XyphroLabs UsbGpib V2 Windows + Visa Guide

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1 Introduction

This document offers instructions for using the UsbGpib adapter with Windows environments, particularly when integrating with Python.

Although the UsbGpib Adapter functions like other USBTMC instruments by presenting a standard UsbTmc interface, these guidelines are primarily aimed at assisting users who are new to instrument control, providing them with an effective starting point for configuration and utilization.

On Windows platforms, there 2 popular methods for interfacing with USBTMC instruments: One utilizes LibUsb in conjunction with PyVisa-Py, while the other employs the conventional approach of using a VISA tool. Given the complexities that can arise during LibUsb installation, it is advisable to proceed with a standard VISA provider.

Leading VISA tools are offered by National Instruments, Key-sight, and Tektronix. However, these solutions often require significant disk space. In contrast, the R&S VISA package is notably compact - requiring less than 100 MB - enabling swift installation without compromising on performance or compatibility. Many alternative Visa tools include superfluous components and may require over 1 GByte of storage space in addition to extended download times.

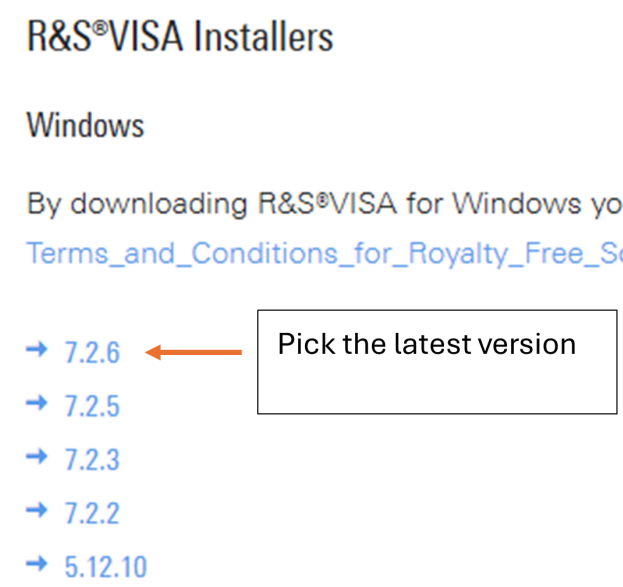
This document details the process for installing R&S VISA and PyVisa, guiding users through to the initial stages of communicating with an instrument using Python.

2 SW setup

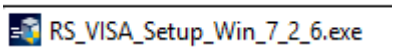
2.1 Installation of R&S Visa

Download R&S Visa from the R&S Page: https://www.rohde-schwarz.com/us/driver-pages/remote-control/3-visa-and-tools_231388.html?change_c=true

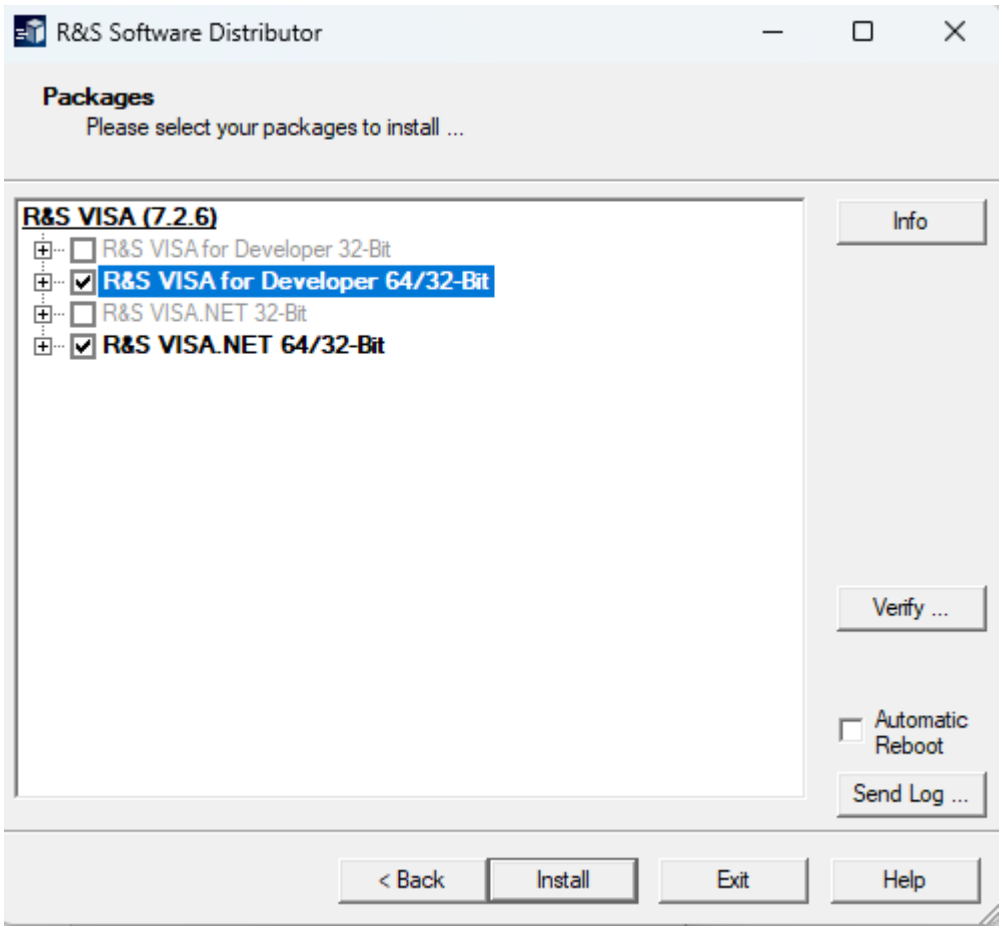
In case that link does not work at time of reading, search the web with ”R&S Visa Windows download”.



DoubleClick the downloaded file to start installation.



Please select the necessary components. For this guide, the primary requirement is the R&S VISA for Developer 64/32-Bit. If you also plan to use VISA with .NET applications in the future, it may be beneficial to include that component as well. However, for Python-specific usage, this selection is not required.

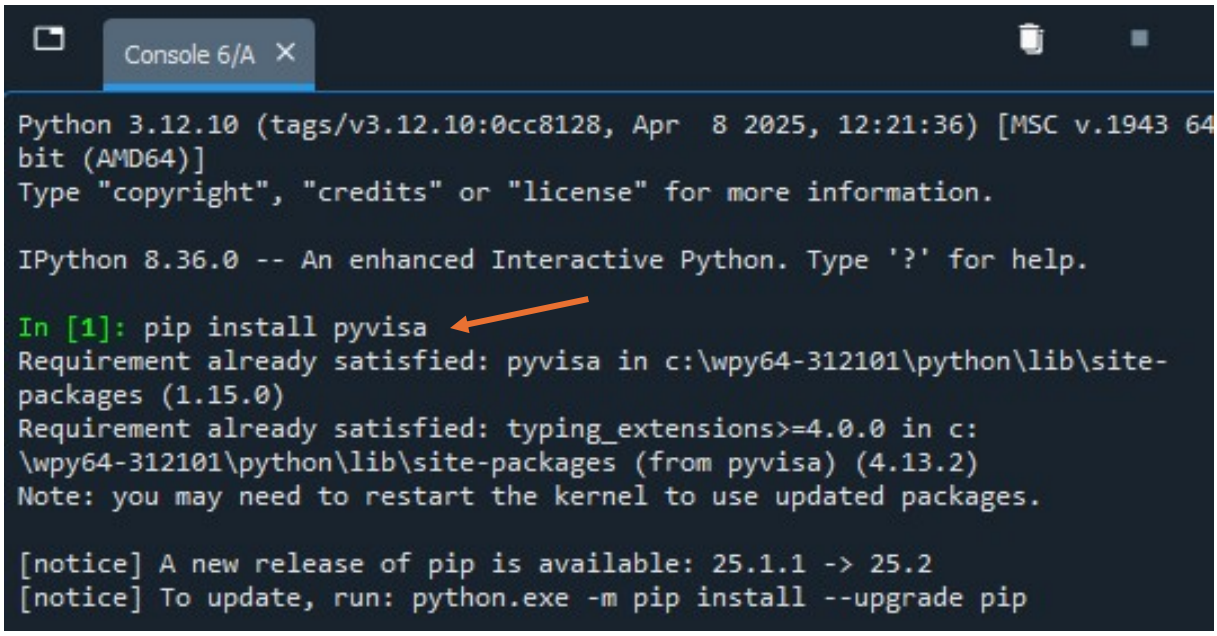


After selecting, click Install.

The R&S Visa installation also installs the USB driver for the UsbGpib adapter.

2.2 Python setup

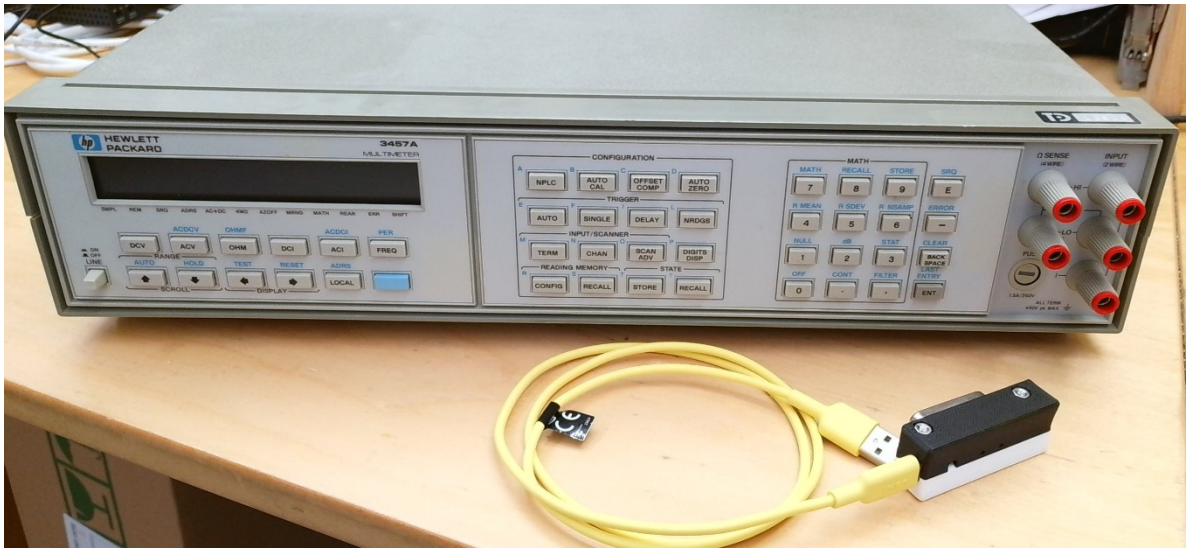
For accessing R&S Visa using Python you need to install pyvisa. Depending on your Python environment that can be done with Anaconda or Pip. When you use pip, you can just type "`pip install pyvisa`" in a command window. In case you have multiple python installations, ensure you do that for the one that you also use later. When using Spyder as python IDE, you can also type that command directly into the python Console:



After the HW setup we will come back to python and some basic first steps in using it.

3 HW Setup

In this example I use a HP3457A Multimeter with GPIB:



Initial one-time steps:

- Connect it to power but keep it powered off.
- Connect the USB GPIB converter to the GPIB port and the USB cable to your PC. Note: The PC won't detect a USB device yet as the instrument is powered off. This is a feature to prevent inaccessible devices are showing up on your PC.

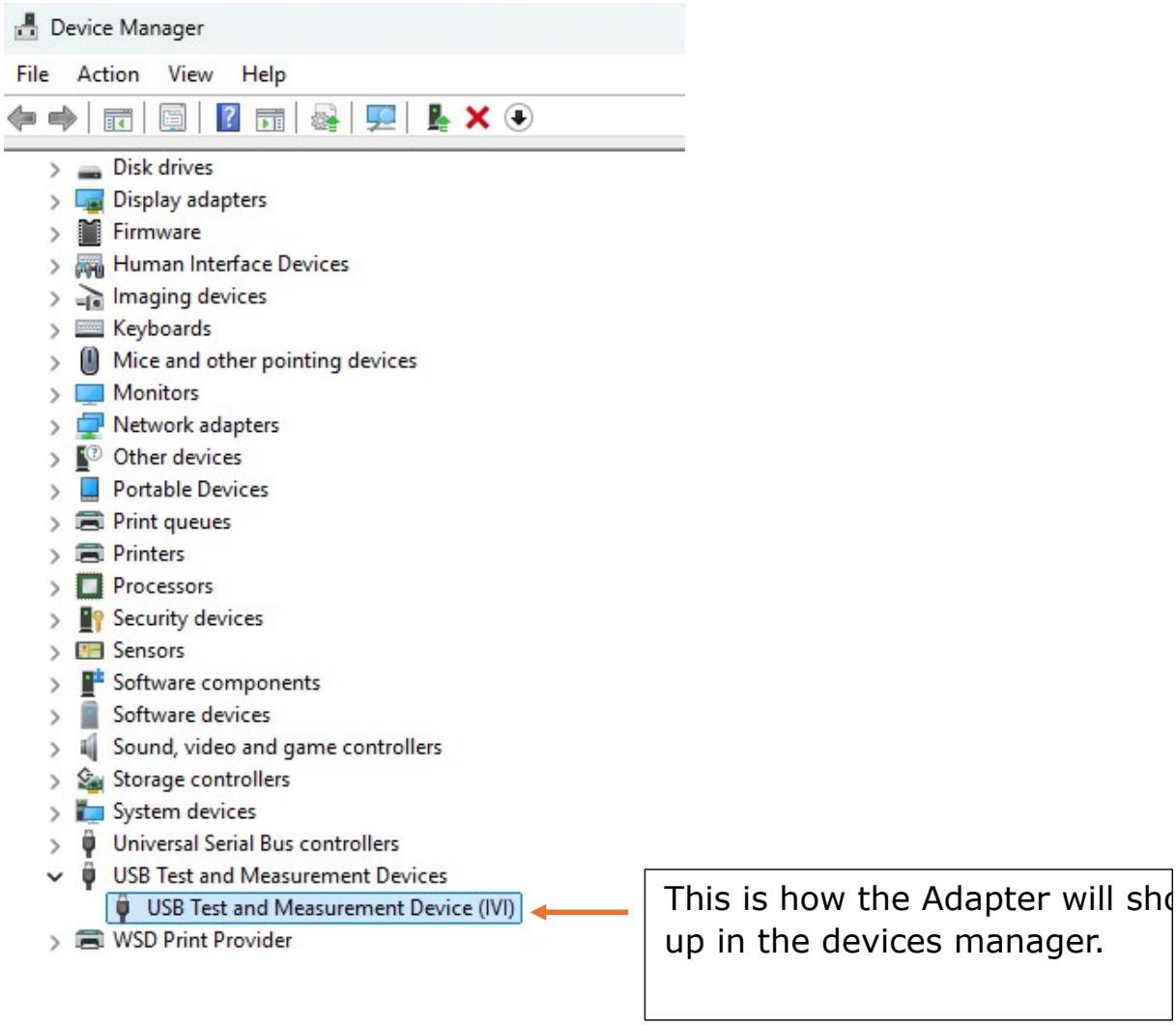
- Power on the GPIB device.
  Note: The PC does now detect a new USB Device.

It is not necessary to follow a specific sequence for connecting or disconnecting devices, powering them up or down, and similar actions. However, the following order is provided to present the instructions in a logical, step-by-step manner. As indicated in the procedure, the adapter will only be detected by a PC when the instrument is powered on and GPIB functionality is enabled. The adapter monitors USB connections to identify whether any devices with GPIB enabled are present. Regardless of the specific GPIB address, it systematically scans all available addresses on its GPIB port. Upon detecting a responsive GPIB address, the adapter enumerates the device on the USB interface, thereby enabling access from the PC.

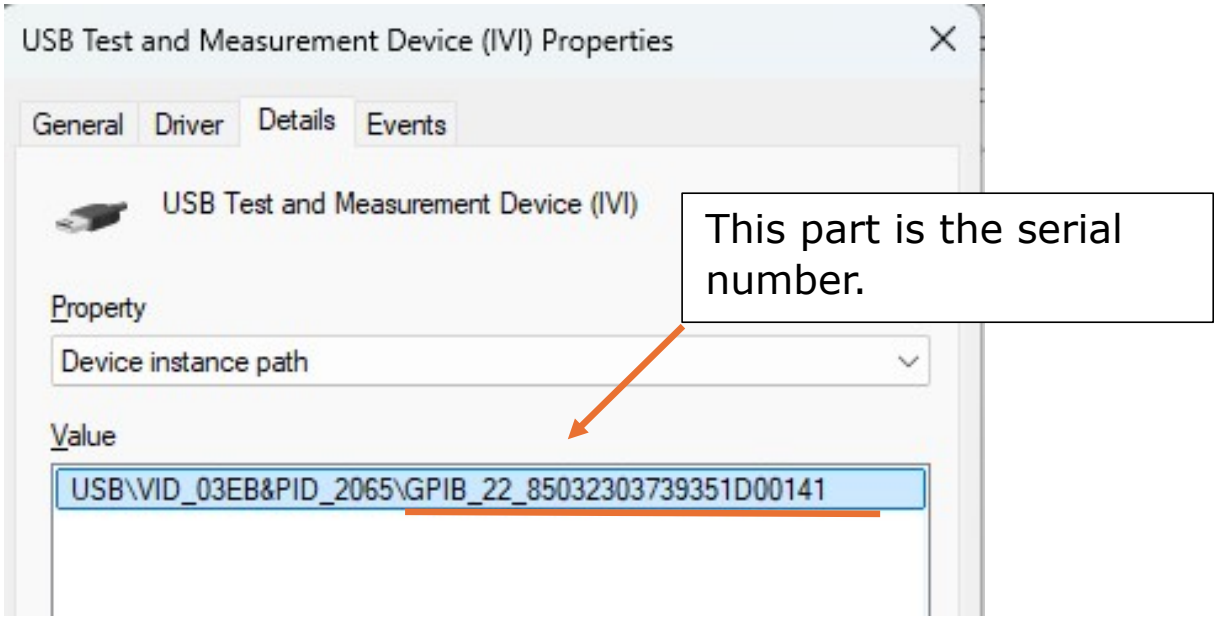
4 First interaction with the instrument

4.1 Confirming that the USB device is detected

You can check in the Device manager to confirm if the instrument was found and the driver (which got installed by the R&S Visa installation) is found.



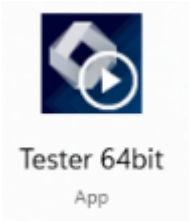
When double-clicking that item and selecting Details you can check if this is the Adapter and also see the serial number:



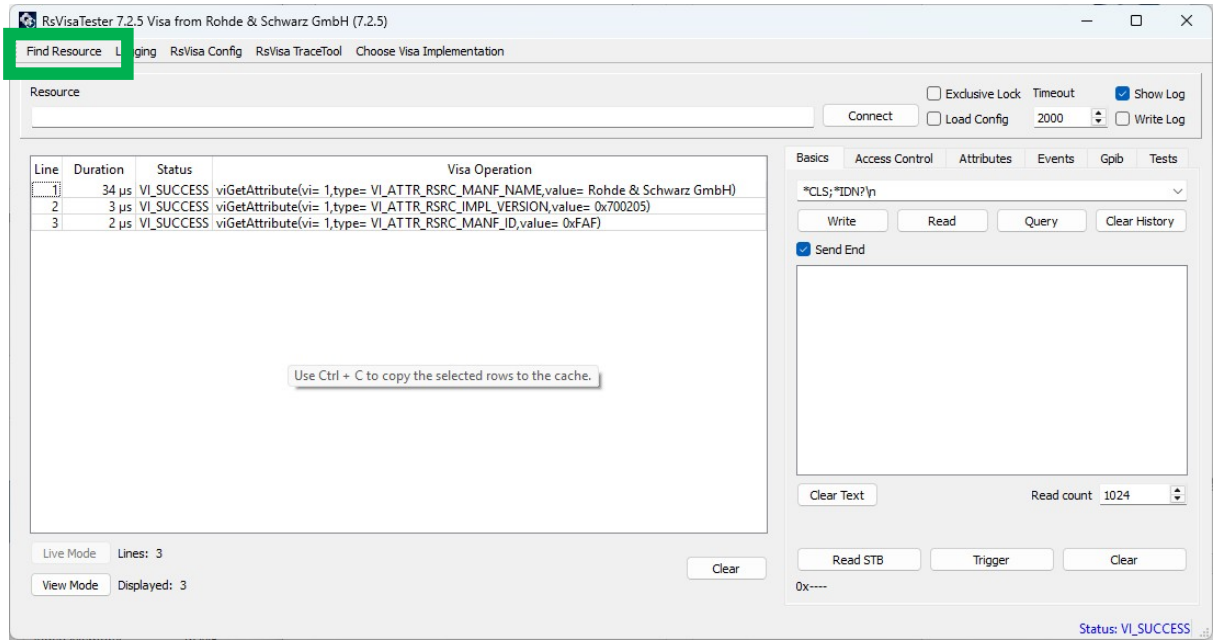
The serial number is different for each device. It is constructed out of the detected GPIB address of the connected GPIB instrument (here GPIB_22) followed by a unique ID which is different for each adapter. That allows to use same GPIB addresses for multiple instruments, without them disturbing each other.

4.2 Testing if the instrument is detected by R&S Visa

Start the RsVisa Tester application:

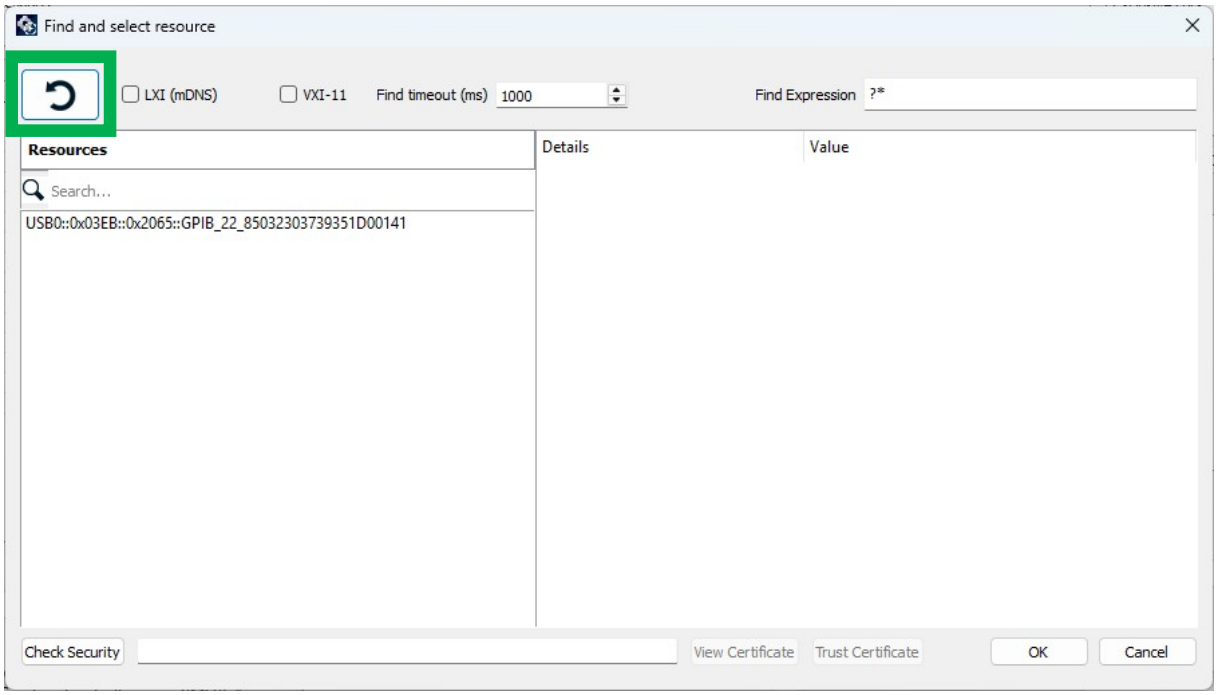


After starting the below GUI window is shown:



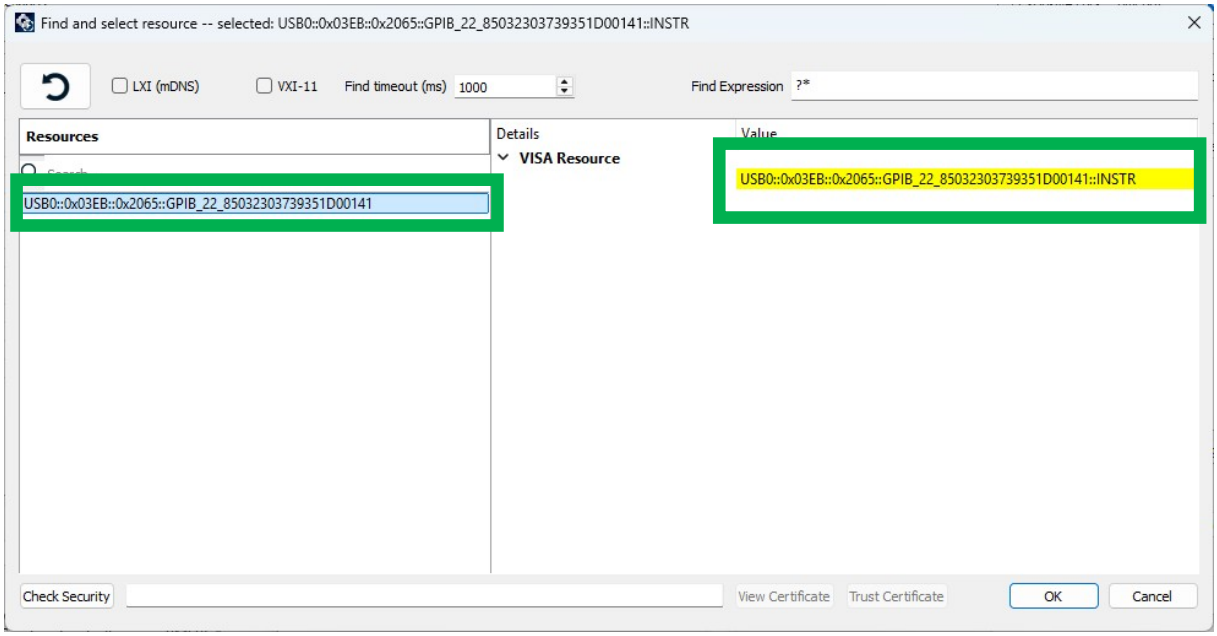
While the interface may appear complex to first-time users, it contains numerous standard features that help in initial instrument communication and debug. To verify detection of the GPIB instrument, select ”Find Resource” in the upper left corner.

A new window opens:



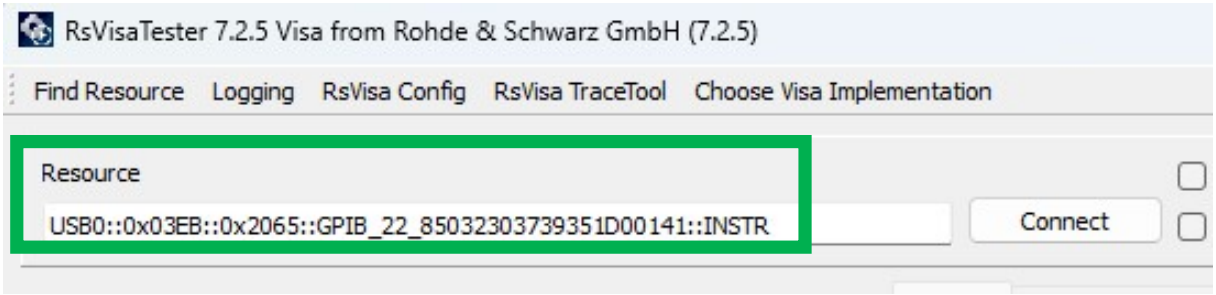
Select the green-highlighted button to initiate an instrument scan.

If the operation is successful, a USB device should be visible as shown. Please note that the previously displayed serial number forms part of the resource string.

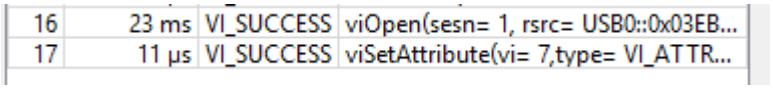


Select the found devices and click OK.

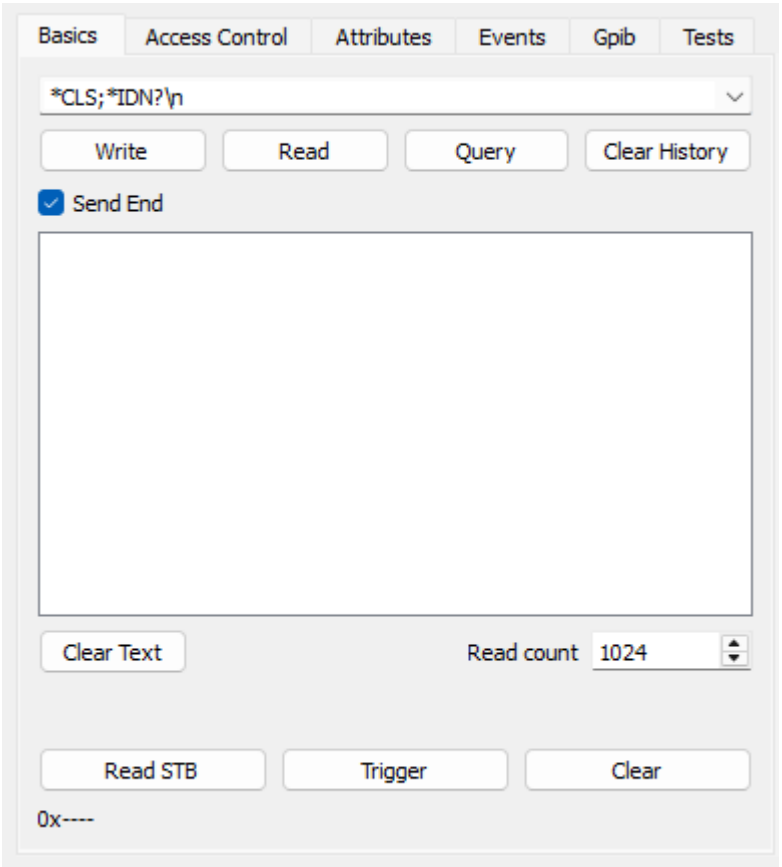
Now you are back to the main window. The resource field should show the previously detected device:



Now you can click on the connect button to connect to the instrument. The log lines should show a successful connection:



The right side of the main GUI window now gives the ability to interact with the instrument:



If your instrument supports the `*IDN?` query, you may enter "`*IDN?`" in the designated field and click Query; the instrument's response will then be displayed. However, many legacy instruments do not support this command and may also lack EOI termination during read operations, which can lead to unsatisfactory timeout errors giving the impression that communication is not possible

For this reason, I have prepared this manual for the older HP3457A, which requires some additional configuration steps. These requirements are not unique to this USB

GPIB Adapter - they apply to any GPIB adapter and are dictated by the instrument itself.

The equipment's GPIB programming manuals offer detailed guidance on configuring the appropriate settings, and additional support is available in the troubleshooting section if necessary. For certain legacy instruments, these settings may be challenging to locate and may require some degree of experimentation.

Point #1: The used HP3457A does default wise not terminate with EOI, but with \n. A query will result in a timeout. To enable \n termination, go to the Attributes tab, select VI_ATTR_TERMCHAR_EN, enter 1 in New AttributeValue field and click on SetAttribute.

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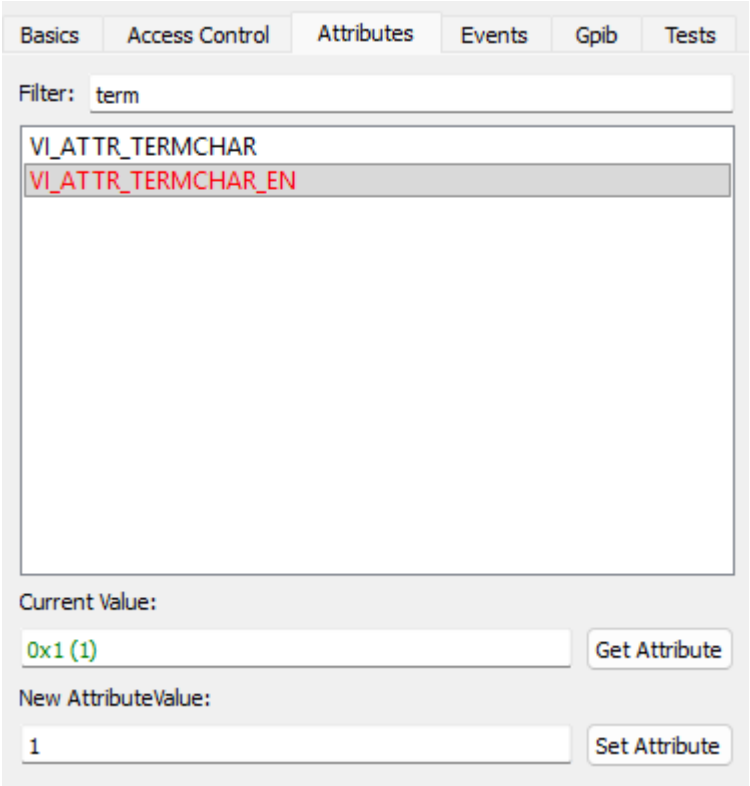
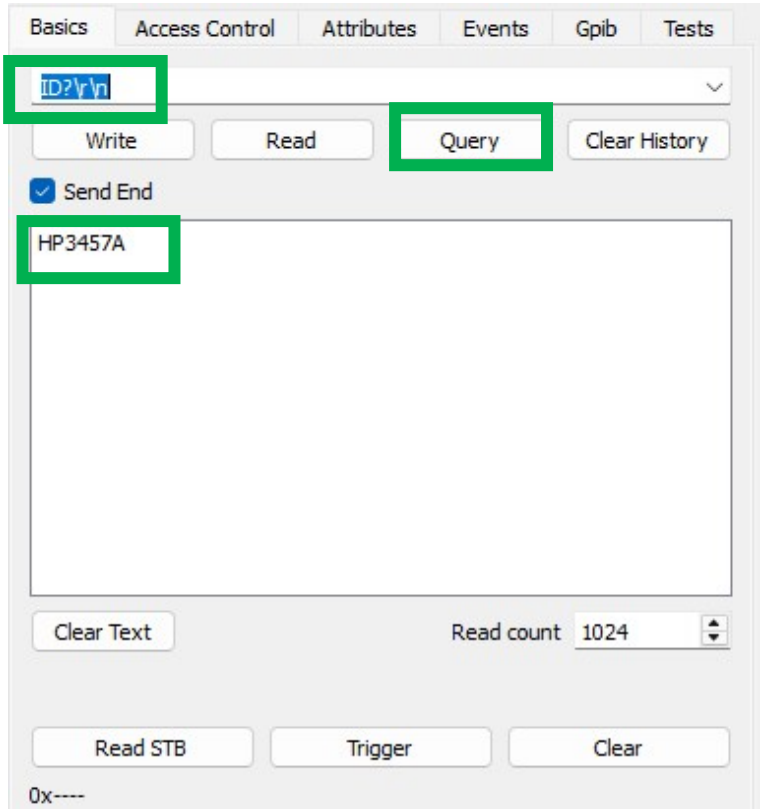


This is a non permanent setting, which is only valid for this currently active session.

The attribute VI_ATTR_TERMCHAR does select the actual termination character which is used to detect a termination of read GPIB messages. Default wise it is 0xa (10), which matches \n and is for most older HP instruments the correct settings.

Point #2: HP3457A does not support the *IDN? SCPI standard query. Older HP Equipment required "ID?\r\n" as query.

After adjusting the termination settings as stated in Point #1 you can try to execute the ID?\r\n query:



The green highlighted section shows the response and the log window shows no time-out, but VI_SUCCESS on the read and write instructions. This confirms that the communication is working.

As mentioned, most equipment does not require an adjustment of the read termination as they generate an EOI on read to terminate.

Note: Above items show the usage using RSVisaTester in an interactive way. If you just want to access your instrument using Python, this is typically not required, but it is a nice tool to debug your instrument. It can also create logs of your visa instructions which you execute using Python & PyVisa which is a powerful too for debugging during development phase.

5 Usage with Python

If all above steps succeeded, we can start using the UsbGpib device with python. The following sections show a step-by-step guide using python interactively. You can of course also create a script.

5.1 Scanning for connected devices

Start python and import PyVisa.

Import PyVisa:

```
In [2]: import pyvisa
```

List available measurement devices:

```
In [3]: rm = pyvisa.ResourceManager()

In [4]: rm.list_resources()
Out[4]: ('USB0::0x03EB::0x2065::GPIB_22_85032303739351D00141::INSTR',)
```

In above output you can see, that one instrument is found. The returned array contains a single string which is the so called ”ressource string” of the device. As mentioned before, that resource-string will be different, depending on your actual GPIB device configuration and serial number of the UsbGpib Adapter.

In case you see multiple devices being returned – the ones containing texttt0x03EB::0x2065 are the one from the UsbGpib Adapter.

Open the instrument (adjust the string to the one which was returned by the previous command):

```
In [6]: inst = rm.open_resource('USB0::0x03EB::0x2065::GPIB_22_85032303739351D00141::INSTR')
```

If successful, no error is shown, and we can interact with the instrument using the ”inst” object.

If your instrument is SCPI compliant, you can now simply execute `instr.query('*IDN')` to read the instrument name or better identification string over GPIB.

As the used HP3457a is not SCPI compliant and requires specific termination settings, we apply those settings now first during the next steps.

To set \n termination for that instrument, execute those 2 lines:

```
In [7]: inst.set_visa_attribute(pyvisa.constants.VI_ATTR_TERMCHAR, ord('\n'))
Out[7]: <StatusCode.success: 0>

In [8]: inst.set_visa_attribute(pyvisa.constants.VI_ATTR_TERMCHAR_EN, True)
Out[8]: <StatusCode.success: 0>
```

Afterwards the read termination will be set to \n and queries or reads will be successful from this instrument:

```
In [11]: inst.query('ID?')
Out[11]: 'HP3457A\r\n'
```

You can now write to the instrument using commands like `inst.write()` for ASCII strings, `inst_write_binary_values` to send raw binary data, among other variants.

To read data use inst.read() for ASCII strings, `inst.read_binary_values()`, etc.

The previously used inst.query command is just a combination of write followed by read. It will write the provided text strings (here 'ID?') to the instrument, followed by a read and returns the information.

To disconnect from the instrument, execute `inst.close()`.

5.2 Some more pyvisa Hints

5.2.1 Stripping of read termination

An instrument which returns read termination, like the one used here will contain in reads always read termination. As visible in previous example, the ID? Query answer is terminated with \r\n.

Pyvisa can "strip away" the \r\n termination automatically, if you specify a read_termination to it:

```
In [12]: inst.read_termination = '\r\n'

In [13]: inst.query('ID?')
Out[13]: 'HP3457A'
```

This read_termination setting is just a string handling within PyVisa, it does not set any read termination of the GPIB adapter itself. So it is no substitution of the previous `TERMCHAR` and `TERMCHAR_EN` attributes which were used before.

5.2.2 Automatic write Termination addition

As you saw in the examples, the query command string included \r\n as termination. PyVisa can add this automatically, if you specify a write termination, making the code a bit easier to read.

```
In [15]: inst.write_termination = '\r\n'

In [16]: inst.query('ID?')
Out[16]: 'HP3457A'
```

Again, `write_termination` is just a string based handling. Before the string gets sent to the device, the set `write_termination` string is added to the message internally.

5.2.3 Timeout handling

Some instruments can take a longer time to return a response. This can e.g. happen for large data transfers. There are sophisticated ways using service requests that an instrument can signal with interrupts its readiness, but sometimes it is easier to just increase the timeout.

The property timeout will return the current timeout in units of milliseconds.

```
In [17]: inst.timeout
Out[17]: 2000
```

2000 means 2000ms which is 2s. This is the default timeout value.

You can change it by assigning another number to it. To increase the timeout to 5s, execute:

```
In [18]: inst.timeout = 5000
```

Don't forget: Timeouts can indicate actual errors like an unsupported command; It can also indicate wrong write or read termination but also be just simply the instrument taking a longer time to process a command.