

ECE 528 – Understanding Power Quality

<http://www.ece.uidaho.edu/ee/power/ECE528/>

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Lecture 1

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Getting Started

- Introductions
- Course Logistics
- Class website:
www.ece.uidaho.edu/ee/power/ECE528/
- General Information, Syllabus, Grading
- Lecture Notes / Homework / Exams
- BBLearn – “About us” blog

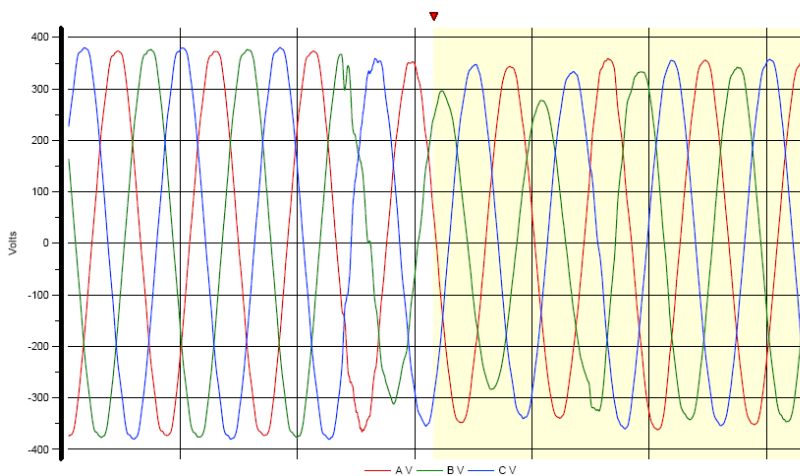
What is "Power Quality" (PQ)?

- Power Quality = Voltage Quality (from PSQ)
 - frequency, amplitude, distortion
- Voltage quality issues may be temporary or continuous
 - Faults, switching, lightning
 - Non-linear loads, use of power conductors for data transmission
 - System design problems
- Power Quality is similar to Electromagnetic Compatibility
 - Emissions – what a device puts into its environment
 - Immunity – what a device can tolerate in its environment

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A temporary voltage quality issue:



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What is "Power Quality" (PQ)?

- From IEEE 1100-2005:
"The concept of powering and grounding electronic equipment in a manner that is suitable to the operation of that equipment and compatible with the premise wiring system and other connected equipment"
- From IEC61000-1-1
"...the ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment."

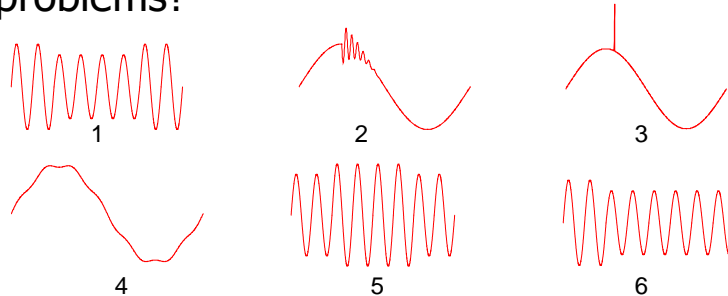
PQ Problems:

- From PSQ, a PQ problem is:
"Any power problem manifested in voltage, current, or frequency deviations that results in failure or misoperation of customer equipment."
- The "Power Quality Equation":

$$\text{Electrical Disturbance} + \text{Path} + \text{Vulnerable Equipment} = \text{Power Quality Problem}$$

What is a PQ problem?

Do these voltage waveforms represent PQ problems?



Only if they cause equipment to misoperate or fail.

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Is it a PQ problem?

- A network server reboots randomly.
- Utility distribution capacitors blow fuses repeatedly.
- Variable speed drives at a sewage treatment plant trip off occasionally while the rest of the plant keeps running.
- A retail store reports that individual cash registers sometimes stop working properly.
- Variable speed drives in a large HVAC system occasionally fail catastrophically during the monthly generator test.
- A customer receives a small shock when they touch a cable-TV signal splitter in their home.

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Why is power quality important?

- Power quality problems impact us more often:
 - New equipment:
 - more efficient, more features but may be more sensitive and may be “always on”
 - Emphasis on efficiency:
 - increased use of power electronics
 - 24/7 production streams operating at nearly 100% capacity - no time to catch up after interruptions
 - Increased use of automation

Why is power quality important?

- Interconnected/interdependent systems
 - Building Automation
 - temperature in my office is controlled from 130 miles away.
 - Business networks
 - Delta Airlines: power problem in their main computer network in Atlanta impacted thousands of flights worldwide for several days

What is Power Quality Engineering?

- PQ Engineers investigate equipment malfunctions and failures to determine:
 - Is the malfunction or failure a “PQ problem”, i.e., was it caused by an electrical disturbance?
 - What mitigation is appropriate? (disturbance, path, vulnerability, some combination?)
- We may find that the problem isn’t strictly a “Power Quality problem” after all!

Questions?

- Before next session:
 - Visit class website – download homework 1
 - Visit UI library online, log in and visit IEEE Xplore database – download and read the paper: “Are Voltage Sags Destroying Equipment?” by Ashish Bendre et.al.
- Coming up:
 - Review AC circuits
 - Fourier Series
 - Symmetrical components