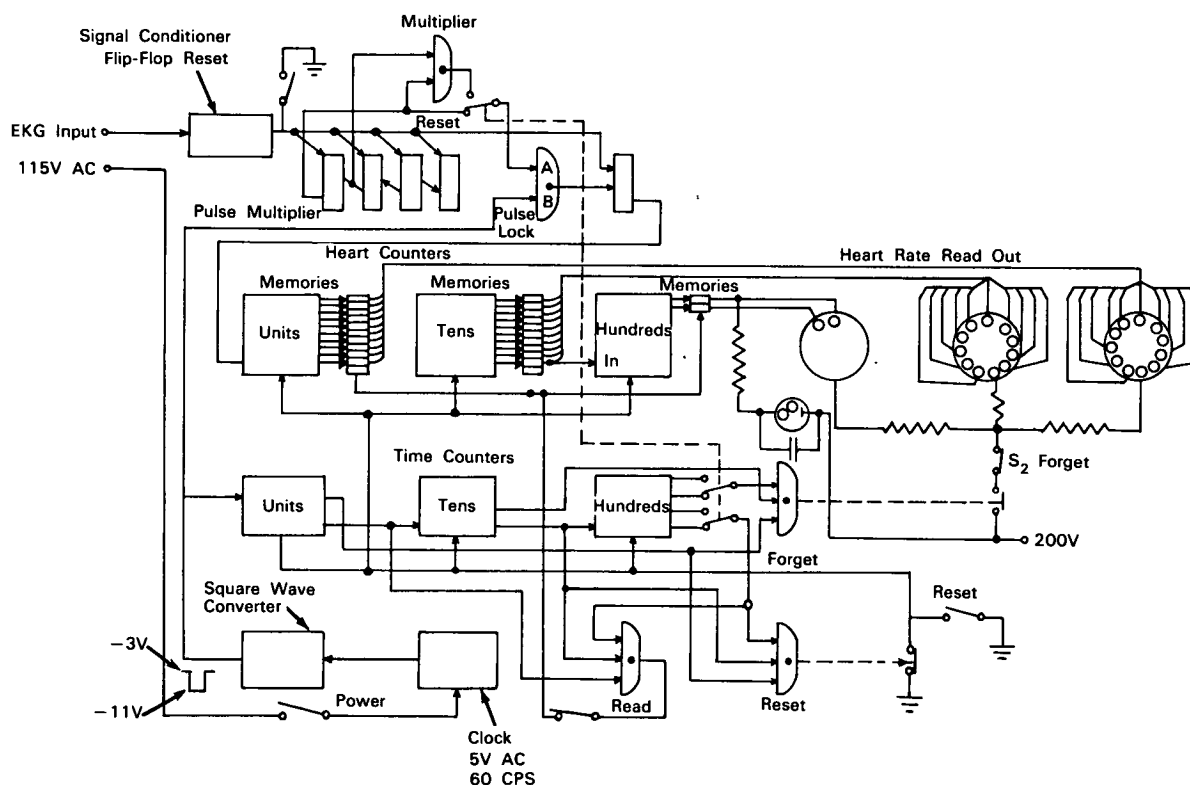# NASA TECH BRIEF

This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the space program.

Digital Cardiometer Computes and Displays Heartbeat Rate

The problem: To provide an instrument which will compute heartbeat rate from the waveform output of an electrocardiograph (EKG) and visually display the data in beats per minute.

The solution: An instrument (a digital cardiometer) with solid-state circuit .elements which computes the heartbeat rate every 15 seconds and presents the data on numerical display tubes.

How it's done: The cardiometer basically consists of a source of 60-cps pulses, a clock, decade counters, a pulse multiplier, a memory, and numerical display tubes.

The three-stage decade counter in the clock circuit counts the 60-cps pulses from the square-wave converter. At the count of 895 (i.e., 5 pulses less than the number of pulses in 15 seconds = $60 \times 15 - 5$), the last heartbeat reading on the numerical display tubes is erased. At the count of 900 (pulses in 15 seconds), a read pulse triggers the display tube to present the new heartbeat reading. At the count of 901, the counters are reset, and the cycle is repeated.

The waveform from the EKG amplifier is converted into a short negative pulse which resets the pulse multiplier (a binary counting circuit). Four time pulses are counted for each heartbeat, so that at the end of 15 seconds the number displayed is the number of heartbeats per minute. The pulse is routed through an AND gate which is held open until the eighth pulse enters the counter portion of the pulse multiplier. (The output of the AND gate also goes to an output circuit consisting of a single flip-flop. The odd-numbered pulses 3, 5, and 7, are the output.) At the count of 8, the multiplier feeds back a pulse to the AND gate and deactivates it until another heartbeat resets the system and opens the gate.

The four pulses per heartbeat are fed to a three-stage decade counter (heart counter), and the output for each number in the counter is fed to an AND circuit. The other input to the AND circuits is a common read voltage. When 15 seconds have passed, the read voltage is removed from one pulse length. The two or three AND circuits which are keyed by the counter at that instant will trigger silicon-controlled rectifiers to act as latching relays for the numbers selected by the counter. When the read voltage is replaced, the other AND circuits of the memory are locked. (The display remains until a cancelling signal is sent at pulse number 895 which momentarily interrupts the B+ from the display tubes). This action resets the memory circuits and removes the old reading.

Notes:

1. The cardiometer should have application as a medical diagnostic and teaching aid.

2. A related innovation is described in NASA Tech Brief B64-10003, March 1964. Inquiries may also be directed to:

> Technology Utilization Officer
> Manned Spacecraft Center
> P.O. Box 1537
> Houston, Texas, 77001
> Reference: B64-10258

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

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