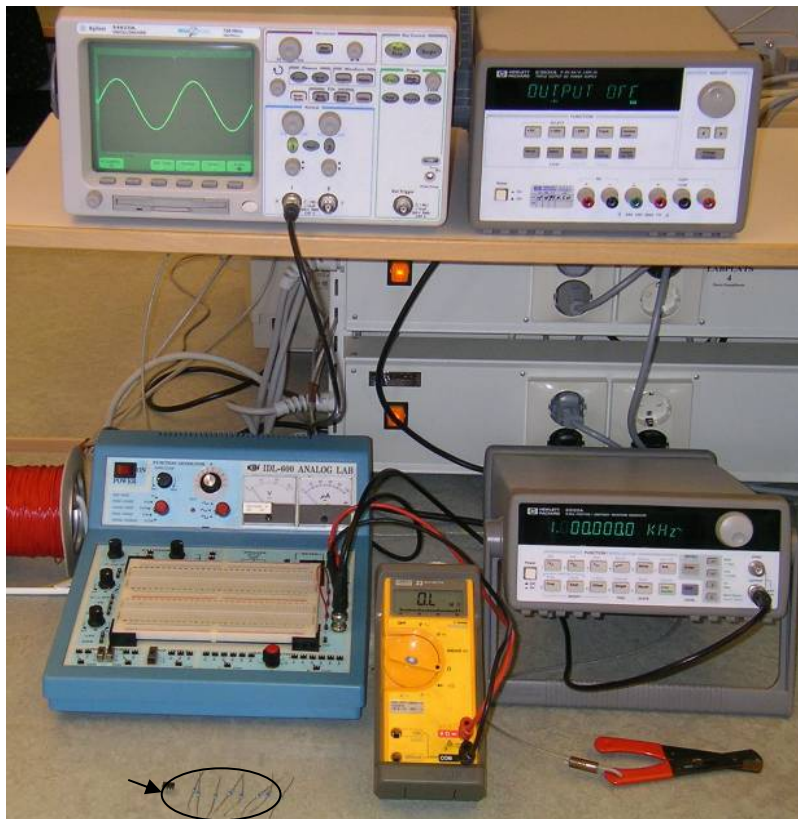


## STUDENT'S GUIDE TO THE VISIR ONLINE LABORATORY FOR ELECTRICAL EXPERIMENTS

An online workbench can supplement workbenches of traditional hands-on laboratories for electrical experiments enabling students to perform physical electrical experiments 24/7 within limits set by the teacher using a web browser only. In this manual it is presumed that you have some experience of working in a hands-on laboratory. Fig. 1 shows a workbench in a laboratory for electrical experiments at Blekinge Institute of Technology in Sweden (BTH). The small components (an operational amplifier and 8 resistors) in the lower left corner of Fig. 1 at the arrow are the set of component provided by the instructor to be used in a certain laboratory session. The goal for the research at BTH is an online replica of such a workbench.



**Figure 1. A workbench for electrical experiments in a laboratory at BTH.**

### **The online workbench is a supplement providing free access**

Most instruments in an electronics laboratory have a remote control option but the breadboard has not. Remote wiring of circuits requires a wiring manipulator possible to control remotely. A switching matrix equipped with controllable switches i.e. electro-mechanical relays can serve as such a device.

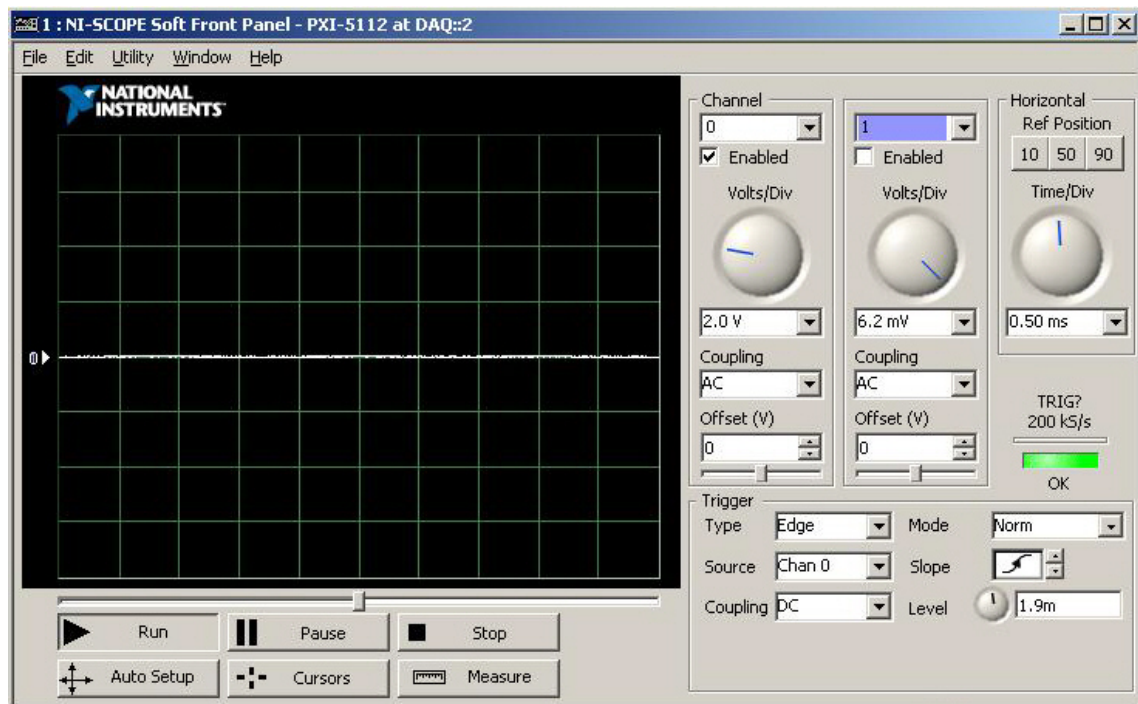
Fig. 2 shows an online workbench at BTH and copies of this workbench are online at three other universities abroad. The desktop instruments are replaced by PXI instruments. PXI (PCI eXtensions for Instrumentation) is an international standard for instrumentation. PXI instruments are PC controlled plug-in boards with a tiny front panel fitted with connectors only. Usually the control knobs and buttons of these instruments are displayed on the monitor of the controller of the PXI system. An example of such a virtual front panel is shown in Fig. 3. The chassis and the instruments in Fig. 2 are manufactured by National Instruments.

It is possible to combine a virtual front panel representing a particular instrument from one manufacturer with the corresponding hardware from another, as long as the performance of the hardware matches that of the displayed instrument. The workbench has a virtual instrument shelf. The idea is that you should be able to select the instrument model you want to use. The soft panels belonging to the PXI instruments and to the instruments of the workbenches of the BTH laboratories are available on the shelf. As an example, the virtual panel of the oscilloscope of the BTH workbench is shown in Fig. 4.



**Figure 2. The online workbench at BTH**

The switching matrix for remote wiring of electrical circuits is shown at the upper left side of Fig. 2. It is the card stack on the top of the PXI chassis. The relays are arranged in a three dimensional pattern together with instrument connectors and component sockets. Sets of components for a number of laboratory sessions are installed in component sockets at the edge of some of the boards of the switching matrix. The PC to the right in the figure controls the workbench.



**Figure 3. Virtual front panel for an oscilloscope.**

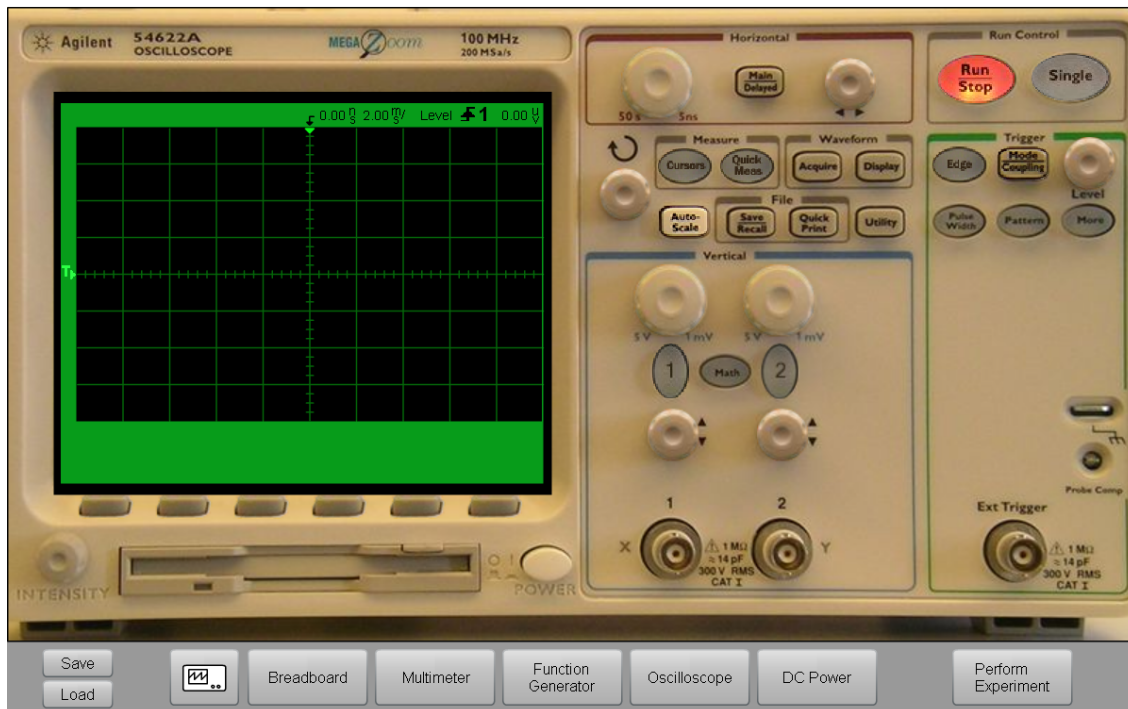
## **The students wire desired circuits using a virtual breadboard**

A virtual breadboard shown in Fig. 5 is used as a “virtual front panel” for the matrix. It is a photograph of an ordinary physical solderless breadboard. Thus, you control the matrix hardware by wiring on the virtual breadboard using the mouse. A software module called Virtual Instructor checks that the circuit you wire is safe i.e. that neither a component nor an instrument can be damaged. The laboratory staff creates the rules for the Virtual Instructor when configuring the matrix. Thus, it is up to the laboratory staff to make sure that no hazardous circuit can be created physically.

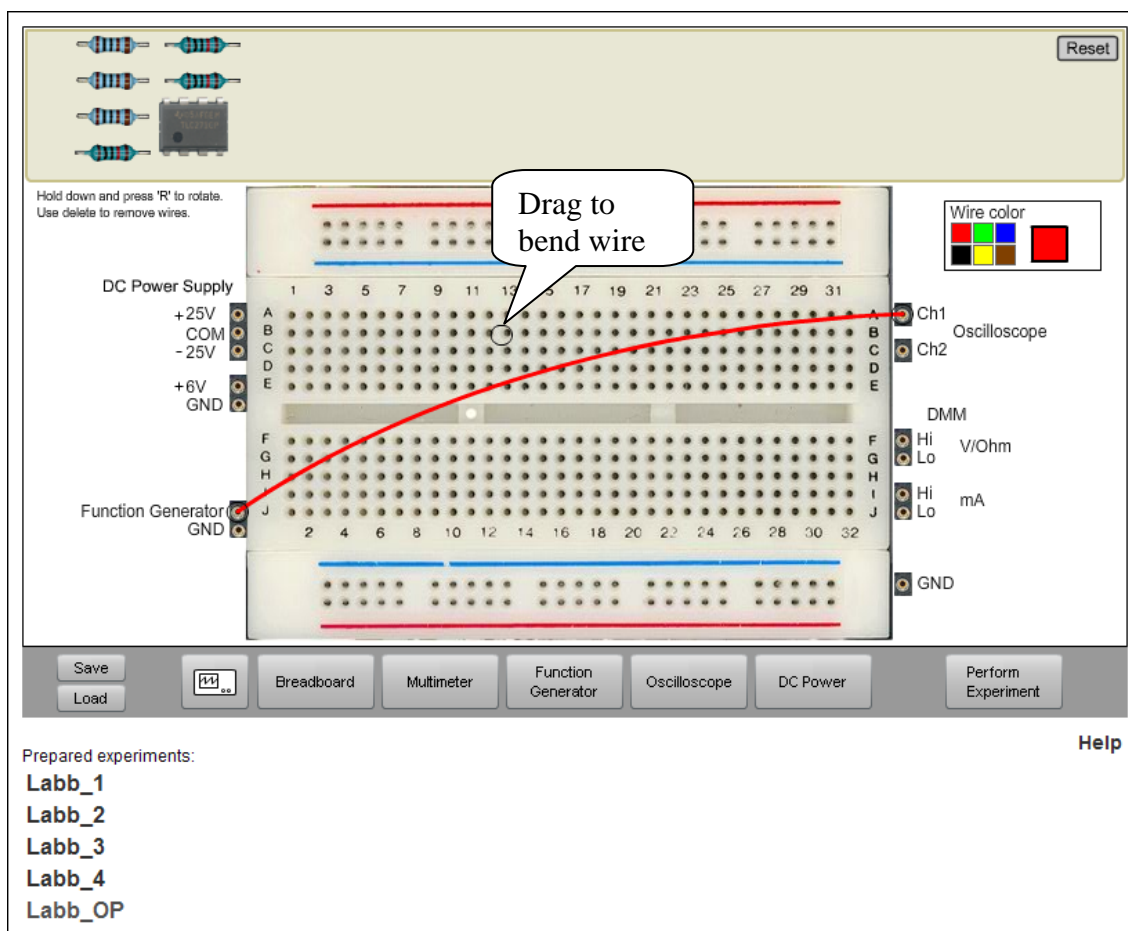
Refer to Appendix A for a description of how the instruments are connected to the wire holes adjacent to the breadboard. The terminals denoted GND are connected to protective earth via the function generator, the non-floating power supply, and the oscilloscope.

The physical breadboard is detachable. You can remove it with a wired circuit on and store it for later use. To be compatible a circuit wired on the virtual breadboard can be saved in a file.





**Figure 4. Virtual front panel of the oscilloscope of the BTH workbench**



**Figure 5. Breadboard view**

## Many remote students can perform physical experiments simultaneously

By selecting different values of the components controlling the time constants, it is possible to study a certain phenomenon at different time scales. This feature is used in the online workbench to allow simultaneous access by time-sharing. In this way, the workbench can emulate a whole laboratory with many workbenches. However, you can use all the time you need to wire your circuit and set up your instruments because you then use your local PC. Your circuit and your instrument set-up are sent to the server only when you press the *Perform Experiment* button. Then the client software sends a message containing a description of the desired circuit and the instrument settings to the workbench (server). If the workbench is not occupied, the experiment procedure is performed, and the result or an error message is returned to the requesting client computer. Otherwise, the request is queued and is executed in proper order. The current time slice period is 0.1 second. The teachers who design the experiments to be performed in a laboratory session are instructed to select the values of the components so that an experiment last less than this period.

Time-sharing means that you can only get a single acquisition from the oscilloscope when you press the *Perform Experiments* button. In Fig 5, for example, The *Run/Stop* button will be red. However, if the administrator allows run mode, the *Run/Stop* button will be green when you press it. Then run mode of the oscilloscope will be emulated and you will get repetitive acquisitions without pressing the *Perform Experiments* button repetitively. Just press the *Run/Stop* button again to stop run mode. Please use run mode for short periods only. The reason why the administrator may not allow run mode is that the response time will be longer for other users who are online.

Two types of errors, which are special for the online version of the laboratory, are reported:

1. The Virtual Instructor finds the desired circuit hazardous.
2. The desired circuit may be safe but the Virtual Instructor has not been instructed to allow it.


## A log on procedure is required



If you are enrolled in a course containing laboratory sessions that use the online workbench, you should find a link to the workbench at your course page. If not (or you are a guest) the URL of the online workbench is <http://openlabs.bth.se/electronics/>. For guests there is a demo page and an open guest course. As a student, you must log in to start experimenting. The first time you visit, you must activate your account using your email address. The login screen is shown in Fig. 6.

# OpenLabs Electronics Laboratory

MAIN MENU

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[→ Demo](#)
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[Login](#)



Login

E-Mail

Password

Login

If this is your first visit, you will have to [activate](#) your account.

If you have any questions about this page or the laboratory, contact the [administrator](#).


**Figure 6. Log in screen**



In Fig. 7 you are logged in as a student. You can only see the courses in which you are enrolled.

# OpenLabs Electronics Laboratory

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Courses

Name	Start	End
<a href="#">Circuit Analysis (ET1107)</a>	2009-08-18	2009-12-31

STUDENT

[→ Circuit Analysis \(ET1107\)](#)

If you have any questions about this page or the laboratory, contact the [administrator](#).

**Figure 7. Student's course list**

Select the course you want. Now you will see the student's course page, Fig.8. "My reservations" lists future time reservations you have made. When such a reservation is in progress it will show up under "My ongoing reservations".

When a teacher has scheduled the supervised laboratory sessions of a course, you may reserve a seat. A link "Reserve a seat" will show up for each laboratory session scheduled.

When you click "Start Experimenting" in Fig. 8 the virtual instrument shelf will be displayed. Select the instruments you want to use. When you press the "Done" button, the virtual breadboard will be displayed. The names of the laboratory sessions of the course you have selected and the names of prepared experiments if any are listed under the heading "Prepared experiments" as is shown in Fig.5. Each session is associated with a set of components and a laboratory instruction manual. However, the instruction manual is included in the course material and is not a part of the documentation of the laborato-

C:\Documents and Settings\All Users\Documents\VISIR lab 41\Beskrivningar\Student manual\Student manual5.doc 2009-10-02  
08:42 Ingvar Gustavsson

ry. The manual can be found on the course web site. It describes the experiments to be performed during the laboratory session. Select the list item you want. Then the corresponding component set or prepared experiment will be displayed. Use “Help” in the lower right corner of the breadboard view if you are not familiar with how the wiring holes of the breadboard are connected. Use the mouse to move components and wire your desired circuit. If you point to a component with the mouse the value will be displayed to the right of the breadboard. For example, the resistors are small (0.6 W) and it may be hard to read the color code. If needed, you can bend the wires. The instrument manuals should be available on the course web site or may be downloaded from the manufacturer’s web site.

You can save a circuit and the instrument connections by pressing the “Save” button but the instrument settings are not saved. When saving press the “Save” button in the “File Download” dialog and close the “Navigation cancelled” page.

OpenLabs Electronics Laboratory

**MAIN MENU**

- Start
- About
- Demo
- FAQ

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**STUDENT**

- Circuit Analysis (ET1107)

[Logout](#)

Circuit Analysis (ET1107)

Start Experimenting

Starting an experiment without a reservation gives you one hour of experimentation time. Experimenting without a reservation has lower priority and you will be kicked out if a reservation needs your seat.

My ongoing reservations

No ongoing reservations

My reservations

No reservations

Make new reservation

Teacher scheduled reservations

No teacher scheduled reservations

If you have any questions about this page or the laboratory, contact the [administrator](#).

**Figure 8. Student’s course page**

## Restrictions and known errors

1. The ordinary transfer between the client and the server uses IP port 2324. If this port is closed and you cannot access the server you can perform experiments over HTTP by clicking “over HTTP” if this option is available.

2. If you try to measure the resistance of a component with a very high resistance such as a capacitor or without anything connected to the input of the DMM the instrument reading should be OL (overload) but it will be zero. This error will be corrected.
3. Only the Agilent oscilloscope supports run mode.

## **Feedback are welcome**

This manual describes version 4.1 of the online workbench. Please send feedback to the administrator, Johan Zackrisson, [johan.zackrisson@bth.se](mailto:johan.zackrisson@bth.se).

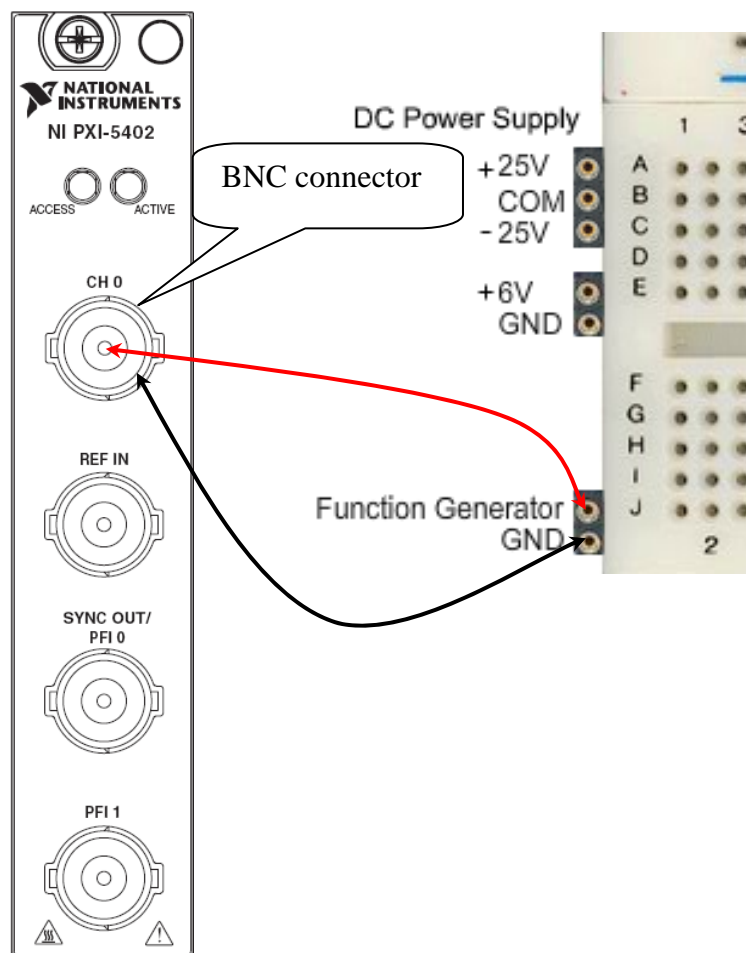


## Appendix A. Instrument connections

Most of the wire holes at the right side of the breadboard in Fig. 1 are connected to BNC connectors or banana plugs in the box. These connectors are used to connect the instruments. The virtual breadboard and the adjacent holes for wires in Fig. 5 mimic the breadboard and its supporting box in Fig.1. However the BNC connectors and banana plugs shown in Fig 1 are concealed in Fig 5 but the connections are shown in this Appendix.

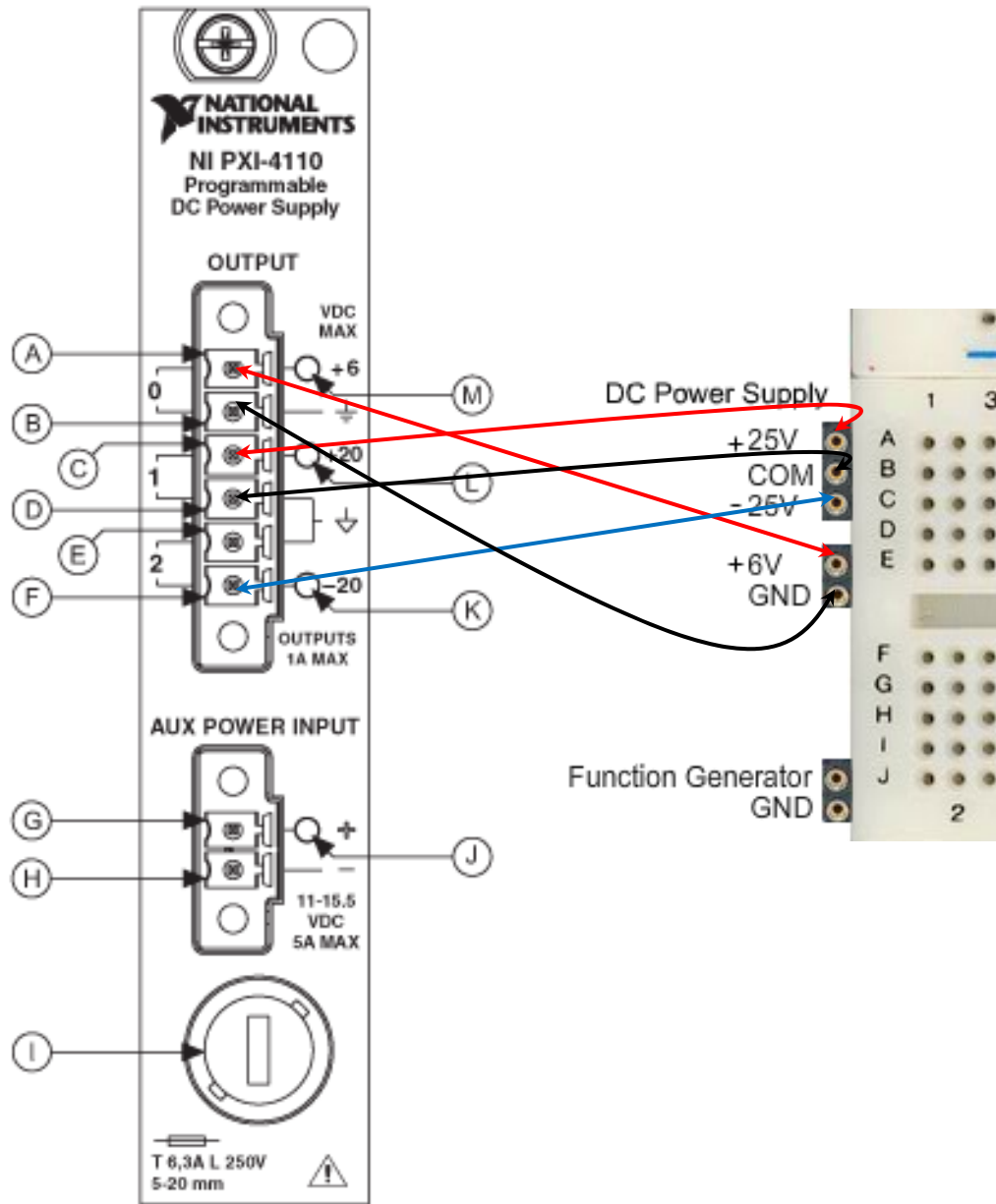
The instruments in the PXI chassis are connected to the matrix using either coaxial cables or cords. The center conductor of the coaxial cables is connected to the center pin of the BNC connectors and the cable shield is connected to the shield of the BNC connectors. All shields are connected to protective earth via the PXI chassis. The connecting lines between the physical front panels and the wire holes adjacent to the virtual breadboard in the Figures below are no wires they only indicate what hardware connections are available in the wire holes adjacent to the virtual breadboard.

### Function generator



## DC Power Supply

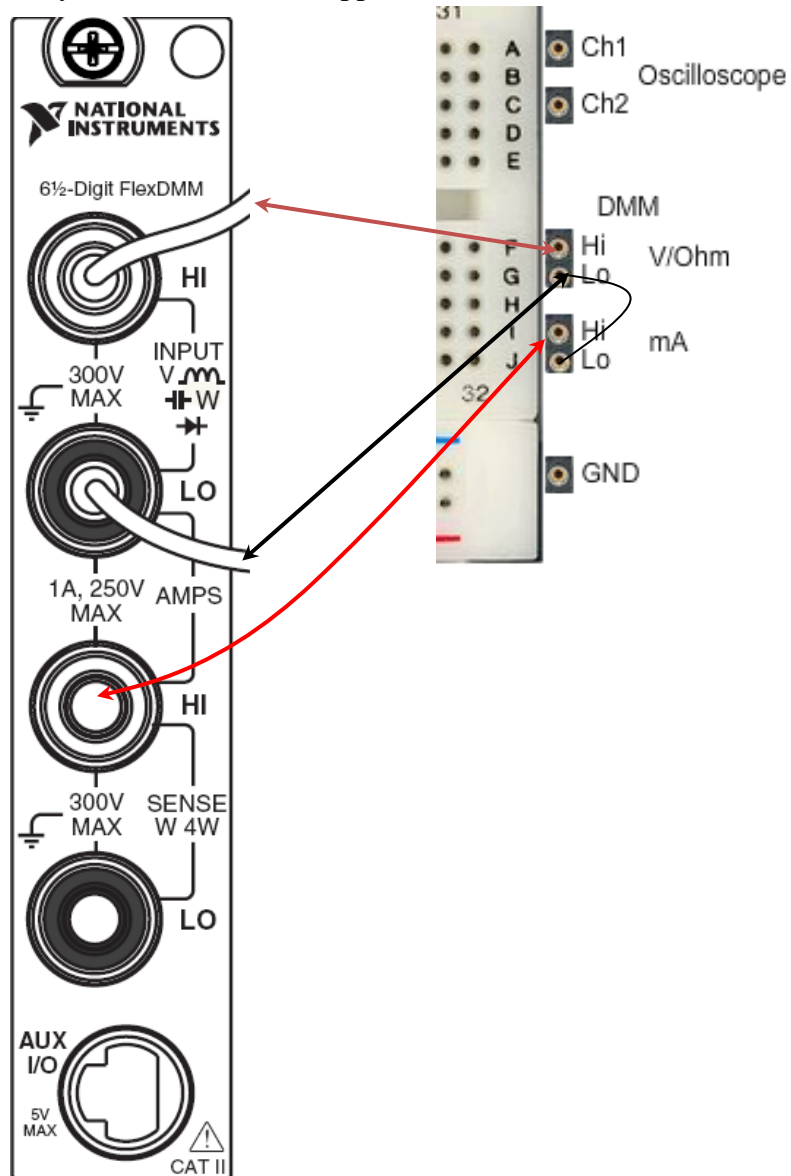
The notations +25V, -25V, and +6V are emanating from the previous power supply which had these ranges. The current floating<sup>1</sup> dual power supply range is  $\pm 20$  V. The +6 V supply is referenced to Protective Earth in the PXI chassis.



<sup>1</sup> Floating means not referenced to any ground.

## DMM

Only two wire mode is supported.



## Oscilloscope

Both BNC shields are connected to Protective Earth. Probes are not used.

