radio. It is more convenient to interconnect the components directly. Figure 3 shows one method for this.

The 'chassis' is made of plastic having the same dimensions as the 'tray' of a matchbox. The variable capacitor is mounted onto the chassis by means of appropriate screws. The ferrite rod is attached by glueing each end to the sides of the chassis.

A standard earphone socket is used. Normally the switch part acts to isolate the loudspeaker, but in this case it is utilised as a battery connection. The moving contact part of the switch is cut off with pliers or a wire cutter to leave only the fixed terminal. This serves as the positive contact for the battery. A small brass plate (glued to the side of the chassis) serves as the negative contact. The position of the socket is determined by the size (width) of the battery.

Note that an on/off switch is not necessary when constructing the circuit as in figure 2a. The supply is automatically switched on when the earpiece is plugged in. However, the circuit as in figure 2b does require a switch.

The battery should be a mercury type cell such as a 'Mallory' supplying 1.35 V.

Final remarks

A whine or whistle heard in the earpiece when tuning between stations can be eliminated by swapping over the connections to the aerial coil. Normal mercury cells are able to deliver 200 mAh, so each cell should give between 400 and 500 hours of listening pleasure.

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the Junior Computer as a frequency counter

G. Sullivan

Microprocessor systems are often regarded as mathematical wizards, so the Junior Computer's aptitude as a frequency counter will come as no surprise . . .

As the name suggests a 'frequency counter' records a recurrent series of events. This does not necessarily have to be anything to do with electronics. The merry month of May, for instance, (and any other month, for that matter) has a frequency of one sunset every 24 hours (although it isn't often seen in the British Isles). To take an electronic example, if an AC voltage changes its polarity one hundred times per second, this is referred to as a frequency of 50 Hz.

The point is, by what criteria is frequency measured? In the second example the number of polarity changes (from positive to negative, or vice versa) that occur during one second are simply counted. When a microprocessor is 'hired' to do the calculation work, a program consecutively displays the contents of three display buffers, in other words the last frequency to be measured. The program is interrupted either once the one second measuring time has passed, or the AC voltage has gone low. A new program is now run to check the cause of the interrupt. If a zero-crossing was involved, the period counter is incremented by one. But if the measuring time (1 second) has passed, the contents of the counter memory locations are copied into the display buffers. At the same time, a new measuring period begins. At the end of the process, a return is made to the main routine, after which the whole procedure starts all over again.

1

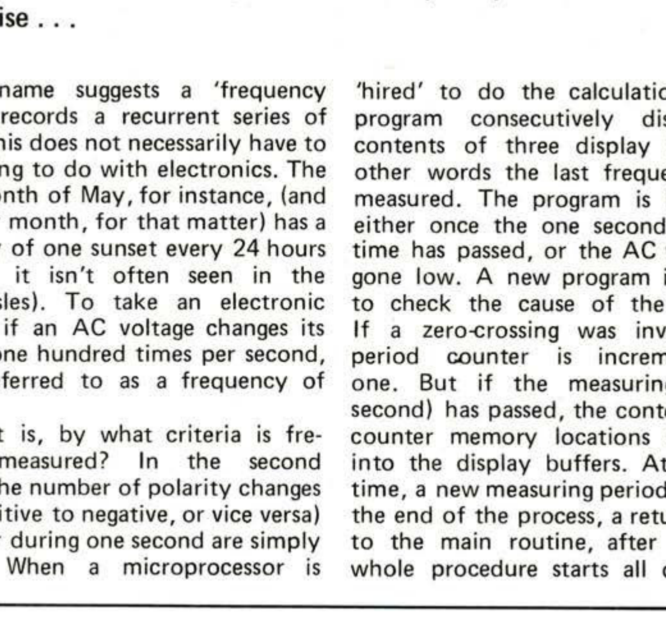

Figure 1. A series of interrupts (IRQ) are required for frequency measurement.

```
$1A00 A9 00       INITPR LDAIM $00
$1A02 85 D0              STAZ  ACCUL
$1A04 85 D1              STAZ  ACCUM
$1A06 85 D2              STAZ  ACCUH
$1A08 A9 29              LDAIM IRQSRV
$1A0A 8D 7E 1A           STA   IRQL
$1A0D A9 1A              LDAIM IRQSRV/256
$1A0F 8D 7F 1A           STA   IRQH
$1A12 8D E6 1A           STA   EDETC
$1A15 A9 10              LDAIM $10 (16$_{10}$)
$1A17 85 D4              STAZ  TIMEH
$1A19 85 D3              STAZ  COUNT
$1A1B A9 3D              LDAIM $3D (61$_{10}$)
$1A1D 85 D5              STAZ  TIMEL
$1A1F 8D FF 1A           STA   CNTH
$1A22 58                 CLI
$1A23 20 8E 1D LOOP      JSR   SCANDS
$1A26 4C 23 1A           JMP   LOOP
$1A29 48          IRQSRV PHA
$1A2A 8A                 TXA
$1A2B 48                 PHA
$1A2C 98                 TYA
$1A2D 48                 PHA
$1A2E 2C D5 1A           BIT   RDFLAG
$1A31 10 1C              BPL   ADD
$1A33 A5 D5              LDAZ  TIMEL
$1A35 8D FF 1A           STA   CNTH
$1A38 C6 D3              DECZ  COUNT
$1A3A D0 28              BNE   EXIT
$1A3C A2 02              LDXIM $02
$1A3E A0 00              LDYIM $00
$1A40 B5 D0       STORE  LDAZ  ACCUL,X
$1A42 95 F9              STAZ  INH,X
$1A44 94 D0              STYZ  ACCUL,X
$1A46 CA                 DEX
$1A47 10 F7              BPL   STORE
$1A49 A5 D4              LDAZ  TIMEH
$1A4B 85 D3              STAZ  COUNT
$1A4D D0 15              BNE   EXIT
$1A4F F8          ADD    SED
$1A50 18                 CLC
$1A51 A5 D0              LDAZ  ACCUL
$1A53 69 01              ADCIM $01
$1A55 85 D0              STAZ  ACCUL
$1A57 A5 D1              LDAZ  ACCUM
$1A59 69 00              ADCIM $00
$1A5B 85 D1              STAZ  ACCUM
$1A5D A5 D2              LDAZ  ACCUH
$1A5F 69 00              ADCIM $00
$1A61 85 D2              STAZ  ACCUH
$1A63 D8                 CLD
$1A64 68          EXIT   PLA
$1A65 A8                 TAY
$1A66 68                 PLA
$1A67 AA                 TAX
$1A68 68                 PLA
$1A69 40                 RTI


ADDITIONAL ZERO PAGE LOCATIONS
ACCUL   $00D0
ACCUM   $00D1
ACCUH   $00D2
COUNT   $00D3
TIMEH   $00D4
TIMEL   $00D5
```

Table 1. The frequency counter program.

2

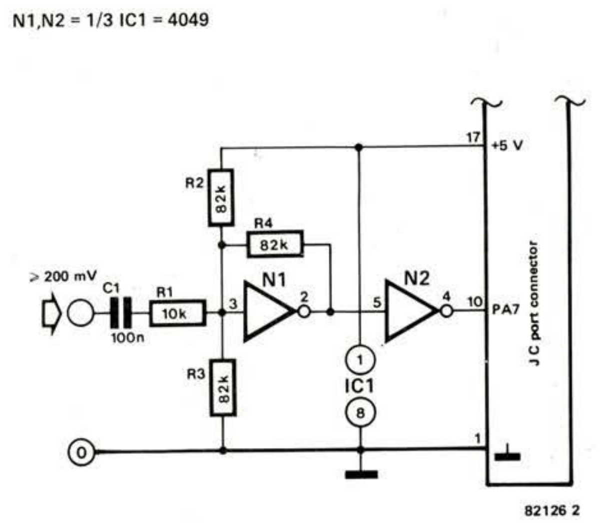

Figure 2. This circuit is added to the Junior Computer to effect the program in figure 1.

The events are depicted in the flow chart in figure 1.

A certain amount of hardware is also needed and this is shown in figure 2. This circuit is connected to the port connector of the Junior Computer to allow the frequency data to be entered into the computer. A significant negative zero-crossing in the input signal will pull port line PA7 low. The program makes sure this is accompanied by an IRQ.

The software is provided in the table. The start address of the program is $1A00. When data is written into location EDETC, PA7 is pulled low thereby enabling an IRQ. Preparations include defining the IRQ jump vector at the start address of the IRQSRV interrupt routine, starting the interval timer (CNTH, in other words, an IRQ is enabled after every 1024 clock pulses) and storing the contents of location COUNT. Then the program LOOP is run until an IRQ takes place.

As soon as any type of IRQ is detected, the IRQSRV program is run. After saving the A, X and Y contents (used during SCANDS) on the stack, the computer examines the N flag. If N, or rather the timer flag, is zero, the IRQ cannot have been enabled by a time out. This means that it must have been caused by a change in logic level on PA7. A new AC voltage period has passed and so the computer proceeds to label ADD. The 24-bit BCD number (ACCUH, ACCUM, ACCUL — the period counter in figure 1) is incremented by one. After restoring A, X and Y (EXIT) and executing an RTI, the computer returns to LOOP.

Supposing the IRQ was caused by a time out in the interval timer. The timer is started afresh and the contents of COUNT are decremented by one. Provided COUNT has not yet reached zero, a jump will be made to EXIT. If, however, COUNT is in fact zero, the STORE section is run. The measuring period has now passed and the display buffers, POINTH, POINTL and INH, are assigned values equal to those of ACCUH, ACCUM and ACCUL, respectively.

So much for the program, let's put everything into practice. Connect the circuit in figure 2 to the port connector, enter the program on the keyboard (or even better, read it in from cassette) and start it via the main JC keyboard. (The main JC keyboard must be used, so as to provide the I/O definition for SCANDS.) The highest frequency that can be measured is about 10 kHz. At low frequencies greater accuracy may be obtained by extending the measuring time to 10 seconds (load A0 instead of 10 into TIMEH, address $1A16). The result on display will of course have to be divided by ten to give the correct frequency.

Literature:
Chapter 6 of the Junior Computer Book II.