LabVIEW Power Grid Application Usage

The LabVIEW Power Grid application allows you to operate each Power Grid model independently as well as components connected in a power grid.

The LabVIEW VIs for operating the Power Grid. The following are the VIs (files) needed to operate the power grid:

- Main Power Grid.vi
- balance grid.vi
- Get All Values.vi
- Command and Return Value.vi
- Confirm USB Devices and IO.vi
- VISA Configure Serial Port
- VISA Configure Serial Port (Serial Instr).vi
- VISA Configure Serial Port (Instr).vi
- Clear Errors.vi

The first five VIs are found on the built-in USB drive in the Power Grid case. When the Power Grid case is plugged into your computer, you will find these VIs on the USB drive in the folder named **LabVIEW Power Grid VIs.** You may copy these VIs to your computer or run them from the USB drive in the Power Grid case. It is recommended to copy them to the laptop with the LabVIEW installation on it.

The **VISA VIs** and the **Clear_Errors.vi** will show up with the installation of the NI VISA driver.

Note: when you plug the Power Grid case into the Windows laptop, you will be prompted on which action to take with the USB drive. It is recommended you chose "Take no action" to suppress future repeated prompts on which action to take with the drive.

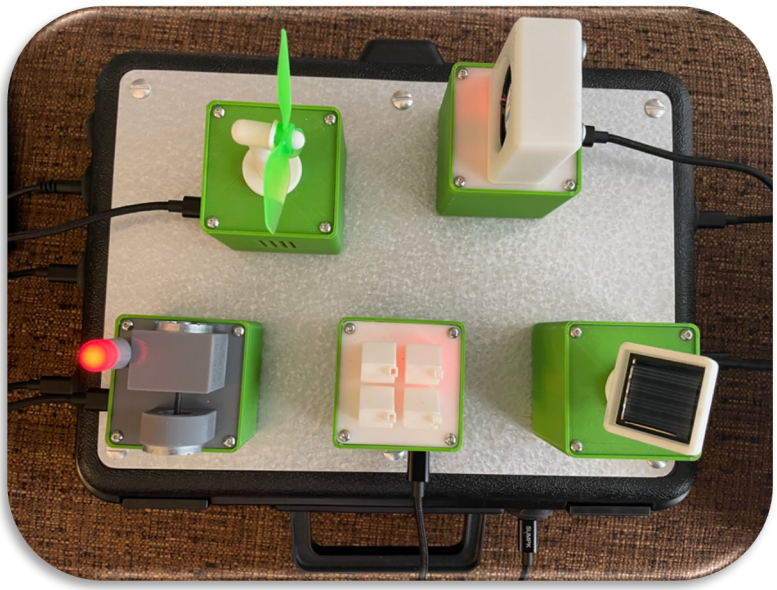
Setting up the Power Grid Hardware

First, open the Power Grid case and remove:

- **All models**. Handle the models with care. They are instrumented systems. Take special care with the Wind Turbine Model and the Solar Panel Model as these are both instrumented and actuated.
- **USB C cables**. There are 5 of these cables bundled together.
- **Cable labeled "PC"**. This is for connecting to the Windows laptop serial port.
- **AC power adapter** (used if plugging the Power Grid case into an AC outlet)
- **Cable labeled "BAT"**. (used if plugging the power grid case into a 5VDC battery)

Next:

- Close and latch the Power Grid case lid.
- **Connect the short USB C cables to each model.** It's easier to plug the cable into the model while holding the model.
- Once each cable is connected, **place the models on the Power Grid case top** in the following configuration:



- **Plug each model into the closest USB C port** on the edge of the case.

- **If using the AC adapter to power the Power Grid**, plug the adapter into a 120V AC outlet, and then plug the barrel jack connector into the power port on the side of the Power Grid case.
- **If using a battery to power the Power Grid**, plug the **cable labeled "BAT" into the battery's USB connector** and the barrel jack into the Power Grid case.

Lastly:

- **Connect the USB B cable to the Power Grid 's USB B jack**, and the end of the cable labeled **PC** to the laptop's USB A port.
- Use Windows Device Manager to verify the presence of each model. Often Windows misses several models. If so, right-click on the USB device in the Devices list, choose **disable device**, then right-click that device again and choose **enable device**. Do this for each device missed.

Running the Main Power Grid LabVIEW program.

Select the app named Main Power Grid.vi and click the small arrow in the upper left corner. This will launch the app which will launch a sup-app that will check the USB connections for each model. **You should see 5 devices listed in the "Detected USB Device Address" column**. The VI will automatically attempt to communicate with each device and indicate that the IO communication was successful and what the name of the device is. If any of the models were not registered, they will be missing from this list or the IO communication will fail.

For any missing USB devices or failed communcations, use the Windows Device manager to Disable and Enable each device – or - unplug the missing model's USB C cable from the Power Grid case, and plug it back in.

Do this for each unregistered or missing device. The VI should then recognize the devices and list them for a total of 5 devices. Once all 5 devices are present, click the "Continue" button. This will take you to the Main Power Grid app.

The Main Power Grid App looks as follows:

The app will show the 5 devices we verified in the previous app window and their USB addresses will show up in the USB Device address column in the upper left corner.

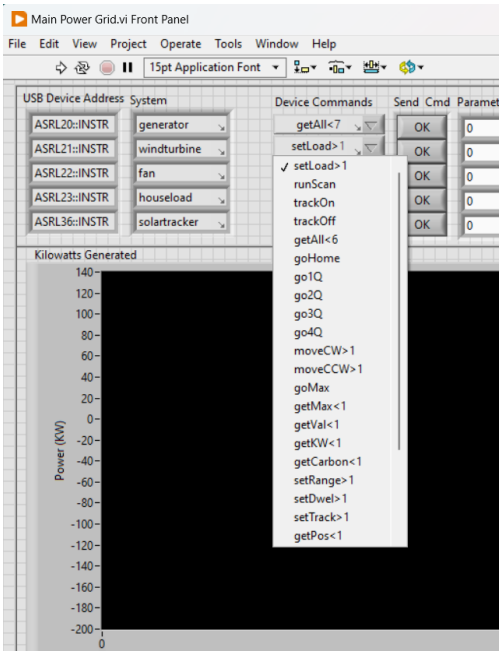
Next, the program will query each device for its name by sending the command **"*ID?"** to each model. Each model will respond with its identification name as follows (not necessarily in this order):

- Power Plant ID: "generator"
- Wind Turbine ID: "windturbine"
- Fan ID: "fan"
- House Loads ID: "houseload"
- Solar Panel ID: "solartracker"

After the model IDs have been received and displayed, the program will query each model for its command list by sending the **"getCommands?"** string. Each model will upload its command set to the application program which will populate the "Device Commands" column.

Sending Commands to ProtoGrid Models

The “Device Commands” column contains rows of commands. Each element in the row is a pull-down menu with commands that each model will respond to. These commands were uploaded directly from the model upon startup. By clicking on the element of a row, you will see all the commands displayed.

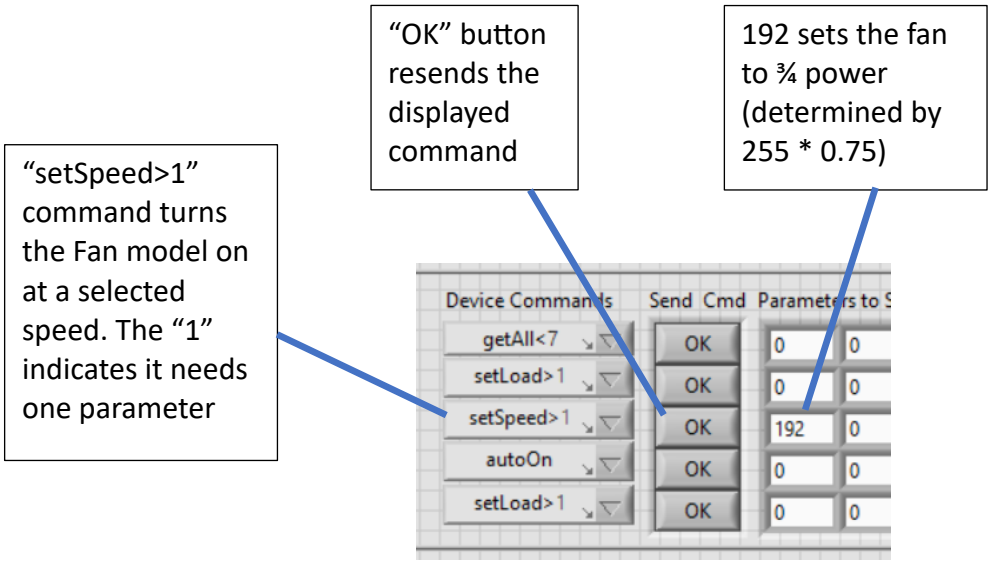


Selecting any of the commands in the menu will send that command to the corresponding Power Grid model. For example, if you select “goF” for the wind turbine, the wind turbine will move to its front facing position. Selecting any command will automatically send that command to its model **unless that command is already the one selected**. For example, selecting goF will not be sent again if it was just selected and is currently the command being shown. To force the same command to be sent, click the “OK” button just to the right.

Clicking the “OK” button will resend the existing displayed command

Sending Commands to Models with Parameters

Some commands to models require parameters. For instance, you may wish the fan to run at a certain speed. To do this, you enter the parameter in the element of the “Parameters to



If a command needs more than on parameter, it will be indicated by the number to the right of the “>” symbol. For instance, if a 2 were specified, it would need 2 parameters and would be sourced from the cells in the table at the right of the “OK” button.

A good test to send a simple command to a model is to turn on the fan and see if the Wind Turbine responds. To do this:-

- Click the command box in the Wind Turbine row and select **fanOn**. This will turn the fan on full. If this command was already selected, then just click **OK** just to the right of the command.

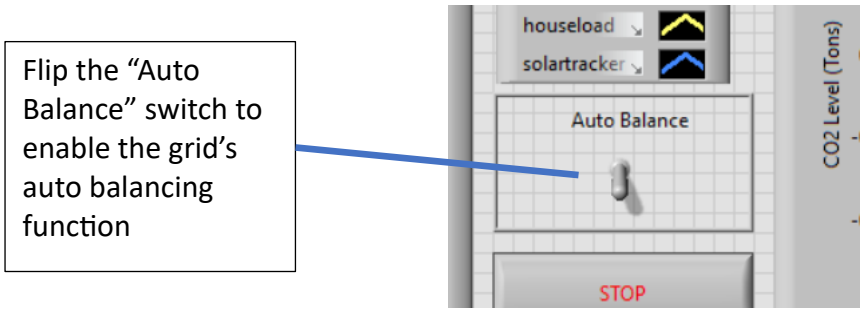
- You may need to move the wind turbine model around on the platform to get it to align with the wind. *For Wind Turbines that have been in storage for a while, you may need to gently help the blades turn to reduce any friction that may have built up during storage.*
- Next you can tell the Wind Turbine to run a scan and look for the maximum wind speed. Do this by clicking the command in the Wind Turbine row and choose **runScan**. This will command the Wind Turbine to seek out and return to the position of maximum wind speed.

Sending Commands that return Values

Some commands return values. The command indicates this with a "<" symbol next to the command. The values will be displayed in the "Values Read" table on the right up corner of the front panel.

Balancing the Grid

The Power Grid can be balance by turning on the Auto Balance Function. This function is enabled by flipping the toggle switch on the front panel.



Monitoring the Grid Values

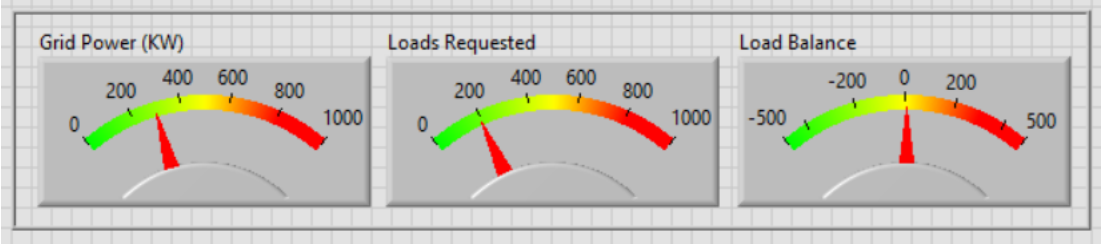
The values of the grid can be monitored in the main table. Here, seven main grid levels are displayed for each model in the grid. Any values that are not contained

in the main table will be displayed in the “Values Read” table to the right of the main monitoring table.

Kilowatts Generated Strip Chart. This strip chart indicates the kilowatts generated from each of the power sources and loads on the grid. These will display over time. The House Load kilowatt value will display as negative values, the Fan model will display as Zero, and the Power Plant, Solar Panel and Wind Turbine will display as positive values.

CO2 Accumulation Strip Chart. This strip chart displays the accumulated CO2 being generated by the Power Plant. These values accumulate over time and can maintain but do not decrease.

The Power Meters. The three grid meters display the Grid Power, Loads Requested and the Load Balance.



The Power Grid Meters

The **Grid Power meter** shows the total sum of how much power the grid is generating in kilowatts. This is the combination of the Wind Turbine, Solar Panel and the Power Plant.

The **Loads Requested meter** shows the total kilowatt load being requested by the House Load model. This model can request up to 800 kilowatts. The value this meter shows is subtracted or uses the power shown in the Grid Power meter.

The **Load Balance meter** shows the difference between how much power the grid is supplying and how much power the house loads are requesting. If the house loads are requesting more power than the grid can supply, then this meter will show negative values.