly determine the success or failure of the write, although a subsequent, functioning read call can be a good sign.

- Reset the client side timeout to a reasonable value for your network by calling `ilantimeout` again with a value sufficiently large enough to allow a read reply to be received. It is recommended that you use a value which provides some margin for error. Note that the timeout specified to `ilantimeout` is in milliseconds (rounded up to the nearest second).

- Make the blocking `iread` call (or formatted I/O call that will read data). Since `ilantimeout` has been set to a value other than `1` (preferably not `0`), the `iread` call will wait for a response from the server for the specified time (rounded up to the nearest second).

Note If the no-wait value is used in a multi-threaded application and multiple threads are attempting I/O over the LAN, the I/O operations using the no-wait option will wait for access to the LAN for 2 minutes. If another thread is using the LAN interface for greater than 2 minutes, the no-wait operation will timeout.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also ILANGETTIMEOUT, and the "Using Timeouts with LAN" section of the "Using HP SICL with LAN" chapter of this manual.

ILOCAL

Supported sessions: . . . . . device
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int ilocal (id);
INST id;
```

Visual BASIC Syntax

```
Function ilocal
(ByVal id As Integer)
```

Description Use the `ilocal` function to put a device into Local Mode. Putting a device in Local Mode enables the device's front panel interface.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IREMOTE", and the interface-specific chapter of this manual for details of implementation.

ILOCK

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `itimeout`

C Syntax

```
#include <sicl.h>

int ilock (id);
INST id;
```

Visual BASIC Syntax

```
Function ilock
(ByVal id As Integer)
```

Note Locks are not supported for LAN interface sessions, such as those opened with:

```
lan_intf = iopen("lan");
```

Description To lock a session, ensuring exclusive use of a resource, use the `ilock` function.

The *id* parameter refers either to a device, interface, or commander session. If it refers to an interface, then the entire interface is locked; other interfaces are not affected by this session. If the *id* refers to a device or commander, then only that device or commander is locked, and only that session may access that device or commander. However, other devices either on that interface or on other interfaces may be accessed as usual.

Locks are implemented on a per-session basis. If a session within a given process locks a device or interface, then that device or interface is only accessible from that session. It is not accessible from any other session in this process, or in any other process.

Attempting to call a SICL function that obeys locks on a device or interface that is locked will cause the call either to hang until the device or interface is unlocked, to timeout, or to return with the error `I_ERR_LOCKED` (see `isetlockwait`).

Locking an **interface** (from an interface session) restricts other device and interface sessions from accessing this interface.

Locking a **device** restricts other device sessions from accessing this device; however, other interface sessions may continue to use this interface.

Locking a **commander** (from a commander session) restricts other commander sessions from accessing this controller; however, interface sessions may continue to use this interface.

Note Locking an interface *does* lock out all device session accesses on that interface, such as `iwrite (`*dev2*`,...)`, as well as all other SICL interface session accesses on that interface.

The following C example will cause the device session to hang:

```
intf = iopen (“hpib”);
dev = iopen (“hpib,7”);
     .
     .
     .
ilock (intf);
ilock (dev);                    /* this will succeed */
iwrite (dev, “*CLS”, 4, 1, 0); /* this will hang */
```

The following Visual BASIC example will cause the device session to hang:

```
intf = iopen(“hpib”)
dev = iopen(“hpib,7”)
     .
     .
     .
call ilock (intf)
call ilock(dev)                   ‘ this will succeed
call iwrite(dev, “*CLS”, 4, 1, 0&) ‘ this will hang
```

Locks can be nested. So every `ilock` requires a matching `iunlock`.

Note If `iclose` is called (either implicitly by exiting the process, or explicitly) for a session that currently has a lock, the lock will be released.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IUNLOCK", "ISETLOCKWAIT", "IGETLOCKWAIT"

IMAP

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `ilock`, `itimeout`

Note Not recommended for new program development. Use IMAPX instead.

C Syntax

```
#include <sicl.h>

char *imap (id, map_space, pagestart, pagecnt, suggested);
INST id;
int map_space;
unsigned int pagestart;
unsigned int pagecnt;
char *suggested;
```

Visual BASIC Syntax

```
Function imap
(ByVal id As Integer, ByVal mapspace As Integer,
 ByVal pagestart As Integer, ByVal pagecnt As Integer,
 ByVal suggested As Long) As Long
```

Note Not supported over LAN.

Description The `imap` function maps a memory space into your process space. The SICL `i?peek` and `i?poke` functions can then be used to read and write to VXI address space.

The *id* argument specifies a VXI interface or device. The *pagestart* argument indicates the page number within the given memory space where the memory mapping starts. The *pagecnt* argument indicates how many pages to use. For Visual BASIC, you must specify `1` for the *pagecnt* argument.

The *map_space* argument will contain one of the following values:

`I_MAP_A16`	Map in VXI A16 address space (64 Kbyte pages).
`I_MAP_A24`	Map in VXI A24 address space (64 Kbyte pages).
`I_MAP_A32`	Map in VXI A32 address space (64 Kbyte pages).
`I_MAP_VXIDEV`	Map in VXI device registers. (Device session only, 64 bytes.)
`I_MAP_EXTEND`	Map in VXI Device Extended Memory address space in A24 or A32 address space. See individual device manuals for details regarding extended memory address space. (Device session only.)
`I_MAP_SHARED`	Map in VXI A24/A32 memory that is physically located on this device (sometimes called local shared memory). If the hardware supports it (that is, the local shared VXI memory is dual-ported), this map should be through the local system bus and not through the VXI memory. This mapping mechanism provides an alternate way of accessing local VXI memory without having to go through the normal VXI memory system. The value of *pagestart* is the offset (in 64 Kbyte pages) into the shared memory. The value of *pagecnt* is the amount of memory (in 64 Kbyte pages) to map.

Note The E1489 MXIbus Controller Interface can generate 32-bit data reads and writes to VXIbus devices with D32 capability. To use 32-bit transfers with the E1489, use `I_MAP_A16_D32`, `I_MAP_A24_D32`, and `I_MAP_A32_D32` in place of `I_MAP_A16`, `I_MAP_A24`, and `I_MAP_A32` when mapping to D32 devices.

The *suggested* argument, if non-NULL, contains a suggested address to begin mapping memory. However, the function may not always use this suggested address. For Visual BASIC, you must pass a 0 (zero) for this argument.

After memory is mapped, it may be accessed directly. Since this function returns a C pointer, you can also use C pointer arithmetic to manipulate the

pointer and access memory directly. Note that accidentally accessing non-existent memory will cause bus errors. See the "Using HP SICL with VXI" chapter in the *HP SICL User's Guide for HP-UX* for an example of trapping bus errors. Or see your operating system's programming information for help in trapping bus errors. You will probably find this information under the command `signal` in your operating system's manuals. Note that Visual BASIC programs can perform pointer arithmetic within a single page.

Note Due to hardware constraints on a given device or interface, not all address spaces may be implemented. In addition, there may be a maximum number of pages that can be simultaneously mapped. If a request is made that cannot be granted due to hardware constraints, the process will hang until the desired resources become available. To avoid this, use the `isetlockwait` command with the *flag* parameter set to `0`, and thus generate an error instead of waiting for the resources to become available. You may also use the `imapinfo` function to determine hardware constraints before making an `imap` call.

Remember to `iunmap` a memory space when you no longer need it. The resources may be needed by another process.

Return Value

For C programs, this function returns a zero (0) if an error occurs or a non-zero number if successful. This non-zero number is the address to begin mapping memory.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also

"IUNMAP", "IMAPINFO"

IMAPX

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

unsigned long imapx (id, mapspace, pagestart, pagecnt);
   INST id;
   int mapspace;
   unsigned int pagestart;
   unsigned int pagecnt;
```

Visual BASIC Syntax

```
Function imapx
ByVal id As Integer, ByVal mapspace As Integer,
ByVal pagestart As Integer, ByVal pagecnt As Integer)
```

Note Not supported over LAN.

Description The `imapx` function returns an unsigned long number, used in other functions, that maps a memory space into your process space. The SICL `ipeek?x` and `ipoke?x` functions can then be used to read and write to VXI address space.

The *id* argument specifies a VXI interface or device. The *pagestart* argument indicates the page number within the given memory space where the memory mapping starts. The *pagecnt* argument indicates how many pages to use. For Visual BASIC, you must specify `1` for the *pagecnt* argument.

The *map_space* argument will contain one of the following values:

`I_MAP_A16`	Map in VXI A16 address space (64 Kbyte pages).
`I_MAP_A24`	Map in VXI A24 address space (64 Kbyte pages).
`I_MAP_A32`	Map in VXI A32 address space (64 Kbyte pages).

`I_MAP_VXIDEV`	Map in VXI device registers. (Device session only, 64 bytes.)
`I_MAP_EXTEND`	Map in VXI Device Extended Memory address space in A24 or A32 address space. See individual device manuals for details regarding extended memory address space. (Device session only.)
`I_MAP_SHARED`	Map in VXI A24/A32 memory that is physically located on this device (sometimes called local shared memory). If the hardware supports it (that is, the local shared VXI memory is dual-ported), this map should be through the local system bus and not through the VXI memory. This mapping mechanism provides an alternate way of accessing local VXI memory without having to go through the normal VXI memory system. The value of *pagestart* is the offset (in 64 Kbyte pages) into the shared memory. The value of *pagecnt* is the amount of memory (in 64 Kbyte pages) to map.

Note The E1489 MXIbus Controller Interface can generate 32-bit data reads and writes to VXIbus devices with D32 capability. To use 32-bit transfers with the E1489, use `I_MAP_A16_D32`, `I_MAP_A24_D32`, and `I_MAP_A32_D32` in place of `I_MAP_A16`, `I_MAP_A24`, and `I_MAP_A32` when mapping to D32 devices.

Depending on what *iderefptr* returns, memory may be accessed directly. Since this function returns a C pointer, you can also use C pointer arithmetic to manipulate the pointer and access memory directly. Note that accidentally accessing non-existent memory will cause bus errors. See the “Using HP SICL with VXI” chapter in the *HP SICL User’s Guide for HP-UX* for an example of trapping bus errors. Or see your operating system’s programming information for help in trapping bus errors. You will probably find this information under the command `signal` in your operating system’s manuals. Note that Visual BASIC programs can perform pointer arithmetic within a single page.

Note Due to hardware constraints on a given device or interface, not all address spaces may be implemented. In addition, there may be a maximum number of pages that can be simultaneously mapped. If a request is made that cannot be granted due to hardware constraints, the process will hang until the desired resources become available. To avoid this, use the `isetlockwait` command with the *flag* parameter set to `0`, and thus generate an error instead of waiting for the resources to become available. You may also use the `imapinfo` function to determine hardware constraints before making an `imap` call.

Remember to `iunmapx` a memory space when you no longer need it. The resources may be needed by another process.

Return Value For C programs, this function returns a zero (0) if an error occurs or a non-zero number if successful. This non-zero number is either a handle or the address to begin mapping memory. Use the `iderefptr` function to determine wheter the returned handle is a valid address or a handle.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IUNMAPX", "IMAPINFO", "IDEREFPTR"

IMAPINFO

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int imapinfo (id, map_space, numwindows, winsize);
INST id;
int map_space;
int *numwindows;
int *winsize;
```

Visual BASIC Syntax

```
Function imapinfo
(ByVal id As Integer, ByVal mapspace As Integer,
 numwindows As Integer, winsize As Integer)
```

Note Not supported over LAN.

Description To determine hardware constraints on memory mappings imposed by a particular interface, use the `imapinfo` function.

The *id* argument specifies a VXI interface. The *map_space* argument specifies the address space. Valid values for *map_space* are:

`I_MAP_A16`	VXI A16 address space (64 Kbyte pages).
`I_MAP_A24`	VXI A24 address space (64 Kbyte pages).
`I_MAP_A32`	VXI A32 address space (64 Kbyte pages).

The *numwindows* argument is filled in with the total number of windows available in the address space.

The *winsize* argument is filled in with the size of the windows in pages.

Hardware design constraints may prevent some devices or interfaces from implementing all of the various address spaces. Also there may be a limit to the number of pages that can simultaneously be mapped for usage. In addition, some resources may already be in use and locked by another

process. If resource constraints prevent a mapping request, the `imap` function will hang, waiting for the resources to become available.

Remember to unmap a memory space when you no longer need it. The resources may be needed by another process.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IMAP", "IUNMAP"

IONERROR

C Syntax

```
#include <sicl.h>

int ionerror(proc);
void ( *proc)(id, error);
INST id;
int error;
```

Note For WIN16 programs on Microsoft Windows platforms, handler functions used with `ionerror`, `ionintr`, and `ionsrq` must be exported and declared as `_far _pascal`.

Note For Visual BASIC, error handlers are installed using the Visual BASIC `On Error` statement. See the section titled "Error Handlers in Visual BASIC" in the "Programming with HP SICL" chapter of this manual for more information on error handling with Visual BASIC.

Description The `ionerror` function is used to install a SICL error handler. Many of the SICL functions can generate an error. When a SICL function errors, it typically returns a special value such as a NULL pointer, zero, or a non-zero error code. A process can specify a procedure to execute when a SICL error occurs. This allows your process to ignore the return value and simply permit the error handler to detect errors and do the appropriate action.

The error handler procedure executes immediately before the SICL function that generated the error completes its operation. There is only one error handler for a given process which handles all errors that occur with any session established by that process.

On operating systems that support multiple **threads**, the error handler is still per-process. However, the error handler will be called in the context of the thread that caused the error.

Error handlers are called with the following arguments:

```
void proc (id, error);
INST id;
int error;
```

The *id* argument indicates the session that generated the error.

The *error* argument indicates the error that occurred. See Appendix D, HP SICL Error Codes, for a complete description of the error codes.

Note The `INST` *id* that is passed to the error handler is the same `INST` *id* that was passed to the function that generated the error. Therefore, if an error occurred because of an invalid `INST` *id*, the `INST` *id* passed to the error handler is also invalid. Also, if `iopen` generates an error before a session has been established, the error handler will be passed a zero (`0`) `INST` *id*.

Two special reserved values of *proc* can be passed to the `ionerror` procedure:

`I_ERROR_EXIT`	This value installs a special error handler which logs a diagnostic message and terminates the process.
`I_ERROR_NO_EXIT`	This value also installs a special error handler which logs a diagnostic message but does not terminate the process.

If a zero (`0`) is passed as the value of *proc*, it will remove the error handler.

Note that the error procedure could perform a *setjmp*/*longjmp* or an escape using the *try*/*recover* clauses.

Example for using *setjmp*/*longjmp*:

```
#include <sicl.h>

INST id;
jmp_buf env;
... void proc (INST,int) {
   /* Error occurred, perform a longjmp */
   longjmp (env, 1);
}

void xyzzy () {
   if (setjmp (env) == 0) {
      /* Normal code */
      ionerror (proc);

      /* Do actions that could cause errors */
      iwrite (.......);
      iread (........);
      ...etc...

      ionerror (0);
   } else {
      /* Error Code */
      ionerror (0);
      ... do error processing ...
      if (igeterrno () ==...)
      ... etc ...;
   }
}
```

Or, using *try*/*recover*/*escape*:

```
#include <sicl.h>

INST id;
...
void proc (INST id, int error) {
   /* Error occurred, perform an escape */
   escape (id);
}
void xyzzy () {
   try {
      /* Normal code */
      ionerror (proc);

      /* Do actions that could cause errors */
      iwrite (.......);
      iread (........);
      ...etc...

      ionerror (0);
   } recover {
      /* Error Code */
      ionerror (0);
      ... do error processing ...
      if (igeterrno () == ...)
         ... etc ...;
   }
}
```

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also “IGETONERROR”, “IGETERRNO”, “IGETERRSTR”, “ICAUSEERR”

IONINTR

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int ionintr (id, proc);
INST id;
void ( *proc)(id, reason, secval);
 INST id;
 long reason;
 long secval;
```

Note Not supported on Visual BASIC.

Note For WIN16 programs on Microsoft Windows platforms, handler functions used with `ionerror`, `ionintr`, and `ionsrq` must be exported and declared as `_far _pascal`.

Description The library can notify a process when an interrupt occurs by using the `ionintr` function. This function installs the procedure *proc* as an interrupt handler.

After you install the interrupt handler with `ionintr`, use the `isetintr` function to enable notification of the interrupt event or events.

The library calls the *proc* procedure whenever an enabled interrupt occurs. It calls *proc* with the following parameters:

```
void proc (id, reason, secval);
INST id;
long reason;
long secval;
```

Where:

id	The `INST` that refers to the session that installed the interrupt handler.
reason	Contains a value which corresponds to the reason for the interrupt. These values correspond to the `isetintr` function parameter *intnum*. See a listing of the values below.
secval	Contains a secondary value which depends on the type of interrupt which occurred. For `I_INTR_TRIG`, it contains a bit mask corresponding to the trigger lines which fired. For interface-dependent and device-dependent interrupts, it contains an appropriate value for that interrupt.

The *reason* parameter specifies the cause for the interrupt. Valid *reason* values for all interface sessions are:

`I_INTR_INTFACT`	Interface became active.
`I_INTR_INTFDEACT`	Interface became deactivated.
`I_INTR_TRIG`	A Trigger occurred. The *secval* parameter contains a bit-mask specifying which triggers caused the interrupt. See the `ixtrig` function's *which* parameter for a list of valid values.
`I_INTR_*`	Individual interfaces may use other interface-interrupt conditions.

Valid *reason* values for all device sessions are:

`I_INTR_*`	Individual interfaces may include other interface-interrupt conditions.

To remove the interrupt handler, pass a zero (`0`) in the *proc* parameter. By default, no interrupt handler is installed.

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "ISETINTR", "IGETONINTR", "IWAITHDLR", "IINTROFF", "IINTRON", and the section titled "Asynchronous Events and HP-UX Signals" in the "Programming with HP SICL" chapter of the *HP SICL User's Guide for HP-UX* for protecting I/O calls against interrupts.

IONSRQ

Supported sessions: . . . . . .device, interface

C Syntax

```
#include <sicl.h>

int ionsrq (id, proc);
INST id;
void ( *proc)(id);
 INST id;
```

Note For WIN16 programs on Microsoft Windows platforms, handler functions used with `ionerror`, `ionintr`, and `ionsrq` must be exported and declared as `_far _pascal`.

Note Not supported on Visual BASIC.

Description Use the `ionsrq` function to notify an application when an SRQ occurs. This function installs the procedure *proc* as an SRQ handler.

An SRQ handler is called any time its corresponding interface generates an SRQ. If an interface device driver receives an SRQ and cannot determine the generating device (for example, on HP-IB), it passes the SRQ to *all* SRQ handlers assigned to the interface. Therefore, an SRQ handler cannot assume that its corresponding device actually generated an SRQ. An SRQ handler should use the `ireadstb` function to determine whether its corresponding device generated the SRQ. It calls *proc* with the following parameters:

```
void proc (id);
INST id;
```

To remove an SRQ handler, pass a zero (`0`) as the *proc* parameter.

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "IGETONSRQ", "IWAITHDLR", "IINTROFF", "IINTRON", "IREADSTB"

IOPEN

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

INST iopen (addr);
char *addr
```

Visual BASIC Syntax

```
Function iopen
(ByVal addr As String)
```

Description Before using any of the SICL functions, the application program must establish a session with the desired interface or device. Create a session by using the `iopen` function.

This function creates a session and returns a session identifier. Note that the session identifier should only be passed as a parameter to other SICL functions. It is not designed to be updated manually by you.

The *addr* parameter contains the device, interface, or commander address.

An application may have multiple sessions open at the same time by creating multiple session identifiers with the `iopen` function.

Note If an error handler has been installed (see `ionerror`), and an `iopen` generates an error before a session has been established, the handler will be called with the session identifier set to zero (`0`). Caution must be used if using the session identifier in an error handler.

Also, it is possible for an `iopen` to succeed on a device that does not exist. In this case, other functions (such as `iread`) will fail with a nonexistent device error.

Creating A Device Session

To create a device session, specify a particular interface name followed by the device's address in the *addr* parameter. For more information on addressing devices, see the section on "Addressing Device Sessions" in the "Programming with HP SICL" chapter of this manual.

C example:

```
INST dmm;
dmm = iopen("hpib,15");
```

Visual BASIC example:

```
DIM dmm As Integer
dmm = iopen("hpib,15")
```

Creating An Interface Session

To create an interface session, specify a particular interface in the *addr* parameter. For more information on addressing interfaces, see the section on "Addressing Interface Sessions" in the "Programming with HP SICL" chapter of this manual.

C example:

```
INST hpib;
hpib = iopen("hpib");
```

Visual BASIC example:

```
DIM hpib As Integer
hpib = iopen("hpib")
```

Creating A Commander Session

To create a commander session, use the keyword `cmdr` in the *addr* parameter. For more information on commander sessions, see the section on "Addressing Commander Sessions" in the "Programming with HP SICL" chapter of this manual.

C example:

```
INST cmdr;
cmdr = iopen("hpib,cmdr");
```

Visual BASIC example:

```
DIM cmdr As Integer
cmdr = iopen("hpib,cmdr")
```

Return Value The `iopen` function returns a zero (0) *id* value if an error occurs; otherwise a valid session *id* is returned.

See Also "ICLOSE"

IPEEK

Note Not recommended for new program development. Use IPEEKX8, IPEEKX16, IPEEKX32 instead.

C Syntax

```
#include <sicl.h>

unsigned char ibpeek (addr);
unsigned char *addr;

unsigned short iwpeek (addr);
unsigned short *addr;

unsigned long ilpeek (addr);
unsigned long *addr;
```

Visual BASIC Syntax

```
Function ibpeek
(ByVal addr As Long) As Byte

Function iwpeek
(ByVal addr As Long) As Integer

Function ilpeek
(ByVal addr As Long) As Long
```

Note Not supported over LAN.

Description The `i?peek` functions will read the value stored at *addr* from memory and return the result. The `i?peek` functions are generally used in conjunction with the SICL `imap` function to read data from VXI address space.

Note The `iwpeek` and `ilpeek` functions perform byte swapping (if necessary) so that VXI memory accesses follow correct VXI byte ordering.
Also, if a bus error occurs, unexpected results may occur.

See Also "IPOKE", "IMAP"

IPEEKX8, IPEEKX16, IPEEKX32

C Syntax

```
#include <sicl.h>

int ipeekx8 (id, handle, offset, *value);
   INST id;
   unsigned long handle;
   unsigned long offset;
   unsigned char *value;

int ipeekx16 (id, handle, offset, *value);
   INST id;
   unsigned long handle;
   unsigned long offset;
   unsigned short *value

int ipeekx32 (id, handle, offset, *value);
   INST id;
   unsigned long handle;
   unsigned long offset;
   unsigned long *value))
```

Visual BASIC Syntax

```
Function ipeekx8
(ByVal id As Integer, ByVal handle As Long,
 ByVal offset as Long, ByVal value As Integer)
```

(syntax is the same for *ipeekx16* and *ipeekx32*)

Note Not supported over LAN.

Description The `ipeekx8, ipeekx16,` and `ipeekx32` functions read the values stored at *handle* and *offset* from memory and returns the value from that address. These functions are generally used in conjunction with the SICL `imapx` function to read data from VXI address space.

Note The `ipeekx8` and `ipeekx16` functions perform byte swapping (if necessary) so that VXI memory accesses follow correct VXI byte ordering. Also, if a bus error occurs, unexpected results may occur.

See Also "IPOKEX8, IPOKEX16, IPOKEX32", "IMAPX"

IPOKE

Note Not recommended for new program development. Use IPOKEX8, IPOKEX16, IPOKEX32 instead.

C Syntax

```
#include <sicl.h>

void ibpoke (addr, val);
unsigned char *addr;
unsigned char val;

void iwpoke (addr, val);
unsigned short *addr;
unsigned short val;

void ilpoke (addr, val);
unsigned long *addr;
unsigned long val;
```

Visual BASIC Syntax

```
Sub ibpoke
(ByVal addr As Long, ByVal value As Integer)

Sub iwpoke
(ByVal addr As Long, ByVal value As Integer)

Sub ilpoke
(ByVal addr As Long, ByVal value As Long)
```

Note Not supported over LAN.

Description The `i?poke` functions will write to memory. The `i?poke` functions are generally used in conjunction with the SICL `imap` function to write to VXI address space.

The *addr* is a valid memory address. The *val* is a valid data value.

Note The `iwpoke` and `ilpoke` functions perform byte swapping (if necessary) so that VXI memory accesses follow correct VXI byte ordering.

Also, if a bus error occurs, unexpected results may occur.

See Also "IPEEK", "IMAP"

IPOKEX8, IPOKEX16, IPOKEX32

C Syntax

```
#include <sicl.h>

int ipokex8 (id, handle, offset, value);
   INST id;
   unsigned long handle;
   unsigned long offset;
   unsigned char value;

int ipokex16 (id, handle, offset, value);
   INST id;
   unsigned long handle;
   unsigned long offset;
   unsigned short value;

int ipokex8 (id, handle, offset, value);
   INST id;
   unsigned long handle;
   unsigned long offset;
   unsigned long value;
```

Visual BASIC Syntax

```
Sub ipokex8
(ByVal id As Integer, ByVal handle As Long,
 ByVal offset as Long, ByVal value As Integer)
```

(syntax is the same for *ipokex16* and *ipokex32*.)

Note Not supported over LAN.

Description The `ipokex8, ipokex16, and ipokex32` functions write to memory. The functions are generally used in conjunction with the SICL `imapx` function to write to VXI address space.

The *handle* is a valid memory address, *offset* is a valid memory offset. The *val* is a valid data value.

Note The `ipokex16` and `ipokex32` functions perform byte swapping (if necessary) so that VXI memory accesses follow correct VXI byte ordering.

Also, if a bus error occurs, unexpected results may occur.

See Also "IPEEKX8, IPEEKX16, IPEEKX32", "IMAPX"

IPOPFIFO

C Syntax

```
#include <sicl.h>

int ibpopfifo (id, fifo, dest, cnt);
INST id;
unsigned char *fifo;
unsigned char *dest;
unsigned long cnt;

int iwpopfifo (id, fifo, dest, cnt, swap);
INST id;
unsigned char *fifo;
unsigned char *dest;
unsigned long cnt;
int swap;

int ilpopfifo (id, fifo, dest, cnt, swap);
INST id;
unsigned char *fifo;
unsigned char *dest;
unsigned long cnt;
int swap;
```

Visual BASIC Syntax

```
Function ibpopfifo
(ByVal id As Integer, ByVal fifo As Long,
 ByVal dest As Long, ByVal cnt As Long)

Function iwpopfifo
(ByVal id As Integer, ByVal fifo As Long,
 ByVal dest As Long, ByVal cnt As Long,
 ByVal swap As Integer)

Function ilpopfifo
(ByVal id As Integer, ByVal fifo As Long,
 ByVal dest As Long, ByVal cnt As Long,
 ByVal swap As Integer)
```

Note Not supported over LAN.

Description The `i?popfifo` functions read data from a FIFO and puts it in memory. Use `b` for byte, `w` for word, and `l` for long word (8-bit, 16-bit, and 32-bit, respectively). These functions increment the write address, to write successive memory locations, while reading from a single memory (FIFO) location. Thus, these functions can transfer entire blocks of data.

The *id*, although specified, is normally ignored except to determine an interface-specific transfer mechanism such as DMA. To prevent using an interface-specific mechanism, pass a zero (`0`) in this parameter. The *dest* argument is the starting memory address for the destination data. The *fifo* argument is the memory address for the source FIFO register data. The *cnt* argument is the number of transfers (bytes, words, or longwords) to perform. The *swap* argument is the byte swapping flag. If *swap* is zero, no swapping occurs. If *swap* is non-zero, the function swaps bytes (if necessary) to change byte ordering from the internal format of the controller to/from the VXI (big-endian) byte ordering.

Note If a bus error occurs, unexpected results may occur.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also “IPEEK”, “IPOKE”, “IPUSHFIFO”, “IMAP”

IPRINTF

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iprintf (id, format [,arg1][,arg2][,...]);
int isprintf (buf, format [,arg1][,arg2][,...]);
int ivprintf (id, format, va_list ap);
int isvprintf (buf, format, va_list ap);
INST id;
char *buf;
const char *format;
param arg1, arg2, ...;
va_list ap;
```

Note For WIN16 programs on Microsoft Windows platforms, if compiling with tiny, small, or medium models, make sure all pointer/address parameters are passed as `_far`.

Visual BASIC Syntax

```
Function ivprintf
(ByVal id As Integer, ByVal fmt As String,
 ByVal ap As Any)
```

Description These functions convert data under the control of the *format* string. The *format* string specifies how the argument is converted before it is output. If the first argument is an `INST`, the data is sent to the device to which the `INST` refers. If the first argument is a character buffer, the data is placed in the buffer.

The *format* string contains regular characters and special conversion sequences. The `iprintf` function sends the regular characters (not a `%` character) in the *format* string directly to the device. Conversion specifications are introduced by the `%` character. Conversion specifications control the type, the conversion, and the formatting of the *arg* parameters.

Note The formatted I/O functions, `iprintf` and `ipromptf`, can re-address the bus multiple times during execution. This behavior may cause problems with instruments which do not comply with IEEE 488.2.

Re-addressing occurs under the following circumstances:

- After the internal buffer fills. (See `isetbuf`.)
- When a `\n` is found in the *format* string in C/C++, or when a `Chr$(10)` is found in the *format* string in Visual BASIC.
- When a `%C` is found in the *format* string.

This behavior affects only non-IEEE 488.2 devices on the GPIB interface.

Use the special characters and conversion commands explained later in this section to create the *format* string's contents.

Restrictions Using ivprintf in Visual BASIC

The following restrictions apply when using `ivprintf` with Visual BASIC.

- Format Conversion Commands:

  Only one format conversion command can be specified in a format string for `ivprintf` (a format conversion command begins with the `%` character). For example, the following is invalid:

  ```
  nargs% = ivprintf(id, "%lf%d" + Chr$(10), ...)
  ```

  Instead, you must call `ivprintf` once for each format conversion command, as shown in the following example:

  ```
  nargs% = ivprintf(id, "%lf" + Chr$(10), dbl_value)
  nargs% = ivprintf(id, "%d" + Chr$(10), int_value)
  ```

- Writing Numeric Arrays:

  For Visual BASIC, when writing from a numeric array with `ivprintf`, you must specify the first element of a numeric array as the *ap* parameter to `ivprintf`. This passes the address of the first array element to `ivprintf`. For example:

  ```
  Dim flt_array(50) As Double
  nargs% = ivprintf(id, "%,50f", dbl_array(0))
  ```

  This code declares an array of 50 floating point numbers and then calls `ivprintf` to write from the array.

  For more information on passing numeric arrays as arguments with Visual BASIC, see the "Arrays" section of the "Calling Procedures in DLLs" chapter of the *Visual BASIC Programmer's Guide.*

- Writing Strings:

  The `%S` format string is not supported for `ivprintf` on Visual BASIC.

Special Characters for C/C++

Special characters in C/C++ consist of a backslash (\) followed by another character. The special characters are:

`\n`	Send the ASCII LF character with the END indicator set.
`\r`	Send the ASCII CR character.
`\\`	Send the backslash (\) character.
`\t`	Send the ASCII TAB character.
`\###`	Send the ASCII character specified by the octal value ###.
`\v`	Send the ASCII VERTICAL TAB character.
`\f`	Send the ASCII FORM FEED character.
`\"`	Send the ASCII double-quote (") character.

Special Characters for Visual BASIC

Special characters in Visual BASIC are specified with the `CHR$()` function. These special characters are added to the format string by using the + string concatenation operator in Visual BASIC. For example:

```
nargs=ivprintf(id, "*RST"+CHR$(10), 0&)
```

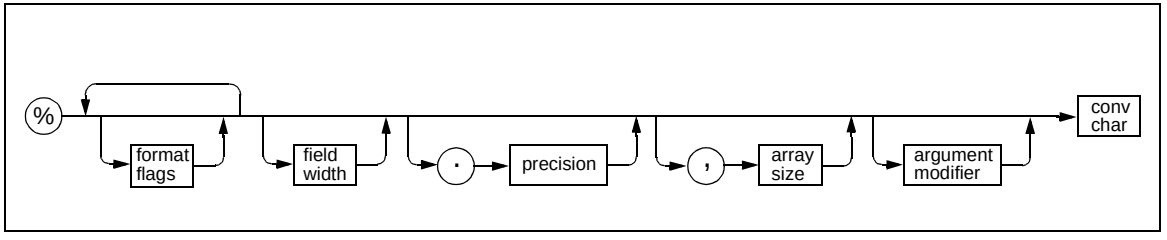
The special characters are:

`Chr$(10)`	Send the ASCII LF character with the END indicator set.
`Chr$(13)`	Send the ASCII CR character.
`\`	Sends the backslash (\) character.[a]
`Chr$(9)`	Send the ASCII TAB character.
`Chr$(11)`	Send the ASCII VERTICAL TAB character.
`Chr$(12)`	Send the ASCII FORM FEED character.
`Chr$(34)`	Send the ASCII double-quote (") character.

a. In Visual BASIC, the backslash character can be specified in a format string directly, instead of being "escaped" by prepending it with another backslash.

Format Conversion Commands

An `iprintf` format conversion command begins with a `%` character. After the `%` character, the optional modifiers appear in this order: format flags, field width, a period and precision, a comma and array size (comma operator), and an argument modifier. The command ends with a conversion character.



The modifiers in a conversion command are:

format flags	Zero or more flags (in any order) that modify the meaning of the conversion character. See the following subsection, "List of *format flags*" for the specific flags you may use.
field width	An optional minimum *field width* is an integer (such as "`%8d`"). If the formatted data has fewer characters than field width, it will be padded. The padded character is dependent on various flags. In C/C++, an asterisk (`*`) may appear for the integer, in which case it will take another *arg* to satisfy this conversion command. The next *arg* will be an integer that will be the *field width* (for example, `iprintf (`*id*`, "%*d", 8, num)`).
. *precision*	The precision operator is an integer preceded by a period (such as "`%.6d`"). The optional precision for conversion characters `e`, `E`, and `f` specifies the number of digits to the right of the decimal point. For the `d`, `i`, `o`, `u`, `x`, and `X` conversion characters, it specifies the minimum number of digits to appear. For the `s` and `S` conversion characters, the precision specifies the maximum number of characters to be read from your *arg* string. In C/C++, an asterisk (`*`) may appear in the place of the integer, in which case it will take another *arg* to satisfy this conversion command. The next *arg* will be an integer that will be the *precision* (for example, `iprintf (`*id*`, "%.*d", 6, num)`).

, array size	The comma operator is an integer preceded by a comma (such as "%,10d"). The optional comma operator is only valid for conversion characters d and f. This is a comma followed by a number. This indicates that a list of comma-separated numbers is to be generated. The argument is an array of the specified type instead of the type (that is, an array of integers instead of an integer). In C/C++, an asterisk (*) may appear for the number, in which case it will take another *arg* to satisfy this conversion command. The next *arg* will be an integer that is the number of elements in the array.
argument modifier	The meaning of the modifiers h, l, w, z, and Z is dependent on the conversion character (such as "%wd").
conv char	A conversion character is a character that specifies the type of *arg* and the conversion to be applied. This is the only required element of a conversion command. See the following subsection, "List of *conv chars*" for the specific conversion characters you may use.

Examples of Format Conversion Commands

The following are some examples of conversion commands used in the *format* string and the output that would result from them. (The output data is arbitrary.)

Conversion Command	Output	Description
%@Hd	#H3A41	format flag
%10s	str	field width
%-10s	str	format flag (left justify) & field width
%.6f	21.560000	precision
%,3d	18,31,34	comma operator

Conversion Command	Output	Description
`%6ld`	`  132`	field width & argument modifier (long)
`%.6ld`	`000132`	precision & argument modifier (long)
`%@1d`	`61`	format flag (IEEE 488.2 NR1)
`%@2d`	`61.000000`	format flag (IEEE 488.2 NR2)
`%@3d`	`6.100000E+01`	format flag (IEEE 488.2 NR3)

List of *format flags* The *format flags* you can use in conversion commands are:

`@1`	Convert to an NR1 number (an IEEE 488.2 format integer with no decimal point). Valid only for `%d` and `%f`. Note that `%f` values will be truncated to the integer value.
`@2`	Convert to an NR2 number (an IEEE 488.2 format floating point number with at least one digit to the right of the decimal point). Valid only for `%d` and `%f`.
`@3`	Convert to an NR3 number (an IEEE 488.2 format number expressed in exponential notation). Valid only for `%d` and `%f`.
`@H`	Convert to an IEEE 488.2 format hexadecimal number in the form `#Hxxxx`. Valid only for `%d` and `%f`. Note that `%f` values will be truncated to the integer value.
`@Q`	Convert to an IEEE 488.2 format octal number in the form `#Qxxxx`. Valid only for `%d` and `%f`. Note that `%f` values will be truncated to the integer value.
`@B`	Convert to an IEEE 488.2 format binary number in the form `#Bxxxx`. Valid only for `%d` and `%f`. Note that `%f` values will be truncated to the integer value.
`-`	Left justify the result.
`+`	Prefix the result with a sign (`+` or `-`) if the output is a signed type.
`space`	Prefix the result with a blank ( ) if the output is signed and positive. Ignored if both blank and + are specified.

`#` Use alternate form. For the `o` conversion, it prints a leading zero. For `x` or `X`, a non-zero will have `0x` or `0X` as a prefix. For `e`, `E`, `f`, `g`, and `G`, the result will always have one digit on the right of the decimal point.

`0` Will cause the left pad character to be a zero (`0`) for all numeric conversion types.

List of *conv chars* The *conv chars* (conversion characters) you can use in conversion commands are:

`d` Corresponding *arg* is an integer. If no flags are given, send the number in IEEE 488.2 NR1 (integer) format. If flags indicate an NR2 (floating point) or NR3 (floating point) format, convert the argument to a floating point number. This argument supports all six flag modifier formatting options: NR1 - `@1`, NR2 - `@2`, NR3 - `@3`, `@H`, `@Q`, or `@B`. If the `l` argument modifier is present, the *arg* must be a long integer. If the `h` argument modifier is present, the *arg* must be a short integer for C/C++, or an Integer for Visual BASIC.

`f` Corresponding *arg* is a double for C/C++, or a Double for Visual BASIC. If no flags are given, send the number in IEEE 488.2 NR2 (floating point) format. If flags indicate that NR1 format is to be used, the *arg* will be truncated to an integer. This argument supports all six flag modifier formatting options: NR1 - `@1`, NR2 - `@2`, NR3 - `@3`, `@H`, `@Q`, or `@B`. If the `l` argument modifier is present, the *arg* must be a double. If the `L` argument modifier is present, the *arg* must be a long double for C/C++ (not supported for Visual BASIC).

`b` In C/C++, corresponding *arg* is a pointer to an arbitrary block of data. (Not supported in Visual BASIC.) The data is sent as IEEE 488.2 Definite Length Arbitrary Block Response Data. The field width must be present and will specify the number of elements in the data block. An asterisk (`*`) can be used in place of the integer, which indicates that two *arg*s are used. The first is a long used to specify the number of elements. The second is the pointer to the data block. No byte swapping is performed.

If the w argument modifier is present, the block of data is an array of unsigned short integers. The data block is sent to the device as an array of words (16 bits). The *field width* value now corresponds to the number of short integers, not bytes. Each word will be appropriately byte swapped and padded so that they are converted from the internal computer format to the standard IEEE 488.2 format.

If the l argument modifier is present, the block of data is an array of unsigned long integers. The data block is sent to the device as an array of longwords (32 bits). The *field width* value now corresponds to the number of long integers, not bytes. Each word will be appropriately byte swapped and padded so that they are converted from the internal computer format to the standard IEEE 488.2 format.

If the z argument modifier is present, the block of data is an array of floats. The data is sent to the device as an array of 32-bit IEEE 754 format floating point numbers. The *field width* is the number of floats.

If the Z argument modifier is present, the block of data is an array of doubles. The data is sent to the device as an array of 64-bit IEEE 754 format floating point numbers. The *field width* is the number of doubles.

B — Same as b in C/C++, except that the data block is sent as IEEE 488.2 Indefinite Length Arbitrary Block Response Data. (Not supported in Visual BASIC.) Note that this format involves sending a newline with an END indicator on the last byte of the data block.

c — In C/C++, corresponding *arg* is a character. (Not supported in Visual BASIC.)

C — In C/C++, corresponding *arg* is a character. Send with END indicator. (Not supported in Visual BASIC.)

t — In C/C++, control sending the END indicator with each LF character in the *format* string. (Not supported in Visual BASIC.) A + flag indicates to send an END with each succeeding LF character (default), a - flag indicates to not send END. If no + or - flag appears, an error is generated.

`s`	Corresponding *arg* is a pointer to a null-terminated string that is sent as a string.
`S`	In C/C++, corresponding *arg* is a pointer to a null-terminated string that is sent as an IEEE 488.2 string response data block. (Not supported in Visual BASIC.) An IEEE 488.2 string response data block consists of a leading double quote (″) followed by non-double quote characters and terminated with a double quote.
`%`	Send the ASCII percent (%) character.
`i`	Corresponding *arg* is an integer. Same as `d` except that the six flag modifier formatting options: NR1 - `@1`, NR2 - `@2`, NR3 - `@3`, `@H`, `@Q`, or `@B` are ignored.
`o,u,x,X`	Corresponding *arg* will be treated as an unsigned integer. The argument is converted to an unsigned octal (o), unsigned decimal (u), or unsigned hexadecimal (x,X). The letters `abcdef` are used with `x`, and the letters `ABCDEF` are used with `X`. The precision specifies the minimum number of characters to appear. If the value can be represented with fewer than precision digits, leading zeros are added. If the precision is set to zero and the value is zero, no characters are printed.
`e,E`	Corresponding *arg* is a double in C/C++, or a Double in Visual BASIC. The argument is converted to exponential format (that is, `[-]d.dddde+/-dd`). The precision specifies the number of digits to the right of the decimal point. If no precision is specified, then six digits will be converted. The letter `e` will be used with `e` and the letter `E` will be used with `E`.
`g,G`	Corresponding *arg* is a double in C/C++, or a Double in Visual BASIC. The argument is converted to exponential (`e` with `g`, or `E` with `G`) or floating point format depending on the value of the *arg* and the precision. The exponential style will be used if the resulting exponent is less than -4 or greater than the precision; otherwise it will be printed as a float.

`n`	**Corresponding *arg* is a pointer to an integer in C/C++, or an Integer for Visual BASIC. The number of bytes written to the device for the entire `iprintf` call is written to the *arg*. No argument is converted.**
`F`	On HP-UX or Windows NT, corresponding *arg* is a pointer to a FILE descriptor. (Not supported on Windows 95.) The data will be read from the file that the FILE descriptor points to and written to the device. The FILE descriptor must be opened for reading. No flags or modifiers are allowed with this conversion character.

Return Value

This function returns the total number of arguments converted by the format string.

Buffers and Errors

Since `iprintf` does not return an error code and data is buffered before it is sent, it cannot be assumed that the device received any data after the `iprintf` has completed.

The best way to detect errors is to install your own error handler. This handler can decide the best action to take depending on the error that has occurred.

If an error has occurred during an `iprintf` with no error handler installed, the only way you can be informed that an error has occurred is to use `igeterrno` right after the `iprintf` call.

Remember that `iprintf` can be called many times without any data being flushed to the session. There are only three conditions where the write formatted I/O buffer is flushed. Those conditions are:

- If a newline is encountered in the format string.
- If the buffer is filled.
- If `iflush` is called with the `I_BUF_WRITE` value.

If an error occurs while writing data, such as a timeout, the buffer will be flushed (that is, the data will be lost) and, if an error handler is installed, it will be called, or the error number will be set to the appropriate value.

See Also

"ISCANF", "IPROMPTF", "IFLUSH", "ISETBUF", "ISETUBUF", "IFREAD", "IFWRITE"

IPROMPTF

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int ipromptf (id, writefmt, readfmt[, arg1][, arg2][, ...]);
int ivpromptf (id, writefmt, readfmt, va_list ap);
INST id;
const char *writefmt;
const char *readfmt;
param arg1,arg2,...;
va_list ap;
```

Note Not supported on Visual BASIC.

Note For WIN16 programs on Microsoft Windows platforms, if compiling with tiny, small, or medium models, make sure all pointer/address parameters are passed as `_far`.

Description The `ipromptf` function is used to perform a formatted write immediately followed by a formatted read. This function is a combination of the `iprintf` and `iscanf` functions. First, it flushes the read buffer. It then formats a string using the *writefmt* string and the first *n* arguments necessary to implement the prompt string. The write buffer is then flushed to the device. It then uses the *readfmt* string to read data from the device and to format it appropriately.

The *writefmt* string is identical to the format string used for the `iprintf` function.

The *readfmt* string is identical to the format string used for the `iscanf` function. It uses the arguments immediately following those needed to satisfy the *writefmt* string.

This function returns the total number of arguments used by both the read and write format strings.

See Also "IPRINTF", "ISCANF", "IFLUSH", "ISETBUF", "ISETUBUF", "IFREAD", "IFWRITE"

IPUSHFIFO

C Syntax

```
#include <sicl.h>

int ibpushfifo (id, src, fifo, cnt);
INST id;
unsigned char *src;
unsigned char *fifo;
unsigned long cnt;

int iwpushfifo (id, src, fifo, cnt, swap);
INST id;
unsigned short *src;
unsigned short *fifo;
unsigned long cnt;
int swap;

int ilpushfifo (id, src, fifo, cnt, swap);
INST id;
unsigned long *src;
unsigned long *fifo;
unsigned long cnt;
int swap;
```

Visual BASIC Syntax

```
Function ibpushfifo
(ByVal id As Integer, ByVal src As Long,
 ByVal fifo As Long, ByVal cnt As Long)

Function iwpushfifo
(ByVal id As Integer, ByVal src As Long,
 ByVal fifo As Long, ByVal cnt As Long,
 ByVal swap As Integer)

Function ilpushfifo
(ByVal id As Integer, ByVal src As Long,
 ByVal fifo As Long, ByVal cnt As Long,
 ByVal swap As Integer)
```

Note Not supported over LAN.

Description The `i?pushfifo` functions copy data from memory on one device to a FIFO on another device. Use `b` for byte, `w` for word, and `l` for long word (8-bit, 16-bit, and 32-bit, respectively). These functions increment the read address, to read successive memory locations, while writing to a single memory (FIFO) location. Thus, they can transfer entire blocks of data.

The *id*, although specified, is normally ignored except to determine an interface-specific transfer mechanism such as DMA. To prevent using an interface-specific mechanism, pass a zero (`0`) in this parameter. The *src* argument is the starting memory address for the source data. The *fifo* argument is the memory address for the destination FIFO register data. The *cnt* argument is the number of transfers (bytes, words, or longwords) to perform. The *swap* argument is the byte swapping flag. If *swap* is zero, no swapping occurs. If *swap* is non-zero the function swaps bytes (if necessary) to change byte ordering from the internal format of the controller to/from the VXI (big-endian) byte ordering.

Note If a bus error occurs, unexpected results may occur.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IPOPFIFO", "IPOKE", "IPEEK", "IMAP"

IREAD

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iread (id, buf, bufsize, reason, actualcnt);
INST id;
char *buf;
unsigned long bufsize;
int *reason;
unsigned long *actualcnt;
```

Visual BASIC Syntax

```
Function iread
(ByVal id As Integer, buf As String,
 ByVal bufsize As Long, reason As Integer,
 actual As Long)
```

Description

This function reads raw data from the device or interface specified by *id*. The *buf* argument is a pointer to the location where the block of data can be stored. The *bufsize* argument is an unsigned long integer containing the size, in bytes, of the buffer specified in *buf*.

The *reason* argument is a pointer to an integer that, on exiting the `iread` call, contains the reason why the read terminated. If the *reason* parameter contains a zero (`0`), then no termination reason is returned. Reasons include:

`I_TERM_MAXCNT`	bufsize characters read.
`I_TERM_END END`	indicator received on last character.
`I_TERM_CHR`	Termination character enabled and received.

The *actualcnt* argument is a pointer to an unsigned long integer. Upon exit, this contains the actual number of bytes read from the device or interface. If the *actualcnt* parameter is NULL, then the number of bytes read will not be returned.

If you want to pass a NULL *reason* or *actualcnt* parameter to `iread` in Visual BASIC, you should pass the expression `0&`.

For LAN, if the client times out prior to the server, the *actualcnt* returned will be 0, even though the server may have read some data from the device or interface.

This function reads data from the specified device or interface and stores it in *buf* up to the maximum number of bytes allowed by *bufsize*. The read terminates only on one of the following conditions:

- It reads bufsize number of bytes.
- It receives a byte with the END indicator attached.
- It receives the current termination character (set with itermchr).
- An error occurs.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IWRITE", "ITERMCHR", "IFREAD", "IFWRITE"

IREADSTB

Supported sessions: . . . . . .device
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int ireadstb (id, stb);
INST id;
unsigned char *stb;
```

Visual BASIC Syntax

```
Function ireadstb
(ByVal id As Integer, stb As String)
```

Description The `ireadstb` function reads the status byte from the device specified by *id*. The *stb* argument is a pointer to a variable which will contain the status byte upon exit.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IONSRQ", "ISETSTB"

IREMOTE

Supported sessions: . . . . . device
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iremote (id);
INST id;
```

Visual BASIC Syntax

```
Function iremote
(ByVal id As Integer)
```

Description Use the `iremote` function to put a device into remote mode. Putting a device in remote mode disables the device's front panel interface.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "ILOCAL", and the interface-specific chapter in this manual for details of implementation.

ISCANF

Supported sessions: . . . . . device, interface, commander
* Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iscanf (id, format [,arg1][,arg2][,...]);
int isscanf (buf, format [,arg1][,arg2][,...]);
int ivscanf (id, format, va_list ap);
int isvscanf (buf, format, va_list ap);
INST id;
char *buf;
const char *format;
ptr arg1, arg2, ...;
va_list ap;
```

Note For WIN16 programs on Microsoft Windows platforms, if compiling with tiny, small, or medium models, make sure all pointer/address parameters are passed as `_far`.

Visual BASIC Syntax

```
Function ivscanf
(ByVal id As Integer, ByVal fmt As String,
 ByRef ap As Any)
```

Description These functions read formatted data, convert it, and store the results into your *args*. These functions read bytes from the specified device, or from *buf*, and convert them using conversion rules contained in the *format* string. The number of *arg*s converted is returned.

The *format* string contains:

- White-space characters, which are spaces, tabs, or special characters.
- An ordinary character (not %), which must match the next non-white-space character read from the device.
- Format conversion commands.

Use the white-space characters and conversion commands explained later in this section to create the *format* string's contents.

Notes on Using `iscanf`

- Using `itermchr` with `iscanf`:

  The `iscanf` function only terminates reading on an END indicator or the termination character specified by `itermchar`.

- Using `iscanf` with Certain Instruments:

  The `iscanf` function cannot be used easily with instruments that do not send an END indicator.

- Buffer Management with iscanf:

  By default, `iscanf` does *not* flush its internal buffer after each call. This means data left from one call of `iscanf` can be read with the next call to `iscanf`. One side effect of this is that successive calls to `iscanf` may yield unexpected results. For example, reading the following data:

  ```
  "1.25\r\n"
  "1.35\r\n"
  "1.45\r\n"
  ```

  With:

  ```
  iscanf(id, "%lf", &res1); // Will read the 1.25
  iscanf(id, "%lf", &res2); // Will read the \r\n
  iscanf(id, "%lf", &res3); // Will read the 1.35
  ```

  There are four ways to get the desired results:

  -- Use the newline and carriage return characters at the end of the format string to match the input data. This is the recommended approach. For example:

  ```
  iscanf(id, "%lf%\r\n", &res1);
  iscanf(id, "%lf%\r\n", &res2);
  iscanf(id, "%lf%\r\n", &res3);
  ```

-- Use `isetbuf` with a negative buffer size. This will create a buffer the size of the absolute value of *bufsize*. This also sets a flag that tells `iscanf` to flush its buffer after every `iscanf` call.

```
isetbuf(id, I_BUF_READ, -128);
```

-- Do explicit calls to `iflush` to flush the read buffer.

```
iscanf(id, "%lf", &res1);
iflush(id, I_BUF_READ);
iscanf(id, "%lf", &res2);
iflush(id, I_BUF_READ);
iscanf(id, "%lf", &res3);
iflush(id, I_BUF_READ);
```

-- Use the `%*t` conversion to read to the end of the buffer and discard the characters read, if the last character has an END indicator.

```
iscanf(id, "%lf%*t", &res1);
iscanf(id, "%lf%*t", &res2);
iscanf(id, "%lf%*t", &res3);
```

Restrictions Using `ivscanf` in Visual BASIC

The following restrictions apply when using `ivscanf` with Visual BASIC.

- Format Conversion Commands:

  Only one format conversion command can be specified in a format string for `ivscanf` (a format conversion command begins with the `%` character). For example, the following is *invalid*:

```
nargs% = ivscanf(id, "%,50lf%,50d", ...)
```

  Instead, you must call `ivscanf` once for each format conversion command, as shown in the following valid example:

```
nargs% = ivscanf(id, "%,50lf", dbl_array(0))
nargs% = ivscanf(id, "%,50d", int_array(0))
```

- Reading in Numeric Arrays:

  For Visual BASIC, when reading into a numeric array with `ivscanf`, you must specify the first element of a numeric array as the *ap* parameter to `ivscanf`. This passes the address of the first array element to `ivscanf`. For example:

  ```
  Dim preamble(50) As Double
  nargs% = ivscanf(id, "%,50lf", preamble(0))
  ```

  This code declares an array of 50 floating point numbers and then calls `ivscanf` to read into the array.
  For more information on passing numeric arrays as arguments with Visual BASIC, see the "Arrays" section of the "Calling Procedures in DLLs" chapter of the *Visual BASIC Programmer's Guide.*

- Reading in Strings:

  For Visual BASIC, when reading in a string value with `ivscanf`, you must pass a fixed length string as the *ap* parameter to `ivscanf`. For more information on fixed length strings with Visual BASIC, see the "String Types" section of the "Variables, Constants, and Data Types" chapter of the *Visual BASIC Programmer's Guide*.

White-Space Characters for C/C++

White-space characters are spaces, tabs, or special characters. For C/C++, the white-space characters consist of a backslash (\) followed by another character. The white-space characters are:

`\t`	The ASCII TAB character
`\v`	The ASCII VERTICAL TAB character
`\f`	The ASCII FORM FEED character
space	The ASCII space character

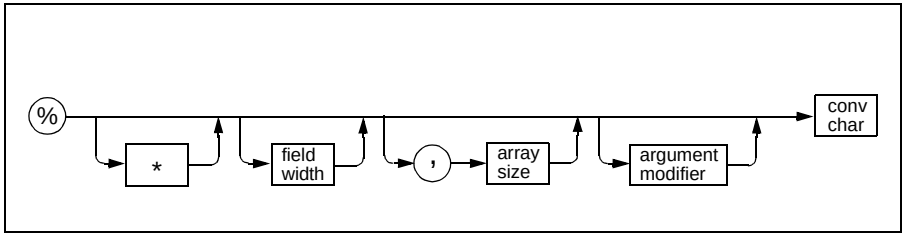
White-Space Characters for Visual BASIC

White-space characters are spaces, tabs, or special characters. For Visual BASIC, the white-space characters are specified with the `Chr$()` function. The white-space characters are:

`Chr$(9)`	The ASCII TAB character
`Chr$(11)`	The ASCII VERTICAL TAB character
`Chr$(12)`	The ASCII FORM FEED character
space	The ASCII space character

Format Conversion Commands

An `iscanf` format conversion command begins with a `%` character. After the `%` character, the optional modifiers appear in this order: an assignment suppression character (`*`), field width, a comma and array size (comma operator), and an argument modifier. The command ends with a conversion character.



The modifiers in a conversion command are:

*	An optional, assignment suppression character (*). This provides a way to describe an input field to be skipped. An input field is defined as a string of non-white-space characters that extends either to the next inappropriate character, or until the *field width* (if specified) is exhausted.
field width	An optional integer representing the *field width*. In C/C++, if a pound sign (#) appears instead of the integer, then the next *arg* is a pointer to the *field width*. This *arg* is a pointer to an integer for `%c`, `%s`, `%t`, and `%S`. This *arg* is a pointer to a long for `%b`. The field width is not allowed for `%d` or `%f`.
, array size	An optional comma operator is an integer preceded by a comma. It reads a list of comma-separated numbers. The comma operator is in the form of `,dd`, where `dd` is the number of array elements to read. In C/C++, a pound sign (#) can be substituted for the number, in which case the next argument is a pointer to an integer that is the number of elements in the array.

	The function will set this to the number of elements read. This operator is only valid with the conversion characters `d` and `f`. The argument must be an array of the type specified.
argument modifier	The meaning of the optional argument modifiers `h`, `l`, `w`, `z`, and `Z` is dependent on the conversion character.
conv char	A conversion character is a character that specifies the type of arg and the conversion to be applied. This is the only required element of a conversion command. See the following subsection, "List of conv chars" for the specific conversion characters you may use.

Note Unlike C's `scanf` function, SICL's `iscanf` functions do not treat the newline (`\n`) and carriage return (`\r`) characters as white-space. Therefore, they are treated as ordinary characters and must match input characters. (Note that this does *not* apply in Visual BASIC.)

The conversion commands direct the assignment of the next *arg*. The `iscanf` function places the converted input in the corresponding variable, unless the `*` assignment suppression character causes it to use no *arg* and to ignore the input.

This function ignores all white-space characters in the input stream.

Examples of Format Conversion Commands

The following are examples of conversion commands used in the format string and typical input data that would satisfy the conversion commands.

Conversion Command	Input Data	Description
`%*s`	`onestring`	suppression (no assignment)
`%*s %s`	`two strings`	suppression (two) assignment (strings)
`%,3d`	`21,12,61`	comma operator
`%hd`	`64`	argument modifier (short)

`%10s`	`onestring`	field width
`%10c`	`onestring`	field width
`%10t`	`two strings`	field width (10 chars read into 1 arg)

List of *conv chars* The *conv chars* (conversion characters) are:

`d` Corresponding *arg* must be a pointer to an integer for C/C++, or an Integer in Visual BASIC. The library reads characters until an entire number is read. It will convert IEEE 488.2 HEX, OCT, BIN, and NRf format numbers. If the `l` (ell) argument modifier is used, the argument must be a pointer to a long integer in
C/C++, or it must be a Long in Visual BASIC. If the h argument modifier is used, the argument must be a pointer to a short integer for C/C++, or an Integer for Visual BASIC.

`i` Corresponding *arg* must be a pointer to an integer in C/C++, or an Integer in Visual BASIC. The library reads characters until an entire number is read. If the number has a leading zero (`0`), the number will be converted as an octal number. If the data has a leading `0x` or `0X`, the number will be converted as a hexadecimal number. If the `l` (ell) argument modifier is used, the argument must be a pointer to a long integer in C/C++, or it must be a Long for Visual BASIC. If the h argument modifier is used, the argument must be a pointer to a short integer for C/C++, or an Integer for Visual BASIC.

`f` Corresponding *arg* must be a pointer to a float in C/C++, or a Single in Visual BASIC. The library reads characters until an entire number is read. It will convert IEEE 488.2 HEX, OCT, BIN, and NRf format numbers. If the `l` (ell) argument modifier is used, the argument must be a pointer to a double for C/C++, or it must be a Double for Visual BASIC. If the `L` argument modifier is used, the argument must be a pointer to a long double for C/C++ (not supported for Visual BASIC).

`e,g` Corresponding *arg* must be a pointer to a float for C/C++, or a Single for Visual BASIC. The library reads characters until an entire number is read. If the `l` (ell) argument modifier is used, the argument must be a pointer to a double for C/C++, or a Double for Visual BASIC. If the `L` argument modifier is used, the argument must be a pointer to a long double for C/C++ (not supported for Visual BASIC).

`c` Corresponding *arg* is a pointer to a character sequence for C/C++, or a fixed length String for Visual BASIC. Reads the number of characters specified by field width (default is `1`) from the device into the buffer pointed to by *arg*. White-space is not ignored with `%c`. No null character is added to the end of the string.

`s` Corresponding *arg* is a pointer to a string for C/C++, or a fixed length String for Visual BASIC. All leading white-space characters are ignored, then all characters from the device are read into a string until a white-space character is read. An optional *field width* indicates the maximum length of the string. Note that you should specify the maximum field width of the buffer being used to prevent overflows.

`S` Corresponding *arg* is a pointer to a string for C/C++, or a fixed length String for Visual BASIC. This data is received as an IEEE 488.2 string response data block. The resultant string will not have the enclosing double quotes in it. An optional *field width* indicates the maximum length of the string. Note that you should specify the maximum field width of the buffer being used to prevent overflows.

`t` Corresponding *arg* is a pointer to a string for C/C++, or a fixed length String for Visual BASIC. Read all characters from the device into a string until an END indicator is read. An optional *field width* indicates the maximum length of the string. All characters read beyond the maximum length are ignored until the END indicator is received. Note that you should specify the maximum field width of the buffer being used to prevent overflows.

b

Corresponding *arg* is a pointer to a buffer. This conversion code reads an array of data from the device. The data must be in IEEE 488.2 Arbitrary Block Program Data format. Note that, depending on the structure of the data, data may be read until an END indicator is read.

The *field width* must be present to specify the maximum number of elements the buffer can hold. For C/C++ programs, the *field width* can be a pound sign (#). If the *field width* is a pound sign, then two arguments are used to fulfill this conversion type. The first argument is a pointer to a long that will be used as the *field width*. The second will be the pointer to the buffer that will hold the data. After this conversion is satisfied, the *field width* pointer is assigned the number of elements read into the buffer. This is a convenient way to determine the actual number of elements read into the buffer.

If there is more data than will fit into the buffer, the extra data is lost.

If no argument modifier is specified, the array is assumed to be an array of bytes.

If the `w` argument modifier is specified, then the array is assumed to be an array of short integers (16 bits). The data read from the device is byte swapped and padded as necessary to convert from IEEE 488.2 byte ordering (big endian) to the native ordering of the controller. The *field width* is the number of words.

If the `l` (ell) argument modifier is specified, then the array is assumed to be an array of long integers (32 bits). The data read from the device is byte swapped and padded as necessary to convert from IEEE 488.2 byte ordering (big endian) to the native ordering of the controller. The *field width* is the number of long words.

If the `z` argument modifier is specified, then the array is assumed to be an array of floats. The data read from the device is an array of 32 bit IEEE-754 floating point numbers. The *field width* is the number of floats.

If the Z argument modifier is specified, then the array is assumed to be an array of doubles. The data read from the device is an array of 64 bit IEEE-754 floating point numbers. The *field width* is the number of doubles.

o — Corresponding *arg* must be a pointer to an unsigned integer for C/C++, or an Integer for Visual BASIC. The library reads characters until the entire octal number is read. If the `l` (ell) argument modifier is used, the argument must be a pointer to an unsigned long integer for C/C++, or a Long for Visual BASIC. If the h argument modifier is used, the argument must be a pointer to an unsigned short integer for C/C++, or the argument must be an Integer for Visual BASIC.

u — Corresponding *arg* must be a pointer to an unsigned integer for C/C++, or an Integer for Visual BASIC. The library reads characters until an entire number is read. It will accept any valid decimal number. If the `l` (ell) argument modifier is used, the argument must be a pointer to an unsigned long integer for C/C++, or a Long for Visual BASIC. If the h argument modifier is used, the argument must be a pointer to an unsigned short integer for C/C++, or the argument must be an Integer for Visual BASIC.

x — Corresponding *arg* must be a pointer to an unsigned integer for C/C++, or an Integer for Visual BASIC. The library reads characters until an entire number is read. It will accept any valid hexadecimal number. If the `l` (ell) argument modifier is used, the argument must be a pointer to an unsigned long integer for C/C++, or a Long for Visual BASIC. If the h argument modifier is used, the argument must be a pointer to an unsigned short integer for C/C++, or it must be an Integer for Visual BASIC.

`[` Corresponding *arg* must be a character pointer for C/C++, or a fixed length character String for Visual BASIC. The `[` conversion type matches a non-empty sequence of characters from a set of expected characters. The characters between the `[` and the `]` are the scanlist. The scanset is the set of characters that match the scanlist, unless the circumflex (^) is specified. If the circumflex is specified, then the scanset is the set of characters that do not match the scanlist. The circumflex must be the first character after the `[`, otherwise it will be added to the scanlist.

The `-` can be used to build a scanlist. It means to include all characters between the two characters in which it appears (for example, `%[a-z]` means to match all the lower case letters between and including a and z). If the `-` appears at the beginning or the end of conversion string, `-` is added to the scanlist.

`n` Corresponding *arg* is a pointer to an integer for C/C++, or it is an Integer for Visual BASIC. The number of bytes currently converted from the device is placed into the arg. No argument is converted.

`F` Supported on HP-UX only. (Not supported on Windows 95 or Windows NT.) Corresponding *arg* is a pointer to a FILE descriptor. The input data read from the device is written to the file referred to by the FILE descriptor until the END indicator is received. The file must be opened for writing. No other modifiers or flags are valid with this conversion character.

Data Conversions

The following table lists the types of data that each of the numeric formats accept.

`d` IEEE 488.2 HEX, OCT, BIN, and NRf formats (for example, `#HA`, `#Q12`, `#B1010`, `10`, `10.00`, and `1.00E+01`).

`f` IEEE 488.2 HEX, OCT, BIN, and NRf formats (for example, `#HA`, `#Q12`, `#B1010`, `10`, `10.00`, and `1.00E+01`).

`i`	Integer. Data with a leading 0 will be converted as octal; data with leading `0x` or `0X` will be converted as hexadecimal.
`u`	Unsigned integer. Same as `i` except value is unsigned.
`o`	Unsigned integer. Data will be converted as octal.
`x,X`	Unsigned integer. Data will be converted as hexadecimal.
`e,g`	Floating. Integers, floating point, and exponential numbers will be converted into floating point numbers (default is float).

Note that the conversion types `i` and `d` are not the same. This is also true for `f` and `e,g`.

Return Value This function returns the total number of arguments converted by the format string.

See Also "IPRINTF", "IPROMPTF", "IFLUSH", "ISETBUF", "ISETUBUF", "IFREAD", "IFWRITE"

ISERIALBREAK

Supported sessions: . . . . . interface
* Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iserialbreak (id);
INST id;
```

Visual BASIC Syntax

```
Function iserialbreak
(ByVal id As Integer)
```

Description The `iserialbreak` function is used to send a BREAK on the interface specified by *id*.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

ISERIALCTRL

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iserialctrl (id, request, setting);
INST id;
int request;
unsigned long setting;
```

Visual BASIC Syntax

```
Function iserialctrl
(ByVal id As Integer, ByVal request As Integer,
 ByVal setting As Long)
```

Description The `iserialctrl` function is used to set up the serial interface for data exchange. This function takes *request* (one of the following values) and sets the interface to the setting. The following are valid values for *request*:

`I_SERIAL_BAUD`	The *setting* parameter will be the new speed of the interface. The value should be a valid baud rate for the interface (for example, 300, 1200, 9600). The baud rate is represented as an unsigned long integer, in bits per second. If the value is not a recognizable baud rate, an err_param error is returned. The following are the supported baud rates: 50, 110, 300, 600, 1200, 2400, 4800, 7200, 9600, 19200, 38400, and 57600.
`I_SERIAL_PARITY`	The following values are acceptable values for *setting*: `I_SERIAL_PAR_EVEN`Even parity `I_SERIAL_PAR_ODD`Odd parity `I_SERIAL_PAR_NONE`No parity bit is used `I_SERIAL_PAR_MARK`Parity is always one `I_SERIAL_PAR_SPACE`Parity is always zero

`I_SERIAL_STOP`	The following are acceptable values for *setting*: `I_SERIAL_STOP_1`1 stop bit `I_SERIAL_STOP_2`2 stop bits
`I_SERIAL_WIDTH`	The following are acceptable values for *setting*: `I_SERIAL_CHAR_5`5 bit characters `I_SERIAL_CHAR_6`6 bit characters `I_SERIAL_CHAR_7`7 bit characters `I_SERIAL_CHAR_8`8 bit characters
`I_SERIAL_READ_BUFSZ`	This is used to set the size of the read buffer. The *setting* parameter is used as the size of buffer to use. This value must be in the range of 1 and 32767.
`I_SERIAL_DUPLEX`	The following are acceptable values for *setting*: `I_SERIAL_DUPLEX_FULL`Use full duplex `I_SERIAL_DUPLEX_HALF`Use half duplex
`I_SERIAL_FLOW_CTRL`	The *setting* parameter must be set to one of the following values. If no flow control is to be used, set *setting* to zero (`0`). The following are the supported types of flow control: `I_SERIAL_FLOW_NONE`No handshaking `I_SERIAL_FLOW_XON`Software handshaking `I_SERIAL_FLOW_RTS_CTS`Hardware handshaking `I_SERIAL_FLOW_DTR_DSR`Hardware handshaking
`I_SERIAL_READ_EOI`	Used to set the type of END Indicator to use for reads. In order for `iscanf` to work as specified, data must be terminated with an END indicator. The RS-232 interface has no standard way of doing this. SICL gives you two different methods of indicating EOI.

The first method is to use a character. The character can have a value between 0 and 0xff. Whenever this value is encountered in a read (`iread`, `iscanf`, or `ipromptf`), the read will terminate and the term reason will include `I_TERM_END`. The default for serial is the newline character (`\n`).

The second method is to use bit 7 (if numbered 0-7) of the data as the END indicator. The data would be bits 0 through 6 and, when bit 7 is set, that means EOI. The following values are valid for the *setting* parameter:

- `I_SERIAL_EOI_CHR`|(*n*) - A character is used to indicate EOI, where *n* is the character. This is the default type, and `\n` is used.
- `I_SERIAL_EOI_NONE` - No EOI indicator.
- `I_SERIAL_EOI_BIT8` - Use the eighth bit of the data to indicate EOI. On the last byte, the eighth bit will be masked off, and the result will be placed into the buffer.

`I_SERIAL_WRITE_EOI`	The *setting* parameter will contain the value of the type of END Indicator to use for writes. The following are valid values to use: • `I_SERIAL_EOI_NONE` - No EOI indicator. This is the default for `I_SERIAL_WRITE` (`iprintf`). • `I_SERIAL_EOI_BIT8` - Use the eighth bit of the data to indicate EOI. On the last byte, the eighth bit will be masked off, and the result will be placed into the buffer.
`I_SERIAL_RESET`	This will reset the serial interface. The following actions will occur: any pending writes will be aborted, the data in the input buffer will be discarded, and any error conditions will be reset. This differs from `iclear` in that no BREAK will be sent.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "ISERIALSTAT"

ISERIALMCLCTRL

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iserialmclctrl (id, sline, state);
INST id;
int sline;
int state;
```

Visual BASIC Syntax

```
Function iserialmclctrl
(ByVal id As Integer, ByVal sline As Integer,
 ByVal state As Integer)
```

Description The `iserialmclctrl` function is used to control the Modem Control Lines. The *sline* parameter sends one of the following values:

`I_SERIAL_RTS` Ready To Send line
`I_SERIAL_DTR` Data Terminal Ready line

If the *state* value is non-zero, the Modem Control Line will be asserted; otherwise it will be cleared.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "ISERIALMCLSTAT", "IONINTR", "ISETINTR"

ISERIALMCLSTAT

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iserialmclstat (id, sline, state);
INST id;
int sline;
int *state;
```

Visual BASIC Syntax

```
Function iserialmclstat
(ByVal id As Integer, ByVal sline As Integer,
 state As Integer)
```

Description The `iserialmclstat` function is used to determine the current state of the Modem Control Lines. The *sline* parameter sends one of the following values:

`I_SERIAL_RTS` Ready To Send line
`I_SERIAL_DTR` Data Terminal Ready line

If the value returned in *state* is non-zero, the Modem Control Line is asserted; otherwise it is clear.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "ISERIALMCLCTRL"

ISERIALSTAT

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iserialstat (id, request, result);
INST id;
int request;
unsigned long *result;
```

Visual BASIC Syntax

```
Function iserialstat
(ByVal id As Integer, ByVal request As Integer,
 result As Long)
```

Description The `iserialstat` function is used to find the status of the serial interface. This function takes one of the following values passed in *request* and returns the status in the *result* parameter:

`I_SERIAL_BAUD`	The *result* parameter will be set to the speed of the interface.
`I_SERIAL_PARITY`	The *result* parameter will be set to one of the following values: `I_SERIAL_PAR_EVEN` Even parity `I_SERIAL_PAR_ODD` Odd parity `I_SERIAL_PAR_NONE` No parity bit is used `I_SERIAL_PAR_MARK` Parity is always one `I_SERIAL_PAR_SPACE` Parity is always zero
`I_SERIAL_STOP`	The *result* parameter will be set to one of the following values: `I_SERIAL_STOP_1` 1 stop bits `I_SERIAL_STOP_2` 2 stop bits

`I_SERIAL_WIDTH`	The *result* parameter will be set to one of the following values: `I_SERIAL_CHAR_5` 5 bit characters `I_SERIAL_CHAR_6` 6 bit characters `I_SERIAL_CHAR_7` 7 bit characters `I_SERIAL_CHAR_8` 8 bit characters
`I_SERIAL_DUPLEX`	The *result* parameter will be set to one of the following values: `I_SERIAL_DUPLEX_FULL` Use full duplex `I_SERIAL_DUPLEX_HALF` Use half duplex

`I_SERIAL_MSL`

- The *result* parameter will be set to the bit wise OR of all of the Modem Status Lines that are currently being asserted. The value of the *result* parameter will be the logical OR of all of the serial lines currently being asserted. The serial lines are both the Modem Control Lines and the Modem Status Lines. The following are the supported serial lines:
- `I_SERIAL_DCD` - Data Carrier Detect.
- `I_SERIAL_DSR` - Data Set Ready.
- `I_SERIAL_CTS` - Clear To Send.
- `I_SERIAL_RI` - Ring Indicator.
- `I_SERIAL_TERI` - Trailing Edge of RI.
- `I_SERIAL_D_DCD` - The DCD line has changed since the last time this status has been checked.
- `I_SERIAL_D_DSR` - The DSR line has changed since the last time this status has been checked.
- `I_SERIAL_D_CTS` - The CTS line has changed since the last time this status has been checked.

`I_SERIAL_STAT`	This is a read destructive status. That means reading this request resets the condition. The *result* parameter will be set the bit wise OR of the following conditions: • `I_SERIAL_DAV` - Data is available. • `I_SERIAL_PARITY` - Parity error has occurred since the last time the status was checked. • `I_SERIAL_OVERFLOW` - Overflow error has occurred since the last time the status was checked. • `I_SERIAL_FRAMING` - Framing error has occurred since the last time the status was checked. • `I_SERIAL_BREAK` - Break has been received since the last time the status was checked. • `I_SERIAL_TEMT` - Transmitter empty.
`I_SERIAL_READ_BUFSZ`	The *result* parameter will be set to the current size of the read buffer.
`I_SERIAL_READ_DAV`	The *result* parameter will be set to the current amount of data available for reading.

`I_SERIAL_FLOW_CTRL`	The *result* parameter will be set to the value of the current type of flow control that the interface is using. If no flow control is being used, *result* will be set to zero (`0`). The following are the supported types of flow control: `I_SERIAL_FLOW_NONE` No handshaking `I_SERIAL_FLOW_XON` Software handshaking `I_SERIAL_FLOW_RTS_CTS` Hardware handshaking `I_SERIAL_FLOW_DTR_DSR` Hardware handshaking

`I_SERIAL_READ_EOI`	The *result* parameter will be set to the value of the current type of END indicator that is being used for reads. The following values can be returned: • `I_SERIAL_EOI_CHR`|(*n*) - A character is used to indicate EOI, where *n* is the character. These two values are logically OR-ed together. To find the value of the character, AND *result* with 0xff. The default is a `\n`. • `I_SERIAL_EOI_NONE` - No EOI indicator. This is the default for `I_SERIAL_READ` (`iscanf`). • `I_SERIAL_EOI_BIT8` - Use the eighth bit of the data to indicate EOI. This last byte will mask off this bit and use the rest for the data that is put in your buffer.
`I_SERIAL_WRITE_EOI`	The *result* parameter will be set to the value of the current type of END indicator that is being used for reads. The following values can be returned: • `I_SERIAL_EOI_NONE` - No EOI indicator. This is the default for `I_SERIAL_WRITE` (`iprintf`). • `I_SERIAL_EOI_BIT8` - Use the eighth bit of the data to indicate EOI. This last byte will mask off this bit and use the rest for the data that is put in your buffer.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "ISERIALCTRL"

ISETBUF

Supported sessions: . . . . . device, interface, commander
* Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int isetbuf (id, mask, size);
INST id;
int mask;
int size;
```

Note Not supported on Visual BASIC.

Description This function is used to set the size and actions of the read and/or write buffers of formatted I/O. The *mask* can be one or the bit-wise OR of both of the following flags:

`I_BUF_READ` Specifies the read buffer.
`I_BUF_WRITE` Specifies the write buffer.

The *size* argument specifies the size of the read or write buffer (or both) in bytes. Setting a size of zero (`0`) disables buffering. This means that for write buffers, each byte goes directly to the device. For read buffers, the driver reads each byte directly from the device.

Setting a size greater than zero creates a buffer of the specified size. For write buffers, the buffer flushes (writes to the device) whenever the buffer fills up and for each newline character in the format string. (However, note that the buffer is *not* flushed by newline characters in the argument list.) For read buffers, the buffer is never flushed (that is, it holds any leftover data for the next `iscanf`/`ipromptf` call). This is the default action.

Setting a size less than zero creates a buffer of the absolute value of the specified size. For write buffers, the buffer flushes (writes to the device) whenever the buffer fills up, for each newline character in the format string, or at the completion of every `iprintf` call. For read buffers, the buffer flushes (erases its contents) at the end of every `iscanf` (or `ipromptf`) function.

Note Calling `isetbuf` flushes any data in the buffer(s) specified in the *mask* parameter.

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "IPRINTF", "ISCANF", "IPROMPTF", "IFWRITE", "IFREAD", "IFLUSH", "ISETUBUF"

ISETDATA

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int isetdata (id, data);
INST id;
void *data;
```

Note Not supported on Visual BASIC.

Description The `isetdata` function stores a pointer to a data structure and associates it with a session (or `INST` *id*).

You can use these user-defined data structures to associate device-specific data with a session such as device name, configuration, instrument settings, and so forth.

You are responsible for the management of the buffer (that is, if the buffer needs to be allocated or deallocated, you must do it).

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "IGETDATA"

ISETINTR

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int isetintr (id, intnum, secval);
INST id;
int intnum;
long secval;
```

Note Not supported on Visual BASIC.

Description The `isetintr` function is used to enable interrupt handling for a particular event. Installing an interrupt handler only allows you to receive enabled interrupts. By default, all interrupt events are disabled.

The *intnum* parameter specifies the possible causes for interrupts. A valid *intnum* value for *any* type of session is:

`I_INTR_OFF`	Turns off all interrupt conditions previously enabled with calls to `isetintr`.

A valid intnum value for *all* **device sessions** (except for GPIB and GPIO, which have no device-specific interrupts) is:

`I_INTR_*`	Individual interfaces may include other interface-interrupt conditions. See the following information on each interface for more details.

Valid *intnum* values for *all* **interface** sessions are:

`I_INTR_INTFACT`	Interrupt when the interface becomes active. Enable if *secval*!=0; disable if *secval*=0.
`I_INTR_INTFDEACT`	Interrupt when the interface becomes deactivated. Enable if *secval*!=0; disable if *secval*=0.
`I_INTR_TRIG`	Interrupt when a trigger occurs. The *secval* parameter contains a bit-mask specifying which triggers can cause an interrupt. See the `ixtrig` function's *which* parameter for a list of valid values.
`I_INTR_*`	Individual interfaces may include other interface-interrupt conditions. See the following information on each interface for more details.

Valid *intnum* values for *all* **commander sessions** (except RS-232 and GPIO, which do not support commander sessions) are:

`I_INTR_STB`	Interrupt when the commander reads the status byte from this controller. Enable if *secval*!=0; disable if *secval*=0.
`I_INTR_DEVCLR`	Interrupt when the commander sends a device clear to this controller (on the given interface). Enable if *secval*!=0; disable if *secval*=0.

Interrupts on GPIB

GPIB Device Session Interrupts. There are no device-specific interrupts for the GPIB interface.

GPIB Interface Session Interrupts. The interface-specific interrupt for the GPIB interface is:

`I_INTR_GPIB_IFC`	Interrupt when an interface clear occurs. Enable when *secval*!=0; disable when *secval*=0. This interrupt will be generated regardless of whether this interface is the system controller or not (that is, regardless of whether this interface generated the IFC, or another device on the interface generated the IFC).

The following are generic interrupts for the GPIB interface:

`I_INTR_INTFACT`	Interrupt occurs whenever this controller becomes the active controller.
`I_INTR_INTFDEACT`	Interrupt occurs whenever this controller passes control to another GPIB device. (For example, the `igpibpassctl` function has been called.)

GPIB Commander Session Interrupts. The following are commander-specific interrupts for GPIB:

`I_INTR_GPIB_PPOLLCONFIG`	This interrupt occurs whenever there is a change to the PPOLL configuration. This interrupt is enabled using `isetintr` by specifying a *secval* greater than 0. If *secval*=0, this interrupt is disabled.
`I_INTR_GPIB_REMLOC`	This interrupt occurs whenever a remote or local message is received and addressed to listen. This interrupt is enabled using `isetintr` by specifying a *secval* greater than 0. If *secval*=0, this interrupt is disabled.

`I_INTR_GPIB_GET`	This interrupt occurs whenever the GET message is received and addressed to listen. This interrupt is enabled using `isetintr` by specifying a *secval* greater than 0. If *secval*=0, this interrupt is disabled.
`I_INTR_GPIB_TLAC`	This interrupt occurs whenever this device has been addressed to talk or untalk, or the device has been addressed to listen or unlisten. When the interrupt handler is called, the *secval* value is set to a bit mask. Bit 0 is for listen, and bit 1 is for talk. If: • Bit 0 = 1, then this device is addressed to listen. • Bit 0 = 0, then this device is not addressed to listen. • Bit 1 = 1, then this device is addressed to talk. • Bit 1 = 0, then this device is not addressed to talk. This interrupt is enabled using *isetintr* by specifying a *secval* greater than 0. If *secval*=0, this interrupt is disabled.

Interrupts on GPIO

GPIO Device Session Interrupts. GPIO does not support device sessions. Therefore, there are no device session interrupts for GPIO.

GPIO Interface Session Interrupts. The interface-specific interrupts for the GPIO interface are:

`I_INTR_GPIO_EIR`	This interrupt occurs whenever the EIR line is asserted by the peripheral device. Enabled when *secval*!=0, disabled when *secval*=0.
`I_INTR_GPIO_RDY`	This interrupt occurs whenever the interface becomes ready for the next handshake. (The exact meaning of "ready" depends on the configured handshake mode.) Enabled when *secval*!=0, disabled when *secval*=0.

Note The GPIO interface is always active. Therefore, the interrupts for `I_INTR_INTFACT` and `I_INTR_INTFDEACT` will never occur.

GPIO Commander Session Interrupts. GPIO does not support commander sessions. Therefore, there are no commander session interrupts for GPIO.

Interrupts on RS-232 (Serial)

RS-232 Device Session Interrupts. The device-specific interrupt for the RS-232 interface is:

`I_INTR_SERIAL_DAV`	This interrupt occurs whenever the receive buffer in the driver goes from the empty to the non-empty state.

RS-232 Interface Session Interrupts. The interface-specific interrupts for the RS-232 interface are:

`I_INTR_SERIAL_MSL` This interrupt occurs whenever one of the specified modem status lines changes states. The *secval* argument in `ionintr` is the logical OR of the Modem Status Lines to monitor. In the interrupt handler, the *sec* argument will be the logical OR of the MSL line(s) that caused the interrupt handler to be invoked.

Note that most implementations of the ring indicator interrupt only deliver the interrupt when the state goes from high to low (that is, a trailing edge). This differs from the other MSLs in that it's not simply just a state change that causes the interrupts.

The status lines that can cause this interrupt are DCD, CTS, DSR, and RI.

`I_INTR_SERIAL_BREAK` This interrupt occurs whenever a BREAK is received.

`I_INTR_SERIAL_ERROR` This interrupt occurs whenever a parity, overflow, or framing error happens. The *secval* argument in `ionintr` is the logical OR of one or more of the following values to enable the appropriate interrupt. In the interrupt handler, the *sec* argument will be the logical OR of these values that indicate which error(s) occurred:

- `I_SERIAL_PARERR` - Parity Error
- `I_SERIAL_OVERFLOW`- Buffer Overflow Error
- `I_SERIAL_FRAMING` - Framing Error

`I_INTR_SERIAL_DAV`	This interrupt occurs whenever the receive buffer in the driver goes from the empty to the non-empty state.
`I_INTR_SERIAL_TEMT`	This interrupt occurs whenever the transmit buffer in the driver goes from the non-empty to the empty state.

The following are generic interrupts for the RS-232 interface:

`I_INTR_INTFACT`	This interrupt occurs when the Data Carrier Detect (DCD) line is asserted.
`I_INTR_INTFDEACT`	This interrupt occurs when the Data Carrier Detect (DCD) line is cleared.

RS-232 Commander Session Interrupts. RS-232 does not support commander sessions. Therefore, there are no commander session interrupts for RS-232.

Interrupts on VXI

VXI Device Session Interrupts. The device-specific interrupt for the VXI interface is:

`I_INTR_VXI_SIGNAL`	A specified device wrote to the VXI signal register (or a VME interrupt arrived from a VXI device that is in the servant list), and the signal was an event you defined. This interrupt is enabled using `isetintr` by specifying a *secval*!=0. If *secval*=0, then this is disabled. The value written into the signal register is returned in the *secval* parameter of the interrupt handler.

VXI Interface Session Interrupts. The following are interface-specific interrupts for the VXI interface:

`I_INTR_VXI_SYSRESET`	A VXI SYSRESET occurred. This interrupt is enabled using `isetintr` by specifying a *secval*!=0. If *secval*=0, then this is disabled.
`I_INTR_VXI_VME`	A VME interrupt occurred from a non-VXI device, or a VXI device that is not a servant of this interface. This interrupt is enabled using `isetintr` by specifying a *secval*!=0. If *secval*=0, then this is disabled.
`I_INTR_VXI_UKNSIG`	A write to the VXI signal register was performed by a device that is not a servant of this controller. This interrupt condition is enabled using `isetintr` by specifying a *secval*!=0. If *secval*=0, then this is disabled. The value written into the signal register is returned in the *secval* parameter of the interrupt handler.
`I_INTR_VXI_VMESYSFAIL`	The VME SYSFAIL line has been asserted.
`I_INTR_VME_IRQ1`	VME IRQ1 has been asserted.
`I_INTR_VME_IRQ2`	VME IRQ2 has been asserted.
`I_INTR_VME_IRQ3`	VME IRQ3 has been asserted.
`I_INTR_VME_IRQ4`	VME IRQ4 has been asserted.
`I_INTR_VME_IRQ5`	VME IRQ5 has been asserted.
`I_INTR_VME_IRQ6`	VME IRQ6 has been asserted.
`I_INTR_VME_IRQ7`	VME IRQ7 has been asserted.

The following are generic interrupts for the VXI interface:

`I_INTR_INTFACT`	This interrupt occurs whenever the interface receives a BNO (Begin Normal Operation) message.
`I_INTR_INTFDEACT`	This interrupt occurs whenever the interface receives an ANO (Abort Normal Operation) or ENO (End Normal Operation) message.

VXI Commander Session Interrupts. The commander-specific interrupt for VXI is:

`I_INTR_VXI_LLOCK`	A lock/clear lock word-serial command has arrived. This interrupt is enabled using `isetintr` by specifying a *secval*!=0. If *secval*=0, then this is disabled. If a lock occurred, the *secval* in the handler is passed a 1; if an unlock, the *secval* in the handler is passed 0.

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "IONINTR", "IGETONINTR", "IWAITHDLR", "IINTROFF", "IINTRON", "IXTRIG", and the section titled "Asynchronous Events and HP-UX Signals" in the "Programming with HP SICL" chapter of the *HP SICL User's Guide for HP-UX* for protecting I/O calls against interrupts.

ISETLOCKWAIT

Supported sessions: . . . . . .device, interface, commander

C Syntax

```
#include <sicl.h>

int isetlockwait (id, flag);
INST id;
int flag;
```

Visual BASIC Syntax

```
Function isetlockwait
(ByVal id As Integer, ByVal flag As Integer)
```

Description The `isetlockwait` function determines whether library functions wait for a device to become unlocked or return an error when attempting to operate on a locked device. The error that is returned is `I_ERR_LOCKED`.

If *flag* is non-zero, then all operations on a device or interface locked by another session will wait for the lock to be removed. This is the default case.

If *flag* is zero (0), then all operations on a device or interface locked by another session will return an error (`I_ERR_LOCKED`). This will disable the timeout value set up by the `itimeout` function.

Note If a request is made that cannot be granted due to hardware constraints, the process will hang until the desired resources become available. To avoid this, use the `isetlockwait` command with the *flag* parameter set to 0, and thus generate an error instead of waiting for the resources to become available.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "ILOCK", "IUNLOCK", "IGETLOCKWAIT"

ISETSTB

Supported sessions: . . . . . commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int isetstb (id, stb);
INST id;
unsigned char stb;
```

Visual BASIC Syntax

```
Function isetstb
(ByVal id As Integer, ByVal stb As Byte)
```

Description The `isetstb` function allows the status byte value for this controller to be changed. This function is only valid for commander sessions.

Bit 6 in the *stb* (status byte) has special meaning. If bit 6 is set, then an SRQ notification is given to the remote controller, if its identity is known. If bit 6 is not set, then the SRQ notification is canceled. The exact mechanism for sending the SRQ notification is dependent on the interface.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also “IREADSTB”, “IONSRQ”

ISETUBUF

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int isetubuf (id, mask, size, buf);
INST id;
int mask;
int size;
char *buf;
```

Note Not supported on Visual BASIC.

Description The `isetubuf` function is used to supply the buffer(s) used for formatted I/O. With this function you can specify the size and the address of the formatted I/O buffer.

This function is used to set the size and actions of the read and/or write buffers of formatted I/O. The *mask* may be one, but NOT both of the following flags:

`I_BUF_READ`	Specifies the read buffer.
`I_BUF_WRITE`	Specifies the write buffer.

Setting a *size* greater than zero creates a buffer of the specified size. For write buffers, the buffer flushes (writes to the device) whenever the buffer fills up and for each newline character in the format string. For read buffers, the buffer is never flushed (that is, it holds any leftover data for the next `iscanf`/`ipromptf` call). This is the default action.

Setting a *size* less than zero creates a buffer of the absolute value of the specified size. For write buffers, the buffer flushes (writes to the device) whenever the buffer fills up, for each newline character in the format string, or at the completion of every `iprintf` call. For read buffers, the buffer

flushes (erases its contents) at the end of every `iscanf` (or `ipromptf`) function.

Note Calling `isetubuf` flushes the buffer specified in the mask parameter.

Note Once a buffer is allocated to `isetubuf`, do not use the buffer for any other use. In addition, once a buffer is allocated to `isetubuf` (either for a read or write buffer), don't use the same buffer for any other session or for the opposite type of buffer on the same session (write or read, respectively).

In order to free a buffer allocated to a session, make a call to `isetbuf`, which will cause the user-defined buffer to be replaced by a system-defined buffer allocated for this session. The user-defined buffer may then be either re-used, or freed by the program.

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "IPRINTF", "ISCANF", "IPROMPTF", "IFWRITE", "IFREAD", "ISETBUF", "IFLUSH"

ISWAP

C Syntax

```
#include <sicl.h>

int iswap (addr, length, datasize);
int ibeswap (addr, length, datasize);
int ileswap (addr, length, datasize);
char *addr;
unsigned long length;
int datasize;
```

Visual BASIC Syntax

```
Function iswap
(ByVal addr As Long, ByVal length As Long,
 ByVal datasize As Integer)

Function ibeswap
(ByVal addr As Long, ByVal length As Long,
 ByVal datasize As Integer)

Function ileswap
(ByVal addr As Long, ByVal length As Long,
 ByVal datasize As Integer)
```

Description

These functions provide an architecture-independent way of byte swapping data received from a remote device or data that is to be sent to a remote device. This data may be received/sent using the `iwrite`/`iread` calls, or the `ifwrite`/`ifread` calls.

The `iswap` function will always swap the data.

The `ibeswap` function assumes the data is in big-endian byte ordering (big-endian byte ordering is where the most significant byte of data is stored at the least significant address) and converts the data to whatever byte ordering is native on this controller's architecture. Or it takes the data that is byte ordered for this controller's architecture and converts the data to big-endian byte ordering. (Notice that these two conversions are identical.)

The `ileswap` function assumes the data is in little-endian byte ordering (little-endian byte ordering is where the most significant byte of data is stored at the most significant address) and converts the data to whatever byte

ordering is native on this controller's architecture. Or it takes the data that is byte ordered for this controller's architecture and converts the data to little-endian byte ordering. (Notice that these two conversions are identical.)

Note Depending on the native byte ordering of the controller in use (either little-endian, or big-endian), that either the `ibeswap` or `ileswap` functions will always be a no-op, and the other will always swap bytes, as appropriate.

In all three functions, the *addr* parameter specifies a pointer to the data. The *length* parameter provides the length of the data in bytes. The *datasize* must be one of the values 1, 2, 4, or 8. It specifies the size of the data in bytes and the size of the byte swapping to perform:

- 1 = byte data and no swapping is performed.
- 2 = 16-bit word data and bytes are swapped on word boundaries.
- 4 = 32-bit longword data and bytes are swapped on longword boundaries.
- 8 = 64-bit data and bytes are swapped on 8-byte boundaries.

The *length* parameter must be an integer multiple of *datasize*. If not, unexpected results will occur.

IEEE 488.2 specifies the default data transfer format to transfer data in big-endian format. Non-488.2 devices may send data in either big-endian or little-endian format.

Note These functions do not depend on a SICL session *id*. Therefore, they may be used to perform non-SICL related task (namely, file I/O).

The following constants are available for use by your application to determine which byte ordering is native to this controller's architecture.

`I_ORDER_LE`	This constant is defined if the native controller is little-endian.
`I_ORDER_BE`	This constant is defined if the native controller is big-endian.

These constants may be used in `#if` or `#ifdef` statements to determine the byte ordering requirements of this controller's architecture. This information can then be used with the known byte ordering of the devices being used to determine the swapping that needs to be performed.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IPOKE", "IPEEK", "ISCANF", "IPRINTF"

ITERMCHR

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int itermchr (id, tchr);
INST id;
int tchr;
```

Visual BASIC Syntax

```
Function itermchr
(ByVal id As Integer, ByVal tchr As Integer)
```

Description By default, a successful `iread` only terminates when it reads *bufsize* number of characters, or it reads a byte with the END indicator. The `itermchr` function permits you to define a termination character condition.

The *tchr* argument is the character specifying the termination character. If *tchr* is between 0 and 255, then `iread` terminates when it reads the specified character. If *tchr* is -1, then no termination character exists, and any previous termination character is removed.

Calling `itermchr` affects all further calls to `iread` and `ifread` until you make another call to `itermchr`. The default termination character is -1, meaning no termination character is defined.

Note The `iscanf` function terminates reading on an END indicator or the termination chqaracter specified by `itermchr`.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IREAD", "IFREAD", "IGETTERMCHR"

ITIMEOUT

Supported sessions: . . . . . .device, interface, commander

C Syntax

```
#include <sicl.h>

int itimeout (id, tval);
INST id;
long tval;
```

Visual BASIC Syntax

```
Function itimeout
(ByVal id As Integer, ByVal tval As Long)
```

Description The `itimeout` function is used to set the maximum time to wait for an I/O operation to complete. In this function, *tval* defines the timeout in milliseconds. A value of zero (0) disables timeouts.

Note Not all computer systems can guarantee an accuracy of one millisecond on timeouts. Some computer clock systems only provide a resolution of 1/50th or 1/60th of a second. Other computers have a resolution of only 1 second. Note that the time value is *always* rounded up to the next unit of resolution.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IGETTIMEOUT"

ITRIGGER

Supported sessions: . . . . . .device, interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int itrigger (id);
INST id;
```

Visual BASIC Syntax

```
Function itrigger
(ByVal id As Integer)
```

Description The `itrigger` function is used to send a trigger to a device.

Triggers on GPIB

GPIB Device Session Triggers. The `itrigger` function performs an addressed GPIB group execute trigger (GET).

GPIB Interface Session Triggers. The `itrigger` function performs an unaddressed GPIB group execute trigger (GET). The `itrigger` command on a GPIB interface session should be used in conjunction with `igpibsendcmd`.

Triggers on GPIO

GPIO Interface Session Triggers. The `itrigger` function performs the same function as calling `ixtrig` with the `I_TRIG_STD` value passed to it: it pulses the CTL0 control line.

Triggers on RS-232 (Serial)

RS-232 Device Session Triggers. The `itrigger` function sends the 488.2 `*TRG\n` command to the serial device.

RS-232 Interface Session Triggers. The `itrigger` function performs the same function as calling `ixtrig` with the `I_TRIG_STD` value passed to it: it pulses the DTR modem control line.

VXI Triggers

VXI Device Session Triggers. The `itrigger` function sends a word-serial trigger command to the specified device.

Note The `itrigger` function is only supported on message-based device sessions with VXI.

VXI Interface Session Triggers. The `itrigger` function performs the same function as calling `ixtrig` with the `I_TRIG_STD` value passed to it: it causes one or more VXI trigger lines to fire. Which trigger lines are fired is determined by the `ivxitrigroute` function.

Return Value

For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also

"IXTRIG", and the interface-specific chapter in this manual for more information on trigger actions.

IUNLOCK

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int iunlock (id);
INST id;
```

Visual BASIC Syntax

```
Function iunlock
(ByVal id As Integer)
```

Description

The `iunlock` function unlocks a device or interface that has been previously locked. If you attempt to perform an operation on a device or interface that is locked by another session, the call will hang until the device or interface is unlocked.

Calls to `ilock`/`iunlock` may be nested, meaning that there must be an equal number of unlocks for each lock. This means that simply calling the `iunlock` function may not actually unlock a device or interface again. For example, note how the following C code locks and unlocks devices:

```
ilock(id);      /* Device locked */
iunlock(id);    /* Device unlocked */

ilock(id);      /* Device locked */
   ilock(id);      /* Device locked */
   iunlock(id);    /* Device still locked */
iunlock(id);    /* Device unlocked */
```

Return Value

For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also

"ILOCK", "ISETLOCKWAIT", "IGETLOCKWAIT"

IUNMAP

Supported sessions: . . . . . device, interface, commander

Note Not recommended for new program development. Use IUNMAPX instead.

C Syntax

```
#include <sicl.h>

int iunmap (id, addr, map_space, pagestart, pagecnt);
INST id;
char *addr;
int map_space;
unsigned int pagestart;
unsigned int pagecnt;
```

Visual BASIC Syntax

```
Function iunmap
(ByVal id As Integer, ByVal addr As Long,
 ByVal mapspace As Integer,
 ByVal pagestart As Integer,
 ByVal pagecnt As Integer)
```

Note Not supported over LAN.

Description The `iunmap` function unmaps a mapped memory space. The *id* specifies a VXI interface or device session. The *addr* argument contains the address value returned from the `imap` call. The *pagestart* argument indicates the page within the given memory space where the memory mapping starts. The *pagecnt* argument indicates how many pages to free.

The *map_space* argument contains the following legal values:

`I_MAP_A16`	Map in VXI A16 address space.
`I_MAP_A24`	Map in VXI A24 address space.
`I_MAP_A32`	Map in VXI A32 address space.
`I_MAP_VXIDEV`	Map in VXI device registers. (Device session only.)
`I_MAP_EXTEND`	Map in VXI A16 address space. (Device session only.)
`I_MAP_SHARED`	Map in VXI A24/A32 memory that is physically located on this device (sometimes called local shared memory).

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IMAP"

IUNMAPX

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int iunmapx (id, handle, mapspace, pagestart, pagecnt);
   INST id;
   unsigned long handle;
   int mapspace;
   unsigned int pagestart;
   unsigned int pagecnt;
```

Visual BASIC Syntax

```
Function iunmap
(ByVal id As Integer, ByVal addr As Long,
 ByVal mapspace As Integer,
 ByVal pagestart As Integer,
 ByVal pagecnt As Integer)
```

Note Not supported over LAN.

Description The `iunmapx` function unmaps a mapped memory space. The *id* specifies a VXI interface or device session. The *addr* argument contains the address value returned from the `imap` call. The *pagestart* argument indicates the page within the given memory space where the memory mapping starts. The *pagecnt* argument indicates how many pages to free.

The *map_space* argument contains the following legal values:

`I_MAP_A16`	Map in VXI A16 address space.
`I_MAP_A24`	Map in VXI A24 address space.
`I_MAP_A32`	Map in VXI A32 address space.
`I_MAP_VXIDEV`	Map in VXI device registers. (Device session only.)

`I_MAP_EXTEND`	Map in VXI A16 address space. (Device session only.)
`I_MAP_SHARED`	Map in VXI A24/A32 memory that is physically located on this device (sometimes called local shared memory).

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IMAPX"

IVERSION

C Syntax

```
#include <sicl.h>

int iversion (siclversion, implversion);
int *siclversion;
int *implversion;
```

Visual BASIC Syntax

```
Function iversion
(ByVal id As Integer, siclversion As Integer,
 implversion As Integer)
```

Description The `iversion` function stores in *siclversion* the current SICL revision number times ten that the application is currently linked with. The SICL version number is a constant defined in `sicl.h` for C, and in `SICL.BAS` or `SICL4.BAS` for Visual BASIC, as `I_SICL_REVISION`. This function stores in *implversion* an implementation specific revision number (the version number of this implementation of the SICL library).

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

IVXIBUSSTATUS

Supported sessions: . . . . . interface

C Syntax

```
#include <sicl.h>

int ivxibusstatus (id, request, result);
INST id;
int request;
unsigned long *result;
```

Visual BASIC Syntax

```
Function ivxibusstatus
(ByVal id As Integer, ByVal request As Integer,
 result As Long)
```

Description The `ivxibusstatus` function returns the status of the VXI interface. This function takes one of the following parameters in the request parameter and returns the status in the *result* parameter.

`I_VXI_BUS_TRIGGER`	Returns a bit-mask corresponding to the trigger lines which are currently being driven active by a device on the VXI bus.
`I_VXI_BUS_LADDR`	Returns the logical address of the VXI interface (viewed as a device on the VXI bus).
`I_VXI_BUS_SERVANT_AREA`	Returns the servant area size of this device.
`I_VXI_BUS_NORMOP`	Returns 1 if in normal operation, and a 0 otherwise.
`I_VXI_BUS_CMDR_LADDR`	Returns logical address of this device's commander, or -1 if no commander is present (either this device is the top level commander, or normal operation has not been established.

`I_VXI_BUS_MAN_ID`	Returns the manufacturer's ID of this device.
`I_VXI_BUS_MODEL_ID`	Returns the model ID of this device.
`I_VXI_BUS_PROTOCOL`	Returns the value stored in this device's protocol register.
`I_VXI_BUS_XPROT`	Returns the value that this device will use to respond to a *read protocol* word-serial command.
`I_VXI_BUS_SHM_SIZE`	Returns the size of VXI memory available on this device. For A24 memory, this value represents 256 byte pages. For A32 memory, this value represents 64 Kbyte pages. Interpret as an unsigned integer for this command.
`I_VXI_BUS_SHM_ADDR_SPACE`	Returns either `24` or `32` depending on whether the device's VXI memory is located in A24 or A32 memory space.
`I_VXI_BUS_SHM_PAGE`	Returns the location of the device's VXI memory. For A24 memory, the *result* is in 256 byte pages. For A32 memory, the *result* is in 64 Kbyte pages.

`I_VXI_BUS_VXIMXI`	Returns 0 if device is a VXI device. Returns 1 if device is a MXI device.
`I_VXI_BUS_TRIGSUPP`	Returns a numeric value indicating which triggers are supported. The numeric value is the sum of the following values:

I_TRIG_STD	0x00000001L
I_TRIG_ALL	0xffffffffL
I_TRIG_TTL0	0x00001000L
I_TRIG_TTL1	0x00002000L
I_TRIG_TTL2	0x00004000L
I_TRIG_TTL3	0x00008000L
I_TRIG_TTL4	0x00010000L
I_TRIG_TTL5	0x00020000L
I_TRIG_TTL6	0x00040000L
I_TRIG_TTL7	0x00080000L
I_TRIG_ECL0	0x00100000L
I_TRIG_ECL1	0x00200000L
I_TRIG_ECL2	0x00400000L
I_TRIG_ECL3	0x00800000L
I_TRIG_EXT0	0x01000000L
I_TRIG_EXT1	0x00200000L
I_TRIG_EXT2	0x00400000L
I_TRIG_EXT3	0x00800000L
I_TRIG_CLK0	0x10000000L
I_TRIG_CLK1	0x20000000L
I_TRIG_CLK2	0x40000000L
I_TRIG_CLK10	0x80000000L
I_TRIG_CLK100	0x00000800L
I_TRIG_SERIAL_DTR	0x00000400L
I_TRIG_SERIAL_RTS	0x00000200L
I_TRIG_GPIO_CTL0	0x00000100L
I_TRIG_GPIO_CTL1	0x00000080L

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also “IVXITRIGON”, “IVXITRIGOFF”

IVXIGETTRIGROUTE

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int ivxigettrigroute (id, which, route);
INST id;
unsigned long which;
unsigned long *route;
```

Visual BASIC Syntax

```
Function ivxigettrigroute
(ByVal id As Integer, ByVal which As Long,
 route As Long)
```

Description The `ivxigettrigroute` function returns in *route* the current routing of the *which* parameter. See the `ivxitrigroute` function for more details on routing and the meaning of *route*.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IVXITRIGON", "IVXITRIGOFF", "IVXITRIGROUTE", "IXTRIG"

IVXIRMINFO

Supported sessions: . . . . . device, interface, commander

C Syntax

```
#include <sicl.h>

int ivxirminfo (id, laddr, info);
INST id;
int laddr;
struct vxiinfo *info;
```

Visual BASIC Syntax

```
Function ivxirminfo
(ByVal id As Integer, ByVal laddr As Integer,
 info As vxiinfo)
```

Description The `ivxirminfo` function returns information about a VXI device from the VXI Resource Manager. The *id* is the `INST` for any open VXI session. The *laddr* parameter contains the logical address of the VXI device. The *info* parameter points to a structure of type `struct vxiinfo`. The function fills in the structure with the relevant data.

The structure `struct vxiinfo` (defined in the file `sicl.h`) is listed on the following pages.

For C programs, the `vxiinfo` structure has the following syntax:

```
struct vxiinfo {
  /* Device Identification */
  short laddr;              /* Logical Address */
  char name[16];            /* Symbolic Name (primary) */
  char manuf_name[16];      /* Manufacturer Name */
  char model_name[16];      /* Model Name */
  unsigned short man_id;    /* Manufacturer ID */
  unsigned short model;     /* Model Number */
  unsigned short devclass;  /* Device Class */

  /* Self Test Status */
  short selftest;           /* 1=PASSED 0=FAILED */

  /* Location of Device */
  short cage_num;           /* Card Cage Number */
  short slot;       /* Slot #, -1 is unknown, -2 is MXI */
```

```
   /* Device Information */
   unsigned short protocol;  /* Value of protocol register
*/
   unsigned short x_protocol;/* Value from Read Protocol
command */
   unsigned short servant_area;/* Value of servant area */

   /* Memory Information */
   /* page size is 256 bytes for A24 and 64K bytes for
A32*/
   unsigned short addrspace;/* 24=A24, 32=A32, 0=none */
   unsigned short memsize;/* Amount of memory in pages */
   unsigned short memstart;/* Start of memory in pages */

   /* Misc. Information */
   short slot0_laddr;  /* LU of slot 0 device, -1 if unknown
*/
   short cmdr_laddr; /* LU of commander, -1 if top level*/

   /* Interrupt Information */
   short int_handler[8];   /* List of interrupt handlers */
   short interrupter[8];   /* List of interrupters */
   short file[10];         /* Unused */
}
```

This static data is set up by the VXI resource manager.

For Visual BASIC programs, the vxiinfo structure has the following syntax:

```
Type vxiinfo
   laddr As Integer
   name As String * 16
   manuf_name As String * 16
   model_name As String * 16
   man_id As Integer
   model As Integer
   devclass As Integer
   selftest As Integer
   cage_num As Integer
   slot As Integer
   protocol As Integer
   x_protocol As Integer
   servant_area As Integer
   addrspace As Integer
   memsize As Integer
```

```
   memstart As Integer
   slot0_laddr As Integer
   cmdr_laddr As Integer
   int_handler(0 To 7) As Integer
   interrupter(0 To 7) As Integer
   fill(0 To 9) As Integer
End Type
```

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also See the platform-specific manual for the section on the Resource Manager.

IVXISERVANTS

Supported sessions: . . . . . interface

C Syntax

```
#include <sicl.h>

int ivxiservants (id, maxnum, list);
INST id;
int maxnum;
int *list;
```

Visual BASIC Syntax

```
Function ivxiservants
(ByVal id As Integer, ByVal maxnum As Integer,
 list() As Integer)
```

Description The `ivxiservants` function returns a list of VXI servants. This function returns the first *maxnum* servants of this controller. The *list* parameter points to an array of integers that holds at least *maxnum* integers. This function fills in the array from beginning to end with the list of active VXI servants. All unneeded elements of the array are filled with -1.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

IVXITRIGOFF

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int ivxitrigoff (id, which);
INST id;
unsigned long which;
```

Visual BASIC Syntax

```
Function ivxitrigoff
(ByVal id As Integer, ByVal which As Long)
```

Description The `ivxitrigoff` function de-asserts trigger lines and leaves them deactivated. The *which* parameter uses all of the same values as the `ixtrig` command, namely:

`I_TRIG_ALL`	All standard triggers for this interface (that is, the bitwise OR of all valid triggers)
`I_TRIG_TTL0`	TTL Trigger Line 0
`I_TRIG_TTL1`	TTL Trigger Line 1
`I_TRIG_TTL2`	TTL Trigger Line 2
`I_TRIG_TTL3`	TTL Trigger Line 3
`I_TRIG_TTL4`	TTL Trigger Line 4
`I_TRIG_TTL5`	TTL Trigger Line 5
`I_TRIG_TTL6`	TTL Trigger Line 6
`I_TRIG_TTL7`	TTL Trigger Line 7
`I_TRIG_ECL0`	ECL Trigger Line 0
`I_TRIG_ECL1`	ECL Trigger Line 1

`I_TRIG_ECL2`	ECL Trigger Line 2
`I_TRIG_ECL3`	ECL Trigger Line 3
`I_TRIG_EXT0`	External BNC or SMB Trigger Connector 0
`I_TRIG_EXT1`	External BNC or SMB Trigger Connector 1

Any combination of values may be used in *which* by performing a bit-wise OR of the desired values.

Note To simply fire trigger lines (assert then de-assert the lines), use `ixtrig` instead of `ivxitrigon` and `ivxitrigoff`.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IVXITRIGON", "IVXITRIGROUTE", "IVXIGETTRIGROUTE", "IXTRIG"

IVXITRIGON

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h"
int ivxitrigon (id, which);
INST id;
unsigned long which;
```

Visual BASIC Syntax

```
Function ivxitrigon
(ByVal id As Integer, ByVal which As Long)
```

Description The `ivxitrigon` function asserts trigger lines and leaves them activated. The *which* parameter uses all of the same values as the `ixtrig` command, namely:

`I_TRIG_ALL`	All standard triggers for this interface (that is, the bitwise OR of all valid triggers)
`I_TRIG_TTL0`	TTL Trigger Line 0
`I_TRIG_TTL1`	TTL Trigger Line 1
`I_TRIG_TTL2`	TTL Trigger Line 2
`I_TRIG_TTL3`	TTL Trigger Line 3
`I_TRIG_TTL4`	TTL Trigger Line 4
`I_TRIG_TTL5`	TTL Trigger Line 5
`I_TRIG_TTL6`	TTL Trigger Line 6
`I_TRIG_TTL7`	TTL Trigger Line 7
`I_TRIG_ECL0`	ECL Trigger Line 0
`I_TRIG_ECL1`	ECL Trigger Line 1
`I_TRIG_ECL2`	ECL Trigger Line 2

`I_TRIG_ECL3`	ECL Trigger Line 3
`I_TRIG_EXT0`	External BNC or SMB Trigger Connector 0
`I_TRIG_EXT1`	External BNC or SMB Trigger Connector 1

Any combination of values may be used in *which* by performing a bit-wise OR of the desired values.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IVXITRIGOFF", "IVXITRIGROUTE", "IVXIGETTRIGROUTE", "IXTRIG"

IVXITRIGROUTE

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int ivxitrigroute (id, in_which, out_which);
INST id;
unsigned long in_which;
unsigned long out_which;
```

Visual BASIC Syntax

```
Function ivxitrigroute
(ByVal id As Integer, ByVal in_which As Long,
 ByVal out_which As Long)
```

Description

The `ivxitrigroute` function routes VXI trigger lines. With some VXI interfaces, it is possible to route one trigger input to several trigger outputs.

The *in_which* parameter may contain only one of the valid trigger values. The *out_which* may contain zero, one, or several of the following valid trigger values:

`I_TRIG_ALL`	All standard triggers for this interface (that is, the bit-wise OR of all valid triggers) (*out_which* ONLY)
`I_TRIG_TTL0`	TTL Trigger Line 0
`I_TRIG_TTL1`	TTL Trigger Line 1
`I_TRIG_TTL2`	TTL Trigger Line 2
`I_TRIG_TTL3`	TTL Trigger Line 3
`I_TRIG_TTL4`	TTL Trigger Line 4
`I_TRIG_TTL5`	TTL Trigger Line 5
`I_TRIG_TTL6`	TTL Trigger Line 6

`I_TRIG_TTL7`	TTL Trigger Line 7
`I_TRIG_ECL0`	ECL Trigger Line 0
`I_TRIG_ECL1`	ECL Trigger Line 1
`I_TRIG_ECL2`	ECL Trigger Line 2
`I_TRIG_ECL3`	ECL Trigger Line 3
`I_TRIG_EXT0`	External BNC or SMB Trigger Connector 0
`I_TRIG_EXT1`	External BNC or SMB Trigger Connector 1

The *in_which* parameter may also contain:

`I_TRIG_CLK0`	Internal clocks provided by the controller (implementation- specific)
`I_TRIG_CLK1`	Internal clocks provided by the controller (implementation- specific)
`I_TRIG_CLK2`	Internal clocks provided by the controller (implementation- specific)

This function routes the trigger line in the *in_which* parameter to the trigger lines contained in the *out_which* parameter. In other words, when the line contained in *in_which* fires, all of the lines contained in *out_which* are also fired.

For example, the following command causes EXT0 to fire whenever TTL3 fires:

```
ivxitrigroute(id, I_TRIG_TTL3, I_TRIG_EXT0);
```

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IVXITRIGON", "IVXITRIGOFF", "IVXIGETTRIGROUTE", "IXTRIG"

IVXIWAITNORMOP

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `itimeout`

C Syntax

```
#include <sicl.h>

int ivxiwaitnormop (id);
INST id;
```

Visual BASIC Syntax

```
Function ivxiwaitnormop
(ByVal id As Integer)
```

Description The `ivxiwaitnormop` function is used to suspend the process until the interface or device is active (that is, establishes normal operation). See the `iwaithdlr` function for other methods of waiting for an interface to become ready to operate.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IWAITHDLR", "IONINTR", "ISETINTR", "ICLEAR"

IVXIWS

Supported sessions: . . . . . device
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int ivxiws(id,wscmd,wsresp,rpe);
INST id;
unsigned short wscmd;
unsigned short *wsresp;
unsigned short *rpe;
```

Visual BASIC Syntax

```
Function ivxiws
(ByVal id As Integer, ByVal wscmd As Integer,
 wsresp As Integer, rpe As Integer)
```

Description The `ivxiws` function sends a word-serial command to a VXI message-based device. The *wscmd* contains the word-serial command. If *wsresp* contains zero (0), then this function does not read a word-serial response. If *wsresp* is non-zero, then the function reads a word-serial response and stores it in that location. If `ivxiws` executes successfully, *rpe* does not contain valid data. If the word-serial command errors, *rpe* contains the Read Protocol Error response, the `ivxiws` function returns `I_ERR_IO`, and the *wsresp* parameter contains invalid data.

Note The `ivxiws` function will always try to read the response data if the *wsresp* parameter is non-zero. If you send a word serial command that does not return response data, and the *wsresp* argument is non-zero, this function will hang or timeout (see `itimeout`) waiting for the response.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "ITIMEOUT"

IWAITHDLR

C Syntax

```
#include <sicl.h>

int iwaithdlr (timeout);
long timeout;
```

Note Not supported on Visual BASIC.

Description The `iwaithdlr` function causes the process to suspend until either an enabled SRQ or interrupt condition occurs and the related handler executes. Once the handler completes its operation, this function returns and processing continues.

If *timeout* is non-zero, then iwaithdlr terminates and generates an error if no handler executes before the given time expires. If *timeout* is zero, then `iwaithdlr` waits indefinitely for the handler to execute.

Specify *timeout* in milliseconds.

Note Not all computer systems can guarantee an accuracy of one millisecond on timeouts. Some computer clock systems only provide a resolution of 1/50th or 1/60th of a second. Other computers have a resolution of only 1 second. Note that the time value is *always* rounded up to the next unit of resolution.

The `iwaithdlr` function will implicitly enable interrupts. In other words, if you have called `iintroff`, `iwaithdlr` will re-enable interrupts, then disable them again before returning.

Note Interrupts should be disabled if you are using `iwaithdlr`. Use `iintroff` to disable interrupts.

The reason for disabling interrupts is because there is a race condition between the `isetintr` and `iwaithdlr`, and, if you only expect one interrupt, it might come before the `iwaithdlr` executes.

The interrupts will still be disabled after the `iwaithdlr` function has completed.

For example:

```
... iintroff ();
ionintr (hpib, act_isr);
isetintr (hpib, I_INTR_INTFACT, 1);
...
igpibpassctl (hpib, ba);
iwaithdlr (0);
iintron ();
...
```

In a multi-threaded application, `iwaithdlr` will enable interrupts for the whole process. If two threads call `iintroff`, and one of them then calls `iwaithdlr`, interrupts will be enabled and both threads can receive interrupt events. Note that this is not a defect, since your application must handle the enabling/disabling of interrupts and keep track of when all threads are ready to receive interrupts.

Return Value This function returns zero (0) if successful, or a non-zero error number if an error occurs.

See Also "IONINTR", "IGETONINTR", "IONSRQ", "IGETONSRQ", "IINTROFF", "IINTRON"

IWRITE

Supported sessions: . . . . . device, interface, commander
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int iwrite (id, buf, datalen, endi, actualcnt);
INST id;
char *buf;
unsigned long datalen;
int endi;
unsigned long *actualcnt;
```

Visual BASIC Syntax

```
Function iwrite
(ByVal id As Integer, ByVal buf As String,
 ByVal datalen As Long, ByVal endi As Integer,
 actual As Long)
```

Description

The `iwrite` function is used to send a block of data to an interface or device. This function writes the data specified in *buf* to the session specified in *id*. The *buf* argument is a pointer to the data to send to the specified interface or device. The *datalen* argument is an unsigned long integer containing the length of the data block in bytes.

If the *endi* argument is non-zero, this function will send the END indicator with the last byte of the data block. Otherwise, if *endi* is set to zero, no END indicator will be sent.

The *actualcnt* argument is a pointer to an unsigned long integer which, upon exit, will contain the actual number of bytes written to the specified interface or device. A NULL pointer can be passed for this argument and no value will be written.

If you want to pass a NULL *actualcnt* parameter to `iwrite` in Visual BASIC, you should pass the expression `0&`.

For LAN, if the client times out prior to the server, the *actualcnt* returned will be 0, even though the server may have written some data to the device or interface.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "IREAD", "IFREAD", "IFWRITE"

IXTRIG

Supported sessions: . . . . . interface
Affected by functions: . . . . . `ilock`, `itimeout`

C Syntax

```
#include <sicl.h>

int ixtrig (id, which);
INST id;
unsigned long which;
```

Visual BASIC Syntax

```
Function ixtrig
(ByVal id As Integer, ByVal which As Long)
```

Description The ixtrig function is used to send an extended trigger to an interface. The argument which can be:

`I_TRIG_STD`	Standard trigger operation for all interfaces. The exact operation of I_TRIG_STD depends on the particular interface. See the following subsections for interface-specific information.
`I_TRIG_ALL`	All standard triggers for this interface (that is, the bit-wise OR of all supported triggers).
`I_TRIG_TTL0`	TTL Trigger Line 0
`I_TRIG_TTL1`	TTL Trigger Line 1
`I_TRIG_TTL2`	TTL Trigger Line 2
`I_TRIG_TTL3`	TTL Trigger Line 3
`I_TRIG_TTL4`	TTL Trigger Line 4
`I_TRIG_TTL5`	TTL Trigger Line 5
`I_TRIG_TTL6`	TTL Trigger Line 6
`I_TRIG_TTL7`	TTL Trigger Line 7

`I_TRIG_ECL0`	ECL Trigger Line 0
`I_TRIG_ECL1`	ECL Trigger Line 1
`I_TRIG_ECL2`	ECL Trigger Line 2
`I_TRIG_ECL3`	ECL Trigger Line 3
`I_TRIG_EXT0`	External BNC or SMB Trigger Connector 0
`I_TRIG_EXT1`	External BNC or SMB Trigger Connector 1
`I_TRIG_EXT2`	External BNC or SMB Trigger Connector 2
`I_TRIG_EXT3`	External BNC or SMB Trigger Connector 3

Triggers on GPIB

When used on a GPIB interface session, passing the `I_TRIG_STD` value to the `ixtrig` function causes an unaddressed GPIB group execute trigger (GET). The `ixtrig` command on a GPIB interface session should be used in conjunction with the `igpibsendcmd`. There are no other valid values for the `ixtrig` function.

Triggers on GPIO

The `ixtrig` function will pulse either the CTL0 or CTL1 control line. The following values can be used:

`I_TRIG_STD`	CTL0
`I_TRIG_GPIO_CTL0`	CTL0
`I_TRIG_GPIO_CTL1`	CTL1

Triggers on RS-232 (Serial)

The `ixtrig` function will pulse either the DTR or RTS modem control lines. The following values can be used:

`I_TRIG_STD`	Data Terminal Ready (DTR)
`I_TRIG_SERIAL_DTR`	Data Terminal Ready (DTR)
`I_TRIG_SERIAL_RTS`	Ready To Send (RTS)

Triggers on VXI When used on a VXI interface session, passing the `I_TRIG_STD` value to the `ixtrig` function causes one or more VXI trigger lines to fire. Which trigger lines are fired is determined by the `ivxitrigroute` function. The `I_TRIG_STD` value has no default value. Therefore, if it is not defined before it is used, no action will be taken.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

See Also "ITRIGGER", "IVXITRIGON", "IVXITRIGOFF"

_SICLCLEANUP

C Syntax

```
#include <sicl.h>

int _siclcleanup(void);
```

Visual BASIC Syntax

```
Function siclcleanup () As Integer
```

Note Visual BASIC programs call this routine without the initial underscore (_).

Description This routine is called when a program is done with all SICL I/O resources. The routine must be called before a WIN16 SICL program terminates on Windows 95. Calling this routine is not required on Windows NT or HP-UX. Calling this routine is also not required for WIN32 SICL programs on Windows 95.

Return Value For C programs, this function returns zero (0) if successful, or a non-zero error number if an error occurs.

For Visual BASIC programs, no error number is returned. Instead, the global `Err` variable is set if an error occurs.

A

HP SICL System Information

HP SICL System Information

This appendix provides information on SICL software files and system interaction in Windows 95, Windows NT, and Windows 3.1. This information can be used as a reference for removing SICL from a system, if necessary.

Windows 95

File Location

All SICL files are installed in the base directory specified by the person who installs SICL, with the exception of several common files that Windows must be able to locate. On Windows 95, the following files are copied to the system subdirectory of the main Windows directory:

- `SICL16.DLL`
- `SICLUT17.DLL`
- `SICLUT16.DLL`
- `SICL32.DLL`
- `SICLUT31.DLL`
- `SICLRPC.DLL`
- `HPCSCP32.DLL`
- `VBSICL32.DLL`
- `VBSICL16.DLL`
- `HPIB.DLL`
- `HPIOCLAS.DLL`
- `HP341I32.VXD`

The Registry

SICL places the following key in the Windows 95 registry under `HKEY_LOCAL_MACHINE`:

```
Software\Hewlett-Packard\SICL\CurrentVersion
```

Also, if the LAN Server is configured, the following key will be created under `HKEY_LOCAL_MACHINE` if it didn't previously exist:

```
Software\Microsoft\Windows\CurrentVersion\RunServices
```

HP SICL Configuration Information

SICL configuration information is stored in the Windows 95 registry under the `Software\Hewlett-Packard\SICL\CurrentVersion` branch under `HKEY_LOCAL_MACHINE`.

Windows NT

File Location

All SICL files are installed in the base directory specified by the person who installs SICL, with the exception of several common files that Windows must be able to locate. The common files `SICL32.DLL`, `SICLRPC.DLL`, `HPCSCP32.DLL`, and `VBSICL32.DLL` are placed in the `SYSTEM32` directory, and the `HP341I32.SYS` and `HP074I32.SYS` are placed in the `SYSTEM32\DRIVERS` directory, under the main Windows directory.

The Registry

SICL places the following keys in the Windows NT registry under `HKEY_LOCAL_MACHINE`:

- `Software\Hewlett-Packard\SICL\CurrentVersion`
- `System\CurrentControlSet\Control\GroupOrderList`
- `System\CurrentControlSet\Control\ServiceOrderList`
- `System\CurrentControlSet\Services\hp341i32`
- `System\CurrentControlSet\Services\EventLog\Application\SICL Log`
- `System\CurrentControlSet\Services\EventLog\System\hp341i32`

HP SICL Configuration Information

SICL configuration information is stored in the Windows NT registry under the `Software\Hewlett-Packard\SICL\CurrentVersion` branch under `HKEY_LOCAL_MACHINE`.

Windows 3.1

File Location

All SICL files are installed in the base directory specified by the person who installs SICL, with the exception of several common files that WIndows must be able to locate. These common files, `SICL16.DLL`, `SICLUT16.DLL`, and `HPIB.DLL`, are placed in the Windows Directory.

Use of WIN.INI

SICL modifies the the `WIN.INI` file in the Windows directory during installation. A `[SICL]` section is added, and a `BASEDIR` declaration is made to record the location of the SICL directory on the system. This has no other impact on your Windows configuration.

Also note that SICL uses the `[ports]` section of the `WIN.INI` file to get configuration parameters for RS-232 interfaces. Both the `I/O Config` utility and the Windows control Panel will modify this section.

HP SICL Configuration Database

The `I/O Config` utility creates and maintains a `SICL.INI` file containing all SICL configuration information. This file is located under the SICL base directory. under normal circumstances, this file should only be modified using the `I/O Config` utility.

B

Porting from the HP 82335 Command Library

Porting from the HP 82335 Command Library

The following table provides a cross-reference between HP 82335 Command Library commands and SICL function calls. It can be used as an aid for porting programs written for the older-style calls to using SICL calls instead.

Remember to add `iopen`, `iclose`, and `_siclcleanup` calls to the program. Additionally, SICL provides other features (such as error handling) that you may wish to take advantage of, instead of doing a straight translation of your existing code.

Definitions:

-- n/a --	Means “Not Available.”
auto	Means “Happens Automatically” with no commands needed.

	82335 DOS Command Lib	82335 Windows DLL	SICL
SESSION CONTROL			
- Open/Close	auto	HpibOpen/HpibClose	iopen/iclose
- Lock/Unlock	-- n/a --	-- n/a --	ilock/iunlock
- Timeout	IOTIMEOUT	HpibTimeout	itimeout
- Error handler	-- n/a --	-- n/a --	ionerror
DATA OUTPUT			
- Unformatted	IOOUTPUTB	HpibOutputb	iwrite
- Formatted Strings	IOOUTPUTS	HpibOutputs	iprintf
- 488.2 Quoted Strings	-- n/a --	-- n/a --	iprintf
- ASCII Formatted Numbers			
- - Integer (NR1)	IOOUTPUT	HpibOutput	iprintf
- - Real number(NR2,NR3)	IOOUTPUT	HpibOutput	iprintf
- - Real array	IOOUTPUTA	HpibOutputa	iprintf
- Binary			
- - 16-bit Integers	IOOUTPUTB	HpibOutputb	iprintf
- - 32-bit Integers	IOOUTPUTB	HpibOutputb	iprintf
- - 32-bit Reals	IOOUTPUTB	HpibOutputb	iprintf
- - 64-bit Reals	IOOUTPUTB	HpibOutputb	iprintf
- 488.2 Binary			
- - #B, #Q, #H	-- n/a --	-- n/a --	iprintf
- - Arbitrary Block	IOOUTPUTAB	HpibOutputab	iprintf
- File Output	IOOUTPUTF	HpibOutputf	iprintf

	82335 DOS Command Lib	82335 Windows DLL	SICL
DATA INPUT			
- Unformatted	IOENTERB	HpibEnterb	iread
- Formatted Strings	IOENTERS	HpibEnters	iscanf
- 488.2 Quoted Strings	-- n/a --	-- n/a --	iscanf
- ASCII Formatted Numbers			
- - Integer (NR1)	IOENTER	HpibEnter	iscanf
- - Real number(NR2,NR3)	IOENTER	HpibEnter	iscanf
- - Real array	IOENTERA	HpibEntera	iscanf
- Binary			
- -16-bit Integers			
- -32-bit Integers	IOENTERB	HpibEnterb	iscanf
- -32-bit Reals	IOENTERB	HpibEnterb	iscanf
- -64-bit Reals	IOENTERB	HpibEnterb	iscanf
- 488.2 Binary	IOENTERB	HpibEnterb	iscanf
- - #B, #Q, #H			
- - Arbitrary Block	-- n/a --	-- n/a --	iscanf
- File Input	IOENTERAB	HpibEnterab	iscanf
	IOENTERF	HpibEnterF	iscanf
DATA I/O CONTROL			
- Prompted Input	-- n/a --	-- n/a --	ipromptf
- Auto Byte Swap	YES	YES	YES
- DMA ON/OFF	IODMA	-- n/a --	ihint
- EOI ON/OFF	IOEOI	HpibEoi	auto
- EOL string [length]	IOEOI	HpibEoi	see note (2)
- Short T1 Capability	IOFASTOUT	HpibFastout	auto
- Set Match Char	IOMATCH	HpibMatch	itermchar
- Read termination reason	IOGETTERM	HpibGetterm	auto
INSTRUMENT CONTROL			
- CLEAR an instrument	IOCLEAR	HpibClear	iclear
- Put device in LOCAL	IOLOCAL	HpibLocal	ilocal or igpibrenctl
- Put device in REMOTE	IOREMOTE	HpibRemote	iremote or igpibrenctl
- TRIGGER a device	IOTRIGGER	HpibTrigger	itrigger
- Read stb (serial poll)	IOSPOLL	HpibSpoll	ireadstb

	82335 DOS Command Lib	82335 Windows DLL	SICL
BUS CONTROL			
- Send IFC	IOABORT	Hpibabort	iclear
- Make all dev's REMOTE	IOREMOTE	HpibRemote	igpibrenctl
- Make all dev's LOCAL	IOLOCAL	HpibLocal	igpibrenctl
- CLEAR all devices	IOCLEAR	HpibClear	iclear
- Lock device front panel	IOLLOCKOUT	HpibLlockout	igpibllo
- Send bus commands	IOSEND	HpibSend	igpibsendcmd
- TRIGGER bus	IOTRIGGER	HpibTrigger	itrigger
- Reset to Power up state	IORESET	HpibReset	auto
- Set interface bus addr.	IOCONTROL	HpibControl	igpibbusaddr
- Get interface status	IOSTATUS	HpibStatus	igpibbusstatus
- Set/Drop ATN	IOCONTROL	HpibControl	igpibatnctl
PARALLEL POLL			
- Configure Parallel Poll	IOPPOLLC	HpibPpollc	igpibppollconfig
- Unconfigure parallel poll	IOPPOLLU	HpibPpollu	igpibppollconfig
- Conduct a parallel poll	IOPPOLL	HpibPpoll	igpibppoll
MISC. CAPABILITIES			
- SRQ Support	IOPEN	-- n/a --	ionsrq
- Interrupt support	-- n/a --	-- n/a --	ionintr/isetintr
- Wait for event	-- n/a --(1)	-- n/a --	iwaithdlr
NON-CONTROLLER			
- Respond to serial poll	IOREQUEST	HpibRequest	isetstb
- Respond to parallel poll	-- n/a --	-- n/a --	igpibppollresp
- Request Service	IOREQUEST	HpibRequest	isetstb
- Pass Control	IOPASSCTRL	HpibPassctl	igpibpassctl
- Take Control	IOTAKECTRL	HpibTakectl	auto
- Can be non-Sys Ctlr?	YES	YES	YES

Notes:

1. Can be done manually using IOSTATUS in a loop.

2. The LF^END EOL sequence (required by 488.2) can be added with `iprintf`.

C

Porting to Visual BASIC 4.0

Porting to Visual BASIC 4.0

This edition of this manual supports and shows how to program SICL applications in Visual BASIC version 4.0 or later. If you have SICL applications written in an earlier Visual BASIC version than version 4.0 (for example, version 3.0), you can easily port your SICL applications to Visual BASIC version 4.0.

Porting your SICL applications to Visual BASIC 4.0 is a simple matter of adding the `SICL4.BAS` declaration file (rather than the `SICL.BAS` file) to each project that calls SICL for WIN16 or WIN32 (16-bit or 32-bit) Visual BASIC 4.0 programs. There may also be changes in functions where you are passing null pointers for strings to SICL functions. For example, in Visual BASIC version 3.0, the preceding `ByVal` keyword was used as follows:

```
ivprintf(id, mystring, ByVal 0&)
```

In Visual BASIC version 4.0, you only need to pass the `0&` null pointer because version 4.0 knows this is by reference:

```
ivprintf(id, mystring, 0&)
```

Once you have added the `SICL4.BAS` declaration file to each project and removed `ByVal` keywords preceding null pointers for strings, your SICL applications will run correctly with Visual BASIC 4.0.

D

HP SICL Error Codes

HP SICL Error Codes

The following table contains the error codes for the SICL software.

Error Code	Error String	Description
I_ERR_ABORTED	Externally aborted	A SICL call was aborted by external means.
I_ERR_BADADDR	Bad address	The device/interface address passed to `iopen` doesn't exist. Verify that the interface name is the one assigned in the `I/O Setup` utility (`hwconfig.cf` file) for HP-UX, or with the `I/O Config` utility for Windows.
I_ERR_BADCONFIG	Invalid configuration	An invalid configuration was identified when calling `iopen`.
I_ERR_BADFMT	Invalid format	Invalid format string specified for `iprintf` or `iscanf`.
I_ERR_BADID	Invalid INST	The specified `INST` !!*id*!! does not have a corresponding `iopen`.
I_ERR_BADMAP	Invalid map request	The `imap` call has an invalid map request.
I_ERR_BUSY	Interface is in use by non-SICL process	The specified interface is busy.
I_ERR_DATA	Data integrity violation	The use of CRC, Checksum, and so forth imply invalid data.
I_ERR_INTERNAL	Internal error occurred	SICL internal error.
I_ERR_INTERRUPT	Process interrupt occurred	A process interrupt (signal) has occurred in your application.
I_ERR_INVLADDR	Invalid address	The address specified in `iopen` is not a valid address (for example, "`hpib,57`").
I_ERR_IO	Generic I/O error	An I/O error has occurred for this communication session.
I_ERR_LOCKED	Locked by another user	Resource is locked by another session (see `isetlockwait`).
I_ERR_NESTEDIO	Nested I/O	Attempt to call another SICL function when current SICL function has not completed (WIN16). More than one I/O operation is prohibited.
I_ERR_NOCMDR	Commander session is not active or available	Tried to specify a commander session when it is not active, available, or does not exist.

Error Code	Error String	Description
I_ERR_NOCONN	No connection	Communication session has never been established, or connection to remote has been dropped.
I_ERR_NODEV	Device is not active or available	Tried to specify a device session when it is not active, available, or does not exist.
I_ERR_NOERROR	No Error	No SICL error returned; function return value is zero (0).
I_ERR_NOINTF	Interface is not active	Tried to specify an interface session when it is not active, available, or does not exist.
I_ERR_NOLOCK	Interface not locked	An `iunlock` was specified when device wasn't locked.
I_ERR_NOPERM	Permission denied	Access rights violated.
I_ERR_NORSRC	Out of resources	No more system resources available.
I_ERR_NOTIMPL	Operation not implemented	Call not supported on this implementation. The request is valid, but not supported on this implementation.
I_ERR_NOTSUPP	Operation not supported	Operation not supported on this implementation.
I_ERR_OS	Generic O.S. error	SICL encountered an operating system error.
I_ERR_OVERFLOW	Arithmetic overflow	Arithmetic overflow. The space allocated for data may be smaller than the data read.
I_ERR_PARAM	Invalid parameter	The constant or parameter passed is not valid for this call.
I_ERR_SYMNAME	Invalid symbolic name	Symbolic name passed to `iopen` not recognized.
I_ERR_SYNTAX	Syntax error	Syntax error occurred parsing address passed to `iopen`. Make sure that you have formatted the string properly. White space is not allowed.
I_ERR_TIMEOUT	Timeout occured	A timeout occurred on the read/write operation. The device may be busy, in a bad state, or you may need a longer timeout value for that device. Check also that you passed the correct address to `iopen`.
I_ERR_VERSION	Version incompatibility	The `iopen` call has encountered a SICL library that is newer than the drivers. Need to update drivers.

E

HP SICL Function Summary

HP SICL Function Summary

The following tables summarize the supported features for each SICL function. The first table lists the core (interface-independent) SICL functions. The core SICL functions work on all types of devices and interfaces. The tables after that list the interface-specific SICL functions (that is, the SICL functions that are specific to HP-IB/GPIB, GPIO, LAN, RS-232/Serial, and VXI interfaces, respectively).

Each table notes if the particular SICL function that is listed:

- Supports device (**DEV**), interface (**INTF**), and/or commander (**CMDR**) session(s).
- Is affected by the `ilock` (**LOCK**) and/or the `itimeout` (**TIMEOUT**) function(s).

Also, the first table titled "Core SICL Functions" and the last table titled "VXI-Specific SICL Functions" have the additional column, **LAN CLIENT TIMEOUT**. The SICL functions that have X's in this column may timeout over LAN, even those functions which cannot timeout over local interfaces.

Function	DEV	INTF	CMDR	LOCK	TIMEOUT	LAN CLIENT TIMEOUT
IABORT						
IBLOCKCOPY						
ICAUSEERR	X	X	X			
ICLEAR	X	X		X	X	X
ICLOSE	X	X	X			X
IFLUSH	X	X	X	X	X	X
IFREAD	X	X	X	X	X	X

Function	DEV	INTF	CMDR	LOCK	TIMEOUT	LAN CLIENT TIMEOUT
IFWRITE	X	X	X	X	X	X
IGETADDR	X	X	X			
IGETDATA	X	X	X			
IGETDEVADDR	X					
IGETERRNO						
IGETERRSTR						
IGETINTFSESS	X		X			X
IGETINTFTYPE	X	X	X			
IGETLOCKWAIT	X	X	X			
IGETLU	X	X	X			
IGETLUINFO						
IGETLULIST						
IGETONERROR	X	X	X			
IGETONINTR	X	X	X			
IGETONSRQ	X	X				
IGETSESSTYPE	X	X	X			
IGETTERMCHR	X	X	X			
IGETTIMEOUT	X	X	X			
IHINT	X	X	X			
IINTROFF						
IINTRON						
ILOCAL	X			X	X	X
ILOCK	X	X	X		X	X

Function	DEV	INTF	CMDR	LOCK	TIMEOUT	LAN CLIENT TIMEOUT
IONERROR						
IONINTR	X	X	X			X
IONSRQ	X	X				X
IOPEN	X	X	X			X
IPOPFIFO						
IPRINTF	X	X	X	X	X	X
IPROMPTF	X	X	X	X	X	X
IPUSHFIFO						
IREAD	X	X	X	X	X	X
IREADSTB	X			X	X	X
IREMOTE	X			X	X	X
ISCANF	X	X	X	X	X	X
ISETBUF	X	X	X			X
ISETDATA	X	X	X			
ISETINTR	X	X	X			X
ISETLOCKWAIT	X	X	X			
ISETSTB			X	X	X	X
ISETUBUF	X	X	X			X
ISWAP						
ITERMCHR	X	X	X			
ITIMEOUT	X	X	X			
ITRIGGER	X	X		X	X	X
IUNLOCK	X	X	X			X

Function	DEV	INTF	CMDR	LOCK	TIMEOUT	LAN CLIENT TIMEOUT
IVERSION						X
IWAITHDLR						
IWRITE	X	X	X	X	X	X
IXTRIG		X		X	X	X

Function	DEV	INTF	CMDR	LOCK	TIMEOUT
IGPIBATNCTL		X		X	X
IGPIBBUSADDR		X		X	X
IGPIBBUSSTATUS		X		X	X
IGPIBGETT1DELAY		X		X	X
IGPIBLLO		X		X	X
IGPIBPASSCTL		X		X	X
IGPIBPPOLL		X		X	X
IGPIBPPOLLCONFIG	X		X	X	X
IGPIBPPOLLRESP			X	X	X
IGPIBRENCTL		X		X	X
IGPIBSENDCMD		X		X	X
IGPIBSETT1DELAY		X		X	X

Function	DEV	INTF	CMDR	LOCK	TIMEOUT
IGPIOCTRL		X		X	X
IGPIOGETWIDTH		X			
IGPIOSETWIDTH		X		X	X
IGPIOSTAT		X			

Function	DEV	INTF	CMDR	LOCK	TIMEOUT
IGETGATEWAYTYPE	X	X	X		
ILANGETTIMEOUT		X			
ILANTIMEOOUT		X			

Function	DEV	INTF	CMDR	LOCK	TIMEOUT
ISERIALBREAK		X		X	X
ISERIALCTRL		X		X	X
ISERIALMCLCTRL		X		X	X
ISERIALMCLSTAT		X		X	X
ISERIALSTAT		X		X	X

Function	DEV	INTF	CMDR	LOCK	TIMEOUT	LAN CLIENT TIMEOUT
IMAP	X	X	X	X	X	
IMAPINFO	X	X	X			
IPEEK						
IPOKE						
IUNMAP	X	X	X			
IVXIBUSSTATUS		X		X	X	X
IVXIGETTRIGROUTE		X		X	X	X
IVXIRMINFO	X	X	X			X
IVXISERVANTS		X				X
IVXITRIGOFF		X		X	X	X
IVXITRIGON		X		X	X	X
IVXITRIGROUTE		X		X	X	X
IVXIWAITNORMOP	X	X	X		X	X
IVXIWS	X			X	X	X

F

RS-232 Cables

This appendix lists several general purpose HP RS-232 cables and adapters. Consult your instrument's operating manual for information on which status lines are used for handshaking. Recommended cables and adapters are shown in **boldface** type; the others are listed because they may work better in some applications.

Instrument Connector	Computer/Printer Connector	HP Cable Part Number	HP Adapter Part Number	Length
9-pin Male	25-pin Male	24542H	none	3m (9ft 10in)
		24542U	5181-6641[a]	3m (9ft 10in)
		F1047-80002[b]	**5181-6641[b]**	2.5m (8ft 2.5in)
9-pin Male	25-pin Female	24542G	none	3m (9ft 10in)
		24542U	5181-6640[a]	3m (9ft 10in)
		F1047-80002[b]	**5181-6640[a]**	2.5m (8ft 2.5in)
9-pin Male	9-pin Male	24542U	none	3m (9ft 10in)
		24542H & 24542M	none	6m (19ft 10in)
		F1047-80002[b]	none	2.5m (8ft 2.5in)

a. One of four adapters in the HP 34399A RS-232 Adapter Kit. Kit includes four adapters to go from DB9 Female Cable (HP 34398A) to PC/Printer DB25 male or female, or to modem DB9 Female or DB25 Female.

b. Part of HP 34398A RS-232 Cable Kit. HP 34398A comes with RS-232, 9-pin female to 9-pin female Null modem/printer cable and one adapter 9-pin male to 25-pin female (HP p.n. 5181-6641). The adapter is also included in HP 34399A above.

Instrument Connector	Computer/Printer Connector	HP Cable Part Number	HP Adapter Part Number	Length
9-pin Male	25-pin Female	24542M 24542U **F1047-80002**[b]	none 5181-6642[a] **5181-6642**[a]	3m (9ft 10in) 3m (9ft 10in) 2.5m (8ft 2.5in)
9-pin Male	9-pin Female	24542U **F1047-80002**[b]	5181-6639[a] **5181-6639**[a]	3m (9ft 10in) 2.5m (8ft 2.5in)

a. One of four adapters in the HP 34399A RS-232 Adapter Kit. Kit includes four adapters to go from DB9 Female Cable (HP 34398A) to PC/Printer DB25 male or female, or to modem DB9 Female or DB25 Female.

b. Part of HP 34398A RS-232 Cable Kit. HP 34398A comes with RS-232, 9-pin female to 9-pin female Null modem/printer cable and one adapter 9-pin male to 25-pin female (HP p.n. 5181-6641). The adapter is also included in HP 34399A above.

Instrument Connector	Computer/Printer Connector	HP Cable Part Number	HP Adapter Part Number	Length
25-pin Female	25-pin Female	24542G	5181-6642[a]	3m (9ft 10in)
25-pin Female	9-pin Female	24542G **24542M**	5181-6639[a] none	3m (9ft 10in) 3m (9ft 10in)

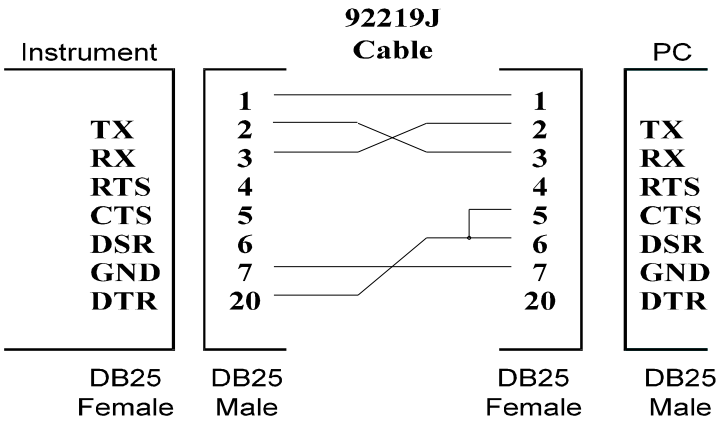
a. One of four adapters in the HP 34399A RS-232 Adapter Kit. Kit includes four adapters to go from DB9 Female Cable (HP 34398A) to PC/Printer DB25 male or female, or to modem DB9 Female or DB25 Female.

Instrument Connector	Computer/Printer Connector	HP Cable Part Number	HP Adapter Part Number	Length
25-pin Female	25-pin Male	17255D C2913A **24542G**	 **5181-6641**[a]	1.2m (3ft 11in) 1.2m (3ft 11in) 3m (9ft 10in)

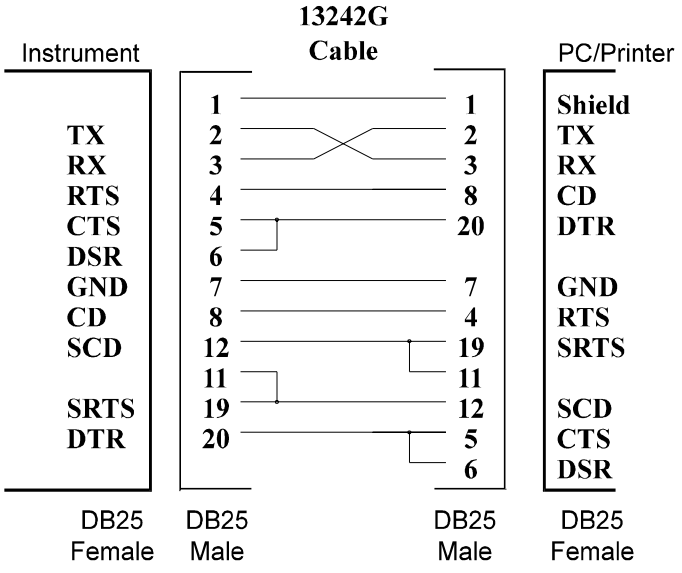
Instrument Connector	Computer/Printer Connector	HP Cable Part Number	HP Adapter Part Number	Length
25-pin Female	25-pin Female	13242G		5m (16ft 8in)
		17255M		1.5m (4ft 11in)
		C2914A		1.2m (3ft 11in)
		24542G	**5181-6640**[a]	3m (9ft 10in)
25-pin Female	9-pin Male	**24542G**	none	3m (9ft 10in)
		24542U	5181-6640[a]	3m (9ft 10in)
		F1047-80002[b]	5181-6640[a]	2.5m (8ft 2.5in)

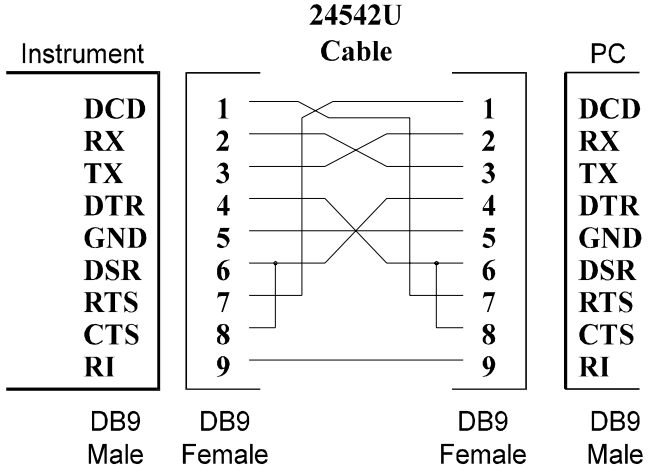
a. One of four adapters in the HP 34399A RS-232 Adapter Kit. Kit includes four adapters to go from DB9 Female Cable (HP 34398A) to PC/Printer DB25 male or female, or to modem DB9 Female or DB25 Female.

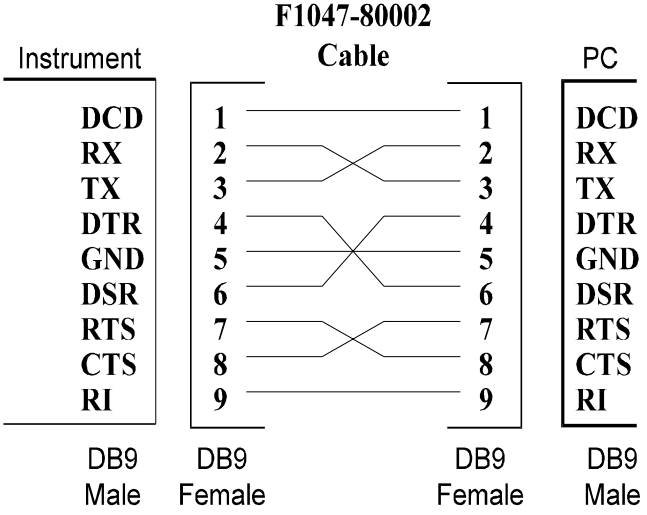
b. Part of HP 34398A RS-232 Cable Kit. HP 34398A comes with RS-232, 9-pin female to 9-pin female Null modem/printer cable and one adapter 9-pin male to 25-pin female (HP p.n. 5181-6641). The adapter is also included in HP 34399A above.

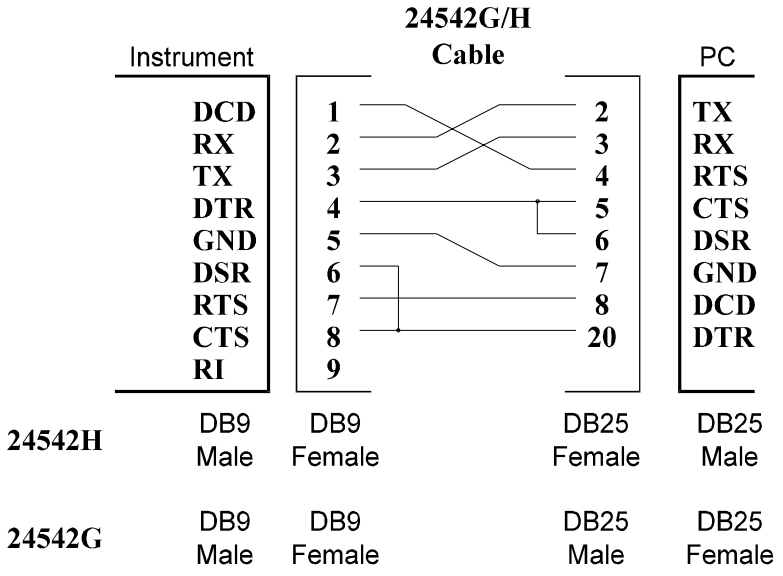


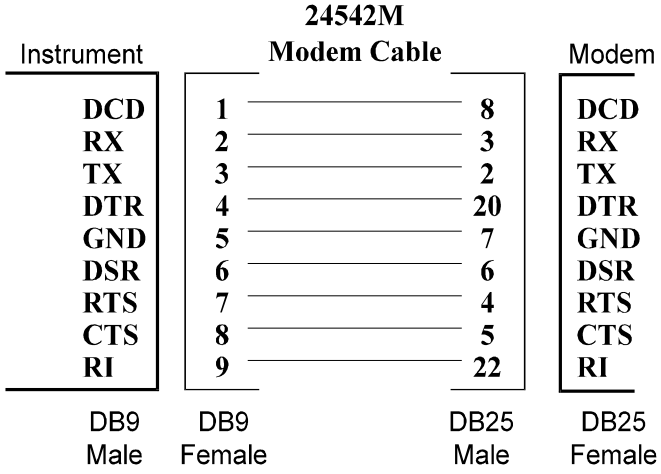
Note: The 92219J is directional. This cable may work differently when swapped end to end.

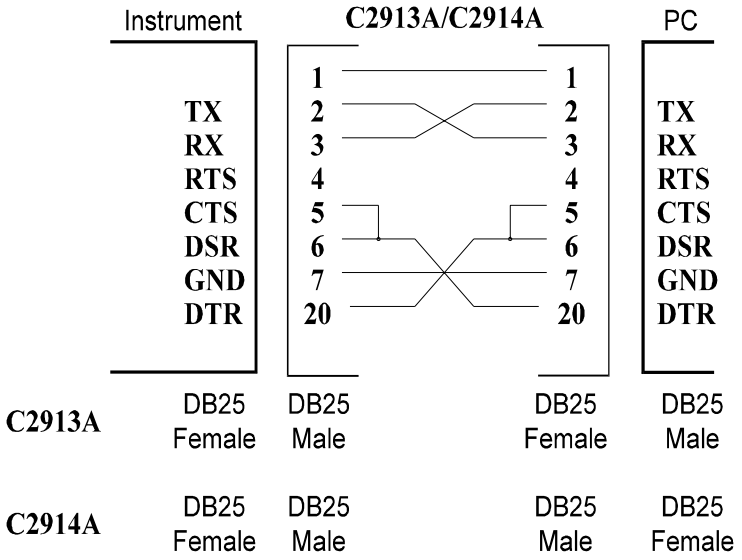


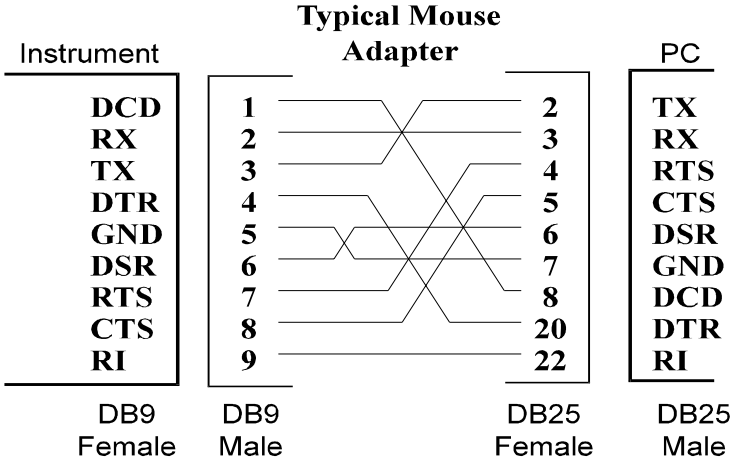

24542U
Cable
Instrument
PC
DCD
RX
TX
DTR
GND
DSR
RTS
CTS
RI
1
2
3
4
5
6
7
8
9
DB9
Male
DB9
Female
DB9
Female
DB9
Male


F1047-80002
Cable
Instrument
PC
DCD
RX
TX
DTR
GND
DSR
RTS
CTS
RI
1
2
3
4
5
6
7
8
9
DB9
Male
DB9
Female
DB9
Female
DB9
Male

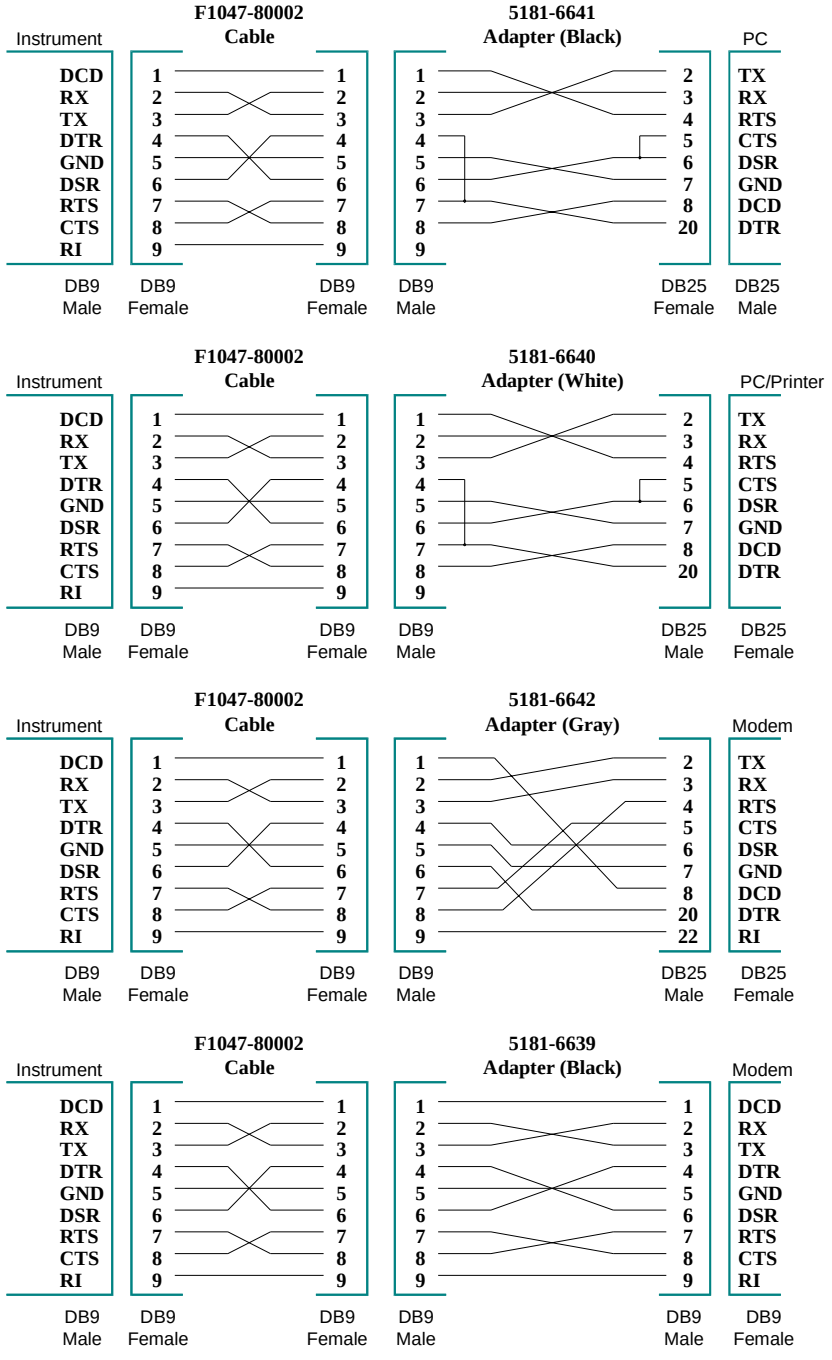

24542G/H
Cable
Instrument
PC
DCD
RX
TX
DTR
GND
DSR
RTS
CTS
RI
1
2
3
4
5
6
7
8
9
2
3
4
5
6
7
8
20
TX
RX
RTS
CTS
DSR
GND
DCD
DTR
24542H
DB9 Male
DB9 Female
DB25 Female
DB25 Male
24542G
DB9 Male
DB9 Female
DB25 Male
DB25 Female

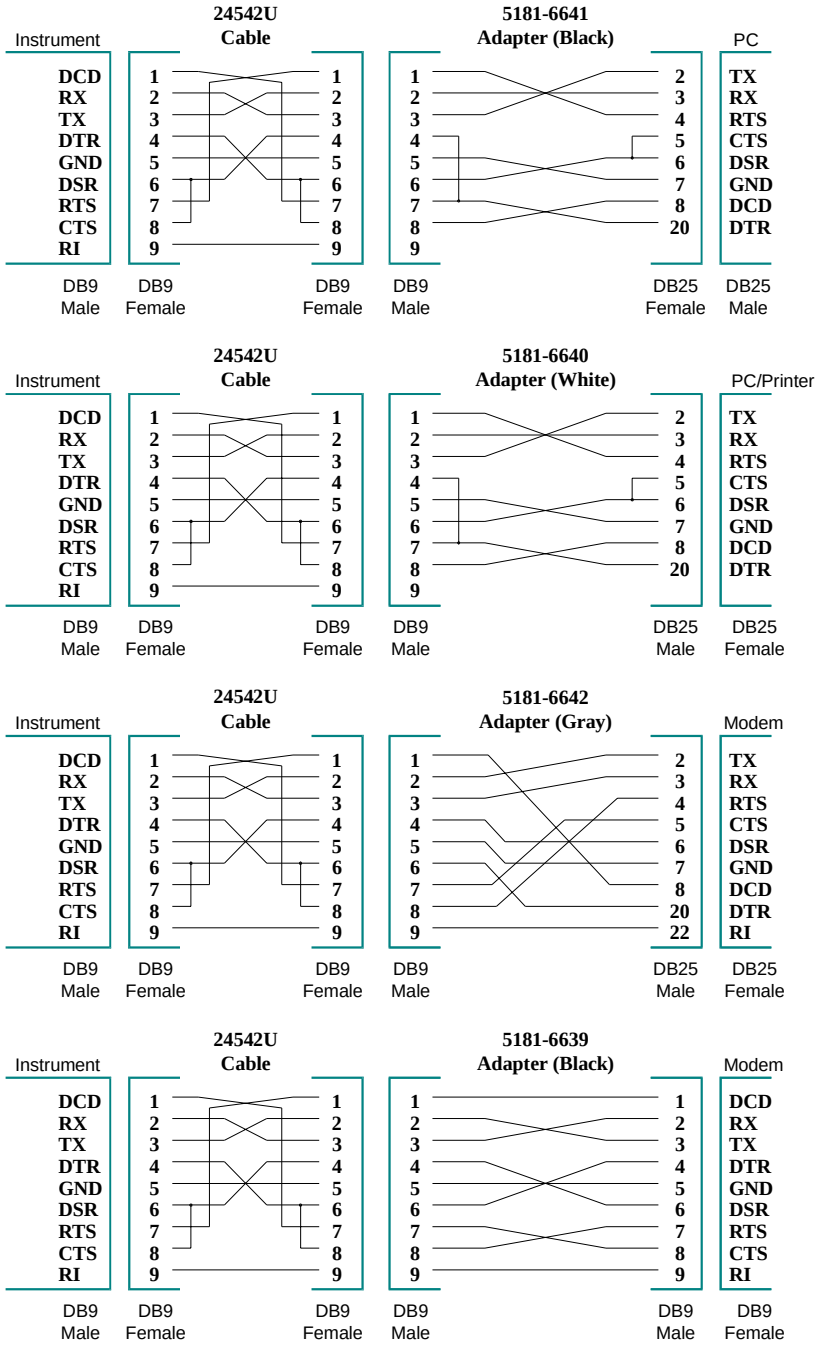

24542M
Modem Cable
Instrument
Modem
DCD
RX
TX
DTR
GND
DSR
RTS
CTS
RI
1
2
3
4
5
6
7
8
9
8
3
2
20
7
6
4
5
22
DCD
RX
TX
DTR
GND
DSR
RTS
CTS
RI
DB9 Male
DB9 Female
DB25 Male
DB25 Female





A mouse adapter works well as a 9 pin to 25 pin adapter with a PC.


F1047-80002
Cable
5181-6641
Adapter (Black)
Instrument
PC
DCD RX TX DTR GND DSR RTS CTS RI
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
2 3 4 5 6 7 8 20
TX RX RTS CTS DSR GND DCD DTR
DB9 Male
DB9 Female
DB9 Female
DB9 Male
DB25 Female
DB25 Male
F1047-80002
Cable
5181-6640
Adapter (White)
Instrument
PC/Printer
DCD RX TX DTR GND DSR RTS CTS RI
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
2 3 4 5 6 7 8 20
TX RX RTS CTS DSR GND DCD DTR
DB9 Male
DB9 Female
DB9 Female
DB9 Male
DB25 Male
DB25 Female
F1047-80002
Cable
5181-6642
Adapter (Gray)
Instrument
Modem
DCD RX TX DTR GND DSR RTS CTS RI
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
2 3 4 5 6 7 8 20 22
TX RX RTS CTS DSR GND DCD DTR RI
DB9 Male
DB9 Female
DB9 Female
DB9 Male
DB25 Male
DB25 Female
F1047-80002
Cable
5181-6639
Adapter (Black)
Instrument
Modem
DCD RX TX DTR GND DSR RTS CTS RI
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
DCD RX TX DTR GND DSR RTS CTS RI
DB9 Male
DB9 Female
DB9 Female
DB9 Male
DB9 Male
DB9 Female


24542U Cable
5181-6641 Adapter (Black)
Instrument
PC
DCD RX TX DTR GND DSR RTS CTS RI
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
2 3 4 5 6 7 8 20
TX RX RTS CTS DSR GND DCD DTR
DB9 Male
DB9 Female
DB9 Female
DB9 Male
DB25 Female
DB25 Male
24542U Cable
5181-6640 Adapter (White)
Instrument
PC/Printer
DCD RX TX DTR GND DSR RTS CTS RI
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
2 3 4 5 6 7 8 20
TX RX RTS CTS DSR GND DCD DTR
DB9 Male
DB9 Female
DB9 Female
DB9 Male
DB25 Male
DB25 Female
24542U Cable
5181-6642 Adapter (Gray)
Instrument
Modem
DCD RX TX DTR GND DSR RTS CTS RI
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
2 3 4 5 6 7 8 20 22
TX RX RTS CTS DSR GND DCD DTR RI
DB9 Male
DB9 Female
DB9 Female
DB9 Male
DB25 Male
DB25 Female
24542U Cable
5181-6639 Adapter (Black)
Instrument
Modem
DCD RX TX DTR GND DSR RTS CTS RI
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9
DCD RX TX DTR GND DSR RTS CTS RI
DB9 Male
DB9 Female
DB9 Female
DB9 Male
DB9 Male
DB9 Female

Glossary

Glossary

address
A string uniquely identifying a particular interface or a device on that interface.

bus error
An action that occurs when access to a given address fails either because no register exists at the given address, or the register at the address refuses to respond.

bus error handler
Programming code executed when a bus error occurs.

commander session
A session that communicates to the controller of this bus.

controller
A computer used to communicate with a remote device such as an instrument. In the communications between the controller and the device the controller is in charge of, and controls the flow of communication (that is, does the addressing and/or other bus management).

controller role
A computer acting as a controller communicating with a device.

device
A unit that receives commands from a controller. Typically a device is an instrument but could also be a computer acting in a non-controller role, or another peripheral such as a printer or plotter.

device driver
A segment of software code that communicates with a device. It may either communicate directly with a device by reading and writing registers, or it may communicate through an interface driver.

device session
A session that communicates as a controller specifically with a single device, such as an instrument.

handler
A software routine used to respond to an asynchronous event such as an error or an interrupt.

instrument
A device that accepts commands and performs a test or measurement function.

interface
A connection and communication media between devices and controllers, including mechanical, electrical, and protocol connections.

interface driver
A software segment that communicates with an interface. It also handles commands used to perform communications on an interface.

interface session
A session that communicates and controls parameters affecting an entire interface.

interrupt
An asynchronous event requiring attention out of the normal flow of control of a program.

lock
A state that prohibits other users from accessing a resource, such as a device or interface.

logical unit
A logical unit is a number associated with an interface. A logical unit, in SICL, uniquely identifies an interface. Each interface on the controller must have a unique logical unit.

mapping
An operation that returns a pointer to a specified section of an address space as well as makes the specified range of addresses accessible to the requester.

non-controller role
A computer acting as a device communicating with a controller.

process
An operating system object containing one or more threads of execution that share a data space. A multi-process system is a computer system that allows multiple programs to execute simultaneously, each in a separate process environment. A single-process system is a computer system that allows only a single program to execute at a given point in time.

register
An address location that controls or monitors hardware.

session
An instance of a communications channel with a device, interface, or commander. A session is established when the channel is opened with the `iopen` function and is closed with a corresponding call to `iclose`.

SRQ
Service Request. An asynchronous request (an interrupt) from a remote device indicating that the device requires servicing.

status byte
A byte of information returned from a remote device showing the current state and status of the device.

symbolic name
A name corresponding to a single interface or device. This name uniquely identifies the interface or device on this controller. If there is more than one interface or device on the controller, each interface or device must have a unique symbolic name.

thread

An operating system object that consists of a flow of control within a process. A single process may have multiple threads that each have access to the same data space within the process. However, each thread has its own stack and all threads may execute concurrently with each other (either on multiple processors, or by time-sharing a single processor). Note that multi-threaded applications are only supported with 32-bit SICL.

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