Module 5: **PV Solar Operator Simulation Lab**

Exercise 1

Operator (student) creates a new project (PV solar system) with the HMI simulation. Student then creates and installs two new devices within the project simulation – one device for an inverter and one device for a weather station – and configures each device with alarm setpoints for critical outputs. Once the devices are created and configured the student will run the data simulation and note any alarm conditions that were triggered.

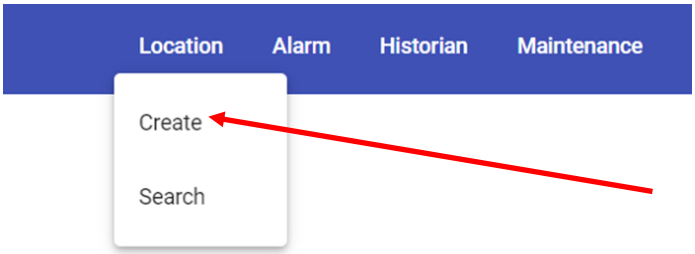
Learning Objectives – Exercise 1

- Create a new HMI project
- Understand how to create new devices within the HMI (i.e. weather station and inverter)
- Understand how to set alarm points for different devices and/or data points within a device (i.e. low output, high temperature, etc.)
- Recognize alarm state and be able to identify what alarm condition was triggered

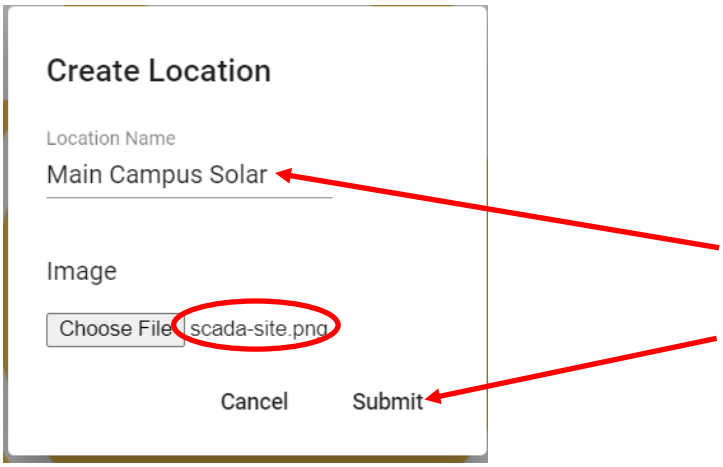
Lab Exercise 1 Steps

1) Open the simulation software program using the following URL: https://scada-student.irsccsdept.org
2) Download and extract the lab files. These images will be used in later steps.

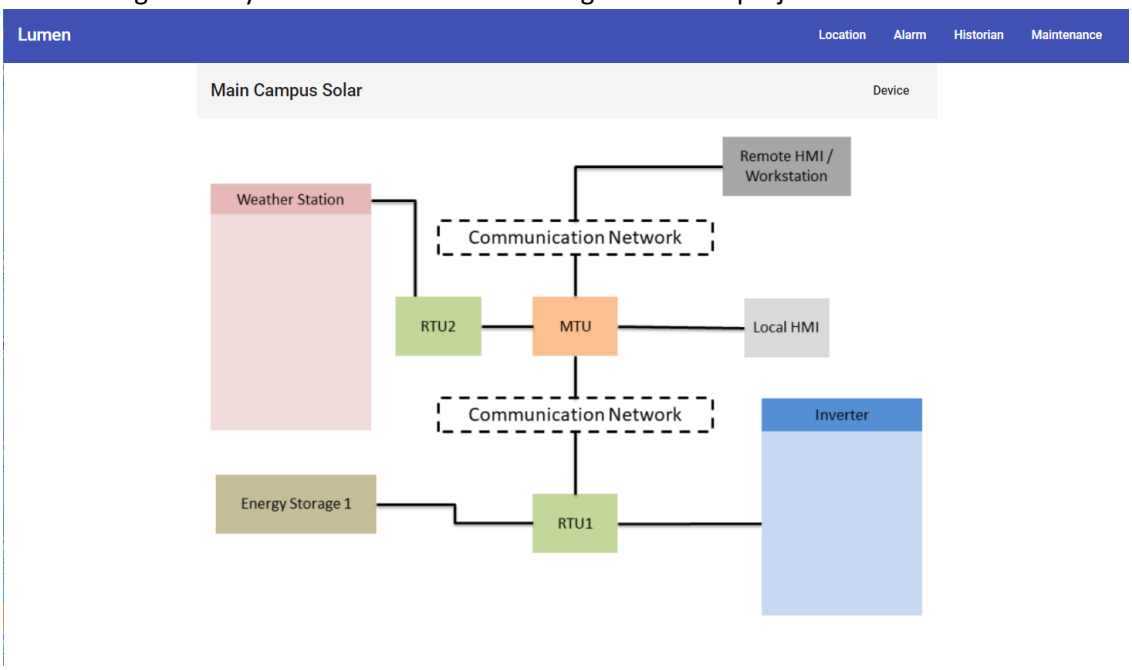
3) Click **Start New Lab Session** to begin the lab. Note: The **Start New Lab Session** button can be pressed at any point during the lab to restart the lab.
4) Under the "Location" menu, select "Create" to start a new project.



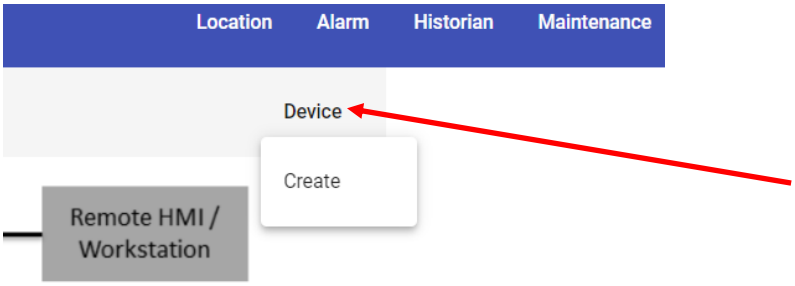
5) Type in the name *Main Campus* for the new location. Browse to the scada-site image downloaded in the previous step. The most common location will be "Downloads" in a folder named "student-files."



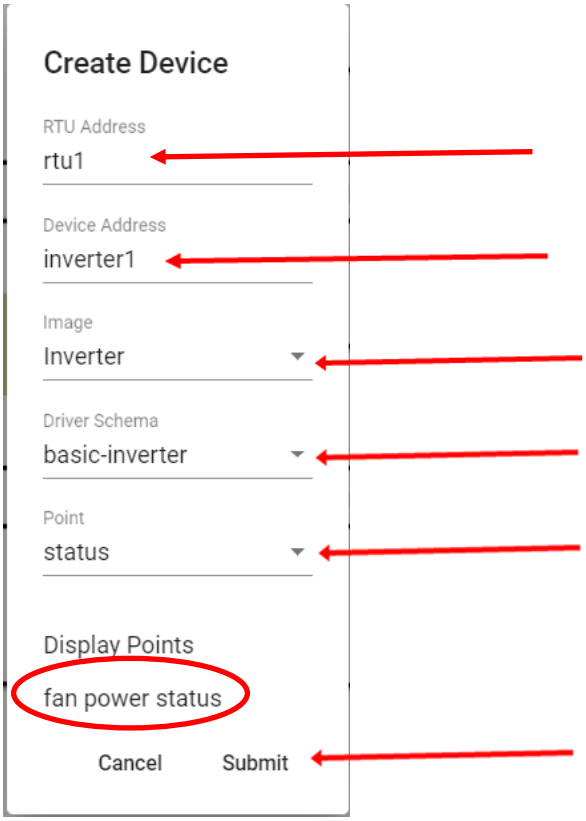
6) After hitting submit you should see the block diagram for the project.



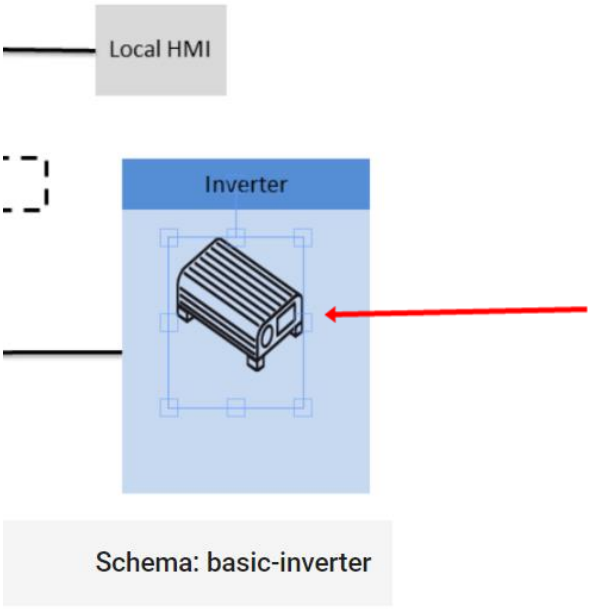
7) Under the “Device” link, select “Create”.



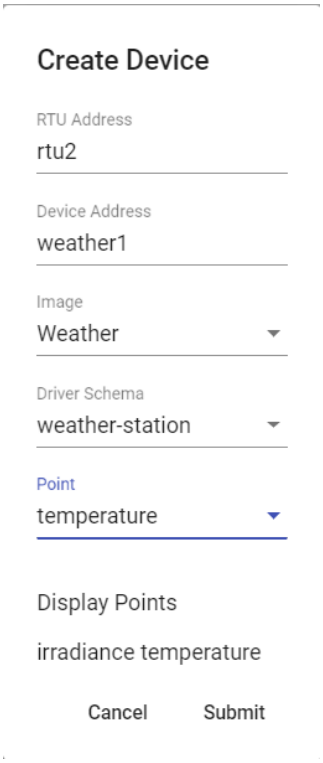
8) Create a new <u>inverter</u> device by assigning a device name, selecting the appropriate parameters. Display points are selected by clicking the “Point” drop-down menu and selecting each point, one at a time. Click “Submit.”



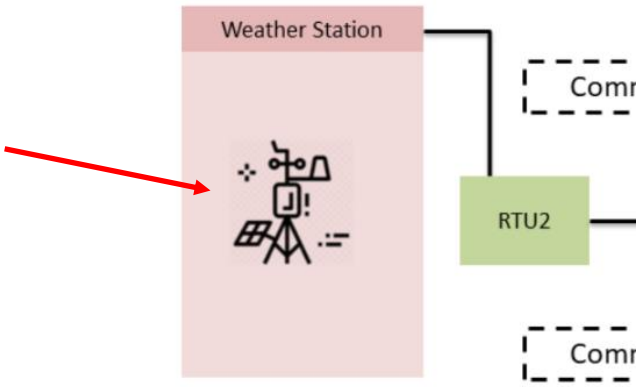
9) Place the inverter device in the appropriate place within the project block diagram.



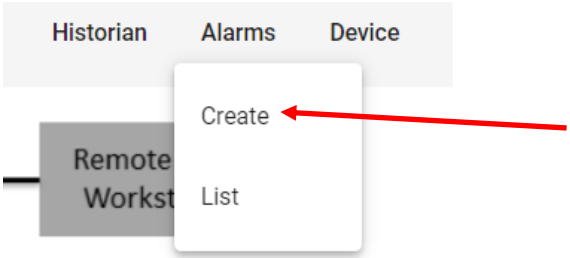
10) Repeat the device creation steps to create a new weather station device.



11) Place the weather station device in the appropriate place within the project block diagram.



12) Click on the new inverter device. Under the “Alarms” link, select “Create”.

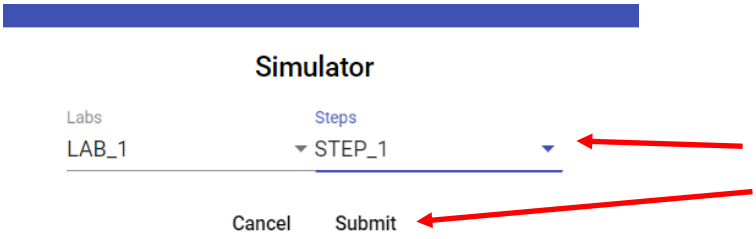


13) Create a new inverter alarm by assigning an alarm name, selecting the appropriate parameters and the hit “Submit.”

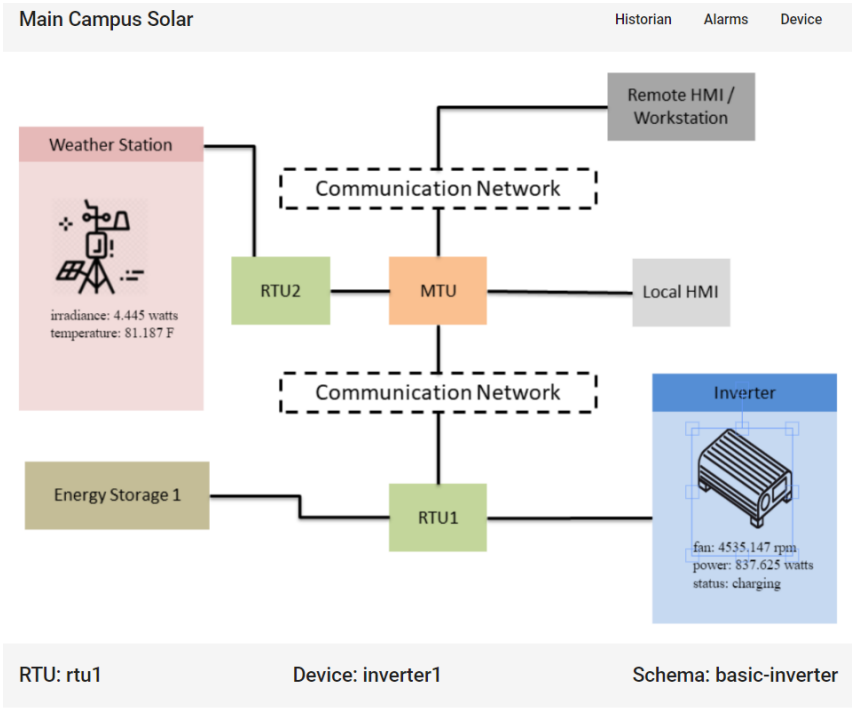
14) Click “Alarm” then “List.” A summary table should pop up confirming the alarm settings.

Name	Point	Compare	Value	Triggered
Low Power	power	lt	500	false

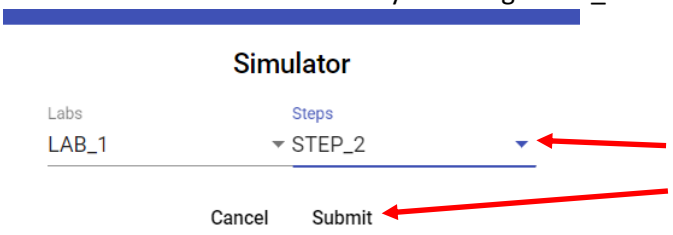
15) Click the *Simulator* link, which will open in a new browser tab. **Do not close your other browser tab.** Run the first data simulator by selecting “STEP_1” and then hitting “Submit”.



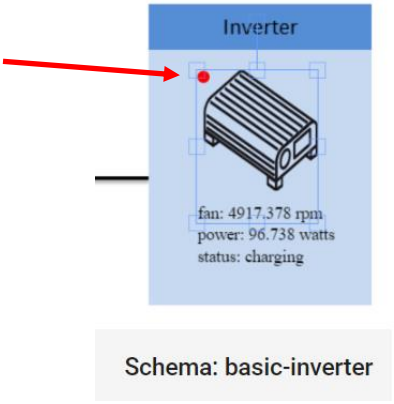
16) Return to the previous browser tab containing your location. You should see the block diagram for the project displaying data for the inverter and weather station devices.



17) Run the second data simulator by selecting “STEP_2” and then hitting “Submit”.



18) After hitting “Submit” you should see the inverter device displaying an alarm condition.



19) Click the inverter image, then click “Alarms”, then “List”. The Low Power alarm should display that is has been triggered.

Name	Point	Compare	Value	Triggered
Low Power	power	lt	500	true

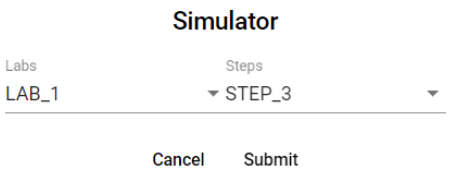
Lab Exercise 2

Operator receives alarm conditions for the inverter for low output. Identify specifics of the equipment failure (what, where,) and the impact to the overall system output.

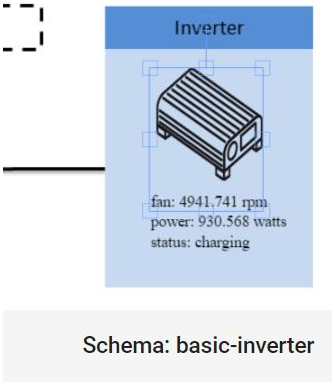
Learning objective:

- Demonstrate use of SCADA data analysis and trend tools
- Demonstrate ability to export data for further/detail analysis
- Utilize troubleshooting skills to identify root cause of decrease in system output
- Utilize data analysis/troubleshooting skills to issue operators report/log of findings and escalate system issue for maintenance and/or engineering follow-up

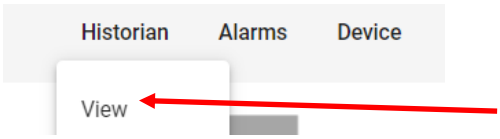
20) Run the third data simulator by selecting “STEP_3” and then hitting “Submit”.



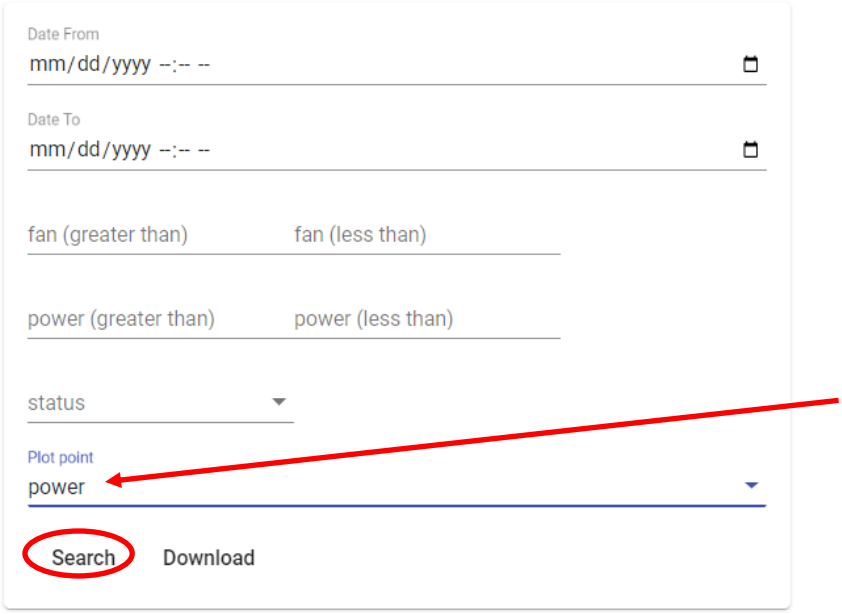
21) After hitting “Submit” the alarm condition on the inverter should clear and new data should be displayed.



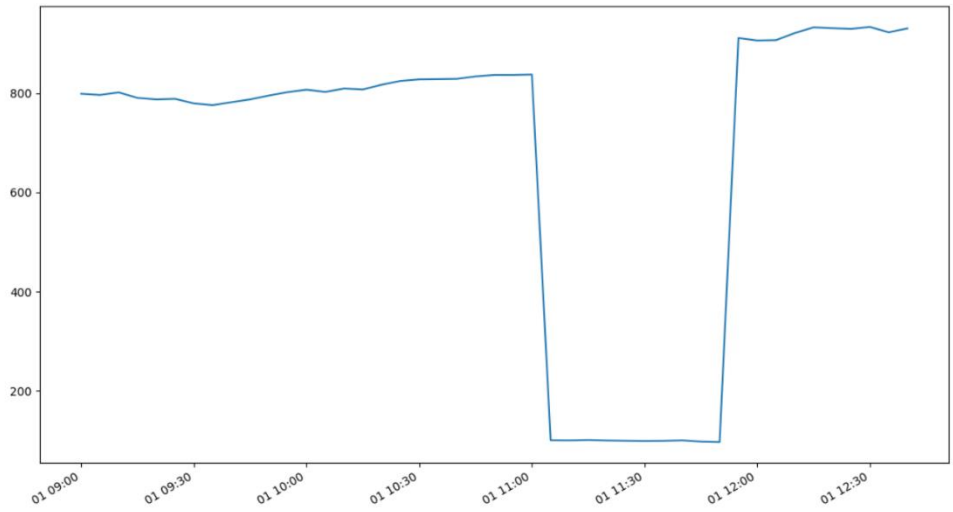
22) Begin analysis to determine the root cause of the inverter alarm. Click the image for the inverter, then from the “Historian” link select “View”.



23) Select “power” as the data to plot and then hit “Search”.



24) The system should generate a trendline of the power output data for the given time period like the chart below.



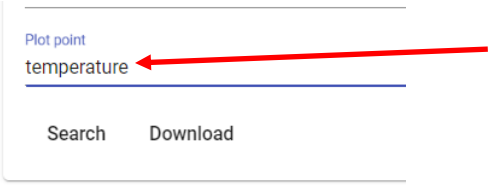
25) Repeat the trend analysis process for the inverter device by next selecting “fan” as the data to plot and hitting “Search”.

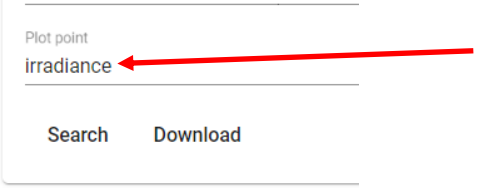
26) After generating trend lines of both “power” and “fan” for the inverter device, hit “Download” to export the data to a .csv file format.

A1 | date

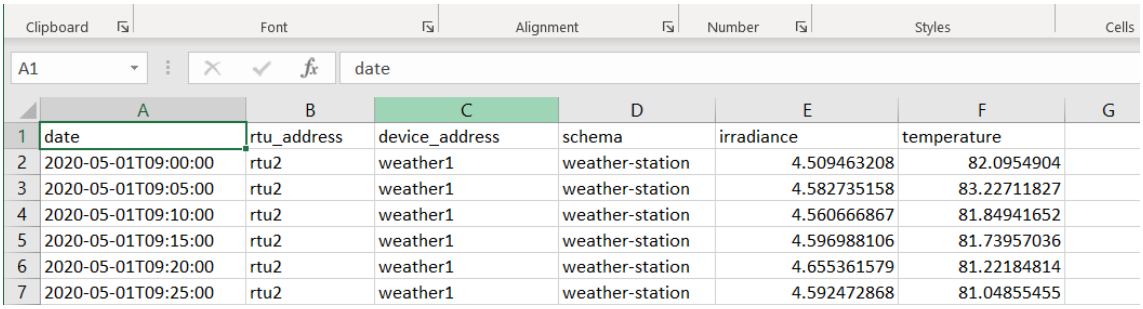
	A	B	C	D	E	F	G	H
1	date	rtu_addres	device_ad	schema	power	fan	status	
2	2020-05-0	rtu1	inverter1	basic-inver	798.8053	4874.387	charging	
3	2020-05-0	rtu1	inverter1	basic-inver	796.4877	4841.14	charging	
4	2020-05-0	rtu1	inverter1	basic-inver	801.6251	4824.187	charging	

27) Press the back button to return to the *Main Campus* location view. Click the weather station image and repeat the previous Historian steps for the weather station device for both “temperature” and “irradiance”.





28) As with the inverter device, after generating trend lines of both “temperature” and “irradiance” for the weather station, hit “Download” to export the data to a .csv file format.

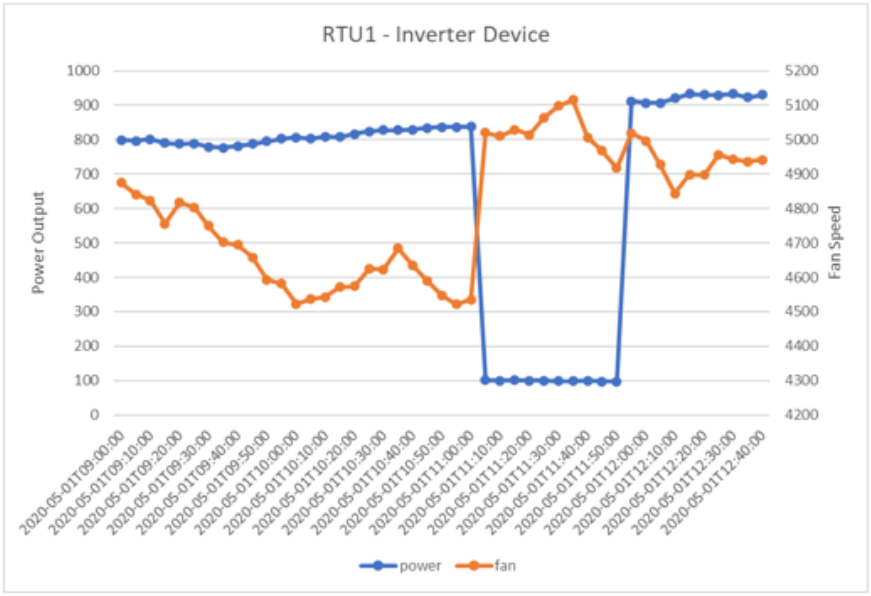


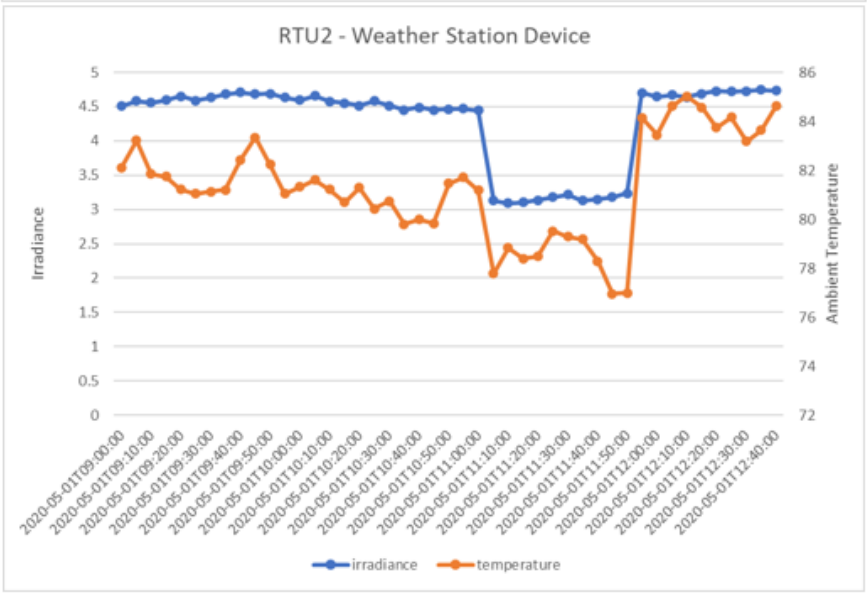
Clipboard | Font | Alignment | Number | Styles | Cells

A1 | date

	A	B	C	D	E	F	G
1	date	rtu_address	device_address	schema	irradiance	temperature	
2	2020-05-01T09:00:00	rtu2	weather1	weather-station	4.509463208	82.0954904	
3	2020-05-01T09:05:00	rtu2	weather1	weather-station	4.582735158	83.22711827	
4	2020-05-01T09:10:00	rtu2	weather1	weather-station	4.560666867	81.84941652	
5	2020-05-01T09:15:00	rtu2	weather1	weather-station	4.596988106	81.73957036	
6	2020-05-01T09:20:00	rtu2	weather1	weather-station	4.655361579	81.22184814	
7	2020-05-01T09:25:00	rtu2	weather1	weather-station	4.592472868	81.04855455	

29) Create charts in Excel to view the data series trendlines. The charts should look similar to the ones below.





30) Using these analytical tools determine the likely root cause of the inverter device alarm condition. Complete the Incident Report form for this project.