SAND2012-6529P

Residential Grid Tied PV

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Overview

- My background
- Residential PV Introduction
- Description of Each Device
- Issues with Single Phase Operation
- Mitigation Method

Background

Publications:

Published Papers:

L. D. Watson, ,S. Atcitty, J. W. Kimball, “Linear Single Phase Inverter Model, for Battery Energy Storage System Evaluation and Controller Design" in *Proceedings of the IEEE Applied Power Electronics Conference (APEC)*, 2012.

L. D. Watson, J. W. Kimball, "Frequency Regulation of a Microgrid Using Solar Power," in *Proceedings of the IEEE Applied Power Electronics Conference (APEC)*, 2011, pp. 321-326.

M.M. Baggu, **L.D. Watson**, J.W. Kimball, B. H. Chowdhury, "Direct power control of doubly-fed generator based wind turbine converters to improve low voltage ride-through during system imbalance," in *Proceedings of the IEEE Applied Power Electronics Conference (APEC)*, 2010, pp. 2121-2125.

J.W. Kimball, K.R. Eckler, **L. Watson**, "Sigma-delta modulation of multi-phase high frequency converters," in *Proceedings of the IEEE Applied Power Electronics Conference (APEC)*, 2010, pp. 2202-2206.

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Manuscript Accepted:

L.D. Watson, J.W. Kimball, "Microgrid Frequency Regulation with Double Frequency Elimination," IEEE Transactions on Power Electronics, submitted May 2 2012.

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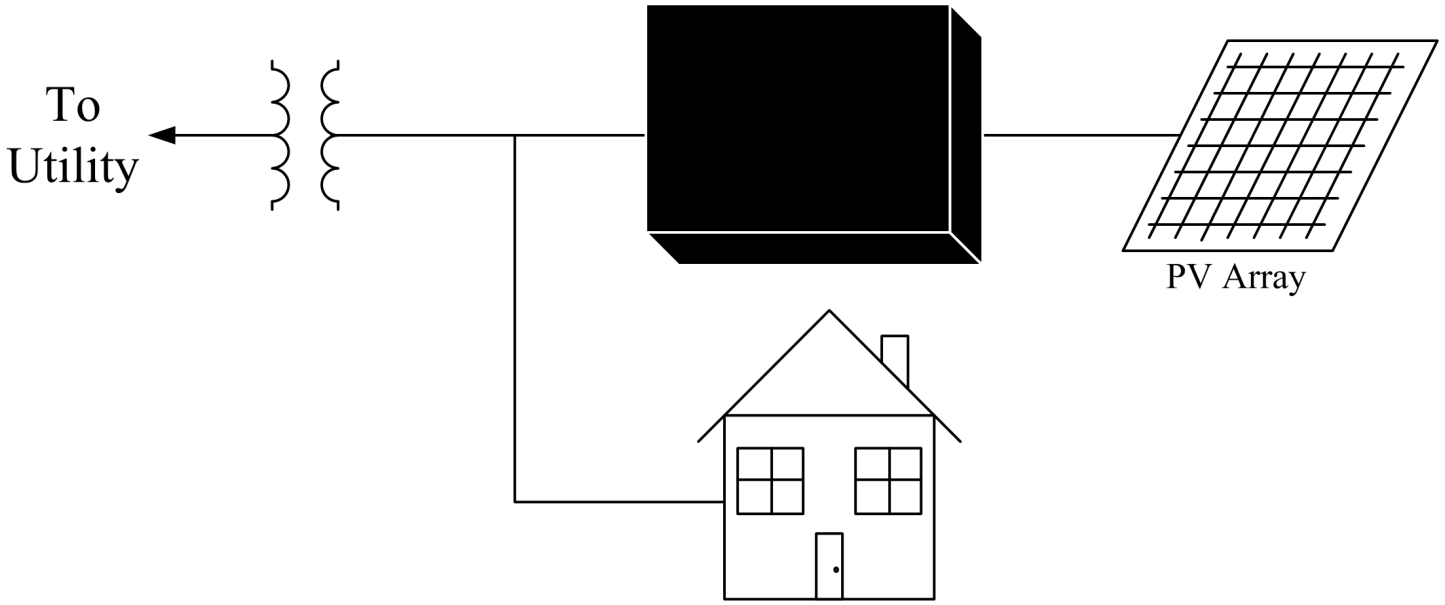
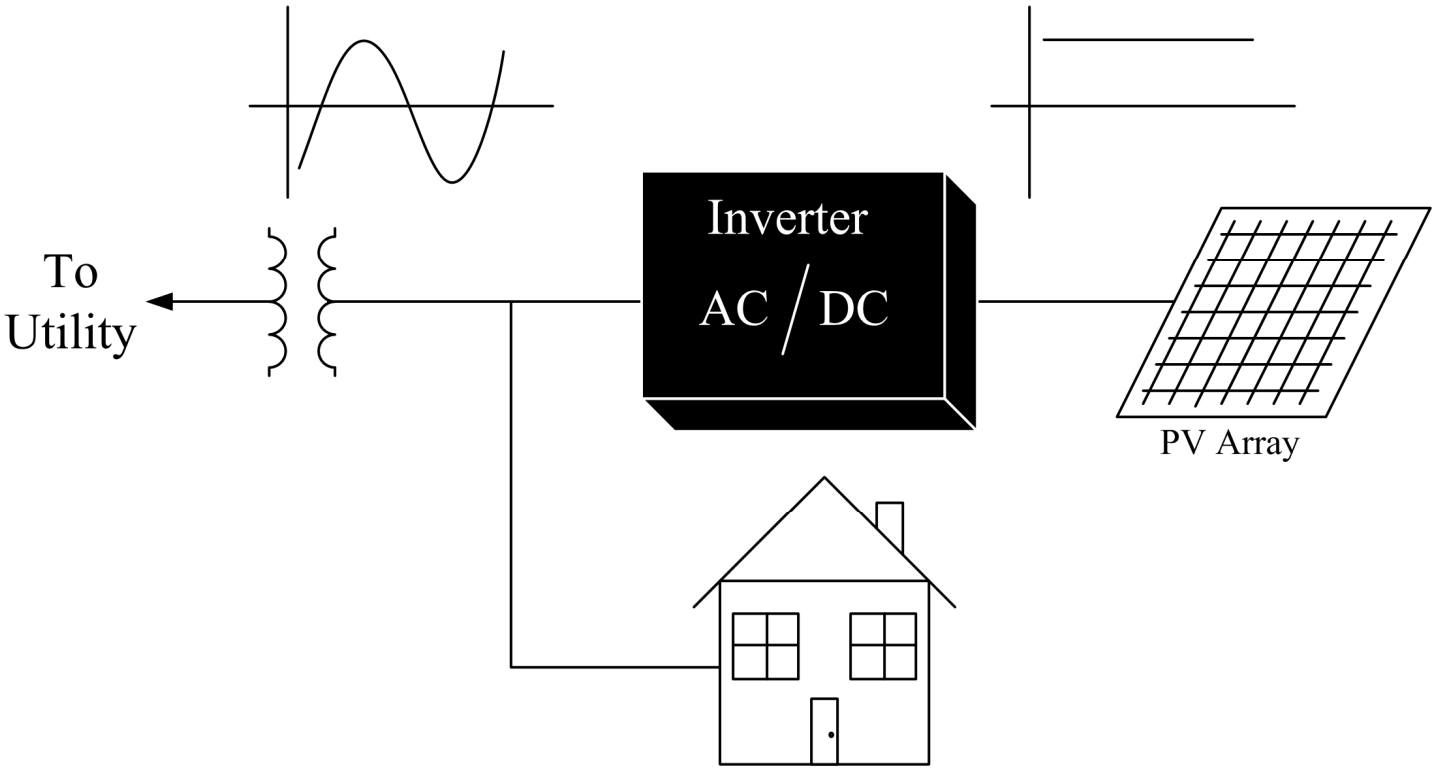
Introduction

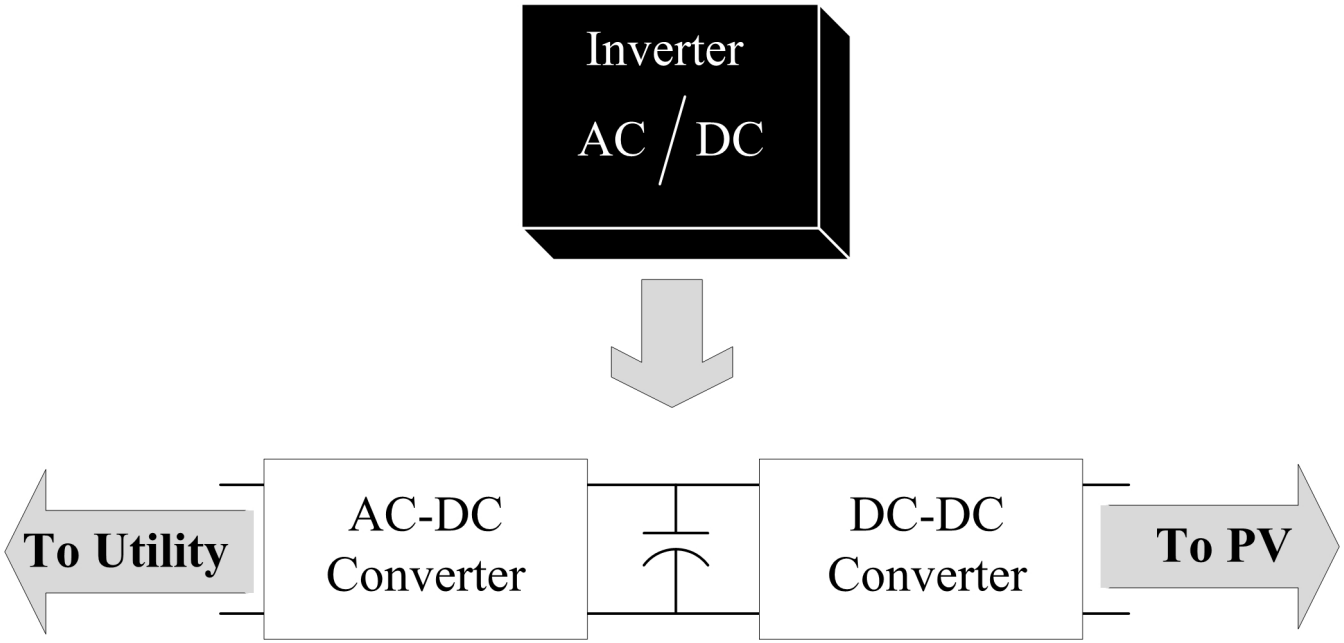


Introduction

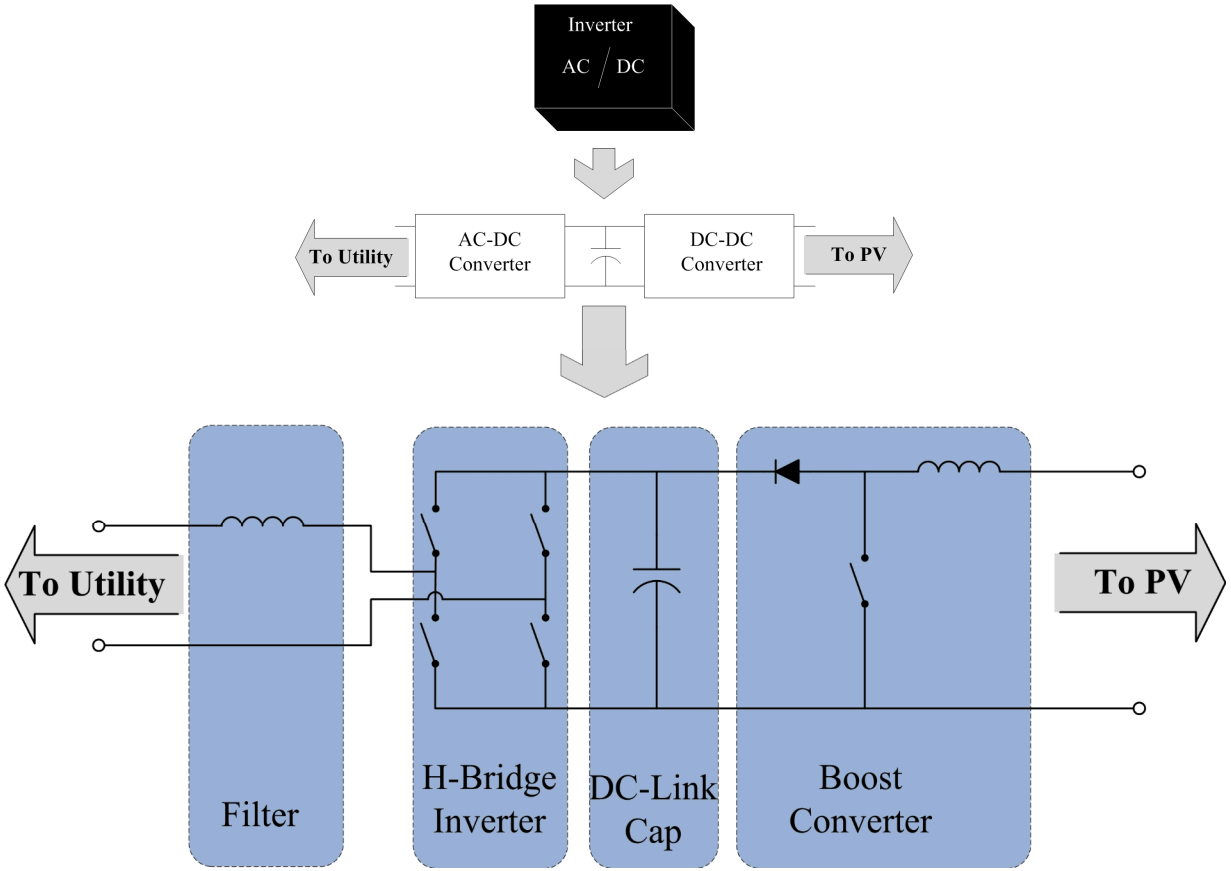


Single Phase Inverter

- **Typical single phase inverter setup**



Single Phase Inverter - Circuit



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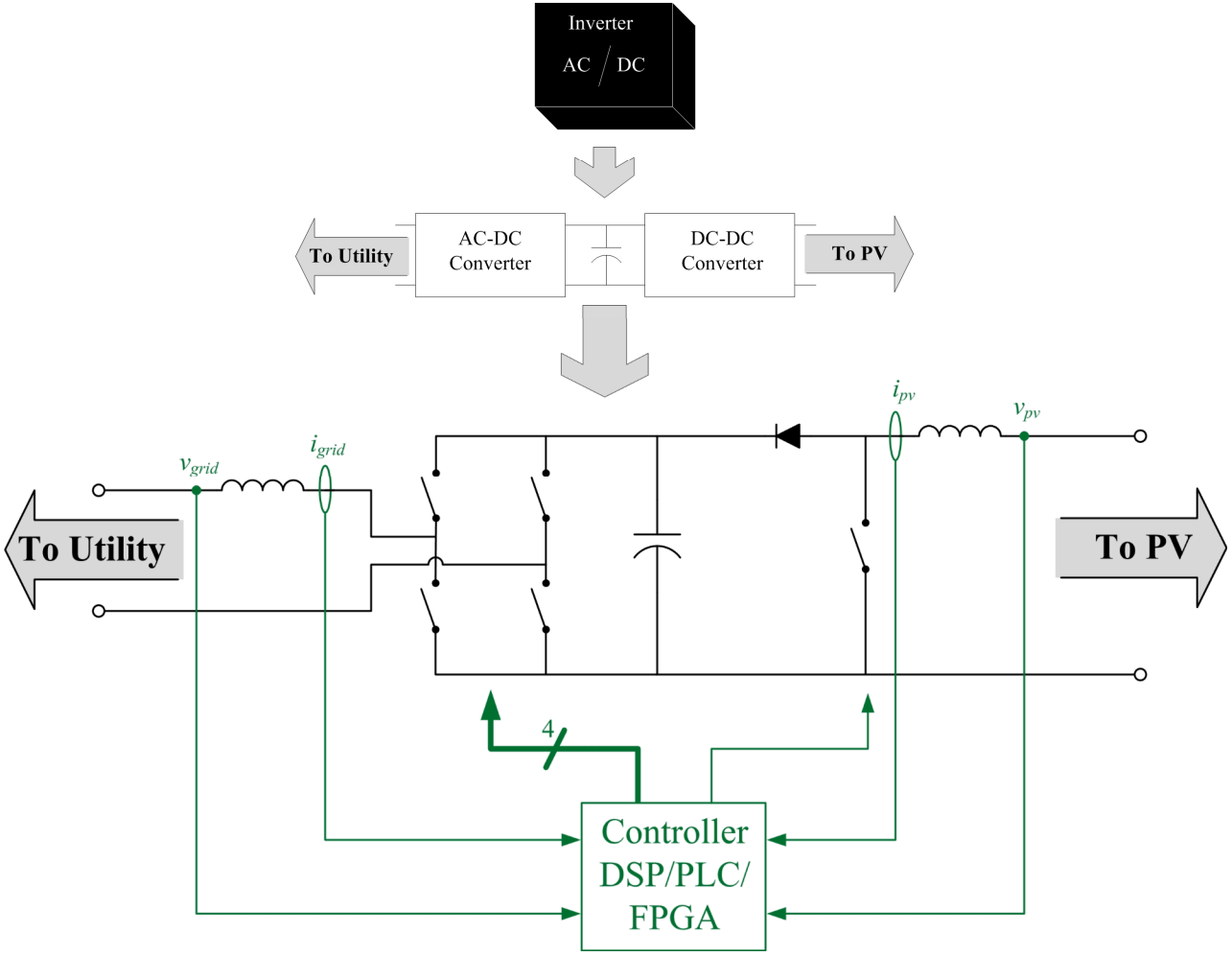
Single Phase Inverter - Controls



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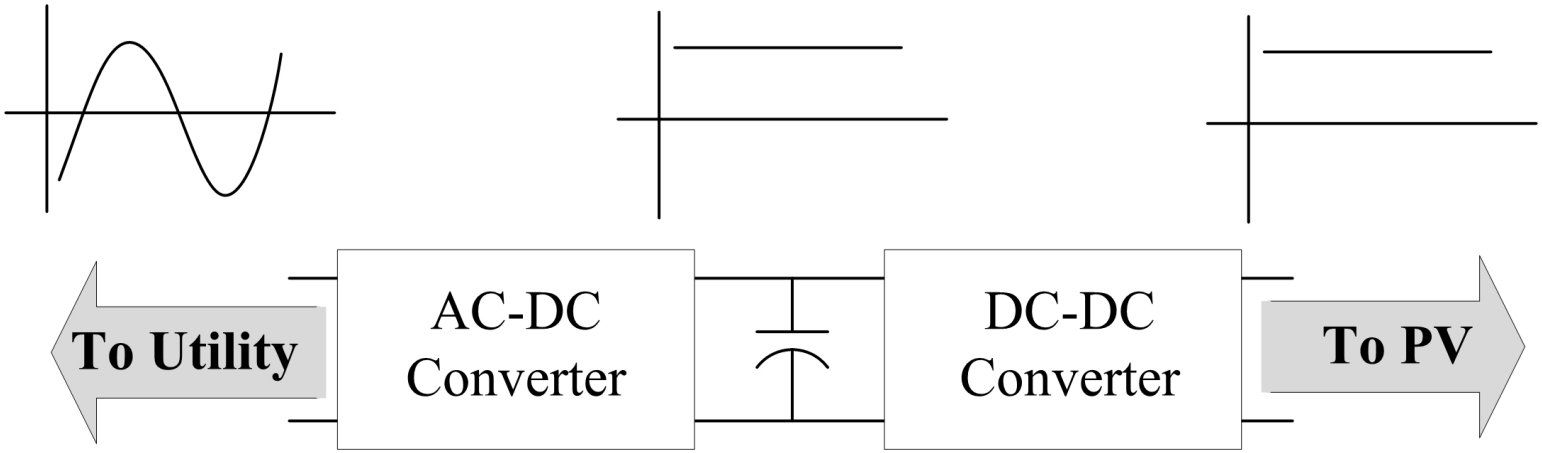
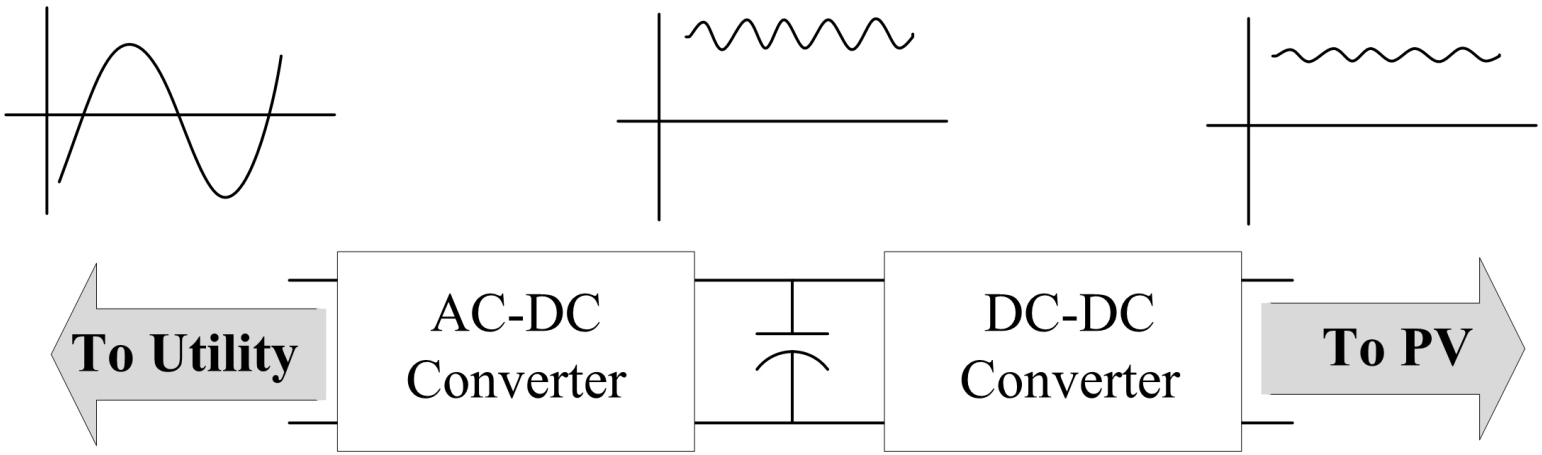
Ideal System Signals

- 60 Hz input
- DC voltage on the DC-link
- DC output from the PV panel



Actual System Signals

- 60 Hz input with harmonics
- DC voltage on the DC-link
- DC-link ripple propagates to the PV panel output



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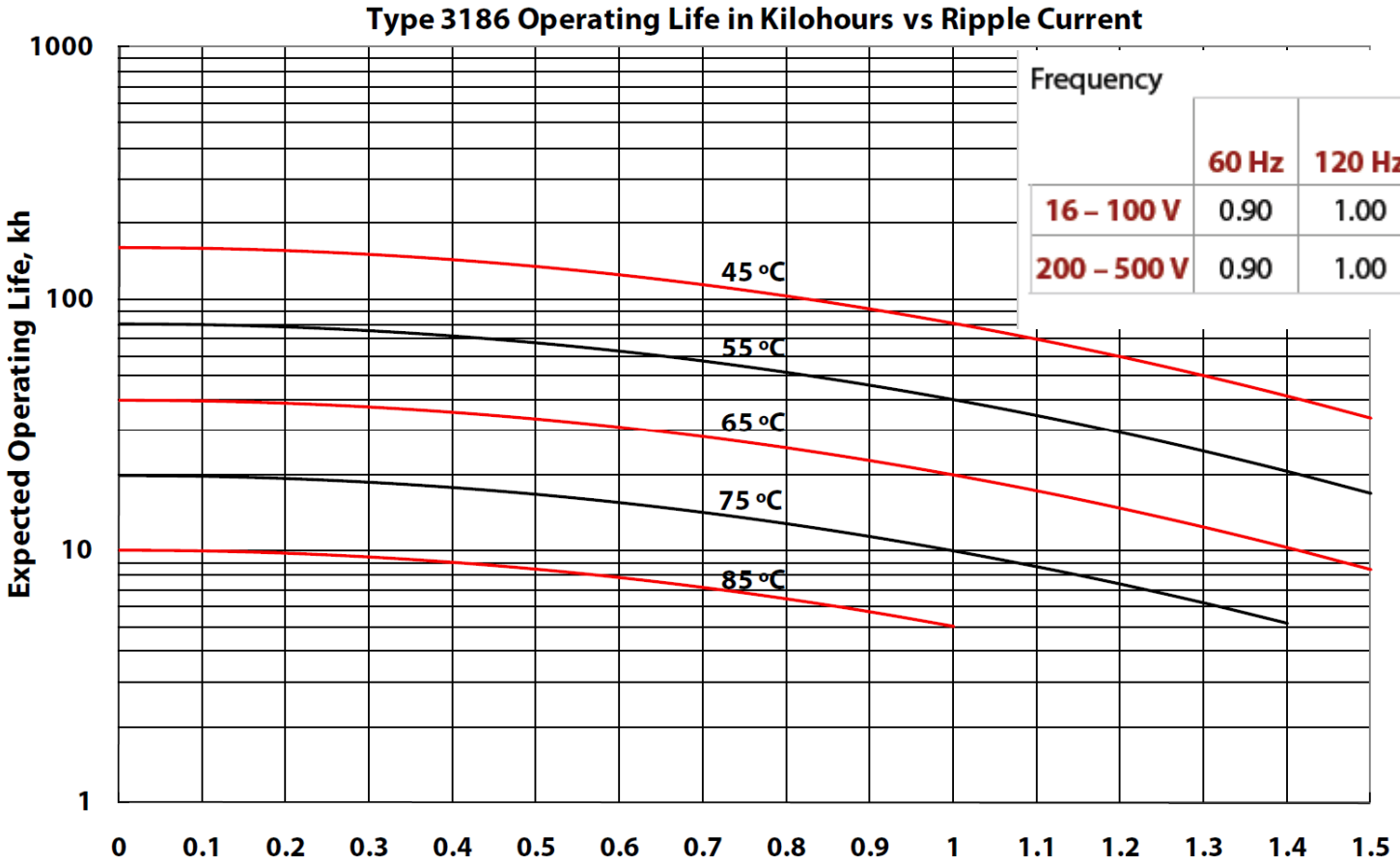
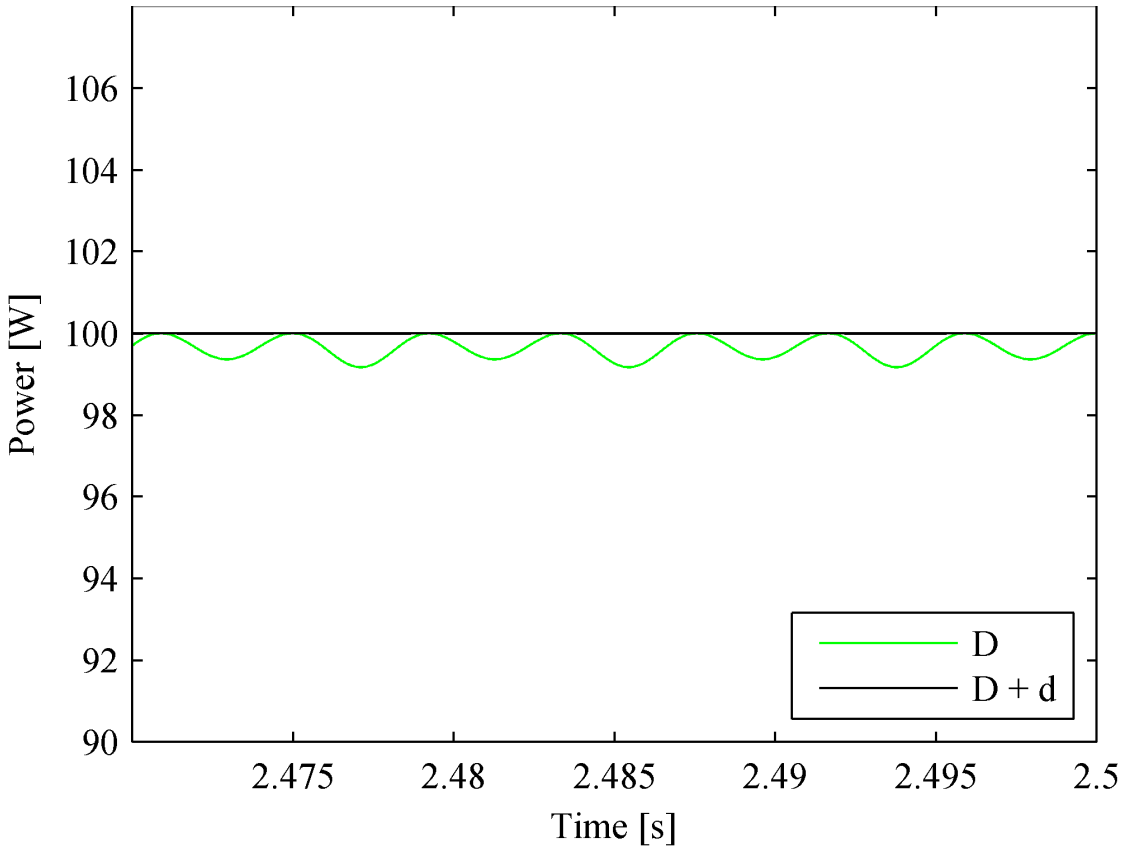
Issues – DC-Link Capacitors



Frequency	60 Hz	120 Hz	300 Hz	1000 Hz	≥10 kHz
16 – 100 V	0.90	1.00	1.15	1.25	1.30
200 – 500 V	0.90	1.00	1.25	1.40	1.50

source: http://www.cde.com/catalogs/3186.pdf

Issues – Operating Away from MPP



- The maximum amount of power is not extracted from PV panels in residential applications.

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Mitigating Ripple Issues

- Develop controls which are immune to large ripples in DC-link voltage
- Allows for smaller capacitors to be used and prevents ripples from propagating to the PV panel
- Cheap solution, since only software needs to be updated, no change to current hardware is required

Questions?

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