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ANALOG DATA TRANSFER FROM SERIAL PORT AT DIFFERENT RESOLUTION

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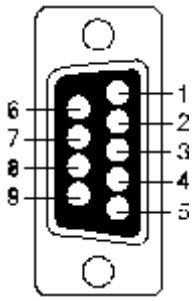
Abstract. Making an analog data transferred into computer as the closest form to its actual value is related with the resolution of ADC (Analog Digital Converter). When the resolution is increased, the loss in data intake is decreasing. In order to transfer digital data on ADC output that has got the intended resolution, there are three different equipment on the computer as parallel, serial and USB port. In this study, it is aimed to transfer and record the change of analog data coming from any sensor with using serial port of the computer by way of user-controlled synchronous serial transmission. The analog data that will be recorded in the study are taken from UGN3177 Hall effect sensor. This analog data's input to one of ADCs which have got 8,12,14 bit resolution is provided by PIC18F4520 microcontroller controlled multiplexer. After that, trigger signals required for the chosen ADC are given by microcontroller and the change of analog data to digital data is ensured and recorded. Also, digital data that has got 12 and 24 resolution is coded with PIC18F4520 microcontroller. A Visual Basic based program is written in order to answer the question that which coded data will be taken from serial port and to determine how fast it will be taken, to take data and to be able to observe data interchange. In this paper, operation of developed electronic cards and data intake program are discussed in detail.

1. Introduction

In the case of communication between the computer and any external equipment, there are three port that can be used on computer. These are parallel port, serial port and USB port. Serial port and USB port can make serial communication among them. So that, with these ports, logic signals are taken and given as 8-bit packets from only one line. If the researcher will use the port for communication with

his/her own system, it will be enough to use 2.3. and 5. pins of 9-pin serial port (Figure 1). TXD pin of the port is used for data transfer from computer and RXD end of the port is used for data flow from external equipment to computer. 5. pin of the port is used for equalizing computer and 0 V (GND) reference voltage ratings of external equipment[1-5].



1. CD (Carrier Detect)
2. RXD (Receive Data)
3. TXD (Transmit Data)
4. DTR (Data terminal Ready)
5. GND (Ground)
6. DSR (Data Set Ready)
7. RTS (Request To Send)
8. CTS (Clear To Send)
9. RI (Ring Indicator)

Figure 1. Serial port

Serial port can transmit logic values between -3 V and +25 V. Serial transmissions can be made as synchronous or asynchronous from serial port (Figure 2) [5-10]. At synchronous transmission, every device uses the same clock signal pulses produced by their own or a device from outside. The frequency of clock signal can change regularly or irregularly. However, synchronous communication is not available at long distances [9-11]. At asynchronous communication, there is no clock line at the link. Every pin offers its own signal. At this communication, the pins should be in accordance with frequency of clock. Therefore, at every transmitted byte there is a clock bit for equalizing clocks and a stop bit for stating that transmission is finished. At serial communication, data transmission speed is described as bps- bits per second. When data transmission speed is being stated, other term used commonly is “baud rate” [12-15].

8 bit data packet coming from external equipment at intended data transmission speed is read and unloaded to the buffer of serial port with the program that will be written by the user. Here, reading rate of buffer should be the same with writing rate of buffer. On the other hand, it is not possible to take 12, 16 or 24 bit data packets to computer from serial port at a time because of the fact that serial port can take only 8 bit data packet at a time. In this case, every logic signal (1 bit) coming from external equipment should be coded as 8 bit data. For instance; for logic 1, 00010101; for logic 0, 00000011 can be chosen. If the user takes 00010101 data when the buffer is read, the computer records that bit as “1”. Therefore, the equivalent of 24 bit is transmitted to the computer as 8*24 bit. However, the user saves the equivalent of every 8 bit in a file in order to calculate it as 1 bit.

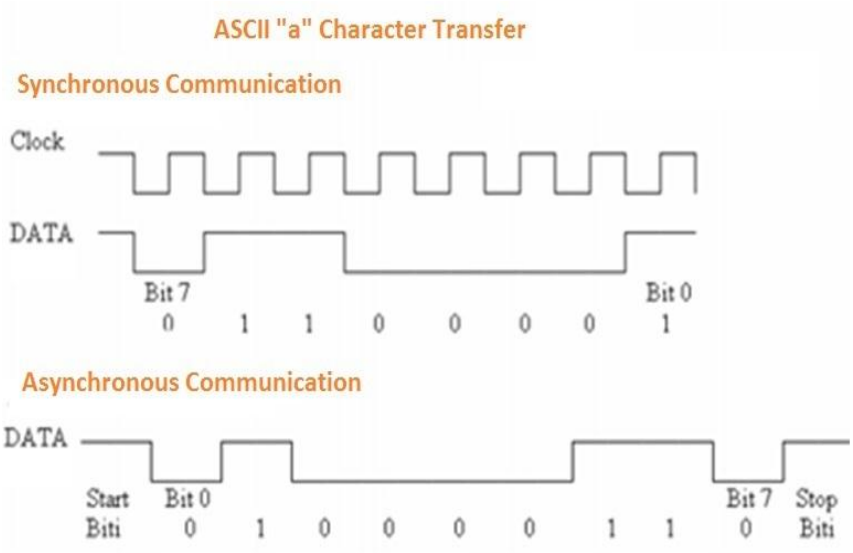


Figure2. The transmission of ASCII "a" character in synchronous and asynchronous serial transmission

A/D convert is a coding process in which an analog signal is expressed in binary cases. The sensitivity of an A/D convertor is in proportion with the number of bit used for resolution. For instance, the maximum voltage combination that can be obtained with a A/D convertor as 8 bit ADC832, ADC832 is 256 in number. If V_{ref} voltage is 5 V, then the smallest voltage unit is approximately 19.5 mV. This can be calculated easily as 5 volt = 5000 mV, 5000/256 = 19.5 mV. If a 12 bit A/D convertor is used, then the sensitivity will be 1/4096 unit. For instance, if it is V_{ref} = 5 Volt = 5000 mV, then a resolution of 5000/4096 = 1.22 mV is obtained. For a 24 bit ADC, this value will be 0.298 μV. One of the most important factors that specifies performance characteristics of A/D convertors apart from resolution is the sampling time. For AD7714, sampling time is 500 ns, for MCP3201 it is 12 μs and for AD831 it is 18 μs.

In this study, first of all, analog voltage rating of UGN3177 Hall effect sensor's output pin is put into one of ADCs that have 8,12 and 24 bit resolution via PIC18F4520 microcontroller-controlled multiplexer. After that, required trigger signals for the chosen ADC is given by the help of microcontroller, then analog data is transformed to digital data and it is recorded. Also, 12 and 24 bit resolution digital data are coded with PIC18F5204 microcontroller. A Visual Basic based program is developed for such several purposes that; to determine which coded data will be taken from serial port and how fast it will be, to make intake process and to be able to observe data interchange. At the following parts of the paper, operation of electronic cards and data intake program is discussed in detail.

2. Material and Method

In the study, UGN3177 Hall effect sensor is chosen for analog data resource, PIC18F4520 microcontroller is chosen for activating ADC and sending data to serial port, Max4618 multiplexer is chosen for switching and ADC831(8 Bit), MCP3201(12 Bit), AD7714 (24 Bit) are chosen for A/D convert. The choice of these ADCs that have different resolution, A/D convert of analog data and circuit diagram designed for intake by serial port are shown at Figure3.

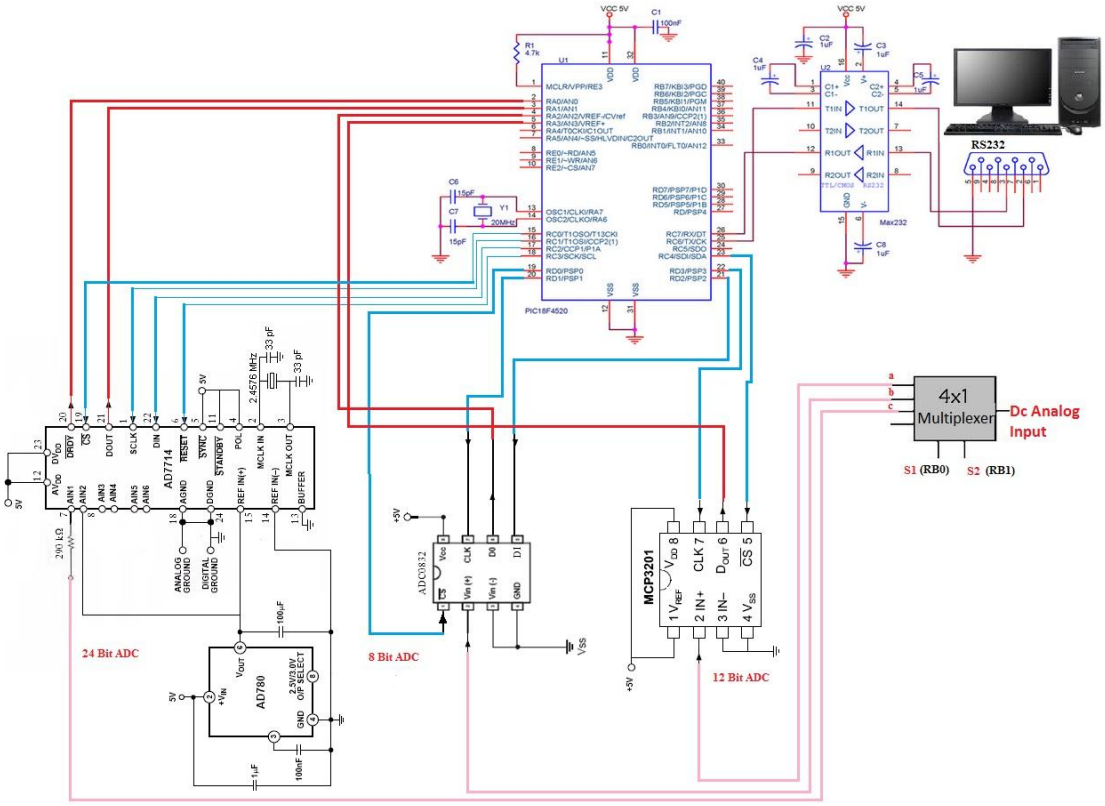
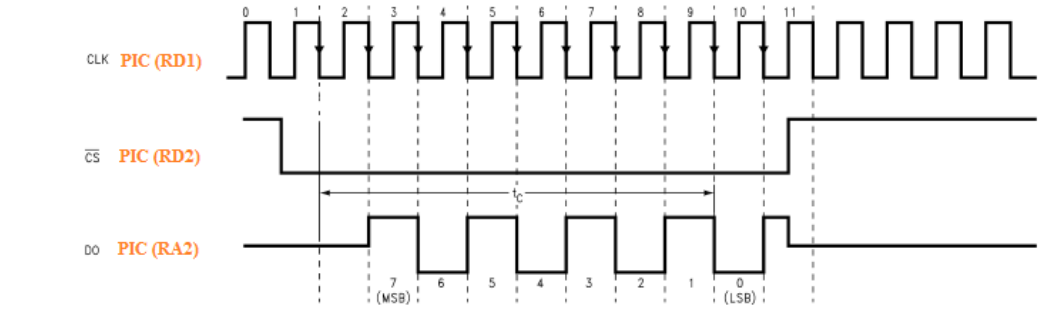
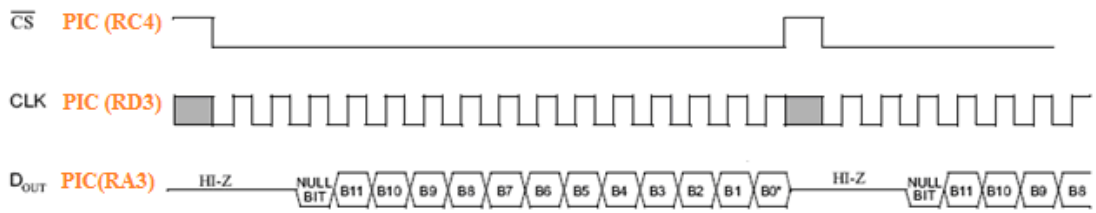


Figure 3. Developed circuit diagram

Central processing unit is PIC18F4520 microcontroller at developed circuit. To which ADC input DC analog signal will be orientated is obtained by microcontroller controlled. As it is seen at Figure 3, chip selection and clock signal application are required for taking a digital output from ADCs. PIC18F4520 makes this process and also EEPROM records digital output of ADC. The application of trigger signals which should be sent by PIC 18F4520 for occurring digital data at each ADC is given at Figure 4. Digital information sent by PIC18F4520 microcontroller according to AD7714's write-read loop is shown at Table 1 to set an example.



(a)



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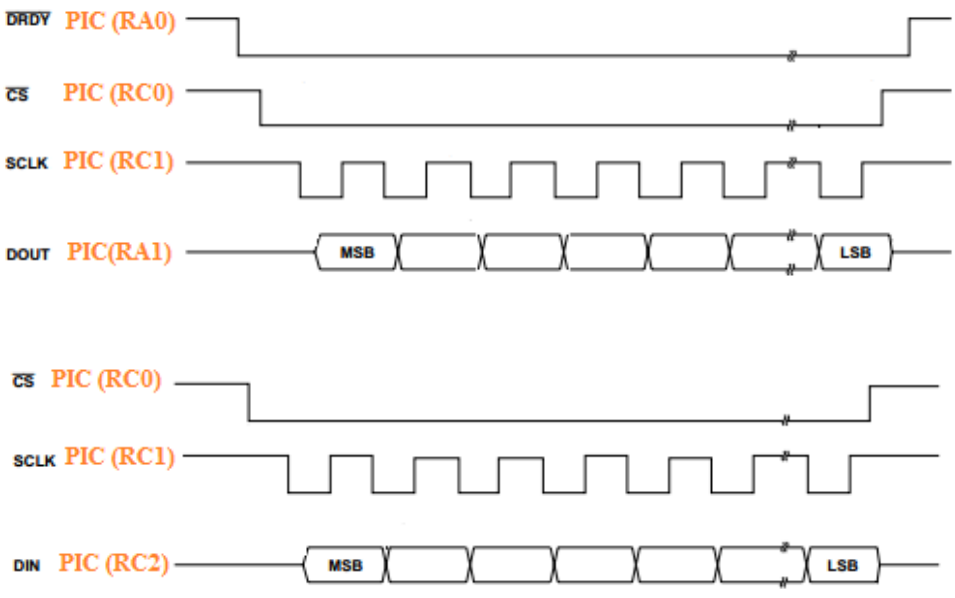

(c)

Figure 4. Write-read loops for a) ADC831, b) MCP3201 and c) AD7714

Table 1. Digital information to be sent by the PIC18F4520 microcontroller for AD7714

Realized Process	**Controlled Entegreted Pin**	**Transmitted Data (Hex)**	**Transmitted Data (Binary)**
AD7714 Reset	Reset pin	3	00000011
Calibration		B	00001011
Filter high Register	DIN pin	24	00100100
Calibration		4F	01001111
Filter low Register	DIN pin	34	00110100
Calibration		A0	10100000
Mode Register	DIN pin	14	00010100
Calibration		20	00100000
Poll DRDY Pin Control	$\overline{\text{DRDY}}$ pin	-	-
Data Register Calibration	DIN pin	5C	01011100
Read from Data Register	DOUT pin	-	-

Because of the fact that serial port is able to import data as 8-bit packets, first of all, recorded 12 and 24 bit digital data should be coded. In our study, also this process is being done with microcontroller. In addition to this, a VB based program is developed in order to intake 8 bit digital data or 12 and 24 bit coded digital data to the computer environment from serial port. The interface of the program is seen at Figure 5.

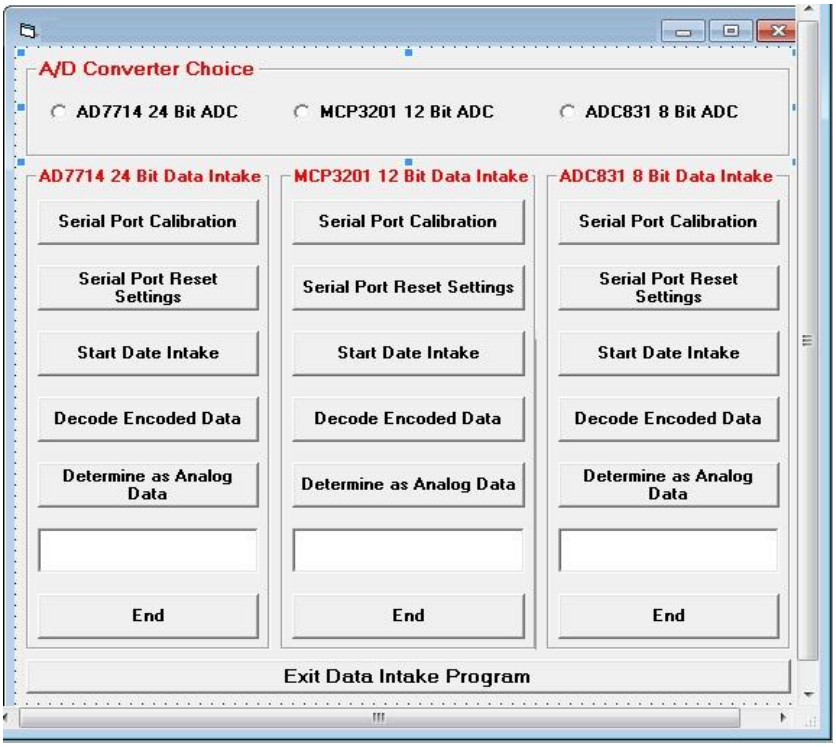

Figure 5. The interface configuration of data intake program

At data intake program, firstly it should be chosen that how much bit the resolution of digital data will be. The trigger signal that is sent to PIC from serial port makes Multiplexer connected to PCI switched. In addition, after the selection, the command buttons of ADC about interface stays active, but all of the other buttons becomes passive. In case of pushing buttons from above in order, all digital data recorded in PIC are taken synchronously and calculated and then they are written into text box as analog value.

The flowchart of PIC Basic Pro program written for PIC18F4520 microcontroller is given at Figure 6.

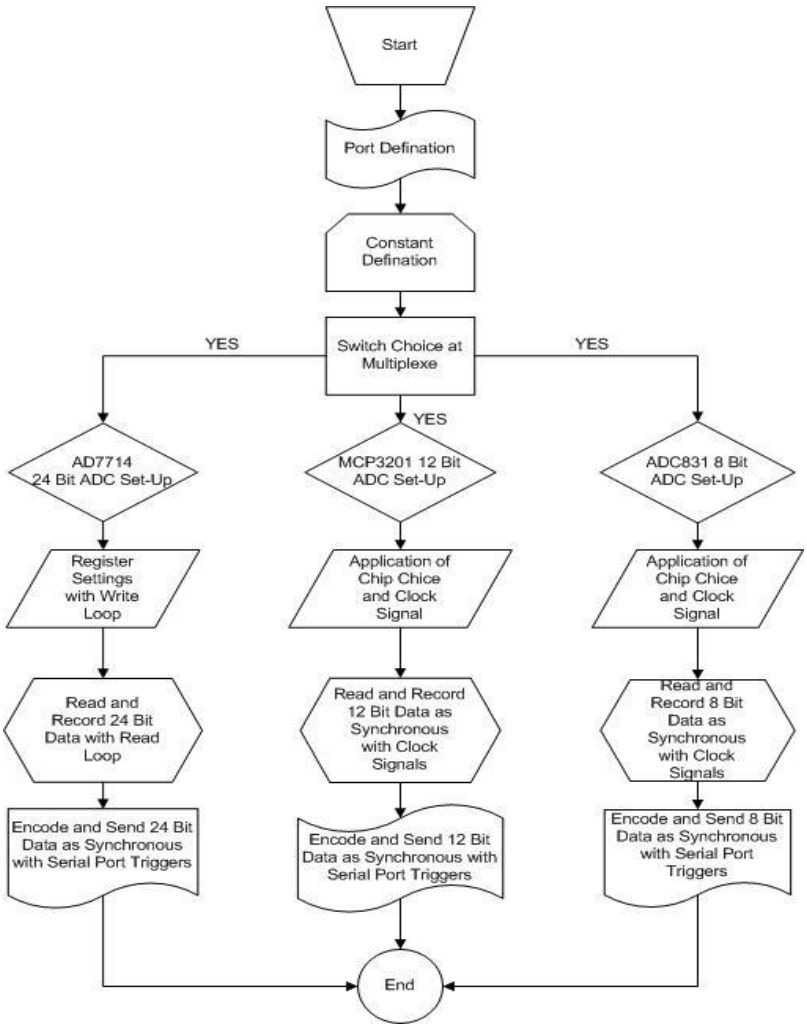

Figure 6. The flowchart of PIC Basic Pro program written for PIC18F4520 microcontroller

3. Discussion and Conclusion

In this study, PIC18F4520 microcontroller is used for central processing unit and the output of UGN3177 Hall effected sensor is used for analog data resource. With ADC control and data transmission to serial port program which is written for PIC18F4520 microcontroller, 8, 12 and 24 bit resolution digital data is enabled to be taken into the computer environment. There are two important situations during these processes. First one is the compatibility of ADCs' sampling time and digital data intake and record time of PIC, the second is the synchronization between data intake and discharge speed of serial port and sending recorded digital data by PIC. In this study, these two important

situations are insured by the program written on PIC and VB based program. Synchronization is related with the processor speed of the computer. That is why it can be necessary to redispose the program at two computers which have got different processors. In such a case, putting a "spooling" into the appropriate places at the programs written for both of two hardwares can be a solution. Also, Max232 should be necessarily used between serial port and any external equipment. If not, serial port can be burnt. If any, optoisolator (4N25) can be used in order to prevent the flow of any short circuit current from external equipment to the serial port. In addition to this, the dongle that converts USB port to serial port can be used with the computers which have only USB port but not serial port. After the dongle is put into USB port, the program which will be in a unity with the operating system is loaded and now programming can be done like there was a serial port at the computer hardware.

REFERENCES

[1] Han, Xiangbo; Liu, Zhanli, IFIP Advances in Information and Communication Technology. 344, 717-720 2011

[2] Wu Maosheng; Wu Ximeng; Liu Wenjuan, Advanced Materials Research. 271-273, 1884-1889 2011

[3] Mohideen, Syed Sulaiman Bin Kaja; Noor, Shamsul Bahari Mohd, 2009 IEEE International Conference On Virtual Environments, Human-Computer Interfaces And Measurement Systems., 327-329 2009

[4] Zhang, Junjie; Wei, Wei, 2009 IITA International Conference On Control, Automation And Systems Engineering, 472-475 2009

[5] Luo, Bin; Chia, Michael Yan-Wah, IEEE Transactions On Microwave Theory And Techniques. 56, 2062-2068 2008

[6] Machacek, J.; Drapela, J., Proceedings Of The 2008 International Conference Modern Technique And Technologies, 36-40 2008

[7] Zhu Jian-Jun; Lin Shi-Wei; Yu Jun; et al., ISTM/2007: 7Th International Symposium On Test And Measurement. 1-7, 4643-4645 2007

[8] Jindal, V, Electronics World. 112, 25-29 2006

[9] Xia, YP, Electronics World.110, 41-41 2004

[10] Xia, YP, EDN. 46, 84-+ 2001

[11] Segovia, A; Diaz, A; Garduno, M, Computers & Electrical Engineering. 27, 109-117 2001

[12] Strassberg, D, EDN. 44, 22-22 1999

[13] Xia, YP, Electronic Design. 46, 96-+ 1998

[14] Xia, YP, Electronic Design. 45, 102-& 1997

[15] Pia, YP, Electronic Design. 45, 140-& 1997