International Journal of Education and Science Research
Review
E-ISSN 2348-6457
Volume-3, Issue-1
February- 2016
www.ijesrr.org
Email- editor@ijesrr.org

Microcontroller Based Telephone Exchange System

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ABSTRACT:
EPABX plays a vital role in office inter communication. An EPABX is basically a telephone switch that is used by businesses that is at their business location. EPABX is an abbreviation that stands for Electronic Private Automatic Branch Exchange. The aims of paper is to study telecommunication, connection with PIC16F877A and DTMF MT8870D. In microcontroller system, PIC 16F877 microcontroller is used to control the call processing. Dial tone, busy tone and ring tone are provided during call progress. Instead of using readymade tone generator IC, oscillator based tone generator is used.The private branch exchange (EPABX) provides internal station-to-station communications for a well-defined set of users. It also provides access to outside telephone lines, called trunks, which connect the private branch exchange to the telephone company's central office.This paper uses regulated 5V, 500mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

KEYWORDS: Control software, DTMF receiver and decoder, hooksensing, microcontroller system, power supply, ring generator and oscillator based tone generator.

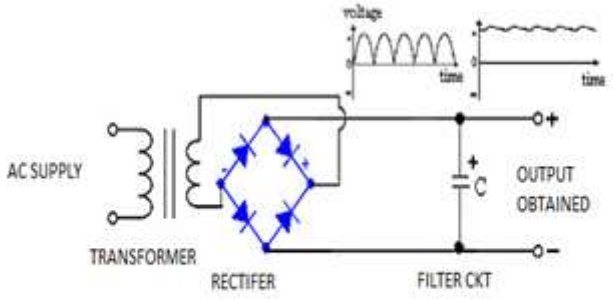
ANALYSIS OF THE MICROCONTROLLER-BASED TELEPHONE EXCHANGE SYSTEM:

This paper demonstrates the telephone systems with full signaling and switching functions. Thetelephones are connected to the switching devices and common line. In microcontroller system, PIC16F877A microcontroller is utilized to controltone, sensing on/off-hook switch when the telephone is used. Dial tone, busy tone, Ring tone is getting by Tone generator. Ringing is generated at the receiving end of the phone being called. Ring relay is used to get tone andring processes. DTMF is the basis for voice communication control. Each number consists of a combination of two frequencies. DTMF decoder converts the DTMF tones to the binary numbers and sends to the microcontroller.In the signaling and switching system, transistors and relaysare used to switch audio signals and control signals and todecode the DTMF signals. These switches are controlled bypowerful software procedures to be implemented.The supply feeds 5V DC for microcontroller 24V DC for telephone operation, 90V ACfor ringing. DC power supplies are needed mainly to producethe large voltages required to power the phone during normaloperation. In this paper, 24V DC for telephone operation, 90V AC for ringing and 5V zener voltage regulator for microcontroller, DTMF, tone generator and switching devices. Surge arrestor is used for overvoltage protection. Ring relay is used for ringing. Opto-coupler is used for supervision. Surge arrestor or surge protector is an appliance designed to protect electrical devices from power surges and voltage spikes.

POWER SUPPLY:

In most power supply applications, the standard 60Hz AC power line voltage must be converted to a sufficiently constant DC voltage. The output of a bridge rectifier must be filtered to reduce the large voltage variations. The capacitor filtered the output of the bridge rectifier. The filtering concept shows a nearly smooth DC output voltage from the filter. The small amount of fluctuation in the filter output voltage is

called ripple. In this paper, there are three kinds of power supply: 5V DC for microcontroller, DTMF and switching devices 24V for telephone operation and 90V for ringing.

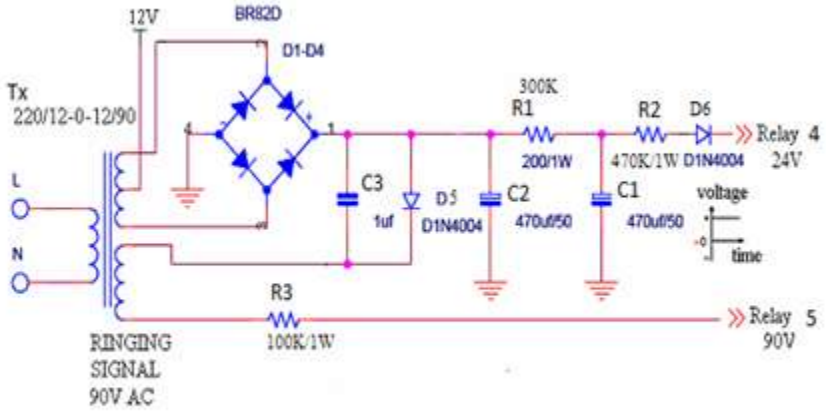


output voltage of power supply

FILTER CIRCUIT:

Low pass filters using LC components, i.e. inductors andcapacitors are arranged in either a pi or T network. For the pi section filter, each section has one series component and either side a component to ground.

Transformer steps down high voltage AC mains to low voltage AC. Rectifier converts AC to DC, but the DC output is varying. DC is smoothed from varying greatly to a small ripple. Generally, ripple is undesirable; thus, the smaller the ripple, the better the filtering action. If the circuit connected to the power supply takes a lot of current, the capacitor will discharge more quickly and there will be a higher ripple voltage. The more frequent the voltage peaks from the rectifier, the more often the capacitor will be charged, and the lower the ripple voltage will be.



output voltage of filter circuit

If the ripple voltage is calculated, this formula can be used.

Vr =Io 2/fC(1)

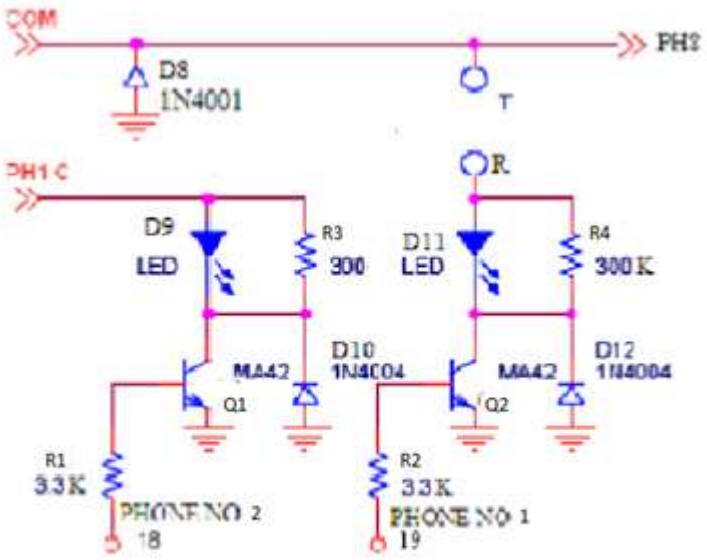
whereVris the ripple voltage in Volts, I is the current taken by the circuit in Amps, C is the value of the smoothing capacitor in Farads, and f is the frequency of the peaks from the full wave rectifier, in Hertz. This frequency will be double the normal mains frequency, i.e. 100Hz in the case of the UK mains supply, or 120Hz in the case of the US mains supply. The ripple voltage should not be more than 10% of Vs - if it is,

increase the value of the smoothing capacitor. The larger the capacitor value, the more charge it can store, and the slower it will discharge. Therefore, smoothing capacitors are normally electrolytic capacitors with values over 470µF. 4700µF capacitor is the largest and 20mA is the smallest value. Even using these values noise are appeared.

POWERING THE TELEPHONE:

Telephones require large DC voltages for standard operation. When a phone is in the on-hook state (receiver in cradle) the required voltage is 24V DC. This is said to be called the idle voltage. When the phone is in the off-hook state (receiver has been picked up) the required voltage is 12V DC. When the phone is on-hook no DC current actually flows.

This is because the only circuitry connected to the line is the ringer circuitry, which includes a capacitor. The capacitor will only allow AC signals to pass through such as the ringing signal. When the phone becomes off-hook the resistance of the whole phone circuitry was found to be 600Ω. Once off-hook, DC current can now pass through the phone.

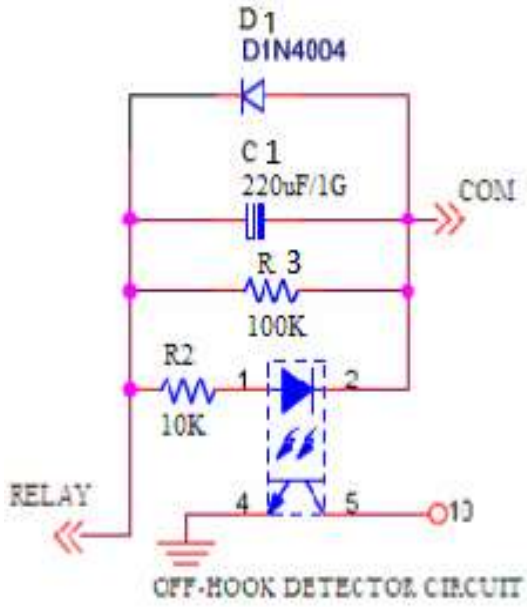


Telephones and switching circuit

DESIGN OF ON-HOOK/OFF-HOOK SENSING:

Each telephone is connected in series with the common line and the collector of the transistor. Microcontroller always scans which phone is off-hooked by giving high voltage to the transistors alternately. If one of the phones is off-hooked, the transistor associated with the off-hooked phone will turn on and the collector current flows through the phone line and the common line to the opto-coupler. The opto-coupler is used to detect hook sensing. In controlling environment must always be aware of the current hook state of each telephone. Obviously the phone can either be in the on or off-hook state. In the hook sensing design, NEC 2403 opto-coupler is used to sense the line current. Opto-coupler is designed to provide complete electrical isolation between an input circuit and an output circuit. The input circuit of an optical coupler is typically an LED, but the output circuit can take several forms, such as the photo transistor. When the input voltage forward-biases the LED, light transmitted to the photo transistor turns it on, producing current through the external load. When the phone becomes off-hook, current flows through the opto-coupler

causing it to switch. The switching normally changes an external circuit so that the phone becoming off-hook can be reported to the microcontroller. When the phone is on-hook, no current flows through the opto-coupler and phone circuitry because the capacitor within the phone's ringer circuitry blocks DC current. This means there is no connection in the switching circuitry and the value of the hook sensing pin is 5V. When the phone becomes offhook current will now flow down through the opto-coupler and phone circuitry. The current through the opto-coupler causes it to switch. Therefore current now flows in the switching circuitry and the value of the hook sensing pin will 0V.



5V ZENER DIODE REGULATOR:

A regulator circuit can use to provide a DC voltage that not only has much less ripple voltage but also remains the same DC value even if the input DC voltage varies somewhat, or the load connected to the output DC voltage change. The large value of the capacitor is needed to filter the ripple voltage according to charging and discharging actions. The unregulated DC voltage is achieved from the capacitor filter which is regulated to have 5V DC voltage by using Zener diode regulator. 24V DC and 90V AC are not regulated. Because the voltage must be stable for microcontroller .The supply voltage needs to be between 5.5V and 4.5V at most.The line voltage 220V AC is transformed to 12V. The stepdown voltage is then applied to the bridge rectifier. In thiscircuit, transformer center tap is kept 12V DC is got because of the bridge rectifier. Using 5V zener diode regulator is cheap.

IMPLEMENTATION OF STATE CONTROL SYSTEM:

Firstly, when the telephone is off-hook, a signal is sent to the microcontroller which the microcontroller understands to receive the phone number and the first digit is dialed. The firstdigit is internal code. When the code is dialed, the microcontroller knows whether the code is correct or wrong. It begins the routing process. If internal key is received, the number the user want to call is entered. When the number is correct, the call progress starts. If there is invalid code or invalid phone number or idle called phone or self call, busy tone will be heard. In call progress state, there are four sub states: tone wait, tone generate, ring wait and ring

generate. If the called phone is off-hook, success state begins. If the caller phone is on-hook in any state, the state must be idled and if the time is out, the busy tone will be heard.

FUTURE SCOPE:

1. Include VOIP PBX
2. Additional features

CONCLUSION:

A modern PBX from the equipment point of view , is much simpler then the older electromechanical systems . Most of its sophistication is built inside the chips that actually carry outside the work. The switching matrix tends to be quite small, & new opportunities are available for convenient design of user terminals. Trunk circuits, going mostly to obsolete (2-wire analog) central offices and to analog long-haul tie-trunks, still have to meet the outside world on its own terms, but even they, while they are still with us, take advantage of PBX control and component sophistication. Fortunately, new standards may soon let us leave the analog world behind.

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