Report: RFReduce103

Field Testing of Palma Engineering Parallel Dirty Electricity Filters.

Site 003

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.
- On some sites, Double filtering will be useful and effective.

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.

Site003 Solar Array Pedestal Mounted

Inverter: Schneider Electric Conext XW+ 5548
Slide 1

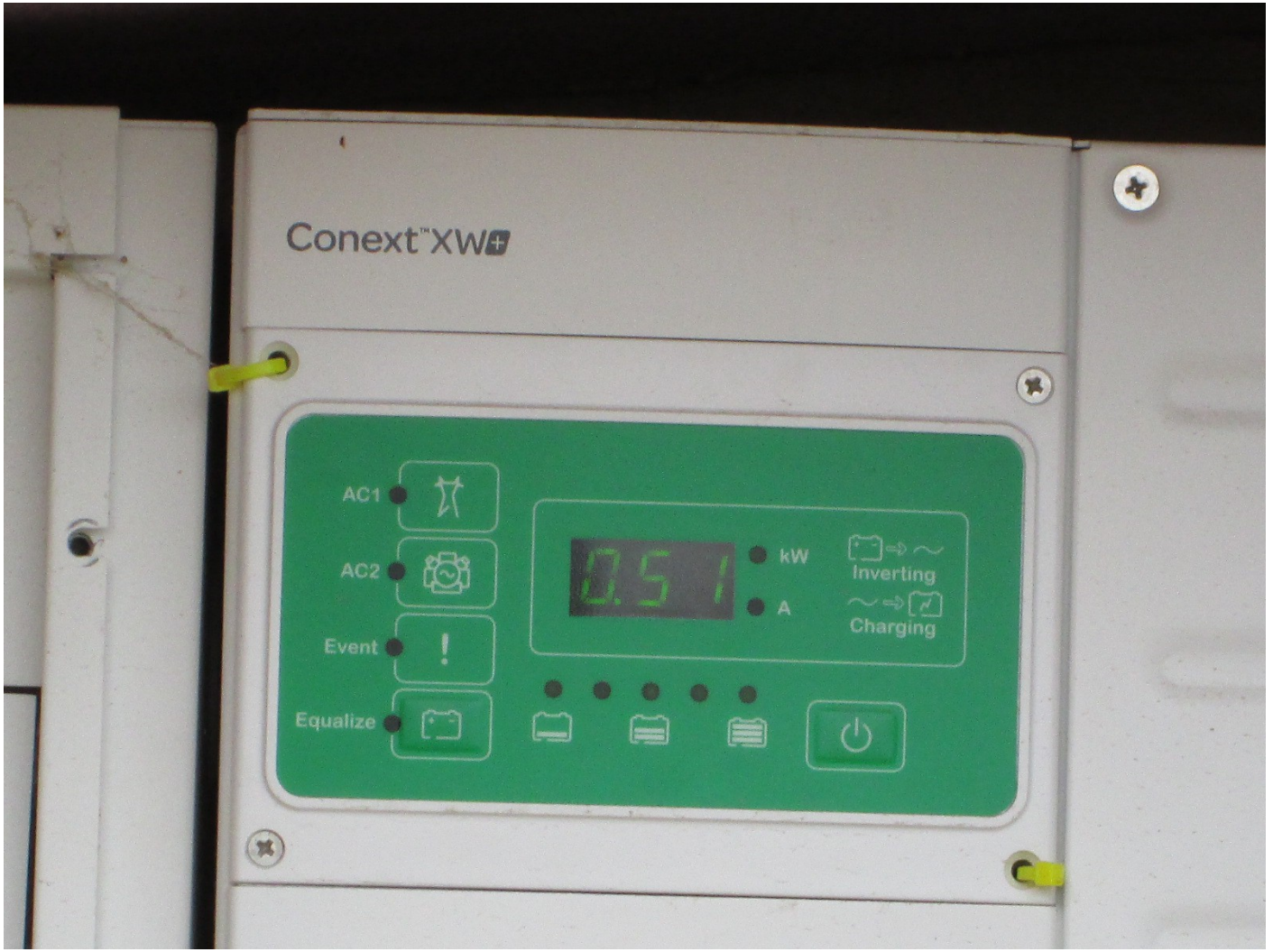
Inverter 2

Inverter 3


PHOTOVOLTAIC
DC DISCONNECT
WARNING
ELECTRICAL SHOCK HAZARD
WARNING
ELECTRICAL SHOCK HAZARD
PHOTOVOLTAIC
DC DISCONNECT
'AC' SWITCH GEAR
CLASSIC
PHOTOVOLTAIC 'DC' SYSTEM

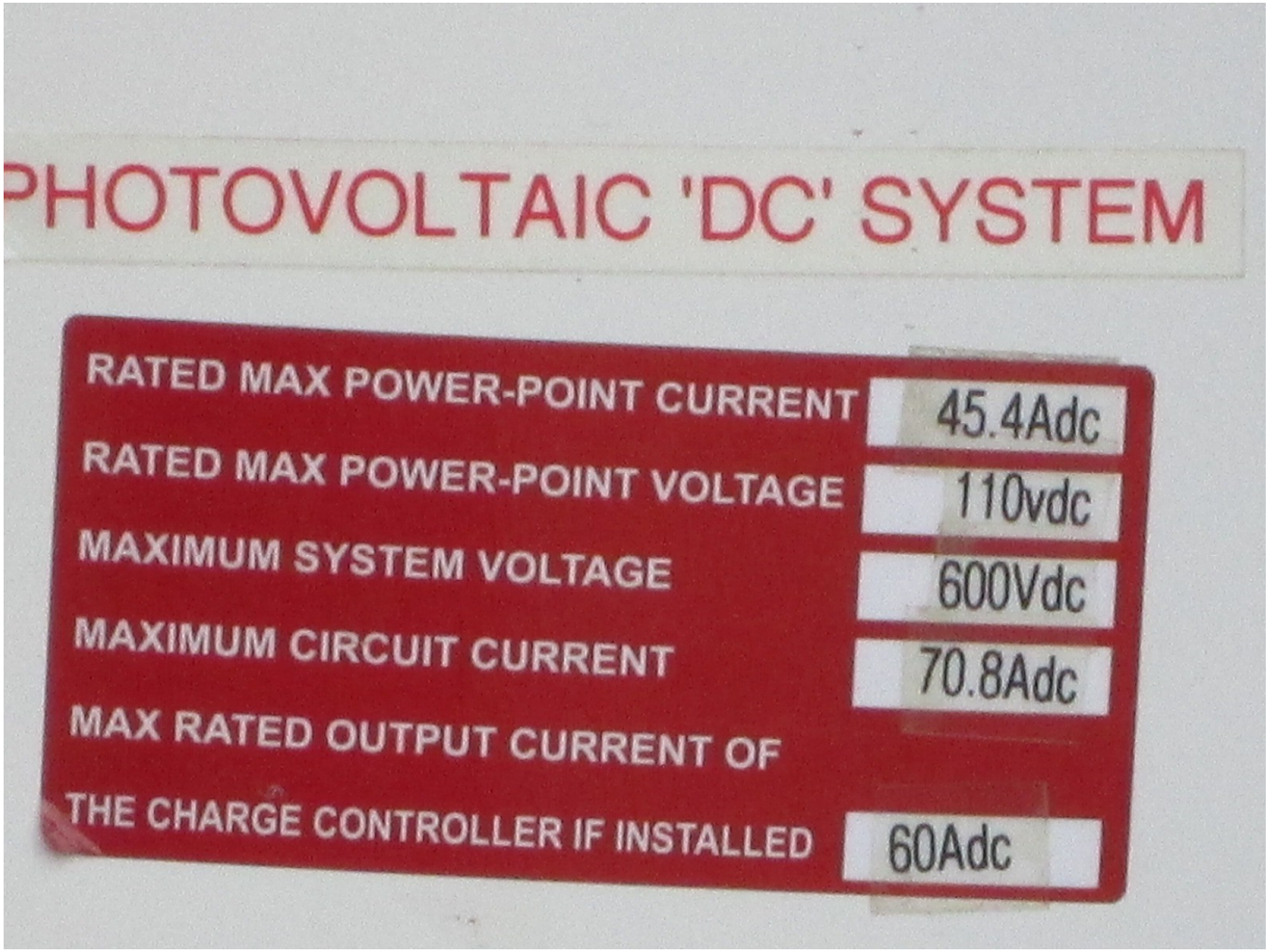
Inverter 4

Inverter 5


Conext™XW+
AC1
AC2
Event
Equalize
0.5 1
kW
A
Inverting
Charging

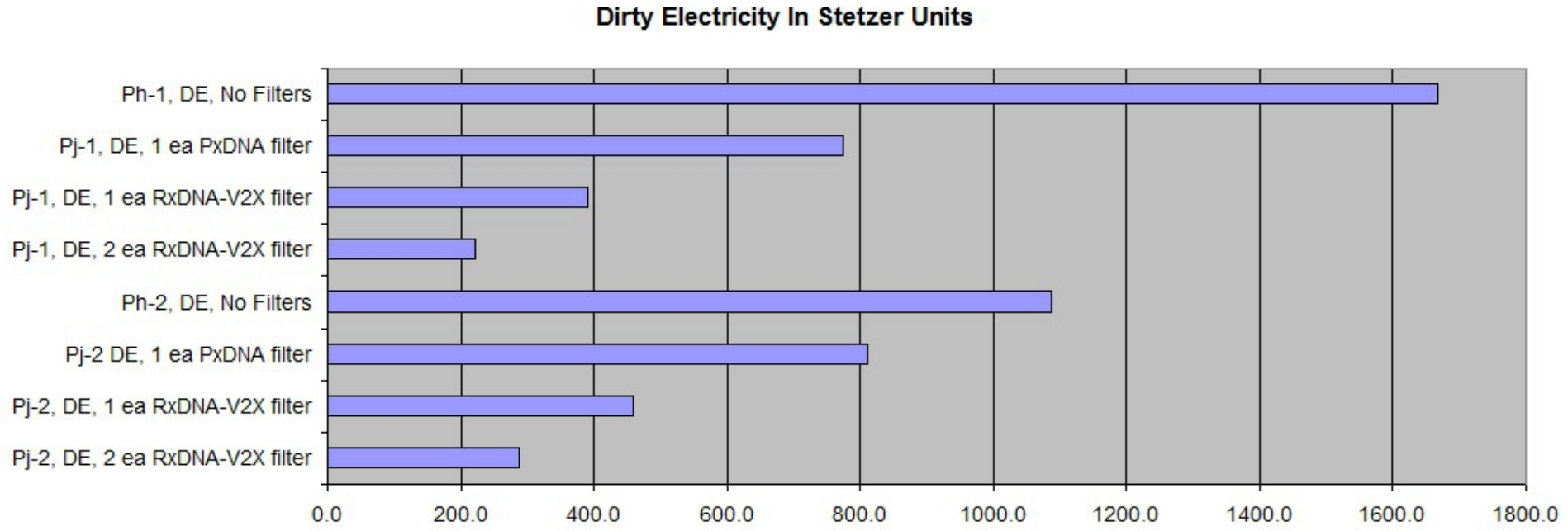
Inverter 6

Inverter 7

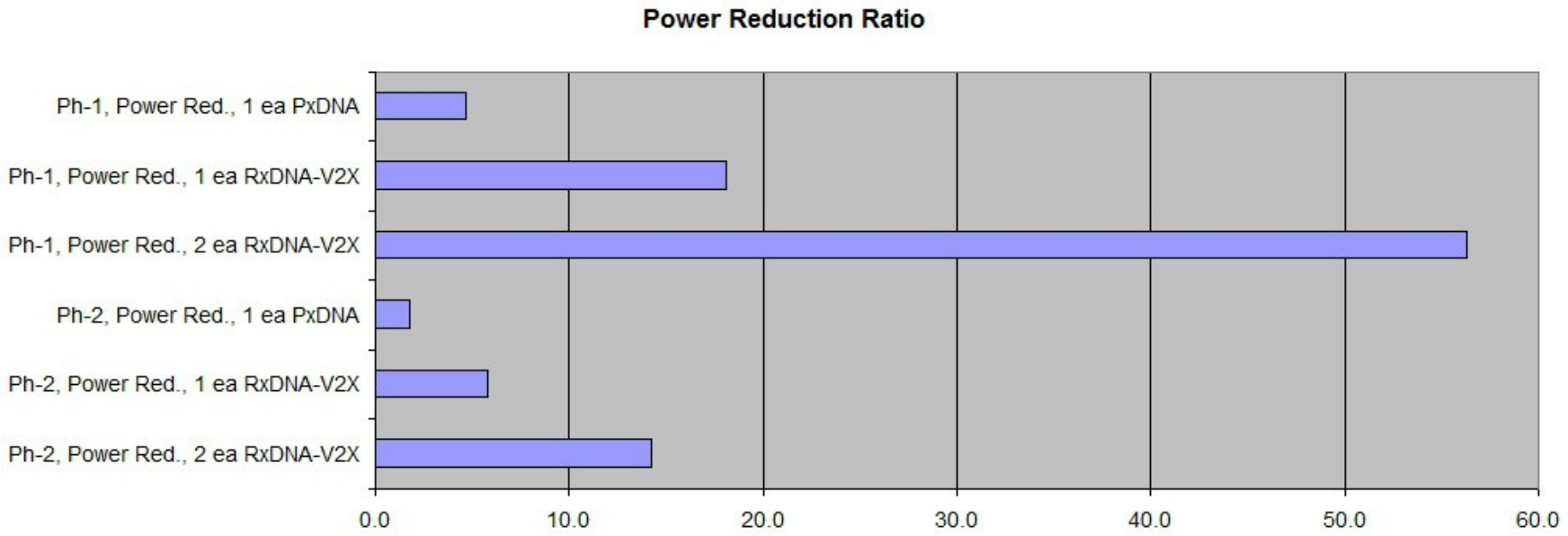

PHOTOVOLTAIC 'DC' SYSTEM
RATED MAX POWER-POINT CURRENT
45.4Adc
RATED MAX POWER-POINT VOLTAGE
110vdc
MAXIMUM SYSTEM VOLTAGE
600Vdc
MAXIMUM CIRCUIT CURRENT
70.8Adc
MAX RATED OUTPUT CURRENT OF
THE CHARGE CONTROLLER IF INSTALLED
60Adc

Battery Pack

Averaged Dirty Electricity Values



Power Reduction Ratios



Power Reduction Ratio	
Ph-2, Power Red., 2 ea RxDNA-V2X	14.2
Ph-2, Power Red., 1 ea RxDNA-V2X	5.8
Ph-2, Power Red., 1 ea PxDNA	1.8
Ph-1, Power Red., 2 ea RxDNA-V2X	56.3
Ph-1, Power Red., 1 ea RxDNA-V2X	18.1
Ph-1, Power Red., 1 ea PxDNA	4.6

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.

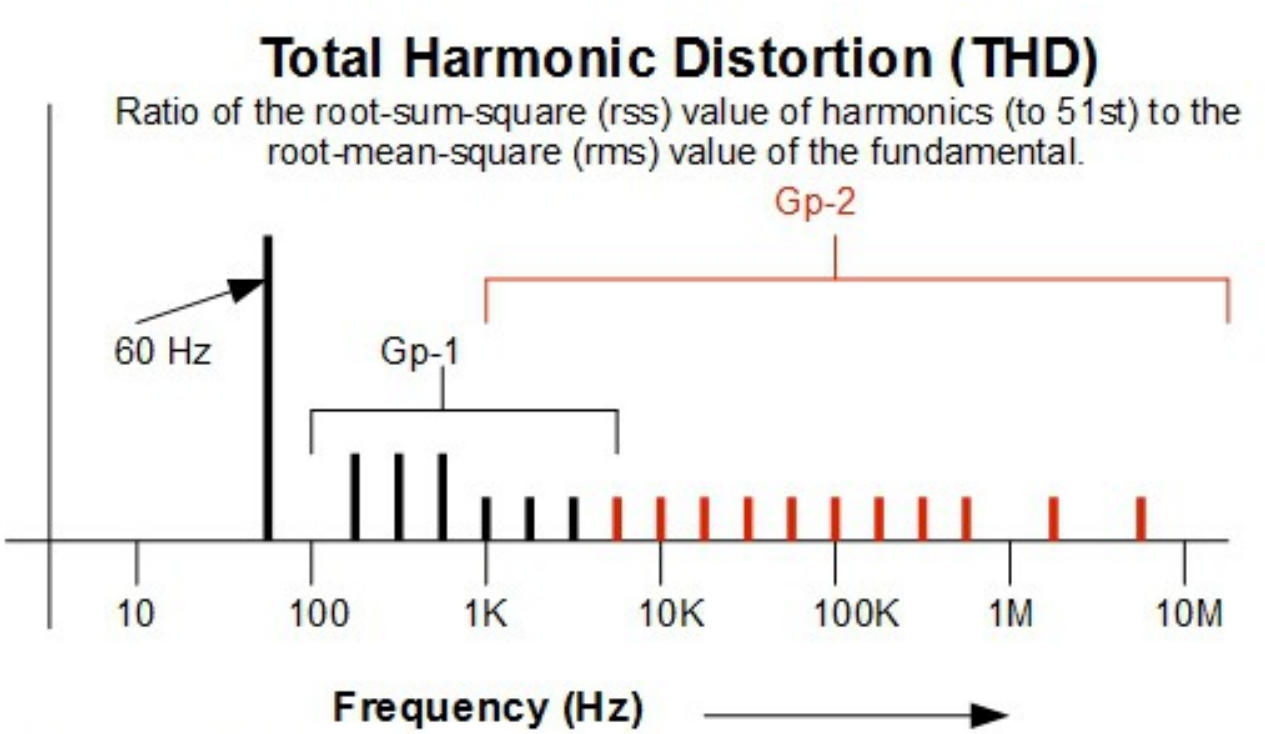
Total Harmonic Distortion 2

- 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: 3.7 %
- Phase 2: 4.9%
- These are acceptable THD numbers.

Summary and Conclusions 1

- The Dirty Electricity (DE) on this site was a high value. While there are indeed inverters in operation around the country that have more DE than this Site, here in this town, this is the highest DE that we have measured so far.
- The PxDNA reduced the DE by varying amounts on the 2 phases as the data shows.
- The RxDNA-V2X filter was also tested, as was Double RxDNA-V2Xs.
- The RxDNA-V2Xs accomplished significantly more reduction than the PxDNA filter.

Summary and Conclusions 2

- An expected reduction ratio for the PxDNA is 5:1 to 10:1.
- The 4.6 Power Reduction Ratio for Phase 1 is right below the low end of the expected reduction range.
- The 1.8 Power Reduction Ratio for Phase 2 is significantly less than the low end of the expected reduction range.
- For both phases, the inverter appears to be a “tough case”.

Summary and Conclusions 3

- While the PxDNA performance was less than would typically be expected, it is noted that a single RxDNA-V2X, on each phase, produced approximately 3 times the DE power reduction.
- Upgrading to RxDNA-V2X might be an idea to consider.
- THD on both phases was acceptable.
- Phase 1: 3.7 %
- Phase 2: 4.9%
- THD on Phase 2 was close to the limit that inverter manufacturers typically specify.

Instrumentation

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

RxDNA-V2X Parallel Filter

- Thanks For Watching The Video !