# Automatic Measuring and Calculation of System Harmonics

## Abstract

Recently more and more non-linear loads have been used in the power system , which causes the waveforms of the power network to be more distorted . The distorted waveforms can greatly reduce not only the electrical power quality from the electric power supplier , but also the performance of the conventional electric measuring meters , e.g. the induction meters . The performance of the revenue meters under distorted waveform conditions is no longer of theoretical interest only . The conventional meters for measuring the r.m.s. voltage , r.m.s. current , active power , power factor , etc. can be accurately measured under perfect sinusoidal waveforms , but they will have large error in measuring under the non-sinusoidal waveforms . The problems we face are not only about the practical technology , but also about the definitions for power parameters . For those twenty years , the research activities around the world pay a lot of attention on this topics .

In this thesis , the automatic measuring is designed as a system that can measure the r.m.s voltage , r.m.s. current , frequency spectrum , active power , reactive power , power factor , apparent power , etc. under the influence of the distorted waveforms . The calculation of the system harmonics is defined as the process or work to determine the definitions of the power's parameters and any event it relates to the influence of harmonic for single-phase or 3-phase system .

The investigation on the implementation of a harmonic analyzer , a single-phase power meter and a 3-phase power meter during strong harmonics is achieved . The secret generation of harmonic active power and oscillating power are observed and the different ways of decomposition of apparent power in single phase system are obtained . The result that I obtained during investigation for single-phase system is extended to 3-phase system .

The automatic measuring equipment is achieved by a Personal Computer , one A/D card , Hall Effect Transducers and other related components .

This thesis is divided into three main parts : I ) Harmonic Spectrum
II ) Single-phase system
III ) Three-phase system .

The harmonic spectrum analyzer is achieved by cheaper components such as hall effect transducers , filters , an A/D card and a PC . Fast Fourier Transform is employed . Power factor should be defined as a merit to check the electric system whether there is any possibility to minimize the loss . In single-phase system , power factor is affected by the storage elements (e.g. inductors and capacitors ) and harmonic components . In 3-phase system , power factor is influenced by storage elements , harmonic components and unbalanced condition . 3-phase power factor is defined without confusion as past years . Conventionally , complex plane power analysis is considered only for oscillating components without dc information . The dc power and oscillating power are decomposed and it reveals the secret of delivering active power . The apparent power in 3-phase system is defined healthy by using symmetrical components . Some indices are suggested to check whether generators , transformers or loads cause harmonics and to answer how much harmonic oscillating power is flowing on the system .

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