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REMOTE CONTROL OF ELECTRICAL APPLIANCES VIA POWER LINE 230V

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ABSTRACT
The submitted work deals with problems of data transfer via power line 230 V for purposes of remote control electrical appliances. In this work were designed devices which provide relative communication via power line within the frame of the one-family house. Designed devices concretely input-output unit, PC interface and GSM gate work on a bus principle. The bus is constructed by power line 230 V. Designed devices are composed of microcontrollers AVR and modem TDA5051AT provides their relative communication via power line. Communications protocol with which devices work was developed so that corresponds with hardware resolution of particular devices. Particular devices were practically realized and their activity was checked up.
Keywords: power line, remote control, wireless, data transfer

1. INTRODUCTION
The idea to use power lines to data transfer is relatively old. The first tests were made 20 years ago but principles were described during the first half of the 20th century. The date transfer via power lines can be used in computer areas, building automation or industrial automation. The mentioned technology brings a lot of advantages. The main priority of this technology is using installed power cable to date transfer, so there isn´t necessity to install data cable. On the other side the system for data transfer is very sensitive towards a signal noise.
This paper describes design of system for remote control of electrical appliances via power line 230 V. The paper is organised as follows: Section 2 contains principle of physical data transfer via power line; Section 3 presents basic requests on transmission equipment in power line and Section 4 describes design of bus system for remote control of electrical appliances via power line 230 V.

2. PRINCIPLE OF PHYSICAL DATA TRANSFER VIA POWER LINE
The basic principle of data communication via power lines 230 V can be designed according to the model ISO/OSI. The applied protocols and services of individual layers of the model ISO/OSI are dependent on data transfer character. The physical data transfer use rules of communication engineering, it means rules of telecommunications and radio-communications. The communication system is the set of devices that realise optimal data transfer via power lines. The principle of the communication devices setting is shown in Figure 1.
The information in power line system are transferred via serial transmission. Outgoing information is decomposed on serial bit sequence. This sequence goes to coder, the coder encodes separate bits to

potential pulses (data encoding Manchester). By the help of the modulator the transfer current pulses are modulated in order to safer transfer. The modulator uses analogue type of modulation with discreet modulation signal (ASK, FSK). The coupled circuit is separate part on communication system and is used as a band – elimination filter. It means that this part transmits only frequency band of modulated signal, the rest of frequency spectrum is blocked. This part separates transceiver and receiver. The data between coupled circuits are transferred via power lines. The data transfer can be designed as full-duplex mode or half-duplex mode [3].

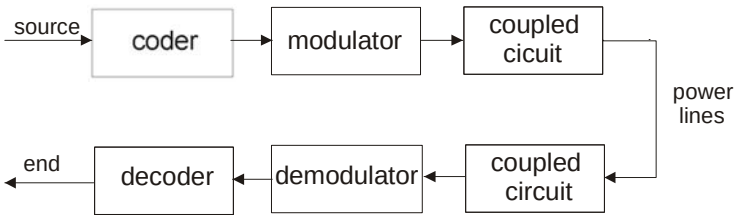

Figure 1. Setting of communication parts in power line system

3. BASIC REQUESTS ON TRANSMISSION EQUIPMENT IN POWER LINE

The system requirements on transmission equipment via power line are as follows:

- maximum speed of data transfer
- to conserve original function of power lines – energy transfer
- electromagnetic compatibility
- to respect norm ČSN EN 50065-1.

3.1. Frequency band used for data transfer in power line

In Europe four frequency bands are used for data transfer via power lines. Because of perturbation in power lines (perturbation of electromotor, perturbation of thyristor regulator etc.) the low frequency boundary for data transfer is 100 kHz. In Table 1 are described frequency bands for data transfer via power line.

3.2. Source of noisy

The most frequent source of perturbation in power lines are:

- pulse source – often used in consumer electronics (from 15 kHz to 1 MHz)
- thyristor regulator – used in speed control (from 100 Hz to 120 Hz)

Table 1. Frequency bands for data transmission via power lines (CSN EN 50065-1)

Band	Transmission bandwith [kHz]	Purpose
	3 - 95	for provider of electrical energy
A	9 - 95	for provider of electrical energy and with agreement of customer
B	95- 125	for customer of electrical energy
C	125 - 140	for customer of electrical energy with agreement
D	140 – 148,5	

- serial motor – used in household
- communication of distribution company.

4. DESIGN OF BUS SYSTEM FOR REMOTE CONTROL OF ELECTRICAL APPLIANCES VIA POWER LINE 230V

Essential features of designed bus system are:

- applicable for remote control (switch on/off mode)
- maximum of working reach – 400 m
- remote control via PC, GSM network, input/output unit
- open system (maximum of connecting equipment is 254)
- transfer path – power line 230 V (supply system TN-S, TN-C)
- non-standard communication protocol
- system correspond to norm CSN EN 50065-1.

Structure of the bus system is shown in Figure 2. The system contains three types of modules [1]. There are:

- input – output unit PLM 16 IO
- PC interface PLM 162 PCI
- GSM pager PLM 162 GSM G.

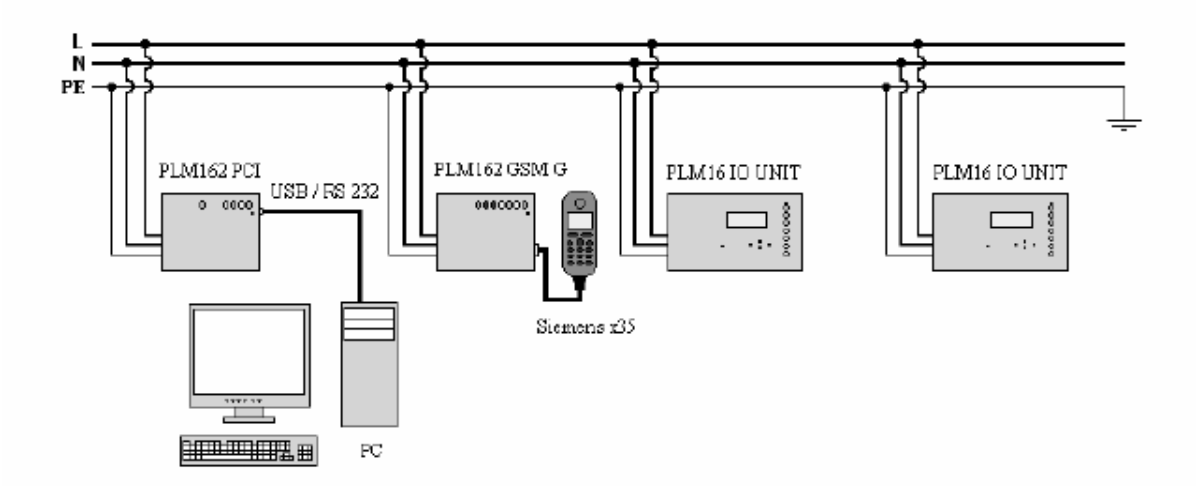

Figure 2. Structure of design bus system

PC interface is unit between PC and designed bus system. By the help of designed program there is possibility to monitor data transfer in power line system and to configure individual equipment of the bus system.

GSM gate with mobile phone Siemens x35 (or another mobile type) via GSM network is used for remote control of individual equipment od the bus system.

Input – output unit contains binary inputs and outputs, relay outputs, seven inputs pro temperature sensors, A/D converter. By the help of this unit is possible to control individual inputs of bus system equipments.

All designed modules have common features that can be described as follows [2]:

- equipments are handled with microcontrollers AVR (Atmega 162, Atmega 16)
- modem TDA 5051 AT is used for data transfer via power line
- equipments are supplied via 230V
- equipments are handled with zero detector.

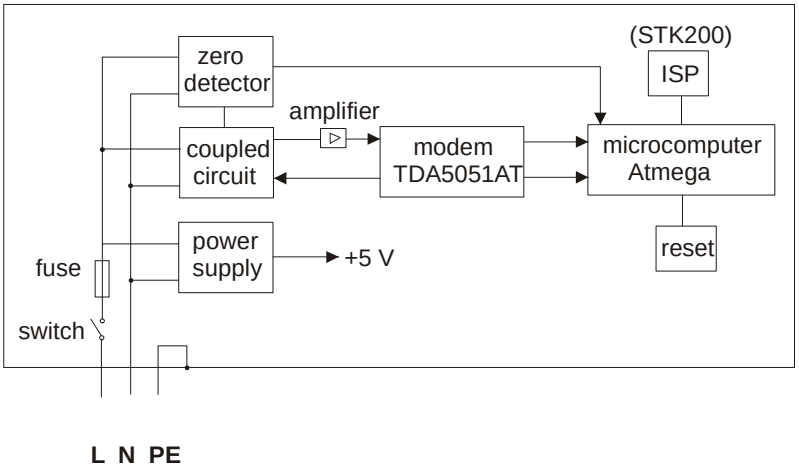

Figure 3. Main elements of individual models

The individual parts of the bus system have different function but the parts have similar hardware structure. The main parts of the module are shown in Figure 3.

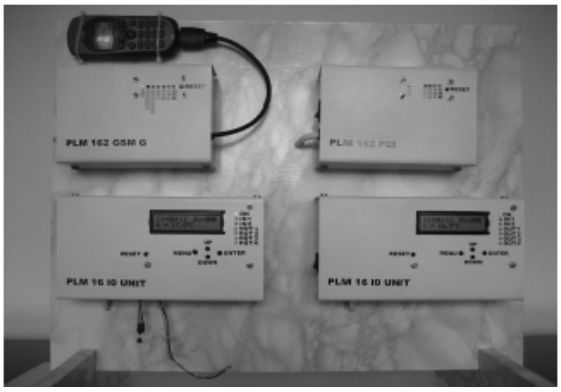

Figure 4. Designed bus system

Figure 5. Input – output unit

6. DISCUSSION

Designed system generally could find large use in the area of buildings technology. Especially in the areas where is needed to solve tasks of remote control or remote monitoring. For example remote control and monitoring of heating, air-conditioning, lighting and etc..

7. ACKNOWLEDGEMENT

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