

gclib 437

C API for Galil controllers and PLCs

Galil Motion Control

Tue Feb 26 2019



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# Chapter 1

## Getting Started

The Galil Communication Library (gclib) is a communication library for Galil motion controllers and PLCs. A number of programming languages, operating systems, and hardware platforms are supported.

The library consists of a basic set of function calls ([gclib.h](#)), and an open-source extension library ([gclibo.h](#)). A number of examples are provided to demonstrate how to use the library with various [languages](#).

The gclib will import virtually anywhere a dll/so/dylib can be imported. See [installation](#) for details. Please contact [softwaresupport@galil.com](mailto:softwaresupport@galil.com) if the language or platform required is not listed.

### Contents

- [List of all functions](#)
- [Installation](#) and supported operating systems
- [Language Support](#)
- [Using gclib](#)

### Release Notes

See the update history of gclib in the [release notes](#).

Galil maintains an [RSS](#) page to notify users of updates.

See the update history of [gcaps](#) in the [release notes](#).

### Technical Support

For help please email [softwaresupport@galil.com](mailto:softwaresupport@galil.com), or call [Galil Applications](#).





## Chapter 2

# Installation

gclib is available on the following operating systems.

- [Microsoft Windows](#)
  - 10 x64 ◇, x86
  - 8.1 x64 ◇, x86
  - 8 x64 ◇, x86
  - 7 x64 ◇, x86
- [Ubuntu Linux](#)
  - 18.04 LTS x64 ◇
  - 16.04 LTS x64 ◇ †
  - 14.04 LTS x64 †
  - 12.04 LTS x64 †
- [Fedora Linux](#)
  - fc29 x64 ◇
  - fc28 x64 ◇ †
  - fc27 x64 ◇ †
  - fc26 x64 ◇ †
  - fc25 x64 ◇ †
  - fc24 x64 ◇ †
  - fc23 x64 ◇ †
  - fc22 x64 †
  - fc21 x64 †
- Red Hat and CentOS
  - [Red Hat 7 & CentOS 7 Linux](#)
    - \* RHEL 7 x64 ◇
    - \* CentOS 7 x64 ◇
  - [Red Hat 6 & CentOS 6 Linux](#)
    - \* RHEL 6 x64 †
    - \* CentOS 6 x64 †
- Raspbian, [Raspberry Pi](#)
  - Raspberry Pi 3 Model B+, Stretch 9.8

- Raspberry Pi 3 Model B, Stretch 9.1 †
  - Raspberry Pi 2 Model B, Jessie 8.0 †
- [Apple OS X](#)
  - Yosemite 10.10 x64
  - Mavericks 10.9 x64
- Other builds, contact [Galil Applications](#) for more info
  - [Nvidia Jetson TX1](#) running Ubuntu 16.04 arm64

◇ [gcaps](#) available on these operating systems.

† Although no longer built on these older operating systems, previous versions of gclib are available.

Don't see your OS? Please email [softwaresupport@galil.com](mailto:softwaresupport@galil.com), or call [Galil Applications](#).

## 2.1 Microsoft Windows

### Tested versions

See the [installation](#) page for supported versions.

### Installation

On Windows, gclib is distributed in the following formats.

- An executable installer which will install the library in the proper location to work with the included examples and documentation. PCI users can optionally install the PCI driver from within this installer.
- A zip file containing the same set of files as the executable but in a zip archive. PCI users can use the stand-alone PCI driver installer.
  - A stand-alone PCI driver installer for PCI users (DMC-1806, 1800, 1802, 1417).

### Note

The PCI driver is compatible with GalilTools but is enhanced for gclib communications.

### Download Installer

**Recommended.** All instructions and examples depend on the installation paths.

### Download Zip

For custom deployment or non-default file locations. Downloads are available on the [release notes](#) page.

### Required third-party DLLs

gclib is built using **MSVC 2015** and requires run-time components available in the [Microsoft Visual C++ Redistributable Packages for Visual Studio 2015](#).

The gclib installer will automatically install these prerequisites for both 32 bit (x86) and 64 bit (x64) builds. The installer allows the user to opt out of this installation, if desired.

If using the zip installation, the binaries must be downloaded and installed manually.

### Silent Installation

For developers wishing to bundle gclib within their own installers, execute the gclib installer with the /S switch to run silently with defaults. If the Galil security certificate is not already trusted on the deployment target, a digital signature dialog may be presented.

### Uninstall gclib

- Run `uninstall.exe` in "C:\Program Files (x86)\Galil\gclib"

### Installed Files

Installation from the executable installer looks like the following.

```
C:\Program Files (x86)\Galil\gclib>tree /a
Folder PATH listing for volume OS
Volume serial number is AE3F-6836
C:.
+---dll
|   +---x64
|   \---x86
+---doc
|   \---html
|   \---search
+---examples
|   +---cpp
|   +---cs
|   |   \---2013_12.0
|   |       \---gclib_example
|   |           \---gclib_example
|   |               \---Properties
|   +---gcc
|   +---mingw
|   +---msvc
|   |   \---2013_12.0
|   |       \---gclib_example
|   |           \---gclib_example
|   \---vb
|       \---2013_12.0
|           \---gclib_example
|               \---gclib_example
|                   \---My Project
+---include
+---lib
|   \---dynamic
|   +---x64
|   \---x86
\---source
    +---gclibo
    \---wrappers
        +---cs
        +---gcl
        \---vb
```

#### dll

The *dll* directory contains the binary *dynamic link libraries* (DLLs) for both x86 and x64 architectures. **Dynamically linked executables must have the correct dlls in their path at runtime.**

#### doc

The *doc* directory contains this documentation and a printable, pdf version.

### examples

The *examples* directory contains example projects for various compilers. The *cpp* directory contains *x\_examples.h* and the implementation of the example files documented in this manual.

### Warning

Before using the examples, copy the files to a user location such as *C:\Users\user\Documents*. Failing to do so may cause source files to be deleted upon gclib uninstallation.

### include

The *include* directory contains header files needed for compiling code. The compiler will need to know where these files are at compile time.

See the compiler-specific directions for more information, e.g. [gclib using MinGW](#).

### lib

The *lib* directory contains linker files (*gclib.lib* and *gclibo.lib*) for both x86 and x64 architectures. The linker should include *gclib.lib* and *gclibo.lib*.

### source

The *source* directory contains source files such as [gclibo.c](#).

## 2.2 Ubuntu Linux

### Tested versions

This version of Linux has **x64/AMD64 Support Only**. Contact Galil if another version is required for an application.

See the [installation](#) page for supported versions.

### Installation

#### Create a temporary variable for OS version

```
$ os=$(lsb_release -r -s)
$ echo $os
18.04
```

The number printed must be in the [installation](#) list of supported operating systems.

#### Install Galil's public certificate

```
$ wget http://www.galil.com/sw/pub/ubuntu/$os/GALIL-PUB-KEY
# apt-key add GALIL-PUB-KEY
```

#### Get Galil's apt sources list

```
# wget http://www.galil.com/sw/pub/ubuntu/$os/galil.list -O /etc/apt/sources.list.d/galil.list
# apt-get update
```

### Install Package

#### Install gclib

```
# apt-get install gclib
```

#### Install gcaps on 16.04 and better (optional)

Following Linux's daemon naming conventions, gcaps is called *gcapsd* on Ubuntu. See the [gcaps](#) documentation for more information.

```
# apt-get install gcapsd
```

Verify that the systemd unit is running.

```
$ systemctl is-active gcapsd
active
```

### Uninstall Package

If the packages need to be removed from the system, the following commands may be used.

#### Uninstall gclib

```
# apt-get remove gclib
```

#### Uninstall gcaps

```
# apt-get remove gcapsd
```

## Serial Ports and USB

If access to the serial ports or USB (e.g. DMC-4103) is desired through gclib, the following will provide steps to join the correct access group. If using USB, be sure the controller is powered and the usb is plugged in before beginning.

### Determine group with access

```
$ ls -l /dev/ttyUSB* /dev/ttyS*
crw-rw----. 1 root dialout  4, 64 Mar  3 16:39 /dev/ttyS0
crw-rw----. 1 root dialout  4, 65 Mar  3 16:39 /dev/ttyS1
crw-rw----. 1 root dialout  4, 66 Mar  3 16:39 /dev/ttyS2
crw-rw----. 1 root dialout  4, 67 Mar  3 16:39 /dev/ttyS3
crw-rw----. 1 root dialout 188,  0 Mar  6 11:08 /dev/ttyUSB0
```

In the above listing, **dialout** is the group that needs to be joined. **uucp** is another common group that may be listed.

### Add the desired *username* to the group.

```
$ sudo gpasswd -a username dialout
[sudo] password for username:
Adding user username to group dialout
```

Log out and back in for change to take effect.

```
$ groups
username wheel dialout
```

gclib can now connect to serial and usb devices from user *username*.

## PCI Controllers

If using a Galil PCI controller, the PCI driver must be installed.

### Extract source and build driver

```
$ tar -xf /usr/share/doc/gclib/src/gclib_pci.tar.gz
$ make
```

### Copy module and add to kernel

```
$ sudo cp galilpci.ko /lib/modules/$(uname -r)
$ sudo depmod
$ sudo modprobe galilpci
```

### Add galil group for access to PCI

```
$ sudo groupadd -f -K GID_MIN=100 -K GID_MAX=499 galil
$ sudo cp 90-galilpci.rules /etc/udev/rules.d/
$ sudo udevadm control --reload-rules
$ sudo udevadm trigger
$ sudo usermod -a -G galil username #exchange "username" with actual user's name
```

Logout and back in. The PCI hardware is now available for access.

```
$ ls -l /dev/galil*
crw-rw---- 1 root galil 10, 56 Jun  9 11:07 /dev/galilpci0
$ echo -e "\x12\x16\r" > /dev/galilpci0
$ cat /dev/galilpci0
DMC1846 Rev 1.1a
:
```

## Documentation

The documentation is left as a tarball to minimize disk usage. The latest release version of the user manual is available at the following link.

- <http://www.galil.com/sw/pub/all/doc/gclib/html/>

### Offline html

The following allows viewing of the html docs from the installation.

```
$ tar -xzf /usr/share/doc/gclib/gclib_doc.tar.gz html
$ firefox html/index.html
```

## 2.3 Fedora Linux

### Tested versions

This version of Linux has **x64/AMD64 Support Only**. Contact Galil if another version is required for an application. See the [installation](#) page for supported versions.

### Installation

On Fedora, gclib and [gcaps](#) are distributed in RPM repositories. The following steps can be performed to install.

### Download Galil's repository information

Point a browser at <http://www.galil.com/sw/pub/fedora/galilrpm-3-1.noarch.rpm> and install the rpm. This installs Galil's RPM repositories and can be done from the terminal with the following.

```
$ wget http://www.galil.com/sw/pub/fedora/galilrpm-3-1.noarch.rpm
# rpm -Uvh galilrpm-3-1.noarch.rpm
```

### Install Packages

#### Install gclib

```
# yum install gclib
```

Approve "Installed size" and "Importing GPG key", if prompted.

#### Install gcaps (optional)

Following Linux's daemon naming conventions, gcaps is called *gcapsd* on Fedora. See the [gcaps](#) documentation for more information.

```
# yum install gcapsd
```

Verify that the systemd unit is running.

```
$ systemctl is-active gcapsd
active
```

### Uninstall Packages

If the packages need to be removed from the system, the following commands may be used.

#### Uninstall gclib

```
# yum remove gclib
```

#### Uninstall gcaps

```
# yum remove gcaps
```

## Serial Ports and USB

If access to the serial ports or USB (e.g. DMC-4103) is desired through gclib, the following will provide steps to join the correct access group. If using USB, be sure the controller is powered and the usb is plugged in before beginning.

### Determine group with access

```
$ ls -l /dev/ttyUSB* /dev/ttyS*
crw-rw----. 1 root dialout  4, 64 Mar  3 16:39 /dev/ttyS0
crw-rw----. 1 root dialout  4, 65 Mar  3 16:39 /dev/ttyS1
crw-rw----. 1 root dialout  4, 66 Mar  3 16:39 /dev/ttyS2
crw-rw----. 1 root dialout  4, 67 Mar  3 16:39 /dev/ttyS3
crw-rw----. 1 root dialout 188,  0 Mar  6 11:08 /dev/ttyUSB0
```

In the above listing, **dialout** is the group that needs to be joined. **uucp** is another common group that may be listed.

Add the desired *username* to the group.

```
$ sudo gpasswd -a username dialout
[sudo] password for username:
Adding user username to group dialout
```

Log out and back in for change to take effect.

```
$ groups
username wheel dialout
```

gclib can now connect to serial and usb devices from user *username*.

## PCI Controllers

If using a Galil PCI controller, the PCI driver must be installed.

### Install prerequisites

```
$ sudo yum install kernel-devel-$(uname -r)
$ sudo yum install kernel-headers-$(uname -r)
$ sudo yum install gcc
```

### Extract source and build driver

```
$ tar -xf /usr/share/doc/gclib/src/gclib_pci.tar.gz
$ make
```

### Copy module and add to kernel

```
$ sudo cp galilpci.ko /lib/modules/$(uname -r)
$ sudo depmod
$ sudo modprobe galilpci
```

### Add galil group for access to PCI

```
$ sudo groupadd -f -K GID_MIN=100 -K GID_MAX=499 galil
$ sudo cp 90-galilpci.rules /etc/udev/rules.d/
$ sudo udevadm control --reload-rules
$ sudo udevadm trigger
$ sudo usermod -a -G galil username #exchange "username" with actual user's name
```

Logout and back in. The PCI hardware is now available for access.

```
$ ls -l /dev/galil*
crw-rw---- 1 root galil 10, 56 Jun  9 11:07 /dev/galilpci0
$ echo -e "\x12\x16\r" > /dev/galilpci0
$ cat /dev/galilpci0
DMC1846 Rev 1.1a
:
```

## Documentation

The documentation is left as a tarball to minimize disk usage. The latest release version of the user manual is available at the following link.

- <http://www.galil.com/sw/pub/all/doc/gclib/html/>



### Offline html

The following allows viewing of the html docs from the installation.

```
$ tar -xzf /usr/share/doc/gclib/gclib_doc.tar.gz html
$ firefox html/index.html
```

## 2.4 Red Hat 7 & CentOS 7 Linux

### Tested versions

This version of Linux has **x64/AMD64 Support Only**. Contact Galil if another version is required for an application.

See the [installation](#) page for supported versions.

### Installation

On Red Hat, gclib and [gcaps](#) are distributed in RPM repositories. The following steps can be performed to install.

#### Download Galil's repository information

Point a browser at <http://www.galil.com/sw/pub/rhel/7/galilrpm-4-1.noarch.rpm> and install the rpm. This installs Galil's RPM repositories and can be done from the terminal with the following.

```
$ wget http://www.galil.com/sw/pub/rhel/7/galilrpm-4-1.noarch.rpm
# rpm -Uvh galilrpm-4-1.noarch.rpm
```

### Install Packages

#### Install gclib

```
# yum install gclib
```

Approve "Installed size" and "Importing GPG key", if prompted.

#### Install gcaps (optional)

Following Linux's daemon naming conventions, gcaps is called *gcapsd* on Red Hat. See the [gcaps](#) documentation for more information.

```
# yum install gcapsd
```

Verify that the systemd unit is running.

```
$ systemctl is-active gcapsd
active
```

### Uninstall Packages

If the packages need to be removed from the system, the following commands may be used.

#### Uninstall gclib

```
# yum remove gclib
```

#### Uninstall gcaps

```
# yum remove gcaps
```

## Serial Ports and USB

If access to the serial ports or USB (e.g. DMC-4103) is desired through gclib, the following will provide steps to join the correct access group. If using USB, be sure the controller is powered and the usb is plugged in before beginning.

### Determine group with access

```
$ ls -l /dev/ttyUSB* /dev/ttyS*
crw-rw----. 1 root dialout  4, 64 Mar  3 16:39 /dev/ttyS0
crw-rw----. 1 root dialout  4, 65 Mar  3 16:39 /dev/ttyS1
crw-rw----. 1 root dialout  4, 66 Mar  3 16:39 /dev/ttyS2
crw-rw----. 1 root dialout  4, 67 Mar  3 16:39 /dev/ttyS3
crw-rw----. 1 root dialout 188,  0 Mar  6 11:08 /dev/ttyUSB0
```

In the above listing, **dialout** is the group that needs to be joined. **uucp** is another common group that may be listed.

### Add the desired *username* to the group.

```
$ sudo gpasswd -a username dialout
[sudo] password for username:
Adding user username to group dialout
```

Log out and back in for change to take effect.

```
$ groups
username wheel dialout
```

gclib can now connect to serial and usb devices from user *username*.

## PCI Controllers

If using a Galil PCI controller, the PCI driver must be installed.

### Install prerequisites

```
# yum update kernel
```

### Reboot

```
# yum install kernel-devel-$(uname -r)
# yum install kernel-headers-$(uname -r)
# yum install gcc
```

### Extract source and build driver

```
$ tar -xf /usr/share/doc/gclib/src/gclib_pci.tar.gz
$ make
```

### Copy module and add to kernel

```
# cp galilpci.ko /lib/modules/$(uname -r)
# depmod
# modprobe galilpci
```

### Add galil group for access to PCI

```
# groupadd -f -K GID_MIN=100 -K GID_MAX=499 galil
# cp 90-galilpci.rules /etc/udev/rules.d/
# udevadm control --reload-rules
# udevadm trigger
# usermod -a -G galil username #exchange "username" with actual user's name
```

Logout and back in. The PCI hardware is now available for access.

```
$ ls -l /dev/galil*
crw-rw---- 1 root galil 10, 56 Jun  9 11:07 /dev/galilpci0
$ echo -e "\x12\x16\r" > /dev/galilpci0
$ cat /dev/galilpci0
DMC1846 Rev 1.1a
:
```

### Documentation

The documentation is left as a tarball to minimize disk usage. The latest release version of the user manual is available at the following link.

- <http://www.galil.com/sw/pub/all/doc/gclib/html/>

#### Offline html

The following allows viewing of the html docs from the installation.

```
$ tar -xzf /usr/share/doc/gclib/gclib_doc.tar.gz html
$ firefox html/index.html
```

## 2.5 Red Hat 6 & CentOS 6 Linux

### Tested versions

This version of Linux has **x64/AMD64 Support Only**. Contact Galil if another version is required for an application. See the [installation](#) page for supported versions.

### Installation

On Red Hat, gclib is distributed in an RPM repository. The following steps can be performed to install gclib.

#### Download Galil's repository information

This step installs Galil's RPM repositories and only needs to be done once.

Point a browser at <http://www.galil.com/sw/pub/rhel/6/galilrpm-2-1.noarch.rpm> and install the rpm.

#### Install Package

Install gclib package, approve "Installed size" and "Importing GPG key", if prompted.

```
# yum install gclib
```

## Uninstall Package

To uninstall gclib.

```
# yum remove gclib
```

## Serial Ports and USB

If access to the serial ports or USB (e.g. DMC-4103) is desired through gclib, the following will provide steps to join the correct access group. If using USB, be sure the controller is powered and the usb is plugged in before beginning.

### Determine group with access

```
$ ls -l /dev/ttyUSB* /dev/ttyS*
crw-rw----. 1 root dialout  4, 64 Mar  3 16:39 /dev/ttyS0
crw-rw----. 1 root dialout  4, 65 Mar  3 16:39 /dev/ttyS1
crw-rw----. 1 root dialout  4, 66 Mar  3 16:39 /dev/ttyS2
crw-rw----. 1 root dialout  4, 67 Mar  3 16:39 /dev/ttyS3
crw-rw----. 1 root dialout 188,  0 Mar  6 11:08 /dev/ttyUSB0
```

In the above listing, **dialout** is the group that needs to be joined. **uucp** is another common group that may be listed.

### Add the desired *username* to the group.

```
$ sudo gpasswd -a username dialout
[sudo] password for username:
Adding user username to group dialout
```

Log out and back in for change to take effect.

```
$ groups
username wheel dialout
```

gclib can now connect to serial and usb devices from user *username*.

## PCI Controllers

If using a Galil PCI controller, the PCI driver must be installed.

### Install prerequisites

```
# yum update kernel
```

### Reboot

```
# yum install kernel-devel-$(uname -r)
# yum install kernel-headers-$(uname -r)
# yum install gcc
```

### Extract source and build driver

```
$ tar -xf /usr/share/doc/gclib/src/gclib_pci.tar.gz
$ make
```

**Copy module and add to kernel**

```
# cp galilpci.ko /lib/modules/$(uname -r)
# depmod
# modprobe galilpci
```

**Add galil group for access to PCI**

```
# groupadd -f -K GID_MIN=100 -K GID_MAX=499 galil
# cp 90-galilpci.rules /etc/udev/rules.d/
# udevadm control --reload-rules
# udevadm trigger
# usermod -a -G galil username #exchange "username" with actual user's name
```

Logout and back in. The PCI hardware is now available for access.

```
$ ls -l /dev/galil*
crw-rw---- 1 root galil 10, 56 Jun  9 11:07 /dev/galilpci0
$ echo -e "\x12\x16\r" > /dev/galilpci0
$ cat /dev/galilpci0
DMC1846 Rev 1.1a
:
```

**Documentation**

The documentation is left as a tarball to minimize disk usage. The latest release version of the user manual is available at the following link.

- <http://www.galil.com/sw/pub/all/doc/gclib/html/>

**Offline html**

The following allows viewing of the html docs from the installation.

```
$ tar -xzf /usr/share/doc/gclib/gclib_doc.tar.gz html
$ firefox html/index.html
```

## 2.6 Raspberry Pi

**Tested versions**

See the [installation](#) page for supported versions.

**Installation****Create a temporary variable for OS version**

```
$ os=$(lsb_release -r -s)
$ echo $os
9.8
```

The number printed must be in the [installation](#) list of supported operating systems.

**Install Galil's public certificate**

```
$ wget http://www.galil.com/sw/pub/raspbian/$os/GALIL-PUB-KEY
$ sudo apt-key add GALIL-PUB-KEY
```

### Get Galil's apt sources list

```
$sudo wget http://www.galil.com/sw/pub/raspbian/$os/galil.list -O /etc/apt/sources.list.d/galil.list
$sudo apt-get update
```

### Install Package

```
$sudo apt-get install gclib
```

### Uninstall Package

To uninstall gclib.

```
$sudo apt-get remove gclib
```

## Serial Ports and USB

If access to the serial ports or USB (e.g. DMC-4103) is desired through gclib, the following will provide steps to join the correct access group. If using USB, be sure the controller is powered and the usb is plugged in before beginning.

### Determine group with access

```
$ ls -l /dev/ttyUSB* /dev/ttyS*
crw-rw----. 1 root dialout  4, 64 Mar  3 16:39 /dev/ttyS0
crw-rw----. 1 root dialout  4, 65 Mar  3 16:39 /dev/ttyS1
crw-rw----. 1 root dialout  4, 66 Mar  3 16:39 /dev/ttyS2
crw-rw----. 1 root dialout  4, 67 Mar  3 16:39 /dev/ttyS3
crw-rw----. 1 root dialout 188,  0 Mar  6 11:08 /dev/ttyUSB0
```

In the above listing, **dialout** is the group that needs to be joined. **uucp** is another common group that may be listed.

### Check the user's group

The default *pi* username is already a member of dialout.

```
$ groups
pi adm dialout cdrom sudo audio video plugdev games users input netdev gpio i2c spi
```

If needed, add the desired *username* to the group.

```
$ sudo gpasswd -a username dialout
[sudo] password for username:
Adding user username to group dialout
```

Log out and back in for change to take effect.

```
$ groups
username wheel dialout
```

gclib can now connect to serial and usb devices from user *username*.

## Documentation

The documentation is left as a tarball to minimize disk usage. The latest release version of the user manual is available at the following link.

- <http://www.galil.com/sw/pub/all/doc/gclib/html/>

### Offline html

The following allows viewing of the html docs from the installation, in the GUI mode.

```
$ tar -xzf /usr/share/doc/gclib/gclib_doc.tar.gz html
$ epiphany html/index.html
```

## 2.7 Apple OS X

### Tested versions

See the [installation](#) page for supported versions.

### Installation

On OS X, gclib is distributed in a dmg image. The following steps can be performed to install gclib.

#### Download the gclib dmg

- Open the dmg file and drag the gclib directory to the Applications alias or another installation location.

### Create Environment Variable (Optional)

- To provide maximum functionality, e.g. usage of the [Python](#) wrapper, add to the `DYLD_LIBRARY_PATH` by typing the following at a Terminal prompt.

```
$ echo "export DYLD_LIBRARY_PATH=/Applications/gclib/dylib/:\$DYLD_LIBRARY_PATH" >> ~/.profile
```

- Log Out and back in to set the environment variable.

### Make links for usb devices

If using the DMC4103 or another Galil USB product, symbolic links may be created so [GAddresses\(\)](#) can list the controllers.

Make a link from the Terminal.

```
user-mac:~ user$ #plug in DMC4103 usb cable
user-mac:~ user$ ls /dev/tty.usb*
/dev/tty.usbserial-A402L6KG
user-mac:~ user$ #make a symbolic link so gclib can list it
user-mac:~ user$ sudo ln -s /dev/tty.usbserial-A402L6KG /dev/tty.usbserial0
user-mac:~ user$ #gclib searches start at 0
user-mac:~ user$ #GAddresses() will now list this device
```

### Demonstrating with Python.

```
user-mac:~ user$ python
Python 2.7.10 (default, Jul 14 2015, 19:46:27)
[GCC 4.2.1 Compatible Apple LLVM 6.0 (clang-600.0.39)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> import gclib
>>> g = gclib.py()
```

```
>>> g.GAddresses()
{'/dev/tty.usbserial0': ''}
>>> g.GOpen("/dev/tty.usbserial0 -d")
>>> print(g.GInfo())
/dev/tty.usbserial0, DMC4143 Rev 1.2b, 9998
>>> g.GClose()
>>> exit()
user-mac:~ user$
```

## Installed files

- The gclib shared object files
  - /Applications/gclib/dylib/gclib.0.dylib
  - /Applications/gclib/dylib/gclibo.0.dylib
- The gclib header files
  - /Applications/gclib/include/gclib\_errors.h
  - /Applications/gclib/include/gclibo.h
  - /Applications/gclib/include/gclib.h
  - /Applications/gclib/include/gclib\_record.h
- gclib documentation tarball
  - /Applications/gclib/doc/gclib\_doc.tar.gz
- Example source tarball
  - /Applications/gclib/examples/gclib\_examples.tar.gz
- Source files to modify/rebuild libgclibo.so
  - /Applications/gclib/source/gclibo\_229\_src.tar.gz
- GalilTools Communication Library (gcl) wrapper
  - /Applications/gclib/source/gclib\_gcl.tar.gz

## Documentation

The documentation is left as a tarball to minimize disk usage. The latest release version of the user manual is available at the following link.

- <http://www.galil.com/sw/pub/all/doc/gclib/html/>

## Offline pdf

The following allows viewing of the pdf docs from the installation.

- Browse in the Finder to Applications/gclib/doc.
- Double-click the tar.gz file to extract it.
- Open the resultant directory.
- Open the pdf.



### Offline html

The following allows viewing of the html docs from the installation.

- Browse in the Finder to Applications/gclib/doc.
- Double-click the tar.gz file to extract it.
- Open the resultant directory.
- Open the html directory.
- Double-click index.html to open the help.



## Chapter 3

# Language Support

Below are a number of examples demonstrating how to use the library with various languages and on various platforms.

- [C/C++](#)
- [Python](#)
- [.Net](#)
- [Java](#)

Can't find what you need? Please email [softwaresupport@galil.com](mailto:softwaresupport@galil.com), or call [Galil Applications](#).

### 3.1 C/C++

- [Microsoft Visual Studio 2015 \(14.0\)](#)
- [Microsoft Visual Studio 2013 \(12.0\)](#)
- [MinGW](#)
- [Borland C++](#)
- [gcc \(Linux\)](#)
- [clang \(OS X\)](#)

#### 3.1.1 Microsoft Visual Studio 2015 (14.0)

For brevity, these instructions assume the default installation location of **C:\Program Files (x86)\Galil\gclib**.

**x\_simple.c** from *VS2015 x64 Native Tools Command Prompt*

Open *VS2015 x64 Native Tools Command Prompt*.

Copy files

Navigate to a convenient, empty, writable location.

Set an environment variable for the base path.

```
>set base=C:\Program Files (x86)\Galil\gclib
```

Copy simple example

```
>copy "%base%\examples\cpp\x_simple.c" .
```

Edit [GOpen\(\)](#) call as necessary

In a text editor, open *x\_simple.c*. Find the [GOpen\(\)](#) call and update the address to match the desired hardware. See the documentation for [GOpen\(\)](#) for address formatting options.

Compile

```
>cl x_simple.c "%base%\lib\dynamic\x64\*.lib" -I "%base%\include"
```

Set Path to DLL

```
>set PATH=%base%\dll\x64\;%PATH%
```

Execute

```
>x_simple.exe
version: 211.211.211 1.0.0.128
info: 192.168.0.42, DMCC640 Rev 1.0g, 9999
response: 3757802.0000
:
```

## Using the pre-configured MSVC project (x\_examples.cpp)

The directory *gclib\examples\msvc* has fully functional MSVC examples. These instructions detail how to use the 2013 version.

- Copy *gclib\examples\msvc\2015\_14.0\gclib\_example* to a convenient, writable location.
- Run *gclib\_example\gclib\_example\copy\_source.bat* to copy the files.
- Open *gclib\_example\gclib\_example.sln* in Visual Studio 2015.
- In the *Solution Explorer*, expand the *gclib\_example* and expand *Source Files* to show a listing of source.
- Open *x\_examples.cpp*.
- Find the [GOpen\(\)](#) call and update the address to match the desired hardware. See the documentation for [GOpen\(\)](#) for address formatting options.
- Find the `#if 0` preprocessor block enclosing the example calls. Change to `#if 1` to run the examples. Comment out the function calls to be avoided. Note some calls attempt to move motors and not all functions are compatible with all Galil products.
- Hit *F5* to build and run the example.

### Create Project with MSVC 2015 (x\_examples.cpp)

The instructions below allow building a project from scratch.

The following instructions were performed on *Visual Studio Professional 2015* and can be extended to other Visual Studio versions. For brevity, the instructions assume the default installation location of **C:\Program Files (x86)\Galil\gclib** and a build type of **x64**.

- Launch *Visual Studio 2015*.
- Choose *File->New->Project*.
- In the *New Project* dialog, choose *Visual C++->Empty Project*.
- Choose a Name, e.g. **gclib\_example**.
- Choose a Location, e.g. *C:\Users\user\Desktop*.
- Check *Create directory for solution*.
- Click *OK*.
- In the *Solution Explorer*, right-click on *Source Files* and choose *Add->Existing Item*.
  - Navigate to the gclib installation directory, then to *examples\cpp* in the installation directory.
  - In *File Name* type **x\_\*.cpp** and click *Add*, this will filter out the files needed
  - Select all files in the file chooser and click *Add*.
- In the *Solution Explorer* right-click on *gclib\_example*, choose *Properties*.
  - Click the *Configuration Manager...* button.
    - \* Under *Active solution platform*: choose **x64**.
    - \* Click *Close*.
  - Highlight *Configuration Properties* in the side bar, and set the following project properties.
    - \* At the top of the window, change *Configuration:* to *All Configurations* and ensure *Platform* lists *Active(x64)*.
    - \* *Configuration Properties -> C/C++ -> Additional Include Directories* add **C:\Program Files (x86)\Galil\gclib\include**
    - \* *Configuration Properties -> Linker -> General -> Additional Library Directories* add **C:\Program Files (x86)\Galil\gclib\lib\dynamic\x64**
    - \* *Configuration Properties -> Linker -> Input -> Additional Dependencies* add **gclib.lib;gclibo.lib;{rest of text}** where {rest of text} is the original string that was in the cell. Note the semicolons between library files.
    - \* *Configuration Properties -> Debugging -> Environment* add **PATH=C:\Program Files (x86)\Galil\gclib\dll\x64;%PATH%**
    - \* Click *OK*.
- In the *Solution Explorer* open *x\_examples.cpp*. Find the **GOpen()** call and update the address to match the desired hardware. See the documentation for **GOpen()** for address formatting options.
- Find the **#if 0** preprocessor blocks enclosing the example calls. Change to **#if 1** to run the examples. Comment out the function calls to be avoided. Note some calls attempt to move motors and not all functions are compatible with all Galil products.
- Hit *F5* to build and run the example.

#### 3.1.2 Microsoft Visual Studio 2013 (12.0)

For brevity, these instructions assume the default installation location of **C:\Program Files (x86)\Galil\gclib**.

### **x\_simple.c from VS2013 x64 Native Tools Command Prompt**

Open *VS2013 x64 Native Tools Command Prompt*.

#### **Copy files**

Navigate to a convenient, empty, writable location, e.g. *C:\temp*.

**Set an environment variable for the base path.**

```
C:\temp>set base=C:\Program Files (x86)\Galil\gclib
```

#### **Copy simple example**

```
C:\temp>copy "%base%\examples\cpp\x_simple.c" .
```

#### **Edit [GOpen\(\)](#) call as necessary**

In a text editor, open *x\_simple.c*. Find the [GOpen\(\)](#) call and update the address to match the desired hardware. See the documentation for [GOpen\(\)](#) for address formatting options.

#### **Compile**

```
C:\temp>cl x_simple.c "%base%\lib\dynamic\x64\*.lib" -I "%base%\include"
```

#### **Set Path to DLL**

```
C:\temp>set PATH=%base%\dll\x64;%PATH%
```

#### **Execute**

```
C:\temp>x_simple.exe
rc: 0
version: 85.60.138
rc: 0
rc: 0
info: 10.1.3.17, DMC4020 Rev 1.2b, 291
rc: 0
response: 357247808.0000
:
```

### **Using the pre-configured MSVC project (x\_examples.cpp)**

The directory *gclib\examples\msvc* has fully functional MSVC examples. These instructions detail how to use the 2013 version.

- Copy *gclib\examples\msvc\2013\_12.0\gclib\_example* to a convenient, writable location, e.g. *C:\temp*.
- Run *gclib\_example\gclib\_example\copy\_source.bat* to copy the files.
- Open *gclib\_example\gclib\_example.sln* in Visual Studio 2013.
- In the *Solution Explorer*, expand the *gclib\_example* and expand *Source Files* to show a listing of source.
- Open *x\_examples.cpp*
- Find the [GOpen\(\)](#) call and update the address to match the desired hardware. See the documentation for [GOpen\(\)](#) for address formatting options.

- Find the `#if 0` preprocessor block enclosing the example calls. Change to `#if 1` to run the examples. Comment out the function calls to be avoided. Note some calls attempt to move motors and not all functions are compatible with all Galil products.
- Hit *F5* to build and run the example.

### Create Project with MSVC 2013 (x\_examples.cpp)

The instructions below allow building a project from scratch.

The following instructions were performed on *Visual Studio Professional 2013* and can be extended to other Visual Studio versions. For brevity, the instructions assume the default installation location of **C:\Program Files (x86)\Galil\gclib** and a build type of **x86 (win32)**.

- Launch *Visual Studio 2013*
- Choose *File->New->Project*
- In the *New Project* dialog, choose *Visual C++->Empty Project*
- Choose a Name, e.g. **gclib\_example**
- Choose a Location, e.g. *C:\Users\user\Desktop*
- Check *Create directory for solution*
- Click *OK*
- In the *Solution Explorer*, right-click on *Source Files* and choose *Add->Existing Item*
  - Navigate to the gclib installation directory, then to *examples\cpp* in the installation directory
  - In *File Name* type **x\_\*.cpp** and click *Add*, this will filter out the files needed
  - Select all files in the file chooser and click *Add*
- In the *Solution Explorer* right-click on *gclib\_example*, choose *Properties*, highlight *Configuration Properties*, and set the following project properties
  - At the top of the window, change *Configuration:* to *All Configurations* and ensure *Platform* lists *Active* (Win32)
  - *Configuration Properties -> C/C++ -> Additional Include Directories* add **C:\Program Files (x86)\Galil\gclib\include**
  - *Configuration Properties -> Linker -> General -> Additional Library Directories* add **C:\Program Files (x86)\Galil\gclib\lib\dynamic\x86**
  - *Configuration Properties -> Linker -> Input -> Additional Dependencies* add **gclib.lib;gclibo.lib**;{rest of text} where {rest of text} is the original string that was in the cell. Note the semicolons between library files.
  - *Configuration Properties -> Debugging -> Environment* add **PATH=C:\Program Files (x86)\Galil\gclib\dl\x86;%PATH%**
- In the *Solution Explorer* open *x\_examples.cpp*. Find the **GOpen()** call and update the address to match the desired hardware. See the documentation for **GOpen()** for address formatting options.
- Find the `#if 0` preprocessor block enclosing the example calls. Change to `#if 1` to run the examples. Comment out the function calls to be avoided. Note some calls attempt to move motors and not all functions are compatible with all Galil products.
- Hit *F5* to build and run the example.

### 3.1.3 MinGW

The following instructions were performed with x86 Minimalist GNU for Windows (MinGW) installed from <http://mingw-w64.sourceforge.net/download.php#mingw-builds>

For brevity, these instructions assume the default installation location of "C:\Program Files (x86)\Galil\gclib".

#### Copy Files

Copy "gclib\examples\mingw" to a convenient, writable location, e.g. "C:\temp". Run `C:\temp\mingw\copy_source.bat` to copy all files.

#### x\_simple.c

Edit `GOpen()` call as necessary

In a text editor, open `x_simple.c`. Find the `GOpen()` call and update the address to match the desired hardware. See the documentation for `GOpen()` for address formatting options.

#### Compile

- Launch the MinGW terminal, e.g. *Start -> All Programs -> MinGW-W64 project -> i686-4.9.1-posix-dwarf-rt\_v3-rev3 -> Run Terminal*.
- Navigate to the directory with the files above.
- Compile the code.

```
C:\temp\mingw>gcc x_simple.c -L. -lgclibo -lgclib -o simple.exe
```

#### Execute

```
C:\temp\mingw>simple.exe
rc: 0
version: 85.60.138
rc: 0
rc: 0
info: 10.1.3.17, DMC4020 Rev 1.2b, 291
rc: 0
response: 1584328.0000
:
```

#### x\_examples.cpp

##### Review and Modify source

- In a text editor, open `x_examples.cpp`. Find the `GOpen()` call and update the address to match the desired hardware. See the documentation for `GOpen()` for address formatting options.
- Find the `#if 0` preprocessor block enclosing the example calls. Change to `#if 1` to run the examples. Comment out the function calls to be avoided. Note some calls attempt to move motors and not all functions are compatible with all Galil products.



## Compile

- Launch the MinGW terminal, e.g. *Start -> All Programs -> MinGW-W64 project -> i686-4.9.1-posix-dwarf-rt\_v3-rev3 -> Run Terminal.*
- Navigate to the directory with the files above.
- Compile the code.

```
C:\temp\mingw>g++ *.cpp -L. -lgclibo -lgclib -o examples.exe
```

## Execute

```
C:\temp\mingw>examples.exe
```

```
Library version: 41.35.34
```

```
192.168.0.43, DMC4020 Rev 1.2b, 291
```

```
*****
Example GRead() and GWrite() usage
*****
```

```
Read 155 QR bytes.
```

```
*****
Example GCommand() usage
*****
Revision report, ^R^V
DMC4020 Rev 1.2b
:
```

```
Command Values
```

```
val is 10
val is 11
val is 3.1415
val is 9.869
```

```
Command Trimming
```

```
> 95653016.0000
:<
> 95653016.0000<
>95653016.0000<
```

```
Receiving Binary Data
```

```
QR read 155 bytes
```

```
Error handling
```

```
QD correctly trapped, not allowed, try GArrayDownload()
DL correctly trapped, not allowed, try GProgramDownload()
```

```
Modifying timeout
```

```
Burning program...OK
```

```
*****
Example GProgramDownload() and GProgramUpload() usage
*****
GProgramDownload() correctly errored. Can't fit with level 3 compression
Program Downloaded with compression level 4
Uploading program:
#A;i=0;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i
i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;EN
```

```
Program executed as expected
```

```
*****
Example GArrayDownload() and GArrayUpload() usage
*****
2.0000, 4.0000, 6.0000, 8.0000, 10.0000, 12.0000, 14.0000, 16.0000, 18.000
0000
```

```
2.0000, 1.0000, 3.0000, 5.0000, 10.0000, 12.0000, 14.0000, 16.0000, 18.0000
0000
```

```
3.0000, 5.0000, 10.0000
```

```
*****
Example GRecord() usage
*****
```

```
QR-based data record
38564
393216000
```

```
DR-based data record
38670
38772
38874
38976
39078
39180
39282
39384
39486
39588
39690
```

```
QR-based data record with offsets
39692
39692
```

```
*****
Example GMessage() usage
*****
```

```
0.0000
1.0000
2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
9.0000
```

```
*****
Example GInterrupt() usage
*****
"UI 8" executed.
```

```
*****
Example GMotionComplete() usage
*****
```

```
Position: 0, 0
Beginning independent motion... Motion Complete on A
Position: 8000, 0
```

```
Position: 0, 0
Beginning vector motion... Motion Complete on vector plane S
Position: 6000, 0
```

```
examples.cpp executed OK
main() is finished. Press Enter to exit:
```

### 3.1.4 Borland C++

The following instructions were performed on:

Embarcadero C++ 7.10 for Win32 Copyright (c) 1993-2015 Embarcadero Technologies, Inc.

For brevity, these instructions assume the default installation location of "C:\Program Files (x86)\Galil\gclib".

## Copy Files

Copy "gclib\examples\borland" to a convenient, writable location, e.g. "C:\temp". Run `C:\temp\borland\copy←_source.bat` to copy all files.

```
C:\temp>cd borland

C:\temp\borland>copy_source.bat
\Program Files (x86)\Galil\gclib\examples\cpp\x_arrays.cpp
\Program Files (x86)\Galil\gclib\examples\cpp\x_examples.cpp
\Program Files (x86)\Galil\gclib\examples\cpp\x_examples.h
\Program Files (x86)\Galil\gclib\examples\cpp\x_gcommand.cpp
\Program Files (x86)\Galil\gclib\examples\cpp\x_ginterrupt.cpp
\Program Files (x86)\Galil\gclib\examples\cpp\x_gmessage.cpp
\Program Files (x86)\Galil\gclib\examples\cpp\x_gmotioncomplete.cpp
\Program Files (x86)\Galil\gclib\examples\cpp\x_gread_gwrite.cpp
\Program Files (x86)\Galil\gclib\examples\cpp\x_grecord.cpp
\Program Files (x86)\Galil\gclib\examples\cpp\x_nonblocking.cpp
\Program Files (x86)\Galil\gclib\examples\cpp\x_programs.cpp
\Program Files (x86)\Galil\gclib\examples\cpp\x_simple.c
    12 file(s) copied.
\Program Files (x86)\Galil\gclib\include\gclib.h
\Program Files (x86)\Galil\gclib\include\gclibo.h
\Program Files (x86)\Galil\gclib\include\gclib_errors.h
\Program Files (x86)\Galil\gclib\include\gclib_record.h
    4 file(s) copied.
\Program Files (x86)\Galil\gclib\lib\dynamic\x86\gclib.lib
\Program Files (x86)\Galil\gclib\lib\dynamic\x86\gclibo.lib
    2 file(s) copied.
\Program Files (x86)\Galil\gclib\dll\x86\gclib.dll
\Program Files (x86)\Galil\gclib\dll\x86\gclibo.dll
    2 file(s) copied.

C:\temp\borland>
```

## Modify Path

- Add Borland's compiler to the PATH variable.

```
C:\temp\borland>set PATH=c:\Program Files (x86)\Embarcadero\Studio\17.0\bin;%PATH%
```

## Convert lib files

```
C:\temp\borland>move gclib.lib _gclib.lib
    1 file(s) moved.

C:\temp\borland>move gclibo.lib _gclibo.lib
    1 file(s) moved.

C:\temp\borland>coff2omf.exe _gclib.lib gclib.lib
COFF to OMF Converter Version 1.2.0 Copyright (c) 1999-2009 Embarcadero Technologies, Inc.
All rights reserved.

C:\temp\borland>coff2omf.exe _gclibo.lib gclibo.lib
COFF to OMF Converter Version 1.2.0 Copyright (c) 1999-2009 Embarcadero Technologies, Inc.
All rights reserved.
```

## x\_simple.c

**Edit `GOpen()` call as necessary**

In a text editor, open `x_simple.c`. Find the `GOpen()` call and update the address to match the desired hardware. See the documentation for `GOpen()` for address formatting options.

**Compile**

```
C:\temp\borland>bcc32 gclib.lib gclibo.lib x_simple.c
Embarcadero C++ 7.10 for Win32 Copyright (c) 1993-2015 Embarcadero Technologies, Inc.
x_simple.c:
Turbo Incremental Link 6.72 Copyright (c) 1997-2015 Embarcadero Technologies, Inc.
```

**Execute**

```
C:\temp\borland>x_simple.exe
version: 130.115.279
info: 192.168.0.43, DMC4143 Rev 1.2b, 9998
response: 61016.0000
:
```

**x\_examples.cpp****Review and Modify source**

- In a text editor, open `x_examples.cpp`. Find the `GOpen()` call and update the address to match the desired hardware. See the documentation for `GOpen()` for address formatting options.
- Find the `#if 0` preprocessor block enclosing the example calls. Change to `#if 1` to run the examples. Comment out the function calls to be avoided. Note some calls attempt to move motors and not all functions are compatible with all Galil products.

**Compile**

```
C:\temp\borland>bcc32 -c *.cpp
```

**Link**

```
C:\temp\borland>bcc32 -o examples.exe *.obj gclib.lib gclibo.lib
```

**Execute**

```
C:\temp\borland>examples.exe
Library version: 130.115.279

192.168.0.43, DMC4020 Rev 1.2b, 291

*****
Example GRead() and GWrite() usage
*****

Read 155 QR bytes.

*****
Example GCommand() usage
*****
Revision report, ^R^V
DMC4020 Rev 1.2b
:
```



```

2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
9.0000

*****
Example GInterrupt() usage
*****
"UI 8" executed.

*****
Example GMotionComplete() usage
*****

Position: 0, 0
Beginning independent motion... Motion Complete on A
Position: 8000, 0

Position: 0, 0
Beginning vector motion... Motion Complete on vector plane S
Position: 6000, 0

examples.cpp executed OK
main() is finished. Press Enter to exit:

```

### 3.1.5 gcc (Linux)

The following instructions were performed on

```

$ uname -a
Linux localhost.localdomain 3.17.4-301.fc21.x86_64 #1 SMP Thu Nov 27 19:09:10 UTC 2014 x86_64 x86_64 x86_64 GNU/Linux
$ g++ --version
g++ (GCC) 4.9.2 20150212 (Red Hat 4.9.2-6)

```

### Copy Files

```

$ mkdir test
$ cd test
$ tar -xzf /usr/share/doc/gclib/src/gclib_examples.tar.gz
$ ls
x_arrays.cpp      x_gcommand.cpp    x_gmotioncomplete.cpp  x_programs.cpp
x_examples.cpp    x_ginterrupt.cpp  x_gread_gwrite.cpp     x_simple.c
x_examples.h      x_gmessage.cpp    x_grecord.cpp

```

### x\_simple.c

- In a text editor, open `x_simple.c`. Find the `GOpen()` call and update the address to match the desired hardware. See the documentation for `GOpen()` for address formatting options.

### Compile

```
$ gcc -Wall -Werror x_simple.c -lgclib -lgclibo -o simple
```

### Run

```

$ ./simple
rc: 0
version: 85.60.131

```

```
rc: 0
rc: 0
info: 10.1.3.17, DMC4020 Rev 1.2b, 291
rc: 0
response: 179340166.0000
:
```

### x\_examples.cpp

- In a text editor, open *x\_examples.cpp*. Find the `GOpen()` call and update the address to match the desired hardware. See the documentation for `GOpen()` for address formatting options. Don't forget `-s ALL` if data records, interrupts, and messages are to be tested.
- Find the `#if 0` preprocessor block enclosing the example calls. Change to `#if 1` to run the examples. Comment out the function calls to be avoided. Note some calls attempt to move motors and not all functions are compatible with all Galil products.

### Compile

```
$ g++ x_*.cpp -lgclib -lgclibo -o example
```

### Run

```
$/example Library version: 85.60.131
```

```
10.1.3.17, DMC4020 Rev 1.2b, 291
```

```
*****
Example GRead() and GWrite() usage
*****
```

```
Read 155 QR bytes.
```

```
*****
Example GCommand() usage
*****
Revision report, ^R^V
DMC4020 Rev 1.2b
:
```

```
Command Values
val is 10
val is 11
val is 3.1415
val is 9.869
```

```
Command Trimming
> 179798738.0000
:<
> 179798738.0000<
>179798738.0000<
```

```
Receiving Binary Data
QR read 155 bytes
```

```
Error handling
QD correctly trapped, not allowed, try GArrayDownload()
DL correctly trapped, not allowed, try GProgramDownload()
```

```
Modifying timeout
Burning program...OK
```

```
*****
Example GProgramDownload() and GProgramUpload() usage
*****
GProgramDownload() correctly errored. Can't fit with level 3 compression
```





```
examples.cpp executed OK
main() is finished. Press Enter to exit:
```

### 3.1.6 clang (OS X)

The following instructions were performed on

```
$ sw_vers
ProductName:  Mac OS X
ProductVersion: 10.10.5
BuildVersion: 14F27
$ gcc --version
Configured with: --prefix=/Library/Developer/CommandLineTools/usr --with-gxx-include-dir=/usr/include/c++/4.2.1
Apple LLVM version 6.1.0 (clang-602.0.53) (based on LLVM 3.6.0svn)
Target: x86_64-apple-darwin14.5.0
Thread model: posix
```

### Copy Files

```
$ cd ~
$ mkdir test
$ cd test
$ tar -xzf /Applications/gclib/examples/gclib_examples.tar.gz
$ cp /Applications/gclib/include/* .
$ cp /Applications/gclib/dylib/* .
$ ls
gclib.0.dylib  x_arrays.cpp      x_gmotioncomplete.cpp
gclib.h        x_examples.cpp    x_gread_gwrite.cpp
gclib_errors.h x_examples.h      x_grecord.cpp
gclib_record.h x_gcommand.cpp    x_nonblocking.cpp
gclibo.0.dylib x_ginterrupt.cpp  x_programs.cpp
gclibo.h       x_gmessage.cpp    x_simple.c
```

### x\_simple.c

- In a text editor, open *x\_simple.c*. Find the [GOpen\(\)](#) call and update the address to match the desired hardware. See the documentation for [GOpen\(\)](#) for address formatting options.

### Compile

```
$ gcc -Wall -Werror x_simple.c gclib.0.dylib gclibo.0.dylib -o simple
```

### Run

```
$ ./simple
rc: 0
version: 126.108.229
rc: 0
rc: 0
info: 10.1.3.142, DMC4020 Rev 1.2a-BH, 291
rc: 0
response: 206676.0000
:
```

**x\_examples.cpp**

- In a text editor, open *x\_examples.cpp*. Find the [GOpen\(\)](#) call and update the address to match the desired hardware. See the documentation for [GOpen\(\)](#) for address formatting options. Don't forget `-s ALL` if data records, interrupts, and messages are to be tested.
- Find the `#if 0` preprocessor block enclosing the example calls. Change to `#if 1` to run the examples. Comment out the function calls to be avoided. Note some calls attempt to move motors and not all functions are compatible with all Galil products.

**Compile**

```
$ g++ x_*.cpp gclib.0.dylib gclibo.0.dylib -o example
```

**Run**

```
$ ./example
Library version: 126.108.229

10.1.3.142, DMC4020 Rev 1.2a-BH, 291

*****
Example GRead() and GWrite() usage
*****

Read 1 byte(s)
:
Program test OK.

*****
Example GCommand() usage
*****
Revision report, ^R^V
DMC4020 Rev 1.2a-BH
:

Command Values
val is 10
val is 11
val is 3.1415
val is 9.869

Command Trimming
> 408978.0000
:<
> 408978.0000<
>408978.0000<

Receiving Binary Data
QR read 155 bytes

Error handling
QD correctly trapped, not allowed, try GArrayDownload()
DL correctly trapped, not allowed, try GProgramDownload()

Modifying timeout
Burning program...OK

*****
Example GProgramDownload() and GProgramUpload() usage
*****
GProgramDownload() correctly errored. Can't fit with level 3 compression
Program Downloaded with compression level 4
Uploading program:
#A;i=0;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1
i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;EN

Program executed as expected
```

```

*****
Example GArrayDownload(), GArrayUploadFile()
GArrayDownloadFile(), and GArrayUpload usage
*****
2.0000, 4.0000, 6.0000, 8.0000, 10.0000, 12.0000, 14.0000, 16.0000, 18.0000, 20.0000

2.0000, 1.0000, 3.0000, 5.0000, 10.0000, 12.0000, 14.0000, 16.0000, 18.0000, 20.0000

3.0000, 5.0000, 10.0000
2.0000, 1.0000, 3.0000, 5.0000, 10.0000, 12.0000, 14.0000, 16.0000, 18.0000, 20.0000

*****
Example GRecord() usage
*****

QR-based data record
18358
0

DR-based data record
18462
18564
18666
18768
18870
18972
19074
19176
19278
19380
19482

QR-based data record with offsets
19482
19482

*****
Example GMessage() usage
*****
0.0000
1.0000
2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
9.0000

*****
Example GInterrupt() usage
*****
"UI 8" executed.

*****
Example GMotionComplete() usage
*****

Position: 0, 0
Beginning independent motion... Motion Complete on A
Position: 8000, 0

Position: 0, 0
Beginning vector motion... Motion Complete on vector plane S
Position: 6000, 0

*****
Example GMessage non-blocking usage
*****
422902.0000

```

```

*****
Example GInterrupt non-blocking usage
*****
F1

*****
Example GRecord non-blocking usage
*****
33786

examples.cpp executed OK
main() is finished. Press Enter to exit:

```

## 3.2 Python

### Install gclib

The gclib Python wrapper assumes the default gclib [installation](#) location.

### Install Python

- See <https://www.python.org/> if Python is not already installed on the system. The gclib Python wrapper supports Python versions 2 and 3.
- On Windows, choose to add Python to the environment variable during installation. This allows Python to be invoked from the command line.

### Install the gclib Python module

#### Windows

- Type the following commands into a command prompt.

```

>cd %temp%
>mkdir py
>cd py
>copy "c:\Program Files (x86)\Galil\gclib\source\wrappers\python\*" .
c:\Program Files (x86)\Galil\gclib\source\wrappers\python\gclib.py
c:\Program Files (x86)\Galil\gclib\source\wrappers\python\setup.py
2 file(s) copied.
>copy "c:\Program Files (x86)\Galil\gclib\examples\python\*" .
c:\Program Files (x86)\Galil\gclib\examples\python\example.py
1 file(s) copied.
>python setup.py install
running install
running build
running build_py
creating build
creating build\lib
copying gclib.py -> build\lib
running install_lib
running install_egg_info
Removing C:\Users\user\AppData\Local\Programs\Python\Python37-32\Lib\site-packages\gclib-1.0-py3.7.egg-info
Writing C:\Users\user\AppData\Local\Programs\Python\Python37-32\Lib\site-packages\gclib-1.0-py3.7.egg-info

```

- The gclib Python wrapper is now installed. Go to the next section, **Using gclib from the Python Interpreter**.

#### Linux

- Type the following commands into a terminal prompt.

```
$ mkdir ~/py
$ cd ~/py
$ tar -xvf /usr/share/doc/gclib/src/gclib_python.tar.gz
gclib.py
setup.py
$ tar -xvf /usr/share/doc/gclib/src/gclib_python_examples.tar.gz
example.py
$ sudo python setup.py install
[sudo] password for user:
running install
running build
running build_py
creating build
creating build/lib
copying gclib.py -> build/lib
running install_lib
copying build/lib/gclib.py -> /usr/lib/python2.7/site-packages
byte-compiling /usr/lib/python2.7/site-packages/gclib.py to gclib.pyc
running install_egg_info
Writing /usr/lib/python2.7/site-packages/gclib-1.0-py2.7.egg-info
```

- The gclib Python wrapper is now installed. Go to the next section, **Using gclib from the Python Interpreter**.

## OS X

- Be sure that the *Create Environment Variable* step has been followed in the [OS X](#) installation instructions.
- Type the following commands into a Terminal prompt.

```
$ mkdir ~/python_temp
$ cd ~/python_temp/
$ tar -xvf /Applications/gclib/source/gclib_python.tar.gz
x gclib.py
x setup.py
$ tar -xvf /Applications/gclib/examples/gclib_python_examples.tar.gz
x example.py
$ sudo python setup.py install
running install
running build
running build_py
creating build
creating build/lib
copying gclib.py -> build/lib
running install_lib
copying build/lib/gclib.py -> /Library/Python/2.7/site-packages
byte-compiling /Library/Python/2.7/site-packages/gclib.py to gclib.pyc
running install_egg_info
Writing /Library/Python/2.7/site-packages/gclib-1.0-py2.7.egg-info
```

- The gclib Python wrapper is now installed. Go to the next section, **Using gclib from the Python Interpreter**.

## Using gclib from the Python Interpreter

- Invoke the [Python Interpreter](#).
- Type the following into the Python prompt.

```
>>> import gclib
>>> g = gclib.py()
>>> g.GOpen('192.168.0.42 --direct')
>>> print(g.GInfo())
192.168.0.42, DMC4080 Rev 1.2c, 783
```

## Running Python scripts

- Navigate the terminal to the location from **Install the gclib Python module** where `example.py` was copied.
- Open `example.py` in a text editor.
- Set the address in the `g.GOpen()` call to match an available connection.
- Execute the following command at the Terminal.

```
$ python example.py
gclib version: py.127.110.250
192.168.0.42, DMC4080 Rev 1.2c, 783
```

- Experiment with the example by uncommenting sections, between the triple quotes, "".

```
$ python example.py
gclib version: py.127.110.250
192.168.0.42, DMC4080 Rev 1.2c, 783
GProgramDownload() correctly errored. Can't fit with level 3 compression
Uploaded program:
#A;i=0;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1
i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;i=i+1;EN
Downloaded program verified
Array element verified
  187942.0000

Starting move...
done.
```

## Getting help

```
>>> help(g.GOpen)
Help on method GOpen in module gclib:
```

```
GOpen(address) method of gclib.py instance
  Opens a connection a galil controller.
  See the gclib docs for address string formatting.
  See Link GOpen() <http://www.galil.com/sw/pub/all/doc/gclib/html/gclib\_8h\_aef4aec8a85630eed029b7a46aea7db5>
```

```
>>> help(g.GCommand)
Help on method GCommand in module gclib:
```

```
GCommand(command) method of gclib.py instance
  Performs a command-and-response transaction on the connection.
  Trims the response.
  See Link GCommand() <http://www.galil.com/sw/pub/all/doc/gclib/html/gclib\_8h\_a5ac031e76efc965affdd73a1bec0>
```

```
>>> 'for a full listing, try help(g)'
```

## 3.3 .Net

- [VB.NET](#)
- [C#.NET](#)

### 3.3.1 VB.NET

`gclib` ships with `gclib.vb`, a Visual Basic class which exposes the functionality of the `gclib`. In addition, a VB forms example is included which demonstrates how to use `gclib.vb`. The following instructions were performed on Visual Studio Professional 2013 and can be extended to other Visual Studio versions.

## Running the included Visual Basic Example

For brevity, these instructions assume the default installation location of **C:\Program Files (x86)\Galil\gclib**.

### Copy files

- Navigate to a convenient, empty, writable location, e.g. *C:\temp*.
- Copy the contents of *C:\Program Files (x86)\Galil\gclib\examples\vb\2013\_12.0\gclib\_example* to this location.

### Open in Microsoft Visual Studio 2013

- Open *gclib\_example.sln* in Visual Studio. This demo was tested on MSVS 2013.

### Add existing item, *gclib.vb*

- In the *Solution Explorer*, right-click on *gclib\_example* and choose *Add->Existing Item...*
- Choose *C:\Program Files (x86)\Galil\gclib\source\wrappers\vb\gclib.vb*

### Run Demo

- Type *F5* to run the program.
- Type a valid [GOpen\(\)](#) address in the text box and click Go.

## Create Project from scratch with MSVC 2013

For brevity, these instructions assume the default installation location of **C:\Program Files (x86)\Galil\gclib**.

### Configure Project

- Launch Visual Studio 2013
- Choose *File->New->Project*
- In the *New Project* dialog, choose *Visual Basic -> Windows Forms Application*
- Type *gclib\_example* for the Name
- Choose a Location, e.g. *C:\Users\user\Desktop*
- Check *Create directory for solution*
- Click OK, the project will configure itself
- In the *Solution Explorer*, right click on *Solution 'gclib\_example' (1 project)* and choose *Configuration Manager...*
  - In the *gclib\_example* project row, click in the *Platform* column and choose *<New...>*
    - \* Choose *x86* from *Type or select the new platform:*
    - \* Choose *Any CPU* from *Copy settings from:*
    - \* Check *Create new solutions platform*
    - \* Click OK.
  - If x64 support is also desired, repeat the *<New...>* procedure for *x64*

- In the *Active solution platform* combobox at the top of the *Configuration Manager* dialog, choose <Edit...>
  - \* Select *Any CPU* and click the *Remove* button
  - \* Click *Close*
- Close the *Configuration Manager* dialog
- In the *Solution Explorer*, right-click on *gclib\_example* and choose Add->Existing Item
  - Navigate to the installation location C:\Program Files (x86)\Galil\gclib\source\wrappers\vb
  - Choose *gclib.vb*
- In the *Solution Explorer* double-click on *gclib.vb*
  - Note that there is a preprocessor definition starting with `#if PLATFORM = "x86" Then` and `#ElseIf PLATFORM = "x64" Then`
  - Note that these sections of code enable/disable with the choice of the *Solution Platform* x86/x64, usually found in the Visual Studio toolbar
  - If a non-default gclib installation location is used, the paths in these sections of code must be updated to reflect the dll locations

#### Add some simple code

- In the *Solution Explorer* right-click on *Form1.vb* and choose *View Code*
- Replace the text in *Form1.vb* with the following code

```
Public Class Form1
    Dim gclib As New Gclib()
    Private Sub Form1_Load(sender As Object, e As EventArgs) Handles MyBase.Load
        Me.Text = "gclib simple example"
        Dim tb As New TextBox
        With tb
            .Multiline = True
            .Dock = DockStyle.Fill
            .Parent = Me
            Try
                'calls to gclib should be in a try-catch
                .AppendText("GVersion: " & gclib.GVersion() & vbCrLf)
                gclib.GOpen("192.168.0.42 -d") 'Set an appropriate IP address here
                .AppendText("GInfo: " & gclib.GInfo() & vbCrLf)
                .AppendText("GCommand: " & gclib.GCommand("MG TIME") & vbCrLf)
            Catch ex As Exception
                .AppendText("ERROR: " & ex.Message)
            Finally
                gclib.GClose() ' Don't forget to close!
            End Try
        End With
    End Sub
End Class
```

- Hit *F5* to run the project

### 3.3.2 C#.NET

gclib ships with *gclib.cs*, a C# class which exposes the functionality of the gclib. In addition, a C# forms example is included which demonstrates how to use *gclib.cs*.

For brevity, these instructions assume the default installation location of **C:\Program Files (x86)\Galil\gclib**.



## Running the C# Example

### Copy files

- Navigate to a convenient, empty, writable location, e.g. `C:\temp`.
- Copy the contents of `C:\Program Files (x86)\Galil\gclib\examples\cs\2013_12.0\gclib_example` to this location.

### Open in Microsoft Visual Studio 2013

- Open `gclib_example.sln` in Visual Studio. This demo was tested on MSVS 2013.

### Add existing item, `gclib.cs`

- In the *Solution Explorer*, right-click on `gclib_example` and choose *Add->Existing Item...*
- Choose `C:\Program Files (x86)\Galil\gclib\source\wrappers\cs\gclib.cs`

### Run Demo

- Type `F5` to run the program.
- Type a valid `GOpen()` address in the text box and click Go.

## Create Project from scratch with MSVC 2013

For brevity, these instructions assume the default installation location of `C:\Program Files (x86)\Galil\gclib`.

### Configure Project

- Launch Visual Studio 2013
- Choose *File->New->Project*
- In the *New Project* dialog, choose *Visual C# -> Windows Forms Application*
- Type `gclib_example` for the Name
- Choose a Location, e.g. `C:\Users\user\Desktop`
- Check *Create directory for solution*
- Click OK, the project will configure itself
- In the *Solution Explorer*, right click on *Solution 'gclib\_example' (1 project)* and choose *Configuration Manager...*
  - In the `gclib_example` project row, click in the *Platform* column and choose *<New...>*
    - \* Choose *x86* from *Type or select the new platform:*
    - \* Choose *Any CPU* from *Copy settings from:*
    - \* Check *Create new solutions platform*
    - \* Click OK.
  - If x64 support is also desired, repeat the *<New...>* procedure for *x64*
  - In the *Active solution platform* combobox at the top of the *Configuration Manager* dialog, choose *<Edit...>*
    - \* Select *Any CPU* and click the *Remove* button

- \* Click *Close*
  - Close the *Configuration Manager* dialog
- In the *Solution Explorer*, right-click on *gclib\_example* and choose *Properties*
  - Choose the *Build* item on the left
    - \* In the *Configuration:* combobox, choose *All Configurations*
    - \* Choose *x86* from the *Platform* combobox
    - \* In *Conditional compilation symbols* type *x86*
  - If x64 is to be used also, add an *x64* token as well to the *x64 Platform*
  - Save and close the *Properties* window
- In the *Solution Explorer*, right-click on *gclib\_example* and choose *Add->Existing Item*
  - Navigate to the installation location *C:\Program Files (x86)\Galil\gclib\source\wrappers\cs*
  - Choose *gclib.cs*
- In the *Solution Explorer* double-click on *gclib.cs*
  - Note that there is a preprocessor definition starting with *#if x86* and *#elif x64*
  - Note that these sections of code enable/disable with the choice of the *Solution Platform* x86/x64, usually found in the Visual Studio toolbar
  - If a non-default gclib installation location is used, the paths in these sections of code must be updated to reflect the dll locations

#### Add some simple code

- In the *Solution Explorer* right-click on *Form1.cs* and choose *View Code*
- Replace the text in *Form1.vb* with the following code

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Windows.Forms;

namespace gclib_example
{
    public partial class Form1 : Form
    {
        gclib gclib = new gclib();
        public Form1()
        {
            InitializeComponent();
            this.Text = "gclib simple example";
            TextBox tb = new TextBox();
            tb.Multiline = true;
            tb.Dock = DockStyle.Fill;
            tb.Parent = this;
            try
            {
                //calls to gclib should be in a try-catch
                tb.AppendText("GVersion: " + gclib.GVersion() + "\n");
                gclib.GOpen("192.168.0.42 -d"); //Set an appropriate IP address here
                tb.AppendText("GInfo: " + gclib.GInfo() + "\n");
                tb.AppendText("GCommand: " + gclib.GCommand("MG TIME") + "\n");
            }
            catch (Exception ex)
            {
            }
        }
    }
}
```

```

        {
            tb.AppendText("ERROR: " + ex.Message);
        }
        finally
        {
            gclib.GCclose(); //Don't forget to close!
        }
    }
}
}

```

- Hit *F5* to run the project

## 3.4 Java

gclib uses the venerable

[Java Native Access \(JNA\)](#) library to simplify integration into the Java Native Interface (JNI).

### Attention

This is the initial version of the the gclib Java wrapper. As such, GclibJava ships as source files, not the compiled jar files. All functions are subject to change in future releases of gclib. Java hackers with recommendations on how to make this library better are encouraged to email [softwaresupport@galil.com](mailto:softwaresupport@galil.com). Somebody has to teach those Galil Java noobs what's what.

### Windows

The following instructions were performed with 64 bit Windows 7 on [Oracle NetBeans IDE 8.2](#) and [Java 1.8.0\\_131](#).

For brevity, these instructions assume the default gclib installation location of "C:\Program Files (x86)\Galil\gclib".

### Step-by-Step

1. Install [gclib](#) with 64 bit binaries (default install).
2. Install 64 bit NetBeans and Java, [jdk-8u131-nb-8\\_2-windows-x64.exe](#).
3. Launch NetBeans.
4. Create a new application.
  - (a) File | New Project...
  - (b) Under *Categories*, select *Java*.
  - (c) Under *Projects*, select *Java Application*.
  - (d) Click *Next*.
  - (e) Type `GclibTest` for the *Project Name*.
  - (f) Note the location of the *Project Folder*.
  - (g) Uncheck *Create Main Class*
  - (h) Click *Finish*
5. Open the *Project Folder* as noted above.
6. Open the *src* directory in the *Project Folder* location.
7. Copy the whole directory `C:\Program Files (x86)\Galil\gclib\examples\java\gclibtest` to this directory.

8. Copy the whole directory `C:\Program Files (x86)\Galil\gclib\source\wrappers\java\gclibjava` to this directory.
9. Create a directory at `c:\jna\`.
  - Another directory may be chosen. The purpose of this directory is to hold jna's *jar* binary for the Java classpath.
10. Download a copy of *jna.jar* to the new directory.
  - <https://github.com/java-native-access/jna#download>
  - This example uses *jna-4.4.0.jar*.
11. In the NetBeans *Projects* tab, expand *GclibTest*.
12. Right-click on *Libraries* and choose *Add JAR/Folder...*
13. Navigate to the *jna.jar* saved above. Click *Open* to add *jna.jar* to the classpath.
14. In the NetBeans *Projects* tab, right-click on *GclibTest* and choose *Properties*.
15. Choose the *Run* item out of the *Categories* options tree.
16. In the *Main Class* text box, type `gclibtest.GclibTest`. Click *OK*.
17. In the NetBeans *Projects* tab, expand *GclibTest* | *Source Packages* | *gclibtest*.
18. Double click *GclibTest.java*, and find the line containing `gclib.GOpen`.
19. Update the address for the desired hardware.
20. Choose *Run* | *Run Project (GclibTest)* or hit the `F6` key to run the application.
21. The application output will print in the NetBeans *Output* window.

## Documentation

The *GclibJava* class has helpful documentation for developing a Java application. Use the following instructions to create the Javadoc.

1. In the NetBeans *Projects* tab, right-click *GclibTest*.
2. Choose *Generate Javadoc* to create the documentation and open it in the system's default browser.

## Chapter 4

# Using gclib

- [gcaps](#)
- [Program Preprocessor](#)
- [Thread Safety](#)
- [Galil Widgets](#)
- [Rebuilding gclibo](#)
- [Software Licenses](#)
- [Legacy Compatibility](#)

### 4.1 gcaps

gcaps is a communication server natively supported by gclib to multiplex Galil hardware communication features. It runs in the background on the host computer, as a service or daemon.

Incidentally, the name *gcaps* is an acronym for the improbable name *Galil Controller Asynchronous Proxy Server*. Yet another tidbit to impress friends at parties.

#### gclib & gcaps

gclib will attempt to use gcaps whenever [GOpen\(\)](#) is called without the `--direct` or `-d` switch. Other than this small difference, gclib function calls through gcaps operate as if the connection was direct. The first version of gclib supporting gcaps is 299.

At this time, gcaps must be running on the same host as gclib (localhost). Contact Galil if connection to a remote host is desired.

#### Other gcaps Usage

The following functions will attempt to use gcaps first to gather data. If gcaps is not found, the functions will fall back to user space calls to populate information.

gclib Function	Usage	If gcaps unavailable
<a href="#">GVersion()</a>	Provide the version of gclib and gcaps (if available).	No gcaps version.
<a href="#">GlpRequests()</a>	Provide a list of all Galil controllers requesting IP addresses via BOOT-P or DHCP.	Must be root.

gclib Function	Usage	If gcaps unavailable
<a href="#">GAssign()</a>	Assigns an IP address over the Ethernet to a controller at a given MAC address.	Must be root.
<a href="#">GAddresses()</a>	Provides a listing of all available connection addresses.	Must be root, or user must be in device group.

Because gcaps runs as a service on Windows, and as a system daemon on Linux, gcaps runs with root privileges. See *If gcaps unavailable* column in the above table when running without gcaps.

If gcaps is unavailable when these functions are run, a ~1 second delay will be incurred while gclib searches for the absent server. In order to prevent gcaps usage in these functions, comment out the symbol [G\\_USE\\_GCAPS](#) in [gclibo.h](#) and rebuild gclibo. See [Rebuilding gclibo](#).

### gcaps Benefits

- Connections through gcaps multiplex a single connection resource. This means that single-channel connection protocols like USB, RS232, or PCI can be shared with as many simultaneous connections as needed. Furthermore, Ethernet-based connections with gcaps leave plenty of Ethernet handles available for other communications, such as MODBUS.
- All communications features are available to all connecting clients. This means that a software application can be running simultaneously with Galil's diagnostic software (Galil Design Kit). This significantly simplifies support and aides in debugging.
- Data Records, Messages, and Interrupts everywhere. No longer does one connection *steal* data streams from another.
- gcaps runs as a service providing more capabilities than a user space application. This allows functions like [GIpRequests\(\)](#) and [GAssign\(\)](#) to operate from a gclib application without root privileges.

### gcaps Installation

See the [installation](#) page to see if gcaps is available on your OS. Support is marked with a diamond (◇).

If gcaps is needed on a different OS, please email [softwaresupport@galil.com](mailto:softwaresupport@galil.com), or call [Galil Applications](#).

#### Windows

gcaps is bundled in the gclib and GDK installer packages. Install with defaults to get the gcaps service included. gcaps is also available as a standalone installer. Downloads are available on the [release notes](#) page.

gcaps is currently available only on **64 bit** Windows.

#### Linux

Instructions to install gcaps are listed with the instructions to install gclib. Follow the link for your OS on the [installation](#) page.

gcaps is currently available only on **64 bit** versions of Linux.

### Changes and updates to gcaps

See the [release notes](#) page.

## 4.2 Program Preprocessor

gclib's program downloader provides a preprocessor for DMC code. The preprocessor modifies the program prior to download providing a number of language features not present in native DMC code.

The preprocessor is invoked in the following two ways.

1. With both `GProgramDownload()` and `GProgramDownloadFile()` via the `preprocessor` argument. Downloading code with null for the preprocessor argument uses defaults.
2. From within DMC code via in-band preprocessor directives.

### The `preprocessor` argument

`GProgramDownload()` and `GProgramDownloadFile()` can be called with a string passed to the `preprocessor` argument. The program will be modified based on this string prior to download. See *Preprocessor Options* below for syntax.

### In-band Operation

DMC code can be written with special markup to signal the preprocessor to take actions prior to download.

For example, the following program will invoke the in-band preprocessor. The specifics are described below.

```
## Author: Zaphod Beeblebrox
## Project: Total Perspective Vortex
//the above 4 hashmarks enable the preprocessor
##option "--min 4" //use a minimum of level four compression
REM REM-style comments are supported at all times
PRA=1000
BGA
AMA
EN
```

### The REM Comment

Lines beginning with the string `REM` are removed prior to download. `REM` comments are always removed regardless of whether the other preprocessor options are enabled or not.

### Double Hash

Most preprocessor statements begin with a double hash, `##`. When proceeded by a space, the double hash acts like a `REM` comment.

When proceeded by a character other than space, `##` is interpreted as a preprocessor directive. For example, see `##option` below.

### Note

Double hash lines are removed from the program only when the preprocessor is enabled with a quad hash.

### Quad Hash to enable

In order to enable the in-band preprocessor, the first two lines of the DMC program must start with a double hash. This syntax of using two lines with double hashmarks is called a *quad hash*.

Content may follow the hash marks. For example, a good code writing style is to use double hash comments as a comment header showing author, project name, etc.

## C-style comments

With the preprocessor enabled, C-style comments may be used with the `//` prefix. These comments are very similar to `REM` comments. The primary advantage of using this comment over `REM` is that `//` comments may occur anywhere in a line. This is helpful for line comments such as the following.

```
SIA= 1,25,25,0<4>1 //SSI 25 bits total, all single turn, no status
```

Strings containing `//` are not interpreted as comments.

### Note

`//` comments are removed from the program only when the preprocessor is enabled with a quad hash.

## Preprocessor Directives

### Note

Directives are only followed when the preprocessor is enabled with a quad hash.

```
##option
```

The `option` directive allows passing switches directly to the preprocessor with the same syntax as the `preprocessor` argument in `GProgramDownload()` and `GProgramDownloadFile()`. The syntax of the `option` directive is the following.

```
##option "{preprocessor switches}"
```

For example, the following line will disable compression in the program.

```
##option "--max 0"
```

See *Preprocessor Options* below for other switches.

```
##include
```

The `include` directive provides a way to include the contents of another DMC file in the current program. This is useful for reusing code such as automatic subroutines, homing operations, or controller initialization routines.

The contents of the file will be inserted in place of the `include` line. The insertion occurs prior to code compression.

The syntax of the `include` directive is the following.

```
##include "{filename}"
```

For example,

```
##include "c:\galil\initialize.dmc"
##include "homing.dmc"
```

To write more portable code, use the `include` directive with just the file name, no absolute path. The path to find the file on the system is set depending on usage.

1. In the *Galil Design Kit*, specify the include path in GDK's *settings* with the `--search` or `-I` switch as defined below.
2. When downloading code via `GProgramDownload()` or `GProgramDownloadFile()`, use the `--search` or `-I` switch in the `preprocessor` argument.
3. Finally, if the file is in the executable search path, the file will be found. However, one of the previous two options is more reliable.



```
##gclib
```

Galil Design Kit uses the ##gclib directive in GDK Macros. gclib ignores this directive.

### In-band Support

In addition to gclib, Galil Design Kit supports the preprocessor. Proper preprocessor usage will be colored in the Editor's syntax highlighter. If the quad hash is not present, preprocessor syntax will be colored differently to indicate improper usage.

The preprocessor is not supported in software prior to GDK/gclib. DMC code downloads using the in-band preprocessor in prior generation software (e.g. GalilTools or SmartTerm) will fail with a TC code of 61, *Duplicate or bad label*.

## Preprocessor Options

Compression, --min, --max

- Default uses minimum compression needed to fit the program.
- --max *n* provides compression up to and including level *n*. Only the necessary compression will be performed up to level *n*.
- --min *n* will compress at least up to and including *n*. *n* defined as with --max.

### Compression Levels, *n*

- Level 0 (mandatory)
  1. Remove lines beginning with REM.
  2. Remove trailing semicolons.
  3. Comment blank lines with '.
  4. Remove white space (space/tab) in front of # (label declarations).
  5. Remove white space after commands.
  6. Line ends changed to carriage return.
  7. Replace leading tabs with double space.
  8. Replace non-leading tabs with single space.
  9. A backslash (\) character on a line other than a preprocessor line will result in an error.
- Level 1
  1. Remove unnecessary spaces. Strings, comments ('), and no-ops (NO) are not changed.
- Level 2
  1. Remove comments (') but not no-ops (NO).
- Level 3
  1. Remove no-ops (NO).
- Level 4
  1. Break apart compound lines that are too long.
  2. Compact lines of code to maximize line usage.
  3. Use backtick to support long lines where applicable.

**Code insertion, `--insert`**

- Default begins at line zero and overwrites anything present.
- `--insert arg` invokes the insert option of the firmware's *DL* command. *arg* can be one of the following.
  1. Line number, e.g. 100. Program insertion will occur on the line after the line specified.
  2. Variable name, e.g. `myvar`. Program insertion will occur on the line after the line equal to the value of the variable.
  3. Label callout, e.g. `#mylabel`. Program insertion will occur on the line after the label.
  4. A lone `#` symbol. Program insertion will occur on the line after the last line in the program buffer.
- Compression directives `--max` and `--min` are followed.
- All original code following the point of insertion is cleared.
- Not all products support the `--insert` operation, e.g. DMC-30010. See the [DL](#) command for support.

**Warning**

It is the user's responsibility to ensure that the code will fit in the inserted location. The preprocessor will not check line numbers when executing the `--insert` option.

**Include Search Paths, `--search, -I`**

- The `##include` directive will attempt to open its string argument directly. The open will succeed if the argument is the absolute path, or if the argument is in the executable's path, e.g. in the same directory.
- `--search path` allows the user to specify a directory or directories to be searched for the `include` file in case the first open fails.
  - For historical reasons, `-I` is shorthand for `--search`.
- Multiple directories may be specified with multiple `-I` directives.
- For in-band code, `-I` must be specified prior to the include.
- A common use for `-I` is to specify only the filename in the DMC source code and use the `preprocessor` argument during download to specify the path to the files. This allows the files to be moved without a change to source code.
- Search order
  1. The `##include` argument is checked first as-is.
  2. Then each `-I` argument in the `preprocessor` argument, in the order specified.
  3. Then `##option` directives in the DMC file, in the order specified.
- If the search path contains spaces, enclose the path in double quotes, escaped with a backslash. See example below.

**In-band Example**

```
##option "-I /code/dmc/homing"
##option "-I \"/code/dmc/other code\"
##include "auto.dmc"
//executable's directory will be checked
//then c:\code\dmc\homing
//then c:\code\dmc\other code
```

**Macro Definition, `--define`, `-D`**

- `--define` provides a way to substitute one token for another. This is useful for writing code that is generic until program download. Wherever the token is found in code, it is substituted by the replacement. The replacement occurs right before code compression.
- `-D` is shorthand for `--define`.
- The token should consist of a starting backslash character, followed by upper or lower case alphanumeric characters, underscores, and an ending backslash.
- The common usage for this feature is to write code with a token, and then call the program download with the `-D` switch.

In this example, an axis is defined at download time. Specifying the following for the preprocessor argument

```
--define \ax\:A
```

would cause the following code

```
SH\ax\  
JG\ax\=1000  
BG\ax\  

```

to be downloaded as

```
SHA  
JGA=1000  
BGA  

```

This causes the *A* axis to be addressed.

**Note**

The macro `\pid\` is reserved for exclusive use by GDK.

**Conditional Directives, `--ifdef`, `--ifndef`**

To specify a preprocessor directive should be executed only if a macro is defined, use `--ifdef`.

```
##option "--ifdef \minify\ --min 4" //maximally compress code if minify macro set
```

To specify a preprocessor directive should be executed only if a macro is NOT defined, use `--ifndef`.

```
##option "--ifndef \axis\ -D \axis\:A" //Default to axis A
```

**GDK Support**

- See the `preprocessor` text box in the *Editor* settings page to set the desired preprocessor setting for developing in GDK's editor.

## 4.3 Thread Safety

**The Basics**

- The easiest way to multithread, and/or to use multiple applications to access the same hardware, is to communicate through [gcaps](#).
- Just leave out `-d` and `--direct` in your [GOpen\(\)](#) address and gcaps will be used.
- Each thread, and each application, should use their own [GCon](#) handle. In the higher-level [Language Support](#), each thread or application should manage their own gclib object. Don't pass the connection handle between threads.

## The Formalism

gclib supports multi-threaded operation with the following operational definitions.

### gclib is "reentrant"

Reentrant means that a given gclib function call may be invoked in multiple threads when passed distinct arguments. For example, `GCommand()` may be called simultaneously in different threads so long as the following arguments have unique values, indicating they point to unique memory.

- `GCon g`, the connection must be unique.
- `GBufOut buffer`, the writable buffer must be unique.
- `GSize *bytes_returned`, the writable value must be unique.

### gclib is not "thread-safe"

Thread safety would imply that a given gclib function call could be invoked in multiple threads when passed *the same* arguments. This mode of operation **is not** supported by gclib. In other words, it is not safe to call `GCommand()` simultaneously in different threads if any mutable arguments point to the same memory.

In short, it is **not** safe to call `GCommand()` in multiple threads to the same physical connection.

If such operation is required, it is the user's responsibility to use a mutual exclusion (mutex) or other mechanism to protect memory.

### Multi-threaded access to the same connection with gcaps

`gcaps` provides a multiplexing capability to Galil hardware. When using `gcaps`, it is therefore safe to call `GCommand()` in multiple threads to the *same physical connection* (though not the same `GCon` value). gclib can connect multiple times to the same Galil connection through `gcaps`. Because the `GCon` variable is unique, the reentrant capability of gclib can be used to communicate to the same physical connection through `gcaps`.

## 4.4 Galil Widgets

### Note

gclib provides the communications foundation for the Galil Widgets project. Galil Widgets are a collection of .Net WinForms User Controls that provide quick development of custom graphical user interfaces (GUIs) that communicate with Galil Motion Controllers and PLCs.

### Galil Widgets has been designed to support three general user needs

#### The software novice, or the hurried prototyper

Within minutes, a full UI can be laid out. All controls can be configured with menus and mouse clicks for an absolute minimum requirement for writing code. The quick start guide, and Microsoft Visual Studio Express is all that is needed to make a free application GUI with minimal effort.

#### The .Net developer, adding to pre-existing code.

In addition to the point-and-click configuration of the tools, each tool has a set of public function calls and properties which allows the C# or VB.Net user the ability to integrate the Galil Widgets into a .Net application with ease.

### The power user

The entire Galil Widgets source code is available in the installation package. This allows users to tweak, extend, and add Widgets to the library with ease. The "GalilWidget" interface defines a number of function calls that new Widgets should implement to function correctly.

### The following widgets are currently available

- **GWComs**: Communications to Galil hardware including event-driven handling of asynchronous traffic.
- **GWTerm**: A terminal for direct user interaction with the hardware.
- **GWPoll**: A polling tool to display important data on screen.
- **GWSettings**: A tool for displaying, editing, backing up, and restoring controller parameters and mission-critical variables. Program backup and loading, and firmware upgrades are also supported.
- **GWDataRec**: A data record visualization tool. Used to display controller status through user-configurable labels, "soft LEDs", and analog sliders.

For more information, get the free [Galil Widgets package](#)

See the [Galil Widgets release notes](#) for changes.

Screen shots of an example motion controller configuration (left), and a similar RIO configuration (right)

## 4.5 Rebuilding gclibo

gclib ships with a compiled version of the open source portion, *gclibo*. However, if a source modification is desired, the following instructions will help with recompiling this portion of the library.

### Windows

For brevity, these instructions assume the default installation location of **C:\Program Files (x86)\Galil\gclib** and a build type of **x86 (win32)**. The following instructions were performed on *Visual Studio Professional 2015* and can be extended to other Visual Studio versions.

### Preparation

Create a working directory. A convenient, empty, writable location, e.g.

```
C:\>mkdir %homepath%\Desktop\temp
```

### Note

In this documentation, a single *greater-than* character (>) will indicate a command prompt at this working directory.

Recompiling gclibo requires the source code for the open source compression library **zlib**. This can be downloaded from the zlib website: <http://zlib.net/zlib1211.zip>.

Extract the downloaded zlib source files to the working directory.

Open *VS2015 x86 Native Tools Command Prompt* and navigate to the working directory.

```
C:\Program Files (x86)\Microsoft Visual Studio 14.0\VC>cd %homepath%\Desktop\temp
C:\Users\user\Desktop\temp>dir /b
zlib-1.2.11
```

## Copy files

Set an environment variable for the base path.

```
>set base="C:\Program Files (x86)\Galil\gclib"
```

Set an environment variable for the zlib base path.

```
>set zlib="%CD%\zlib-1.2.11"
```

Copy the gclibo source files.

```
>copy %base%\source\gclibo\*.c .
C:\Program Files (x86)\Galil\gclib\source\gclibo\arrays.c
C:\Program Files (x86)\Galil\gclib\source\gclibo\gclibo.c
        2 file(s) copied.
```

## Modify source

Make any necessary changes. For this example, the [GInfo\(\)](#) function was changed from

```
GReturn GCALL GInfo(GCon g, GCStringOut info,
    GSize info_len)
{
    return GUtility(g, G_UTIL_INFO, info, &info_len);
}
```

to

```
GReturn GCALL GInfo(GCon g, GCStringOut info,
    GSize info_len)
{
    strncpy(info, "My controller", info_len);
    return G_NO_ERROR;
    //return GUtility(g, G_UTIL_INFO, info, &info_len);
}
```

## Compile and copy

Compile the source code.

```
>cl -c *.c %zlib%\*.c -I %base%\include -I %zlib% -DBUILDING_GCLIB
```

Link the binaries.

```
>link /DLL *.obj %base%\lib\dynamic\x86\gclib.lib /OUT:gclibo.dll
```

## Copy

Copy back to the installation location from the file explorer. This will require administrator privileges.

- Copy gclibo.lib to "C:\Program Files (x86)\Galil\gclib\lib\dynamic\x86"
- Copy gclibo.dll to "C:\Program Files (x86)\Galil\gclib\dl\x86"

## Test

Copy simple example

```
>copy %base%\examples\cpp\x_simple.c .
```

Edit `GOpen()` call as necessary.

### Compile

```
>cl x_simple.c %base%\lib\dynamic\x86\*.lib -I %base%\include
```

### Set Path to DLL

```
>set PATH=%base%\dll\x86\;%PATH%
```

### Execute

```
>x_simple.exe
rc: 0
version: 85.60.138
rc: 0
rc: 0
info: My controller
rc: 0
response: 355000958.0000
:
```

## Linux

Recompiling gclibo requires the source code for the open source compression library **zlib**. Make will automatically download the needed project from the zlib website: <https://www.zlib.net/>.

### Copy files

```
$ mkdir test
$ cd test
$ tar -xzf /usr/share/doc/gclib/src/gclibo_src.tar.gz
$ cp /usr/include/gclib*.h .
```

### Modify source

Make any necessary changes. For this example, the `GInfo()` function was changed from

```
GReturn GCALL GInfo(GCon g, GCStringOut info,
    GSize info_len)
{
    return GUtility(g, G_UTIL_INFO, info, &info_len);
}
```

to

```
GReturn GCALL GInfo(GCon g, GCStringOut info,
    GSize info_len)
{
    strncpy(info, "My controller", info_len);
    return G_NO_ERROR;
    //return GUtility(g, G_UTIL_INFO, info, &info_len);
}
```

### Make and install

```
# make install -f makefile_gclibo
Acquiring zlib
wget -q http://zlib.net/zlib-1.2.11.tar.gz
shasum -a 256 -c zlib.sha256
zlib-1.2.11.tar.gz: OK
tar -xzf zlib-1.2.11.tar.gz
Compiling zlib
```

```
gcc -c -Wall -w -fPIC -fvisibility=hidden -DBUILDING_GCLIB -DHAVE_VISIBILITY zlib-1.2.11/*.c
Compiling open source component, libgclibo.so.0.0
gcc -Izlib-1.2.11 -c -Wall -Werror -fPIC -fvisibility=hidden -DBUILDING_GCLIB -DHAVE_VISIBILITY gclibo.c array
Linking open source component into shared library.
gcc -shared -o libgclibo.so.0.0 *.o -lgclib -L. -Wl,-rpath=/usr/lib -Wl,-soname=libgclibo.so.0
strip --strip-unneeded libgclibo.so.0.0
Installing libgclibo.so.0.0
install -m 755 libgclibo.so.0.0 /usr/lib
ldconfig
# make clean -f makefile_gclibo
Cleaning project...
```

## Test

### Extract simple example

```
$ tar -xzf /usr/share/doc/gclib/src/gclib_examples.tar.gz x_simple.c
```

Edit [GOpen\(\)](#) call as necessary.

### Compile

```
$ gcc x_simple.c -Wall -Werror -lgclib -lgclibo -o simple
```

### Execute

```
$ ./simple
rc: 0
version: 85.60.131
rc: 0
rc: 0
info: My controller
rc: 0
response: 182879322.0000
:
```

## OS X

### Copy files

```
$ mkdir test
$ cd test
$ tar -xvf /Applications/gclib/source/gclibo_src.tar.gz x gclibo.h
x gclibo.c
x arrays.c
x makefile_gclibo
$ cp /Applications/gclib/include/* .
$ cp /Applications/gclib/dylib/gclib.0.dylib .
$ ls
arrays.c gclib.h gclib_record.h gclibo.h
gclib.0.dylib gclib_errors.h gclibo.c makefile_gclibo
```

### Modify source

Make any necessary changes. For this example, the [GInfo\(\)](#) function was changed from

```
GReturn GCALL GInfo(GCon g, GCStringOut info,
    GSize info_len)
{
    return GUtility(g, G_UTIL_INFO, info, &info_len);
}
```

to



```
GReturn GCALL GInfo(GCon g, GCStringOut info,
    GSize info_len)
{
    strncpy(info, "My controller", info_len);
    return G_NO_ERROR;
    //return GUtility(g, G_UTIL_INFO, info, &info_len);
}
```

### Make and install

```
$ make -f makefile_gclibo
Open source component, gclibo.0.dylib
Compiling open source component.
gcc -c -Wall -Werror -fPIC -fvisibility=hidden -DBUILDING_GCLIB -DHAVE_VISIBILITY *.c
Linking open source component into shared library.
gcc -dynamiclib -o gclibo.0.dylib *.o gclib.0.dylib
strip -u -r gclibo.0.dylib
Cleaning up.
$ make install -f makefile_gclibo
Installing gclibo.0.dylib
cp gclibo.0.dylib /Applications/gclib/dylib
$ make clean -f makefile_gclibo
Cleaning project...
```

### Test

#### Extract simple example

```
$ tar -xzf /Applications/gclib/examples/gclib_examples.tar.gz x_simple.c
```

Edit [GOpen\(\)](#) call as necessary.

### Compile

```
$ gcc x_simple.c -Wall -Werror gclib.0.dylib gclibo.0.dylib -o simple
```

### Execute

```
$ ./simple
rc: 0
version: 127.110.253
rc: 0
rc: 0
info: My controller
rc: 0
response: 182879322.0000
:
```

## 4.6 Software Licenses

For purposes of licensing, gclib is broken into two categories.

1. The closed source portion is covered under the [Closed Source License](#). This covers the binaries created for the [gclib.h](#) interface.
2. The open source portion and all examples and wrappers are covered under the [Open Source License](#).

The informal software licenses are provided to describe the user's responsibilities in a format that is easy to read and understand. If more legal verbiage is required or if any questions arise regarding the following details, please contact Galil for clarification.

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## 4.7 Legacy Compatibility

- [GalilTools](#) included the GCL (GalilTools Communication Library). gclib ships with an open source wrapper implementation of the GCL.
- [DMC32 OSU](#) is intended for existing applications that used software based on the legacy DMCWIN32 library for Windows XP and earlier.

### 4.7.1 GalilTools

To provide maximum compatibility, gclib ships with an open source wrapper implementation of the GCL (GalilTools Communication Library). Users wanting to upgrade to gclib that have source built on Galil.h can use this wrapper to minimize source changes. This wrapper is also indicated for users that want the same function calls as Galil.h, but don't want the usage of [QT](#) as in galil1.dll.

**This wrapper is intended for existing applications already using the library distributed with GalilTools (galil1.dll) or the previous STL library (galil2.dll). New applications should be written with gclib.**

### Windows

#### Compile galil2.dll with MSVC 2013

The following instructions were performed on *Visual Studio Professional 2013* and can be extended to other Visual Studio versions. For brevity, the instructions assume the default installation location of **C:\Program Files (x86)\Galil\gclib** and a build type of **x86 (win32)**.

#### Launch the compiler command prompt

- Open *VS2013 x86 Native Tools Command Prompt*.
- Navigate to a convenient, writable location, e.g. *C:\temp*.

#### Set an environment variable for the base path

```
C:\temp>set base=C:\Program Files (x86)\Galil\gclib
```

#### Compile the source code

##### Note the quotes.

```
C:\temp>cl -c "%base%\source\wrappers\gcl\*.cpp" -I "%base%\include" -EHsc -MD
```

#### Link the source code

##### Note the quotes.

```
C:\temp>link /DLL gcl_datarecord.obj gcl_galil.obj "%base%\lib\dynamic\x86\gclib.lib" "%base%\lib\dynamic\x86\gclibo.lib"
```

The output files *galil2.dll* and *galil2.lib* can now be used in a project using the GCL.

## Test

Help the loader find the right dlls.

```
C:\temp>set PATH=%PATH%;%BASE%\dll\x86
```

Link the simple example.

```
C:\temp>link gcl_simple.obj "%base%\lib\dynamic\x86\gclib.lib" "%base%\lib\dynamic\x86\gclibo.lib" galil2.lib
```

Run the example.

```
C:\temp>simple.exe
Galil2.dll wrapper, gclib 106.75.180
10.1.3.169, DMC4020 Rev 1.2c, 291
```

## Linux

### Copy files

```
$ tar -xzf /usr/share/doc/gclib/src/gclib_gcl.tar.gz
$ ls
Galil.h          gcl_galil.cpp  gcl_simple.cpp
gcl_datarecord.cpp gcl_galil.h    makefile
```

### Make and install

```
$ make
gcl open source wrapper for gclib
  Compiling wrapper, libgalil.so.2.0
g++ -c -fPIC -std=c++11 gcl_datarecord.cpp gcl_galil.cpp
  Linking wrapper into shared library.
g++ -shared -o libgalil.so.2.0 *.o -Wl,-soname=libgalil.so.2
strip --strip-unneeded libgalil.so.2.0
  Cleaning up.
$ sudo make install
Installing libgalil.so.2.0
install -m 755 libgalil.so.2.0 /usr/lib
install -m 644 Galil.h /usr/lib
ldconfig
ln -s /usr/lib/libgalil.so.2 /usr/lib/libgalil.so
$ make clean
Cleaning project...
```

## Test

```
$ g++ gcl_simple.cpp -lgalil -lgclib -lgclibo -o simple
$ ./simple
Galil2.dll wrapper, gclib 95.71.164
10.1.3.169, DMC4020 Rev 1.2c, 291
```

## 4.7.2 DMC32 OSU

**Note**

gclib provides the communications foundation for the *DMC32 Operating System Upgrade (OSU)* project.

DMC32 OSU is intended for existing applications that used software based on the legacy DMCWIN32 library for Windows XP and earlier. If such an application must be upgraded to Windows 7, 8, or 8.1, DMC32 OSU may be used on these O.S. upgrades.

Galil's Windows XP support statement, <http://www.galil.com/about/xp-support>

- For more information refer to the documentation, <http://www.galil.com/sw/pub/all/doc/dmc32osu/html/index.html>
- See the release notes for changes, <http://www.galil.com/sw/pub/all/rn/dmc32osu.html>
- The installer is available for download from Galil's website, [http://www.galil.com/sw/pub/win/dmc32osu/galil\\_dmc32\\_osu\\_exe.html](http://www.galil.com/sw/pub/win/dmc32osu/galil_dmc32_osu_exe.html)



## Chapter 5

# Data Structure Index

### 5.1 Data Structures

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## Chapter 6

# File Index

### 6.1 File List

Here is a list of all documented files with brief descriptions:

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## Chapter 7

# Data Structure Documentation

### 7.1 GDataRecord Union Reference

Data record union, containing all structs and a generic byte array accessor.

```
#include <gclib_record.h>
```

#### Data Fields

- struct [GDataRecord4000 dmc4000](#)  
*The DMC-4000 data record.*
- struct [GDataRecord4000 dmc4103](#)  
*The DMC-4103 data record.*
- struct [GDataRecord4000 dmc50000](#)  
*The DMC-50000 data record.*
- struct [GDataRecord52000 dmc52000](#)  
*The DMC-52000 data record.*
- struct [GDataRecord30000 dmc30000](#)  
*The DMC-30000 data record.*
- struct [GDataRecord2103 dmc2103](#)  
*The DMC-21x3 data record.*
- struct [GDataRecord1806 dmc1806](#)  
*The DMC-1806 data record.*
- struct [GDataRecord1802 dmc1802](#)  
*The DMC-1802 data record.*
- struct [GDataRecord47000\\_ENC rio47000](#)  
*The RIO-471xx & 472xx data record, including encoder support.*
- struct [GDataRecord47300\\_ENC rio47300](#)  
*The RIO 473xx data record, including encoder support.*
- struct [GDataRecord47300\\_24EX rio47300\\_24ex](#)  
*The RIO 473xx data record, with 24EXOUT/24EXIN support.*
- struct [GDataRecord47162 rio47162](#)  
*The RIO 47162 data record.*
- unsigned char [byte\\_array](#) [[GALILDATARECORDMAXLENGTH](#)]  
*Generic byte array for offsets.*

### 7.1.1 Detailed Description

Data record union, containing all structs and a generic byte array accessor.

Named structs can be used to access typed data by name. Offsets into the data record can also be used by referencing the member `byte_array`.

```
//Getting the sample counter for the DMC-4000.
cout << data_record->dmc4000.sample_number << '\n'; //access by 4000 product
cout << * ((unsigned short *) (data_record->byte_array + 4)) << '\n'; //access by pointer arithmetic
```

Definition at line 1078 of file `gclib_record.h`.

The documentation for this union was generated from the following file:

- [gclib\\_record.h](#)

## 7.2 GDataRecord1802 Struct Reference

```
#include <gclib_record.h>
```

### Data Fields

- UW [sample\\_number](#)  
*sample number.*
- UB [input\\_bank\\_0](#)  
*general input bank 0 (inputs 1-8).*
- UB [input\\_bank\\_1](#)  
*general input bank 1 (inputs 9-16).*
- UB [input\\_bank\\_2](#)  
*general input bank 2 (inputs 17-24).*
- UB [input\\_bank\\_3](#)  
*general input bank 3 (inputs 25-32).*
- UB [input\\_bank\\_4](#)  
*general input bank 4 (inputs 33-40).*
- UB [input\\_bank\\_5](#)  
*general input bank 5 (inputs 41-48).*
- UB [input\\_bank\\_6](#)  
*general input bank 6 (inputs 49-56).*
- UB [input\\_bank\\_7](#)  
*general input bank 7 (inputs 57-64).*
- UB [input\\_bank\\_8](#)  
*general input bank 8 (inputs 65-72).*
- UB [input\\_bank\\_9](#)  
*general input bank 9 (inputs 73-80).*
- UB [output\\_bank\\_0](#)  
*general output bank 0 (outputs 1-8).*
- UB [output\\_bank\\_1](#)  
*general output bank 1 (outputs 9-16).*
- UB [output\\_bank\\_2](#)  
*general output bank 2 (outputs 17-24).*
- UB [output\\_bank\\_3](#)  
*general output bank 3 (outputs 25-32).*

- UB [output\\_bank\\_4](#)  
*general output bank 4 (outputs 33-40).*
- UB [output\\_bank\\_5](#)  
*general output bank 5 (outputs 41-48).*
- UB [output\\_bank\\_6](#)  
*general output bank 6 (outputs 49-56).*
- UB [output\\_bank\\_7](#)  
*general output bank 7 (outputs 57-64).*
- UB [output\\_bank\\_8](#)  
*general output bank 8 (outputs 65-72).*
- UB [output\\_bank\\_9](#)  
*general output bank 9 (outputs 73-80).*
- UB [error\\_code](#)  
*error code.*
- UB [general\\_status](#)  
*general status*
- UW [s\\_plane\\_segment\\_count](#)  
*segment count of coordinated move for S plane.*
- UW [s\\_plane\\_move\\_status](#)  
*coordinated move status for S plane.*
- SL [s\\_distance](#)  
*distance traveled in coordinated move for S plane.*
- UW [t\\_plane\\_segment\\_count](#)  
*segment count of coordinated move for T plane.*
- UW [t\\_plane\\_move\\_status](#)  
*Coordinated move status for T plane.*
- SL [t\\_distance](#)  
*distance traveled in coordinated move for T plane.*
- UW [axis\\_a\\_status](#)  
*A axis status.*
- UB [axis\\_a\\_switches](#)  
*A axis switches.*
- UB [axis\\_a\\_stop\\_code](#)  
*A axis stop code.*
- SL [axis\\_a\\_reference\\_position](#)  
*A axis reference position.*
- SL [axis\\_a\\_motor\\_position](#)  
*A axis motor position.*
- SL [axis\\_a\\_position\\_error](#)  
*A axis position error.*
- SL [axis\\_a\\_aux\\_position](#)  
*A axis auxiliary position.*
- SL [axis\\_a\\_velocity](#)  
*A axis velocity.*
- SW [axis\\_a\\_torque](#)  
*A axis torque.*
- UB [axis\\_a\\_reserved\\_0](#)  
*Reserved.*
- UB [axis\\_a\\_reserved\\_1](#)  
*Reserved.*
- UW [axis\\_b\\_status](#)

- B axis status.*
- UB [axis\\_b\\_switches](#)
  - B axis switches.*
- UB [axis\\_b\\_stop\\_code](#)
  - B axis stop code.*
- SL [axis\\_b\\_reference\\_position](#)
  - B axis reference position.*
- SL [axis\\_b\\_motor\\_position](#)
  - B axis motor position.*
- SL [axis\\_b\\_position\\_error](#)
  - B axis position error.*
- SL [axis\\_b\\_aux\\_position](#)
  - B axis auxiliary position.*
- SL [axis\\_b\\_velocity](#)
  - B axis velocity.*
- SW [axis\\_b\\_torque](#)
  - B axis torque.*
- UB [axis\\_b\\_reserved\\_0](#)
  - Reserved.*
- UB [axis\\_b\\_reserved\\_1](#)
  - Reserved.*
- UW [axis\\_c\\_status](#)
  - C axis status.*
- UB [axis\\_c\\_switches](#)
  - C axis switches.*
- UB [axis\\_c\\_stop\\_code](#)
  - C axis stop code.*
- SL [axis\\_c\\_reference\\_position](#)
  - C axis reference position.*
- SL [axis\\_c\\_motor\\_position](#)
  - C axis motor position.*
- SL [axis\\_c\\_position\\_error](#)
  - C axis position error.*
- SL [axis\\_c\\_aux\\_position](#)
  - C axis auxiliary position.*
- SL [axis\\_c\\_velocity](#)
  - C axis velocity.*
- SW [axis\\_c\\_torque](#)
  - C axis torque.*
- UB [axis\\_c\\_reserved\\_0](#)
  - Reserved.*
- UB [axis\\_c\\_reserved\\_1](#)
  - Reserved.*
- UW [axis\\_d\\_status](#)
  - D axis status.*
- UB [axis\\_d\\_switches](#)
  - D axis switches.*
- UB [axis\\_d\\_stop\\_code](#)
  - D axis stop code.*
- SL [axis\\_d\\_reference\\_position](#)
  - D axis reference position.*

- SL [axis\\_d\\_motor\\_position](#)  
*D axis motor position.*
- SL [axis\\_d\\_position\\_error](#)  
*D axis position error.*
- SL [axis\\_d\\_aux\\_position](#)  
*D axis auxiliary position.*
- SL [axis\\_d\\_velocity](#)  
*D axis velocity.*
- SW [axis\\_d\\_torque](#)  
*D axis torque.*
- UB [axis\\_d\\_reserved\\_0](#)  
*Reserved.*
- UB [axis\\_d\\_reserved\\_1](#)  
*Reserved.*

### 7.2.1 Detailed Description

Data record struct for DMC-1802 controllers.

The 18x2 Data record is the Same as 2103 except the following.

1. No header bytes. Software removes it from QR.
2. No analog in axis data.

Definition at line 723 of file `gclib_record.h`.

The documentation for this struct was generated from the following file:

- [gclib\\_record.h](#)

## 7.3 GDataRecord1806 Struct Reference

Data record struct for DMC-1806 controller.

```
#include <gclib_record.h>
```

### Data Fields

- UW [sample\\_number](#)  
*sample number.*
- UB [input\\_bank\\_0](#)  
*general input bank 0 (inputs 1-8).*
- UB [input\\_bank\\_1](#)  
*general input bank 1 (inputs 9-16).*
- UB [input\\_bank\\_2](#)  
*general input bank 2 (inputs 17-24).*
- UB [input\\_bank\\_3](#)  
*general input bank 3 (inputs 25-32).*
- UB [input\\_bank\\_4](#)  
*general input bank 4 (inputs 33-40).*

- UB [input\\_bank\\_5](#)  
*general input bank 5 (inputs 41-48).*
- UB [input\\_bank\\_6](#)  
*general input bank 6 (inputs 49-56).*
- UB [input\\_bank\\_7](#)  
*general input bank 7 (inputs 57-64).*
- UB [input\\_bank\\_8](#)  
*general input bank 8 (inputs 65-72).*
- UB [input\\_bank\\_9](#)  
*general input bank 9 (inputs 73-80).*
- UB [output\\_bank\\_0](#)  
*general output bank 0 (outputs 1-8).*
- UB [output\\_bank\\_1](#)  
*general output bank 1 (outputs 9-16).*
- UB [output\\_bank\\_2](#)  
*general output bank 2 (outputs 17-24).*
- UB [output\\_bank\\_3](#)  
*general output bank 3 (outputs 25-32).*
- UB [output\\_bank\\_4](#)  
*general output bank 4 (outputs 33-40).*
- UB [output\\_bank\\_5](#)  
*general output bank 5 (outputs 41-48).*
- UB [output\\_bank\\_6](#)  
*general output bank 6 (outputs 49-56).*
- UB [output\\_bank\\_7](#)  
*general output bank 7 (outputs 57-64).*
- UB [output\\_bank\\_8](#)  
*general output bank 8 (outputs 65-72).*
- UB [output\\_bank\\_9](#)  
*general output bank 9 (outputs 73-80).*
- SW [reserved\\_0](#)  
*Reserved.*
- SW [reserved\\_2](#)  
*Reserved.*
- SW [reserved\\_4](#)  
*Reserved.*
- SW [reserved\\_6](#)  
*Reserved.*
- SW [reserved\\_8](#)  
*Reserved.*
- SW [reserved\\_10](#)  
*Reserved.*
- SW [reserved\\_12](#)  
*Reserved.*
- SW [reserved\\_14](#)  
*Reserved.*
- UB [reserved\\_16](#)  
*Reserved.*
- UB [reserved\\_17](#)  
*Reserved.*
- UB [reserved\\_18](#)



- Reserved.*
- UB [reserved\\_19](#)  
*Reserved.*
- UB [reserved\\_20](#)  
*Reserved.*
- UB [reserved\\_21](#)  
*Reserved.*
- UB [reserved\\_22](#)  
*Reserved.*
- UB [reserved\\_23](#)  
*Reserved.*
- UB [error\\_code](#)  
*error code.*
- UB [thread\\_status](#)  
*thread status.*
- UL [reserved\\_24](#)  
*Reserved.*
- UL [contour\\_segment\\_count](#)  
*Segment Count for Contour Mode.*
- UW [contour\\_buffer\\_available](#)  
*Buffer space remaining, Contour Mode.*
- UW [s\\_plane\\_segment\\_count](#)  
*segment count of coordinated move for S plane.*
- UW [s\\_plane\\_move\\_status](#)  
*coordinated move status for S plane.*
- SL [s\\_distance](#)  
*distance traveled in coordinated move for S plane.*
- UW [s\\_plane\\_buffer\\_available](#)  
*Buffer space remaining, S Plane.*
- UW [t\\_plane\\_segment\\_count](#)  
*segment count of coordinated move for T plane.*
- UW [t\\_plane\\_move\\_status](#)  
*Coordinated move status for T plane.*
- SL [t\\_distance](#)  
*distance traveled in coordinated move for T plane.*
- UW [t\\_plane\\_buffer\\_available](#)  
*Buffer space remaining, T Plane.*
- UW [axis\\_a\\_status](#)  
*A axis status.*
- UB [axis\\_a\\_switches](#)  
*A axis switches.*
- UB [axis\\_a\\_stop\\_code](#)  
*A axis stop code.*
- SL [axis\\_a\\_reference\\_position](#)  
*A axis reference position.*
- SL [axis\\_a\\_motor\\_position](#)  
*A axis motor position.*
- SL [axis\\_a\\_position\\_error](#)  
*A axis position error.*
- SL [axis\\_a\\_aux\\_position](#)  
*A axis auxiliary position.*

- SL [axis\\_a\\_velocity](#)  
*A axis velocity.*
- SL [axis\\_a\\_torque](#)  
*A axis torque.*
- UW [axis\\_a\\_analog\\_in](#)  
*A axis analog input.*
- UB [axis\\_a\\_reserved\\_0](#)  
*Reserved.*
- UB [axis\\_a\\_reserved\\_1](#)  
*Reserved.*
- SL [axis\\_a\\_variable](#)  
*A User-defined variable (ZA).*
- UW [axis\\_b\\_status](#)  
*B axis status.*
- UB [axis\\_b\\_switches](#)  
*B axis switches.*
- UB [axis\\_b\\_stop\\_code](#)  
*B axis stop code.*
- SL [axis\\_b\\_reference\\_position](#)  
*B axis reference position.*
- SL [axis\\_b\\_motor\\_position](#)  
*B axis motor position.*
- SL [axis\\_b\\_position\\_error](#)  
*B axis position error.*
- SL [axis\\_b\\_aux\\_position](#)  
*B axis auxiliary position.*
- SL [axis\\_b\\_velocity](#)  
*B axis velocity.*
- SL [axis\\_b\\_torque](#)  
*B axis torque.*
- UW [axis\\_b\\_analog\\_in](#)  
*B axis analog input.*
- UB [axis\\_b\\_reserved\\_0](#)  
*Reserved.*
- UB [axis\\_b\\_reserved\\_1](#)  
*Reserved.*
- SL [axis\\_b\\_variable](#)  
*B User-defined variable (ZA).*
- UW [axis\\_c\\_status](#)  
*C axis status.*
- UB [axis\\_c\\_switches](#)  
*C axis switches.*
- UB [axis\\_c\\_stop\\_code](#)  
*C axis stop code.*
- SL [axis\\_c\\_reference\\_position](#)  
*C axis reference position.*
- SL [axis\\_c\\_motor\\_position](#)  
*C axis motor position.*
- SL [axis\\_c\\_position\\_error](#)  
*C axis position error.*
- SL [axis\\_c\\_aux\\_position](#)

- C axis auxiliary position.*
- SL [axis\\_c\\_velocity](#)
  - C axis velocity.*
- SL [axis\\_c\\_torque](#)
  - C axis torque.*
- UW [axis\\_c\\_analog\\_in](#)
  - C axis analog input.*
- UB [axis\\_c\\_reserved\\_0](#)
  - Reserved.*
- UB [axis\\_c\\_reserved\\_1](#)
  - Reserved.*
- SL [axis\\_c\\_variable](#)
  - C User-defined variable (ZA).*
- UW [axis\\_d\\_status](#)
  - D axis status.*
- UB [axis\\_d\\_switches](#)
  - D axis switches.*
- UB [axis\\_d\\_stop\\_code](#)
  - D axis stop code.*
- SL [axis\\_d\\_reference\\_position](#)
  - D axis reference position.*
- SL [axis\\_d\\_motor\\_position](#)
  - D axis motor position.*
- SL [axis\\_d\\_position\\_error](#)
  - D axis position error.*
- SL [axis\\_d\\_aux\\_position](#)
  - D axis auxiliary position.*
- SL [axis\\_d\\_velocity](#)
  - D axis velocity.*
- SL [axis\\_d\\_torque](#)
  - D axis torque.*
- UW [axis\\_d\\_analog\\_in](#)
  - D axis analog input.*
- UB [axis\\_d\\_reserved\\_0](#)
  - Reserved.*
- UB [axis\\_d\\_reserved\\_1](#)
  - Reserved.*
- SL [axis\\_d\\_variable](#)
  - D User-defined variable (ZA).*
- UW [axis\\_e\\_status](#)
  - E axis status.*
- UB [axis\\_e\\_switches](#)
  - E axis switches.*
- UB [axis\\_e\\_stop\\_code](#)
  - E axis stop code.*
- SL [axis\\_e\\_reference\\_position](#)
  - E axis reference position.*
- SL [axis\\_e\\_motor\\_position](#)
  - E axis motor position.*
- SL [axis\\_e\\_position\\_error](#)
  - E axis position error.*

- SL [axis\\_e\\_aux\\_position](#)  
*E axis auxiliary position.*
- SL [axis\\_e\\_velocity](#)  
*E axis velocity.*
- SL [axis\\_e\\_torque](#)  
*E axis torque.*
- UW [axis\\_e\\_analog\\_in](#)  
*E axis analog input.*
- UB [axis\\_e\\_reserved\\_0](#)  
*Reserved.*
- UB [axis\\_e\\_reserved\\_1](#)  
*Reserved.*
- SL [axis\\_e\\_variable](#)  
*E User-defined variable (ZA).*
- UW [axis\\_f\\_status](#)  
*F axis status.*
- UB [axis\\_f\\_switches](#)  
*F axis switches.*
- UB [axis\\_f\\_stop\\_code](#)  
*F axis stop code.*
- SL [axis\\_f\\_reference\\_position](#)  
*F axis reference position.*
- SL [axis\\_f\\_motor\\_position](#)  
*F axis motor position.*
- SL [axis\\_f\\_position\\_error](#)  
*F axis position error.*
- SL [axis\\_f\\_aux\\_position](#)  
*F axis auxiliary position.*
- SL [axis\\_f\\_velocity](#)  
*F axis velocity.*
- SL [axis\\_f\\_torque](#)  
*F axis torque.*
- UW [axis\\_f\\_analog\\_in](#)  
*F axis analog input.*
- UB [axis\\_f\\_reserved\\_0](#)  
*Reserved.*
- UB [axis\\_f\\_reserved\\_1](#)  
*Reserved.*
- SL [axis\\_f\\_variable](#)  
*F User-defined variable (ZA).*
- UW [axis\\_g\\_status](#)  
*G axis status.*
- UB [axis\\_g\\_switches](#)  
*G axis switches.*
- UB [axis\\_g\\_stop\\_code](#)  
*G axis stop code.*
- SL [axis\\_g\\_reference\\_position](#)  
*G axis reference position.*
- SL [axis\\_g\\_motor\\_position](#)  
*G axis motor position.*
- SL [axis\\_g\\_position\\_error](#)

- G axis position error.*
- SL [axis\\_g\\_aux\\_position](#)
  - G axis auxiliary position.*
- SL [axis\\_g\\_velocity](#)
  - G axis velocity.*
- SL [axis\\_g\\_torque](#)
  - G axis torque.*
- UW [axis\\_g\\_analog\\_in](#)
  - G axis analog input.*
- UB [axis\\_g\\_reserved\\_0](#)
  - Reserved.*
- UB [axis\\_g\\_reserved\\_1](#)
  - Reserved.*
- SL [axis\\_g\\_variable](#)
  - G User-defined variable (ZA).*
- UW [axis\\_h\\_status](#)
  - H axis status.*
- UB [axis\\_h\\_switches](#)
  - H axis switches.*
- UB [axis\\_h\\_stop\\_code](#)
  - H axis stop code.*
- SL [axis\\_h\\_reference\\_position](#)
  - H axis reference position.*
- SL [axis\\_h\\_motor\\_position](#)
  - H axis motor position.*
- SL [axis\\_h\\_position\\_error](#)
  - H axis position error.*
- SL [axis\\_h\\_aux\\_position](#)
  - H axis auxiliary position.*
- SL [axis\\_h\\_velocity](#)
  - H axis velocity.*
- SL [axis\\_h\\_torque](#)
  - H axis torque.*
- UW [axis\\_h\\_analog\\_in](#)
  - H axis analog input.*
- UB [axis\\_h\\_reserved\\_0](#)
  - Reserved.*
- UB [axis\\_h\\_reserved\\_1](#)
  - Reserved.*
- SL [axis\\_h\\_variable](#)
  - H User-defined variable (ZA).*

### 7.3.1 Detailed Description

Data record struct for DMC-1806 controller.

The 18x6 Data record is the same as 4000 except the following.

1. No header bytes. Firmware strips it in DR. Software removes it from QR.
2. No Ethernet status (bytes 42-49).

3. No amplifier status (bytes 52-55).
4. No axis-specific hall input status.

Definition at line 405 of file `gclib_record.h`.

The documentation for this struct was generated from the following file:

- [gclib\\_record.h](#)

## 7.4 GDataRecord2103 Struct Reference

Data record struct for DMC-2103 controllers.

```
#include <gclib_record.h>
```

### Data Fields

- UB [header\\_0](#)  
*1st Byte of Header.*
- UB [header\\_1](#)  
*2nd Byte of Header.*
- UB [header\\_2](#)  
*3rd Byte of Header.*
- UB [header\\_3](#)  
*4th Byte of Header.*
- UW [sample\\_number](#)  
*sample number.*
- UB [input\\_bank\\_0](#)  
*general input bank 0 (inputs 1-8).*
- UB [input\\_bank\\_1](#)  
*general input bank 1 (inputs 9-16).*
- UB [input\\_bank\\_2](#)  
*general input bank 2 (inputs 17-24).*
- UB [input\\_bank\\_3](#)  
*general input bank 3 (inputs 25-32).*
- UB [input\\_bank\\_4](#)  
*general input bank 4 (inputs 33-40).*
- UB [input\\_bank\\_5](#)  
*general input bank 5 (inputs 41-48).*
- UB [input\\_bank\\_6](#)  
*general input bank 6 (inputs 49-56).*
- UB [input\\_bank\\_7](#)  
*general input bank 7 (inputs 57-64).*
- UB [input\\_bank\\_8](#)  
*general input bank 8 (inputs 65-72).*
- UB [input\\_bank\\_9](#)  
*general input bank 9 (inputs 73-80).*
- UB [output\\_bank\\_0](#)  
*general output bank 0 (outputs 1-8).*
- UB [output\\_bank\\_1](#)  
*general output bank 1 (outputs 9-16).*

- UB [output\\_bank\\_2](#)  
*general output bank 2 (outputs 17-24).*
- UB [output\\_bank\\_3](#)  
*general output bank 3 (outputs 25-32).*
- UB [output\\_bank\\_4](#)  
*general output bank 4 (outputs 33-40).*
- UB [output\\_bank\\_5](#)  
*general output bank 5 (outputs 41-48).*
- UB [output\\_bank\\_6](#)  
*general output bank 6 (outputs 49-56).*
- UB [output\\_bank\\_7](#)  
*general output bank 7 (outputs 57-64).*
- UB [output\\_bank\\_8](#)  
*general output bank 8 (outputs 65-72).*
- UB [output\\_bank\\_9](#)  
*general output bank 9 (outputs 73-80).*
- UB [error\\_code](#)  
*error code.*
- UB [general\\_status](#)  
*general status*
- UW [s\\_plane\\_segment\\_count](#)  
*segment count of coordinated move for S plane.*
- UW [s\\_plane\\_move\\_status](#)  
*coordinated move status for S plane.*
- SL [s\\_distance](#)  
*distance traveled in coordinated move for S plane.*
- UW [t\\_plane\\_segment\\_count](#)  
*segment count of coordinated move for T plane.*
- UW [t\\_plane\\_move\\_status](#)  
*Coordinated move status for T plane.*
- SL [t\\_distance](#)  
*distance traveled in coordinated move for T plane.*
- UW [axis\\_a\\_status](#)  
*A axis status.*
- UB [axis\\_a\\_switches](#)  
*A axis switches.*
- UB [axis\\_a\\_stop\\_code](#)  
*A axis stop code.*
- SL [axis\\_a\\_reference\\_position](#)  
*A axis reference position.*
- SL [axis\\_a\\_motor\\_position](#)  
*A axis motor position.*
- SL [axis\\_a\\_position\\_error](#)  
*A axis position error.*
- SL [axis\\_a\\_aux\\_position](#)  
*A axis auxiliary position.*
- SL [axis\\_a\\_velocity](#)  
*A axis velocity.*
- SW [axis\\_a\\_torque](#)  
*A axis torque.*
- UW [axis\\_a\\_analog\\_in](#)

- A axis analog input.*
- UW [axis\\_b\\_status](#)  
*B axis status.*
- UB [axis\\_b\\_switches](#)  
*B axis switches.*
- UB [axis\\_b\\_stop\\_code](#)  
*B axis stop code.*
- SL [axis\\_b\\_reference\\_position](#)  
*B axis reference position.*
- SL [axis\\_b\\_motor\\_position](#)  
*B axis motor position.*
- SL [axis\\_b\\_position\\_error](#)  
*B axis position error.*
- SL [axis\\_b\\_aux\\_position](#)  
*B axis auxiliary position.*
- SL [axis\\_b\\_velocity](#)  
*B axis velocity.*
- SW [axis\\_b\\_torque](#)  
*B axis torque.*
- UW [axis\\_b\\_analog\\_in](#)  
*B axis analog input.*
- UW [axis\\_c\\_status](#)  
*C axis status.*
- UB [axis\\_c\\_switches](#)  
*C axis switches.*
- UB [axis\\_c\\_stop\\_code](#)  
*C axis stop code.*
- SL [axis\\_c\\_reference\\_position](#)  
*C axis reference position.*
- SL [axis\\_c\\_motor\\_position](#)  
*C axis motor position.*
- SL [axis\\_c\\_position\\_error](#)  
*C axis position error.*
- SL [axis\\_c\\_aux\\_position](#)  
*C axis auxiliary position.*
- SL [axis\\_c\\_velocity](#)  
*C axis velocity.*
- SW [axis\\_c\\_torque](#)  
*C axis torque.*
- UW [axis\\_c\\_analog\\_in](#)  
*C axis analog input.*
- UW [axis\\_d\\_status](#)  
*D axis status.*
- UB [axis\\_d\\_switches](#)  
*D axis switches.*
- UB [axis\\_d\\_stop\\_code](#)  
*D axis stop code.*
- SL [axis\\_d\\_reference\\_position](#)  
*D axis reference position.*
- SL [axis\\_d\\_motor\\_position](#)  
*D axis motor position.*



- SL [axis\\_d\\_position\\_error](#)  
*D axis position error.*
- SL [axis\\_d\\_aux\\_position](#)  
*D axis auxiliary position.*
- SL [axis\\_d\\_velocity](#)  
*D axis velocity.*
- SW [axis\\_d\\_torque](#)  
*D axis torque.*
- UW [axis\\_d\\_analog\\_in](#)  
*D axis analog input.*
- UW [axis\\_e\\_status](#)  
*E axis status.*
- UB [axis\\_e\\_switches](#)  
*E axis switches.*
- UB [axis\\_e\\_stop\\_code](#)  
*E axis stop code.*
- SL [axis\\_e\\_reference\\_position](#)  
*E axis reference position.*
- SL [axis\\_e\\_motor\\_position](#)  
*E axis motor position.*
- SL [axis\\_e\\_position\\_error](#)  
*E axis position error.*
- SL [axis\\_e\\_aux\\_position](#)  
*E axis auxiliary position.*
- SL [axis\\_e\\_velocity](#)  
*E axis velocity.*
- SW [axis\\_e\\_torque](#)  
*E axis torque.*
- UW [axis\\_e\\_analog\\_in](#)  
*E axis analog input.*
- UW [axis\\_f\\_status](#)  
*F axis status.*
- UB [axis\\_f\\_switches](#)  
*F axis switches.*
- UB [axis\\_f\\_stop\\_code](#)  
*F axis stop code.*
- SL [axis\\_f\\_reference\\_position](#)  
*F axis reference position.*
- SL [axis\\_f\\_motor\\_position](#)  
*F axis motor position.*
- SL [axis\\_f\\_position\\_error](#)  
*F axis position error.*
- SL [axis\\_f\\_aux\\_position](#)  
*F axis auxiliary position.*
- SL [axis\\_f\\_velocity](#)  
*F axis velocity.*
- SW [axis\\_f\\_torque](#)  
*F axis torque.*
- UW [axis\\_f\\_analog\\_in](#)  
*F axis analog input.*
- UW [axis\\_g\\_status](#)

- G axis status.*
- UB [axis\\_g\\_switches](#)
  - G axis switches.*
- UB [axis\\_g\\_stop\\_code](#)
  - G axis stop code.*
- SL [axis\\_g\\_reference\\_position](#)
  - G axis reference position.*
- SL [axis\\_g\\_motor\\_position](#)
  - G axis motor position.*
- SL [axis\\_g\\_position\\_error](#)
  - G axis position error.*
- SL [axis\\_g\\_aux\\_position](#)
  - G axis auxiliary position.*
- SL [axis\\_g\\_velocity](#)
  - G axis velocity.*
- SW [axis\\_g\\_torque](#)
  - G axis torque.*
- UW [axis\\_g\\_analog\\_in](#)
  - G axis analog input.*
- UW [axis\\_h\\_status](#)
  - H axis status.*
- UB [axis\\_h\\_switches](#)
  - H axis switches.*
- UB [axis\\_h\\_stop\\_code](#)
  - H axis stop code.*
- SL [axis\\_h\\_reference\\_position](#)
  - H axis reference position.*
- SL [axis\\_h\\_motor\\_position](#)
  - H axis motor position.*
- SL [axis\\_h\\_position\\_error](#)
  - H axis position error.*
- SL [axis\\_h\\_aux\\_position](#)
  - H axis auxiliary position.*
- SL [axis\\_h\\_velocity](#)
  - H axis velocity.*
- SW [axis\\_h\\_torque](#)
  - H axis torque.*
- UW [axis\\_h\\_analog\\_in](#)
  - H axis analog input.*

### 7.4.1 Detailed Description

Data record struct for DMC-2103 controllers.

Definition at line 582 of file `gclib_record.h`.

The documentation for this struct was generated from the following file:

- [gclib\\_record.h](#)

## 7.5 GDataRecord30000 Struct Reference

Data record struct for DMC-30010 controllers.

```
#include <gclib_record.h>
```

### Data Fields

- UB [header\\_0](#)  
*1st Byte of Header.*
- UB [header\\_1](#)  
*2nd Byte of Header.*
- UB [header\\_2](#)  
*3rd Byte of Header.*
- UB [header\\_3](#)  
*4th Byte of Header.*
- UW [sample\\_number](#)  
*sample number.*
- UB [input\\_bank\\_0](#)  
*general input bank 0 (inputs 1-8).*
- UB [input\\_bank\\_1](#)  
*general input bank 1 (inputs 9-16).*
- UB [output\\_bank\\_0](#)  
*general output bank 0 (outputs 1-8).*
- UB [output\\_bank\\_1](#)  
*general output bank 1 (outputs 9-16).*
- UB [error\\_code](#)  
*error code.*
- UB [thread\\_status](#)  
*thread status.*
- UW [input\\_analog\\_2](#)  
*Analog input 2. 1 is in axis data, see [axis\\_a\\_analog\\_in](#).*
- UW [output\\_analog\\_1](#)  
*Analog output 1.*
- UW [output\\_analog\\_2](#)  
*Analog output 2.*
- UL [amplifier\\_status](#)  
*Amplifier Status.*
- UL [contour\\_segment\\_count](#)  
*Segment Count for Contour Mode.*
- UW [contour\\_buffer\\_available](#)  
*Buffer space remaining, Contour Mode.*
- UW [s\\_plane\\_segment\\_count](#)  
*segment count of coordinated move for S plane.*
- UW [s\\_plane\\_move\\_status](#)  
*coordinated move status for S plane.*
- SL [s\\_distance](#)  
*distance traveled in coordinated move for S plane.*
- UW [s\\_plane\\_buffer\\_available](#)  
*Buffer space remaining, S Plane.*
- UW [axis\\_a\\_status](#)

- *A axis status.*
- UB [axis\\_a\\_switches](#)  
*A axis switches.*
- UB [axis\\_a\\_stop\\_code](#)  
*A axis stop code.*
- SL [axis\\_a\\_reference\\_position](#)  
*A axis reference position.*
- SL [axis\\_a\\_motor\\_position](#)  
*A axis motor position.*
- SL [axis\\_a\\_position\\_error](#)  
*A axis position error.*
- SL [axis\\_a\\_aux\\_position](#)  
*A axis auxiliary position.*
- SL [axis\\_a\\_velocity](#)  
*A axis velocity.*
- SL [axis\\_a\\_torque](#)  
*A axis torque.*
- UW [axis\\_a\\_analog\\_in](#)  
*A axis analog input.*
- UB [axis\\_a\\_halls](#)  
*A Hall Input Status.*
- UB [axis\\_a\\_reserved](#)  
*Reserved.*
- SL [axis\\_a\\_variable](#)  
*A User-defined variable (ZA).*

### 7.5.1 Detailed Description

Data record struct for DMC-30010 controllers.

Definition at line 814 of file `gclib_record.h`.

The documentation for this struct was generated from the following file:

- [gclib\\_record.h](#)

## 7.6 GDataRecord4000 Struct Reference

Data record struct for DMC-4000 controllers, including 4000, 4200, 4103, and 500x0.

```
#include <gclib_record.h>
```

### Data Fields

- UB [header\\_0](#)  
*1st Byte of Header.*
- UB [header\\_1](#)  
*2nd Byte of Header.*
- UB [header\\_2](#)  
*3rd Byte of Header.*
- UB [header\\_3](#)

- 4th Byte of Header.
- UW [sample\\_number](#)  
sample number.
- UB [input\\_bank\\_0](#)  
general input bank 0 (inputs 1-8).
- UB [input\\_bank\\_1](#)  
general input bank 1 (inputs 9-16).
- UB [input\\_bank\\_2](#)  
general input bank 2 (inputs 17-24).
- UB [input\\_bank\\_3](#)  
general input bank 3 (inputs 25-32).
- UB [input\\_bank\\_4](#)  
general input bank 4 (inputs 33-40).
- UB [input\\_bank\\_5](#)  
general input bank 5 (inputs 41-48).
- UB [input\\_bank\\_6](#)  
general input bank 6 (inputs 49-56).
- UB [input\\_bank\\_7](#)  
general input bank 7 (inputs 57-64).
- UB [input\\_bank\\_8](#)  
general input bank 8 (inputs 65-72).
- UB [input\\_bank\\_9](#)  
general input bank 9 (inputs 73-80).
- UB [output\\_bank\\_0](#)  
general output bank 0 (outputs 1-8).
- UB [output\\_bank\\_1](#)  
general output bank 1 (outputs 9-16).
- UB [output\\_bank\\_2](#)  
general output bank 2 (outputs 17-24).
- UB [output\\_bank\\_3](#)  
general output bank 3 (outputs 25-32).
- UB [output\\_bank\\_4](#)  
general output bank 4 (outputs 33-40).
- UB [output\\_bank\\_5](#)  
general output bank 5 (outputs 41-48).
- UB [output\\_bank\\_6](#)  
general output bank 6 (outputs 49-56).
- UB [output\\_bank\\_7](#)  
general output bank 7 (outputs 57-64).
- UB [output\\_bank\\_8](#)  
general output bank 8 (outputs 65-72).
- UB [output\\_bank\\_9](#)  
general output bank 9 (outputs 73-80).
- SW [reserved\\_0](#)  
Reserved.
- SW [reserved\\_2](#)  
Reserved.
- SW [reserved\\_4](#)  
Reserved.
- SW [reserved\\_6](#)  
Reserved.

- SW [reserved\\_8](#)  
*Reserved.*
- SW [reserved\\_10](#)  
*Reserved.*
- SW [reserved\\_12](#)  
*Reserved.*
- SW [reserved\\_14](#)  
*Reserved.*
- UB [ethernet\\_status\\_a](#)  
*Ethernet Handle A Status.*
- UB [ethernet\\_status\\_b](#)  
*Ethernet Handle B Status.*
- UB [ethernet\\_status\\_c](#)  
*Ethernet Handle C Status.*
- UB [ethernet\\_status\\_d](#)  
*Ethernet Handle D Status.*
- UB [ethernet\\_status\\_e](#)  
*Ethernet Handle E Status.*
- UB [ethernet\\_status\\_f](#)  
*Ethernet Handle F Status.*
- UB [ethernet\\_status\\_g](#)  
*Ethernet Handle G Status.*
- UB [ethernet\\_status\\_h](#)  
*Ethernet Handle H Status.*
- UB [error\\_code](#)  
*error code.*
- UB [thread\\_status](#)  
*thread status*
- UL [amplifier\\_status](#)  
*Amplifier Status.*
- UL [contour\\_segment\\_count](#)  
*Segment Count for Contour Mode.*
- UW [contour\\_buffer\\_available](#)  
*Buffer space remaining, Contour Mode.*
- UW [s\\_plane\\_segment\\_count](#)  
*segment count of coordinated move for S plane.*
- UW [s\\_plane\\_move\\_status](#)  
*coordinated move status for S plane.*
- SL [s\\_distance](#)  
*distance traveled in coordinated move for S plane.*
- UW [s\\_plane\\_buffer\\_available](#)  
*Buffer space remaining, S Plane.*
- UW [t\\_plane\\_segment\\_count](#)  
*segment count of coordinated move for T plane.*
- UW [t\\_plane\\_move\\_status](#)  
*Coordinated move status for T plane.*
- SL [t\\_distance](#)  
*distance traveled in coordinated move for T plane.*
- UW [t\\_plane\\_buffer\\_available](#)  
*Buffer space remaining, T Plane.*
- UW [axis\\_a\\_status](#)

- A axis status.*
- UB [axis\\_a\\_switches](#)  
*A axis switches.*
- UB [axis\\_a\\_stop\\_code](#)  
*A axis stop code.*
- SL [axis\\_a\\_reference\\_position](#)  
*A axis reference position.*
- SL [axis\\_a\\_motor\\_position](#)  
*A axis motor position.*
- SL [axis\\_a\\_position\\_error](#)  
*A axis position error.*
- SL [axis\\_a\\_aux\\_position](#)  
*A axis auxiliary position.*
- SL [axis\\_a\\_velocity](#)  
*A axis velocity.*
- SL [axis\\_a\\_torque](#)  
*A axis torque.*
- UW [axis\\_a\\_analog\\_in](#)  
*A axis analog input.*
- UB [axis\\_a\\_halls](#)  
*A Hall Input Status.*
- UB [axis\\_a\\_reserved](#)  
*Reserved.*
- SL [axis\\_a\\_variable](#)  
*A User-defined variable (ZA).*
- UW [axis\\_b\\_status](#)  
*B axis status.*
- UB [axis\\_b\\_switches](#)  
*B axis switches.*
- UB [axis\\_b\\_stop\\_code](#)  
*B axis stop code.*
- SL [axis\\_b\\_reference\\_position](#)  
*B axis reference position.*
- SL [axis\\_b\\_motor\\_position](#)  
*B axis motor position.*
- SL [axis\\_b\\_position\\_error](#)  
*B axis position error.*
- SL [axis\\_b\\_aux\\_position](#)  
*B axis auxiliary position.*
- SL [axis\\_b\\_velocity](#)  
*B axis velocity.*
- SL [axis\\_b\\_torque](#)  
*B axis torque.*
- UW [axis\\_b\\_analog\\_in](#)  
*B axis analog input.*
- UB [axis\\_b\\_halls](#)  
*B Hall Input Status.*
- UB [axis\\_b\\_reserved](#)  
*Reserved.*
- SL [axis\\_b\\_variable](#)  
*B User-defined variable (ZA).*

- UW [axis\\_c\\_status](#)  
*C axis status.*
- UB [axis\\_c\\_switches](#)  
*C axis switches.*
- UB [axis\\_c\\_stop\\_code](#)  
*C axis stop code.*
- SL [axis\\_c\\_reference\\_position](#)  
*C axis reference position.*
- SL [axis\\_c\\_motor\\_position](#)  
*C axis motor position.*
- SL [axis\\_c\\_position\\_error](#)  
*C axis position error.*
- SL [axis\\_c\\_aux\\_position](#)  
*C axis auxiliary position.*
- SL [axis\\_c\\_velocity](#)  
*C axis velocity.*
- SL [axis\\_c\\_torque](#)  
*C axis torque.*
- UW [axis\\_c\\_analog\\_in](#)  
*C axis analog input.*
- UB [axis\\_c\\_halls](#)  
*C Hall Input Status.*
- UB [axis\\_c\\_reserved](#)  
*Reserved.*
- SL [axis\\_c\\_variable](#)  
*C User-defined variable (ZA).*
- UW [axis\\_d\\_status](#)  
*D axis status.*
- UB [axis\\_d\\_switches](#)  
*D axis switches.*
- UB [axis\\_d\\_stop\\_code](#)  
*D axis stop code.*
- SL [axis\\_d\\_reference\\_position](#)  
*D axis reference position.*
- SL [axis\\_d\\_motor\\_position](#)  
*D axis motor position.*
- SL [axis\\_d\\_position\\_error](#)  
*D axis position error.*
- SL [axis\\_d\\_aux\\_position](#)  
*D axis auxiliary position.*
- SL [axis\\_d\\_velocity](#)  
*D axis velocity.*
- SL [axis\\_d\\_torque](#)  
*D axis torque.*
- UW [axis\\_d\\_analog\\_in](#)  
*D axis analog input.*
- UB [axis\\_d\\_halls](#)  
*D Hall Input Status.*
- UB [axis\\_d\\_reserved](#)  
*Reserved.*
- SL [axis\\_d\\_variable](#)



- D User-defined variable (ZA).*
- UW [axis\\_e\\_status](#)
  - E axis status.*
- UB [axis\\_e\\_switches](#)
  - E axis switches.*
- UB [axis\\_e\\_stop\\_code](#)
  - E axis stop code.*
- SL [axis\\_e\\_reference\\_position](#)
  - E axis reference position.*
- SL [axis\\_e\\_motor\\_position](#)
  - E axis motor position.*
- SL [axis\\_e\\_position\\_error](#)
  - E axis position error.*
- SL [axis\\_e\\_aux\\_position](#)
  - E axis auxiliary position.*
- SL [axis\\_e\\_velocity](#)
  - E axis velocity.*
- SL [axis\\_e\\_torque](#)
  - E axis torque.*
- UW [axis\\_e\\_analog\\_in](#)
  - E axis analog input.*
- UB [axis\\_e\\_halls](#)
  - E Hall Input Status.*
- UB [axis\\_e\\_reserved](#)
  - Reserved.*
- SL [axis\\_e\\_variable](#)
  - E User-defined variable (ZA).*
- UW [axis\\_f\\_status](#)
  - F axis status.*
- UB [axis\\_f\\_switches](#)
  - F axis switches.*
- UB [axis\\_f\\_stop\\_code](#)
  - F axis stop code.*
- SL [axis\\_f\\_reference\\_position](#)
  - F axis reference position.*
- SL [axis\\_f\\_motor\\_position](#)
  - F axis motor position.*
- SL [axis\\_f\\_position\\_error](#)
  - F axis position error.*
- SL [axis\\_f\\_aux\\_position](#)
  - F axis auxiliary position.*
- SL [axis\\_f\\_velocity](#)
  - F axis velocity.*
- SL [axis\\_f\\_torque](#)
  - F axis torque.*
- UW [axis\\_f\\_analog\\_in](#)
  - F axis analog input.*
- UB [axis\\_f\\_halls](#)
  - F Hall Input Status.*
- UB [axis\\_f\\_reserved](#)
  - Reserved.*

- SL [axis\\_f\\_variable](#)  
*F User-defined variable (ZA).*
- UW [axis\\_g\\_status](#)  
*G axis status.*
- UB [axis\\_g\\_switches](#)  
*G axis switches.*
- UB [axis\\_g\\_stop\\_code](#)  
*G axis stop code.*
- SL [axis\\_g\\_reference\\_position](#)  
*G axis reference position.*
- SL [axis\\_g\\_motor\\_position](#)  
*G axis motor position.*
- SL [axis\\_g\\_position\\_error](#)  
*G axis position error.*
- SL [axis\\_g\\_aux\\_position](#)  
*G axis auxiliary position.*
- SL [axis\\_g\\_velocity](#)  
*G axis velocity.*
- SL [axis\\_g\\_torque](#)  
*G axis torque.*
- UW [axis\\_g\\_analog\\_in](#)  
*G axis analog input.*
- UB [axis\\_g\\_halls](#)  
*G Hall Input Status.*
- UB [axis\\_g\\_reserved](#)  
*Reserved.*
- SL [axis\\_g\\_variable](#)  
*G User-defined variable (ZA).*
- UW [axis\\_h\\_status](#)  
*H axis status.*
- UB [axis\\_h\\_switches](#)  
*H axis switches.*
- UB [axis\\_h\\_stop\\_code](#)  
*H axis stop code.*
- SL [axis\\_h\\_reference\\_position](#)  
*H axis reference position.*
- SL [axis\\_h\\_motor\\_position](#)  
*H axis motor position.*
- SL [axis\\_h\\_position\\_error](#)  
*H axis position error.*
- SL [axis\\_h\\_aux\\_position](#)  
*H axis auxiliary position.*
- SL [axis\\_h\\_velocity](#)  
*H axis velocity.*
- SL [axis\\_h\\_torque](#)  
*H axis torque.*
- UW [axis\\_h\\_analog\\_in](#)  
*H axis analog input.*
- UB [axis\\_h\\_halls](#)  
*H Hall Input Status.*
- UB [axis\\_h\\_reserved](#)  
*Reserved.*
- SL [axis\\_h\\_variable](#)  
*H User-defined variable (ZA).*

### 7.6.1 Detailed Description

Data record struct for DMC-4000 controllers, including 4000, 4200, 4103, and 500x0.

Definition at line 31 of file `gclib_record.h`.

The documentation for this struct was generated from the following file:

- [gclib\\_record.h](#)

## 7.7 GDataRecord47000\_ENC Struct Reference

Data record struct for RIO-471xx and RIO-472xx PLCs. Includes encoder fields.

```
#include <gclib_record.h>
```

### Data Fields

- UB [header\\_0](#)  
*1st Byte of Header.*
- UB [header\\_1](#)  
*2nd Byte of Header.*
- UB [header\\_2](#)  
*3rd Byte of Header.*
- UB [header\\_3](#)  
*4th Byte of Header.*
- UW [sample\\_number](#)  
*Sample number.*
- UB [error\\_code](#)  
*Error code.*
- UB [general\\_status](#)  
*General status.*
- UW [output\\_analog\\_0](#)  
*Analog output 0.*
- UW [output\\_analog\\_1](#)  
*Analog output 1.*
- UW [output\\_analog\\_2](#)  
*Analog output 2.*
- UW [output\\_analog\\_3](#)  
*Analog output 3.*
- UW [output\\_analog\\_4](#)  
*Analog output 4.*
- UW [output\\_analog\\_5](#)  
*Analog output 5.*
- UW [output\\_analog\\_6](#)  
*Analog output 6.*
- UW [output\\_analog\\_7](#)  
*Analog output 7.*
- UW [input\\_analog\\_0](#)  
*Analog input 0.*
- UW [input\\_analog\\_1](#)  
*Analog input 1.*

- UW [input\\_analog\\_2](#)  
*Analog input 2.*
- UW [input\\_analog\\_3](#)  
*Analog input 3.*
- UW [input\\_analog\\_4](#)  
*Analog input 4.*
- UW [input\\_analog\\_5](#)  
*Analog input 5.*
- UW [input\\_analog\\_6](#)  
*Analog input 6.*
- UW [input\\_analog\\_7](#)  
*Analog input 7.*
- UW [output\\_bank\\_0](#)  
*Digital outputs 0-15;.*
- UW [input\\_bank\\_0](#)  
*Digital inputs 0-15;.*
- UL [pulse\\_count\\_0](#)  
*Pulse counter (see PC).*
- SL [zc\\_variable](#)  
*ZC User-defined variable (see ZC).*
- SL [zd\\_variable](#)  
*ZD User-defined variable (see ZD).*
- SL [encoder\\_0](#)  
*Encoder channel 0. Data only valid for parts with -BISS, -QUAD, or -SSI.*
- SL [encoder\\_1](#)  
*Encoder channel 1. Data only valid for parts with -BISS, -QUAD, or -SSI.*
- SL [encoder\\_2](#)  
*Encoder channel 2. Data only valid for parts with -BISS, -QUAD, or -SSI.*
- SL [encoder\\_3](#)  
*Encoder channel 3. Data only valid for parts with -BISS, -QUAD, or -SSI.*

### 7.7.1 Detailed Description

Data record struct for RIO-471xx and RIO-472xx PLCs. Includes encoder fields.

Definition at line 866 of file `gclib_record.h`.

The documentation for this struct was generated from the following file:

- [gclib\\_record.h](#)

## 7.8 GDataRecord47162 Struct Reference

Data record struct for RIO-47162.

```
#include <gclib_record.h>
```

## Data Fields

- UB [header\\_0](#)  
*1st Byte of Header.*
- UB [header\\_1](#)  
*2nd Byte of Header.*
- UB [header\\_2](#)  
*3rd Byte of Header.*
- UB [header\\_3](#)  
*4th Byte of Header.*
- UW [sample\\_number](#)  
*Sample number.*
- UB [error\\_code](#)  
*Error code.*
- UB [general\\_status](#)  
*General status.*
- UW [output\\_analog\\_0](#)  
*Analog output 0.*
- UW [output\\_analog\\_1](#)  
*Analog output 1.*
- UW [output\\_analog\\_2](#)  
*Analog output 2.*
- UW [output\\_analog\\_3](#)  
*Analog output 3.*
- UW [output\\_analog\\_4](#)  
*Analog output 4.*
- UW [output\\_analog\\_5](#)  
*Analog output 5.*
- UW [output\\_analog\\_6](#)  
*Analog output 6.*
- UW [output\\_analog\\_7](#)  
*Analog output 7.*
- UW [input\\_analog\\_0](#)  
*Analog input 0.*
- UW [input\\_analog\\_1](#)  
*Analog input 1.*
- UW [input\\_analog\\_2](#)  
*Analog input 2.*
- UW [input\\_analog\\_3](#)  
*Analog input 3.*
- UW [input\\_analog\\_4](#)  
*Analog input 4.*
- UW [input\\_analog\\_5](#)  
*Analog input 5.*
- UW [input\\_analog\\_6](#)  
*Analog input 6.*
- UW [input\\_analog\\_7](#)  
*Analog input 7.*
- UB [output\\_byte\\_0](#)  
*Digital outputs 0-7.*
- UB [output\\_byte\\_1](#)

- Digital outputs 8-15.*
  - UB [output\\_byte\\_2](#)
  - Digital outputs 16-23.*
  - UB [input\\_byte\\_0](#)
  - Digital inputs 0-7.*
  - UB [input\\_byte\\_1](#)
  - Digital inputs 8-15.*
  - UB [input\\_byte\\_2](#)
  - Digital inputs 16-23.*
  - UB [input\\_byte\\_3](#)
  - Digital inputs 24-31.*
  - UB [input\\_byte\\_4](#)
  - Digital inputs 32-39.*
  - UL [pulse\\_count\\_0](#)
  - Pulse counter (see PC).*
  - SL [zc\\_variable](#)
  - ZC User-defined variable (see ZC).*
  - SL [zd\\_variable](#)
  - ZD User-defined variable (see ZD).*
  - SL [encoder\\_0](#)
  - Encoder channel 0. Data only valid for parts with -BISS, -QUAD, or -SSI.*
  - SL [encoder\\_1](#)
  - Encoder channel 1. Data only valid for parts with -BISS, -QUAD, or -SSI.*
  - SL [encoder\\_2](#)
  - Encoder channel 2. Data only valid for parts with -BISS, -QUAD, or -SSI.*
  - SL [encoder\\_3](#)
  - Encoder channel 3. Data only valid for parts with -BISS, -QUAD, or -SSI.*

### 7.8.1 Detailed Description

Data record struct for RIO-47162.

Definition at line 1015 of file `gclib_record.h`.

The documentation for this struct was generated from the following file:

- [gclib\\_record.h](#)

## 7.9 GDataRecord47300\_24EX Struct Reference

Data record struct for RIO-47300 with 24EX I/O daughter board.

```
#include <gclib_record.h>
```

### Data Fields

- UB [header\\_0](#)
- 1st Byte of Header.*
- UB [header\\_1](#)
- 2nd Byte of Header.*
- UB [header\\_2](#)

- 3rd Byte of Header.*
- UB [header\\_3](#)
  - 4th Byte of Header.*
- UW [sample\\_number](#)
  - Sample number.*
- UB [error\\_code](#)
  - Error code.*
- UB [general\\_status](#)
  - General status.*
- UW [output\\_analog\\_0](#)
  - Analog output 0.*
- UW [output\\_analog\\_1](#)
  - Analog output 1.*
- UW [output\\_analog\\_2](#)
  - Analog output 2.*
- UW [output\\_analog\\_3](#)
  - Analog output 3.*
- UW [output\\_analog\\_4](#)
  - Analog output 4.*
- UW [output\\_analog\\_5](#)
  - Analog output 5.*
- UW [output\\_analog\\_6](#)
  - Analog output 6.*
- UW [output\\_analog\\_7](#)
  - Analog output 7.*
- UW [input\\_analog\\_0](#)
  - Analog input 0.*
- UW [input\\_analog\\_1](#)
  - Analog input 1.*
- UW [input\\_analog\\_2](#)
  - Analog input 2.*
- UW [input\\_analog\\_3](#)
  - Analog input 3.*
- UW [input\\_analog\\_4](#)
  - Analog input 4.*
- UW [input\\_analog\\_5](#)
  - Analog input 5.*
- UW [input\\_analog\\_6](#)
  - Analog input 6.*
- UW [input\\_analog\\_7](#)
  - Analog input 7.*
- UW [output\\_bank\\_0](#)
  - Digital outputs 0-15.*
- UW [output\\_bank\\_1](#)
  - Digital outputs 16-23.*
- UW [input\\_bank\\_0](#)
  - Digital inputs 0-15.*
- UW [input\\_bank\\_1](#)
  - Digital inputs 16-23.*
- UL [pulse\\_count\\_0](#)
  - Pulse counter (see PC)8.*

- SL [zc\\_variable](#)  
*ZC User-defined variable (see ZC).*
- SL [zd\\_variable](#)  
*ZD User-defined variable (see ZD).*
- UW [output\\_bank\\_2](#)  
*Digital outputs 24-39. Data only valid for parts with 24EXOUT.*
- UW [output\\_bank\\_3](#)  
*Digital outputs 40-47. Data only valid for parts with 24EXOUT.*
- UW [input\\_bank\\_2](#)  
*Digital inputs 24-39. Data only valid for parts with 24EXIN.*
- UW [input\\_bank\\_3](#)  
*Digital inputs 40-47. Data only valid for parts with 24EXIN.*

### 7.9.1 Detailed Description

Data record struct for RIO-47300 with 24EX I/O daughter board.

Definition at line 964 of file `gclib_record.h`.

The documentation for this struct was generated from the following file:

- [gclib\\_record.h](#)

## 7.10 GDataRecord47300\_ENC Struct Reference

Data record struct for RIO-47300. Includes encoder fields.

```
#include <gclib_record.h>
```

### Data Fields

- UB [header\\_0](#)  
*1st Byte of Header.*
- UB [header\\_1](#)  
*2nd Byte of Header.*
- UB [header\\_2](#)  
*3rd Byte of Header.*
- UB [header\\_3](#)  
*4th Byte of Header.*
- UW [sample\\_number](#)  
*Sample number.*
- UB [error\\_code](#)  
*Error code.*
- UB [general\\_status](#)  
*General status.*
- UW [output\\_analog\\_0](#)  
*Analog output 0.*
- UW [output\\_analog\\_1](#)  
*Analog output 1.*
- UW [output\\_analog\\_2](#)  
*Analog output 2.*



- UW [output\\_analog\\_3](#)  
*Analog output 3.*
- UW [output\\_analog\\_4](#)  
*Analog output 4.*
- UW [output\\_analog\\_5](#)  
*Analog output 5.*
- UW [output\\_analog\\_6](#)  
*Analog output 6.*
- UW [output\\_analog\\_7](#)  
*Analog output 7.*
- UW [input\\_analog\\_0](#)  
*Analog input 0.*
- UW [input\\_analog\\_1](#)  
*Analog input 1.*
- UW [input\\_analog\\_2](#)  
*Analog input 2.*
- UW [input\\_analog\\_3](#)  
*Analog input 3.*
- UW [input\\_analog\\_4](#)  
*Analog input 4.*
- UW [input\\_analog\\_5](#)  
*Analog input 5.*
- UW [input\\_analog\\_6](#)  
*Analog input 6.*
- UW [input\\_analog\\_7](#)  
*Analog input 7.*
- UW [output\\_bank\\_0](#)  
*Digital outputs 0-15;.*
- UW [output\\_bank\\_1](#)  
*Digital outputs 16-23;.*
- UW [input\\_bank\\_0](#)  
*Digital inputs 0-15;.*
- UW [input\\_bank\\_1](#)  
*Digital inputs 16-23;.*
- UL [pulse\\_count\\_0](#)  
*Pulse counter (see PC).*
- SL [zc\\_variable](#)  
*ZC User-defined variable (see ZC).*
- SL [zd\\_variable](#)  
*ZD User-defined variable (see ZD).*
- SL [encoder\\_0](#)  
*Encoder channel 0. Data only valid for parts with -BISS, -QUAD, or -SSI.*
- SL [encoder\\_1](#)  
*Encoder channel 1. Data only valid for parts with -BISS, -QUAD, or -SSI.*
- SL [encoder\\_2](#)  
*Encoder channel 2. Data only valid for parts with -BISS, -QUAD, or -SSI.*
- SL [encoder\\_3](#)  
*Encoder channel 3. Data only valid for parts with -BISS, -QUAD, or -SSI.*

### 7.10.1 Detailed Description

Data record struct for RIO-47300. Includes encoder fields.

Definition at line 914 of file `gclib_record.h`.

The documentation for this struct was generated from the following file:

- [gclib\\_record.h](#)

## 7.11 GDataRecord52000 Struct Reference

Data record struct for DMC-52000 controller. Same as DMC-4000, with bank indicator added at byte 40.

```
#include <gclib_record.h>
```

### Data Fields

- UB [header\\_0](#)  
*1st Byte of Header.*
- UB [header\\_1](#)  
*2nd Byte of Header.*
- UB [header\\_2](#)  
*3rd Byte of Header.*
- UB [header\\_3](#)  
*4th Byte of Header.*
- UW [sample\\_number](#)  
*sample number.*
- UB [input\\_bank\\_0](#)  
*general input bank 0 (inputs 1-8).*
- UB [input\\_bank\\_1](#)  
*general input bank 1 (inputs 9-16).*
- UB [input\\_bank\\_2](#)  
*general input bank 2 (inputs 17-24).*
- UB [input\\_bank\\_3](#)  
*general input bank 3 (inputs 25-32).*
- UB [input\\_bank\\_4](#)  
*general input bank 4 (inputs 33-40).*
- UB [input\\_bank\\_5](#)  
*general input bank 5 (inputs 41-48).*
- UB [input\\_bank\\_6](#)  
*general input bank 6 (inputs 49-56).*
- UB [input\\_bank\\_7](#)  
*general input bank 7 (inputs 57-64).*
- UB [input\\_bank\\_8](#)  
*general input bank 8 (inputs 65-72).*
- UB [input\\_bank\\_9](#)  
*general input bank 9 (inputs 73-80).*
- UB [output\\_bank\\_0](#)  
*general output bank 0 (outputs 1-8).*
- UB [output\\_bank\\_1](#)  
*general output bank 1 (outputs 9-16).*

- UB [output\\_bank\\_2](#)  
*general output bank 2 (outputs 17-24).*
- UB [output\\_bank\\_3](#)  
*general output bank 3 (outputs 25-32).*
- UB [output\\_bank\\_4](#)  
*general output bank 4 (outputs 33-40).*
- UB [output\\_bank\\_5](#)  
*general output bank 5 (outputs 41-48).*
- UB [output\\_bank\\_6](#)  
*general output bank 6 (outputs 49-56).*
- UB [output\\_bank\\_7](#)  
*general output bank 7 (outputs 57-64).*
- UB [output\\_bank\\_8](#)  
*general output bank 8 (outputs 65-72).*
- UB [output\\_bank\\_9](#)  
*general output bank 9 (outputs 73-80).*
- SW [reserved\\_0](#)  
*Reserved.*
- SW [reserved\\_2](#)  
*Reserved.*
- SW [reserved\\_4](#)  
*Reserved.*
- SW [reserved\\_6](#)  
*Reserved.*
- SW [reserved\\_8](#)  
*Reserved.*
- SW [reserved\\_10](#)  
*Reserved.*
- SW [reserved\\_12](#)  
*Reserved.*
- UB [ethercat\\_bank](#)  
*EtherCAT Bank Indicator.*
- UB [reserved\\_14](#)  
*Reserved.*
- UB [ethernet\\_status\\_a](#)  
*Ethernet Handle A Status.*
- UB [ethernet\\_status\\_b](#)  
*Ethernet Handle B Status.*
- UB [ethernet\\_status\\_c](#)  
*Ethernet Handle C Status.*
- UB [ethernet\\_status\\_d](#)  
*Ethernet Handle D Status.*
- UB [ethernet\\_status\\_e](#)  
*Ethernet Handle E Status.*
- UB [ethernet\\_status\\_f](#)  
*Ethernet Handle F Status.*
- UB [ethernet\\_status\\_g](#)  
*Ethernet Handle G Status.*
- UB [ethernet\\_status\\_h](#)  
*Ethernet Handle H Status.*
- UB [error\\_code](#)

- error code.*
- UB [thread\\_status](#)
  - thread status*
- UL [amplifier\\_status](#)
  - Amplifier Status.*
- UL [contour\\_segment\\_count](#)
  - Segment Count for Contour Mode.*
- UW [contour\\_buffer\\_available](#)
  - Buffer space remaining, Contour Mode.*
- UW [s\\_plane\\_segment\\_count](#)
  - segment count of coordinated move for S plane.*
- UW [s\\_plane\\_move\\_status](#)
  - coordinated move status for S plane.*
- SL [s\\_distance](#)
  - distance traveled in coordinated move for S plane.*
- UW [s\\_plane\\_buffer\\_available](#)
  - Buffer space remaining, S Plane.*
- UW [t\\_plane\\_segment\\_count](#)
  - segment count of coordinated move for T plane.*
- UW [t\\_plane\\_move\\_status](#)
  - Coordinated move status for T plane.*
- SL [t\\_distance](#)
  - distance traveled in coordinated move for T plane.*
- UW [t\\_plane\\_buffer\\_available](#)
  - Buffer space remaining, T Plane.*
- UW [axis\\_a\\_status](#)
  - A axis status.*
- UB [axis\\_a\\_switches](#)
  - A axis switches.*
- UB [axis\\_a\\_stop\\_code](#)
  - A axis stop code.*
- SL [axis\\_a\\_reference\\_position](#)
  - A axis reference position.*
- SL [axis\\_a\\_motor\\_position](#)
  - A axis motor position.*
- SL [axis\\_a\\_position\\_error](#)
  - A axis position error.*
- SL [axis\\_a\\_aux\\_position](#)
  - A axis auxiliary position.*
- SL [axis\\_a\\_velocity](#)
  - A axis velocity.*
- SL [axis\\_a\\_torque](#)
  - A axis torque.*
- UW [axis\\_a\\_analog\\_in](#)
  - A axis analog input.*
- UB [axis\\_a\\_halls](#)
  - A Hall Input Status.*
- UB [axis\\_a\\_reserved](#)
  - Reserved.*
- SL [axis\\_a\\_variable](#)
  - A User-defined variable (ZA).*

- UW [axis\\_b\\_status](#)  
*B axis status.*
- UB [axis\\_b\\_switches](#)  
*B axis switches.*
- UB [axis\\_b\\_stop\\_code](#)  
*B axis stop code.*
- SL [axis\\_b\\_reference\\_position](#)  
*B axis reference position.*
- SL [axis\\_b\\_motor\\_position](#)  
*B axis motor position.*
- SL [axis\\_b\\_position\\_error](#)  
*B axis position error.*
- SL [axis\\_b\\_aux\\_position](#)  
*B axis auxiliary position.*
- SL [axis\\_b\\_velocity](#)  
*B axis velocity.*
- SL [axis\\_b\\_torque](#)  
*B axis torque.*
- UW [axis\\_b\\_analog\\_in](#)  
*B axis analog input.*
- UB [axis\\_b\\_halls](#)  
*B Hall Input Status.*
- UB [axis\\_b\\_reserved](#)  
*Reserved.*
- SL [axis\\_b\\_variable](#)  
*B User-defined variable (ZA).*
- UW [axis\\_c\\_status](#)  
*C axis status.*
- UB [axis\\_c\\_switches](#)  
*C axis switches.*
- UB [axis\\_c\\_stop\\_code](#)  
*C axis stop code.*
- SL [axis\\_c\\_reference\\_position](#)  
*C axis reference position.*
- SL [axis\\_c\\_motor\\_position](#)  
*C axis motor position.*
- SL [axis\\_c\\_position\\_error](#)  
*C axis position error.*
- SL [axis\\_c\\_aux\\_position](#)  
*C axis auxiliary position.*
- SL [axis\\_c\\_velocity](#)  
*C axis velocity.*
- SL [axis\\_c\\_torque](#)  
*C axis torque.*
- UW [axis\\_c\\_analog\\_in](#)  
*C axis analog input.*
- UB [axis\\_c\\_halls](#)  
*C Hall Input Status.*
- UB [axis\\_c\\_reserved](#)  
*Reserved.*
- SL [axis\\_c\\_variable](#)

- C User-defined variable (ZA).*
- UW [axis\\_d\\_status](#)
  - D axis status.*
- UB [axis\\_d\\_switches](#)
  - D axis switches.*
- UB [axis\\_d\\_stop\\_code](#)
  - D axis stop code.*
- SL [axis\\_d\\_reference\\_position](#)
  - D axis reference position.*
- SL [axis\\_d\\_motor\\_position](#)
  - D axis motor position.*
- SL [axis\\_d\\_position\\_error](#)
  - D axis position error.*
- SL [axis\\_d\\_aux\\_position](#)
  - D axis auxiliary position.*
- SL [axis\\_d\\_velocity](#)
  - D axis velocity.*
- SL [axis\\_d\\_torque](#)
  - D axis torque.*
- UW [axis\\_d\\_analog\\_in](#)
  - D axis analog input.*
- UB [axis\\_d\\_halls](#)
  - D Hall Input Status.*
- UB [axis\\_d\\_reserved](#)
  - Reserved.*
- SL [axis\\_d\\_variable](#)
  - D User-defined variable (ZA).*
- UW [axis\\_e\\_status](#)
  - E axis status.*
- UB [axis\\_e\\_switches](#)
  - E axis switches.*
- UB [axis\\_e\\_stop\\_code](#)
  - E axis stop code.*
- SL [axis\\_e\\_reference\\_position](#)
  - E axis reference position.*
- SL [axis\\_e\\_motor\\_position](#)
  - E axis motor position.*
- SL [axis\\_e\\_position\\_error](#)
  - E axis position error.*
- SL [axis\\_e\\_aux\\_position](#)
  - E axis auxiliary position.*
- SL [axis\\_e\\_velocity](#)
  - E axis velocity.*
- SL [axis\\_e\\_torque](#)
  - E axis torque.*
- UW [axis\\_e\\_analog\\_in](#)
  - E axis analog input.*
- UB [axis\\_e\\_halls](#)
  - E Hall Input Status.*
- UB [axis\\_e\\_reserved](#)
  - Reserved.*

- SL [axis\\_e\\_variable](#)  
*E User-defined variable (ZA).*
- UW [axis\\_f\\_status](#)  
*F axis status.*
- UB [axis\\_f\\_switches](#)  
*F axis switches.*
- UB [axis\\_f\\_stop\\_code](#)  
*F axis stop code.*
- SL [axis\\_f\\_reference\\_position](#)  
*F axis reference position.*
- SL [axis\\_f\\_motor\\_position](#)  
*F axis motor position.*
- SL [axis\\_f\\_position\\_error](#)  
*F axis position error.*
- SL [axis\\_f\\_aux\\_position](#)  
*F axis auxiliary position.*
- SL [axis\\_f\\_velocity](#)  
*F axis velocity.*
- SL [axis\\_f\\_torque](#)  
*F axis torque.*
- UW [axis\\_f\\_analog\\_in](#)  
*F axis analog input.*
- UB [axis\\_f\\_halls](#)  
*F Hall Input Status.*
- UB [axis\\_f\\_reserved](#)  
*Reserved.*
- SL [axis\\_f\\_variable](#)  
*F User-defined variable (ZA).*
- UW [axis\\_g\\_status](#)  
*G axis status.*
- UB [axis\\_g\\_switches](#)  
*G axis switches.*
- UB [axis\\_g\\_stop\\_code](#)  
*G axis stop code.*
- SL [axis\\_g\\_reference\\_position](#)  
*G axis reference position.*
- SL [axis\\_g\\_motor\\_position](#)  
*G axis motor position.*
- SL [axis\\_g\\_position\\_error](#)  
*G axis position error.*
- SL [axis\\_g\\_aux\\_position](#)  
*G axis auxiliary position.*
- SL [axis\\_g\\_velocity](#)  
*G axis velocity.*
- SL [axis\\_g\\_torque](#)  
*G axis torque.*
- UW [axis\\_g\\_analog\\_in](#)  
*G axis analog input.*
- UB [axis\\_g\\_halls](#)  
*G Hall Input Status.*
- UB [axis\\_g\\_reserved](#)

- *Reserved.*
- SL [axis\\_g\\_variable](#)  
*G User-defined variable (ZA).*
- UW [axis\\_h\\_status](#)  
*H axis status.*
- UB [axis\\_h\\_switches](#)  
*H axis switches.*
- UB [axis\\_h\\_stop\\_code](#)  
*H axis stop code.*
- SL [axis\\_h\\_reference\\_position](#)  
*H axis reference position.*
- SL [axis\\_h\\_motor\\_position](#)  
*H axis motor position.*
- SL [axis\\_h\\_position\\_error](#)  
*H axis position error.*
- SL [axis\\_h\\_aux\\_position](#)  
*H axis auxiliary position.*
- SL [axis\\_h\\_velocity](#)  
*H axis velocity.*
- SL [axis\\_h\\_torque](#)  
*H axis torque.*
- UW [axis\\_h\\_analog\\_in](#)  
*H axis analog input.*
- UB [axis\\_h\\_halls](#)  
*H Hall Input Status.*
- UB [axis\\_h\\_reserved](#)  
*Reserved.*
- SL [axis\\_h\\_variable](#)  
*H User-defined variable (ZA).*

### 7.11.1 Detailed Description

Data record struct for DMC-52000 controller. Same as DMC-4000, with bank indicator added at byte 40.

Definition at line 214 of file `gclib_record.h`.

The documentation for this struct was generated from the following file:

- [gclib\\_record.h](#)

## 7.12 H\_ArrayData Struct Reference

Structure to create a linked list for array data.

### Data Fields

- char **name** [16]
- char \* **data**
- int **len**
- int **elements**
- int **index**
- struct [H\\_ArrayData](#) \* **next**
- struct [H\\_ArrayData](#) \* **tail**
- int **count**



### 7.12.1 Detailed Description

Structure to create a linked list for array data.

Definition at line 18 of file arrays.c.

The documentation for this struct was generated from the following file:

- [arrays.c](#)



## Chapter 8

# File Documentation

### 8.1 arrays.c File Reference

```
#include "gclibo.h"
#include <stdlib.h>
#include <string.h>
#include <stdio.h>
#include <math.h>
#include <zlib.h>
```

#### Data Structures

- struct [H\\_ArrayData](#)  
*Structure to create a linked list for array data.*

#### Typedefs

- typedef struct [H\\_ArrayData](#) **ArrayNode**

#### Functions

- void [H\\_InitArrayNode](#) ([ArrayNode](#) \*node)  
*Function to initialize the memory of a new node.*
- [GReturn H\\_AddArray](#) ([ArrayNode](#) \*head, char \*name, char \*data)  
*Add an ArrayData node to the linked list.*
- void [H\\_FreeArrays](#) ([ArrayNode](#) \*node)  
*Frees all memory downstream of node. After passing list head to this function, all memory is freed and the head node is invalid.*
- [GReturn H\\_UploadArrayToList](#) ([GCon](#) g, [ArrayNode](#) \*head, char \*name)  
*Uploads a particular array and adds it to the linked list.*
- [GReturn H\\_CreateArrayNode](#) ([ArrayNode](#) \*head, char \*name)  
*Creates a buffer on the heap to write data, and adds it to the linked list.*
- [GReturn H\\_ArrayAddElement](#) ([ArrayNode](#) \*node, [GCStringIn](#) element)  
*Adds an array element to an array node.*
- [GReturn H\\_DownloadArraysFromList](#) ([GCon](#) g, [ArrayNode](#) \*head, int fail)  
*Walks through the array linked list, downloading each.*

- [GReturn H\\_WriteArrayCsv](#) ([ArrayNode](#) \*head, [GCStringIn](#) file\_path)  
*After filling the array list, this function is called to write out the CSV.*
- [GReturn H\\_ArrayDownloadFromMemory](#) ([GCon](#) g, const char \*array\_data, int fail)  
*Helper function to download a block of arrays to the controller.*
- [GReturn H\\_DownloadData](#) ([GCon](#) g, const char \*data, int fail)  
*Helper function to send a string of commands to the controller, one at a time.*
- char \* [H\\_FindSector](#) (char \*arr, int arr\_size, int index)  
*Function that returns a pointer to the start of the specified sector in the GCB data.*
- [GReturn GCALL GArrayDownloadFile](#) ([GCon](#) g, [GCStringIn](#) file\_path)  
*Array download from file.*
- [GReturn GCALL GArrayUploadFile](#) ([GCon](#) g, [GCStringIn](#) file\_path, [GCStringIn](#) names)  
*Array upload to file.*
- [GReturn GCALL GSetupDownloadFile](#) ([GCon](#) g, [GCStringIn](#) file\_path, [GOption](#) options, [GCStringOut](#) info, [GSize](#) info\_len)  
*Download a saved controller configuration from a file.*

### 8.1.1 Detailed Description

Function calls for uploading and downloading arrays with CSV files. Also contains functions for support of [GSetupDownloadFile\(\)](#).

#### Warning

All helper functions (names beginning with H\_) are subject to change without notice

### 8.1.2 Function Documentation

#### 8.1.2.1 GArrayDownloadFile()

```
GReturn GCALL GArrayDownloadFile (
    GCon g,
    GCStringIn file_path )
```

Array download from file.

Downloads a csv file containing array data at `file_path`. If the arrays don't exist, they will be dimensioned.

#### Parameters

<i>g</i>	Connection's handle.
<i>file_path</i>	Null-terminated string containing the path to the array file.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_arrays.cpp` for an example.

Definition at line 378 of file `arrays.c`.

References `G_BAD_FILE`, `G_NO_ERROR`, and `H_ArrayDownloadFromMemory()`.

## 8.1.2.2 GArrayUploadFile()

```
GReturn GCALL GArrayUploadFile (
    GCon g,
    GCStringIn file_path,
    GCStringIn names )
```

Array upload to file.

Uploads the entire controller array table or a subset and saves the data as a csv file specified by `file_path`.

## Parameters

<i>g</i>	Connection's handle.
<i>file_path</i>	Null-terminated string containing the path to the array file, file will be overwritten if it exists.
<i>names</i>	Null-terminated string containing the arrays to upload, delimited with space. "" or null uploads all arrays listed in LA.

## Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_arrays.cpp` for an example.

Definition at line 406 of file `arrays.c`.

References `G_NO_ERROR`, `GCmdT()`, `H_FreeArrays()`, `H_InitArrayNode()`, `H_UploadArrayToList()`, and `H_WriteArrayCsv()`.

## 8.1.2.3 GSetupDownloadFile()

```
GReturn GCALL GSetupDownloadFile (
    GCon g,
    GCStringIn file_path,
    GOption options,
    GCStringOut info,
    GSize info_len )
```

Download a saved controller configuration from a file.

## Parameters

<i>g</i>	Connection's handle.
<i>file_path</i>	Null-terminated string containing the path to the gcb file.
<i>options</i>	Bit mask to determine what configuration data to download. See below for all options.
<i>info</i>	Optional pointer to a buffer to store the controller info. If no info is needed, specify as NULL.
<i>info_len</i>	Length of optional info buffer. If no info is needed, specify as NULL.

## Returns

The success status or error code of the function. If the options parameter is set to 0, the return value will be a bit mask indicating which sectors in the specified GCB are not empty. Otherwise, see [gclib\\_errors.h](#) for possible error values.

**Note**

By default, [GSetupDownloadFile\(\)](#) will stop immediately if an error is encountered downloading data. This can be overridden in the options parameter. For example, you may want to override the error if you have a backup from an 8-axis controller and want to restore the parameters for the first 4 axes to a 4-axis controller.

If both info and info\_len are not NULL, the controller information will be provided regardless of the options parameter.

The options parameter is a bit mask. If options is set to 0, [GSetupDownloadFile\(\)](#) will return a bit mask indicating which sectors in the specified GCB are not empty. The following contains a list of all currently available options:

Bit	Value	Function	Description
1	0x0002	Restore parameters	<b>KPA, KIA, KDA</b> , etc...
3	0x0008	Restore variables	Variables are listed by the <b>LV</b> command
4	0x0010	Restore arrays	Arrays are listed by the <b>LA</b> command
5	0x0020	Restore program	The program is listed by the <b>LS</b> command
31	0x8000	Ignore errors	Ignore invalid parameter errors and continue restoring data. <a href="#">GSetupDownloadFile()</a> will still stop immediately if a connection issue or other fatal error is encountered

**Usage example:**

```
GCon g;
GOption opt = 0;

GCStringOut info;
GSize info_len = 4096;

GReturn rc = GOpen("192.168.0.50", &g);
if (rc) return rc;

// Call GSetupDownloadFile() with options set to 0 so we can get the non-empty sector bit mask
opt = GSetupDownloadFile(g, "C:\\path\\to\\gcb\\file.gcb", 0, NULL, NULL);

info = (GCStringOut)malloc(sizeof(GCStringOut) * info_len);

// Call GSetupDownloadFile() with the bit mask returned in the previous function call
rc = GSetupDownloadFile(g, "C:\\path\\to\\gcb\\file.gcb", opt, info, info_len);

printf("Info:\n\n%s", info);

GClose(g);

free(info);
return rc;
```

Definition at line 473 of file arrays.c.

References [G\\_BAD\\_FILE](#), [G\\_NO\\_ERROR](#), [GProgramDownload\(\)](#), [H\\_ArrayDownloadFromMemory\(\)](#), [H\\_↔DownloadData\(\)](#), and [H\\_FindSector\(\)](#).

**8.1.2.4 H\_DownloadArraysFromList()**

```
GReturn H_DownloadArraysFromList (
    GCon g,
    ArrayNode * head,
    int fail )
```

Walks through the array linked list, downloading each.

**Warning**

This function will call DA and DM which modifies the controllers' array table. This should NOT be done while running record array (see RA/RC/RD) or while using the MODBUS array sharing feature (see ME). To prevent any possibility of array table issues, dimension all the arrays used in the applications with the appropriate lengths before use and comment out the *array table modification* section below.

Definition at line 134 of file arrays.c.

References G\_BAD\_RESPONSE\_QUESTION\_MARK, G\_BOUNDS, G\_NO\_ERROR, GArrayDownload(), and GCmd().

Referenced by H\_ArrayDownloadFromMemory().

**8.2 gclib.h File Reference**

```
#include "gclib_record.h"
#include "gclib_errors.h"
```

**Macros**

- #define **GCLIB\_DLL\_EXPORTED**
- #define **GCALL** \_\_stdcall  
*Specify calling convention for Windows.*
- #define **G\_DR** 1  
*Value for GRecord() method variable for acquiring a data record via DR mode.*
- #define **G\_QR** 0  
*Value for GRecord() method variable for acquiring a data record via QR mode.*
- #define **G\_BOUNDS** -1  
*For functions that take range options, e.g. GArrayUpload(), use this value for full range.*
- #define **G\_CR** 0  
*For GArrayUpload(), use this value in the delim field to delimit with carriage returns.*
- #define **G\_COMMA** 1  
*For GArrayUpload(), use this value in the delim field to delimit with commas.*
- #define **G\_UTIL\_TIMEOUT** 1  
*GUtility(), Access to timeout.*
- #define **G\_UTIL\_TIMEOUT\_OVERRIDE** 2  
*GUtility(), read/write access to timeout override.*
- #define **G\_USE\_INITIAL\_TIMEOUT** -1  
*GUtility(), for timeout override. Set G\_UTIL\_TIMEOUT\_OVERRIDE to this value to use initial GOpen() timeout (---timeout).*
- #define **G\_UTIL\_VERSION** 128  
*GUtility(), get a library version string.*
- #define **G\_UTIL\_INFO** 129  
*GUtility(), get a connection info string.*
- #define **G\_UTIL\_SLEEP** 130  
*GUtility(), specify an interval to sleep.*
- #define **G\_UTIL\_ADDRESSES** 131  
*GUtility(), get a list of available connections.*
- #define **G\_UTIL\_IPREQUEST** 132  
*GUtility(), get a list of hardware requesting IPs.*
- #define **G\_UTIL\_ASSIGN** 133

- *GUtility()*, assign IP addresses via Boot-P reply.
- #define **G\_UTIL\_DEVICE\_INITIALIZE** 134  
*GUtility()*, sends CF, CW, EO etc. to initialize the connection. Useful after RS or other reset.
- #define **G\_UTIL\_PING** 135  
*GUtility()*, uses ICMP ping to determine if an IP address is reachable and assigned.
- #define **G\_UTIL\_ERROR\_CONTEXT** 136  
*GUtility()*, provides additional error context, where available.
- #define **G\_UTIL\_GCAPS\_HOST** 256
- #define **G\_UTIL\_GCAPS\_VERSION** 257  
*GUtility()*, get the version of the *gcaps* server.
- #define **G\_UTIL\_GCAPS\_KEEPAIVE** 258  
*GUtility()*, *gcaps* server keepalive.
- #define **G\_UTIL\_GCAPS\_ADDRESSES** 259  
*GUtility()*, get a list of available connections from the *gcaps* server.
- #define **G\_UTIL\_GCAPS\_IPREQUEST** 260  
*GUtility()*, get a list of hardware requesting IPs from the *gcaps* server.
- #define **G\_UTIL\_GCAPS\_ASSIGN** 261  
*GUtility()*, assign IP addresses via Boot-P reply from the *gcaps* server.
- #define **G\_UTIL\_GCAPS\_PING** 262  
*GUtility()*, uses ICMP ping to determine if an IP address is reachable and assigned. Ping sent from the *gcaps* server.
- #define **G\_SMALL\_BUFFER** 1024  
Most reads from Galil are small. This value will easily hold most, e.g. TH, TZ, etc.
- #define **G\_HUGE\_BUFFER** 524288  
Most reads from Galil hardware are small. This value will hold the largest array or program upload/download possible.
- #define **G\_LINE\_BUFFER** 80  
For writes, via command interpreter, to the Galil.

## Typedefs

- typedef int **GReturn**  
Every function returns a value of type GReturn. See *gclib\_errors.h* for possible values.
- typedef void \* **GCon**  
Connection handle. Unique for each connection in process. Assigned a non-zero value in *GOpen()*.
- typedef unsigned int **GSize**  
Size of buffers, etc.
- typedef int **GOption**  
Option integer for various formatting, etc.
- typedef char \* **GCStringOut**  
C-string output from the library. Implies null-termination.
- typedef const char \* **GCStringIn**  
C-string input to the library. Implies null-termination.
- typedef char \* **GBufOut**  
Data output from the library. No null-termination implied. Returned values may be null-terminated, see function documentation for details.
- typedef const char \* **GBufIn**  
Data input to the library. No null-termination, function will have a GSize to indicate bytes to write .
- typedef unsigned char **GStatus**  
Interrupt status byte.
- typedef void \* **GMemory**  
Pointer to untyped memory for use in *GUtility()*.



## Functions

- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GOpen](#) ([GCStringIn](#) address, [GCon](#) \*g)  
*Open a connection to a Galil Controller.*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GClose](#) ([GCon](#) g)  
*Closes a connection to a Galil Controller.*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GRead](#) ([GCon](#) g, [GBufOut](#) buffer, [GSize](#) buffer\_len, [GSize](#) \*bytes\_read)  
*Performs a read on the connection.*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GWrite](#) ([GCon](#) g, [GBufIn](#) buffer, [GSize](#) buffer\_len)  
*Performs a write on the connection.*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GCommand](#) ([GCon](#) g, [GCStringIn](#) command, [GBufOut](#) buffer, [GSize](#) buffer\_len, [GSize](#) \*bytes\_returned)  
*Performs a command-and-response transaction on the connection.*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GProgramDownload](#) ([GCon](#) g, [GCStringIn](#) program, [GCStringIn](#) preprocessor)  
*Downloads a program to the controller's program buffer.*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GProgramUpload](#) ([GCon](#) g, [GBufOut](#) buffer, [GSize](#) buffer\_len)  
*Uploads a program from the controller's program buffer.*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GArrayDownload](#) ([GCon](#) g, const [GCStringIn](#) array\_name, [GOption](#) first, [GOption](#) last, [GCStringIn](#) buffer)  
*Downloads array data to a pre-dimensioned array in the controller's array table.*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GArrayUpload](#) ([GCon](#) g, const [GCStringIn](#) array\_name, [GOption](#) first, [GOption](#) last, [GOption](#) delim, [GBufOut](#) buffer, [GSize](#) buffer\_len)  
*Uploads array data from the controller's array table.*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GRecord](#) ([GCon](#) g, union [GDataRecord](#) \*record, [GOption](#) method)  
*Provides a fresh copy of the controller's data record. Data is cast into a union, [GDataRecord](#).*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GMessage](#) ([GCon](#) g, [GCStringOut](#) buffer, [GSize](#) buffer\_len)  
*Provides access to unsolicited messages from the controller.*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GInterrupt](#) ([GCon](#) g, [GStatus](#) \*status\_byte)  
*Provides access to PCI and UDP interrupts from the controller.*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GFirmwareDownload](#) ([GCon](#) g, [GCStringIn](#) filepath)  
*Upgrade firmware.*
- GCLIB\_DLL\_EXPORTED [GReturn](#) [GCALL](#) [GUtility](#) ([GCon](#) g, [GOption](#) request, [GMemory](#) memory1, [GMemory](#) memory2)  
*Provides read/write access to driver settings and convenience features based on the request variable.*

### 8.2.1 Detailed Description

Defines the interface for the Galil C Library (GCLIB).

### 8.2.2 Function Documentation

### 8.2.2.1 GArrayDownload()

```
GCLIB_DLL_EXPORTED GReturn GCALL GArrayDownload (
    GCon g,
    const GCStringIn array_name,
    GOption first,
    GOption last,
    GCStringIn buffer )
```

Downloads array data to a pre-dimensioned array in the controller's array table.

#### Warning

The array must already exist on the controller and be sufficient dimension to hold the desired array data, e.g. via DM.

#### Parameters

<i>g</i>	Connection's handle.
<i>array_name</i>	Null-terminated string containing the name of the array to download. Must match the array name used in DM.
<i>first</i>	The first element of the array for sub-array downloads. G_BOUNDS to omit.
<i>last</i>	The last element of the array for sub-array downloads. G_BOUNDS to omit.
<i>buffer</i>	Buffer containing the null-terminated data to be sent to the controller. The array data may be separated with <i>carriage return</i> , <i>carriage return + line feed</i> , or a <i>comma</i> . No spaces.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_arrays.cpp` for an example.

Referenced by `H_DownloadArraysFromList()`.

### 8.2.2.2 GArrayUpload()

```
GCLIB_DLL_EXPORTED GReturn GCALL GArrayUpload (
    GCon g,
    const GCStringIn array_name,
    GOption first,
    GOption last,
    GOption delim,
    GBufOut buffer,
    GSize buffer_len )
```

Uploads array data from the controller's array table.

#### Parameters

<i>g</i>	Connection's handle.
<i>array_name</i>	Null-terminated string containing the name of the array to upload.
<i>first</i>	The first element of the array for sub-array uploads. G_BOUNDS to omit.
<i>last</i>	The last element of the array for sub-array uploads. G_BOUNDS to omit.
<i>delim</i>	Sets the delimiter between array elements in the returned data, G_CR specifies carriage return, G_COMMA specifies comma.

## Parameters

<i>buffer</i>	Buffer to receive the uploaded data. The data will be null terminated unless function returns <code>G_BAD_LOST_DATA</code> due to the buffer being too small to hold the data.
<i>buffer_len</i>	The length of the receive buffer.

## Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_arrays.cpp` for an example.

Referenced by `H_UploadArrayToList()`.

## 8.2.2.3 GClose()

```
GCLIB_DLL_EXPORTED GReturn GCALL GClose (
    GCon g )
```

Closes a connection to a Galil Controller.

## Attention

*gclib* requires that `GClose()` be called whenever a program is finished with a controller. This includes when a program closes. A rule of thumb is that for every `GOpen()` call on a given connection, a `GClose()` call should be found on every code path. Failing to call `GClose()` may cause controller resources to not be released or can hang the process if there are outstanding asynchronous operations. The latter can occur, for example, if a call to `GRead()` times out and the process exits without calling `GClose()`. In this case, `GRead()` still has an outstanding asynchronous read pending. `GClose()` will terminate this operation allowing the process to exit correctly.

## Parameters

<i>g</i>	Connection's handle.
----------	----------------------

## Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_examples.cpp` for an example.

## 8.2.2.4 GCommand()

```
GCLIB_DLL_EXPORTED GReturn GCALL GCommand (
    GCon g,
    GCStringIn command,
    GBufOut buffer,
    GSize buffer_len,
    GSize * bytes_returned )
```

Performs a *command-and-response* transaction on the connection.

## Parameters

<i>g</i>	Connection's handle.
----------	----------------------

**Parameters**

<i>command</i>	Null-terminated command string to send to the controller. The library will append a carriage return to the command string.
<i>buffer</i>	Buffer for the response. Will be filled with the response from the controller. The data will be null terminated unless function returns <code>G_BAD_LOST_DATA</code> due to the buffer being too small to hold the data.
<i>buffer_len</i>	The size of the response buffer.
<i>bytes_returned</i>	The size of the data returned from the controller. This does not include null termination. This argument may be null if the value is not desired.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_gcommand.cpp` for an example.

Referenced by `GCmd()`, `GCmdD()`, `GCmdI()`, `GCmdT()`, and `GWaitForBool()`.

**8.2.2.5 GFirmwareDownload()**

```
GCLIB_DLL_EXPORTED GReturn GCALL GFirmwareDownload (
    GCon g,
    GCStringIn filepath )
```

Upgrade firmware.

**Parameters**

<i>g</i>	Connection's handle.
<i>filepath</i>	The full file path to the Galil-supplied firmware hex file. See <a href="http://www.galil.com/downloads/firmware">http://www.galil.com/downloads/firmware</a>

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

```
ec(GInfo(g, buf, sizeof(buf))); //get controller info
cout << buf << '\n'; //print the info
ec(GFirmwareDownload(g, "F:/1806.dmc/dmc-1806-r11a.hex"));
ec(GInfo(g, buf, sizeof(buf))); //get the info again
cout << buf << '\n';
// example output:
// GALILPCI1, DMC1846 Rev 1.1a-CM, 4232
// GALILPCI1, DMC1846 Rev 1.1a, 4232
```

**8.2.2.6 GInterrupt()**

```
GCLIB_DLL_EXPORTED GReturn GCALL GInterrupt (
    GCon g,
    GStatus * status_byte )
```

Provides access to PCI and UDP interrupts from the controller.

Interrupts can be generated automatically by the firmware on important events via `EI` (Enable Interrupt) or by the user in embedded DMC code via `UI` (User Interrupt). To use this function, `-s EI` must be used in the `GOpen()` address string to subscribe to interrupts.

#### Parameters

<i>g</i>	Connection's handle.
<i>status_byte</i>	A pointer to a <code>GStatus</code> to receive the status byte.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

`GInterrupt()` will block until an interrupt is received, or the function times out.

#### Note

If this function is called with a timeout of zero, a non-blocking read is performed. If interrupt data is waiting in the interrupt queue, the oldest byte will be popped off the queue. If there is no interrupt data queued, but there is data waiting in the socket or PCI FIFO, one read will be performed to process the waiting data. If new data is still not found after these two attempts, `G_GCLIB_NON_BLOCKING_READ_EMPTY` will be returned.

See `x_ginterrupt.cpp` for an example. See `x_nonblocking.cpp` for an example of non-blocking usage.

#### 8.2.2.7 GMessage()

```
GCLIB_DLL_EXPORTED GReturn GCALL GMessage (
    GCon g,
    GCStringOut buffer,
    GSize buffer_len )
```

Provides access to unsolicited messages from the controller.

To use this function, `-s MG` must be used in the `GOpen()` address string to subscribe to messages. Unsolicited bytes must be flagged by the high-bit setting, `CW 1`. The driver will automatically set this when subscribing to messages. The user should not overwrite this setting.

Unsolicited messages are data generated by the controller that are not in response to a command, a data record, or an interrupt. Examples follow.

1. Data generated by the `MG` command from embedded code. `MG` sent from the host is solicited.
2. Any command in an embedded program that returns data, e.g. `TP, RP, var=?`
3. A run time error in an embedded program, e.g. `?55 i=var`

#### Note

Messages are unframed byte streams. There is no guarantee that the user will get complete messages or single messages in a call to `GMessage()`.

#### Parameters

<i>g</i>	Connection's handle.
<i>buffer</i>	The buffer to write the message data. The buffer will be null terminated.
<i>buffer_len</i>	The length of the user's buffer.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

[GMessage\(\)](#) will block until a message is received, or the function times out.

**Note**

If this function is called with a timeout of zero, a non-blocking read is performed. If message data has been processed since the last time the function was called, this data will be returned. If there is no processed message data, but there is data waiting in the socket or PCI FIFO, one read will be performed to process the waiting data. If new data is still not found after these two attempts, `G_GCLIB_NON_BLOCKING_READ_EMPTY` will be returned.

**Warning**

When sending message streams through [gcaps](#), the following non-printable bytes are illegal, `$00-$07` and `$10-$17`. These bytes may be routed to a third party device such as an HMI or display panel. See MG and CF.

See `x_gmessage.cpp` for an example. See `x_nonblocking.cpp` for an example of non-blocking usage.

**8.2.2.8 GOpen()**

```
GCLIB_DLL_EXPORTED GReturn GCALL GOpen (
    GCStringIn address,
    GCon * g )
```

Open a connection to a Galil Controller.

**Parameters**

<i>address</i>	Null-terminated address string. See table below.
<i>g</i>	Pointer to user's <code>GCon</code> variable. On success, the library will fill the user's variable with the handle to use for the rest of the connection. A valid <code>g</code> value is nonzero.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

address switch	Meaning	Arguments (default), other options	Examples -----
<code>--address</code>	<b>Simple address to hardware</b>	<i>IP address, PCI, COM port</i>	<code>--address COM1</code>
<code>-a</code>	shorthand for <code>--address</code>	See <i>Address Ranges</i> below	<code>-a GALILPCI1</code>
{no switch}	<code>--address</code> is implicit for any lone token		<code>192.168.0.42</code>
<code>--baud</code>	<b>Baud rate</b>	(115200), <i>valid baud...</i>	<code>COM2 --baud 19200</code>
<code>-b</code>	shorthand for <code>--baud</code>		<code>COM3 -b 38400</code>
<code>--command</code>	<b>Command-and-response socket protocol</b>	(TCP), UDP	<code>192.168.0.42 --command TCP</code>
<code>-c</code>	shorthand for <code>--command</code>		<code>192.168.0.42 -c UDP</code>

address switch	Meaning	Arguments (default), other options	Examples -----
--direct	<b>Connect directly to hardware instead of via <a href="#">gcaps</a></b>		-a GALILPCI2 --direct
-d	shorthand for --direct		GALILPCI2 -d
--handshake	<b>Serial Handshake mode</b>	(HARDWARE), NONE	COM1 --handshake NONE
--p1	<b>Primary port for command-and-response traffic</b>	(23), <i>valid port number</i>	192.168.0.42 --p1 5000
--p2	<b>Secondary port for unsolicited traffic</b>	(60007), <i>valid port number</i>	192.168.0.42 --p2 5000
--subscribe	<b>Subscribe to messages, data records, and/or interrupts</b>	(NONE), MG, DR, EI, ALL	192.168.0.42 --subscribe MG
-s	shorthand for --subscribe		192.168.0.42 -s DR -s EI
--timeout	<b>timeout in ms</b>	(5000), <i>0-65535</i>	192.168.0.42 --timeout 5000
-t	shorthand for --timeout		GALILPCI2 -t 500
--unsolicited	<b>Unsolicited socket protocol</b>	(UDP), TCP, NONE	192.168.0.42 --unsolicited TCP
-u	shorthand for --unsolicited		192.168.1.42 -u NONE

Operating System	Address Range	Notes -----
Windows	COM1 - COM256	RS232 and USB-to-serial
Linux	/dev/ttyS0 - /dev/ttyS255	RS232
Linux	/dev/ttyUSB0 - /dev/ttyUSB255	USB-to-serial, e.g. DMC-4103
Windows	GALILPCI1 - GALILPCI8	PCI
Linux	/dev/galilpci0 - /dev/galilpci7	PCI

See `x_examples.cpp` for an example.

When connecting to a network device, if the command-and-response socket is opened successfully but the unsolicited socket fails, `GOpen()` will still complete successfully. This allows connection to a Galil controller when only one Ethernet handle is available. Unsolicited traffic will not be accessible in this case.

### 8.2.2.9 GProgramDownload()

```
GCLIB_DLL_EXPORTED GReturn GCALL GProgramDownload (
    GCon g,
    GCStringIn program,
    GCStringIn preprocessor )
```

Downloads a program to the controller's program buffer.

#### Parameters

<i>g</i>	Connection's handle.
<i>program</i>	Null-terminated program for download.
<i>preprocessor</i>	Options string for preprocessing the program before sending it to the controller. Null allows the library to use defaults for the download. See the <a href="#">Program Preprocessor</a> documentation for options.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_programs.cpp` for an example.

Referenced by `GProgramDownloadFile()`, and `GSetupDownloadFile()`.

**8.2.2.10 GProgramUpload()**

```
GCLIB_DLL_EXPORTED GReturn GCALL GProgramUpload (
    GCon g,
    GBufOut buffer,
    GSize buffer_len )
```

Uploads a program from the controller's program buffer.

**Parameters**

<i>g</i>	Connection's handle.
<i>buffer</i>	Buffer to receive the controller's program. The data will be null terminated unless function returns <code>G_BAD_LOST_DATA</code> due to the buffer being too small to hold the data.
<i>buffer_len</i>	The length of the receive buffer.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_programs.cpp` for an example.

Referenced by `GProgramUploadFile()`.

**8.2.2.11 GRead()**

```
GCLIB_DLL_EXPORTED GReturn GCALL GRead (
    GCon g,
    GBufOut buffer,
    GSize buffer_len,
    GSize * bytes_read )
```

Performs a read on the connection.

**Parameters**

<i>g</i>	Connection's handle.
<i>buffer</i>	The user's read buffer.
<i>buffer_len</i>	The length of the user's read buffer.
<i>bytes_read</i>	Pointer to a <code>GSize</code> which will be filled with the number of bytes read upon return.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.



**Warning**

This function is deprecated and will be removed in a future gclib version. Please contact Galil for needs not covered by the other gclib functions.

Unsolicited messages may be returned in the read data. The high bit of each message byte will be set unless the user changes the CW setting. Interrupts and Data Records are always filtered from a read.

See `x_gread_gwrite.cpp` for an example.

**8.2.2.12 GRecord()**

```
GCLIB_DLL_EXPORTED GReturn GCALL GRecord (
    GCon g,
    union GDataRecord * record,
    GOption method )
```

Provides a fresh copy of the controller's data record. Data is cast into a union, `GDataRecord`.

**Parameters**

<i>g</i>	Connection's handle.
<i>record</i>	A pointer to the user's DataRecord union to hold the copy.
<i>method</i>	Determines the method for acquiring the data. <ul style="list-style-type: none"> <li>• <code>G_QR</code>: QR is used via command-and-response.</li> <li>• <code>G_DR</code>: DR is used for asynchronous acquisition.</li> </ul>

**Returns**

The success status or error code of the function. See `gclib_errors.h` for possible values.

When using `G_DR`, the asynchronous data record must already be set up.

- `-s DR` must be used in the `GOpen()` `address` string to subscribe to records. The driver will automatically set the second argument of `DR`, where applicable.
- `GRecordRate()` should be issued to set `DR` to an appropriate interval, `n`. The interval must be no faster than the rate at which `GRecord()` is called.

`GRecord()` will block until the data record is received, or the transaction times out.

**Note**

If this function is called with a timeout of zero and the `G_DR` method, a non-blocking read is performed. If a data record has been processed since the last time the function was called, this data will be returned. If there is not a processed data record, but there is data waiting in the socket or PCI FIFO, one read will be performed to process the waiting data. If new data is still not found after these two attempts, `G_GCLIB_NO←N_BLOCKING_READ_EMPTY` will be returned.

See `x_grecord.cpp` for an example. See `x_nonblocking.cpp` for an example of non-blocking usage.

**8.2.2.13 GUtility()**

```
GCLIB_DLL_EXPORTED GReturn GCALL GUtility (
    GCon g,
```

```
GOption request,
GMemory memory1,
GMemory memory2 )
```

Provides read/write access to driver settings and convenience features based on the request variable.

#### Note

The open source library, [gclibo.h](#), has wrappers for most of these utilities.

#### Parameters

<i>g</i>	Connection's handle.
<i>request</i>	Defines the request. Input/Output and type of memory are implicit in the value of request. The following lists the supported request values.

- [G\\_UTIL\\_TIMEOUT](#) Read initial timeout value, as specified in [GOpen\(\)](#) via `--timeout` switch.
  - `memory1` is output and must be an `unsigned short*`.
  - `memory2` is ignored, use null.
- [G\\_UTIL\\_TIMEOUT\\_OVERRIDE](#) See [GTimeout\(\)](#). Write/Read override timeout value.
  - `memory1` is input. If nonnull, value must be a `short*` holding the override, in milliseconds, for the timeout. Write `G_USE_INITIAL_TIMEOUT` to use initial timeout. If null, no write occurs.
  - `memory2` is output. If nonnull, value must be a `short*` which will be filled with the current override. `G_USE_INITIAL_TIMEOUT` indicates initial timeout used. If null, no read occurs. `memory2` is processed before 'memory1'.
- [G\\_UTIL\\_VERSION](#) See [GVersion\(\)](#). Returns the library version. A valid connection (`g`) is not necessary, i.e. `g` may be null.
  - `memory1` is output, and must be a `char*`. Data will be null terminated, even if the data must be truncated to do so.
  - `memory2` is input and must be an `unsigned int*` holding the length of the buffer in `memory1`.
- [G\\_UTIL\\_INFO](#) See [GInfo\(\)](#). Returns information about the connection.
  - `memory1` is output and must be a `char*`. Data will be null terminated, even if the data must be truncated to do so.
  - `memory2` is input and must be an `unsigned int*` holding the length of the buffer in `memory1`.
- [G\\_UTIL\\_SLEEP](#) See [GSleep\(\)](#). Platform-independent, non-busy, sleep. A valid connection (`g`) is not necessary, i.e. `g` may be null.
  - `memory1` is input and must be an `unsigned int*`, units are milliseconds.
  - `memory2` is ignored, use null.
- [G\\_UTIL\\_ADDRESSES](#) see [GAddresses\(\)](#). Provides a `\n` delimited listing of all available IP addresses, PCI addresses, and COM ports. A valid connection (`g`) is not necessary, i.e. `g` may be null. The suffix `-d` will be appended to each address to indicate these addresses are available via direct connection. See [G\\_UTIL\\_↔GCAPS\\_ADDRESSES](#) for addresses through [gcaps](#).
  - `memory1` is output and must be a `char*`. Data will be null terminated, even if the data must be truncated to do so.
  - `memory2` is input and must be an `unsigned int*` holding the length of the buffer in `memory1`.
- [G\\_UTIL\\_IPREQUEST](#) see [GIpRequests\(\)](#). Listens and returns a `\n` delimited listing of Galil MAC addresses sending BOOT-P or DHCP requests. The function will listen, and block, for roughly 5 seconds. A valid connection (`g`) is not necessary, i.e. `g` may be null.

- `memory1` is output and must be a `char*`. Data will be null terminated, even if the data must be truncated to do so.
- `memory2` is input and must be an `unsigned int*` holding the length of the buffer in `memory1`.
- [G\\_UTIL\\_ASSIGN](#) see [GAssign\(\)](#). Provides a method to assign an IP address given a Galil MAC address. A valid connection (`g`) is not necessary, i.e. `g` may be null.
  - `memory1` is input and must be a `char*` containing the null terminated address that is to be assigned. e.g. "192.168.0.43".
  - `memory2` is input and must be a `char*` containing the null terminated controller MAC address. e.g. "00:50:4C:20:01:23".
- [G\\_UTIL\\_DEVICE\\_INITIALIZE](#) Provides a method to reinitialize a connection after a reset, e.g. an RS command. Depending on the device type, the appropriate commands will be sent to configure the communication bus for optimal performance.
  - `memory1` is ignored, use null.
  - `memory2` is ignored, use null.
- [G\\_UTIL\\_PING](#) Uses ICMP ping to determine if an IP address is reachable and assigned. A valid connection (`g`) is not necessary, i.e. `g` may be null.
  - `memory1` is input and must be a `char*` containing the null terminated address that is to be pinged. e.g. "192.168.0.43".
  - `memory2` is output and must be an `int*`. The value will be set to zero if the ping times out, and nonzero if a ping reply is returned.
- [G\\_UTIL\\_ERROR\\_CONTEXT](#) More error detail for the last error on [GCon](#), where available. The internal error message is cleared upon read.
  - `memory1` is output and must be a `char*`. Data will be null terminated, even if the data must be truncated to do so.
  - `memory2` is input and must be an `unsigned int*` holding the length of the buffer in `memory1`.

The following request values are for use with a `gcaps` server.

- [G\\_UTIL\\_GCAPS\\_VERSION](#) see [GVersion\(\)](#). Returns the `gcaps` server version. A valid connection (`g`) is not necessary, i.e. `g` may be null. This operation will connect to the server to determine the version.
  - `memory1` is output and must be a `char*`. Data will be null terminated, even if the data must be truncated to do so.
  - `memory2` is input and must be an `unsigned int*` holding the length of the buffer in `memory1`.
- [G\\_UTIL\\_GCAPS\\_KEEPALIVE](#) Provides a method for kicking the `gcaps` server. After a default period of 10 minutes of inactivity, `gcaps` will disconnect the `gclib` client. To prevent a disconnect, communicate with the hardware or call [G\\_UTIL\\_GCAPS\\_KEEPALIVE](#) within the timeout period to reset the timer. The current interval can be optionally read and overwritten, however, the keep alive signal is only sent if `memory1` and `memory2` are both null.
  - `memory1` is output. If nonnull, value must be an `unsigned int*` which will be filled with the current `gcaps` timeout, in ms.
  - `memory2` is input. If nonnull, value must be an `unsigned int*` holding the new `gcaps` timeout, in ms, for connection `g`.
- [G\\_UTIL\\_GCAPS\\_ADDRESSES](#) see [GAddresses\(\)](#). Provides a \n delimited listing of all available IP addresses, PCI addresses, and COM ports as available from the `gcaps` server. A valid connection (`g`) is not necessary, i.e. `g` may be null.
  - `memory1` is output and must be a `char*`. Data will be null terminated, even if the data must be truncated to do so.
  - `memory2` is input and must be an `unsigned int*` holding the length of the buffer in `memory1`.

- [G\\_UTIL\\_GCAPS\\_IPREQUEST](#) see [GIpRequests\(\)](#). Connects to [gcaps](#) and returns a \n delimited listing of Galil MAC addresses sending BOOT-P or DHCP requests. The function will block for roughly 5 seconds. A valid connection (g) is not necessary, i.e. g may be null.
  - `memory1` is output and must be a `char*`. Data will be null terminated, even if the data must be truncated to do so.
  - `memory2` is input and must be an `unsigned int*` holding the length of the buffer in `memory1`.
- [G\\_UTIL\\_GCAPS\\_ASSIGN](#) see [GAssign\(\)](#). Provides a method to assign an IP address through [gcaps](#) given a Galil MAC address. A valid connection (g) is not necessary, i.e. g may be null.
  - `memory1` is input and must be a `char*` containing the null terminated address that is to be assigned. e.g. "192.168.0.43".
  - `memory2` is input and must be a `char*` containing the null terminated controller MAC address. e.g. "00:50:4C:20:01:23".
- [G\\_UTIL\\_GCAPS\\_PING](#) Uses ICMP ping to determine if an IP address is reachable and assigned. Ping sent from the [gcaps](#) server. A valid connection (g) is not necessary, i.e. g may be null.
  - `memory1` is input and must be a `char*` containing the null terminated address that is to be pinged. e.g. "192.168.0.43".
  - `memory2` is output and must be an `int*`. The value will be set to zero if the ping times out, and nonzero if a ping reply is returned.

#### Parameters

<i>memory1</i>	An untyped pointer to data required for request. The data type is defined by the request variable.
<i>memory2</i>	An untyped pointer to data required for request. The data type is defined by the request variable.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See the following functions from `gclibo`, the open source portion, for implementation of several [GUtility\(\)](#) requests.:

- [GAddresses\(\)](#)
- [GAssign\(\)](#)
- [GInfo\(\)](#)
- [GIpRequests\(\)](#)
- [GSleep\(\)](#)
- [GTimeout\(\)](#)
- [GVersion\(\)](#)

Referenced by [GAddresses\(\)](#), [GAssign\(\)](#), [GInfo\(\)](#), [GIpRequests\(\)](#), [GSleep\(\)](#), [GTimeout\(\)](#), and [GVersion\(\)](#).

#### 8.2.2.14 GWrite()

```
GCLIB_DLL_EXPORTED GReturn GCALL GWrite (
    GCon g,
    GBufIn buffer,
    GSize buffer_len )
```

Performs a write on the connection.

## Parameters

<i>g</i>	Connection's handle.
<i>buffer</i>	The user's write buffer. To send a Galil command, a terminating carriage return is usually required.
<i>buffer_len</i>	The length of the data in the buffer.

## Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values. If `G_NO_ERROR` is returned, all bytes were written.

## Warning

This function is deprecated and will be removed in a future gclib version. Please contact Galil for needs not covered by the other gclib functions.

See `x_gread_gwrite.cpp` for an example.

## 8.3 gclib\_errors.h File Reference

## Macros

- `#define G_NO_ERROR 0`  
*Return value if function succeeded.*
- `#define G_NO_ERROR_S "no error"`
- `#define G_GCLIB_ERROR -1`  
*General library error. Indicates internal API caught an unexpected error. Contact Galil support if this error is returned, [softwaresupport@galil.com](mailto:softwaresupport@galil.com).*
- `#define G_GCLIB_ERROR_S "gclib unexpected error"`
- `#define G_GCLIB_UTILITY_ERROR -2`  
*An invalid request value was specified to GUtility.*
- `#define G_GCLIB_UTILITY_ERROR_S "invalid request value or bad arguments were specified to GUtility()"`
- `#define G_GCLIB_UTILITY_IP_TAKEN -3`  
*The IP cannot be assigned because ping returned a reply.*
- `#define G_GCLIB_UTILITY_IP_TAKEN_S "ip address is already taken by a device on the network"`
- `#define G_GCLIB_NON_BLOCKING_READ_EMPTY -4`  
*GMessage, GInterrupt, and GRecord can be called with a zero timeout. If there wasn't data waiting in memory, this error is returned.*
- `#define G_GCLIB_NON_BLOCKING_READ_EMPTY_S "data was not waiting for a zero-timeout read"`
- `#define G_GCLIB_POLLING_FAILED -5`  
*GWaitForBool out of polling trials.*
- `#define G_GCLIB_POLLING_FAILED_S "exit condition not met in specified polling period"`
- `#define G_TIMEOUT -1100`  
*Operation timed out. Timeout is set by the `-timeout` option in [GOpen\(\)](#) and can be overridden by [GSetting\(\)](#).*
- `#define G_TIMEOUT_S "device timed out"`
- `#define G_OPEN_ERROR -1101`  
*Device could not be opened. E.G. Serial port or PCI device already open.*
- `#define G_OPEN_ERROR_S "device failed to open"`
- `#define G_READ_ERROR -1103`  
*Device read failed. E.G. Socket was closed by remote host. See [G\\_UTIL\\_GCAPS\\_KEEPALIVE](#).*
- `#define G_READ_ERROR_S "device read error"`

- `#define G_WRITE_ERROR` -1104  
*Device write failed. E.G. Socket was closed by remote host. See [G\\_UTIL\\_GCAPS\\_KEEPALIVE](#).*
- `#define G_WRITE_ERROR_S` "device write error"
- `#define G_INVALID_PREPROCESSOR_OPTIONS` -1204  
*GProgramDownload was called with a bad preprocessor directive.*
- `#define G_INVALID_PREPROCESSOR_OPTIONS_S` "preprocessor did not recognize options"
- `#define G_COMMAND_CALLED_WITH_ILLEGAL_COMMAND` -1106  
*GCommand() was called with an illegal command, e.g. ED, DL or QD.*
- `#define G_COMMAND_CALLED_WITH_ILLEGAL_COMMAND_S` "illegal command passed to command call"
- `#define G_DATA_RECORD_ERROR` -1107  
*Data record error, e.g. DR attempted on serial connection.*
- `#define G_DATA_RECORD_ERROR_S` "data record error"
- `#define G_UNSUPPORTED_FUNCTION` -1109  
*Function cannot be called on this bus. E.G. [GInterrupt\(\)](#) on serial.*
- `#define G_UNSUPPORTED_FUNCTION_S` "function not supported on this communication bus"
- `#define G_FIRMWARE_LOAD_NOT_SUPPORTED` -1110  
*Firmware is not supported on this bus, e.g. Ethernet for the DMC-21x3 series.*
- `#define G_FIRMWARE_LOAD_NOT_SUPPORTED_S` "firmware cannot be loaded on this communication bus to this hardware"
- `#define G_ARRAY_NOT_DIMENSIONED` -1200  
*Array operation was called on an array that was not in the controller's array table, see LA command.*
- `#define G_ARRAY_NOT_DIMENSIONED_S` "array not dimensioned on controller or wrong size"
- `#define G_CONNECTION_NOT_ESTABLISHED` -1201  
*Function was called with no connection.*
- `#define G_CONNECTION_NOT_ESTABLISHED_S` "connection to hardware not established"
- `#define G_ILLEGAL_DATA_IN_PROGRAM` -1202  
*Data to download not valid, e.g. \ in data.*
- `#define G_ILLEGAL_DATA_IN_PROGRAM_S` "illegal ASCII character in program"
- `#define G_UNABLE_TO_COMPRESS_PROGRAM_TO_FIT` -1203  
*Program preprocessor could not compress the program within the user's constraints.*
- `#define G_UNABLE_TO_COMPRESS_PROGRAM_TO_FIT_S` "program cannot be compressed to fit on the controller"
- `#define G_BAD_RESPONSE_QUESTION_MARK` -10000  
*Operation received a ?, indicating controller has a TC error.*
- `#define G_BAD_RESPONSE_QUESTION_MARK_S` "question mark returned by controller"
- `#define G_BAD_VALUE_RANGE` -10002  
*Bad value or range, e.g. GCon g variable passed to function was bad.*
- `#define G_BAD_VALUE_RANGE_S` "value passed to function was bad or out of range"
- `#define G_BAD_FULL_MEMORY` -10003  
*Not enough memory for an operation, e.g. all connections allowed for a process already taken.*
- `#define G_BAD_FULL_MEMORY_S` "operation could not complete because of a memory error"
- `#define G_BAD_LOST_DATA` -10004  
*Lost data, e.g. [GCommand\(\)](#) response buffer was too small for the controller's response.*
- `#define G_BAD_LOST_DATA_S` "data was lost due to buffer or fifo limitations"
- `#define G_BAD_FILE` -10005  
*Bad file path, bad file contents, or bad write.*
- `#define G_BAD_FILE_S` "file was not found, contents are invalid, or write failed"
- `#define G_BAD_ADDRESS` -10006  
*Bad address.*
- `#define G_BAD_ADDRESS_S` "a bad address was specified in open"
- `#define G_BAD_FIRMWARE_LOAD` -10008

- Bad firmware upgrade.*
- #define **G\_BAD\_FIRMWARE\_LOAD\_S** "Firmware upgrade failed"
- #define **G\_GCAPS\_OPEN\_ERROR** -20000  
*gcaps connection couldn't open. Server is not running or is not reachable.*
- #define **G\_GCAPS\_OPEN\_ERROR\_S** "gcaps connection could not be opened"
- #define **G\_GCAPS\_SUBSCRIPTION\_ERROR** -20002  
*GMessage(), GRecord(), GInterrupt() called on a connection without --subscribe switch.*
- #define **G\_GCAPS\_SUBSCRIPTION\_ERROR\_S** "function requires subscription not specified in GOpen()"

### 8.3.1 Detailed Description

Defines values for the Galil C Library return codes and error strings.

## 8.4 gclib\_record.h File Reference

```
#include <stdint.h>
```

### Data Structures

- struct **GDataRecord4000**  
*Data record struct for DMC-4000 controllers, including 4000, 4200, 4103, and 500x0.*
- struct **GDataRecord52000**  
*Data record struct for DMC-52000 controller. Same as DMC-4000, with bank indicator added at byte 40.*
- struct **GDataRecord1806**  
*Data record struct for DMC-1806 controller.*
- struct **GDataRecord2103**  
*Data record struct for DMC-2103 controllers.*
- struct **GDataRecord1802**
- struct **GDataRecord30000**  
*Data record struct for DMC-30010 controllers.*
- struct **GDataRecord47000\_ENC**  
*Data record struct for RIO-471xx and RIO-472xx PLCs. Includes encoder fields.*
- struct **GDataRecord47300\_ENC**  
*Data record struct for RIO-47300. Includes encoder fields.*
- struct **GDataRecord47300\_24EX**  
*Data record struct for RIO-47300 with 24EX I/O daughter board.*
- struct **GDataRecord47162**  
*Data record struct for RIO-47162.*
- union **GDataRecord**  
*Data record union, containing all structs and a generic byte array accessor.*

### Macros

- #define **GALILDATARECORDMAXLENGTH** 512  
*Max size for any Galil data record, equal to dual port ram size of PCI.*

## Typedefs

- typedef uint8\_t **UB**
- typedef uint16\_t **UW**
- typedef int16\_t **SW**
- typedef int32\_t **SL**
- typedef uint32\_t **UL**

### 8.4.1 Detailed Description

Defines a union for data records. Each supported controller has a struct member in the union with named record types. Offsets into the data record can also be used by referencing the member `byte_array`.

## 8.5 gclibo.c File Reference

```
#include "gclibo.h"
#include <stdlib.h>
#include <string.h>
#include <stdio.h>
#include <math.h>
```

## Functions

- void **GCALL GSleep** (unsigned int timeout\_ms)  
*Uses [GUtility\(\)](#) and [G\\_UTIL\\_SLEEP](#) to provide a blocking sleep call which can be useful for timing-based chores.*
- **GReturn GCALL GVersion** (GCStringOut ver, GSize ver\_len)  
*Uses [GUtility\(\)](#), [G\\_UTIL\\_VERSION](#) and [G\\_UTIL\\_GCAPS\\_VERSION](#) to provide the library and [gcaps](#) version numbers.*
- **GReturn GCALL GInfo** (GCon g, GCStringOut info, GSize info\_len)  
*Uses [GUtility\(\)](#) and [G\\_UTIL\\_INFO](#) to provide a useful connection string.*
- **GReturn GCALL GAddresses** (GCStringOut addresses, GSize addresses\_len)  
*Uses [GUtility\(\)](#), [G\\_UTIL\\_GCAPS\\_ADDRESSES](#) or [G\\_UTIL\\_ADDRESSES](#) to provide a listing of all available connection addresses.*
- **GReturn GCALL GTimeout** (GCon g, short timeout\_ms)  
*Uses [GUtility\(\)](#) and [G\\_UTIL\\_TIMEOUT\\_OVERRIDE](#) to set the library timeout.*
- **GReturn GCALL GAssign** (GCStringIn ip, GCStringIn mac)  
*Uses [GUtility\(\)](#), [G\\_UTIL\\_GCAPS\\_ASSIGN](#) or [G\\_UTIL\\_ASSIGN](#) to assign an IP address over the Ethernet to a controller at a given MAC address.*
- **GReturn GCALL GIpRequests** (GCStringOut requests, GSize requests\_len)  
*Uses [GUtility\(\)](#), [G\\_UTIL\\_GCAPS\\_IPREQUEST](#) or [G\\_UTIL\\_IPREQUEST](#) to provide a list of all Galil controllers requesting IP addresses via BOOT-P or DHCP.*
- **GReturn GCALL GCmd** (GCon g, GCStringIn command)  
*Wrapper around [GCommand](#) for use when the return value is not desired.*
- **GReturn GCALL GCmdT** (GCon g, GCStringIn command, GCStringOut trimmed\_response, GSize response\_len, GCStringOut \*front)  
*Wrapper around [GCommand](#) that trims the response.*
- **GReturn GCALL GCmdI** (GCon g, GCStringIn command, int \*value)  
*Wrapper around [GCommand](#) that provides the return value of a command parsed into an int.*
- **GReturn GCALL GCmdD** (GCon g, GCStringIn command, double \*value)  
*Wrapper around [GCommand](#) that provides the return value of a command parsed into a double.*
- **GReturn GCALL GMotionComplete** (GCon g, GCStringIn axes)



- *Blocking call that returns once all axes specified have completed their motion.*  
• [GReturn GCALL GWaitForBool](#) ([GCon](#) g, [GCStringIn](#) predicate, int trials)  
*Blocking call that returns when the controller evaluates the predicate as true.*
- [GReturn GCALL GRecordRate](#) ([GCon](#) g, double period\_ms)  
*Sets the asynchronous data record to a user-specified period via DR.*
- [GReturn GCALL GProgramDownloadFile](#) ([GCon](#) g, [GCStringIn](#) file\_path, [GCStringIn](#) preprocessor)  
*Program download from file.*
- [GReturn GCALL GProgramUploadFile](#) ([GCon](#) g, [GCStringIn](#) file\_path)  
*Program upload to file.*
- void [GCALL GError](#) ([GReturn](#) rc, [GCStringOut](#) error, [GSize](#) error\_len)  
*Provides a human-readable description string for return codes.*

### 8.5.1 Detailed Description

Partial implementation of [gclibo.h](#)

### 8.5.2 Function Documentation

#### 8.5.2.1 GAddresses()

```
GReturn GCALL GAddresses (
    GCStringOut addresses,
    GSize addresses_len )
```

Uses [GUtility\(\)](#), [G\\_UTIL\\_GCAPS\\_ADDRESSES](#) or [G\\_UTIL\\_ADDRESSES](#) to provide a listing of all available connection addresses.

#### Note

Serial ports are listed, e.g. COM1. Upon open, it may be necessary to specify a baud rate for the controller, e.g. `--baud 19200`. Default baud is 115200. See [GOpen\(\)](#).

#### Parameters

<i>addresses</i>	Buffer to hold the output string. Buffer will be null terminated, even if the data must be truncated to do so. See below for more information.
<i>addresses_len</i>	Length of buffer.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

If [gcaps](#) is available, the listing will come from the server via [G\\_UTIL\\_GCAPS\\_ADDRESSES](#). In the absence of the server, gclib will use [G\\_UTIL\\_ADDRESSES](#) to generate the list.

- Ethernet controllers will be listed as *ip\_address, revision\_report, network\_adaptor\_name, network\_adaptor↵\_ip\_address*. If an IP address is unreachable via ping, the address will be in parentheses.
- PCI controllers will be listed by their identifier, e.g. GALILPCI1.
- Serial ports will be listed by their identifier, e.g. COM1.

```
10.1.3.91, DMC4020 Rev 1.2e, LAN, 10.1.3.10
192.168.0.63, DMC4040 Rev 1.2f, Static, 192.168.0.41
(192.0.0.42), RIO47102 Rev 1.1j, Static, 192.168.0.41
GALILPCI1
COM1
COM2
```

#### Note

[GAddresses\(\)](#) will take up to 1 second to look for [gcaps](#).

See `x_examples.cpp` for an example.

Definition at line 50 of file `gclibo.c`.

References `G_NO_ERROR`, `G_UTIL_ADDRESSES`, `G_UTIL_GCAPS_ADDRESSES`, and `GUtility()`.

#### 8.5.2.2 GAssign()

```
GReturn GCALL GAssign (
    GCStringIn ip,
    GCStringIn mac )
```

Uses [GUtility\(\)](#), [G\\_UTIL\\_GCAPS\\_ASSIGN](#) or [G\\_UTIL\\_ASSIGN](#) to assign an IP address over the Ethernet to a controller at a given MAC address.

#### Parameters

<i>ip</i>	The null-terminated ip address to assign. The hardware should not yet have an IP address.
<i>mac</i>	The null-terminated MAC address of the hardware.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

On Linux and Mac, the desired IP address will be pinged prior to the assignment. If the ping is returned, [GAssign\(\)](#) will return [G\\_GCLIB\\_UTILITY\\_IP\\_TAKEN](#).

If [gcaps](#) is available, the assign will be performed from the server via [G\\_UTIL\\_GCAPS\\_ASSIGN](#). In the absence of the server, `gclib` will use [G\\_UTIL\\_ASSIGN](#) to assign.

#### Attention

When not using [gcaps](#), Linux/OS X users must be root to use [GAssign\(\)](#) and have UDP access to send on port 68.

#### Note

[GAssign\(\)](#) will take up to 1 second to look for [gcaps](#).

See `x_examples.cpp` for an example.

Definition at line 66 of file `gclibo.c`.

References `G_GCLIB_UTILITY_IP_TAKEN`, `G_NO_ERROR`, `G_UTIL_ASSIGN`, `G_UTIL_GCAPS_ASSIGN`, `G_UTIL_GCAPS_PING`, `G_UTIL_PING`, and `GUtility()`.

### 8.5.2.3 GCmd()

```
GReturn GCALL GCmd (
    GCon g,
    GCStringIn command )
```

Wrapper around GCommand for use when the return value is not desired.

The returned data is still checked for error, e.g. ? or timeout, but is not brought out through the prototype.

#### Parameters

<i>g</i>	Connection's handle.
<i>command</i>	Null-terminated command string to send to the controller.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See x\_gcommand.cpp for an example.

Definition at line 110 of file gclibo.c.

References G\_SMALL\_BUFFER, and GCommand().

Referenced by GRecordRate(), H\_DownloadArraysFromList(), and H\_DownloadData().

### 8.5.2.4 GCmdD()

```
GReturn GCALL GCmdD (
    GCon g,
    GCStringIn command,
    double * value )
```

Wrapper around GCommand that provides the return value of a command parsed into a double.

Use this function to retrieve the full Galil 4.2 range, e.g. for a variable value with fractional data, or the value of an Analog input or Output.

#### Parameters

<i>g</i>	Connection's handle.
<i>command</i>	Null-terminated command string to send to the controller.
<i>value</i>	Pointer to a double that will be filled with the return value.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See x\_gcommand.cpp for an example.

Definition at line 162 of file gclibo.c.

References G\_NO\_ERROR, G\_SMALL\_BUFFER, and GCommand().

Referenced by GRecordRate().

### 8.5.2.5 GCmdI()

```
GReturn GCALL GCmdI (
    GCon g,
    GCStringIn command,
    int * value )
```

Wrapper around GCommand that provides the return value of a command parsed into an int.

Use this function to get most values including TP, RP, TE, Digital I/O states, etc.

#### Parameters

<i>g</i>	Connection's handle.
<i>command</i>	Null-terminated command string to send to the controller.
<i>value</i>	Pointer to an int that will be filled with the return value.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_gcommand.cpp` for an example.

Definition at line 151 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, and `GCommand()`.

### 8.5.2.6 GCmdT()

```
GReturn GCALL GCmdT (
    GCon g,
    GCStringIn command,
    GCStringOut trimmed_response,
    GSize response_len,
    GCStringOut * front )
```

Wrapper around GCommand that trims the response.

For use when the return value is desired, is ASCII (not binary), and the response should be trimmed of trailing colon, whitespace, and optionally leading space.

#### Parameters

<i>g</i>	Connection's handle.
<i>command</i>	Null-terminated command string to send to the controller.
<i>trimmed_response</i>	The trimmed response from the controller. Trailing space is trimmed by null terminating any trailing spaces, carriage returns, or line feeds.
<i>response_len</i>	The length of the <code>trimmed_response</code> buffer.
<i>front</i>	If non-null, upon return <code>*front</code> will point to the first non-space character in <code>trimmed_response</code> . This allows trimming the front of the string without modifying the user's buffer pointer, which may be allocated on the heap.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_gcommand.cpp` for an example.

Definition at line 116 of file `gclibo.c`.

References `G_NO_ERROR`, and `GCommand()`.

Referenced by `GArrayUploadFile()`, and `GRecordRate()`.

**8.5.2.7 GError()**

```
void GCALL GError (
    GReturn rc,
    GCStringOut error,
    GSize error_len )
```

Provides a human-readable description string for return codes.

**Parameters**

<i>rc</i>	The return code to lookup.
<i>error</i>	The buffer to fill with the error text. Buffer will be null terminated, even if the data must be truncated to do so.
<i>error_len</i>	The length of the error buffer.

See `x_examples.cpp` for an example.

Definition at line 332 of file `gclibo.c`.

References `G_NO_ERROR`.

**8.5.2.8 GInfo()**

```
GReturn GCALL GInfo (
    GCon g,
    GCStringOut info,
    GSize info_len )
```

Uses [GUtility\(\)](#) and [G\\_UTIL\\_INFO](#) to provide a useful connection string.

**Parameters**

<i>g</i>	Connection's handle.
<i>info</i>	Buffer to hold the output string. Buffer will be null terminated, even if the data must be truncated to do so.
<i>info_len</i>	Length of buffer.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

The response is *address*, *revision\_report*, *serial\_number*. For example:

```
COM2, RIO47102 Rev 1.1j, 37290
```

See `x_examples.cpp` for an example.

Definition at line 45 of file `gclibo.c`.

References `G_UTIL_INFO`, and `GUtility()`.

#### 8.5.2.9 GIpRequests()

```
GReturn GCALL GIpRequests (
    GCStringOut requests,
    GSize requests_len )
```

Uses `GUtility()`, `G_UTIL_GCAPS_IPREQUEST` or `G_UTIL_IPREQUEST` to provide a list of all Galil controllers requesting IP addresses via BOOT-P or DHCP.

##### Parameters

<i>requests</i>	The buffer to hold the list of requesting controllers. Data will be null terminated, even if the data must be truncated to do so. See below for more information.
<i>requests_len</i>	The length of the requests buffer.

##### Returns

The success status or error code of the function. See `gclib_errors.h` for possible values.

`GIpRequests()` will block about 5 seconds while listening for requests.

If `gcaps` is available, the listing will come from the server via `G_UTIL_GCAPS_IPREQUEST`. In the absence of the server, `gclib` will use `G_UTIL_IPREQUEST` to generate the list.

##### Attention

When not using `gcaps`, Linux/OS X users must be root to use `GIpRequests()` and have UDP access to bind and listen on port 67.

Each line of the returned data will be of the form *model, serial\_number, MAC\_address, network\_adaptor\_name, network\_adaptor\_ip\_address*. For example:

```
DMC4000, 291, 00:50:4C:20:01:23, LAN, 10.1.3.10
RIO47000, 37290, 00:50:4C:28:91:AA, Static, 192.168.0.41
```

##### Note

`GIpRequests()` will take up to 1 second to look for `gcaps`.

See `x_examples.cpp` for an example.

Definition at line 99 of file `gclibo.c`.

References `G_NO_ERROR`, `G_UTIL_GCAPS_IPREQUEST`, `G_UTIL_IPREQUEST`, and `GUtility()`.

#### 8.5.2.10 GMotionComplete()

```
GReturn GCALL GMotionComplete (
    GCon g,
    GCStringIn axes )
```

Blocking call that returns once all axes specified have completed their motion.

**Note**

This function uses a profiled motion indicator, not the position of the encoder. E.G. see the difference between AM (profiled) and MC (encoder-based).

Although using the `_BGm` operand is the most generally compatible method, there are higher-performance ways to check for motion complete by using the data record, or interrupts. See examples `x_dr_motioncomplete()` and `x_ei_motioncomplete()`.

**Parameters**

<i>g</i>	Connection's handle.
<i>axes</i>	A null-terminated string containing a multiple-axes mask. Every character in the string should be a valid argument to <code>MG_BGm</code> , i.e. XYZWABCEFGHST.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_gmotioncomplete.cpp` for an example.

Definition at line 173 of file `gclibo.c`.

References `G_NO_ERROR`, and `GWaitForBool()`.

**8.5.2.11 GProgramDownloadFile()**

```
GReturn GCALL GProgramDownloadFile (
    GCon g,
    GCStringIn file_path,
    GCStringIn preprocessor )
```

Program download from file.

**Parameters**

<i>g</i>	Connection's handle.
<i>file_path</i>	Null-terminated string containing the path to the program file.
<i>preprocessor</i>	Options string for preprocessing the program before sending it to the controller. See <a href="#">GProgramDownload()</a> .

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_programs.cpp` for an example.

Definition at line 260 of file `gclibo.c`.

References `G_BAD_FILE`, `G_BAD_FULL_MEMORY`, `G_NO_ERROR`, and `GProgramDownload()`.

**8.5.2.12 GProgramUploadFile()**

```
GReturn GCALL GProgramUploadFile (
```

```
GCon g,
GCStringIn file_path )
```

Program upload to file.

#### Parameters

<i>g</i>	Connection's handle.
<i>file_path</i>	Null-terminated string containing the path to the program file, file will be overwritten if it exists.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_programs.cpp` for an example.

Definition at line 303 of file `gclibo.c`.

References `G_BAD_FILE`, `G_BAD_FULL_MEMORY`, `G_NO_ERROR`, `GProgramUpload()`, and `MAXPROG`.

#### 8.5.2.13 GRecordRate()

```
GReturn GCALL GRecordRate (
    GCon g,
    double period_ms )
```

Sets the asynchronous data record to a user-specified period via DR.

Takes TM and product type into account and sets the DR period to the period requested by the user, if possible.

#### Parameters

<i>g</i>	Connection's handle.
<i>period_ms</i>	Period, in milliseconds, to set up for the asynchronous data record.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_grecord.cpp` for an example.

Definition at line 215 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, `GCmd()`, `GCmdD()`, and `GCmdT()`.

#### 8.5.2.14 GSleep()

```
void GCALL GSleep (
    unsigned int timeout_ms )
```

Uses [GUtility\(\)](#) and [G\\_UTIL\\_SLEEP](#) to provide a blocking sleep call which can be useful for timing-based chores.

#### Parameters

<i>timeout_ms</i>	The timeout, in milliseconds, to block before returning.
-------------------	--



See [GWaitForBool\(\)](#) for an example.

Definition at line 20 of file gclibo.c.

References [G\\_UTIL\\_SLEEP](#), and [GUtility\(\)](#).

Referenced by [GWaitForBool\(\)](#).

#### 8.5.2.15 GTimeout()

```
GReturn GCALL GTimeout (
    GCon g,
    short timeout_ms )
```

Uses [GUtility\(\)](#) and [G\\_UTIL\\_TIMEOUT\\_OVERRIDE](#) to set the library timeout.

##### Parameters

<i>g</i>	Connection's handle.
<i>timeout_ms</i>	The value to be used for the timeout. Use <a href="#">G_USE_INITIAL_TIMEOUT</a> to set the timeout back to the initial <a href="#">GOpen()</a> value, <code>--timeout</code> .

##### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See [x\\_gcommand.cpp](#) and [x\\_gread\\_gwrite.cpp](#) for examples.

Definition at line 61 of file gclibo.c.

References [G\\_UTIL\\_TIMEOUT\\_OVERRIDE](#), and [GUtility\(\)](#).

#### 8.5.2.16 GVersion()

```
GReturn GCALL GVersion (
    GCStringOut ver,
    GSize ver_len )
```

Uses [GUtility\(\)](#), [G\\_UTIL\\_VERSION](#) and [G\\_UTIL\\_GCAPS\\_VERSION](#) to provide the library and [gcaps](#) version numbers.

##### Parameters

<i>ver</i>	Buffer to hold the output string. Buffer will be null terminated, even if the data must be truncated to do so.
<i>ver_len</i>	Length of buffer.

##### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

The version number of gclib is provided first. If the [gcaps](#) server can be found, its version will be provided after a space.

Example with gcaps version.

```
154.190.329 1.0.0.82
```

Example with gclib version only.

```
154.190.329
```

#### Note

[GVersion\(\)](#) will take up to 1 second to look for [gcaps](#).

See `x_examples.cpp` for an example.

Definition at line 25 of file `gclibo.c`.

References `G_NO_ERROR`, `G_UTIL_GCAPS_VERSION`, `G_UTIL_VERSION`, and `GUtility()`.

#### 8.5.2.17 GWaitForBool()

```
GReturn GCALL GWaitForBool (
    GCon g,
    GCStringIn predicate,
    int trials )
```

Blocking call that returns when the controller evaluates the predicate as true.

Polls the message command (MG) to check the value of predicate. Polling will continue until the controller responds with a nonzero value or the number of polling trials is reached.

The amount of time until the function fails with [G\\_GCLIB\\_POLLING\\_FAILED](#) is roughly (trials \* [POLLINGINTERVAL](#)) milliseconds.

#### Parameters

<i>g</i>	Connection's handle.
<i>predicate</i>	A null-terminated string containing the predicate to be polled. The predicate will be enclosed in parentheses and used in the command <code>MG (predicate)</code> to return the value.
<i>trials</i>	The number of polling cycles to perform looking for a nonzero value. Use -1 to poll indefinitely.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See [GMotionComplete\(\)](#) for an example.

Definition at line 191 of file `gclibo.c`.

References `G_GCLIB_POLLING_FAILED`, `G_LINE_BUFFER`, `G_NO_ERROR`, `G_SMALL_BUFFER`, `G↔Command()`, `GSleep()`, and `POLLINGINTERVAL`.

Referenced by `GMotionComplete()`.

## 8.6 gclibo.h File Reference

```
#include "gclib.h"
```

#### Macros

- `#define GCLIB_DLL_EXPORTED`

- #define **GCALL** \_\_stdcall
- #define **MALLOCBUF** **G\_HUGE\_BUFFER**  
*Malloc used for large program and array uploads.*
- #define **MAXPROG** **MALLOCBUF**  
*Maximum size for a program.*
- #define **MAXARRAY** **MALLOCBUF**  
*Maximum size for an array table upload.*
- #define **POLLINGINTERVAL** 100  
*Interval, in milliseconds, for polling commands, e.g. `GWaitForBool()`.*
- #define **G\_USE\_GCAPS**  
*Use the GCAPS server in `GAddresses()`, `GAssign()`, `GlpRequests()`, and `GVersion()`. To avoid GCAPS, comment out this line and recompile, <http://galil.com/sw/pub/all/doc/gclib/html/gclibo.html>.*

## Functions

- GCLIB\_DLL\_EXPORTED void **GCALL** **GSleep** (unsigned int timeout\_ms)  
*Uses `GUtility()` and `G_UTIL_SLEEP` to provide a blocking sleep call which can be useful for timing-based chores.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GVersion** (**GCStringOut** ver, **GSize** ver\_len)  
*Uses `GUtility()`, `G_UTIL_VERSION` and `G_UTIL_GCAPS_VERSION` to provide the library and `gcaps` version numbers.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GAddresses** (**GCStringOut** addresses, **GSize** addresses\_len)  
*Uses `GUtility()`, `G_UTIL_GCAPS_ADDRESSES` or `G_UTIL_ADDRESSES` to provide a listing of all available connection addresses.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GInfo** (**GCon** g, **GCStringOut** info, **GSize** info\_len)  
*Uses `GUtility()` and `G_UTIL_INFO` to provide a useful connection string.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GTimeout** (**GCon** g, short timeout\_ms)  
*Uses `GUtility()` and `G_UTIL_TIMEOUT_OVERRIDE` to set the library timeout.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GCmd** (**GCon** g, **GCStringIn** command)  
*Wrapper around `GCommand` for use when the return value is not desired.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GCmdT** (**GCon** g, **GCStringIn** command, **GCStringOut** trimmed\_response, **GSize** response\_len, **GCStringOut** \*front)  
*Wrapper around `GCommand` that trims the response.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GCmdI** (**GCon** g, **GCStringIn** command, int \*value)  
*Wrapper around `GCommand` that provides the return value of a command parsed into an int.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GCmdD** (**GCon** g, **GCStringIn** command, double \*value)  
*Wrapper around `GCommand` that provides the return value of a command parsed into a double.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GWaitForBool** (**GCon** g, **GCStringIn** predicate, int trials)  
*Blocking call that returns when the controller evaluates the predicate as true.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GMotionComplete** (**GCon** g, **GCStringIn** axes)  
*Blocking call that returns once all axes specified have completed their motion.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GRecordRate** (**GCon** g, double period\_ms)  
*Sets the asynchronous data record to a user-specified period via `DR`.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GProgramDownloadFile** (**GCon** g, **GCStringIn** file\_path, **GCStringIn** preprocessor)  
*Program download from file.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GProgramUploadFile** (**GCon** g, **GCStringIn** file\_path)  
*Program upload to file.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GArrayDownloadFile** (**GCon** g, **GCStringIn** file\_path)  
*Array download from file.*
- GCLIB\_DLL\_EXPORTED **GReturn** **GCALL** **GArrayUploadFile** (**GCon** g, **GCStringIn** file\_path, **GCStringIn** names)

*Array upload to file.*

- GCLIB\_DLL\_EXPORTED [GReturn GCALL GIpRequests](#) ([GCStringOut](#) requests, [GSize](#) requests\_len)  
*Uses [GUtility\(\)](#), [G\\_UTIL\\_GCAPS\\_IPREQUEST](#) or [G\\_UTIL\\_IPREQUEST](#) to provide a list of all Galil controllers requesting IP addresses via BOOT-P or DHCP.*
- GCLIB\_DLL\_EXPORTED [GReturn GCALL GAssign](#) ([GCStringIn](#) ip, [GCStringIn](#) mac)  
*Uses [GUtility\(\)](#), [G\\_UTIL\\_GCAPS\\_ASSIGN](#) or [G\\_UTIL\\_ASSIGN](#) to assign an IP address over the Ethernet to a controller at a given MAC address.*
- GCLIB\_DLL\_EXPORTED void [GCALL GError](#) ([GReturn](#) rc, [GCStringOut](#) error, [GSize](#) error\_len)  
*Provides a human-readable description string for return codes.*
- GCLIB\_DLL\_EXPORTED [GReturn GCALL GSetupDownloadFile](#) ([GCon](#) g, [GCStringIn](#) file\_path, [GOption](#) options, [GCStringOut](#) info, [GSize](#) info\_len)  
*Download a saved controller configuration from a file.*

### 8.6.1 Detailed Description

Open-source convenience functions for Galil C Lib. Please email [softwarefeedback@galil.com](mailto:softwarefeedback@galil.com) with suggestions for useful/missing functions.

### 8.6.2 Function Documentation

#### 8.6.2.1 GAddresses()

```
GCLIB_DLL_EXPORTED GReturn GCALL GAddresses (
    GCStringOut addresses,
    GSize addresses_len )
```

Uses [GUtility\(\)](#), [G\\_UTIL\\_GCAPS\\_ADDRESSES](#) or [G\\_UTIL\\_ADDRESSES](#) to provide a listing of all available connection addresses.

#### Note

Serial ports are listed, e.g. COM1. Upon open, it may be necessary to specify a baud rate for the controller, e.g. `--baud 19200`. Default baud is 115200. See [GOpen\(\)](#).

#### Parameters

<i>addresses</i>	Buffer to hold the output string. Buffer will be null terminated, even if the data must be truncated to do so. See below for more information.
<i>addresses_len</i>	Length of buffer.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

If [gcaps](#) is available, the listing will come from the server via [G\\_UTIL\\_GCAPS\\_ADDRESSES](#). In the absence of the server, gclib will use [G\\_UTIL\\_ADDRESSES](#) to generate the list.

- Ethernet controllers will be listed as *ip\_address, revision\_report, network\_adaptor\_name, network\_adaptor↵\_ip\_address*. If an IP address is unreachable via ping, the address will be in parentheses.
- PCI controllers will be listed by their identifier, e.g. GALILPCI1.
- Serial ports will be listed by their identifier, e.g. COM1.

10.1.3.91, DMC4020 Rev 1.2e, LAN, 10.1.3.10  
 192.168.0.63, DMC4040 Rev 1.2f, Static, 192.168.0.41  
 (192.0.0.42), RIO47102 Rev 1.1j, Static, 192.168.0.41  
 GALILPCI1  
 COM1  
 COM2

#### Note

[GAddresses\(\)](#) will take up to 1 second to look for [gcaps](#).

See `x_examples.cpp` for an example.

Definition at line 50 of file `gclibo.c`.

References `G_NO_ERROR`, `G_UTIL_ADDRESSES`, `G_UTIL_GCAPS_ADDRESSES`, and `GUtility()`.

#### 8.6.2.2 GArrayDownloadFile()

```
GCLIB_DLL_EXPORTED GReturn GCALL GArrayDownloadFile (
    GCon g,
    GCStringIn file_path )
```

Array download from file.

Downloads a csv file containing array data at `file_path`. If the arrays don't exist, they will be dimensioned.

##### Parameters

<i>g</i>	Connection's handle.
<i>file_path</i>	Null-terminated string containing the path to the array file.

##### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_arrays.cpp` for an example.

Definition at line 378 of file `arrays.c`.

References `G_BAD_FILE`, `G_NO_ERROR`, and `H_ArrayDownloadFromMemory()`.

#### 8.6.2.3 GArrayUploadFile()

```
GCLIB_DLL_EXPORTED GReturn GCALL GArrayUploadFile (
    GCon g,
    GCStringIn file_path,
    GCStringIn names )
```

Array upload to file.

Uploads the entire controller array table or a subset and saves the data as a csv file specified by `file_path`.

##### Parameters

<i>g</i>	Connection's handle.
<i>file_path</i>	Null-terminated string containing the path to the array file, file will be overwritten if it exists.

**Parameters**

<i>names</i>	Null-terminated string containing the arrays to upload, delimited with space. "" or null uploads all arrays listed in LA.
--------------	---

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_arrays.cpp` for an example.

Definition at line 406 of file `arrays.c`.

References `G_NO_ERROR`, `GCmdT()`, `H_FreeArrays()`, `H_InitArrayNode()`, `H_UploadArrayToList()`, and `H_WriteArrayCsv()`.

**8.6.2.4 GAssign()**

```
GCLIB_DLL_EXPORTED GReturn GCALL GAssign (
    GCStringIn ip,
    GCStringIn mac )
```

Uses [GUtility\(\)](#), [G\\_UTIL\\_GCAPS\\_ASSIGN](#) or [G\\_UTIL\\_ASSIGN](#) to assign an IP address over the Ethernet to a controller at a given MAC address.

**Parameters**

<i>ip</i>	The null-terminated ip address to assign. The hardware should not yet have an IP address.
<i>mac</i>	The null-terminated MAC address of the hardware.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

On Linux and Mac, the desired IP address will be pinged prior to the assignment. If the ping is returned, [GAssign\(\)](#) will return [G\\_GCLIB\\_UTILITY\\_IP\\_TAKEN](#).

If [gcaps](#) is available, the assign will be performed from the server via [G\\_UTIL\\_GCAPS\\_ASSIGN](#). In the absence of the server, gclib will use [G\\_UTIL\\_ASSIGN](#) to assign.

**Attention**

When not using [gcaps](#), Linux/OS X users must be root to use [GAssign\(\)](#) and have UDP access to send on port 68.

**Note**

[GAssign\(\)](#) will take up to 1 second to look for [gcaps](#).

See `x_examples.cpp` for an example.

Definition at line 66 of file `gclibo.c`.

References `G_GCLIB_UTILITY_IP_TAKEN`, `G_NO_ERROR`, `G_UTIL_ASSIGN`, `G_UTIL_GCAPS_ASSIGN`, `G_UTIL_GCAPS_PING`, `G_UTIL_PING`, and `GUtility()`.

### 8.6.2.5 GCmd()

```
GCLIB_DLL_EXPORTED GReturn GCALL GCmd (
    GCon g,
    GCStringIn command )
```

Wrapper around GCommand for use when the return value is not desired.

The returned data is still checked for error, e.g. ? or timeout, but is not brought out through the prototype.

#### Parameters

<i>g</i>	Connection's handle.
<i>command</i>	Null-terminated command string to send to the controller.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_gcommand.cpp` for an example.

Definition at line 110 of file `gclibo.c`.

References `G_SMALL_BUFFER`, and `GCommand()`.

Referenced by `GRecordRate()`, `H_DownloadArraysFromList()`, and `H_DownloadData()`.

### 8.6.2.6 GCmdD()

```
GCLIB_DLL_EXPORTED GReturn GCALL GCmdD (
    GCon g,
    GCStringIn command,
    double * value )
```

Wrapper around GCommand that provides the return value of a command parsed into a double.

Use this function to retrieve the full Galil 4.2 range, e.g. for a variable value with fractional data, or the value of an Analog input or Output.

#### Parameters

<i>g</i>	Connection's handle.
<i>command</i>	Null-terminated command string to send to the controller.
<i>value</i>	Pointer to a double that will be filled with the return value.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_gcommand.cpp` for an example.

Definition at line 162 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, and `GCommand()`.

Referenced by `GRecordRate()`.

### 8.6.2.7 GCmdI()

```
GCLIB_DLL_EXPORTED GReturn GCALL GCmdI (
    GCon g,
    GCStringIn command,
    int * value )
```

Wrapper around GCommand that provides the return value of a command parsed into an int.

Use this function to get most values including TP, RP, TE, Digital I/O states, etc.

#### Parameters

<i>g</i>	Connection's handle.
<i>command</i>	Null-terminated command string to send to the controller.
<i>value</i>	Pointer to an int that will be filled with the return value.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_gcommand.cpp` for an example.

Definition at line 151 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, and `GCommand()`.

### 8.6.2.8 GCmdT()

```
GCLIB_DLL_EXPORTED GReturn GCALL GCmdT (
    GCon g,
    GCStringIn command,
    GCStringOut trimmed_response,
    GSize response_len,
    GCStringOut * front )
```

Wrapper around GCommand that trims the response.

For use when the return value is desired, is ASCII (not binary), and the response should be trimmed of trailing colon, whitespace, and optionally leading space.

#### Parameters

<i>g</i>	Connection's handle.
<i>command</i>	Null-terminated command string to send to the controller.
<i>trimmed_response</i>	The trimmed response from the controller. Trailing space is trimmed by null terminating any trailing spaces, carriage returns, or line feeds.
<i>response_len</i>	The length of the <code>trimmed_response</code> buffer.
<i>front</i>	If non-null, upon return <code>*front</code> will point to the first non-space character in <code>trimmed_response</code> . This allows trimming the front of the string without modifying the user's buffer pointer, which may be allocated on the heap.



**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_gcommand.cpp` for an example.

Definition at line 116 of file `gclibo.c`.

References `G_NO_ERROR`, and `GCommand()`.

Referenced by `GArrayUploadFile()`, and `GRecordRate()`.

**8.6.2.9 GError()**

```
GCLIB_DLL_EXPORTED void GCALL GError (
    GReturn rc,
    GCStringOut error,
    GSize error_len )
```

Provides a human-readable description string for return codes.

**Parameters**

<i>rc</i>	The return code to lookup.
<i>error</i>	The buffer to fill with the error text. Buffer will be null terminated, even if the data must be truncated to do so.
<i>error_len</i>	The length of the error buffer.

See `x_examples.cpp` for an example.

Definition at line 332 of file `gclibo.c`.

References `G_NO_ERROR`.

**8.6.2.10 GInfo()**

```
GCLIB_DLL_EXPORTED GReturn GCALL GInfo (
    GCon g,
    GCStringOut info,
    GSize info_len )
```

Uses [GUtility\(\)](#) and [G\\_UTIL\\_INFO](#) to provide a useful connection string.

**Parameters**

<i>g</i>	Connection's handle.
<i>info</i>	Buffer to hold the output string. Buffer will be null terminated, even if the data must be truncated to do so.
<i>info_len</i>	Length of buffer.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

The response is *address*, *revision\_report*, *serial\_number*. For example:

```
COM2, RIO47102 Rev 1.1j, 37290
```

See `x_examples.cpp` for an example.

Definition at line 45 of file `gclibo.c`.

References `G_UTIL_INFO`, and `GUtility()`.

#### 8.6.2.11 GIpRequests()

```
GCLIB_DLL_EXPORTED GReturn GCALL GIpRequests (
    GCStringOut requests,
    GSize requests_len )
```

Uses `GUtility()`, `G_UTIL_GCAPS_IPREQUEST` or `G_UTIL_IPREQUEST` to provide a list of all Galil controllers requesting IP addresses via BOOT-P or DHCP.

##### Parameters

<i>requests</i>	The buffer to hold the list of requesting controllers. Data will be null terminated, even if the data must be truncated to do so. See below for more information.
<i>requests_len</i>	The length of the requests buffer.

##### Returns

The success status or error code of the function. See `gclib_errors.h` for possible values.

`GIpRequests()` will block about 5 seconds while listening for requests.

If `gcaps` is available, the listing will come from the server via `G_UTIL_GCAPS_IPREQUEST`. In the absence of the server, `gclib` will use `G_UTIL_IPREQUEST` to generate the list.

##### Attention

When not using `gcaps`, Linux/OS X users must be root to use `GIpRequests()` and have UDP access to bind and listen on port 67.

Each line of the returned data will be of the form *model, serial\_number, MAC\_address, network\_adaptor\_name, network\_adaptor\_ip\_address*. For example:

```
DMC4000, 291, 00:50:4C:20:01:23, LAN, 10.1.3.10
RIO47000, 37290, 00:50:4C:28:91:AA, Static, 192.168.0.41
```

##### Note

`GIpRequests()` will take up to 1 second to look for `gcaps`.

See `x_examples.cpp` for an example.

Definition at line 99 of file `gclibo.c`.

References `G_NO_ERROR`, `G_UTIL_GCAPS_IPREQUEST`, `G_UTIL_IPREQUEST`, and `GUtility()`.

#### 8.6.2.12 GMotionComplete()

```
GCLIB_DLL_EXPORTED GReturn GCALL GMotionComplete (
    GCon g,
    GCStringIn axes )
```

Blocking call that returns once all axes specified have completed their motion.

**Note**

This function uses a profiled motion indicator, not the position of the encoder. E.G. see the difference between AM (profiled) and MC (encoder-based).

Although using the `_BGm` operand is the most generally compatible method, there are higher-performance ways to check for motion complete by using the data record, or interrupts. See examples `x_dr_motioncomplete()` and `x_ei_motioncomplete()`.

**Parameters**

<i>g</i>	Connection's handle.
<i>axes</i>	A null-terminated string containing a multiple-axes mask. Every character in the string should be a valid argument to <code>MG_BGm</code> , i.e. XYZWABCEFGHST.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_gmotioncomplete.cpp` for an example.

Definition at line 173 of file `gclibo.c`.

References `G_NO_ERROR`, and `GWaitForBool()`.

**8.6.2.13 GProgramDownloadFile()**

```
GCLIB_DLL_EXPORTED GReturn GCALL GProgramDownloadFile (
    GCon g,
    GCStringIn file_path,
    GCStringIn preprocessor )
```

Program download from file.

**Parameters**

<i>g</i>	Connection's handle.
<i>file_path</i>	Null-terminated string containing the path to the program file.
<i>preprocessor</i>	Options string for preprocessing the program before sending it to the controller. See <a href="#">GProgramDownload()</a> .

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_programs.cpp` for an example.

Definition at line 260 of file `gclibo.c`.

References `G_BAD_FILE`, `G_BAD_FULL_MEMORY`, `G_NO_ERROR`, and `GProgramDownload()`.

**8.6.2.14 GProgramUploadFile()**

```
GCLIB_DLL_EXPORTED GReturn GCALL GProgramUploadFile (
```

```
GCon g,
GCStringIn file_path )
```

Program upload to file.

#### Parameters

<i>g</i>	Connection's handle.
<i>file_path</i>	Null-terminated string containing the path to the program file, file will be overwritten if it exists.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_programs.cpp` for an example.

Definition at line 303 of file `gclibo.c`.

References `G_BAD_FILE`, `G_BAD_FULL_MEMORY`, `G_NO_ERROR`, `GProgramUpload()`, and `MAXPROG`.

#### 8.6.2.15 GRecordRate()

```
GCLIB_DLL_EXPORTED GReturn GCALL GRecordRate (
    GCon g,
    double period_ms )
```

Sets the asynchronous data record to a user-specified period via DR.

Takes TM and product type into account and sets the DR period to the period requested by the user, if possible.

#### Parameters

<i>g</i>	Connection's handle.
<i>period_ms</i>	Period, in milliseconds, to set up for the asynchronous data record.

#### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_grecord.cpp` for an example.

Definition at line 215 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, `GCmd()`, `GCmdD()`, and `GCmdT()`.

#### 8.6.2.16 GSetupDownloadFile()

```
GCLIB_DLL_EXPORTED GReturn GCALL GSetupDownloadFile (
    GCon g,
    GCStringIn file_path,
    GOption options,
    GCStringOut info,
    GSize info_len )
```

Download a saved controller configuration from a file.

## Parameters

<i>g</i>	Connection's handle.
<i>file_path</i>	Null-terminated string containing the path to the gcb file.
<i>options</i>	Bit mask to determine what configuration data to download. See below for all options.
<i>info</i>	Optional pointer to a buffer to store the controller info. If no info is needed, specify as NULL.
<i>info_len</i>	Length of optional info buffer. If no info is needed, specify as NULL.

## Returns

The success status or error code of the function. If the options parameter is set to 0, the return value will be a bit mask indicating which sectors in the specified GCB are not empty. Otherwise, see [gclib\\_errors.h](#) for possible error values.

## Note

By default, [GSetupDownloadFile\(\)](#) will stop immediately if an error is encountered downloading data. This can be overridden in the options parameter. For example, you may want to override the error if you have a backup from an 8-axis controller and want to restore the parameters for the first 4 axes to a 4-axis controller.

If both info and info\_len are not NULL, the controller information will be provided regardless of the options parameter.

The options parameter is a bit mask. If options is set to 0, [GSetupDownloadFile\(\)](#) will return a bit mask indicating which sectors in the specified GCB are not empty. The following contains a list of all currently available options:

Bit	Value	Function	Description
1	0x0002	Restore parameters	<b>KPA, KIA, KDA</b> , etc...
3	0x0008	Restore variables	Variables are listed by the <b>LV</b> command
4	0x0010	Restore arrays	Arrays are listed by the <b>LA</b> command
5	0x0020	Restore program	The program is listed by the <b>LS</b> command
31	0x8000	Ignore errors	Ignore invalid parameter errors and continue restoring data. <a href="#">GSetupDownloadFile()</a> will still stop immediately if a connection issue or other fatal error is encountered

## Usage example:

```
GCon g;
GOption opt = 0;

GCStringOut info;
GSize info_len = 4096;

GReturn rc = GOpen("192.168.0.50", &g);
if (rc) return rc;

// Call GSetupDownloadFile() with options set to 0 so we can get the non-empty sector bit mask
opt = GSetupDownloadFile(g, "C:\\path\\to\\gcb\\file.gcb", 0, NULL, NULL);

info = (GCStringOut)malloc(sizeof(GCStringOut) * info_len);

// Call GSetupDownloadFile() with the bit mask returned in the previous function call
rc = GSetupDownloadFile(g, "C:\\path\\to\\gcb\\file.gcb", opt, info, info_len);

printf("Info:\n\n%s", info);

GClose(g);

free(info);
return rc;
```

Definition at line 473 of file arrays.c.

References [G\\_BAD\\_FILE](#), [G\\_NO\\_ERROR](#), [GProgramDownload\(\)](#), [H\\_ArrayDownloadFromMemory\(\)](#), [H\\_↔DownloadData\(\)](#), and [H\\_FindSector\(\)](#).

#### 8.6.2.17 GSleep()

```
GCLIB_DLL_EXPORTED void GCALL GSleep (
    unsigned int timeout_ms )
```

Uses [GUtility\(\)](#) and [G\\_UTIL\\_SLEEP](#) to provide a blocking sleep call which can be useful for timing-based chores.

##### Parameters

<i>timeout_ms</i>	The timeout, in milliseconds, to block before returning.
-------------------	--

See [GWaitForBool\(\)](#) for an example.

Definition at line 20 of file `gclibo.c`.

References [G\\_UTIL\\_SLEEP](#), and [GUtility\(\)](#).

Referenced by [GWaitForBool\(\)](#).

#### 8.6.2.18 GTimeout()

```
GCLIB_DLL_EXPORTED GReturn GCALL GTimeout (
    GCon g,
    short timeout_ms )
```

Uses [GUtility\(\)](#) and [G\\_UTIL\\_TIMEOUT\\_OVERRIDE](#) to set the library timeout.

##### Parameters

<i>g</i>	Connection's handle.
<i>timeout_ms</i>	The value to be used for the timeout. Use <a href="#">G_USE_INITIAL_TIMEOUT</a> to set the timeout back to the initial <a href="#">GOpen()</a> value, <code>--timeout</code> .

##### Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See `x_gcommand.cpp` and `x_gread_gwrite.cpp` for examples.

Definition at line 61 of file `gclibo.c`.

References [G\\_UTIL\\_TIMEOUT\\_OVERRIDE](#), and [GUtility\(\)](#).

#### 8.6.2.19 GVersion()

```
GCLIB_DLL_EXPORTED GReturn GCALL GVersion (
    GStringOut ver,
    GSize ver_len )
```

Uses [GUtility\(\)](#), [G\\_UTIL\\_VERSION](#) and [G\\_UTIL\\_GCAPS\\_VERSION](#) to provide the library and [gcaps](#) version numbers.

## Parameters

<i>ver</i>	Buffer to hold the output string. Buffer will be null terminated, even if the data must be truncated to do so.
<i>ver_len</i>	Length of buffer.

## Returns

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

The version number of gclib is provided first. If the [gcaps](#) server can be found, its version will be provided after a space.

Example with gcaps version.

```
154.190.329 1.0.0.82
```

Example with gclib version only.

```
154.190.329
```

## Note

[GVersion\(\)](#) will take up to 1 second to look for [gcaps](#).

See `x_examples.cpp` for an example.

Definition at line 25 of file `gclibo.c`.

References `G_NO_ERROR`, `G_UTIL_GCAPS_VERSION`, `G_UTIL_VERSION`, and `GUtility()`.

## 8.6.2.20 GWaitForBool()

```
GCLIB_DLL_EXPORTED GReturn GCALL GWaitForBool (
    GCon g,
    GCStringIn predicate,
    int trials )
```

Blocking call that returns when the controller evaluates the predicate as true.

Polls the message command (MG) to check the value of predicate. Polling will continue until the controller responds with a nonzero value or the number of polling trials is reached.

The amount of time until the function fails with [G\\_GCLIB\\_POLLING\\_FAILED](#) is roughly (trials \* [POLLINGINTERVAL](#)) milliseconds.

## Parameters

<i>g</i>	Connection's handle.
<i>predicate</i>	A null-terminated string containing the predicate to be polled. The predicate will be enclosed in parentheses and used in the command <code>MG (predicate)</code> to return the value.
<i>trials</i>	The number of polling cycles to perform looking for a nonzero value. Use -1 to poll indefinitely.

**Returns**

The success status or error code of the function. See [gclib\\_errors.h](#) for possible values.

See [GMotionComplete\(\)](#) for an example.

Definition at line 191 of file gclibo.c.

References `G_GCLIB_POLLING_FAILED`, `G_LINE_BUFFER`, `G_NO_ERROR`, `G_SMALL_BUFFER`, `G←Command()`, `GSleep()`, and `POLLINGINTERVAL`.

Referenced by `GMotionComplete()`.



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