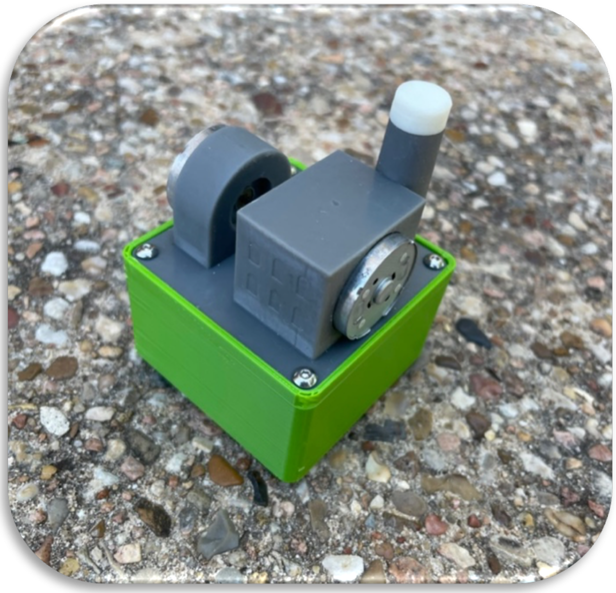
The Power Plant Model

Overview

The Power Plant model (PPm) allows you to explore the operate of a small Power Plant. Features of the PPm are:

- 1 3VDC motor for power (simulated steam turbine)
- 1 3VDC motor for generator
- Proportion control of turbine-motor and generator load (0-255)
- PID control algorithm with user assignable Kp, Ki, and Kd values
- 1 RGB LED for power level indication
- Adruino ATMega 328 based processor with USB serial-power connector
- Pre-installed Arduino sketch with API commands for monitoring and control



Power Plant Model (PPm)

Connecting the Power Plant model

The Power Plant model (PPm) can be connected directly to your computer's USB connector through a standard USB C connector. Simply plug in a USB cable to your computer and then the USB C connector into the PPm model.

Upon connecting the PPm to your computer the PPm is ready for monitoring and control. Always run the **init** command to set the range and to calculate KW capacity.

Monitoring and Controlling the Power Plant model

The PPm has a set of pre-programmed commands for you to interface with it. When these commands are issued to the PPm, it will carry out the requested action. If you issue a command to the PPm that it does not recognize, that command will be ignored.

There are several ways to send commands and receive responses to the PPm. One way is to address it through a serial terminal like those found in the Arduino IDE or in apps. Other ways to control the model is through programming languages like LabVIEW, Matlab, Python, C, or anything that can send and receive serial strings through a USB serial port.

The first two commands that the PPm recognizes are:

****ID?*** **and** ***getCommands***

The ***ID?** function. Sending the ***ID?** string to the PPm will prompt it to respond with its identification string. The PPm responds with the string "generator".

The **getCommands** function. Sending the **getCommands** string to the PPm will prompt it to respond with a list of the commands that it understands. Below is the list of functions and their meanings that the PPm will return when it receives **getCommands**

Overview of Power Plant model Commands

Command	**Description**	**Number of parameters sent or returned**
init	Determines full range and sets PPm to initial states	
runRange	Initiates a run up of the generator to determine the maximum voltage at the maximum load	
setVolts	Sets the target line voltage for the Power Plant. Default is 120 volts. Note – this is a representative number. The power plant model generates voltages below and around 5 volts DC.	1 sent
setLoad	Sets the KW load assigned to the Power Plant	1 sent
setMot	This sets the speed of the motor. Values range from 0 (off) to 255 (max speed)	1 sent
setKp>1	Sets the proportional coefficient for PID control	1 sent
setKi>1	Sets the integral coefficient for PID control	1 sent
setKd>1	Sets the differential coeeficient for PID control	1 sent
trackOn	Initiates a tracking routine to maintain the specified line voltage	
trackOff	Exits the tracking function	
autoOn	Initiates a sinusoidal target voltage setpoint	
autoOff	Exits the auto function	
motOn	Sets the steam turbine motor to max speed	
motOff	Turns the steam turbine motor off	
getVal<1	Returns the most recent line voltage value	1 returned
getKW<1	Returns the most recent KW power value generated	1 returned
getCarbon	This returns the about of carbon dioxide the plant is generating measured in tons. Note: this is a representative number, the Power Plant model generates no CO2	1 returned
getlAll	This returns seven numbers from the Power Plant. These are: Power Plant kilowatt capacity, the current KW level being generated, the load allocated to the PPm, the difference between what's being generated and the load assigned to it, the type of energy (1=renewable, 0=non-renewable, and -1 meaning neither like a house load, and line voltage	7 returned
getLoad<1	Returns the most recent calculated and set load value	1 returned
off	Shuts down power plant, stops motors, returns 0 values	
eoc	Indicates end of command list	