Report: RFReduce101 R2

Field Testing of Palma Engineering Parallel Dirty Electricity Filters.

Site 001

Filter: RxDNA-V2X

2018-03-21

Palma Engineering: Midwest Research Corp and Noble Electronics, Inc.

New Product: RxDNA-V2X Parallel Filter

- Inspiration for this product was to push the filtering performance to the limit for a Parallel filter.
- Thereby providing a Dissipative Parallel filtering solution that in some cases, i.e. some sites, provides acceptable reduction in Dirty Electricity (DE).
- This is a much simpler and lower cost installation than a DNA Line Filter.

Filtering Done With A Filter On Both Phases

- We have found that the Dirty Electricity (DE) on one phase will be affected by a Parallel filter on the other phase.
- Here is an example:
- Ph 1 DE, no filters on either Phase, is 450
- Ph 1 DE, RxDNA-V2X on Ph 1 only, is 82
- Ph 1 DE, RxDNA-V2X on both phases, is 68
- In the testing that follows, any time filters are used, there will be RxDNA-V2Xs on both Phases.

Testing With Double Filters

- As a experiment, testing was done with 2 each RxDNA-V2X filters on EACH Phase.
- This not a configuration that we envision would be used frequently, but we wanted to include that configuration in this testing to see what the result would be, on a particular site.

Source Impedance 1

- Any time a Parallel filter is applied, it's effectiveness depends upon the source impedance in the wiring and in the equipment (inverters, appliances, etc) at the particular site.
- Wiring that leads up to a Parallel filter has series inductance, series AC resistance, and shunt capacitance.
- Any device/system that is generating DE (inverters, speed controls, lighting dimmers, etc), have an effective output impedance at the DE frequencies.
- These all play a significant part in the reduction of DE that a Parallel filter achieves.

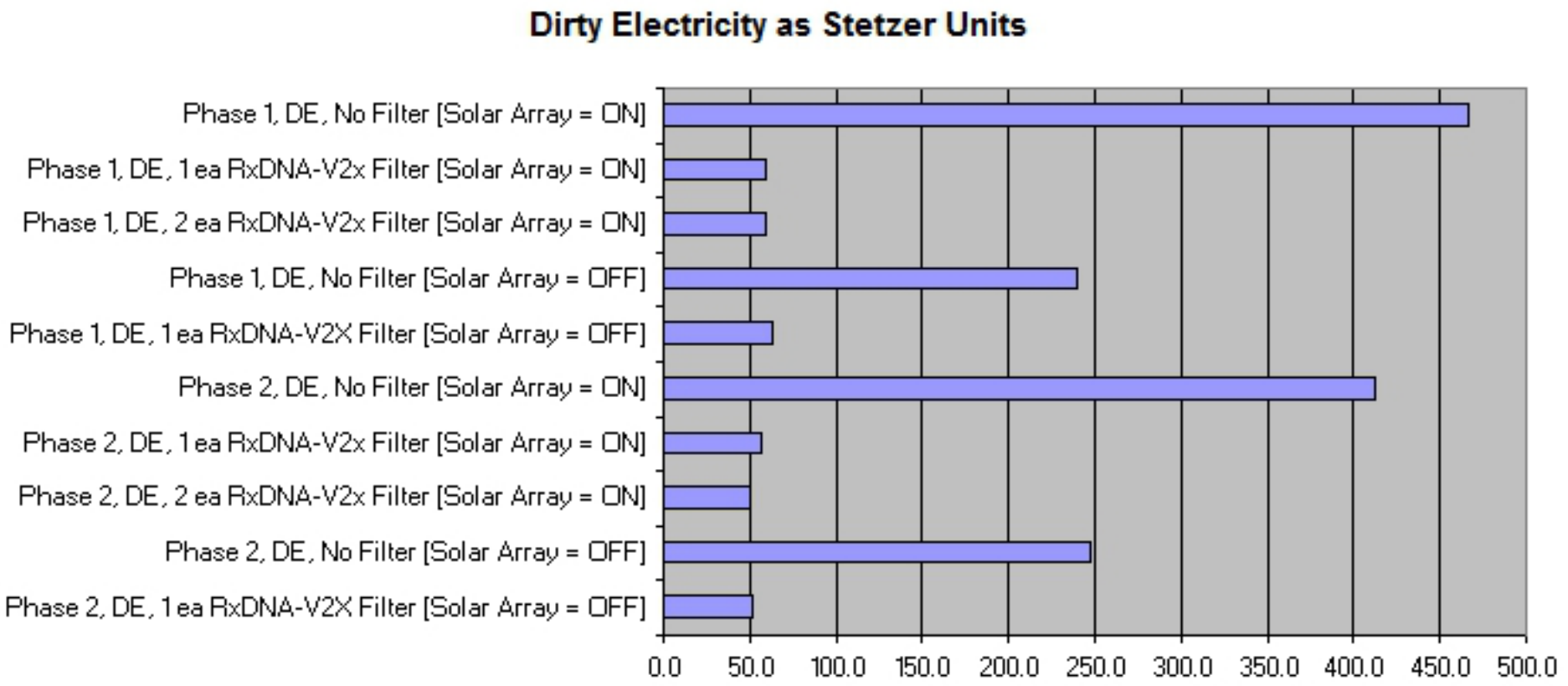
Source Impedance 2

- In terms of getting the most DE reduction from application of a Parallel filter, the higher the source impedance, the better.
- As an example, inverters for solar/wind applications are not all alike, as far as output impedance.
- Some inverters will have a higher output impedance and therefore greater reduction in DE will be seen with Parallel filters.
- Inverters that are a greater distance away from the point of connection of the Parallel filter, will increase the effectiveness of the Parallel filter since the impedance in the connecting wires is greater.

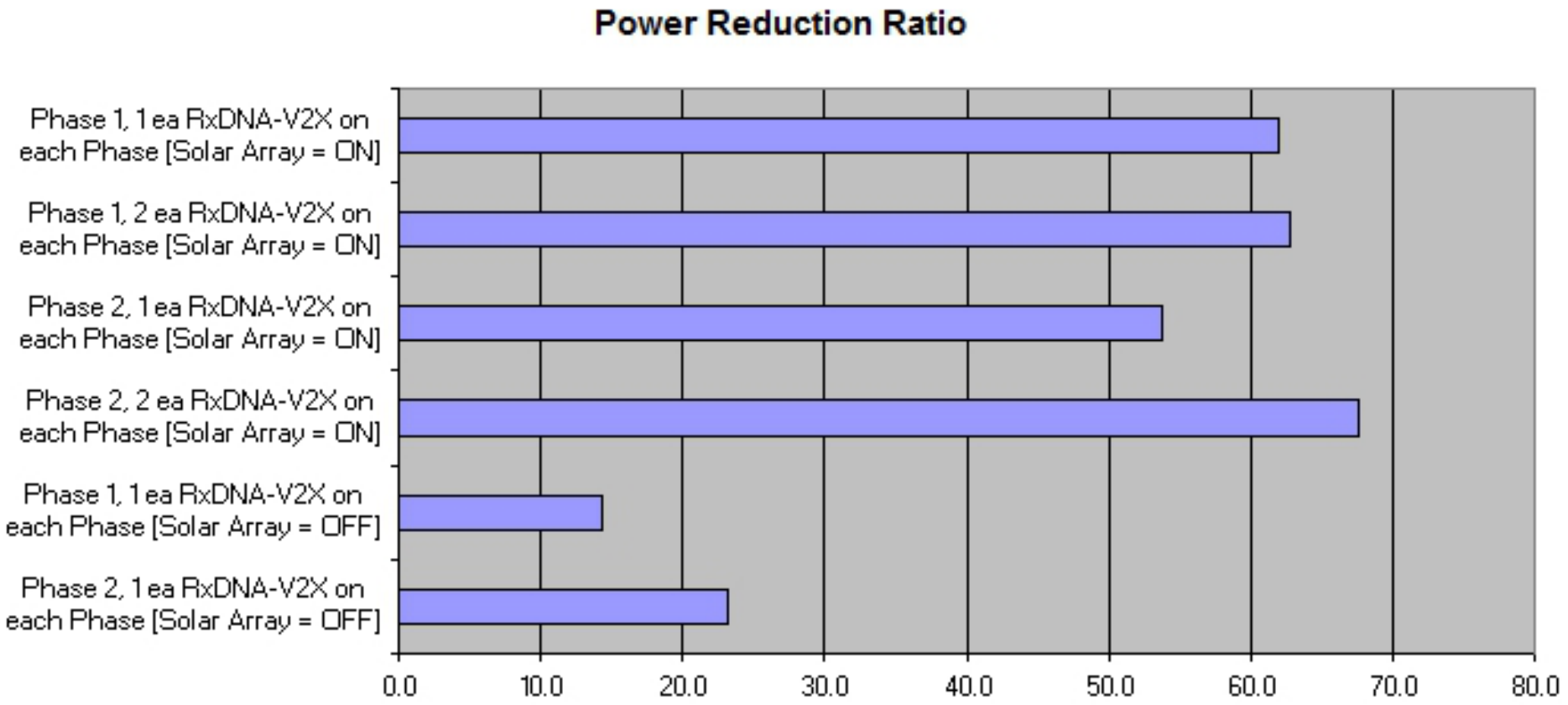
Site001 Solar Array Pedestal Mounted

Inverter: Enphase Model M190-72-240-S11

Averaged Dirty Electricity Values



Power Reduction Ratios



Total Harmonic Distortion 1

- If the charts on this topic seem “too complicated” to you, please don't worry about them. Just skip over them. Folks who are Dirty Electricity mitigation experts will find this data useful, so it is being included.
- Total Harmonic Distortion (THD) is a percentage measure of harmonic content.
- THD is used extensively in audio HiFi equipment.
- THD is also used in the power industry, and this is the reason it is being mentioned here.

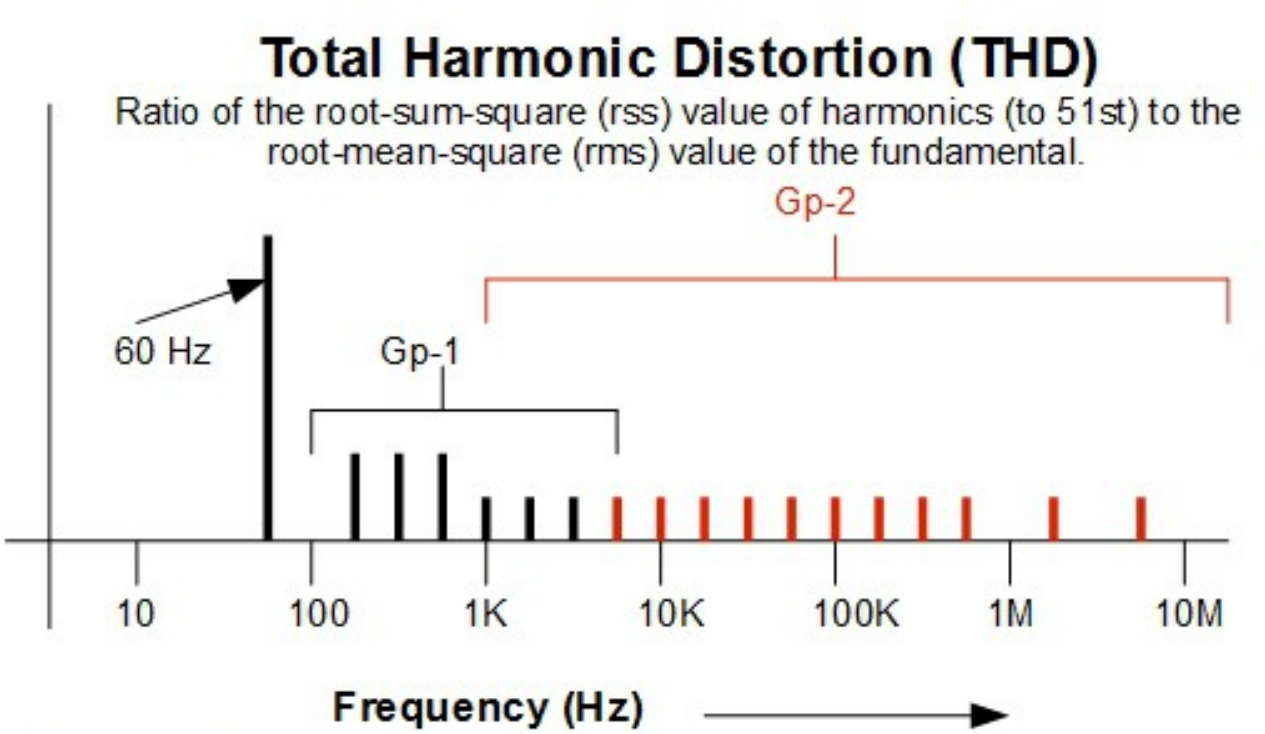
Total Harmonic Distortion 2

- There is a standard by the Institute of Electrical and Electronic Engineers called: IEEE-519. It deals with harmonics of the 60 Hz power.
- Harmonics are integral multiples of the power frequency.
- Example: 120 Hz, 180 Hz, 240 Hz etc.
- IEEE-519 addresses harmonics up to the 51st harmonic: 60 Hz x 51 = 3060 Hz
- Generally the solar installers in the world are only concerned with harmonics up to the 51st.
- This means they are usually entirely ignoring the DE that an inverter is producing at higher frequencies.

Total Harmonic Distortion 3

- The chart on the next slide shows the frequency region for IEEE-519 (Group 1) and the frequency region that DE mitigation experts are dealing with (Group 2).
- When we make measurements of DE we are mostly in the frequency region of Group 2 (see the chart for Group 2).
- The simple reason that THD is included in this report is that we have found a “rough” correlation between THD (the Group 1 region) and the DE that we measure (the Group 2 region)
- Since THD is an easy and quick measurement to make with a handheld instrument, we include that data here.

Total Harmonic Distortion 4



Group1 (Gp-1)
IEEE-519 addresses up to the 51st Harmonic of 60 Hz
51 x 60 = 3060 Hz

Group2 (Gp-2)
Dirty Electricity Region from the low Kilohertz region,
Into the Megahertz region

Total Harmonic Distortion 5

- Most inverter manufacturers will specify the maximum THD that their device produces is 5%.
- THD for this site was measured as:
- Phase 1: 0.5 %
- Phase 2: 0.5%
- These are low (Good) THD numbers.

Summary and Conclusions 1

- Dirty Electricity (DE) was effectively reduced for this site with the RxDNA-V2X filter.
- Reduction ratio in this case was **Unusually High**.
- Reduction was not as high in the Solar Array = OFF mode. A possible reason is that the source impedance from the Solar Inverter is higher than other sources of DE and this makes the Parallel Filter more effective (when source impedance is high).

Summary and Conclusions 2

- An expected reduction ratio for the RxDNA-V2X is 15:1 to 35:1.
- The 60:1+ DE reduction ratio achieved for this site may be due to a combination of the inherrent output impedance on the Enphase inverter (a high impedance) and the fact that the inverter, mounted on the back of the solar array is therefore a long distance from the parallel filters and thereby offers the highest series impedance (line inductance and AC impedance of the wiring).

Summary and Conclusions 3

- The testing showed little additional DE reduction effect by adding 2ea RxDNA-V2Xs on each phase (4 total).
- This might tell us that a single RxDNA-V2X is at the extreme of performance that a Parallel filter can achieve.
- In terms of Solar/Inverter wiring/placement architecture, the mounting of the inverters on the back of the solar array panel, and placing the solar array as far as possible from the main circuit-breaker box, may be an optimum approach.
- THD was Good, 0.5%

Instrumentation

- Stetzer Model GS-M300-A
- Amprobe ACD-50NAV

RxDNA-V2X Parallel Filter

- Thanks For Watching The Video !