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DATA TRANSMISSION OVER COMMUNITY FM BAND

Group No : B2

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ABSTRACT

This report discusses a module which comprises the transmission and reception of data over FM radio from a PC interface with data to be transmitted being sent from a PC interface via keyboard and displayed on a GLCD (Graphic Liquid Crystal Display) after reception. The data will be sent in form of pages (size = 32 characters). Certain number of pages form an article. The user will be capable of going up and down an article using up/down keys.

1 INTRODUCTION

The design of the module comprises of mainly 3 sections namely PC-uC connection, FM transmitter and receiver and finally display of data on a GLCD (2*16). The first one enables the user to enter the data via keyboard which is to be transmitted over FM. The data is sent to the micro-controller through a RS-232 port.

The received data is sent serially to the micro-controller, which stores it in the externally connected RAM. It is interfaced to a 2*16 GLCD module which displays the data sent from the micro-controller. The module is also provided with the up/down keys to help the user move the pages up/down of the article.

The module has a very wide application. Quite often we (particularly the radio users) feel to be kept updated on their radio. But, this thing is not possible if we kept stick to voice communication. Instead if display the same data on a screen on the user radio, it becomes a very efficient and low-cost effective way of communication. The data communication over FM radio could help the user of knowing instant news and alerts, whether predictions etc. within no time after switching ON the radio. It is also of more

importance in certain regions where not much resources are available like coastal regions where instant alert messages are very important.

2 Design Approach

The module incorporates both the hardware and software aspects of the problem. Both are described below separately:

Theory :

The Project consist of modulating and transmitting the data(binary) with information being kept in frequency and demodulating the signal to get the original information. Data is entered in PC and serially transmitted to uC, from here the data is sent to FSK (Frequency Shift Keying) modulation.

The uC is operating at Serial Mode 1 with crystal frequency = 11.0592 MHz. The Baud rate is 9600 bps.

F(baud) = (2^(SMOD))*(Oscillator frequency) / (32* 12*(256 – TH1))

For F = 9600,
SMOD = 0;
TH1 = 252;

3.1 FSK

The FSK is implemented by generating two frequencies from Colpitt oscillators. The frequency of oscillation is selected by using the appropriate values of inductor and capacitor.

f = 1/2 *(pi)[L(c1 || c2)]½

For f1 = 75 kHz,
C1 = C2 = 0.01 uF
L = 1mH

For f2 = 15 kHz,
C1 = C2 = 0.22 uF
L = 1mH

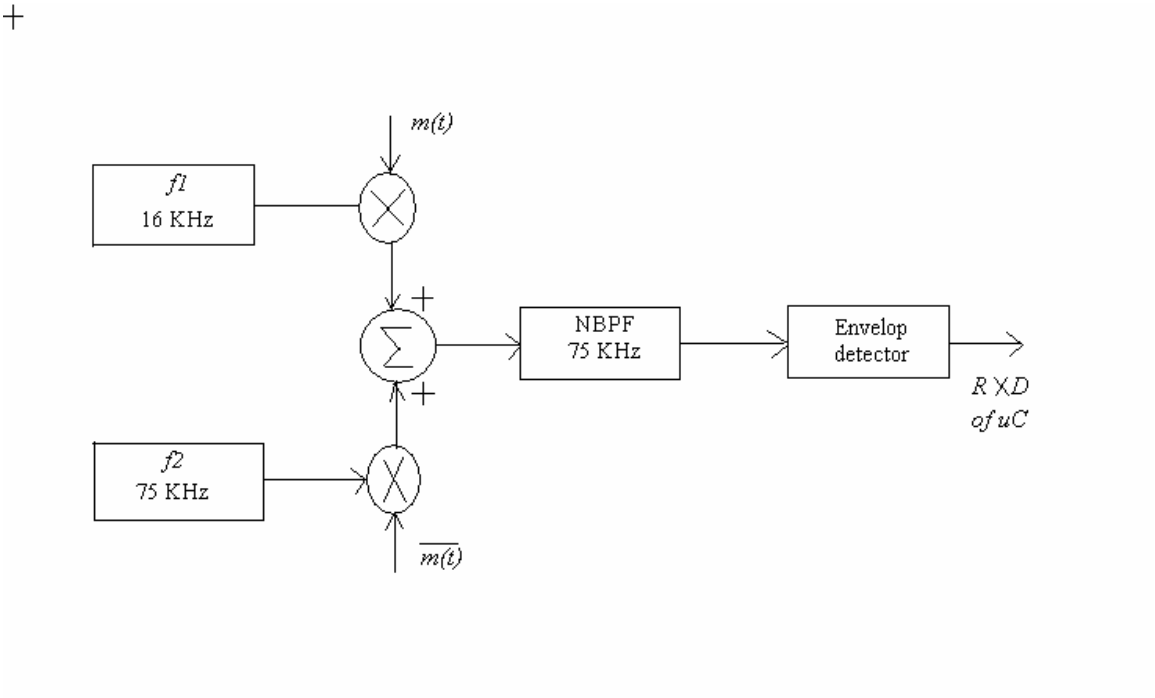

Fig 1. Block Diagram of FSK

After generating the above two frequencies, signals are passed to Analog Multiplexer and it's control bit are given by the data. Depending upon the bits, one of the two analog channel is gets selected and thus the signal varies between two frequencies depending upon logical level of data.

At the receiver end, for selecting the Frequency, we have NBPF (Narrow Band Pass Filter) tuned to 75 kHz. The NBPF, output amplitude depends upon the input frequency. After NBPF the signal is passed to envelope detector which gives output as 5V for higher frequency and 0V for lower frequency.

For selection of NBPF we have

f = 1/2*(pi)C[(R1 ‖ R2)*r3]½

C = 0.01uF
R1 = 217 Ω
R2 = 570 Ω
R3 = 22.7 Ω

The signal is supposed to be sent over FM band (wireless), but this could easily be done using standard transmitter/receiver ICs(we tried but couldn't able to implement in short time.)

3.2 Hardware

In the first part (PC->uC), the data is sent from the PC through the RS-232 port available in the CPU. The data moves from port to the MAX-232 IC via DB-9 connector. The IC is serially connected to the RX pin of microcontroller.

Initially we connected the Tx pin of uC-1 to the Rx pin of uC-2 to conform the serial transmission by a simple wire. After it was completed successfully, we implemented FSK(Frequency Shift Keying) for modulating the binary data to analog signal and vice-varsa.

The FSK consist of two fundamental frequencies of 75 kHz and 16 kHz. It switches between this two frequency and the information (binary) lies in the frequency. The signal is passed on to a NBPF (Narrow Band Pass Filter) which is tuned to 75 kHz. The output of NBPF is connected to Envelope Detector which gives output 5V for 75 kHz and 0V for 16 kHz respectively.

From here data is ready to be sent to transceiver IC ADF-7020 which transmits it over FM band. The data is received on the other end by the similar IC, which feeds it to the microcontroller.

The uc stores the received data in an externally connected RAM (8 KB). The data from the RAM is sent simultaneously to the GLCD for display. Maximum no. of pages that the GLCD module could incorporate is thus 256 (=8*1024/32) with each page containing 32 BYTES each. As soon as all the pages are filled, the data over-rights the previously stored data from page-1. The microcontroller also interfaces the GLCD with two up/down switches, which enables the user to move up and down an article.

3.3 Software

The data sent from the PC is data we write on to the hyper-terminal. As soon as the data is written, it moves to the RS-232 port. The data is received at the uC serially at Rx pin. The uC sends the data to the Tx pin (or SBUF) for transmission subsequently.

The second uC is encoded such that as soon as the data arrives at the Rx pin, it moves it to the externally connected 8KB RAM. The storing is done such that whenever new data arrives it adds it to the previously stored data and no over-righting is done until unless full memory (256 pages of 32 BYTES each) is used. The GLCD shows the first page (first 32 bytes) transmitted by default. We could move to the subsequent second and third page using the down key provided. An up key is provided too, to move to the previous page.

4 Design

We have used two microcontrollers in our whole module. One is in the transmitter part and one is in the receiver. The uC used is AT89C52. We preferred it over AT89C51 because of former's large RAM size. Though the RAM hasn't been used in the first part, but it enables us to have more flexibility in terms of storing the data being transmitted.

Further, in the second part of the project, we formed two oscillators of frequencies 16 KHz and 75 KHz for modulation by the FSK technique. For the frequency selection, a NBPF tuned to the frequency of 75 KHz was designed. NBPF is followed by a envelop detector. A simple RC circuit is formed to detect the envelop of the incoming signal. After scaling up the output of detector by the opamp LM324, the signal is sent to the Rx pin of uC. This microcontroller sends this serial data to the externally connected 6264 RAM. The 16 address pins of uC are joined to the RAM with a DM74LS373 latch connected in between for demultiplexing purpose. As soon as the data arrives, it goes to the LCD for display.

5 Schematic Diagrams

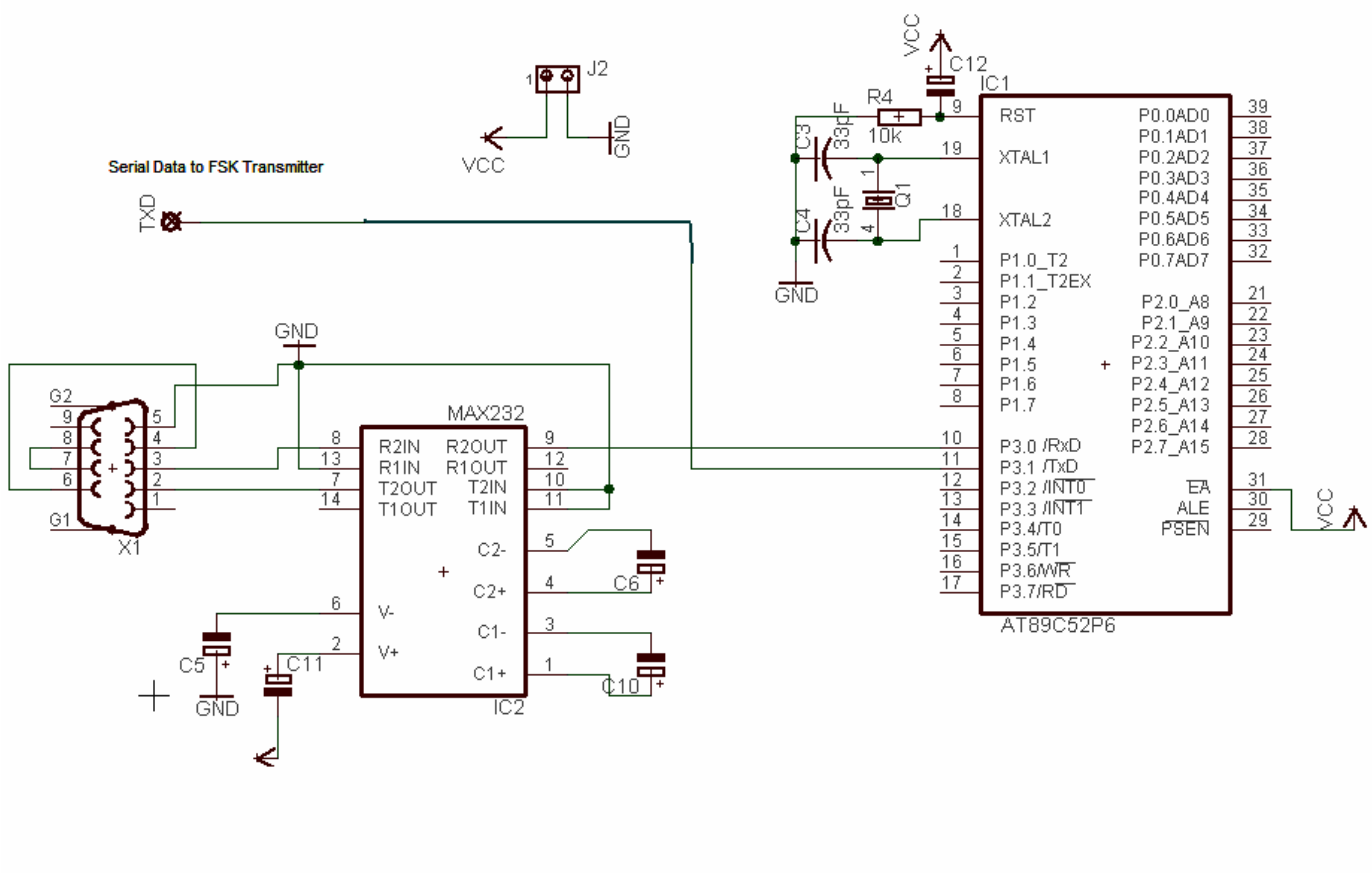

Fig 2. Transmitter Circuit

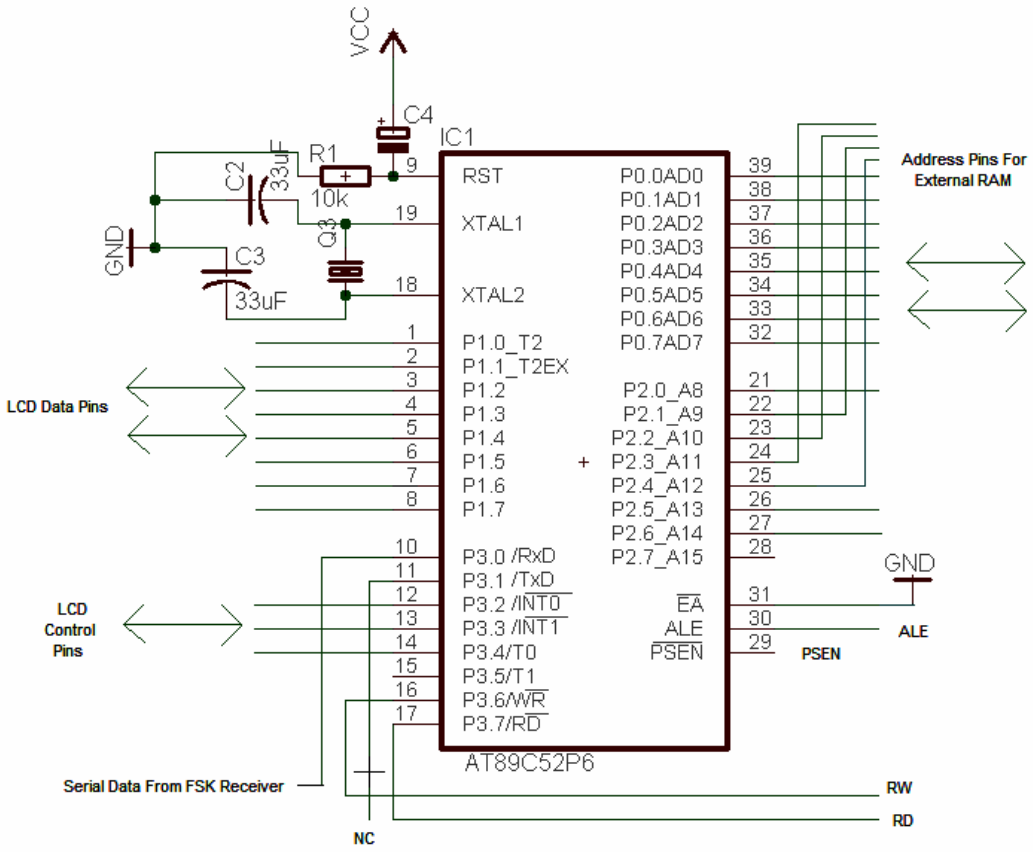

Fig 3. Receiver Circuit (uC Part)

1.3 Receiver Circuit (With External RAM)

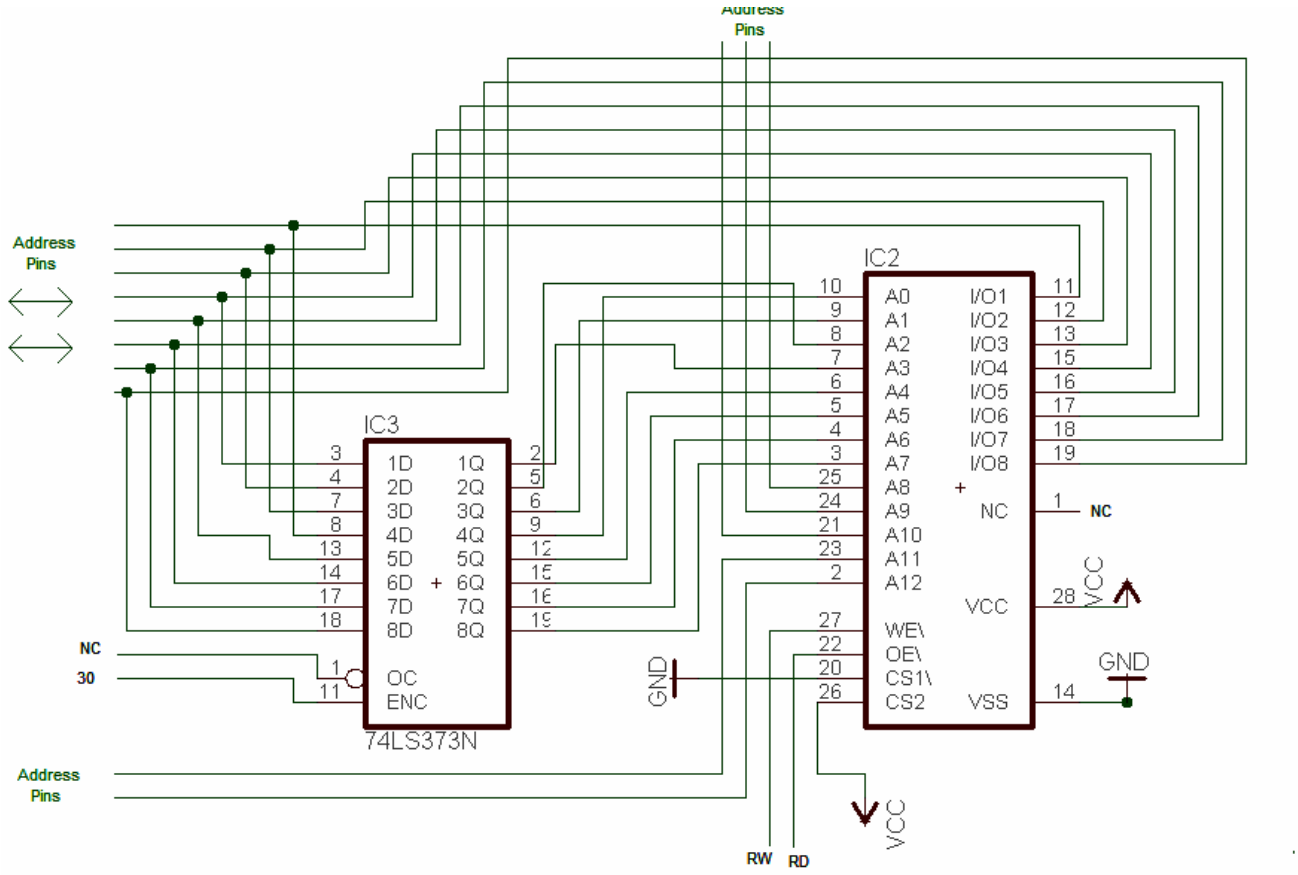

Fig 4. Receiver Part (With External Ram)

6 Further Developments

1. In our design, we have used two frequencies of 16 KHz and 75 KHz for FSK modulation. This makes the bandwidth = 60 kHz. But since for an FM data transmission the BW needs to be as low as 4kHz. So, using a fine NBPF, the BW could be reduced. Also the transmission frequency of FM is 88 MHz-100 MHz. So, the FSK frequencies might also be increased.
2. The transmission and receiver antenna could also be inserted in between adder and NBPF.

7 Components Used

2 AT89C52 Microcontrollers
1 DB-9 connector
1 MAX-232 IC
1 6264 RAM
1 DM74LS373 latch IC
3 LM-324 Opamp
1 7404 NOT gate
1 LCD
2 transistors
1 analog multiplexer

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