

Power Line Communication Based Remote Control of Electrical Equipments

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ABSTRACT

This paper presents the concept of transmission of signal over AC power lines, the signal transmission over power line communication could be occurs in both Narrowband and Broadband Frequency range. The technology can be useful for controlling the one station from another station in same or separate geographical area. The aim of this paper is to make controlling of any electrical appliances from one station to another and vice versa using half duplex bidirectional communication technique, also this makes use of the already existing power lines as a physical medium to control the machines or electrical equipment's.

Keywords: PIC Microcontroller, Power line Modem.

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I. INTRODUCTION

Power line carrier communication systems consists of a high frequency signal injection over the electrical power lines. This kind of technology has been used since the 1950 decade in order to provide signaling and ripple control in high voltage line, at transmission level. In the last years the interest for this technology has suffered a revival because the impressing increase of the mobile telecommunications has brought a big development in transmission technologies for this kind of communications. In particular, new modulation technologies used for wireless communication are especially suitable for PLC communication and make massive data transmissions possible.

The power line modem uses the power line cable as communication medium. It is convenient as it reduces the need to lay extra cable. There is need to invent new kind of technology which is simpler to implement and is not as expensive as other related technologies. The main advantage of this system is simplicity of automation of their house. The system uses power line communication modem as a power line interface for transmission and reception of signal. The

half duplex communication is used, duplex refers to only transmit or receive data at a time but not simultaneously.

The output of this work can become a part of such a product which can be plugged into all devices which are connected to power line. Such method provides affordable and integrated solution. The principle of PLC consists in superimposing a high frequency signal at low energy levels over the 50Hz electrical signal. This second signal is transmitted via the power infrastructure and can be received and decoded remotely. Thus the PLC signal is received by any PLC receiver located on the same electrical network.

Literature Survey :

The idea of using an existing medium to send the communication signals is as old as the telegraph itself. But it not been possible until the recent decades. The first significant step in the field was when two patents were issued to American telephone and telegraph company. In the name of carrier transmission over power circuit in 1920. After four years later in 1924 two other patents were filed for the transmitting and receiving communication signal over three phase power line[2].

Power Line Communications (PLC) is an auspicious unindustrialized technology, which has attracted much attention due to the wide availability of power distribution lines. This concept provides a comprehensive overview to the use of power lines for communication purposes, ranging from channel characterization. The module provides bi-directional half-duplex communication over the mains of any voltage up to 230V AC and for frequency fifty cps or sixty cps[3].

Methods :

Block Diagram :

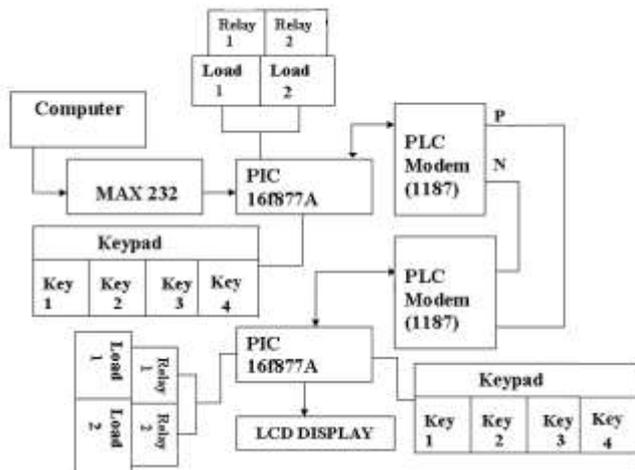


Figure 1: System block diagram of PLCC

Block diagram Description :

Power line communication is the use of existing electrical cable to transport data and it has been around for a very long time. Power utilities have been using this technology for many years to send or receive data on the power grid using the existing infrastructure. This technique is still employed by several utilities that use analog or digital devices to transfer 9.6kbps over many miles of electrical cables. "Power line communication" basically means any technology that enable data transfer at narrow or broadband speed through power line by using advance modulation technology.

The system is basically divided into two parts:

The first one is the transmitter section and second is receiver section. As shown in fig.1 the transmitter section used one PIC controller minimum system to which PLC modem is to be interfaced. The load or electrical appliance which has to be controlled is interfaced to the PIC controller through relay driver circuit. For the controlling purpose we have used computer and backup keys. When we use computer for controlling the communication takes place via serial interface MAX 232 with data rate of 9600bauds/sec. In case of any failure of computer we use the keys which are directly interfaced to the one port of the PIC controller, the key1 is used to switch on first load, the key 2 is used to switch off first load. In the same way the remaining two keys will be used for controlling of other load[1].

At the receiver side the signal is decoded according to the corresponding load which is to be controlled. The

same receiver can be used as transmitter and vice versa so we can control the equipments at the transmitter as well as receiver by using power line modem.

The system uses LCD display to display the name of the equipment to be controlled, so as to identify the signal is transmitted from controlling station. Liquid crystal cell display(LCD's) are used in similar applications where LED's are used. These applications are display of numeric and alphanumeric character in dot matrix and segmental display.

PLC Modem:



Figure 2: Top view of PLC modem

Power line is useful to send and receive serial data over existing AC mains power line of the building. It has high immunity to electrical noise persistence in the power line and built in error checking so it gives out corrupt data. The modem is in form of a ready to use circuit module, which is capable of providing 9600 baud rate low rate bidirectional data communication. Due to its small size it can be integrated into and become part of user power line data communication system.

The module provides bidirectional half duplex communication over the mains of any voltage upto 250vAC and for frequency 50Hz and 60Hz. half duplex communication means it can either transmit or receive data at a time but not both at same time. Normally module is in receiving mode all the time listening to incoming communication on the power line. Once your application gives serial data to transmit on its RX-IN pin, it switches over to transmit and transmits the data through power line. Once transmit process is complete it switches back to receiver mode. The transmission of data is indicated by red LED. The reception of data by modem is indicated by green LED which is on TX-OUT pin itself. Data communication of the module is transparent to users data terminal and protocol independent, as a result, multiple units can be connected to the mains without affecting the operation of the others. There is no hassel of building interface circuits. Interface to users data devices is a simple data in and data out serial link.

Transmission is bases on byte by byte basis. Once you give one byte to module for transmission, you will have to wait at least 500ms before a new byte is given to module against since the modules wait for zero crossing of AC mains to transfer a bit. For AC 50Hz system the zero crossing of AC signal happens every 10ms and modem needs 50 zero crossing to transmit one byte with error checking data. That is why it takes 500ms for one byte.

For example we want to transmit character “TEST”, then we will have to transmit ‘T’, then wait 500ms, then transmit ‘E’ and wait 500ms, then transmit ‘S’ and wait 500ms, then transmit ‘T’ and wait 500ms. This can be quite slow speed for big data transfer, but the purpose of this module is transfer of small data bytes like sensor reading and remote control for which this speed is ok to implement[5].

Application diagram:

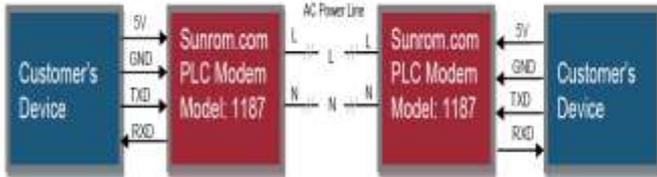


Figure 3: Application Block Diagram

Specification overview :

- Embedded ready to go power line carrier modem module with SMT component
- Small form factor for easy of system integration
- Bidirectional half duplex data communication over the mains
- Applicable to universal mains voltage and frequency upto 250v,50-60Hz
- Protocol independent ,data transfer transparent to users data terminals
- Simple serial interface to users data devices of 9600bps
- Built in carrier generation and detection
- Multiple units can be connected to the power line of the distribution transformers.

Shock Hazards :

It has built in on bold AC isolated coupling circuit, which allows direct and simple connection to mains. Due to isolation on AC part there is no worry to get shock on the low voltage side when working with it which is shown in blue box below. When AC mains line is connected module do not touch the non insulated part which is shown in red[5].

Blue box
Isolated part ok to touch

Red box
AC main section, shock Hazard. Do not touch

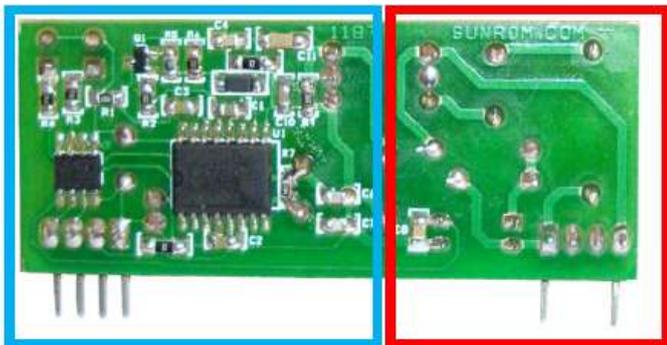


Figure 4:Bottom view of PLC Modem

Interfacing of PLC modem with PIC Controller :

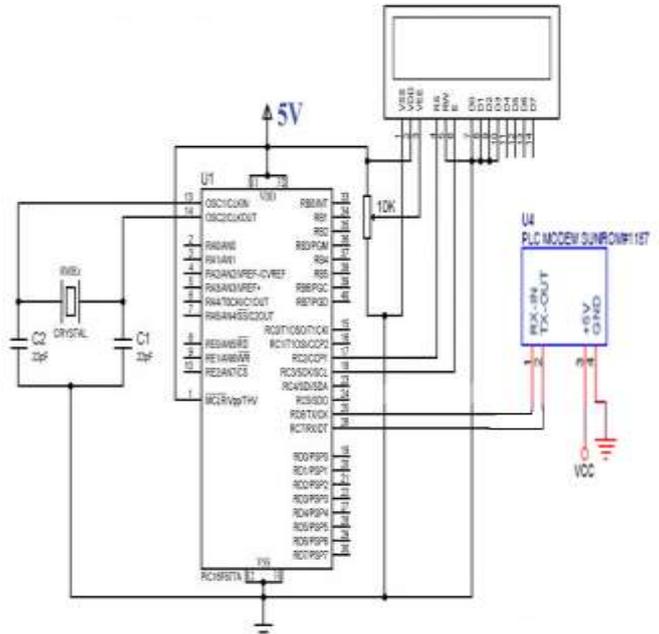


Figure 5: Interfacing of PLC modem 1187 with PIC Controller

Interfacing pin details of PLC modem 1187 :

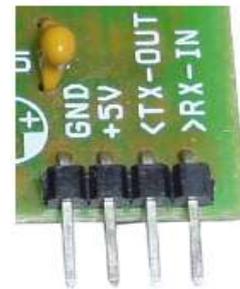


Figure 6:Pins of PLC modem 1187

Table 1: Pin Description Of PLC model

Pin	Pin Name	Pin Details
RX-IN	Receive input	Input serial data of 5V logic level, Usually connected To TXD pin of microcontroller.
TX-OUT	Transmit Output	Output serial of 5V logical level, usually connected toRXD pin of microcontroller.
+5V	Power Supply	Regulated 5V supply input.
GND	Ground	Ground level of power supply must be common Ground with microcontroller.

Standards :

Home plug and CENELEC standards are the most popular standards for high data rate and low data rate PLC system. Several competing standards are evolving as indicated below.

European telecommunications standards institute (ETSI) power line telecommunications (PLT):this provides necessary standards for voice and data services over the power line transmission. Interoperability accept are also discuss [].

Home-Plug Power-Line Alliance: It is a global organization consisting of some 65 member companies. The main aim of this is to enable and promote rapid availability, adoption and implementation of cost-effective, interoperable and standards-based home power-line networks and products. The resulting standards are expected to offer best performance. The Home Plug Power-Line Alliance has defined some standards like,

- (a) Home Plug 1.0 – specification for connecting devices via power-lines in the home,
- (b) Home Plug AV – designed for transmitting high definition television (HDTV) and VoIP around the home.
- (c) Home Plug BPL – a working group to develop a specification for to-the-home connection.
- (d) Home Plug Command and Control (CC) – command and control a specification to enable advanced, whole-house control of lighting, appliances, climate control, security and other devices[4].

Result and Discussion :

Power line communication can be used for Remote control, Emergency alarms, Securitypurpose, Messaging, Home and Industrial Automation.

Conclusion :

Power line channel surely is a cheap way to communicate, since it doesn't require any additional wiring. It can support the social needs for access to digital services from anywhere at any time.

PLC solutions may be seen as complementary or alternative solutions to traditional fixed linenetworks, wireless networks and VDSL networks. According to existing network architectures,buildings or technical constraints, either solution can be chosen, but one can also consider onesolution to complement another. PLC bandwidths are set to increase, the Homeplug AV standard isbeing considered for broadcasting digital television. Many research projects are ongoing into thesesolutions and their applications, it is all to come, and one should pay close attention to news aboutthis technology. We hope this paper gives an overall understanding of the topic in concise and quick way to the reader and researcher in the power line communication. In this we find PLC is attractive research area many studies are still necessary to be better understand and improve the performance of power line for high bit rate transmission.

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