ELECTRICAL AUTOMATION SYSTEMS TOWARDS INTELLIGENT AND ENERGY EFFICIENCY APPLICATIONS

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IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

ISBN: 978-967-418-170-3

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN.BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan
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CHAPTER 17

LOW VOLTAGE POWERLINE ANALYSIS AND SIMULATION RESULTS

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This chapter presents amplitude and phase responses of a case study project, the effect of length to the signal voltage attenuation, discussion and analysis, conclusion and references.

17.1 Amplitude and Phase Responses of Case Study Project

Both the amplitude and phase response are significant parameters for a communications channel. The amplitude response determines the signal voltage attenuation, when the signal propagates through the channel from a transmitter to a receiver. Furthermore, the signal attenuation together with a signal to noise ratio and with the available bandwidth determine the maximum data transfer rate that can be theoretically attained. In addition to the amplitude response, the phase response is also an important parameter when considering the quality of the channel for digital communications. For the channel the linear phase response is desirable characteristics. Due to the phase nonlinearities, the waveform of the transmitted symbol changes when propagating through the channel from the sending point to the receiving point. This easily leads to synchronization errors if data are transmitted parallel using the multi carrier data transfer methods, as e.g. OFDM (orthogonal frequency division multiplexing). The linearity of the phase response is described by a term group delay or envelope delay τ_g (Ahola, 2003):

$$\tau_g(f) = -\frac{1}{2\pi}\frac{d\theta(f)}{df} \tag{17.1}$$

where θ describes the signal phase. With linear phased channel the group delay should be constant. The group delay is interpreted as the propagation time of a signal frequency component from the input to the output of the system (Proakis, 1996).

Simulation models were formed for the power-line channels of the pilot environment using the procedure and methods described in section 3.3. The simulated amplitude responses are illustrated in figures 3.7–3.10.