CyberGlove III MOCAP Glove ®

USER AND PROGRAMMER GUIDE

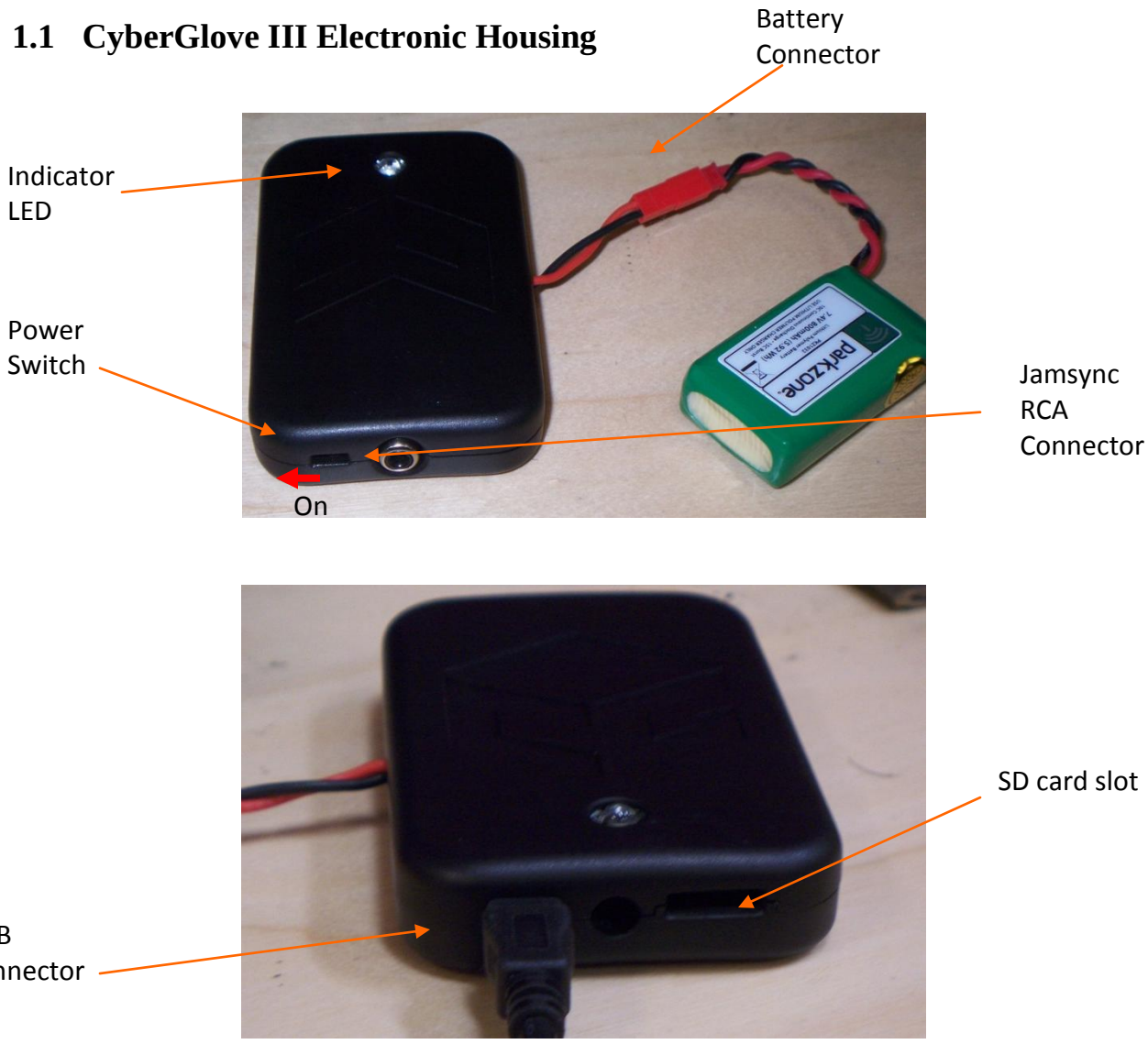
Contents

1 Unpacking the CyberGlove III MOCAP Glove

The CyberGlove III package should include the following items:

- CyberGlove III MOCAP Glove
- Neoprene armband
- VirtualHand Software CD (if purchased)
- 7.4 V Lithium Ion rechargeable battery pack
- Universal Battery charger
- Mini-USB cable
- CGIII Quick Start Guide
- CGIII User Guide
- CGIII WiFi Quick Start Guide

1.1 CyberGlove III Electronic Housing

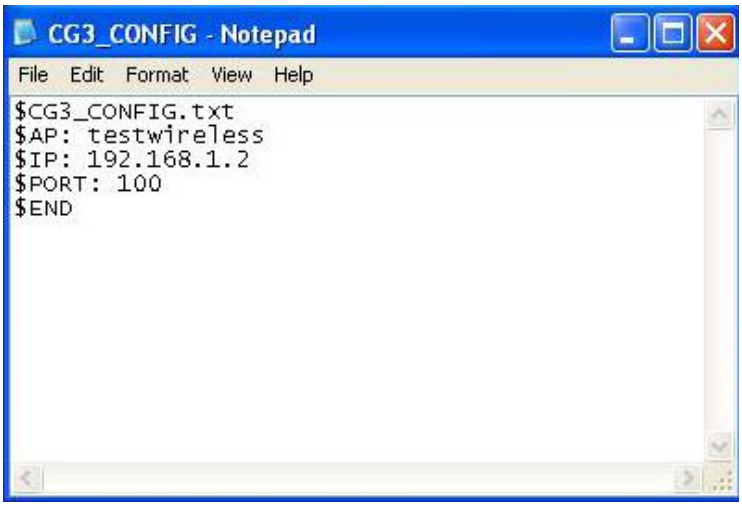


2 CyberGlove III Glove Configuration

The CyberGlove III can be connected to a host computer using either USB or WiFi. Connecting the glove over WiFi requires special configuration described in the following section.

2.1 Configuring Glove to connect to PC over WiFi

The CyberGlove III connects over WiFi to a host that is specified in a configuration file stored on the SD flash card found inside the glove. In order for the glove to work there must be an unsecured WiFi access point setup and running DHCP. When the glove powers on, it will read the file called 'CG3_CONFIG' off the SD card. This file is shown below:



- **$AP** is the NAME of the wireless network (AP)
- **$IP** is the IP ADDRESS of the computer that the glove will connect to
- **$PORT** is the port on the host computer that the glove will try to open

The $AP name should be the name of broadcast access point name on the unsecured router. There host computer indicated by $IP must be on the same subnet as the DHCP addresses assigned by the router.

It is recommended that the host computer have a static IP address, as described in Appendix A.

The $PORT specifier is the target port for the glove on the host computer. The port must be an unused port that can be opened by an application on the host. For users with multiple gloves, each glove will need to have a unique port assigned to it. Note that firewall applications may require an exception or need to be disabled in order to open ports.

The config file should be edited and saved on the SD card, which should be removed and placed in the SD card slot for the CyberGlove III.

There are two ways to connect to the CyberGlove III over WiFi

1. TCP virtual serial port
2. Direct TCP connection

2.1.1 TCP Virtual Serial Port

A TCP virtual serial port is a virtual COM port that is connected to a server socket on the host computer. The CyberGlove III will attempt to establish a client connection to the server socket when it powers up. Once connected, existing software designed to communicate with the CyberGlove or CyberGlove II may be used to communicate with the CyberGlove III.

There are several commercial and free TCP virtual serial port servers available. **CyberGlove Systems LLC has tested and recommends the *"Serial Port Redirector"* (version 2.5.3 or higher) from Fabula Tech. It installs with the existing CyberGlove software installation**. **For more information refer to CGIII WiFi Quick Start Guide.** HWVSP version 3.1.2 or higher software available from HW-Group (software may be downloaded from www.HW-group.com) is another

option. The following steps describe how to setup this software for use as a TCP virtual serial port.

- Start the HWVSP software (1 window per glove)
- Enable the controls by logging in
- On the Settings tab select 'TCP Server Mode'
- from port address (same as was set in the glove config file step 5 above)
- Select 'Create COM'
- The HWVSP software should indicate that the LAN status is 'Listening'
- Turn on the glove(s) and watch for connection LED confirmation.
- GREEN/RED light flashes once on power up, GREEN flashes 3x after ~15 sec. – this means the glove(s) are now connected.
- The HWVSP software will indicate that the LAN status is 'Connected'

Once connected, a new virtual COM port will be available for use by existing applications such as the device manager, the device configuration utility or the existing VirtualHand for CyberGlove III plug-in.

2.1.2 TCP Server Socket

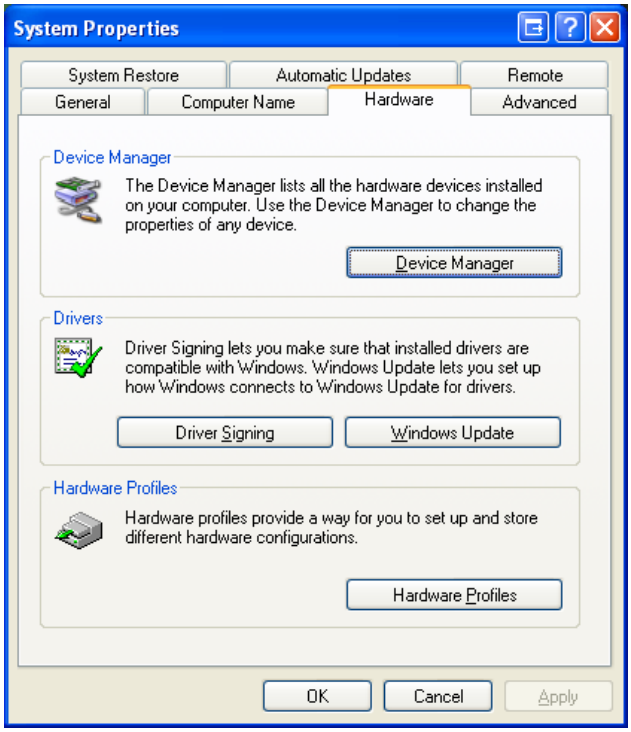
The recommended method for connecting the CyberGlove III with new or custom software is to communicate with the glove over a TCP server socket. In this use mode, users must create an application that opens a server socket on the appropriate host port and communicates with the CyberGlove IIIusing the command set described in Appendix C.

To facilitate the creation of custom software, an open source C++ class has been provided as part of the VH/SDK distribution. The class is described further in section 4.2 below.

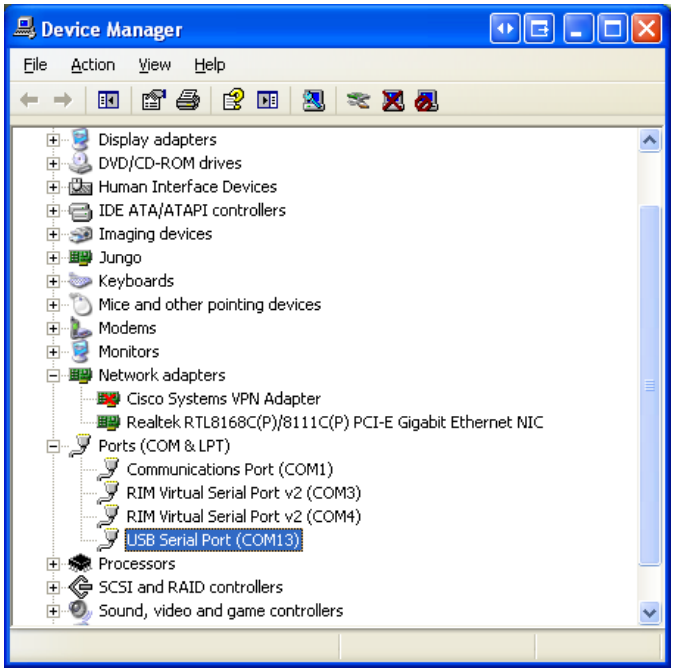
2.2 Connecting over USB

The glove can also be connected to the PC using a mini USB cable, as shown in the photo above. If this option is chosen, it is acceptable to skip the steps of creating the config file and opening the TCP-to-serial port converter.

In order to establish the USB connection, the proper drivers from FTDI must be installed. These should be supplied with the glove, if not you can go online to the FTDI website (http://www.ftdichip.com/FTDrivers.htm) to get the drivers. When connected, the glove will behave as a serial device. After connecting the CyberGlove III to the PC over USB, the connection can be verified by



checking the Windows Device Manager. To open the windows device manager open “My Computer,” right click and select “Properties.” In this window select the “hardware” tab and click the “Device Manager Button.” The CyberGlove III will open a com port called “USB Serial Port.” In this case the port was open on COM13, but the device could select any open port, so it is important to check which one was used.



2.3 Virtual COM Port Configuration

After either a USB or TCP virtual serial port connection is established with the CyberGlove III, the CyberGlove Device Manager and DCU can be used to issue commands, or a terminal window can be opened to issue commands directly to the device. The COM port settings will be the following:

- Baud rate: 115200
- Data bits: 8
- Stop bits: 1
- Parity: none
- Flow control: none

An advanced terminal program such as RealTerm (http://realterm.sourceforge.net/) or Hercules (www.hw-group.com/products/hercules/index_en.html) is needed because some commands contain non-ascii bytes. Consult the CyberGlove III command set in Appendix C for a list of supported commands.

3 Other Hardware Considerations

3.1 JamSync Connector

The device will accept LTC time codes from another device through the RCA connector. If a device is hooked up to the RCA connector and the CyberGlove III reads a valid timecode, the indicator LED will blink green for a half second.

3.2 Battery Status

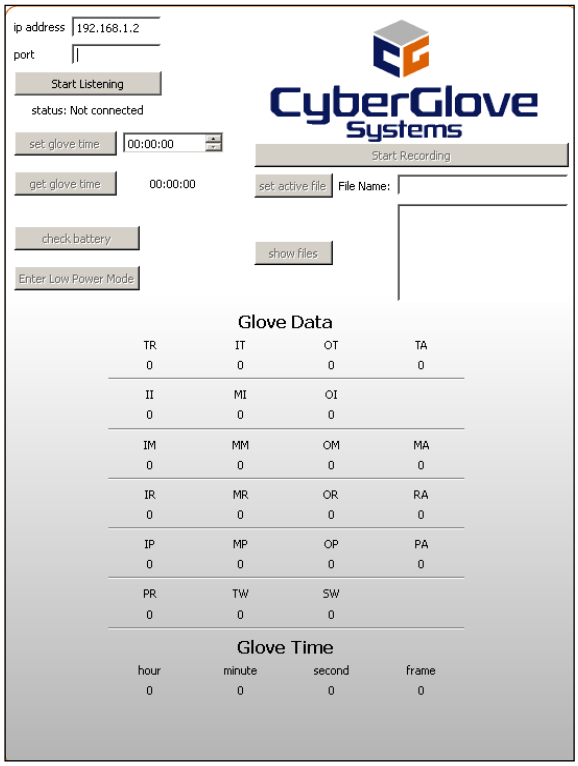
If at any time, the CyberGlove III detects that its battery has dropped below an acceptable voltage for a 2-cell Lithium Ion or Lithium Polymer battery, the indicator LED will turn red and stay on continuously. At that point, the battery must be replaced with a freshly charged one. If a Lithium Ion or Lithium Polymer battery is over-discharged, it may not be able to be re-charged.

Always charge Lithium Ion and Lithium Polymer batteries using a charger approved for their specific chemistry and capacity.

4 Software for CyberGlove III

4.1 Connecting and using the Motion Capture GUI

Several open source samples are provided as part of the VirtualHand SDK distribution. The Motion Capture GUI is a graphical application that can be used to open a server socket, check glove status and capture data on the SD card.



This GUI will display a limited set of new functionalities with the new CG3 glove. This GUI also assumes that the glove's configuration file has been completely setup as described above for the case of a TCP server socket.

The general flow of the GUI is as follows:

- Type in your computer's IP address and what the port you expect your hardware to connect over (this should already be setup on the device)
- Hit the start listening button.
- Turn on the hardware and wait for the

status to show connected.

- Once you're connected then you'll be able to run all the commands on the GUI except for the start recording button.
- The Start recording button requires you to enter a active file before you can start recording data.
- Once you press the start recording data button, you'll not be able to run anymore commands until the same button is pressed again (this button will now become the Stop Recording button).
- There is no disconnect button. Disconnection happens when the device is powered down or the GUI is turned off

The source code for the Motion Capture GUI is found in the VirtualHand software distribution packaged with the CyberGlove III. Note that this sample requires the Nokia QT library to be installed in order to compile or modify the source.

4.2 CyberGlove III Sample Code

In addition to the source code for the motion capture user interface, a fully developed class is provided to enable rapid integration of the CyberGlove III into existing VirtualHand SDK based applications or into other third party custom applications. The CyberGlove III sample code can be found in the VirtualHand SDK Demos/CyberGlove3/HandInSpace directory. To review the code and build the sample, load the VH/SDK demo solution into Visual Studio 2008 or higher.

The sample code provided is communicates with the CyberGlove III using WiFi and requires that the CyberGlove III be setup to communicate with the host computer over wifi, as described above. Note that it is not necessary to setup a virtual serial port to use this class, and it does not rely on the VH device manager or DCU utilities.

The sample code uses the widely available QT library maintained by Nokia to manage socket communications, however it should be straightforward for users to modify this to use other socket libraries or to communicate with the CyberGlove III over a USB connection. The sample code has been tested with QT version 4.7.1 (available from http://qt.nokia.com/downloads under the LGPL).

The code illustrates some of the new features found in the CyberGlove III:

- Motion capture time codes
- 12-bit sensor data
- Glove voltage query
- Streaming to WiFi, USB and SDCARD
- Basic glove calibration

Note that not all new commands found in the CyberGlove III (see appendix C) are supported, however the code should be easily modified to include features needed for specific applications. In each case, it is critical to precisely capture the echo and return codes sent from the glove, as described in Appendix B.

The code also illustrates how to copy data from the CyberGlove III into an existing virtual hand application using the vhtCyberGloveEmulator.

The method CyberGlove3::receivePacket() is called in a loop after streaming is started. This method parses the data sequence returned when the glove is in streaming mode. Each sensor is retuned as 2 bytes, but currently has 12 significant bits. The following table illustrates the mapping of these bytes to specific sensors.

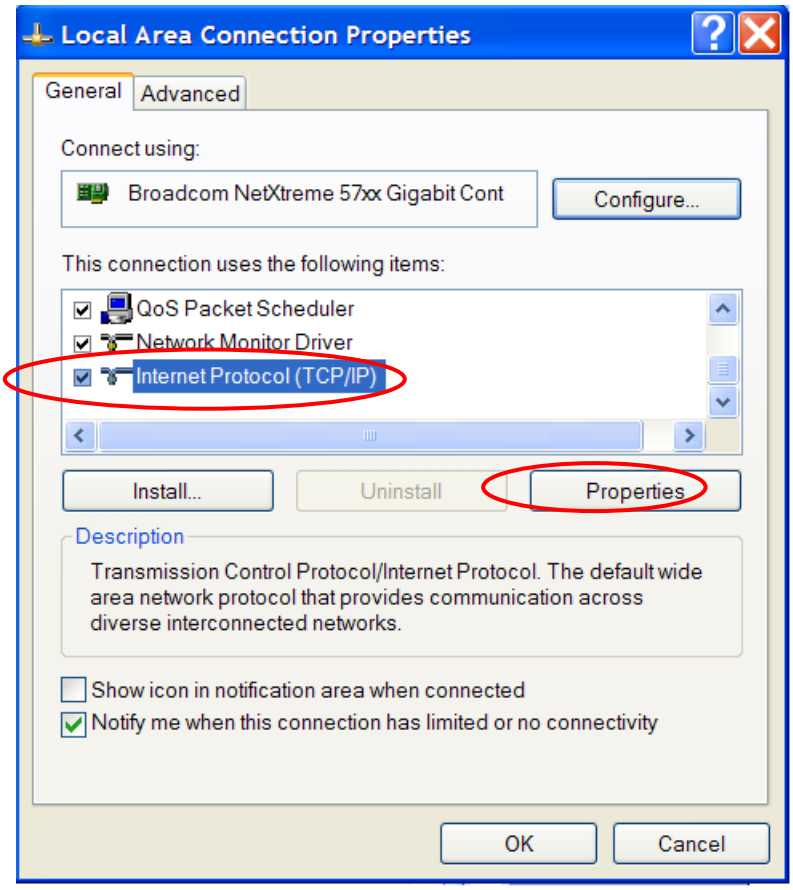
Index	Sensor Group	Sensor Index	Short Name	Joint Name	Stream byte
1	0	0	TMJ	Thumb Roll	47
2	0	1	MPJ	Thumb metacarpal	45
3	0	2	IJ	Thumb proximal	43
4	0	3	Abd	Thumb-index Abduction	41
5	1	0	MPJ	Index metacarpal	39
6	1	1	PIJ	Index proximal	37
7	1	2	DIJ	Index distal (no sensor)	35
8	1	3	ABD		
9	2	0	MPJ	Middle metacarpal	33
10	2	1	PIJ	Middle proximal	31
11	2	2	DIJ	Middle distal (no sensor)	29
12	2	3	ABD	Index-middle abduction	27
13	3	0	MPJ	Ring metacarpal	25
14	3	1	PIJ	Ring proximal	23
15	3	2	DIJ	Ring distal (no sensor)	21
16	3	3	ABD	Middle-ring abduction	19
17	4	0	MPJ	Pinky metacarpal	17
18	4	1	PIJ	Pinky proximal	15
19	4	2	MPJ	Pinky distal (no sensor)	13
20	4	3	ABD	Ring-Pinky abduction	11
21	5	0		Palm flex	9
22	5	1		Wrist pitch	7
	5	2		Wrist yaw	5
	5	3			

Once a packet is received, it is calibrated using the CyberGlove3::GloveMapLinear() method, which converts 12-bit raw data from the glove into joint angles in radians. This method uses the existing algorithm from CyberGlove II and CyberGlove, which currently works only with the 8 MSB of each sensor. This algorithm also estimates distal joint angles and also applies an algorithm for extracting abductions for each finger.

Data in the format appropriate for use by the vhtCyberGloveEmulator is stored in CyberGlove3::m_calData, which can be accessed using CyberGlove3::getCalData(finger, joint). See the HandInSpace::mapGlove() method for an example of how to do this.

Appendix A: Assigning a static IP address

1. Open Windows **Start** menu.
2. Open **Control Panel**.
3. Classic view: Open **Network Connections**
   Category view: Select **Network and Internet Connections**, and then **Network Connections**.
4. Right-click on your active **Local Area Connection**.
5. Click **Properties**.
6. In the **General** tab, highlight the **Internet Protocol (TCP/IP)** item, and click **Properties**.

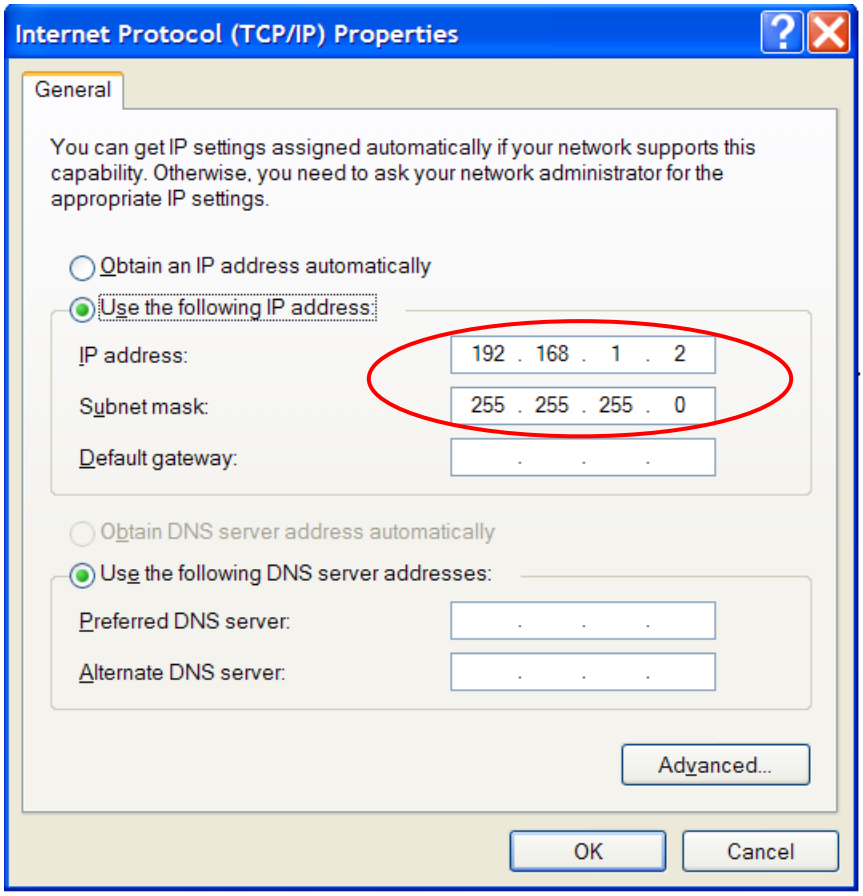


This opens the Internet Protocol (TCP/IP) Properties window.

7. In the General tab, click **Use the following IP address**, and enter the following information. Replace <IP Address> with an available static address on the same subnet as the router's DHCP list.

   IP address: <IP Address>

   Subnet mask: 255.255.255.0



8. Click OK to close each window.

Appendix B: LED Behavior

Table 1: Led Behavior on Startup

Type of Message	***Color***	***Time (seconds)***	***Style***	***Message***
Startup	Green	0.5	1 Blink	Power on Startup
Delay of 5-6 seconds before next set of possible messages				
Bootup Error Messages	Red	0.5	1 Blink	No SD Card present
	Red	1.0	2 Blinks	No SD Card Configuration File Present
	Red	1.5	3 Blinks	Unsuccessful Wifi Connection Attempt
Bootup Ok Message	Green	1.5	3 Blinks	Ready to Send/Receive Commands out of startup

Table 2: Led Behavior during Normal Operations

Type of Message	***Color***	***Time (seconds)***	***Style***	***Message***
Normal Message	Green	0.5	1 Blink	Streaming has Finished
	Green	0.5	1 Blink (on for ½ second every 3 seconds of successful Jamsyncs)	Successful Jamsync
Alert Message	Red	Always On	Solid Red	Battery Level is Low.

Appendix C: CyberGlove III Command Reference

General Description

This appendix outlines the serial commands that are used by the CyberGlove III. All functionality new to the CyberGlove III is explained in detail. Commands that previously existed in Cyberglove II are included but have limited descriptions. When possible, backwards compatibility with the Cyberglove II command set has been maintained.

As currently implemented, the serial commands in CyberGlove II are all one ASCII character long and sometimes include a single or multi-byte payload. The glove replies with a predefined response immediately after receiving a command.

"Prefix" commands are special commands that cause the glove to interpret the command received immediately after the prefix command as a different command than if the prefix command had not been sent. Throughout this document and the source code, the usage of these prefixes is described as usage of various "Levels" of commands. For example, commands sent without a prefix are considered "Main Level" commands, while ones sent after the '?' prefix are considered Query Level commands. The following table describes the currently valid prefixes and their corresponding levels.

Prefix	Level
None	Main Level
?	Query Level
1	Level One

Table 1. Description of command levels

The majority of the commands new to CyberGlove III are Level One Commands. Also note that all commands that initiate streaming are terminated with the special character <CTRL_C> (or <0x03>).

4.3 Main Level Commands

Main Level Commands typically instruct the Cyberglove to perform an action. The majority of Main Level Commands were implemented in both CyberGlove II and CyberGlove III.

Command	Action	Response	Payload	CG2	CG3
'?'	Send Query Level Command	'?'	NONE	X	X
'1'	Send Level One Command	'1'	NONE		X
'C'	Calibrate sensors	'C',0	Calibrate Character	X	X
'E'	Write a byte to the EEPROM	'E',0	Address, Data	X	X
'F'	Set the filter parameter	'F',0	0/1	X	X
'G'	Report one set of data (8bit, compatible with CyberGlove II functionality)	'G',Data,0	NONE	X	X
'J'	Set controls LED parameter state (0 or 1)	'J', 0	0/1	X	X
'L'	Set glove LED	'L',0	0/1	X	X
'M'	Set sensor mask	'M',0	3 bytes	X	X
'P'	Set parameter flags	'P',0	3 bytes	X	X
'S'	Starts data stream (8bit, CG2 format)	'S', data stream	NONE	X	X
'U'	Set status byte	'U',0	0/1	X	X
'V'	Get battery voltage in milliVolts	'V', voltage,"Volts",'\r','\n'	NONE		X
'W'	Set glove parameter switch	'W',0	0/1	X	X
'z'	Clear the CTSCount variable (clear to send)	'z',0	NONE	X	
'Z'	Turn on or off the AD board (1 = on, 0 = off)	'Z',0	0/1		X
'^'	Enter Control Mode (only valid command is 'W' -> set values of pots to EEPROM)	'^'	Control Character	X	X
CTRL_C	Break from streaming	CTRL_C,0	NONE	X	X
CTRL_I	Reload digital pot values from EEPROM	CTRL_I, 0	NONE	X	X
CTRL_R	Software restart of the board	CTRL_R,0	NONE	X	X
Carriage Ret	Explicitly do nothing	NONE	NONE	X	X
Line Feed	Explicitly do nothing	NONE	NONE	X	X
All Other Characters	Return the explicit command error	' ','e','?','\r','\n',0	NONE	X	X

Table 2. Listing of Main Level Commands

Command	Description
'1'	Send command from Level One Command set
'V'	This command returns an ASCII string with the voltage of the battery in the following form: 7445Volts\r\n. Please note that it returns a milliVolt value although the label is Volts.
'Z'	Z1 -> this will set all the corresponding pins to inputs and turn off power to the Analog Board Z0 -> this will enable all functionality and turn on power to the analog board.

Table 3. Description of Main Level Commands new to CyberGlove III

4.4 Query Level Commands ('?' Level)

Query Level Commands typically request information from the Cyberglove.

Command	Action	Response	Additional Inputs	CG2	CG3
'A'	Report the active filename	'A',filename,0	NONE		X
'b'	Return signal strength	See Table 5	See Table 5		X
'C'	Get calibration values	'C',Offsets, Gains,0	NONE	X	X
'c'	Get calibration values (verbose)	'c'	NONE	X	X
'E'	Read one byte from the EEPROM	'E',byte,0	address	X	X
'F'	Get the Parameter filter bit status	'F',0/1, 0	NONE	X	X
'G'	Get Plugged in, & initialized	'G',status, 0	NONE	X	X
'I'	Get the SD card information	'I',"\r\nXXXMB disk\r\nXXXMB left"	NONE		X
'i'	Get the Glove Information	'i',Glove Info,0	NONE	X	X
'J'	Get LED control bit	'J',0/1,0	NONE	X	X
'K'	Get HW Sensor Mask (3 bytes)	'K',b0,b1,b2,0	NONE	X	X
'l'	Get a list of files	'l',filename,'\r','\n'……last filename,'\r','\n', <0x00>	NONE		X
'L'	Get Glove LED	'L',0/1,0	NONE	X	X
'M'	Get Sensor Mask	'M',b0,b1,b2,0	NONE	X	X
'P'	Get Parameter Mask	'P',b0,b1,b2,0	NONE	X	X
'p'	Get Parameter Mask (verbose)	'p', parameters,'\r','\n'0	NONE	X	X
'r'	Get Current Wifi Server Information	'r',SSID,0x01,IP,0x01,PORT,0	NONE		X
'R'	Get Right Handed	'R',0/1,0	NONE	X	X
'S'	Get Number of Sensors	'S',#ofsensors,0	NONE	X	X
'T'	Returns all zeros	'T',0,0,0,0,0	NONE	X	X
'U'	Get the Parameter Inc	'U',0/1,0	NONE	X	X

	Status byte				
'V'	Get Glove Firmware V and Info Format	'V',Fhi,Flo,GIhi,GIlo	NONE	X	X
'v'	Get Glove Firmware V and Info Format (verbose)	'v', Info,' ','\r','\n'0	NONE	X	X
'W'	Get Glove Parameter Switch	'W',0/1,0	NONE	X	X
'z'	Get Clear to Send Count	'z','\r','\n'0	NONE	X	
All other characters	Return the explicit command error	' ','e','?','\r','\n',0	NONE	X	X

Table 4. Listing of Query Level Commands

Command	Description
'A'	This will return the string that is the name of the active file followed by a null character. If there is no active file, then simply a null is returned.
'b'	This will return contents of the message from the Wifi module which contains status information including the wireless signal strength.
'I'	This, will return information about size of the SD card and the space left on it: Response Format: "\r\nXXXXMB disk\r\nXXXXMB left\r\n"
'l'	This returns a listing of all the files in the main level of the SD card. They response will be in this format: File01.txt\r\nFile02.txt\r\n…..FileNN.txt\r\n<0x00>
'r'	This will return what the current wifi server that this glove will attempt to connect to. If there is a server that this glove will connect to loaded in ram then it will appear as the following response: 'r'SSID<0x01>IP<0x01>PORT<0x00> Where SSID is an ASCII string containing the server ID (router name), IP is an ASCII string containing the IP address (e.g. 255.255.1.1), and PORT is an ASCII string representing the port number. If there is no server the response will be the following: 'r'<0x01><0x01><0x00>

Table 5. Description of Query Level Commands new to CyberGlove III

4.5 Level One Commands (‘1’ Level)

Level One Commands typically expose the functionality that is new to CyberGlove III. This includes commands related to SD memory, wireless connectivity, and Jamsync.

Command	Action	Response	Additional Inputs	CG2	CG3
‘A’	Set Active File	See Table 7	None		X
‘a’	AD streaming mode	See Table 7	None		X
‘C’	Connect to the current server in ram	<0x00>	None		X
‘D’	Download File	See Table 7	None		X
‘d’	Disable a streaming destination	<0x00>	‘w’, ‘u’, or ‘s’		X
‘E’	Set streaming parameters	<0x00>	See Table 7		X
‘e’	Enable a streaming destination	<0x00>	‘w’, ‘u’, or ‘s’		X
‘G’	Get one set of data	See Table 7	See Table 7		X
‘h’	SD chip pass through Mode	See Table 7	See Table 7		X
‘J’	Last Jamsync Value	See Table 7	None		X
‘j’	Jamsync Pass through mode	See Table 7	See Table 7		X
‘m’	Frame rate multiplier	<0x00>	None		X
‘o’	Set the odd frame rate acceptance	<0x00>	<0x00> or <0x01>		X
‘P’	Enter Wifi Module Setup Mode (first time wifi module use ONLY)	<0x00>	None		X
‘p’	Wifi Module pass through Mode	See Table 7	See Table 7		X
‘R’	Write Config file	<0x00>	None		X
‘r’	Set the values of the wifi server info in ram	<0x00>	See Table 7		X
‘S’	Start streaming new data format	See Table 7	See Table 7		X
‘s’	Set sd sample rate divider	<0x00>	See Table 7		X
‘T’	Interval streaming/recording Command	See Table 7	See Table 7		X
‘t’	Time set/get	See Table 7	See Table 7		X
‘U’	Interval File Read Command	See Table 7	See Table 7		X

'u'	Set usb sample rate divider	<0x00>	See Table 7		X
'w'	Set Wifi sample rate divider	<0x00>	See Table 7		X
'X'	Format the SD card	See Table 7	See Table 7		X

Table 6. Listing of Level One Commands

Command	Description
'A'	This will set the new active file. The 'A' character is followed by a string which specifies a file name and the then <0x01> character. If the specified file exists, the Glove will return a <0x01> character and the command is complete. Otherwise it will create a file with that name and return <0x00>. After receiving the <0x00> another string must be entered followed by the <0x01> character. The glove will write this string to the file in the header information and return <0x00>. THE ACTIVE FILE MUST BE SET EVERY TIME THE SD CARD IS REMOVED FROM THE GLOVE AND REPLACED. Example: Send: 'A'FILENAME<0x01> Receive: <0x00> Send: HEADERSTR<0x01> Receive: <0x00> Where FILENAME is the name of the file (e.g. myfile.txt) and HEADERSTRING is the header that will appear in the file.
'a'	This command sends the glove to A/D streaming mode, which is used only for debugging. While in this mode, the glove will stream values off of its A/D converter. While in this mode, sending 'x' to the glove will change the multiplexor state so all of the sensors can be observed. Sending 'z' to the glove while in this state will exit this mode.
'C'	This command will cause the glove to connect to the server specified by the parameters loaded into the glove's RAM using the 'r' command.
'D'	Upon receiving this command, the glove will stream the contents of its active file.
'd'	Disable data streaming to a device. This command must be immediately followed by either 'w', 'u', or 's'. 'w' will disable wifi streaming 'u' will disable usb streaming 's' will disable SD card recording
'E'	This command sets the parameters for streaming data from the CyberGlove III. This command consists of the 'E' character followed by seven other characters and has the following format:

	'E'[FM][ES][EU][EW][SD][UD][WD] [FM] is the ASCII character representing the frame rate multiplier to be used for data recording. This value can be '1' through '4'. Currently, a maximum sample rate of 100 Hz has been verified with the CyberGlove III, so if the frame rate is greater than 25 Hz, the maximum frame rate multiplier is '3'. [ES] is an ASCII '0' or '1'. If it is '1' SD card recording will be enabled; if it is '0' SD card recording will be disabled. [EU] is an ASCII '0' or '1'. If it is '1' USB streaming will be enabled; if it is '0' USB streaming will be disabled. [EW] is an ASCII '0' or '1'. If it is '1' wifi streaming will be enabled; if it is '0' wifi streaming will be disabled. [SD] is an ASCII character '1' through '9'. The value will determine the sample rate divider for SD card recording. For example, if the frame rate is 30 Hz and the frame rate multiplier is 3 the sample rate will be 90 Hz. If the SD sample rate divider is 9, data will be recorded to the SD card at 10 Hz. [UD] is an ASCII character '1' through '9'. The value will determine the sample rate divider for USB streaming. [WD] is an ASCII character '1' through '9'. The value will determine the sample rate divider for wifi streaming.
'e'	Enable data streaming to a device. This command must be immediately followed by either 'w', 'u', or 's'. 'w' will enable wifi streaming 'u' will enable usb streaming 's' will enable SD card recording
'G'	After receiving a level one G command, the CyberGlove III will respond with one set of 16-bit data.
'h'	All data that is sent through the UART from the SD module is echoed to the USB connection and vice versa (for debugging purposes ONLY). Use the escape sequence "!!!" to exit this mode.
'J'	This command gets the last time code received over the Jamsync connector
'j'	All data that is sent through the UART from the Jamsync decoder chip is displayed to the user and vice versa (for debugging purposes ONLY). Use the escape sequence "!!!" to exit

	this mode.
'm'	This command sets the frame-rate multiplier for data sampling. The 'm' character is followed by a character <0x01> through <0x04>. The frame-rate of the CyberGlove III is 30 fps by default. It can be set to other frame rates using a jamsync device. The frame-rate multiplier determines the sample rate of the CyberGlove III. If the glove's frame rate is 24 fps and the frame-rate multipier is 2, the sample rate will be 48 Hz. Currently, a maximum sample rate of 100 Hz has been verified with the CyberGlove III, so if the frame rate is greater than 25 Hz, the maximum frame rate multiplier is 3.
'o'	This command either enables or disables non-integer frame-rate detection. The 'o' character is followed by either a <0x01> or a <0x00>. <0x00> disables the odd time detection and the CyberGlove III can only detect the following frame rates: • 30 fps • 24 fps • 25 fps • 30 fps (drop frame) {this is sometimes know as 29 drop frame fps} <0x01> enables the odd time detection and the CyberGlove III can only detect the following frame rates • 29.970 fps • 23.976 fps • 25 fps • 30 fps (drop frame) {this is sometimes know as 29 drop frame fps}
'P'	This command is issued the prior to configuring the wifi module for the first time. It sets the baud rate of the CyberGlove's communication lines with the module to 9600 baud, which is the factory set baud rate for the wifi module. After issuing this command, it is possible to communicate with the wifi module for the first time using the 'p' command. After configuring the wifi module with the settings specified in the "Hardware Bring-Up and Test" document, the wifi module will operate at 115200 baud. The device MUST be powered down and this command should never be issued again.
'p'	This device allows the user to send data directly to the wifi module. All data that is sent through the UART from the wifi module is echoed to the USB and vice versa (for configuration and debugging purposes ONLY). See "Hardware Bring-Up and Test" document for example.
'R'	Write the server information in the CyberGlove's RAM to configuration file on SD card. If a configuration file with the name CG3_CONFIG.txt exists on the SD card the values in the file will be over-written. If a file with this name does not exist, it will be created.

	After a configuration file is created, the server information written to it will be loaded into RAM the next time the CyberGlove III is powered on and the glove will automatically attempt to connect to the server.
'r'	This will set the server information in the CyberGlove's RAM. The format is as follows: 'r'SSID<0x01>IP<0x01>PORT<0x01> Where SSID is an ASCII string containing the server ID (router name), IP is an ASCII string containing the IP address (e.g. 255.255.1.1), and PORT is an ASCII string representing the port number.
'S'	This command will cause the CyberGlove III to start streaming 16-bit data samples with time-codes over the wifi or USB port and/or record the data to the SD card. The streaming/recording destinations are defined by the 'd', 'e', or 'E' commands. To exit this mode, issue the <CRTL-C> character or the escape sequence "!!!".
's'	This command sets the SD card sample-rate divider. The 's' character is followed by a character <0x01> through <0xFF>. This will set the rate at which data is recorded to the SD card during data streaming mode. The SD card data rate will be: Frame-Rate * Frame-Rate-Multiplier / SD-Card-Sample-Rate-Divider
'T'	This command sets up data streaming to begin and end at specified times (according to the time on the CyberGlove III's clock). The start and stop times must be issued as part of this command in the following format: 'T'[Start time]<0x01>[Stop time]<0x01> Where [Start time] and [Stop time] are strings of the following format: HH:MM:SS The CyberGLove III will not be able to any commands before the start time, however the user can cancel this command by issuing the <CTRL-C> character or the escape sequence "!!!" Example: The following command will wait until 6:55:55 am and start streaming until 6:59:00am. "T06:55:55<0x01>06:59:00<0x01>"
't'	Press 's' after this command to set the time. Press 'g' to display the time. The displayed time will come in the format of "HH:MM:SS:FF". To set the time you enter the time in the format of "HH:MM:SS".
'U'	This command will stream data recorded in active file over a specified interval. The start and stop times of this interval are entered in the same format as the 'T' command. This

	data will only stream to the source of the command. Example: "U09:00:00<0x01>10:00:00<0x01>" will cause the CyberGlove to return all data recorded in the active file between 9:00 and 10:00.
'u'	This command sets the USB sample-rate divider. The 'u' character is followed by a character <0x01> through <0xFF>. This will set the rate at which data is streamed over the USB connection during data streaming mode. The USB data rate will be: Frame-Rate * Frame-Rate-Multiplier / USB-Sample-Rate-Divider
'w'	This command sets the wifi sample-rate divider. The 'w' character is followed by a character <0x01> through <0xFF>. This will set the rate at which data is streamed over the wifi connection during data streaming mode. The wifi data rate will be: Frame-Rate * Frame-Rate-Multiplier / Wifi-Sample-Rate-Divider
'X'	This command formats the SD card. The CyberGlove will issue the following response: "Are you sure? (y/n)" To proceed, send 'y', otherwise, send 'n' or "!!!".

Table 7. Description of Level One Commands new to CyberGlove III