



Allied Industrial Marketing, Inc.
Power Quality Specialists

Harmonics Seminar (PQ-103)

Course Outline – 8 hour seminar

- | | | |
|------|---|-------------------------------|
| I. | Introduction | 60 minutes
(slides 1-16) |
| | a. Reference materials | |
| | b. What is harmonic distortion? | |
| | c. Linear and non-linear loads | |
| | d. Voltage and current distortion | |
| | e. Harmonic spectrum | |
| | f. Total Harmonic Distortion | |
| II. | Causes of Harmonic Current Distortion | 90 minutes
(slides 17-38) |
| | a. End user equipment | |
| | b. AC to DC power conversion equipment | |
| | c. Block diagram for VFD or UPS | |
| | d. Types of Rectifiers | |
| | e. Sequence of harmonics by rectifier type | |
| | f. 6-pulse rectifiers | |
| | g. Typical 6-pulse rectifier harmonics | |
| | h. Effect of source impedance on 6-pulse rectifier current distortion | |
| | i. 12-pulse rectifiers | |
| | j. 18-pulse rectifiers | |
| III. | Problems caused by harmonics | 150 minutes
(slides 39-88) |
| | a. Wasted energy, increased current & kVA | |
| | b. Equipment failure, Increased operating temperatures | |
| | c. Effects of harmonics on transformers | |
| | d. Effects of harmonics on capacitors | |
| | e. Fuse blowing, C.B. tripping | |
| | f. Communications equipment interference | |
| | g. Harmonic resonance (series & parallel) | |
| | h. Harmonic voltage distortion | |
| | i. Harmonic voltage distortion analysis | |
| | j. SCR voltage notching | |
| | k. Remedy for SCR voltage notching | |

Allied Industrial Marketing, Inc.

W62 N248 Washington Avenue, Suite 208, Cedarburg, WI 53012

Phone: 1-262-618-2403 (GMT-6) Fax: 1-262-618-2303

www.alliedindustrialmarketing.com



- IV. IEEE std 519 – Limits for Harmonic distortion 30 minutes
(slides 89-98)
 - a. Voltage distortion limits
 - b. Current distortion limits
 - c. IEEE 519 definitions
 - d. Applying IEEE std. 519
 - e. Voltage notching limits
 - f. Telephone interference

- V. Remedies for harmonic distortion 90 minutes
(slides 99-133)
 - a. Passive, multi-pulse and active filter techniques
 - b. Line reactors
 - i. Predicting harmonic currents for 6-pulse rectifiers
 - c. Harmonic cancellation transformers
 - d. Tuned harmonic filters
 - i. General rules for tuned filters
 - e. Wide band hybrid harmonic filters
 - f. Multi-pulse rectifiers and harmonics
 - g. Active harmonic filters
 - h. VFD with active front end

- VI. Harmonics for single phase equipment 45 minutes
(slides 134-146)
 - a. Typical 1-phase non-linear loads
 - b. 1-phase rectifiers
 - i. current waveforms
 - ii. typical harmonics and distortion
 - c. Unique problems with 3rd harmonic
 - d. Typical 1-phase remedies for harmonics

- VII. Wrap-up 15 minutes
(slides 148-152)
 - a. Symptoms of harmonics
 - b. What to do if you suspect a harmonics problem
 - c. Avoiding harmonics problems
 - d. Best practices



Allied Industrial Marketing, Inc.
Power Quality Specialists

Harmonics Seminar (PQ-103)

Course Summary

Commercial and industrial companies have increasingly adopted the use of power electronics equipment to achieve greater energy efficiency and improved process control. Many companies are using power electronics equipment such as adjustable speed drives, uninterruptible power supplies, computer controlled equipment, etc. With the adoption of power electronics equipment, the subject of harmonics has become an important topic for people responsible for installing, specifying or servicing electrical and electronic equipment.

Power electronics equipment typically causes harmonic distortion and can degrade the quality of electrical power in a building, increase equipment operating temperatures, increase demand on power sources and reduce electrical system efficiency. As power electronics equipment becomes a larger percentage of the total building loads, or when the building contains sensitive loads, the problems associated with harmonics become more apparent.

This eight hour seminar explains harmonic distortion and its causes, identifies problems associated with harmonics and practical limits for harmonic distortion. The seminar teaches methods to identify, reduce and to avoid harmonics problems and how to predict estimated levels of harmonic distortion.

Several real life examples are worked as a group to demonstrate the techniques used to perform basic harmonic analysis, evaluate alternative equipment and to quantify the expected results.

Upon completion of this course, participants should have a meaningful understanding of harmonic voltage and current distortion, the impact that harmonics can have on electric power systems, the typical causes, simple methods to analyze harmonic distortion and methods to minimize harmonics.

This course is applicable to electrical industry professionals serving either industrial or commercial environments. For maximum benefit of this course, participants should have an understanding of basic electrical principles such as Ohms law, power, electrical metering, motors and general electrical equipment and systems and a working knowledge of basic algebra.