```
if (numDevices > 0)
//open the first device in the li
result = GDS Connect(serverEndpo
 if (result.ErrorCode != GDS ERRO
     //set configuration
    GDS SetConfiguration(connect:
    //create 1 sec buffer for day
    size t scanCount = 1;
    GDS GetDataInfo(connectionHam
    size_t acquisitionBufferSize
    float *acquisitionBuffer = ne
    //start acquisition on serve
    GDS StartAcquisition(connect:
    //start streaming to client
    GDS_StartStreaming(connection
    //acquire data
    while (acquiredScans < scans)
         size t scansRetrieved = [
         //retrieve available data
         GDS GetData(connectionHam
         //write data to file
         if (scansRetrieved > 0)
             file.write(reinterpro
         acquiredScans += scansRet
     }
    //stop streaming
    GDS StopStreaming(connection
    //stop acquisition
    GDS_StopAcquisition(connection
    //disconnect
     GDS Disconnect(&connectionHar
    //release allocated resource
     delete[] acquisitionBuffer;
}
```

52 53

54

55

56

57

58

59

60

61

62

63

64

65 66

67

68 69

70

71

72 73

74 75 76

77 78

79 80 81

82 83

84 85

86 87 88

89

90 91

92 93

94

95

96

97

98 99 100

101

102

103 }

g.tec medical engineering GmbH Sierningstrasse 14, 4521 Schiedlberg, Austria Tel.: +43 (7251) 22240-0 Fax: +43 (7251) 22240-39 office@gtec.at, http://www.gtec.at





g.NEEDaccess SERVER V1.14.00

Copyright 2012-2015 g.tec medical engineering GmbH printed in January 2015

How to contact g.tec

	+43 (7251) 22240-0	Phone
	+43 (7251) 22240-39	Fax
=	g.tec medical engineering GmbH Sierningstrasse 14, 4521 Schiedlberg AUSTRIA	Mail
	http://www.gtec.at	Web
@	office@gtec.at	Email

Content

NTRODUCTION	4
NTENDED USE	5
INTENDED USE WITH G.USBAMP	5
INTENDED USE WITH G.HIAMP	5
INTENDED USE WITH G.NAUTILUS	5
SYSTEM REQUIREMENTS	6
Hardware	θ
Software	θ
Trademark Notice	ε
WORKING WITH THE PRE-INSTALLED MINI COMPUTER	7
DEFAULT CONFIGURATION OF THE MINI COMPUTER	8
Boot, logon and shutdown	
Network adapter and firewall configuration	8
CONNECTING DEVICES AND A CLIENT MACHINE TO THE MINI COMPUTER	g
MANUAL CONFIGURATION OF THE MINI COMPUTER AND MAINTENANCE OF THE SERVER	10
NSTALLATION AND CONFIGURATION	11
Install g.NEEDaccess Server	11
START / STOP / RESTART THE SERVER SERVICE	13
Disable automatic start and configure the server service for manual start	13
g.NEEDaccess and the Windows firewall configuration	15
Files on your Computer	16
Uninstall g.NEEDaccess Server	17
CHECK IF SERVER SERVICE IS RUNNING CORRECTLY	17
CONNECTING WITH THE SERVER	19
TEST CONNECTION WITH THE G.NEEDACCESS DEMO CLIENT APPLICATION	20
LIST CONNECTED DEVICES	20
CONFIGURE DEVICE FOR DATA ACQUISITION	21
ACQUIRE DATA FROM THE DEVICE	24
IMPEDANCE MEASUREMENT	24
Impedance measurement with g.Hlamp	
Impedance measurement with g.NAUTILUS	26
CALIDRATION	27

Introduction

g.NEEDaccess is a server service that facilitates simple and platform independent data acquisition from (multiple) devices over a network and by that eases the workload of the user to a large extend.

g.NEEDaccess allows to acquire data easily from g.tec devices without having to take care of low-level concepts of data acquisition. The server handles acquisition and preprocessing of data such that the user receives data ready to analyze.

Since data acquisition is realized over the network it is now possible to collect the acquired data on a different computer than the g.tec device is connected to (on condition that both are connected to the network). Moreover the server is capable to provide data from a single acquisition simultaneously for multiple clients, thus monitoring a certain experiment is possible for more than one user at a time.

The server software runs as service in the background of the computer on which it is installed. We refer the PC on which this software is running informal as server. Bio signal amplifiers are physically connected to the server. Client software is used to interact with the server via network.

The reference implementation of the server's network API provides a wide range of functions that ease data acquisition and also support device-specific operations. The Client API provides a high-level C and .NET library for facile integration in your own projects, which handle communication with the server using the network API underneath.

This document contains the terminology of important concepts, encourages a general insight on how to use the server and finally provides a listing of the methods supported by the Client API.

Intended Use

g.NEEDaccess is intended to be used to acquire and transmit measured biosignal data from g.USBamp, g.Hlamp, and g.NAUTILUS devices to an application. These biosignals may include electroencephalogram (EEG), electromyogram (EMG), electrooculogram (EOG), and electrocardiogram (ECG), for example.

Intended use with g.USBamp

Measuring, recording and analysis of electrical activity of the brain (EEG) and/or through the attachment of multiple electrodes at various locations to aid in monitoring and diagnosis as routinely found in clinical settings for the EEG.

Intended use with g.HIamp

The g.Hlamp amplifier is intended to be used to acquire biopotentials and transmit them to a computer via the USB port connection. These biopotentials include for example the electroencephalogram (EEG), electromyogram (EMG), electrooculorgram (EOG), and electrocardiogram (ECG).

Intended use with g.NAUTILUS

g.Nautilus Research is not a medical device and is intended to be used for research purposes only. The device is not intended to be used for other medical applications such as aiding in diagnosis or treatment or disease. The g.Nautilus amplifier is intended to be used to acquire the electroencephalogram (EEG) and/or electrooculogram (EOG) and transmit them wirelessly to a computer.

The device **must not** be used for patient monitoring. The device **must not** be used for the determination of brain death. Additional examinations are needed for diagnosis, and no diagnosis may be done only based on using this device.

System Requirements

Basically g.NEEDaccess requires at least as much resources as the device with highest minimum requirements that is operated with the software. The minimum requirements of g.NEEDaccess itself are listed below:

Hardware

Table 1 shows the minimum hardware requirements for g.NEEDaccess Server.

Table 1: Minimum hardware requirements for g.NEEDaccess Server.

Hardware	Properties
CPU	1 GHz or faster processor
Hard disk	20-30 GB
RAM	4 GB
USB 2.0 port (EHCI – enhanced Host controller interface)	One free USB port for each device that shall be connected to the server
Network	Optional Gigabit or faster Ethernet adapter for peer-to-peer network transmission.

Software

g.NEEDaccess Server requires a Microsoft Windows OS. *Table 2* lists the required software for g.NEEDaccess Server.

Table 2: Software requirements for g.NEEDaccess Server.

Software	Version
Windows 7 Professional English	
	Service Pack 1
	64-bit only
Acrobat Reader	XI

Device drivers of g.tec devices that can be operated with g.NEEDaccess are automatically installed within the g.NEEDaccess Server installation process.

Make sure that your Microsoft Windows installation works correctly before installing g.NEEDaccess Server. Other software packages except the packages listed above MUST NOT be installed on the Windows PC. During operation of g.NEEDaccess other software than listed above MUST NOT be operated.

Trademark Notice

Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

All brands or product names are the property of the respective owners.

Working with the pre-installed mini computer

If g.NEEDaccess Server comes pre-installed on an industrial mini computer as shown in *Figure 1*, you do not need to go through the installation process described in section *Installation and Configuration* and can start using g.NEEDaccess Server right away. If your shipment does not include such a mini computer, skip this chapter and continue with section *Installation and Configuration* for details on how to install g.NEEDaccess Server on your own machine.



Figure 1: The industrial mini computer and its accessories can optionally be delivered with g.NEEDaccess Server.

The mini computer is configured to run stand-alone without a screen, keyboard or mouse required to access the server from an application at another machine over the network. However, the mini computer provides connectors for all common types of user interfaces at the back (*Figure 2*) and front (*Figure 3*).



Figure 2: Back side of the mini computer. Labeling of the connectors can be found at bottom side.



Figure 3: Front side of the mini computer with assembled WiFi antennas.

Default configuration of the mini computer

Boot, logon and shutdown

The mini computer boots automatically after plugging in the power supply. Otherwise, it can be started by keying the power button on the back once. The power indicator light at the front showing the intensePC logo is on while the computer is running. The mini computer boots the Windows operating system and logs on to the default account automatically without a password required. The g.NEEDaccess server service starts automatically on boot. It may take about fifteen to thirty seconds until boot is completed.

To shut down the mini computer, just key the power button on the back once again to initiate shutdown and wait a few seconds until the power indicator light goes off.

Network adapter and firewall configuration

The mini computer provides two gigabit LAN adapters (Ethernet). LAN1 (Intel MAC/PHY gigabit Ethernet controller) is closer to the edge and the WiFi antenna connector. LAN2 (Realtek gigabit Ethernet controller) is closer to the HDMI and DisplayPort receptacles. *Table 3* shows their configured IP addresses.

Table 3: Configured IP addresses of the provided LAN adapters.

LAN Adapter	Configured IP Address
LAN1	192.168.1.1
LAN2	192.168.1.2

The Windows firewall is configured to allow incoming and outgoing connections to g.NEEDaccess.

Connecting devices and a client machine to the mini computer

g.NEEDaccess Server can acquire data from connected g.USBamp, g.Hlamp, and g.NAUTILUS devices. Devices of these types can be connected to the mini computer at the USB ports on the front and the back. When a device is connected to the mini computer the first time, it may take a while until automatic installation of the device driver completes. *Figure 4* and *Figure 5* show examples of possible setups.



Figure 4: The server acquiring data from a g.NAUTILUS device.



Figure 5: The server acquiring data from a g.NAUTILUS, a g.USBamp and a g.Hlamp device.

To be able to retrieve data from the server into a client application that runs on a separate machine (the client machine), establish a peer-to-peer Etherne connection between the client machine and the mini computer at LAN1 or LAN2. The client application can also run at the mini computer itself, in which case the client machine is identically to the mini computer.

Configure the client application to connect to the server at the connected LAN adapter's IP address (see section *Network adapter and firewall configuration*) and the port that the server is listening to for incoming connections (see section *Connecting with the server*).

See sections Connecting with the server and Test connection with the g.NEEDaccess Demo Client application on how to test the installation.

Manual configuration of the mini computer and maintenance of the server

In case you need to change the configuration of the machine or maintain the server service manually, connect a screen, keyboard and mouse to the mini computer that runs the server. See section *Installation and Configuration* for details on how to configure the server service manually.

Installation and Configuration

Install g.NEEDaccess Server

Insert the g.tec product CD into your CD drive, navigate to the folder g.NEEDaccess and the appropriate platform-specific subdirectory (e.g. Win64 for Microsoft Windows 64-bit), and run setup.exe.

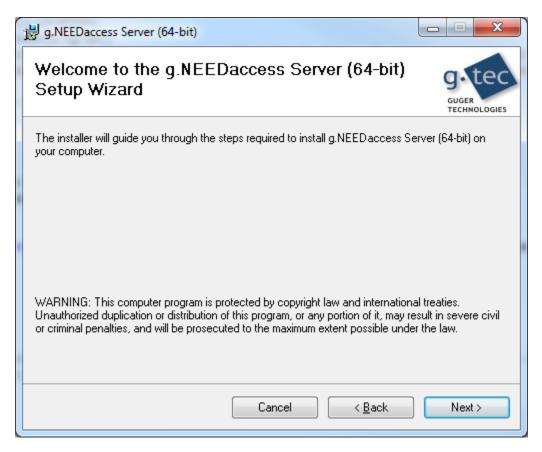


Figure 6: Setup Wizard of g.NEEDaccess

Follow the instructions on the screen to install g.NEEDaccess Server.

If Windows announces that it can't verify the publisher of the provided driver software, please click: *Install this driver software anyway* to proceed. Otherwise the installation process cannot be completed correctly.

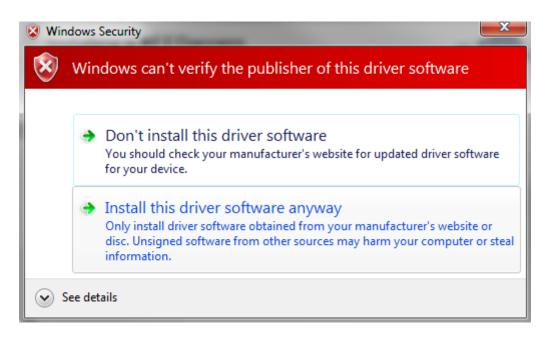


Figure 7: Windows cannot verify the publisher of the driver software.

The server service is started automatically after installation. The following section describes how to stop or start the server and configure it for manual or automatic startup on the desired PC.

Start / Stop / Restart the Server Service

Open the *Task Manager* (usually by pressing the key combination CTRL+ALT+DEL and selecting *Start Task Manager* from the screen) and go to the *Services* tab.

Find the server service named *GDS* (it is possible to arrange the service names alphabetically by clicking on the column header *Name*) and right click for the context menu. There you have the options for starting and stopping the service.

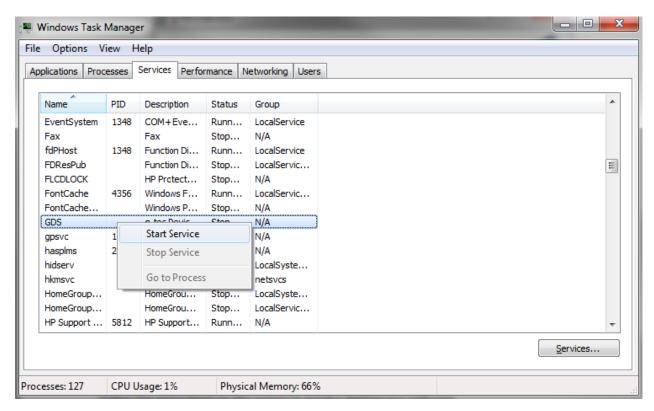


Figure 8: Start or stop the server service from the task manager.

Please note that the service is configured to start automatically on system startup. To disable automatic startup and configure the service for manual start, refer to the following section.

Disable automatic start and configure the server service for manual start

Open the *Task Manager* (usually by pressing the key combination CTRL+ALT+DEL and selecting *Start Task Manager* from the screen), go to the *Services* tab and click the *Services*... button.

Find the server service named *g.tec Device Service (GDS)* (it is possible to arrange the service names alphabetically by clicking on the column header *Name*) and right click for the context menu. Select *Properties*.

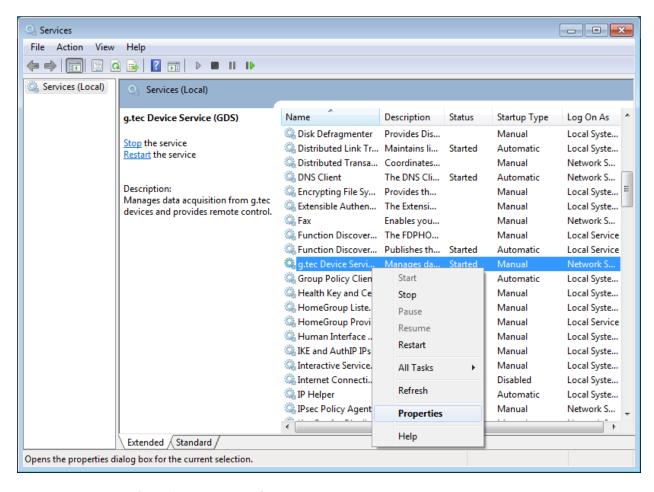


Figure 9: Configure the server service for automatic startup.

In the properties window, change the Startup type to Manual and click OK.

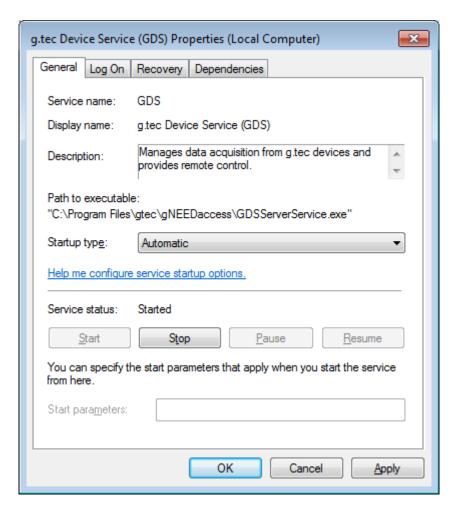


Figure 10: Configure the server service for automatic startup.

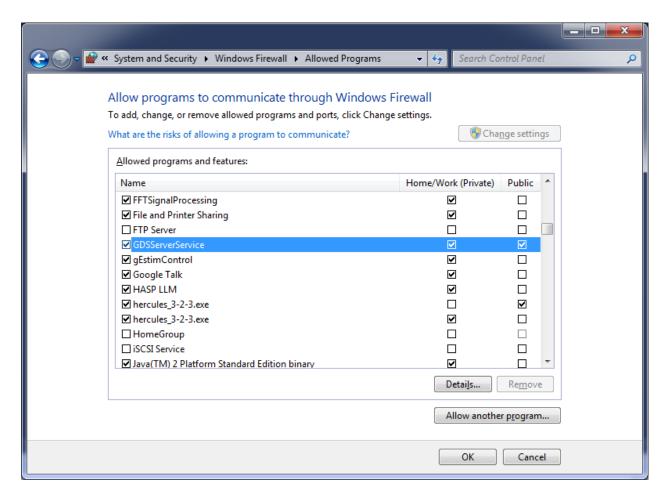
The server does now not start automatically on system startup. It has to be started manually via the Windows *Task Manager*.

g.NEEDaccess and the Windows firewall configuration

To allow remote users to access the server service over the network, your firewall must be configured to permit incoming connections for the program GDSServerService.exe in the selected installation folder.

The installer attempts to add such a rule to the Windows Firewall automatically. If you're using a firewall other than the Windows Firewall, you have to configure it manually.

To check if the installer succeeded in creating and adding the rule to the Windows Firewall, open the Windows Firewall configuration from the Control Panel and select Allow a program through the Windows Firewall.



A list of firewall rules is presented. Find the rule named *GDSServerService* and verify that all checkboxes are checked. If the service has not been enlisted automatically, you can add it manually by clicking *Allow another program...*.

This rule will be removed on uninstallation automatically again.

Files on your Computer

The default installation directory for g.tec products is C:\Program Files\gtec\ .

Within this directory a subdirectory named gNEEDaccess is generated where all installed files are located:

\gNEEDaccess\config	Contains the server configuration file in HDF5 format
\gNEEDaccess\documentation	Contains the documentation PDF (which you are currently reading)
\gNEEDaccess\drivers	Contains hardware drivers for g.tec amplifier devices: g.USBamp (Cypress) g.Hlamp (WinUSB) g.Nautilus (FTDI)

Uninstall g.NEEDaccess Server

Remove g.NEEDaccess Server by using the standard uninstall-process of Windows accessed via the *Control Panel*.

If the server service is still running when attempting to uninstall g.NEEDaccess Server, you will be prompted to close the application before. Select: "Automatically close applications and attempt to restart them after setup is complete." and click OK.

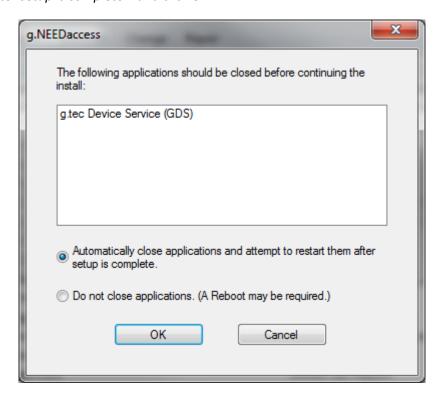


Figure 11: Uninstall prompt: shut down service before uninstalling.

Check if server service is running correctly

To verify if the server is running use the Event Viewer from the Administrative Tools of the OS. Navigate to *Applications and Services Logs* and double click *g.tec* in the center frame or select *g.tec* in the tree view:

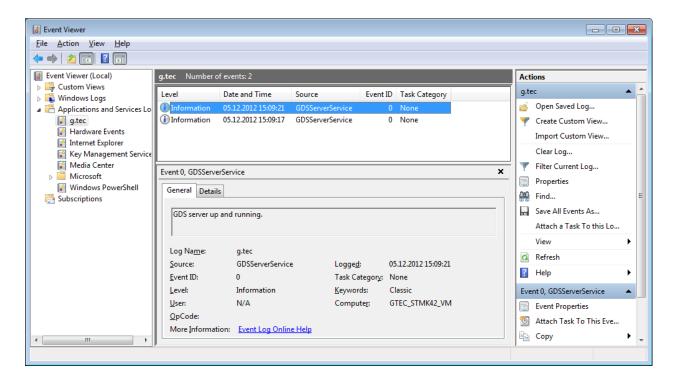


Figure 12: The events of the server are listed in *Administrative Tools – Event Viewer*: Applications and Services Logs – g.tec

Or check the Services tab of the Task Manager:

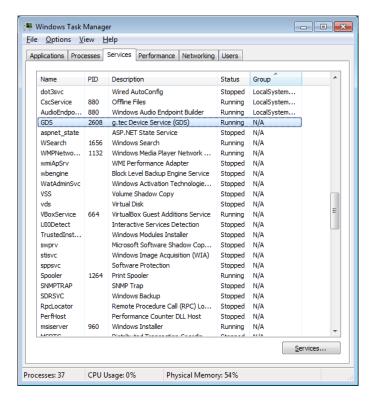


Figure 13: The server service named GDS is listed in Windows Task Manager - Services

Connecting with the server

If the client application that wants to acquire data from g.NEEDaccess Server runs on a different machine as g.NEEDaccess Server, the two machines must be connected peer-to-peer by a gigabit Ethernet connection. Ensure that firewalls on both sides permit incoming and outgoing connections between the client application and g.NEEDaccess server (see section g.NEEDaccess and the Windows firewall configuration).

g.NEEDaccess Server listens for incoming connections at port 50223.

Applications that want to acquire data from g.NEEDaccess Server must be configured to connect to the server at this port and a valid IP address. If the application runs on the same machine as the server, the loopback address (127.0.0.1) can be used.

Test connection with the g.NEEDaccess Demo Client application

List connected devices

g.NEEDaccess Server comes with an application for basic testing of the installation – the g.NEEDaccess Demo Client. Run it from the start menu or from the desktop at the client machine to launch the device explorer as shown in *Figure 14*.

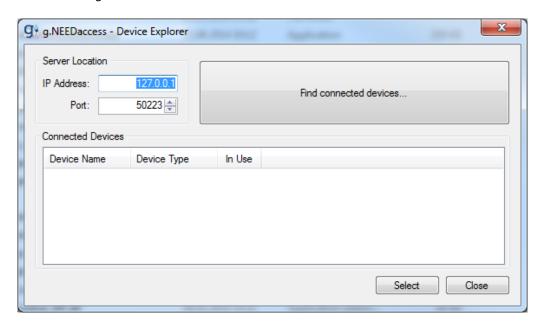


Figure 14: g.NEEDaccess Demo Client application starts up with the device explorer window.

Enter the IP address of the machine that runs g.NEEDaccess Server, or leave it at the loopback address if the client machine is running the server. The device explorer is already configured with the default port number that the server is supposed to listen to. A standard installation does not require to change it.

Connect a supported device to the server, ensure that it's powered on, and click the *Find connected devices*... button. The device explorer connects to the server, retrieves the list of connected supported devices and displays it afterwards.

- If the device's serial number is listed now, connection with the server works and you can continue with configuring the device for data acquisition.
- If the device is not listed without any error message, connection to the server could be established successful but the device is not recognized by the server. Ensure that the device is connected properly and in a valid state. If the device is connected to the server the first time, automatic driver installation could take a little longer. Retry after about a minute without disconnecting the device. If the device is still not listed and the operating system at the server reports that it cannot find the driver, disconnect the device, repair installation of g.NEEDaccess Server via the list of installed programs at the *Control Panel*, and connect the device again.

• If an error message is displayed telling that the g.NEEDaccess Demo Client application couldn't establish a connection with the server at the specified endpoint, ensure that the server service is running on the server (see section *Check if server service is running correctly*) and network connection and firewalls are configured properly (see section *Connecting with the server*). If so, it is recommended to run the g.NEEDaccess Demo Client application locally on the server first using the loopback adapter's address (127.0.0.1) to verify that the server is configured properly.

The *In Use* column gives information about whether the listed device is currently in use by another client application that uses the server (which is not necessarily the demo application). It should say *No* if no other application uses it right now.

Configure device for data acquisition

Select the device from the list in the device explorer and click the *Select* button. The application establishes a connection with the device at the server and shows the device's configuration dialog after some seconds (*Figure 15* to *Figure 17*). Make your settings and confirm the configuration dialog by clickling *OK*. The dialog will deny invalid settings that are not supported by the device. After successful configuration, the data acquisition window from *Figure 18* is shown.

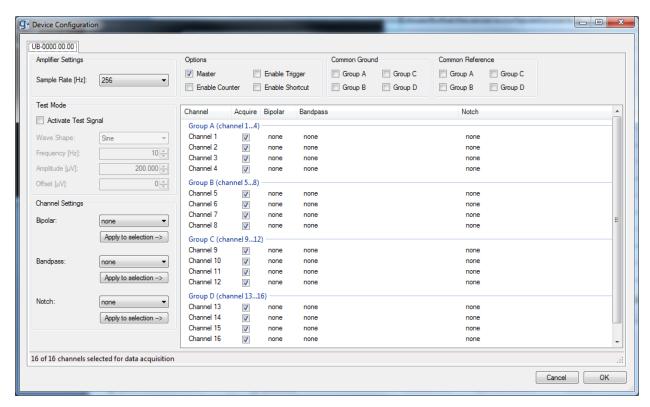


Figure 15: Configuration dialog of g.USBamp devices.

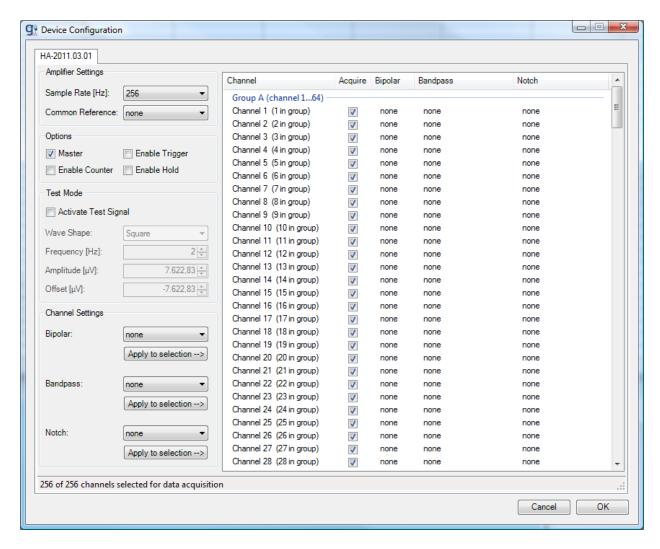


Figure 16: Configuration dialog of g.Hlamp devices.

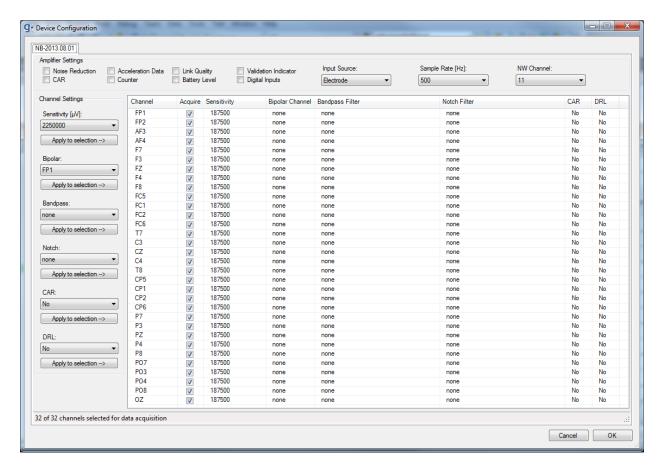


Figure 17: Configuration dialog of g.NAUTILUS devices.

Acquire data from the device

Figure 18 shows the data acquisition window of the g.NEEDaccess Demo Client application.

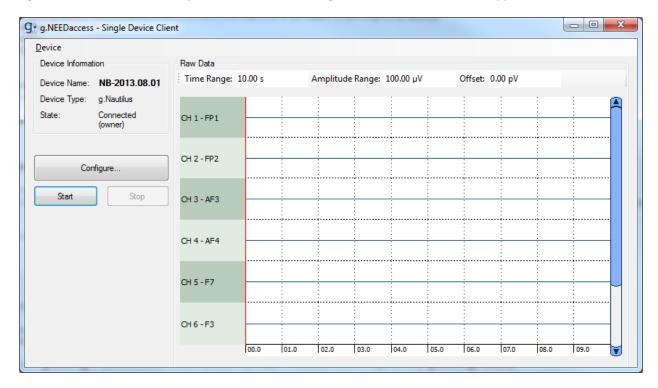


Figure 18: Data acquisition window for g.NAUTILUS devices.

The *Device Information* box gives information about the device currently in use and the application's state. The attribute *owner* in brackets in the state description indicates that the device has not been in use at the time the application opened it. Hence, the application is the owner of the session and can configure and control the device. The g.NEEDaccess Client Demo application also allows to open a device that is currently in use by another application, which will be indicated with the *listen only* attribute in brackets in the state description. Listeners are not allowed to configure or control the device. They're just allowed to 'listen' to the data stream but cannot start or stop acquisition on the device itself.

Click the *Start* button to start data acquisition (or listening). The raw data viewer displays acquired channels selected at configuration only. The raw data viewer allows changing the displayed range of time, amplitude and offset. Acquisition (or listening) can be stopped again by clicking the *Stop* button. Configuration can be changed while acquisition is stopped by clicking *Configure...*.

Impedance measurement

To measure the electrodes impedances, open the impedance measurement window from the main menu as shown in *Figure 19*.

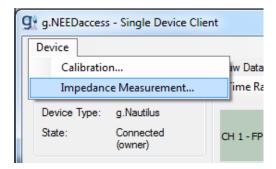


Figure 19: Open the impedance measurement window for the currently selected device from the main menu.

Different conditions apply to impedance measurement depending on the device type (see sections below). Ensure that all conditions described in these sections are met before starting impedance measurement.

Select or deselect the channels to use for impedance measurement by clicking on the appropriate channel number. Deselected channels get a dark gray background while selected channels have a white background.

Click *Start* to start impedance measurement. Impedance measurement will be performed periodically for all channels. Click *Stop* to stop impedance measurement (even if impedance measurement has aborted with an error, e.g. when the device was disconnected during measurement) and close the dialog by clicking *Close*.

The channel coloring indicates the impedance of the connected electrode. Channels with passive electrodes get assigned one of the colors listed in the *Passive Electrodes* box. Channels with active electrodes get assigned one of the colors listed in the *Active Electrodes* box. Optimal values e.g. for EEG recordings with passive electrodes would be below 5 kOhms (color code light green). Acceptable impedance values are in the range of up to 20 kOhms (color code yellow or light blue), while nonconnected channels or electrodes have a very bad impedance value of more than 20 kOhms (color code light red). Optimal values e.g. for EEG recordings with active electrodes would be below 30 kOhms (color code dark green). Acceptable impedance values are in the range of up to 100 kOhms (color code orange or dark blue), while non-connected channels or electrodes have a very bad impedance value of more than 100 kOhms (color code dark red). Channels whose impedance couldn't be measured properly get color code black.

If Acoustic feedback is checked, a short beep is produced on the PC speaker when the impedance of any of the electrodes changes from red to any better impedance value. The better the impedance value the electrode changes to, the higher the frequency of the beep. If the impedance of any electrode changes to red, a long beep sounds. To turn off acoustic feedback, uncheck the Acoustic feedback checkbox.

Impedance measurement with g.HIamp

Figure 20 shows the impedance measurement window for g.Hlamp devices.

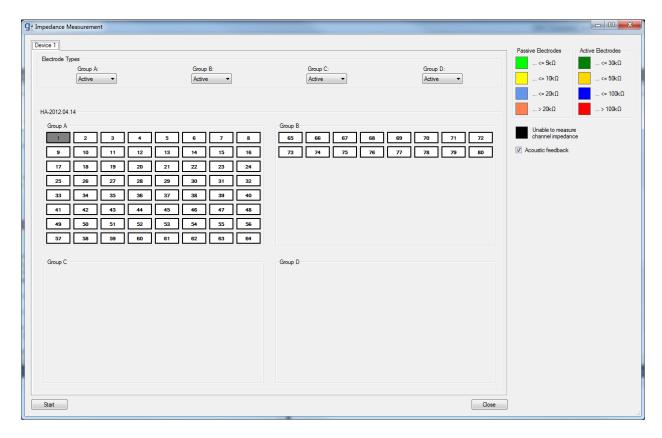


Figure 20: Impedance measurement window for an 80-channel g.Hlamp device.

Select the type of electrode connector boxes that are currently connected to each of the four groups of the g.Hlamp in the *Electrode Types* area. Either passive or active electrode connector boxes can be used for a whole group. If a group is not used, it doesn't matter which type of electrodes you specify for that group. At least on channel 1 (Group A) an electrode must be connected.

IMPORTANT: If an active electrode box is connected to group A, a special electrode has to be used at channel 1. Please see the documentation of the 64-channel active electrode connector box for details on impedance measurement.

Channel 1 and the ground electrode are used as reference for impedance measurement of all other channels. Therefore, no impedance can be measured for those channels. Hence, channel 1 is always grayed and no impedance value will be assigned. However, if the reference signal measured on channel 1 is not valid (which might occur when no electrode is connected on channel 1), no impedance value can be calculated and color code black will be assigned to all other channels.

Impedance measurement with g.NAUTILUS

Figure 21 shows the impedance measurement window for g.NAUTILUS devices.

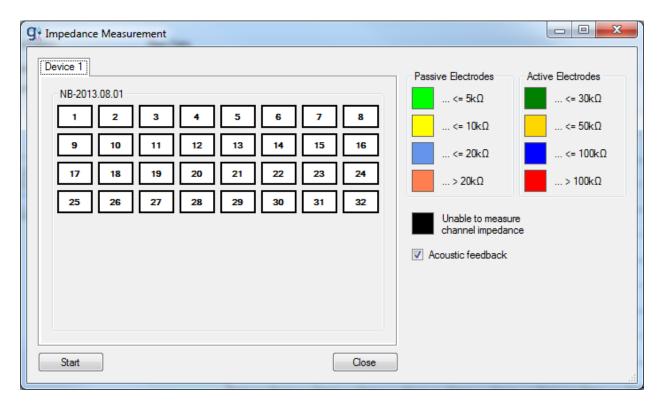


Figure 21: Impedance measurement window for g.NAUTILUS devices.

g.NAUTILUS only has active electrodes. Hence, only the channel coloring given in the *Active Electrodes* box apply.

Electrode *Cz* and the ground electrode are used as reference for impedance measurement of all other channels. If the reference signal measured at electrode *Cz* is not valid (which might occur when no electrode is connected on the corresponding channel), no impedance value can be calculated and color code black will be assigned to all other channels.

Calibration

To show or modify current device calibration, open the calibration window from the main menu as shown in *Figure 22*.

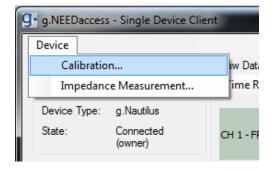


Figure 22: Open the calibration window for the currently selected device from the main menu.

This opens the calibration window from *Figure 23*. If the device requires a calibration set to be applied on, read the manual of the calibration equipment for detailed instructions on how to do this. Then click the *Calibrate Amplifier* button to determine offset and gain of each channel.

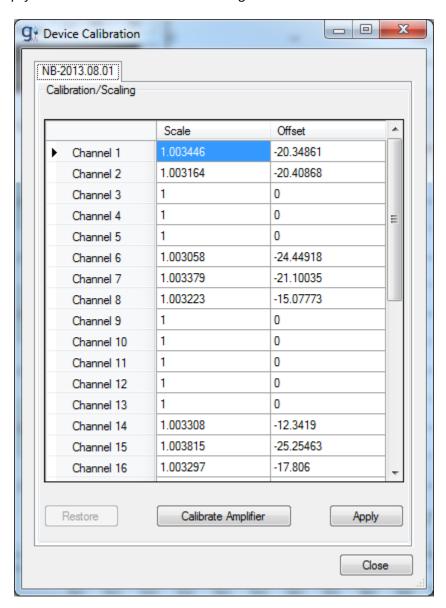


Figure 23: Calibration window of a g.NAUTILUS device.

Calculation of new calibration values lasts about 10 seconds. A dialog will inform you after calculation has been completed. The actual calibration values are then visualized for each channel, but not applied yet. If at least one channel could not be calibrate due to broken channels or broken calibration set for example, a dialog will inform you about the involved channels and their calibration value entries are displayed as *NaN* ("not a number").

Press the *Apply* button to transmit the newly calculated or restored factory calibration values and apply them on the device. Press the *Restore* button to restore the old values on the amplifier. To edit the

calibration values manually, double-click the desired cell and enter your value for scaling and offset (the settings will actually be transmitted and applied after the *Apply* button is pressed).

For channels that received *NaN* values as calibration result, 1.0 will be set for scaling and 0.0 for offset on pressing the *Apply* button.



contact information

g.tec medical engineering GmbH Sierningstrasse 14 4521 Schiedlberg Austria tel. +43 7251 22240 fax. +43 7251 22240 39 web: www.gtec.at e-mail: office@gtec.at