

gclib 393

C API for Galil controllers and PLCs

Galil Motion Control

Wed Nov 15 2017



# Contents

<b>1</b>	<b>Getting Started</b>	<b>1</b>
<b>2</b>	<b>Installation</b>	<b>3</b>
2.1	Microsoft Windows	4
2.2	Apple OS X	6
2.3	Ubuntu Linux	8
2.4	Fedora Linux	10
2.5	Red Hat 7 & CentOS 7 Linux	13
2.6	Red Hat 6 & CentOS 6 Linux	15
2.7	Raspberry Pi	18
<b>3</b>	<b>Language Support</b>	<b>21</b>
3.1	C/C++	21
3.1.1	Microsoft Visual Studio 2015 (14.0)	21
3.1.2	Microsoft Visual Studio 2013 (12.0)	23
3.1.3	MinGW	26
3.1.4	Borland C++	28
3.1.5	gcc (Linux)	32
3.1.6	clang (OS X)	35
3.2	Python	38
3.3	.Net	40
3.3.1	VB.NET	40
3.3.2	C#.NET	42
3.4	Java	45
<b>4</b>	<b>Using gclib</b>	<b>47</b>
4.1	gcaps	47
4.2	Program Preprocessor	49
4.3	Thread Safety	53
4.4	Galil Widgets	54
4.5	Rebuilding gclibo	55
4.6	Software Licenses	59

4.6.1	Closed Source License . . . . .	59
4.6.2	Open Source License . . . . .	60
4.7	Legacy Compatibility . . . . .	60
4.7.1	GalilTools . . . . .	60
4.7.2	DMC32 OSU . . . . .	62
<b>5</b>	<b>Data Structure Index</b>	<b>63</b>
5.1	Data Structures . . . . .	63
<b>6</b>	<b>File Index</b>	<b>65</b>
6.1	File List . . . . .	65
<b>7</b>	<b>Data Structure Documentation</b>	<b>67</b>
7.1	GDataRecord Union Reference . . . . .	67
7.1.1	Detailed Description . . . . .	68
7.2	GDataRecord1802 Struct Reference . . . . .	68
7.2.1	Detailed Description . . . . .	71
7.3	GDataRecord1806 Struct Reference . . . . .	71
7.3.1	Detailed Description . . . . .	77
7.4	GDataRecord2103 Struct Reference . . . . .	78
7.4.1	Detailed Description . . . . .	82
7.5	GDataRecord30000 Struct Reference . . . . .	83
7.5.1	Detailed Description . . . . .	84
7.6	GDataRecord4000 Struct Reference . . . . .	84
7.6.1	Detailed Description . . . . .	91
7.7	GDataRecord47000_ENC Struct Reference . . . . .	91
7.7.1	Detailed Description . . . . .	92
7.8	GDataRecord47300_24EX Struct Reference . . . . .	92
7.8.1	Detailed Description . . . . .	94
7.9	GDataRecord47300_ENC Struct Reference . . . . .	94
7.9.1	Detailed Description . . . . .	96
7.10	GDataRecord52000 Struct Reference . . . . .	96
7.10.1	Detailed Description . . . . .	102
7.11	H_ArrayData Struct Reference . . . . .	102
7.11.1	Detailed Description . . . . .	103
<b>8</b>	<b>File Documentation</b>	<b>105</b>
8.1	arrays.c File Reference . . . . .	105
8.1.1	Detailed Description . . . . .	106
8.1.2	Function Documentation . . . . .	106
8.1.2.1	GArrayDownloadFile . . . . .	106

8.1.2.2	GArrayUploadFile	106
8.1.2.3	H_DownloadArraysFromList	107
8.2	gclib.h File Reference	107
8.2.1	Detailed Description	109
8.2.2	Function Documentation	109
8.2.2.1	GArrayDownload	109
8.2.2.2	GArrayUpload	110
8.2.2.3	GClose	110
8.2.2.4	GCommand	111
8.2.2.5	GFirmwareDownload	111
8.2.2.6	GInterrupt	112
8.2.2.7	GMessage	112
8.2.2.8	GOpen	113
8.2.2.9	GProgramDownload	114
8.2.2.10	GProgramUpload	115
8.2.2.11	GRead	116
8.2.2.12	GRecord	116
8.2.2.13	GUtility	117
8.2.2.14	GWrite	120
8.3	gclib_errors.h File Reference	120
8.3.1	Detailed Description	122
8.4	gclib_record.h File Reference	122
8.4.1	Detailed Description	123
8.5	gclibo.c File Reference	123
8.5.1	Detailed Description	124
8.5.2	Function Documentation	124
8.5.2.1	GAddresses	124
8.5.2.2	GAssign	125
8.5.2.3	GCmd	125
8.5.2.4	GCmdD	126
8.5.2.5	GCmdI	126
8.5.2.6	GCmdT	127
8.5.2.7	GError	127
8.5.2.8	GInfo	127
8.5.2.9	GIpRequests	128
8.5.2.10	GMotionComplete	129
8.5.2.11	GProgramDownloadFile	129
8.5.2.12	GProgramUploadFile	129
8.5.2.13	GRecordRate	130
8.5.2.14	GSleep	130

8.5.2.15	GTimeout	130
8.5.2.16	GVersion	131
8.6	gclibo.h File Reference	131
8.6.1	Detailed Description	133
8.6.2	Function Documentation	133
8.6.2.1	GAddresses	133
8.6.2.2	GArrayDownloadFile	133
8.6.2.3	GArrayUploadFile	134
8.6.2.4	GAssign	134
8.6.2.5	GCmd	135
8.6.2.6	GCmdD	135
8.6.2.7	GCmdI	136
8.6.2.8	GCmdT	136
8.6.2.9	GError	136
8.6.2.10	GInfo	137
8.6.2.11	GlpRequests	137
8.6.2.12	GMotionComplete	138
8.6.2.13	GProgramDownloadFile	138
8.6.2.14	GProgramUploadFile	139
8.6.2.15	GRecordRate	139
8.6.2.16	GSleep	139
8.6.2.17	GTimeout	140
8.6.2.18	GVersion	140

# 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
- [Apple OS X](#)
  - Yosemite 10.10 x64
  - Mavericks 10.9 x64
- [Ubuntu Linux](#)
  - 16.04 LTS x64 ◇
  - 14.04 LTS x64 †
  - 12.04 LTS x64 †
- [Fedora Linux](#)
  - 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](#)
  - Stretch, 9.1

- Jessie, 8.0 †
- 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 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.

## 2.3 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 Ubuntu version

```
$ uver=$(lsb_release -r | cut -f 2); echo $uver  
16.04
```

#### Install Galil's public certificate

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

#### Get Galil's apt sources list

```
# wget http://www.galil.com/sw/pub/ubuntu/$uver/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
```

### Offline pdf

There may be a pdf shipped in the package. The following allows viewing of the pdf docs from the installation.

```
$ tar -xzf /usr/share/doc/gclib/gclib_doc.tar.gz gclib_132.pdf
$ evince gclib.pdf
```

## 2.4 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 pdf

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

```
$ tar -xzf /usr/share/doc/gclib/gclib_doc.tar.gz gclib.pdf
$ evince gclib.pdf
```

### 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 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
```

**Offline pdf**

There may be a pdf shipped in the package. The following allows viewing of the pdf docs from the installation.

```
$ tar -xzf /usr/share/doc/gclib/gclib_doc.tar.gz gclib_132.pdf
$ evince gclib.pdf
```

## 2.6 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 -xvf /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
```

**Offline pdf**

There may be a pdf shipped in the package. The following allows viewing of the pdf docs from the installation.

```
$ tar -xzf /usr/share/doc/gclib/gclib_doc.tar.gz gclib_132.pdf
$ evince gclib.pdf
```

## 2.7 Raspberry Pi

### Tested versions

- Raspberry Pi 3 Model B
- Hardware Raspberry Pi 2 Model B

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

### Installation

#### Create a temporary variable for Raspbian version

```
uver=$(lsb_release -r | cut -f 2); echo $uver
8.0
```

#### Install Galil's public certificate

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

#### Get Galil's apt sources list

```
$sudo wget http://www.galil.com/sw/pub/raspbian/$uver/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
```

#### Offline pdf

There may be a pdf shipped in the package. The following allows viewing of the pdf docs from the installation.

```
$ sudo apt-get update
$ sudo apt-get install evince
$ tar -xzf /usr/share/doc/gclib/gclib_doc.tar.gz gclib_132.pdf
$ evince gclib.pdf
```



## 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\x86;%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
:
```

## 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+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;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, 18.0000
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:

```

### 3.1.5 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](#).

```

C:\Users\username>cd Desktop
C:\Users\username\Desktop>mkdir python_temp
C:\Users\username\Desktop>cd python_temp
C:\Users\username\Desktop\python_temp>copy "c:\Program Files (x86)\Galil\gclib\source\wrappers\python\*" .
C:\Users\username\Desktop\python_temp>copy "c:\Program Files (x86)\Galil\gclib\examples\python\*" .
C:\Users\username\Desktop\python_temp>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 -> C:\Python34\Lib\site-packages
byte-compiling C:\Python34\Lib\site-packages\gclib.py to gclib.cpython-34.pyc
running install_egg_info
Writing C:\Python34\Lib\site-packages\gclib-1.0-py3.4.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 ~/python_temp
$ cd ~/python_temp/
$ 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.
<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 [GlpRequests\(\)](#) 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 pure 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.

```
1 ## Author: Zaphod Beeblebrox
2 ## Project: Total Perspective Vortex
3 //the above 4 hashmarks enable the preprocessor
4 ##option "--min 4" //use a minimum of level four compression
5 REM REM-style comments are supported at all times
6 PRA=1000
7 BGA
8 AMA
9 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.

```
1 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.

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

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

```
1 ##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.

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

For example,

```
1 ##include "c:\galil\initialize.dmc"
2 ##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.



### 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.

### Preprocessor Options

- Lines beginning with `REM` are always removed from the text prior to download.
- A `\` character on a line other than a preprocessor line will result in an error.
- Trailing semicolons are removed.

### Compression, `--min`, `--max`

- Defaults
  - Use maximum compression, only if needed, to fit the program.
- `--max n` provides preprocessing up to and including level *n*. Only the necessary preprocessing will be performed up to level *n*.
- `--min n` will preprocess at least up to and including *n*. *n* defined as with `--max` above.

### Compression Levels, *n*

- Level 0 (mandatory)
  1. Comment blank lines with `'`.
  2. Remove white space (space/tab) in front of `#` (label declarations).
  3. Remove white space after commands.
  4. Line ends changed to carriage return.
  5. Replace leading tabs with double space.
  6. Replace non-leading tabs with single space.
- 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`) too.
- 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`**

- Defaults
  - Code download 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.

**In-band Example**

```
1 ##option "-I /code/dmc/homing"
2 ##option "-I /code/dmc"
3 ##include "auto.dmc"
4 //executable's directory will be checked
5 //then c:\code\dmc\homing
6 //then c:\code\dmc
```

**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

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

would cause the following code

```
1 SH\ax\  
2 JG\ax\=1000  
3 BG\ax\  
4
```

to be downloaded as

```
1 SHA  
2 JGA=1000  
3 BGA  
4
```

This causes the *A* axis to be addressed.

**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.
- **GWDatRec**: 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 2013* and can be extended to other Visual Studio versions.

Open *VS2013 x86 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 the source files. Note the quotes.

```
C:\temp>copy "%base%\source\gclibo\*.c" .
```

### 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. Note the quotes.**

```
C:\temp>cl -c *.c -I "%base%\include" -DBUILDING_GCLIB
```

**Link the source code. Note the quotes.**

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

### Copy

Copy back to the installation location from the file explorer.

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

### Test

#### Copy simple example

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

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

#### Compile

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

#### Set Path to DLL

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

#### Execute

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

## Linux

### Copy files

```
$ mkdir test
$ cd test
$ tar -xvf /usr/share/doc/gclib/src/gclibo_src.tar.gz
gclibo.h
gclibo.c
arrays.c
makefile_gclibo
$ cp /usr/include/gclib*.h .
$ ls
arrays.c          gclib.h  gclibo.h          makefile_gclibo
gclib_errors.h   gclibo.c gclib_record.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 -f makefile_gclibo
Open source component, libgclibo.so.0.0
  Compiling open source component.
gcc -c -Wall -Werror -fPIC -fvisibility=hidden -DBUILDING_GCLIB -DHAVE_VISIBILITY *.c
  Linking open source component into shared library.
gcc -shared -o libgclibo.so.0.0 *.o -Wl,-soname=libgclibo.so.0
strip --strip-unneeded libgclibo.so.0.0
  Cleaning up.
$ sudo make install -f makefile_gclibo
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.

### 4.6.1 Closed Source License

Copyright (c) 2016, Galil Motion Control

#### Galil C Library (gclib) Closed Source Software License - January 4, 2016

This informal software license is 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.

This license includes the closed source portion of the gclib, defined by the header file [gclib.h](#) as outlined in the accompanying documentation (the docs).

Galil hereby grants the following:

The closed source portion may be freely copied and used for any Galil application, commercial and non-commercial in an unmodified format, unless such modifications are detailed in the docs.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE AND NON-INFRINGEMENT. IN NO EVENT SHALL THE COPYRIGHT HOLDERS OR ANYONE DISTRIBUTING THE SOFTWARE BE LIABLE FOR ANY DAMAGES OR OTHER LIABILITY, WHETHER IN CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Galil Motion Control  
 270 Technology Way  
 Rocklin, CA 95765, USA  
 support@galilmc.com  
 1 (800) 377-6329  
 1 (916) 626-0102  
 www.galil.com

## 4.6.2 Open Source License

Copyright (c) 2016, Galil Motion Control

### Galil C Library (gclib) Open Source Software License - January 4, 2016

This informal software license is 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.

This license includes the open source portions of the gclib, as well as examples and wrappers as outlined in the accompanying documentation (the docs).

Galil hereby grants the following:

The open source portions, examples, and wrappers may be freely copied, used, and modified for any Galil application, commercial and non-commercial provided that:

- (1) This license appears with all copies, including modifications, of the software source code.
- (2) Modified files must be commented at the top of the file with the original Galil version number and the author of the modifications.
- (3) This license NEED NOT appear with binaries or executables if the source code is not included.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE AND NON-INFRINGEMENT. IN NO EVENT SHALL THE COPYRIGHT HOLDERS OR ANYONE DISTRIBUTING THE SOFTWARE BE LIABLE FOR ANY DAMAGES OR OTHER LIABILITY, WHETHER IN CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Galil Motion Control  
 270 Technology Way  
 Rocklin, CA 95765, USA  
 support@galilmc.com  
 1 (800) 377-6329  
 1 (916) 626-0102  
 www.galil.com

## 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

Here are the data structures with brief descriptions:

<a href="#">GDataRecord</a>	
Data record union, containing all structs and a generic byte array accessor . . . . .	67
<a href="#">GDataRecord1802</a>	68
<a href="#">GDataRecord1806</a>	
Data record struct for DMC-1806 controller . . . . .	71
<a href="#">GDataRecord2103</a>	
Data record struct for DMC-2103 controllers . . . . .	78
<a href="#">GDataRecord30000</a>	
Data record struct for DMC-30010 controllers . . . . .	83
<a href="#">GDataRecord4000</a>	
Data record struct for DMC-4000 controllers, including 4000, 4200, 4103, and 500x0 . . . . .	84
<a href="#">GDataRecord47000_ENC</a>	
Data record struct for RIO-471xx and RIO-472xx PLCs. Includes encoder fields . . . . .	91
<a href="#">GDataRecord47300_24EX</a>	
Data record struct for RIO-47300 with 24EX I/O daughter board . . . . .	92
<a href="#">GDataRecord47300_ENC</a>	
Data record struct for RIO-47300. Includes encoder fields . . . . .	94
<a href="#">GDataRecord52000</a>	
Data record struct for DMC-52000 controller. Same as DMC-4000, with bank indicator added at byte 40 . . . . .	96
<a href="#">H_ArrayData</a>	
Structure to create a linked list for array data . . . . .	102



## Chapter 6

# File Index

### 6.1 File List

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

<a href="#">arrays.c</a>	105
<a href="#">gclib.h</a>	107
<a href="#">gclib_errors.h</a>	120
<a href="#">gclib_record.h</a>	122
<a href="#">gclibo.c</a>	123
<a href="#">gclibo.h</a>	131





## 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.*
- 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 1029 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 726 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 408 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 585 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 817 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 34 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 869 of file `gclib_record.h`.

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

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

## 7.8 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.*

### 7.8.1 Detailed Description

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

Definition at line 967 of file `gclib_record.h`.

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

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

## 7.9 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.*

### 7.9.1 Detailed Description

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

Definition at line 917 of file `gclib_record.h`.

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

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

## 7.10 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).*

### 7.10.1 Detailed Description

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

Definition at line 217 of file `gclib_record.h`.

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

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

## 7.11 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**

### 7.11.1 Detailed Description

Structure to create a linked list for array data.

Definition at line 16 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>
```

#### 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)  
*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 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.

### 8.1.1 Detailed Description

Function calls for uploading and downloading arrays with CSV files.

Definition in file [arrays.c](#).

### 8.1.2 Function Documentation

#### 8.1.2.1 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 257 of file [arrays.c](#).

References [G\\_BAD\\_FILE](#), [G\\_NO\\_ERROR](#), [H\\_ArrayAddElement\(\)](#), [H\\_CreateArrayNode\(\)](#), [H\\_DownloadArraysFromList\(\)](#), [H\\_FreeArrays\(\)](#), and [H\\_InitArrayNode\(\)](#).

#### 8.1.2.2 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 332 of file [arrays.c](#).

References [G\\_NO\\_ERROR](#), [GCmdT\(\)](#), [H\\_FreeArrays\(\)](#), [H\\_InitArrayNode\(\)](#), [H\\_UploadArrayToList\(\)](#), and [H\\_WriteArrayCsv\(\)](#).



### 8.1.2.3 GReturn H\_DownloadArraysFromList ( GCon g, ArrayNode \* head )

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 132 of file arrays.c.

References G\_BOUNDS, G\_NO\_ERROR, GArrayDownload(), and GCmd().

Referenced by GArrayDownloadFile().

## 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/writes to Galil are small. This value will easily hold most, e.g. TH, TZ, etc.*
- `#define G_HUGE_BUFFER` 524288  
*Most reads/writes to Galil hardware are small. This value will hold the largest array or program upload/download possible.*

## 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).

Definition in file [gclib.h](#).

### 8.2.2 Function Documentation

#### 8.2.2.1 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. <code>G_BOUNDS</code> to omit.
<i>last</i>	The last element of the array for sub-array downloads. <code>G_BOUNDS</code> 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 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. <code>G_BOUNDS</code> to omit.
<i>last</i>	The last element of the array for sub-array uploads. <code>G_BOUNDS</code> to omit.
<i>delim</i>	Sets the delimiter between array elements in the returned data, <code>G_CR</code> specifies carriage return, <code>G_COMMA</code> specifies comma.
<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 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 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.
<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 `GMotionComplete()`.

#### 8.2.2.5 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 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 GStatus 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 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 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>
<code>--direct</code>	<b>Connect directly to hardware instead of via <a href="#">gcaps</a></b>		<code>-a GALILPCI2 --direct</code>
<code>-d</code>	shorthand for <code>--direct</code>		<code>GALILPCI2 -d</code>
<code>--handshake</code>	<b>Serial Handshake mode</b>	(HARDWARE), NONE	<code>COM1 --handshake NONE</code>

--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 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()`.



8.2.2.10 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** `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** `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 <code>DataRecord</code> 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_NON_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 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\\_KEEPAIVE](#) 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\\_KEEPAIVE](#) 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\(\)](#)
- [GlpRequests\(\)](#)
- [GSleep\(\)](#)
- [GTimeout\(\)](#)
- [GVersion\(\)](#)

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

#### 8.2.2.14 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\_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\_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\_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.

Definition in file [gclib\\_errors.h](#).

## 8.4 gclib\_record.h File Reference

### 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.
- 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 unsigned char UB`
- `typedef unsigned short UW`
- `typedef short SW`
- `typedef int SL`
- `typedef unsigned int 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`.

Definition in file [gclib\\_record.h](#).

## 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 (char *ip, char *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 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](#)

Definition in file [gclibo.c](#).

### 8.5.2 Function Documentation

#### 8.5.2.1 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
10.1., 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 46 of file `gclibo.c`.

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

**8.5.2.2 GReturn GCALL GAssign ( char \* ip, char \* 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 62 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 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 106 of file `gclibo.c`.

References `G_SMALL_BUFFER`, and `GCommand()`.

Referenced by `GRecordRate()`, and `H_DownloadArraysFromList()`.

**8.5.2.4 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 158 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, and `GCommand()`.

Referenced by `GRecordRate()`.

**8.5.2.5 GReturn GCALL GCmdl ( 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 147 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, and `GCommand()`.

#### 8.5.2.6 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 trimmed_response buffer.
<i>front</i>	If non-null, upon return *front will point to the first non-space character in trimmed_response. 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 112 of file `gclibo.c`.

References `G_NO_ERROR`, and `GCommand()`.

Referenced by `GArrayUploadFile()`, and `GRecordRate()`.

#### 8.5.2.7 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 312 of file `gclibo.c`.

References `G_ARRAY_NOT_DIMENSIONED`, `G_BAD_ADDRESS`, `G_BAD_FILE`, `G_BAD_FULL_MEMORY`, `G_BAD_LOST_DATA`, `G_BAD_RESPONSE_QUESTION_MARK`, `G_BAD_VALUE_RANGE`, `G_COMMAND_CALL`, `G_DATA_RECORD_ERROR`, `G_FIRMWARE_LOAD_NOT_SUPPORTED`, `G_GCAPS_OPEN_ERROR`, `G_GCAPS_SUBSCRIPTION_ERROR`, `G_GCLIB_ERROR`, `G_GCLIB_NON_BLOCKING_READ_EMPTY`, `G_GCLIB_UTILITY_ERROR`, `G_GCLIB_UTILITY_IP_TAKEN`, `G_ILLEGAL_DATA_IN_PROGRAM`, `G_INVALID_PREPROCESSOR_OPTIONS`, `G_NO_ERROR`, `G_OPEN_ERROR`, `G_READ_ERROR`, `G_TIMEOUT`, `G_UNABLE_TO_COMPRESS_PROGRAM_TO_FIT`, `G_UNSUPPORTED_FUNCTION`, and `G_WRITE_ERROR`.

#### 8.5.2.8 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 41 of file `gclibo.c`.

References `G_UTIL_INFO`, and `GUtility()`.

**8.5.2.9 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 95 of file `gclibo.c`.

References `G_NO_ERROR`, `G_UTIL_GCAPS_IPREQUEST`, `G_UTIL_IPREQUEST`, and `GUtility()`.

**8.5.2.10 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. XYZWABCFGHST.

**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 169 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, `GCommand()`, `GSleep()`, and `POLLINGINTERVAL`.

**8.5.2.11 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="#">G↔ProgramDownload()</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 240 of file `gclibo.c`.

References `G_BAD_FILE`, `G_BAD_FULL_MEMORY`, `G_NO_ERROR`, and `GProgramDownload()`.

**8.5.2.12 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 283 of file `gclibo.c`.

References `G_BAD_FILE`, `G_BAD_FULL_MEMORY`, `G_NO_ERROR`, `GProgramUpload()`, and `MAXPROG`.

#### 8.5.2.13 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 195 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, `GCmd()`, `GCmdD()`, and `GCmdT()`.

#### 8.5.2.14 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 [GMotionComplete\(\)](#) for an example.

Definition at line 16 of file `gclibo.c`.

References `G_UTIL_SLEEP`, and [GUtility\(\)](#).

Referenced by [GMotionComplete\(\)](#).

#### 8.5.2.15 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 <code>G_USE_INITIAL_TIMEOUT</code> 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 57 of file `gclibo.c`.

References `G_UTIL_TIMEOUT_OVERRIDE`, and `GUtility()`.

**8.5.2.16 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 21 of file `gclibo.c`.

References `G_NO_ERROR`, `G_UTIL_GCAPS_VERSION`, `G_UTIL_VERSION`, and `GUtility()`.

**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. `GMotionComplete()`.*
- `#define G_USE_GCAPS`  
*Use the GCAPS server in `GAddresses()`, `GAssign()`, `GIpRequests()`, 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 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` (char \*ip, char \*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.*

### 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.

Definition in file [gclibo.h](#).

### 8.6.2 Function Documentation

#### 8.6.2.1 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
10.1., 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 46 of file `gclibo.c`.

References [G\\_NO\\_ERROR](#), [G\\_UTIL\\_ADDRESSES](#), [G\\_UTIL\\_GCAPS\\_ADDRESSES](#), and [GUtility\(\)](#).

#### 8.6.2.2 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 257 of file `arrays.c`.

References `G_BAD_FILE`, `G_NO_ERROR`, `H_ArrayAddElement()`, `H_CreateArrayNode()`, `H_DownloadArraysFromList()`, `H_FreeArrays()`, and `H_InitArrayNode()`.

### 8.6.2.3 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.
<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 332 of file `arrays.c`.

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

### 8.6.2.4 GCLIB\_DLL\_EXPORTED GReturn GCALL GAssign ( char \* *ip*, char \* *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 62 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 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 106 of file `gclibo.c`.

References `G_SMALL_BUFFER`, and `GCommand()`.

Referenced by `GRecordRate()`, and `H_DownloadArraysFromList()`.

**8.6.2.6 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 158 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, and `GCommand()`.

Referenced by `GRecordRate()`.

### 8.6.2.7 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 147 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, and `GCommand()`.

### 8.6.2.8 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 <i>trimmed_response</i> buffer.
<i>front</i>	If non-null, upon return *front will point to the first non-space character in <i>trimmed_response</i> . 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 112 of file `gclibo.c`.

References `G_NO_ERROR`, and `GCommand()`.

Referenced by `GArrayUploadFile()`, and `GRecordRate()`.

### 8.6.2.9 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 312 of file gclibo.c.

References G\_ARRAY\_NOT\_DIMENSIONED, G\_BAD\_ADDRESS, G\_BAD\_FILE, G\_BAD\_FULL\_MEMORY, G\_BAD\_LOST\_DATA, G\_BAD\_RESPONSE\_QUESTION\_MARK, G\_BAD\_VALUE\_RANGE, G\_COMMAND\_CALLED\_WITH\_ILLEGAL\_COMMAND, G\_DATA\_RECORD\_ERROR, G\_FIRMWARE\_LOAD\_NOT\_SUPPORTED, G\_GCAPS\_OPEN\_ERROR, G\_GCAPS\_SUBSCRIPTION\_ERROR, G\_GCLIB\_ERROR, G\_GCLIB\_NON\_BLOCKING\_READ\_EMPTY, G\_GCLIB\_UTILITY\_ERROR, G\_GCLIB\_UTILITY\_IP\_TAKEN, G\_ILLEGAL\_DATA\_IN\_PROGRAM, G\_INVALID\_PREPROCESSOR\_OPTIONS, G\_NO\_ERROR, G\_OPEN\_ERROR, G\_READ\_ERROR, G\_TIMEOUT, G\_UNABLE\_TO\_COMPRESS\_PROGRAM\_TO\_FIT, G\_UNSUPPORTED\_FUNCTION, and G\_WRITE\_ERROR.

#### 8.6.2.10 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 [glibc\\_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 41 of file gclibo.c.

References G UTIL INFO, and GUtility().

#### 8.6.2.11 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 [glibc errors.h](#) for possible values.

`GlpRequests()` 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 [GlpRequests\(\)](#) 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**

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

See `x_examples.cpp` for an example.

Definition at line 95 of file `gclibo.c`.

References `G_NO_ERROR`, `G_UTIL_GCAPS_IPREQUEST`, `G_UTIL_IPREQUEST`, and `GUtility()`.

#### 8.6.2.12 `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. XYZWABCFGHST.

**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 169 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, `GCommand()`, `GSleep()`, and `POLLINGINTERVAL`.

#### 8.6.2.13 `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="#">G↵ProgramDownload()</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 240 of file `gclibo.c`.

References `G_BAD_FILE`, `G_BAD_FULL_MEMORY`, `G_NO_ERROR`, and `GProgramDownload()`.

#### 8.6.2.14 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 283 of file `gclibo.c`.

References `G_BAD_FILE`, `G_BAD_FULL_MEMORY`, `G_NO_ERROR`, `GProgramUpload()`, and `MAXPROG`.

#### 8.6.2.15 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 195 of file `gclibo.c`.

References `G_NO_ERROR`, `G_SMALL_BUFFER`, `GCmd()`, `GCmdD()`, and `GCmdT()`.

#### 8.6.2.16 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 [GMotionComplete\(\)](#) for an example.

Definition at line 16 of file `gclibo.c`.

References `G_UTIL_SLEEP`, and `GUtility()`.

Referenced by `GMotionComplete()`.

#### 8.6.2.17 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 <code>G_USE_INITIAL_TIMEOUT</code> 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 57 of file `gclibo.c`.

References `G_UTIL_TIMEOUT_OVERRIDE`, and `GUtility()`.

#### 8.6.2.18 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.

## 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 21 of file `gclibo.c`.

References `G_NO_ERROR`, `G_UTIL_GCAPS_VERSION`, `G_UTIL_VERSION`, and `GUtility()`.