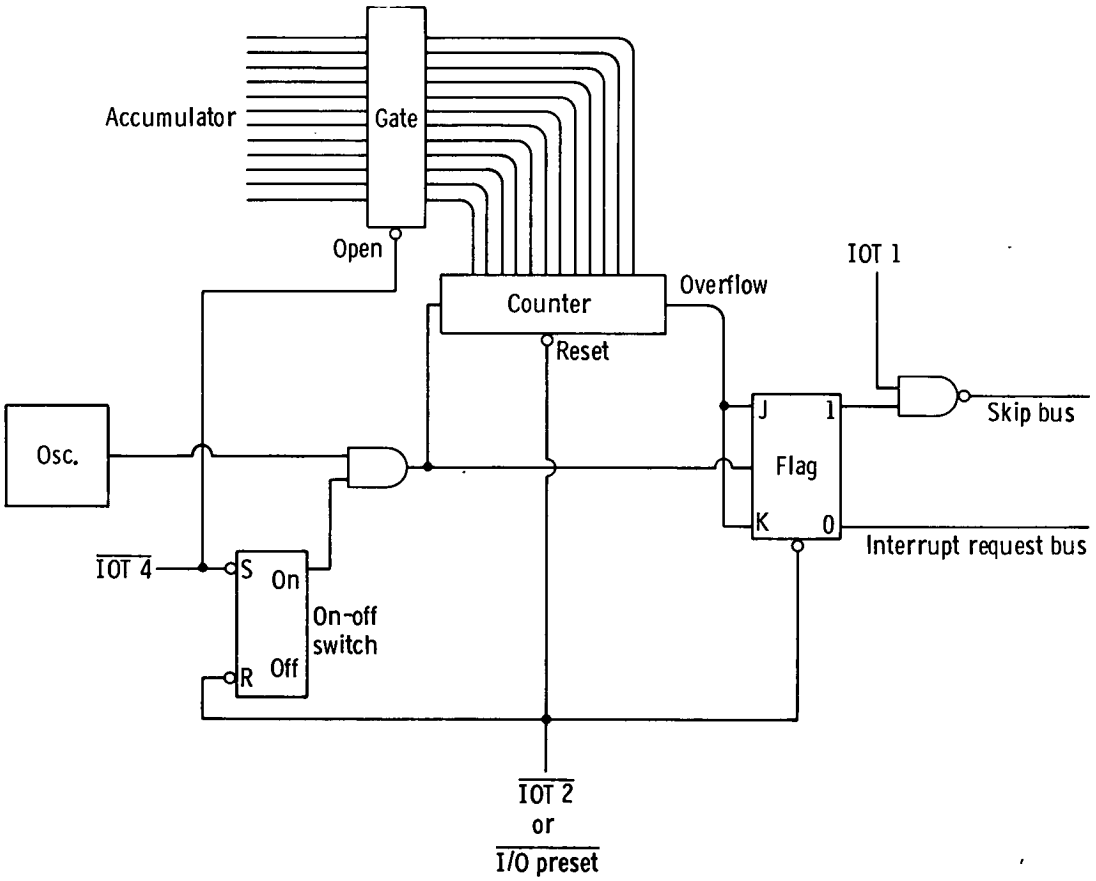
NASA TECH BRIEF

Lewis Research Center

Inexpensive Programmable Computer Clock



An inexpensive interval timer clock, complete with a computer interface, has been developed that can be programmed by a computer.

Communication with a computer is accomplished by devices such as teletypes, line printers, tape readers, etc. To the computer, each device must have a name and often two names to distinguish the direction of data flow. Along with a name, it must have a means of transmitting data. This is accomplished by the computer interface whose logic components provide electrical and communication compatability between the clock and computer.

There are two popular fundamentally different techniques used to communicate with a computer. The first mode can be called the wait mode. It involves giving a device a command and then waiting until the command has been executed and the results are available. However, most input-output (I/O) devices are extremely slow compared to the computer speed, and thus computer time is not utilized efficiently.

The second mode of communication is the interrupt mode. In this mode, the computer again issues a command but does not wait for execution. Instead, it may continue

(continued overleaf)

to execute other instructions. The interrupt mode capability can be turned on and off by the stored programming and other written routines. The actual operation of the interrupt is governed by clock programming. The programmable computer clock can use either of these modes of communication.

The clock's computer interface accepts pulses from the computer (computer commands) and translates them into control signals for the clock, and vice versa. The clock is preset by the computer to a fixed number of time pulses, and then started. After the fixed number of time pulses has occurred, the clock reads a pulse (via the interface) to the computer and stops.

The general scheme of the programmable clock is shown in the figure. An I/O (op-code instruction) preset pulse or an IOT2 (input-output transfer pulse) clears the flag, resets the on-off switch, and clears the counter. In programming, the usual technique would be to issue an IOT2, load the accumulator with the complement of the number of oscillator pulses desired and issue an IOT4. The IOT4 opens the gate between the accumulator and the preset terminals of the counter for 500 nanoseconds. This presets the counter. The IOT4 also turns on the on-off switch allowing the oscillator pulses to be counted by the counter. When the flag becomes set, the interrupt request line is grounded and an interrupt will occur. Interrogation of the flag by an IOT1 will indicate the clock has caused the interrupt and may be reset if desired. In either case, an IOT2 would be issued to clear the counter, reset the flag, and stop the counter. If the flag is left set, it will give a false indication of an interrupt if the interrupt is turned on or if an IOT1 is issued.

The three clock instructs are: skip on flag; clear the flag, clear the clock and stop the clock; and preset the counter with the contents of the accumulator and start the clock. The clock counts at a rate determined by the external oscillator and causes an interrupt and sets a flag when a 12-bit overflow occurs.

The clock was tested on a (DEC) PDP-12 computer and operated correctly as designed.

Notes:

1. While the clock was designed to be used with a 12-bit capacity computer, slight modifications can be made to permit its use on larger machines and logic shifting can be made to make it compatible with any computer.
2. The clock can be built for a total parts cost of less than $100 including power supply and I/O connector.
3. Further information is available in the following report:
   NASA TM-X-2500 (N72-16146), Inexpensive Programmable Clock for a 12-Bit Computer
   Copies may be obtained at cost from:
   Aerospace Research Applications Center
   Indiana University
   400 East Seventh Street
   Bloomington, Indiana 47401
   Telephone: 812-337-7833
   Reference: B73-10308
4. Specific technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B73-10308

Patent Status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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