```
52
53  if (numDevices > 0)
54  {
55      //open the first device in the l
56      result = GDS_Connect(serverEndpo
57
58      if (result.ErrorCode != GDS_ERRO
59      {
60          //set configuration
61          GDS_SetConfiguration(connect
62
63          //create 1 sec buffer for da
64          size_t scanCount = 1;
65          GDS_GetDataInfo(connectionHa
66
67          size_t acquisitionBufferSize
68          float *acquisitionBuffer = n
69
70          //start acquisition on serve
71          GDS_StartAcquisition(connect
72
73          //start streaming to client
74          GDS_StartStreaming(connection
75
76          //acquire data
77          while (acquiredScans < scans
78          {
79              size_t scansRetrieved =
80
81              //retrieve available dat
82              GDS_GetData(connectionHa
83
84              //write data to file
85              if (scansRetrieved > 0)
86                  file.write(reinterpr
87
88              acquiredScans += scansRe
89          }
90
91          //stop streaming
92          GDS_StopStreaming(connection
93
94          //stop acquisition
95          GDS_StopAcquisition(connecti
96
97          //disconnect
98          GDS_Disconnect(&connectionHa
99
100         //release allocated resource
101         delete[] acquisitionBuffer;
102     }
103  }
```

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g.NEEDaccess

SERVER V1.16.01

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Content

Safety Notice

In order to use this product safely and fully understand all its functions, make sure to read this manual before using the product.

Medical client applications that incorporate the g.NEEDaccess Server or Client API must be developed according to national/international laws for medical device and software development and must be thoroughly tested before they are used with patients.

Follow the instructions for use of the used PC and the connected devices for allowed environmental conditions.

The used PC must not go to sleep, hibernate, turn off, or turn on the screensaver during a measurement.

Introduction

g.NEEDaccess is a server service that facilitates simple and platform independent data acquisition from (multiple) devices over a network, and thereby eases the user's workload considerably.

g.NEEDaccess allows users to acquire data easily from g.tec devices without having to take care of low-level data acquisition issues. The server handles data acquisition and preprocessing, so 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 (if both are connected to the network). Moreover, the server can provide data from a single acquisition simultaneously for multiple clients. Thus, more than one user can monitor a certain experiment at the same time.

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

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

This document contains the terminology of important concepts, provides general insight on how to use the server, and then lists 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.HIamp, g.Nautilus PRO 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.HIamp 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), electrooculogram (EOG), and electrocardiogram (ECG).

Intended use with g.Nautilus PRO

The g.Nautilus PRO is intended to be used to acquire the electroencephalogram (EEG) and transmit it wirelessly to a computer.

Intended use with g.Nautilus

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.

Limitation

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.

Release notes

Release notes help to learn about new features and changes of g.NEEDaccess when upgrading to a newer version of the server.

New features

- g.USBamp serial numbers starting with 'UR-' are supported now.

Changes

- Improved measurement for frame size 1 with g.Nautilus devices.

- The configuration dialogs display an information message now if channel-specific settings should be applied but no channels are highlighted.

System Requirements

Basically, g.NEEDaccess requires at least as much resources as the device with highest minimum requirements that the software operates. 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	2 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	Windows 10 Pro English 64-bit
Acrobat Reader	DC 2015

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. Software packages other than 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.

Installation and Configuration

Install g.NEEDaccess Server

Perform the following steps to install g.NEEDaccess Server.

1. Insert the g.tec product CD into your CD drive, navigate to the folder `g.NEEDaccess/g.NEEDaccess Server` and the appropriate platform-specific subdirectory (e.g. `Win64` for Microsoft Windows 64-bit), and run `setup.exe`. If setup asks you for installation of the *.NET Framework*, confirm the dialog by clicking the *Accept* button. The installer will install the *.NET Framework* from the CD.

2. Follow the instructions on the screen. If the *User Account Control* is turned on, additional dialogs may ask for permission. Confirm the dialogs to allow installation of the g.NEEDaccess software through *User Account Control*.
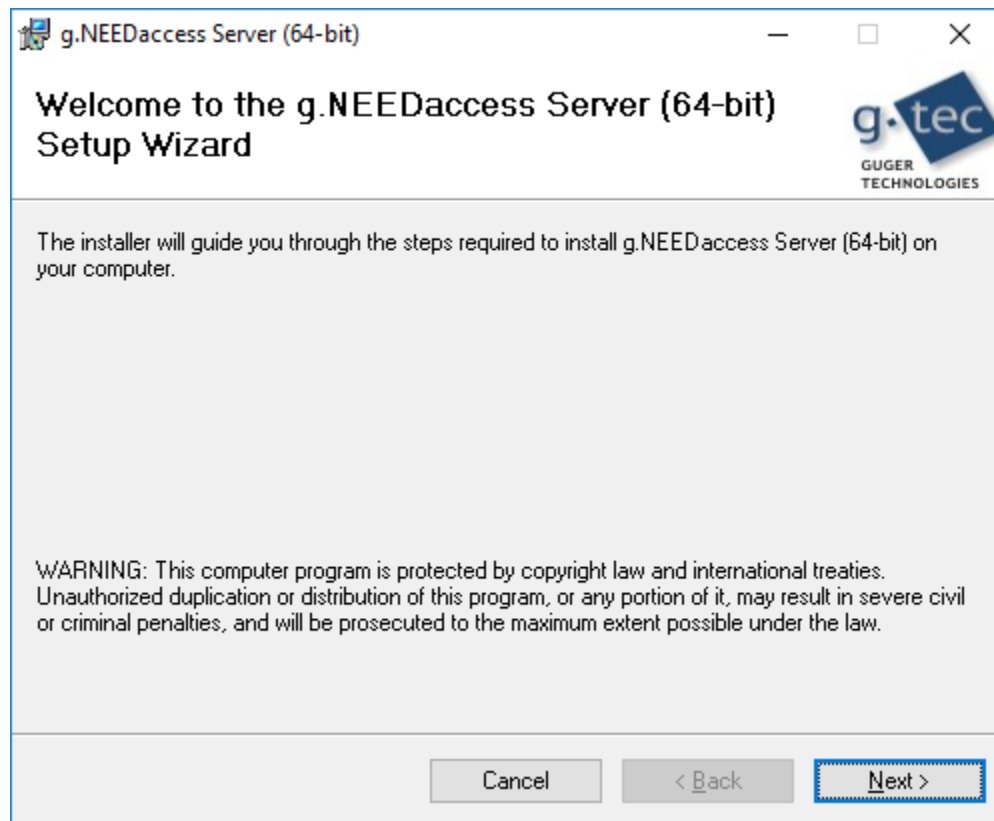

Figure 1: Setup Wizard of g.NEEDaccess.

3. Choose the installation folder (default is `C:\Program Files\gtec\`) where the install routine copies all necessary files and press *Next*.

4. During installation of g.NEEDaccess Server, additional dialogs like the following may ask for permission to install the g.tec device drivers. Click *Install* to continue.
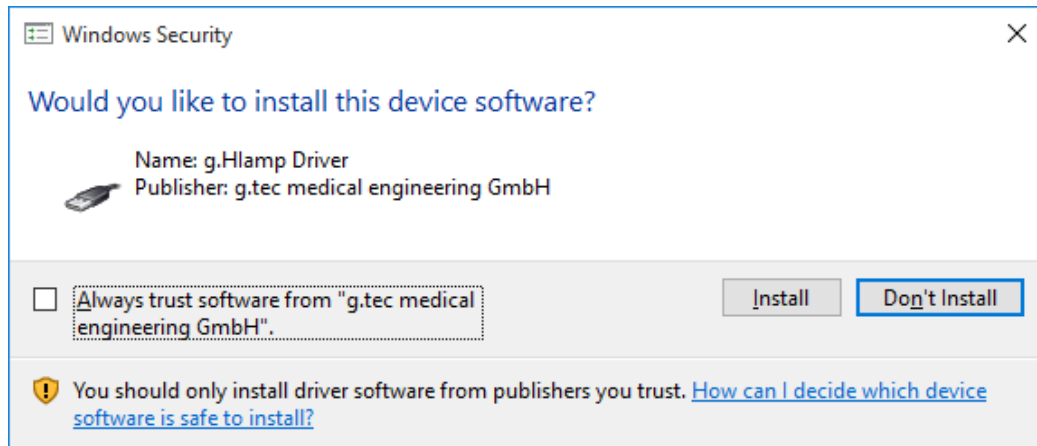
Figure 2: Installation of device drivers.

5. Follow the instructions on the screen. When the following window informs you about completion of the installation, click *Close* to complete.
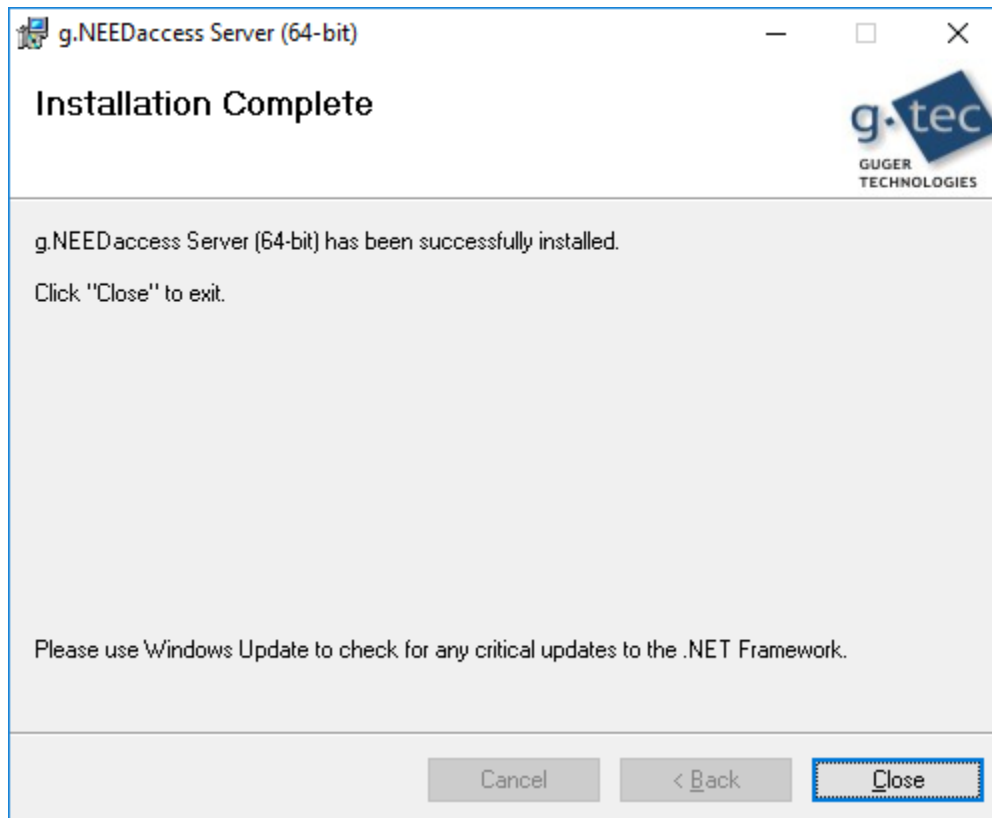

Figure 3: Installation completion.

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 or right-clicking the Windows *Start* button and selecting *Task Manager*) 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.
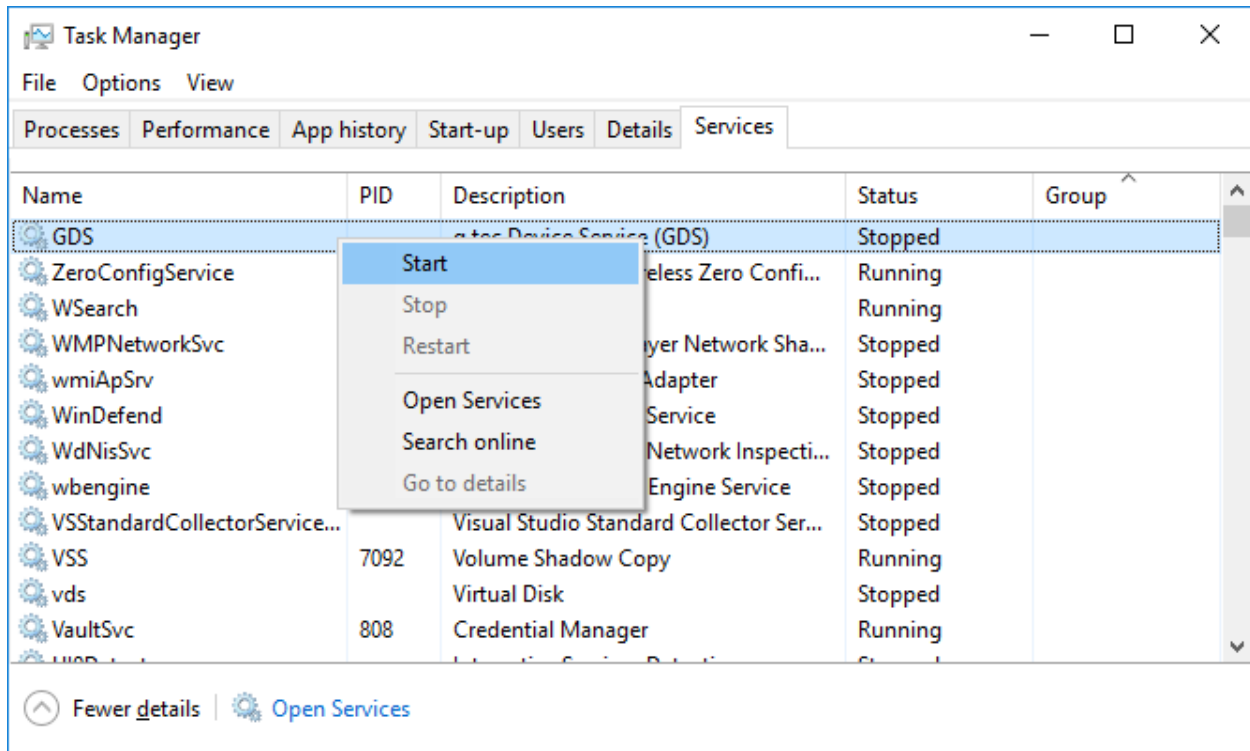

Figure 4: Start or stop the server service from the task manager.

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 or right-clicking the Windows *Start* button and selecting *Task Manager*), go to the *Services* tab and click the *Open 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*.
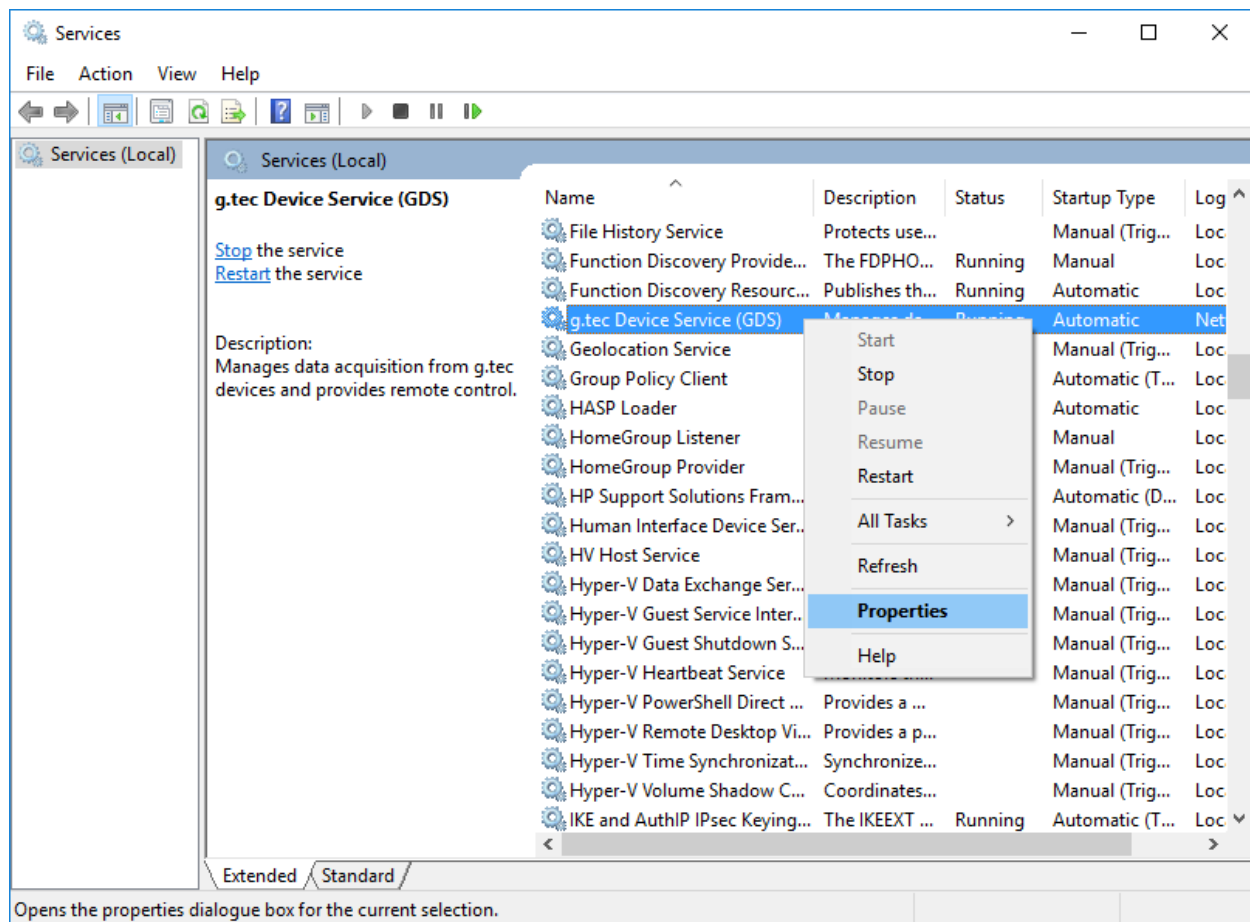
Figure 5: Configure the server service for manual startup.

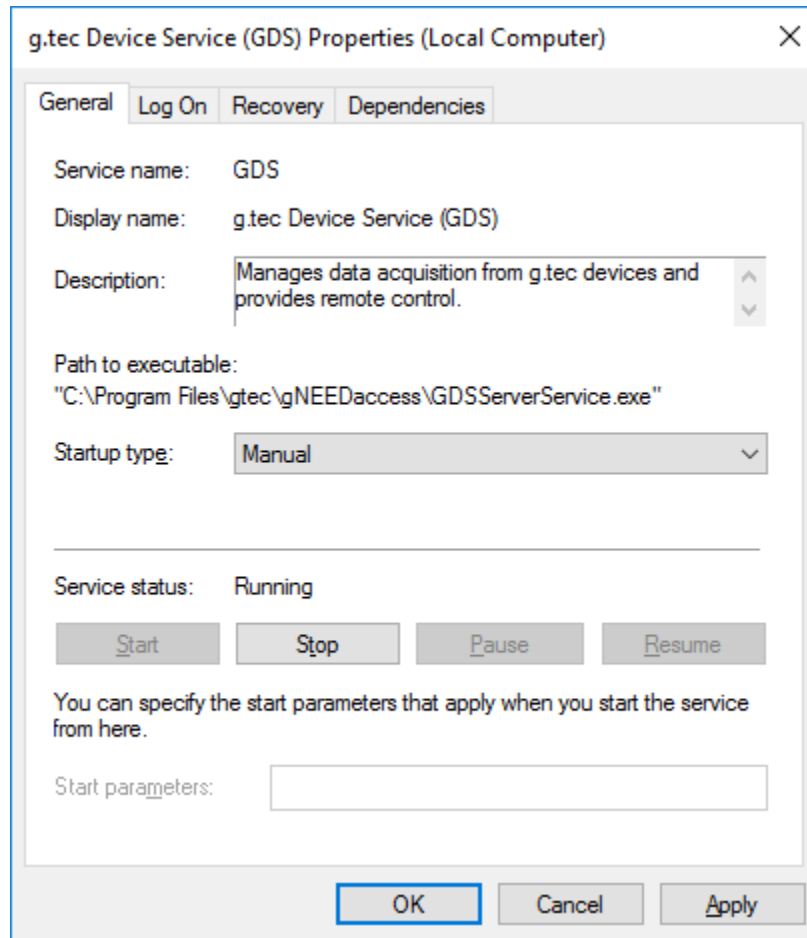In the properties window, change the *Startup type* to *Manual* and click OK.

Figure 6: Configure the server service for manual startup.

The server now does 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 whether 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 an app or feature through Windows Firewall*.
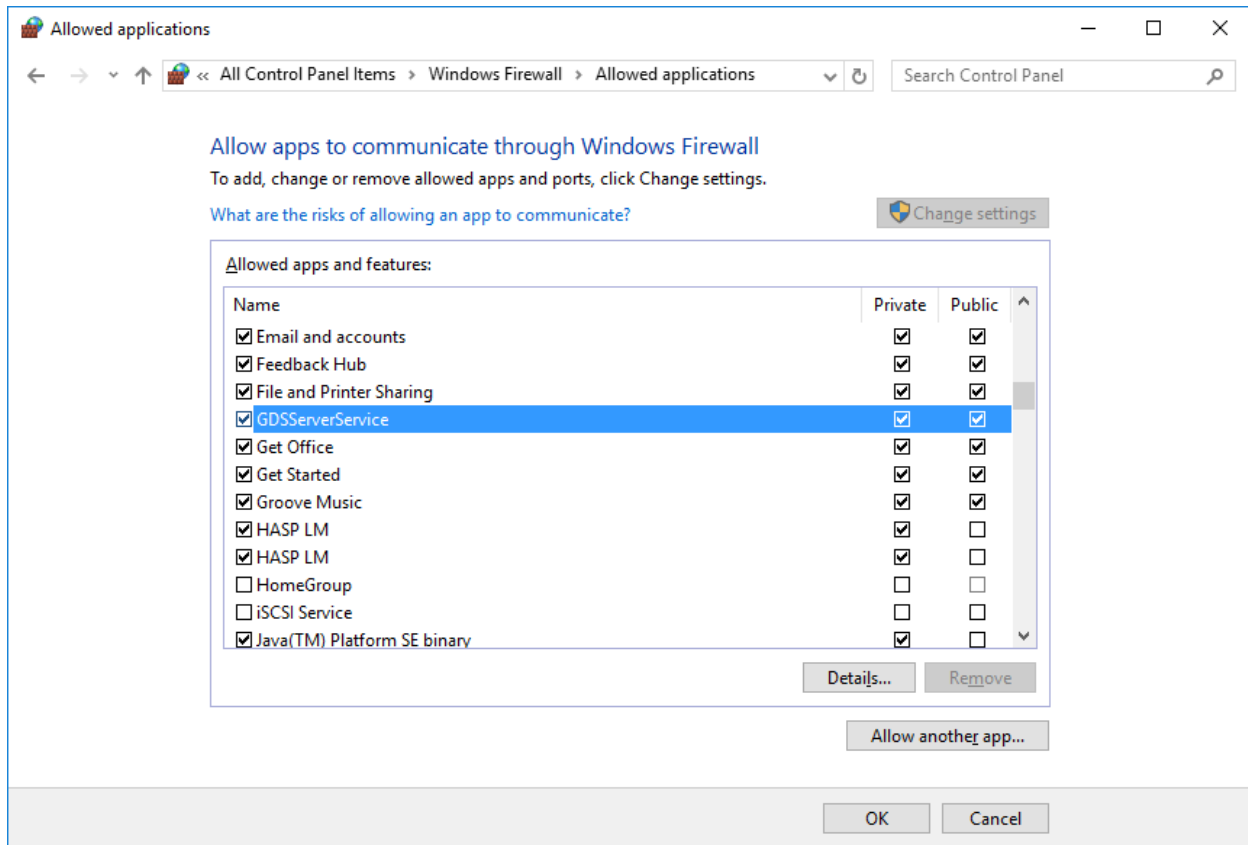
Figure 7: Allow the server service through the firewall to access the server service over network from a different machine.

A list of firewall rules is presented. Find the rule named *GDSServerService* and verify that all checkboxes are checked. If the dialog denies modification of the current settings, click the *Change settings* button before. 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\.`

A subdirectory named `gNEEDaccess` is generated within this directory, 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.HIamp (WinUSB)
g.Nautilus PRO (FTDI)

Uninstall g.NEEDaccess Server

Remove g.NEEDaccess Server 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 might be prompted to close the application first. Select *Automatically close applications and attempt to restart them after setup is complete* and click *OK.*
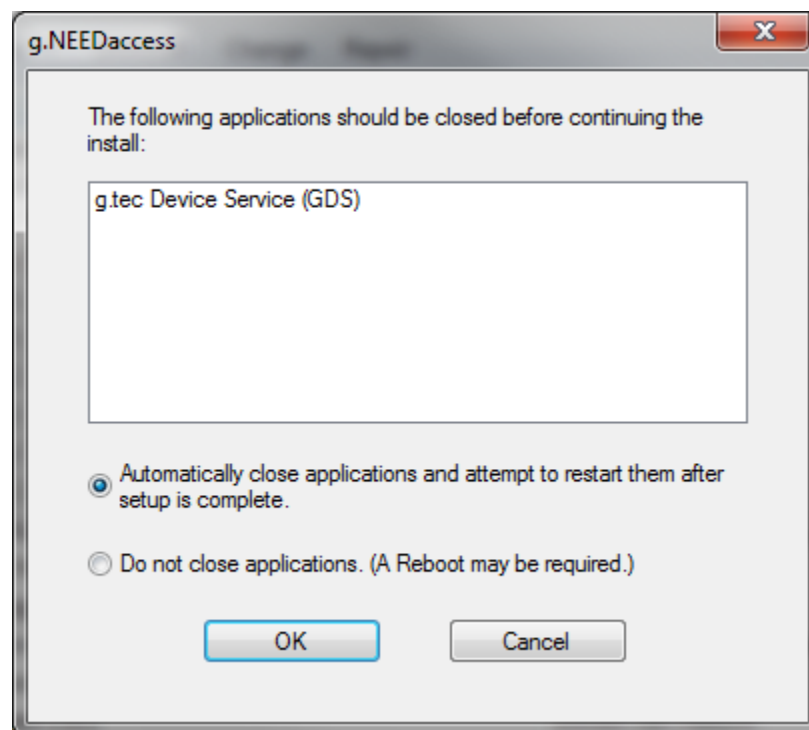

Figure 8: Uninstall prompt: shut down service before uninstalling.

Check if server service is running correctly

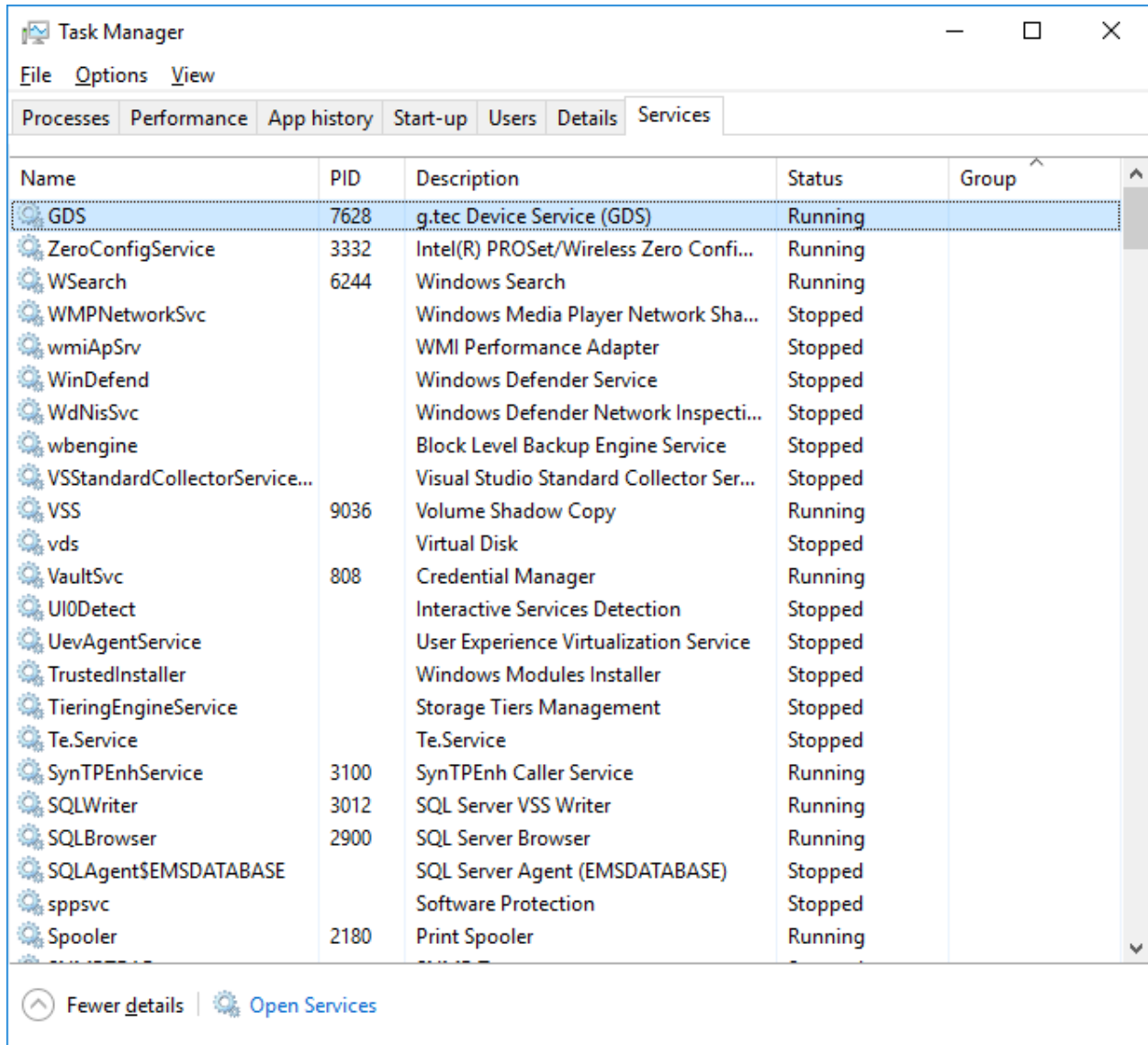To verify that the server is running, check the *Services* tab of the Task Manager.

Figure 9: The server service named GDS is listed in *Windows Task Manager – Services*.

You can use the Event Viewer from the Administrative Tools of the OS to check for log messages. Navigate to *Applications and Services Logs* and double click *g.tec* in the center frame, or select *g.tec* in the tree view:
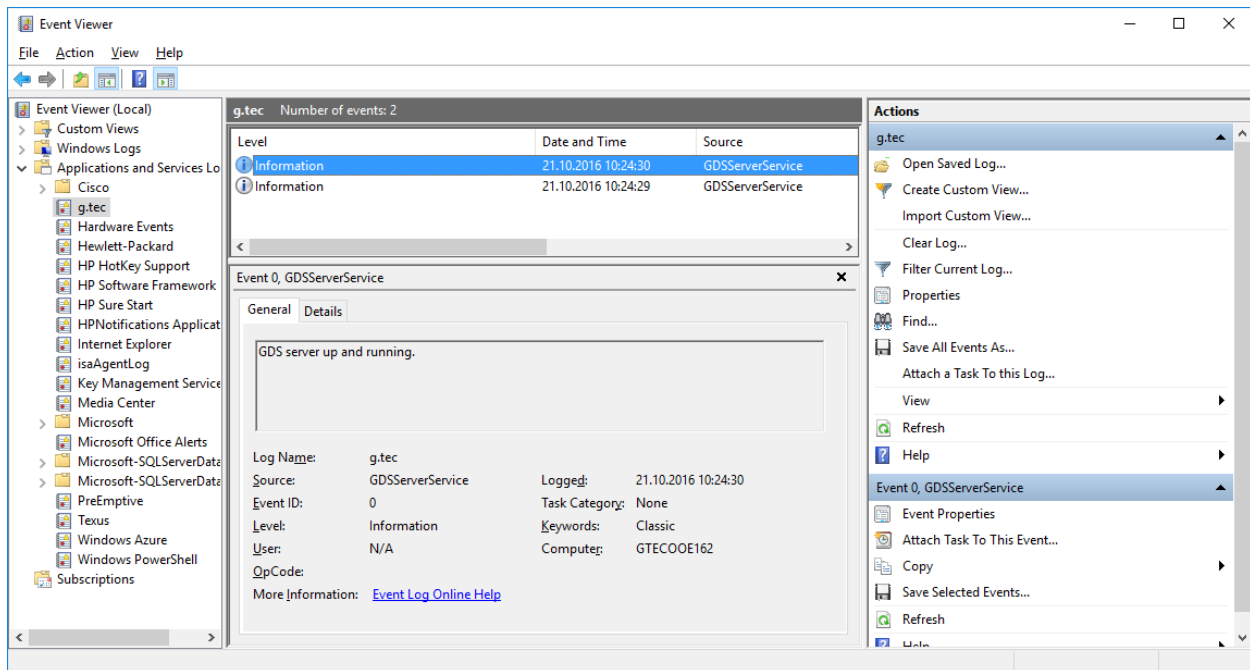
Figure 10: The events of the server are listed in the *g.tec* log of the Event Viewer's *Applications and Services Logs*.

Connecting with the server

If the client application that wants to acquire data from g.NEEDaccess Server runs on a different machine than 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 11*.
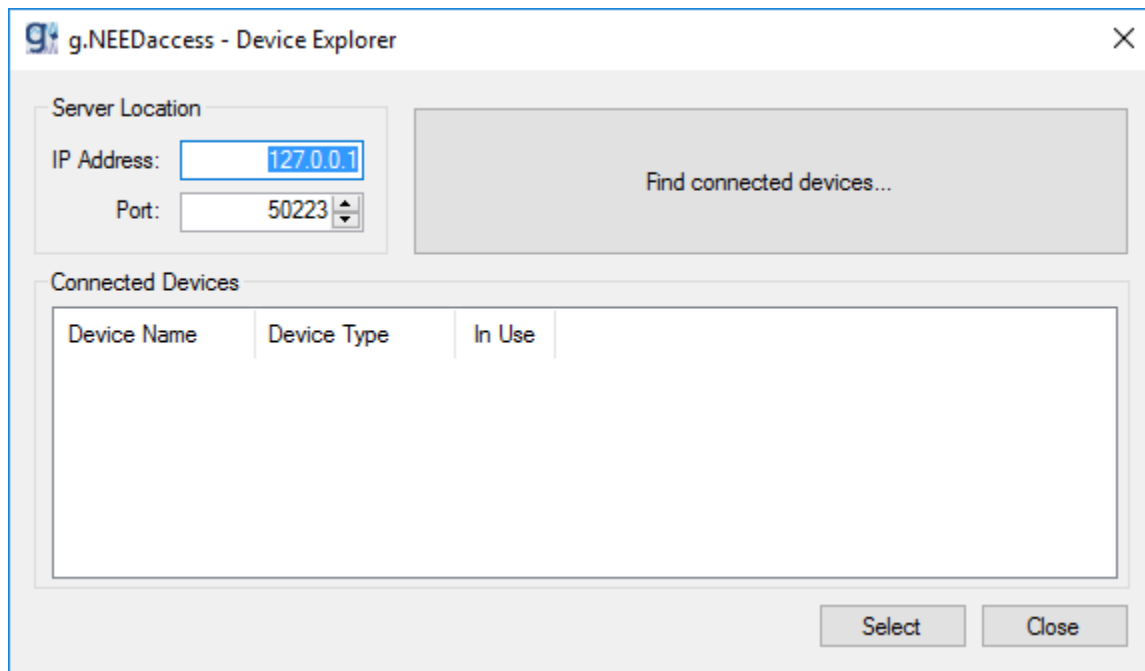

Figure 11: g.NEEDaccess Demo Client application starts up with the device explorer window.

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 changing 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 successfully, 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 for 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 stating 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 12* to *Figure 14*). 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 15* is shown.

To apply channel-specific settings in the configuration dialogs, the desired channels have to be highlighted before the corresponding *Apply to highlighted* button is clicked. To highlight a channel, left-click somewhere in the channel's row, except the *Acquire* check box. A highlighted channel is represented by orange background color (in *Figure 12* to *Figure 14*, the third channel is highlighted). Multiple channels can be highlighted at once holding down the *CTRL* or *SHIFT* keys while highlighting. If no channel is highlighted when the *Apply to highlighted* button is clicked, the system instead informs the user of this error and the settings do not change.
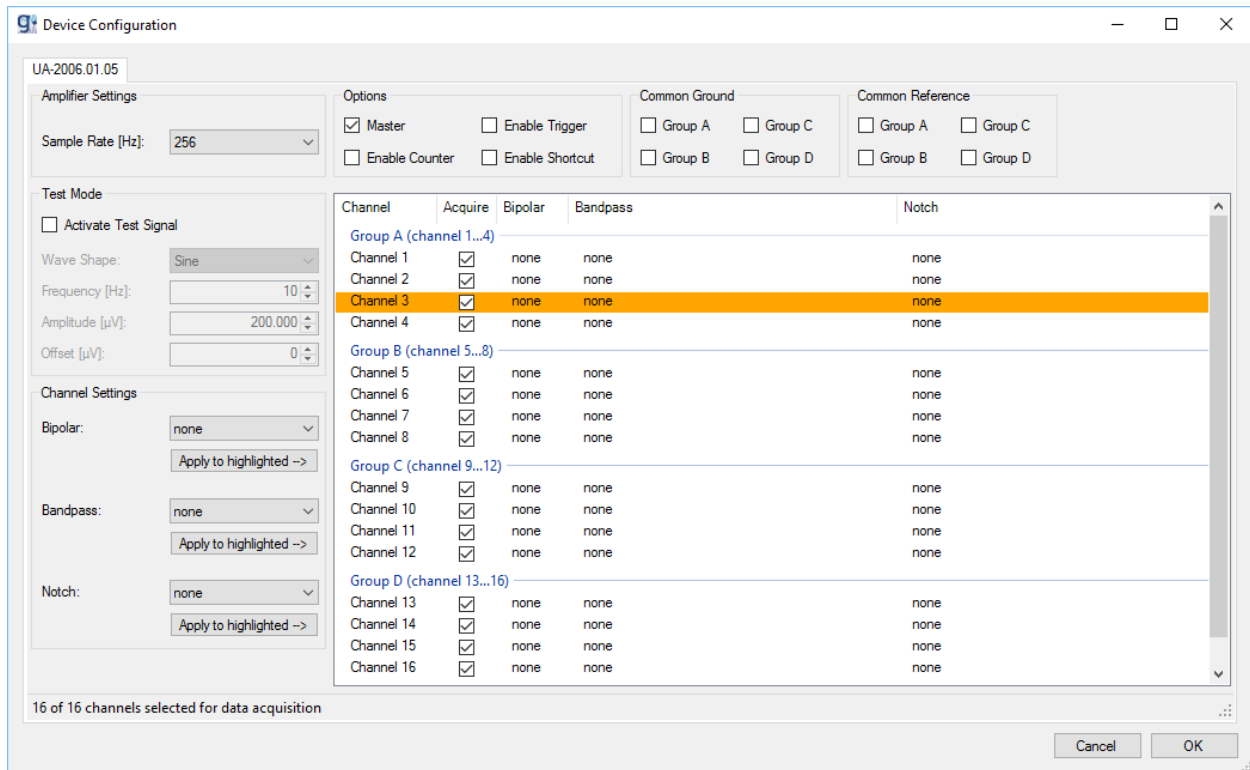
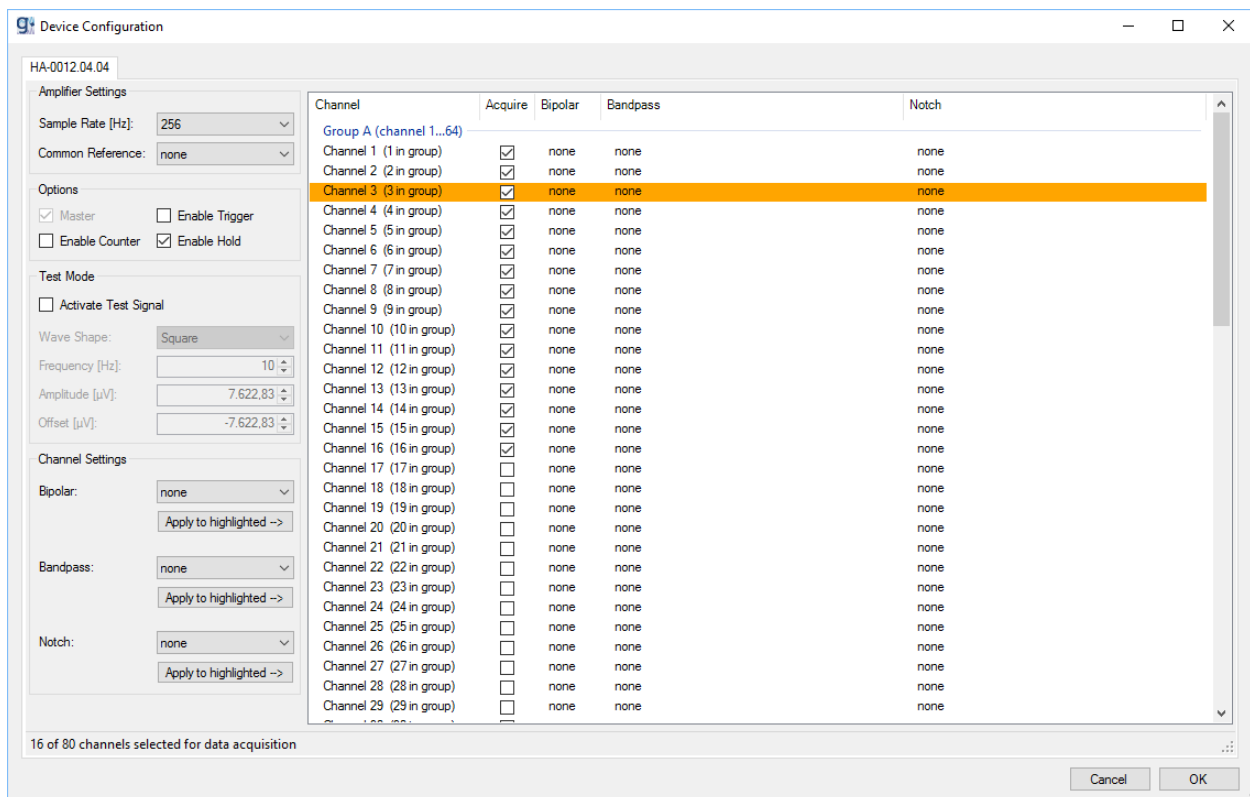Figure 12: Configuration dialog of g.USBamp devices.

Figure 13: Configuration dialog of g.HIamp devices.

Figure 14: Configuration dialog of g.Nautilus PRO devices.

Acquire data from the device

Figure 15 shows the data acquisition window of the g.NEEDaccess Demo Client application.
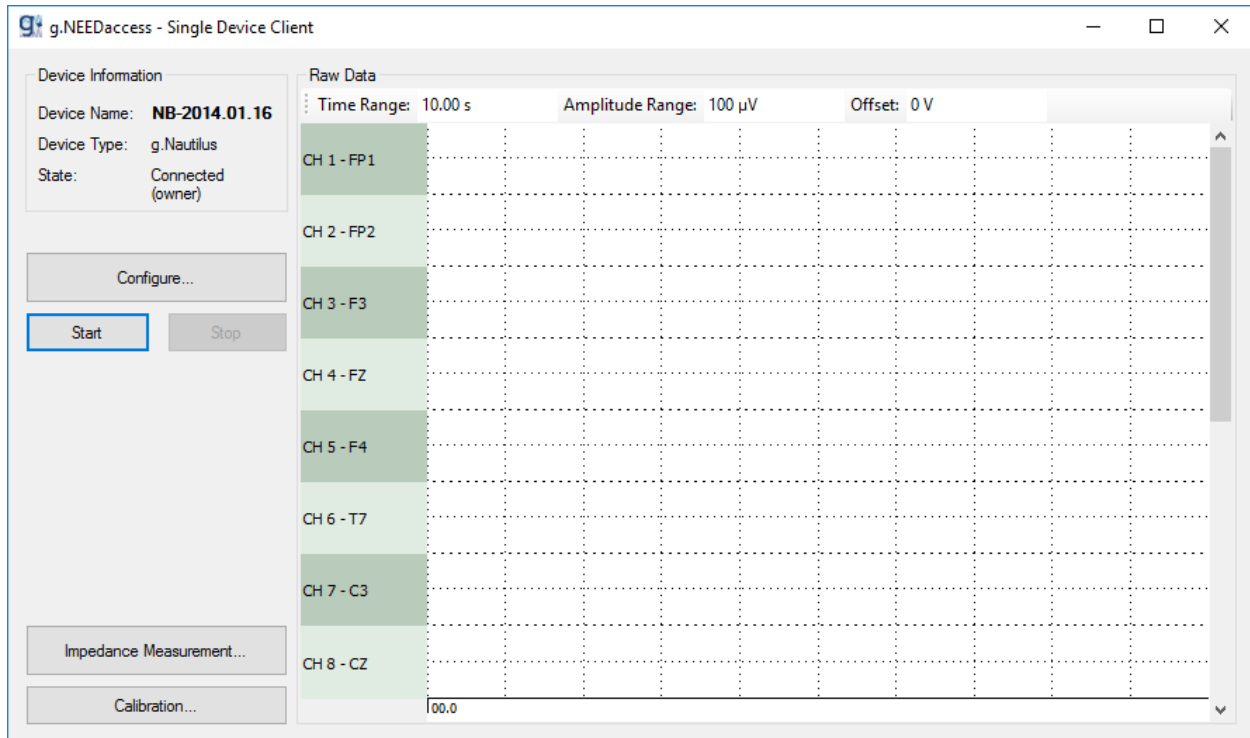

Figure 15: Data acquisition window for g.Nautilus PRO devices.

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 users 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, and 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

Click the *Impedance Measurement…* button to open the impedance measurement window.

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), then 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 for EEG recordings with passive electrodes would be below 5 kOhms (color code light green). Acceptable impedance values for passive electrodes are in the range of up to 20 kOhms (color code yellow or light blue), while unconnected channels or electrodes have a very bad impedance value of more than 20 kOhms (color code light red). Optimal values 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 are colored 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.

The content of the channel boxes to display can be chosen from either:

- The channel numbers (default).

- The channel names if available.

- The measured impedance values of the channels in kilo-ohm.

Impedance measurement with g.HIamp

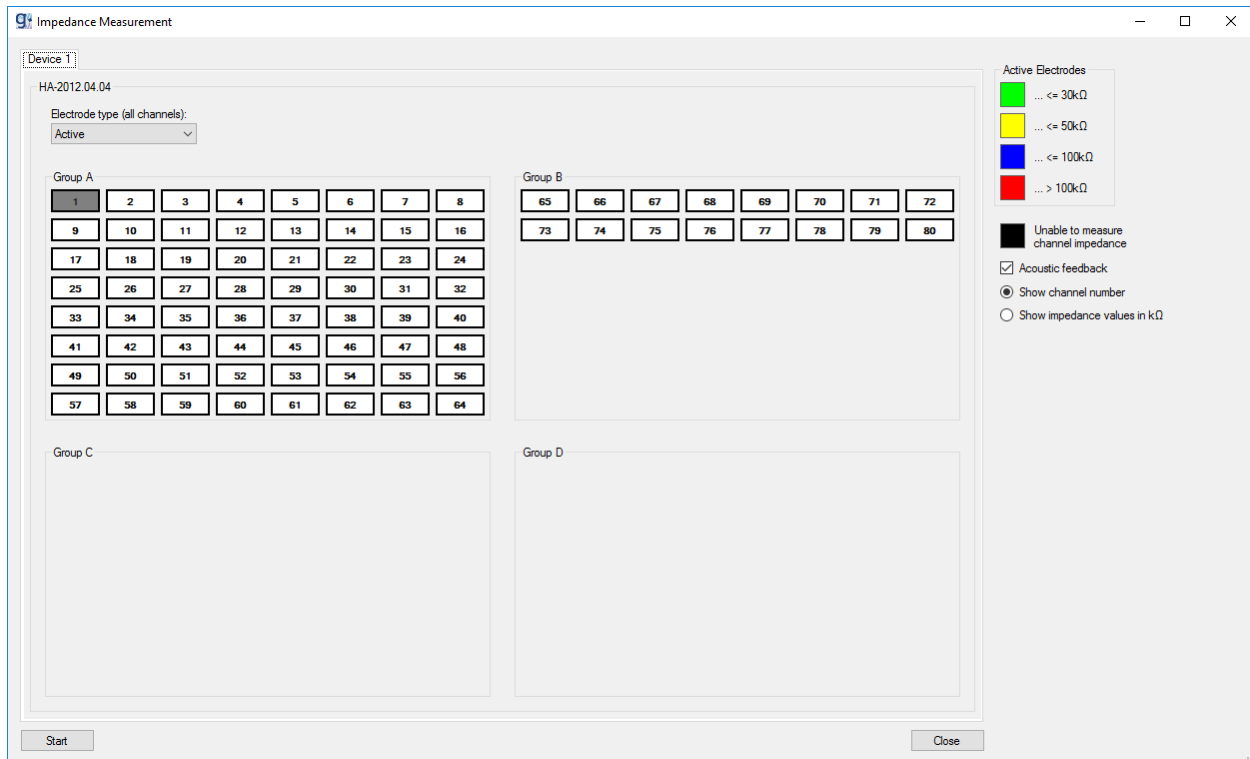*Figure 16* shows the impedance measurement window for g.HIamp devices.

Figure 16: Impedance measurement window for an 80-channel g.HIamp device.

Select the type of electrode connector boxes that are currently connected to each of the four groups of the g.HIamp in the *Electrode Types* area. Either passive or active electrode connector boxes can be connected to the groups. Active and passive electrode connector boxes cannot be mixed. Channel 1 and the ground electrode must always 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 the 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 all other channels will be black.

Impedance measurement with g.Nautilus PRO
Figure 17 shows the impedance measurement window for g.Nautilus PRO devices.
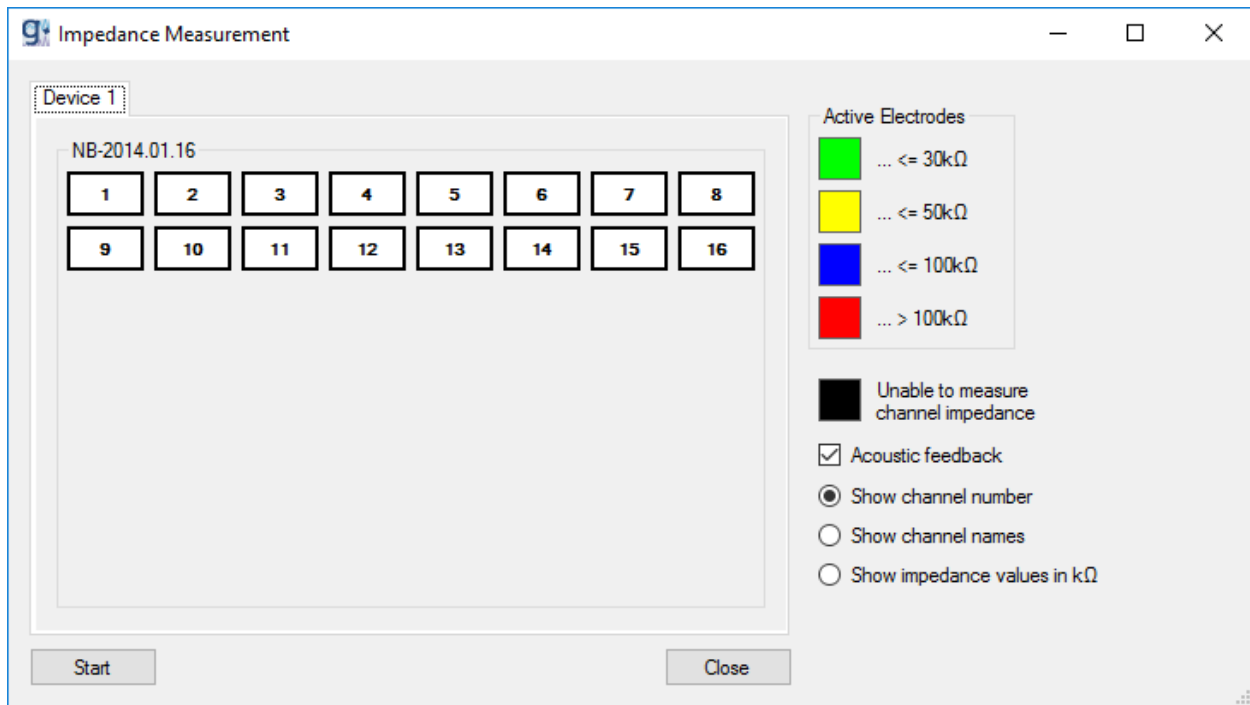
Figure 17: Impedance measurement window for g.Nautilus PRO devices.

g.Nautilus PRO only supports active electrodes.

Electrode *Cz* and the ground electrode are used as the reference for impedance measurement of all other channels. Therefore, no impedance can be measured for those channels. Hence, *Cz* will always show green color code if the reference signal measured at electrode *Cz* is valid. 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 all other channels will be black.

Calibration

To show or modify current device calibration, open the calibration window from *Figure 18* by clicking the *Calibration…* button. 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.
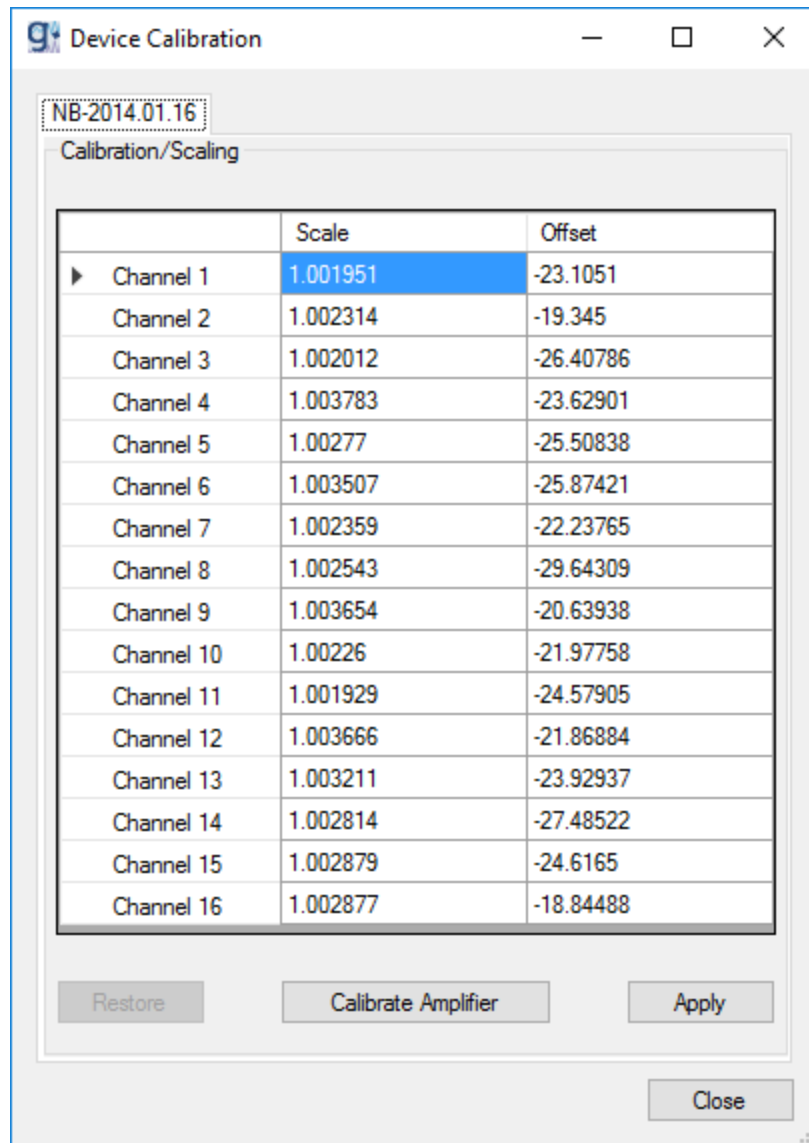
Figure 18: Calibration window of a g.Nautilus PRO device.

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 calibrated due to broken channels or a 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, pressing the *Apply* button will set 1.0 for scaling and 0.0 for offset.

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