

Amplificatore DC con integratore e ADC



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It is a very useful tool for the laboratory of electronic experimenter. The device is designed for amateur radio astronomy applications, amplifies and carries on average detected signal coming from the receiver (radiometer) radio astronomy: you can set the DC gain, the time constant of the low pass filter integrator and the position of the zero of output signal (offset). The system provides for the analog display (using tool on a larger scale), and the analog-digital conversion of the measured signal through the serial interface RS232C for PC, making it easier to capture and automatic data logging.

The need to perform measurements on slowly varying signals (bandwidth with very low, almost constantly) and automatically record the results on a personal computer to document the various working sessions, has led to the design and construction of this useful, as it is reliable tool . It is a post-amplifier-integrator detection in continuous, characterized by a variable gain, and by the possibility to adjust the offset of the output signal (from zero to full scale), equipped with analogue and instrument index card acquisition 8-bit serial interface standard RS232C (for PC) for automated data recording operations (under the control of a suitable software). The system was initially designed to monitor and amplify the detected signal coming from the final stage of a radio astronomy receiver (radiometer): setting the zero reference point on the scale, the DC gain and the time constant of the integrator, it is easy to make precise measurements on the average value of the magnitude applied to the input, testing, therefore, the functionality of the receiver under test. This tool is particularly useful whenever there is the need to amplify and mediate, in addition to display and record, any signal with a very small bandwidth (slowly varying) coming, for example, by sensors.

The circuit diagram of the circuit is shown in Figures 1 and 2, conceptually simple and divided into three parts: the analog section of the treatment of the signal applied, drawn around the LM324 quad op-amp configured as a differential amplifier from instrumentation gain and time constant variables (by setting, respectively, the value of the input resistor and the feedback capacitance on the output stage), the digital section of analog-digital conversion and formation of the word serial RS232 for the transfer of data to the PC, the power supply module represented by the diagram of Figure 2. As is seen, they are cheap and easily available components used, deliberately avoiding the use of microcontrollers to facilitate the construction of the device, while ensuring attractive benefits in terms of stability and precision of

measurement.

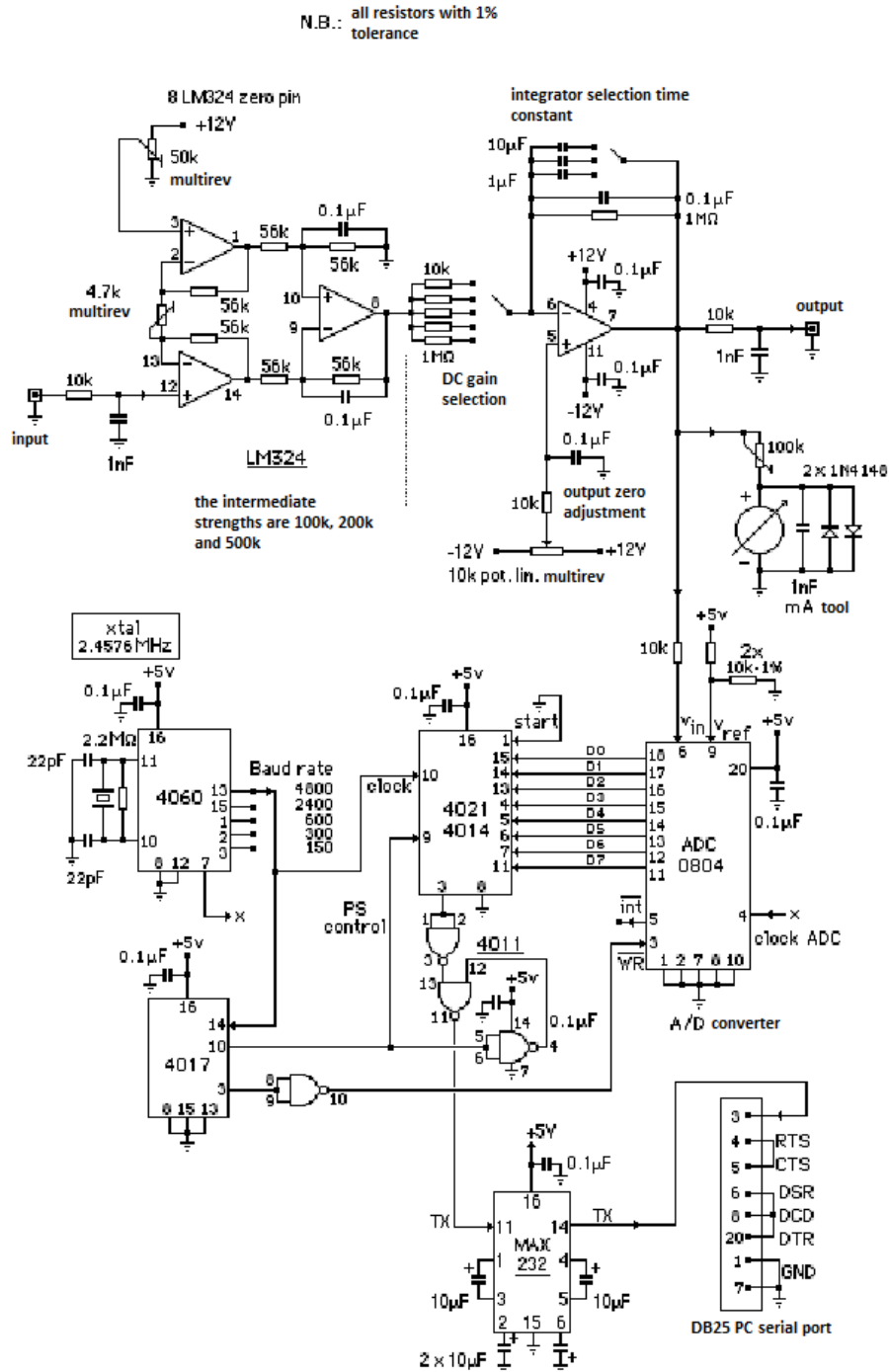


Fig. 1: Circuit diagram of the amplifier-integrator.

The appendix is a simple example of routine management software tool, written in QBasic is left to the reader wide freedom to create sophisticated and functional programs, so that they fit perfectly to the personal application needs.

The resolution of the analog to digital converter is 8 bits, with baud rate set to 4800 bits / sec.:

Management software must be developed to optimize the sampling of the received signal and the subsequent storage on the hard disk of the PC according to the type signal and research to be performed. The card functions as a data transmitter in a continuous cycle, to all advantage of acquisition speed and simplicity of connection. The sampling and the conversion of the analog signal are assigned to the integrated circuit ADC0804, easily available in the market also surplus, which provides (in a time of just over 100 μ sec.) Code to 8-bit parallel relating to the conversion of each signal sample acquired. The subsequent implementation of the serial word requires conversion Serial / Parallel with the addition of the start bit and stop. These operations are carried out by the 8-bit shift register 4021 (replaceable with 4014): after the ADC has made available the byte relative to a sample parallel it is loaded into the shift register. Subsequently, synchronous with the clock signal provided by the 4060, is available at pin 11 of the 4011 serial word to be sent to the PC. The signal is finally adapted to the serial line from the known chip MAX232 driver. The timing and the generation of the control signals of the system is entrusted to 4060, working as a quartz clock generator (with possibility to select the baud rate to 150, 300, 600, 2400, 4800 baud) and the counter decimal 4017 (Figure 3).

Once built, the system requires some simple setting: you need to adjust the trimmer on pin 3 of the LM324 so that it is no voltage on pin 8 in the absence of the applied signal and adjust the trimmer in series with the meter to adjust the analog indicator of full-scale to its sensitivity. The trimmer place between pins 2 and 13 of the LM324 is used to set the minimum gain of the system, which will subsequently be varied by switching the value of resistors placed in series to pin 6. As with all projects proposed in the design has followed a policy of modularity of the system to allow the experimenter to change the various parts of the layout to suit your needs, in the philosophy of simplicity, availability and the economy of components.

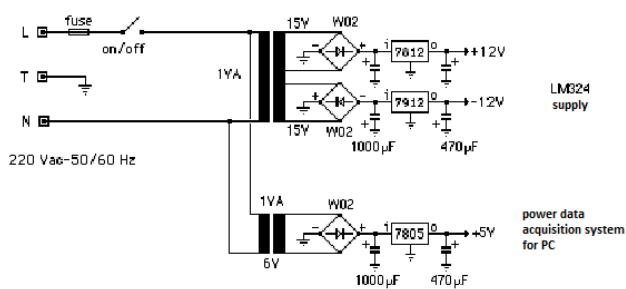
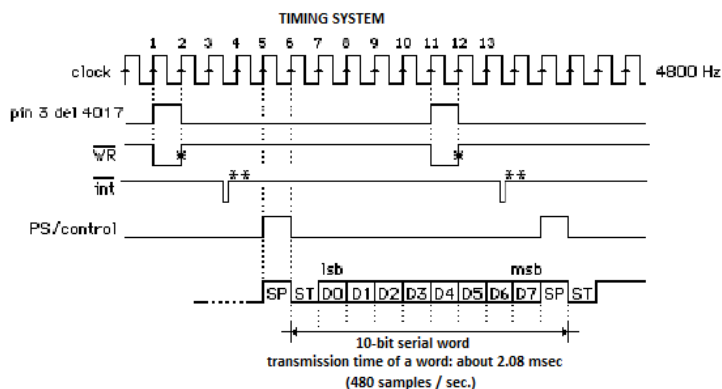


Fig. 2: Schematic of the power supply from the mains. To the right you see a prototype of the instrument. The device was built by retrieving the container (complete with moving-coil instrument) of an electronic voltmeter outside laboratory use: notice the front panel with controls for adjusting the gain and offset of the output signal of the constant integrator time. There are visible BNC connectors for signal input and output, the cable to connect the PC serial.



* : start the conversion process of ADC0804
** : ADC0804 available output data
10-bit serial word: 1 START bit, 8 data bits, 1 STOP bit (no parity error). Baud rate: 4800 baud.

Fig. 3: Interface timing diagram for the AD data transmission to the PC.

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\ Routine esempio di acquisizione dati per amplificatore DC - integratore
\ by Flavio Falcinelli - Luglio 1999
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DIM y%(640): DIM volt(640): DIM tempo$(640)
CLS: BEEP
scherm% = 1: x% = 9
Nmedia% = 20000          \numero di campioni sui quali si esegue la media
-----
5 SCREEN 9              \finestra di visualizzazione dei dati
CLS
data$ = DATE$: tempoin$ = TIME$
LOCATE 2, 3: PRINT "Ora locale inizio osservazione: "; tempoin$;
LOCATE 2, 55: PRINT "Data: "; data$
LINE (10, 35)-(636, 198), 1, B
LINE (9, 34)-(637, 199), 1, B
FOR i% = 35 TO 197 STEP 20
    LINE (10, i%)-(635, i%), 1,, &H1111
NEXT i%
FOR j% = 10 TO 630 STEP 20
    LINE (j%, 35)-(j%, 197), 1,, &H1111
NEXT j%
LOCATE 1, 18
PRINT "ACQUISIZIONE DATI"
LOCATE 25, 1: PRINT "0";
LOCATE 20, 1: PRINT "1";
LOCATE 16, 1: PRINT "2";
LOCATE 13, 1: PRINT "3";
LOCATE 9, 1: PRINT "4";
LOCATE 5, 1: PRINT "5"
LOCATE 3, 3: PRINT "Numero di campioni mediati ="; Nmedia%
LOCATE 4, 3: PRINT "schermata n."; scherm%
-----
OPEN "COM1:4800,N,8,1" FOR RANDOM AS #1 \apre il canale seriale
a$ = INPUT$(1, #1)
dato% = ASC(a$)
v = dato% * 5 / 255: y%(x%) = 195 - 31.8 * v
DO
    somma& = 0
    FOR k% = 1 TO Nmedia%
        IF INKEY$ = CHR$(27) THEN CLOSE #1: END a$ =
        INPUT$(1, #1)
    
```

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                                dato% = ASC(a$)
                                somma& = somma& + dato%
NEXT k%
media = somma& / Nmedia%
v = media * 5 / 255
x% = x% + 1
volt(x%) = v
tempo$(x%) = TIME$ + " " + DATE$
y%(x%) = 195 - 31.8 * v
LOCATE 4, 55: PRINT "Ampiezza segnale ="; PRINT USING "##.##"; v; PRINT " V";
LINE (x% - 1, y%(x% - 1))-(x%, y%(x%)), 1
IF x% > 635 THEN
    x% = 9: scherm% = scherm% + 1
    y%(x%) = y%(635)
    CLOSE #1
    file$ = "ELF-" + HEX$(INT(TIMER)) + ".DAT"
    GOSUB salva: GOTO 5
END IF
LOOP
\-----
\Salvataggio dati su disco
\-----
salva:  OPEN file$ FOR OUTPUT AS #2
        PRINT #2, "Nome file: "; file$
        PRINT #2, "Data: "; data$
        PRINT #2, "Numero campioni mediati: "; Nmedia%
        PRINT #2,
        FOR i% = 10 TO 635
            PRINT #2, tempo$(i%), USING "##.##"; volt(i%)
        NEXT i%
        CLOSE #2
        RETURN
\-----
```

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