DARFON

WHITE PAPER 170922 - SEP 22, 2017

INVERTER PERFORMANCE COMPARISON

Dr. Frank O'Young
frank.oyoung@darfon.com

1. Darfon vs Solar Edge

DNV GL at their Davis California field test site performed a comparison test between Darfon's G320 micro inverter and SolarEdge's 3kW string inverter with DC optimizers. Ten LG 305W solar panels were used to power each of the two types of inverters. Data monitoring was done by AlsoEnergy and their portal interface.

Instantaneous AC power output from the two types of inverters are shown in Figure 1. Data points are collected at 15-minute intervals. Two arbitrary days are selected for illustration. From the graph it is clear that the Darfon G320 micro inverter system produces more AC power than the SolarEdge inverter system, even though both systems have the same solar panels. This higher power result is seen from data every day.

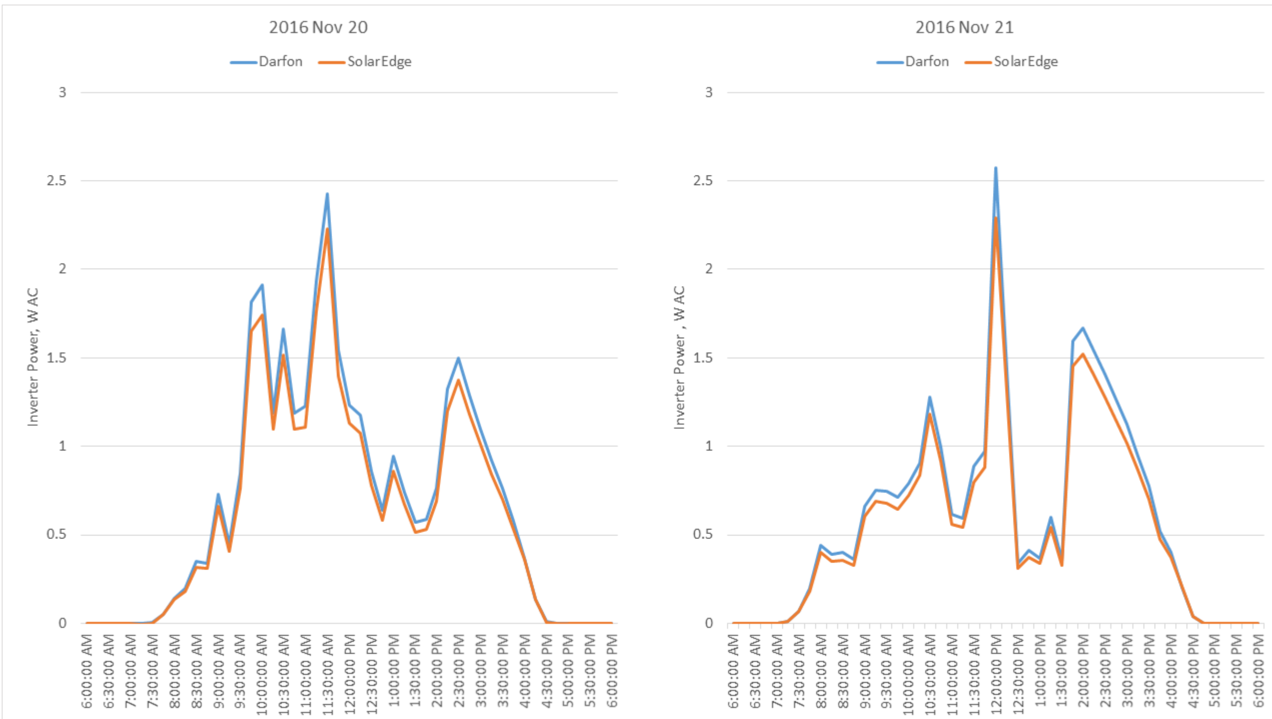

Figure 1. Instantaneous power of Darfon G320 MI vs SolarEdge 3kW SI

Accumulated daily energy generation is also collected by the monitoring system. Figure 2 compares the daily generation data from the Darfon and Solaredge systems for a period of 30 consecutive days. From the graph it shows a clear trend of more energy generated by the Darfon system on a daily basis as compared to the SolarEdge system. Typically the Darfon G320 micro inverter would generate approximately 10% more AC energy than the SolarEdge inverter/optimizer design. Note that in this test the full potential of the Darfon G320 has not yet reached as the optimal panel sizes recommended is 320~350W. The superior energy generation of the Darfon G320 micro inverter is an important feature where financed or PPA projects are concerned. With 320 W or higher panels, the G320 would expect be generate even more energy compared to the competitors.

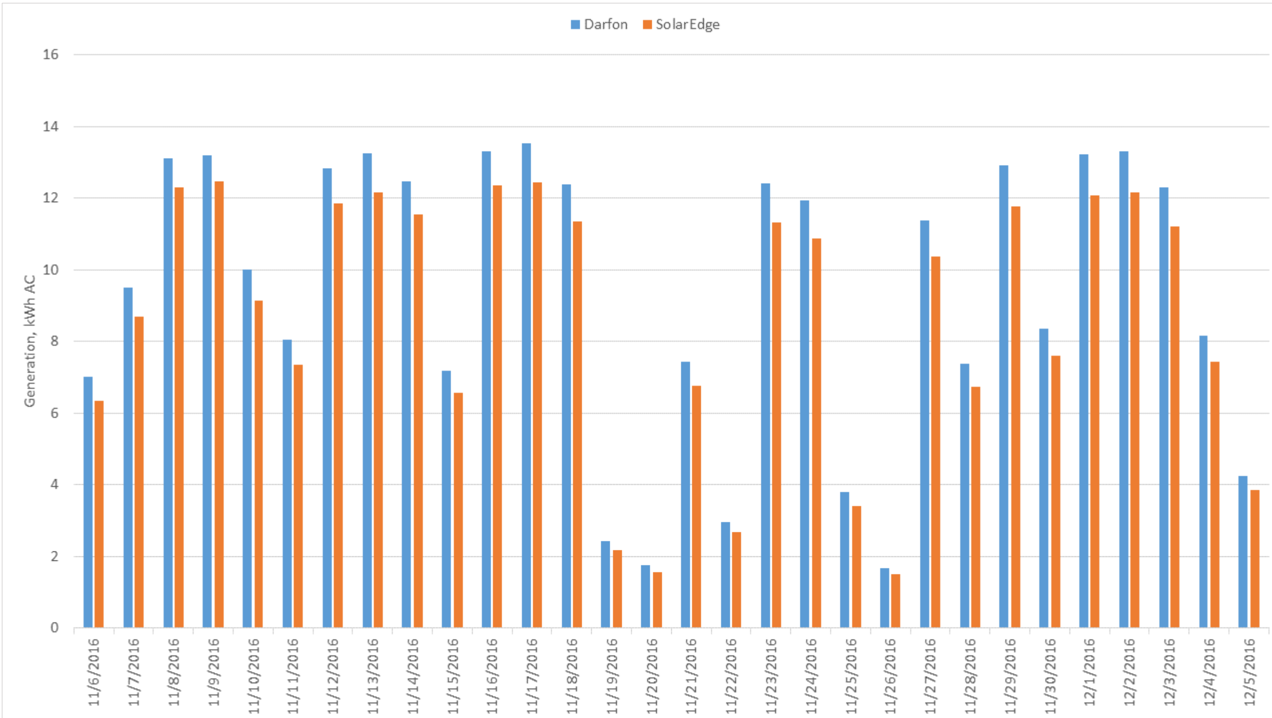

Figure 2. Daily energy generated from Darfon G320 MI vs SolarEdge 3kW SI

2. Darfon vs Enphase

Also at the DNV GL's Davis California site are Enphase's M250 micro inverters attached to 10 LG 305W panels. The system is also 3kWDC and the panels face the same orientation and tilt as the Darfon and SolarEdge systems.

To demonstrate the advantage of higher power with the Darfon G320, and arbitrary day with good insolation was selected to compare the data with Enphase M250. The graph in Figure 3 shows the power curve in blue for the Darfon G320, and red curve for the Enphase M250. Insolation in W/m^2 is shown in purple. One can see that the period between 11:00 and 15:00 the Enphase MI would clip the power at a constant value of 2500W, or 250W per panel. This loss of solar potential is not desirable. The Darfon G320 does not clip and would convert all available solar potential into useful AC power. Note that the Darfon G320 in this test has not yet reached its full potential, as the optimal panel power is recommended at 320~350W.

SolarEdge 3kW SI data is also shown in green. As established in the data shown in the previous section, it has the worst generation capability, losing almost 10% of solar potential compared to the other micro inverters.

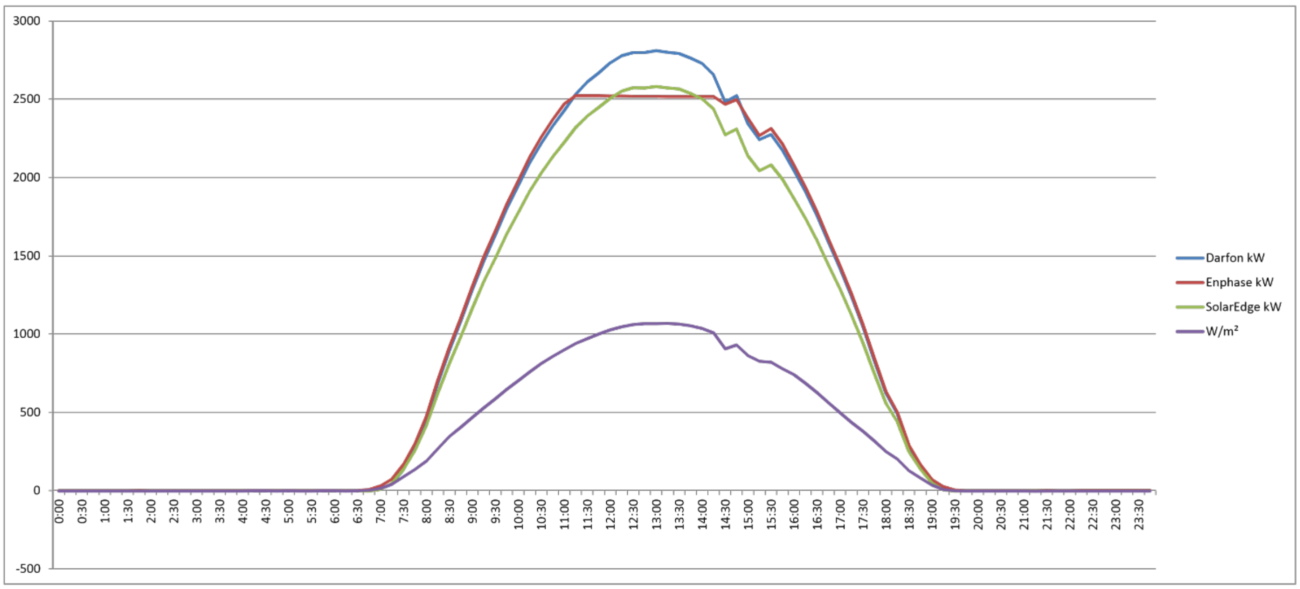

Figure 3. Power output of Darfon G320 vs Enphase M250 vs SolarEdge 3kW.

3. Darfon vs Schneider

A comparison test site in Taoyuan City, Taiwan has been running a long-term outdoor performance test between Darfon G320 micro inverters and Schneider Conext RL 5000 string inverter (see Figure 4). Sixty-six (66) Gintung 270W 60-cell modules are connected the micro inverters, and twenty (20) of the same modules connected to the string inverter. All panels have the same tilt angle and facing nearly south.

Figure 4. (top) Darfon G320 micro inverters (b) Schneider Conext RL 5000

Figure 5 shows 7 consecutive days of data for insolation (top blue curve), Schneider string inverter power (SI, bottom blue curve), and Darfon micro inverter power (MI, bottom orange curve). The power values have been normalized to show per panel power in watts AC. The shape of the power curves follow closely to the shape of the insolation curve, indicating the power sampling device has sufficient response rate

The power curves show in general the Schneider SI follows the shape of the Darfon MI power curve, however the Schneider SI typical generates less power, particular more so in the morning.

Difference between the Darfon MI power and Schneider SI power is calculated and shown in Figure 6 below. Overall in the 7 days of data the Darfon MI would produce somewhere between 0 to 50 watts more power than the Schneider SI. The Schneider Si has some peculiar behaviors where on highly insolated mornings it would not power up as fast as it should. It also displays shutdowns during the day, a possibility where false arc fault detection is triggered.

The data in Figure 5 and Figure 6 is a good reflection of the advantage of the distributed architecture of a micro inverter system over the centralized architecture of a string inverter system. If a centralized string inverter has some unwanted conversion behavior, then all the panel associated to the inverter would suffer at the same time. This undesirable trait would not appear in a micro inverter system since all panels would behave independently from each other.

Another feature of a Darfon G320 microinverter system is the ability to predict energy generation with much higher accuracy than a Schneider Conext system. Power output from the inverters is plotted against insolation, as shown in Figure 7. The graph shows the Darfon G320 micro inverter system has less scatter in the data points and the power vs insolation is highly correlated from 0 to 1200W/m2. The low scatter of the data points means and the high correlation of the power with insolation means that PV energy generation in kWh as long as the nameplate rating of the inverters and panels and insolation are known. This predictability feature is not seen in the Schneider Conext Si system, or any other centralized string inverter system. The graph shows the data scatter is very high for the Schneider inverter, and its data set is poorly correlated with insolation. This type of system behavior would render energy predictability inaccurate and difficult.

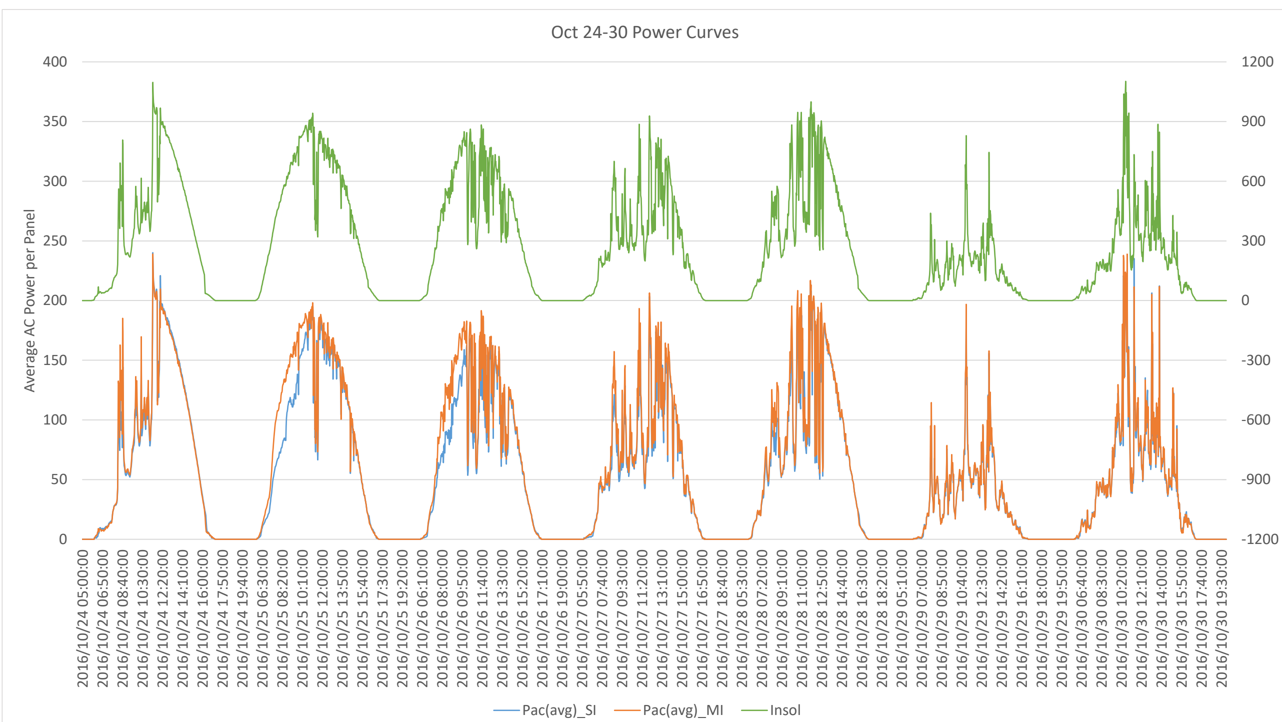

Figure 5. Outdoor data of Darfon G320 micro inverter vs Schneider string inverter

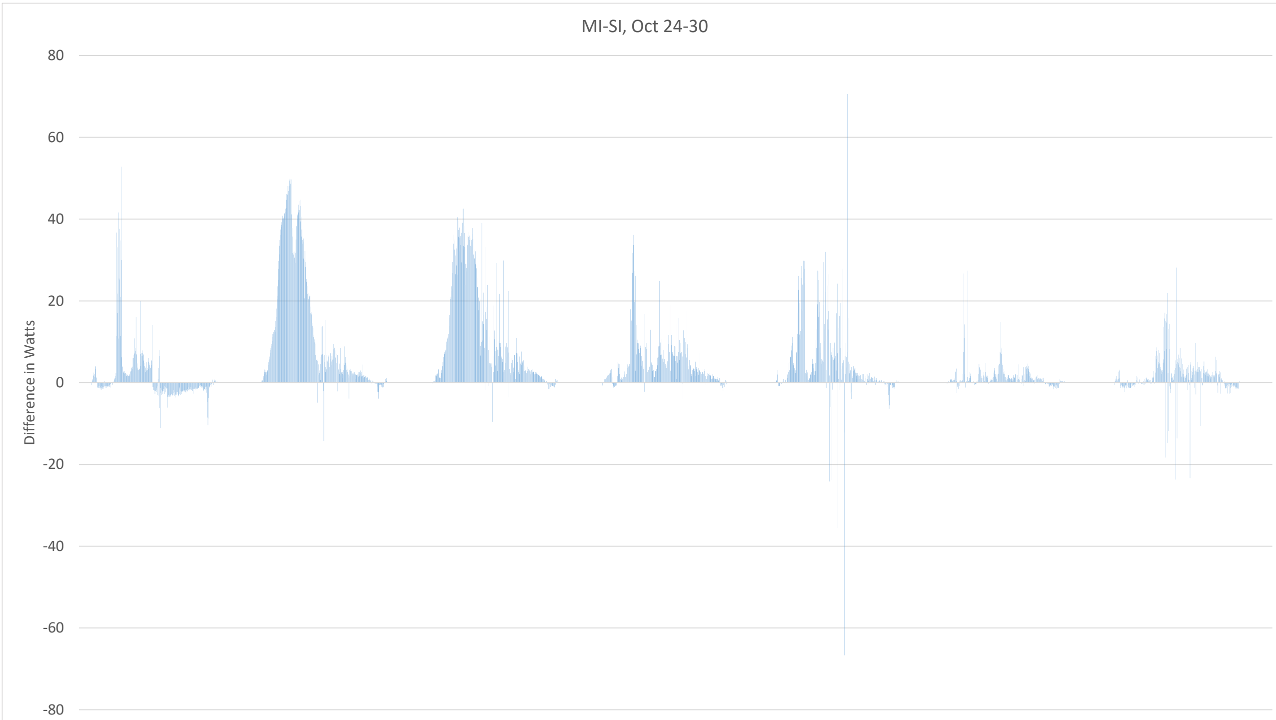

Figure 6. Difference in per-panel power between Darfon MI and Schneider SI

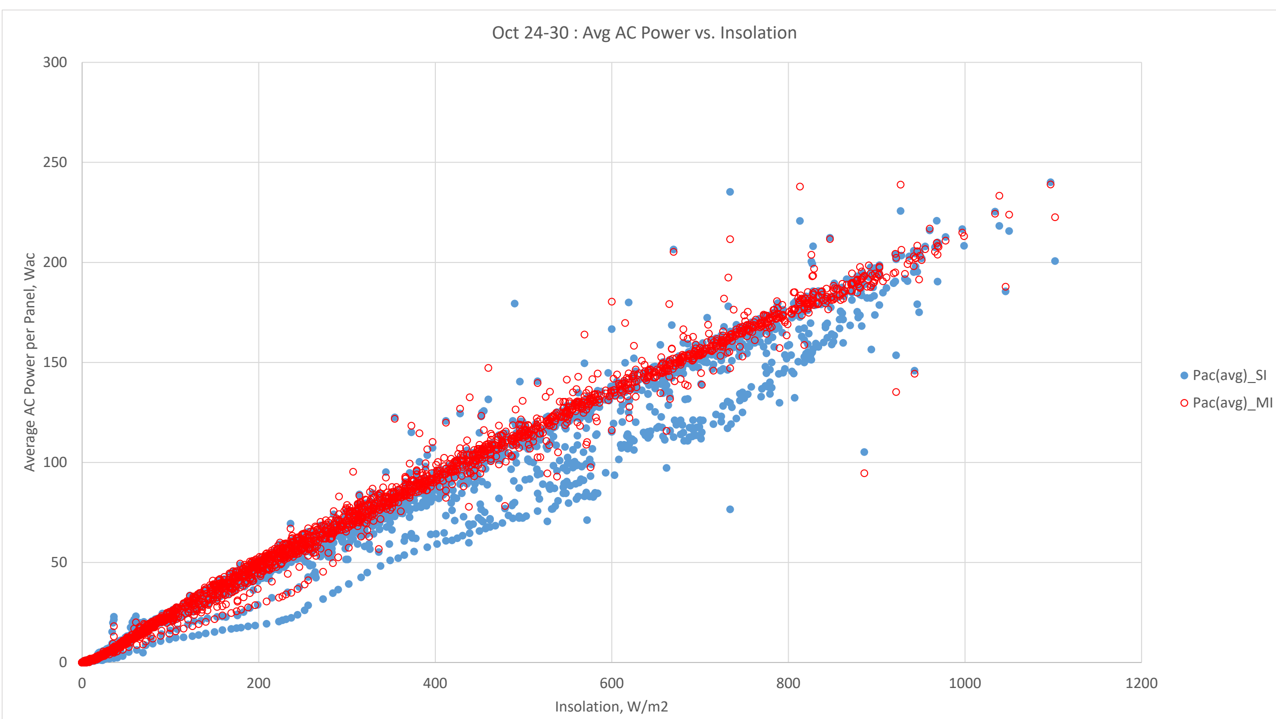

Figure 7. Average AC Power vs Insolation of Darfon MI vs Schneider SI