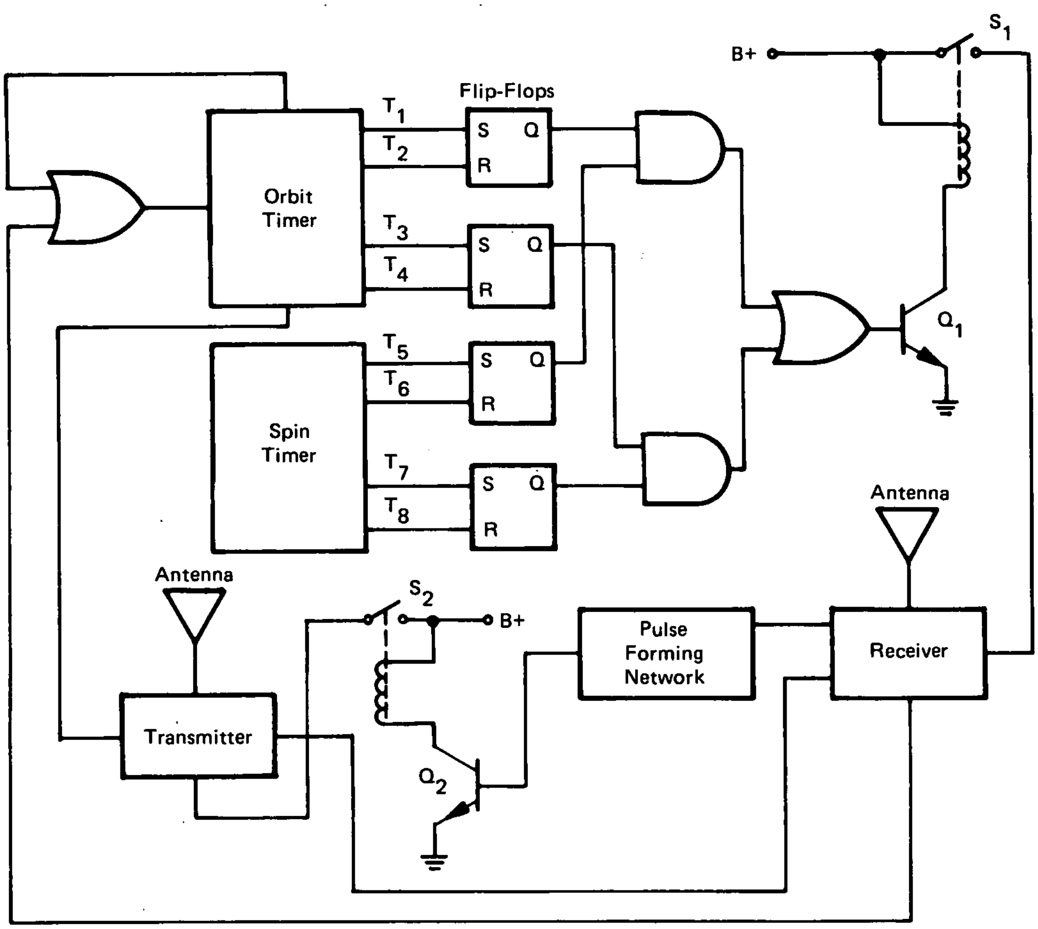
NASA TECH BRIEF

Goddard Space Flight Center

Time-Control System for Communication Between Data-Collection and Orbiting Satellites

The problem:

Data-collection platforms frequently are used in remote, uninhabited areas of the Earth. They are mounted on meteorological balloons and sea buoys, are attached to migrating animals, or are positioned on some fixed geographical location. Because they are out of the radio transmission range of most data-collection centers, these platforms communicate directly with Earth-orbiting satellites which, in turn, relay information to data centers on Earth. Presently used platforms are not very versatile: they contain relatively-heavy solar-cell packages for the continuous transmission of data. As a result, data are often transmitted when satellites are out of radio range. Moreover, in biological studies, the heavy solar-cell packages limit platform application to only a few animal species.



Platform Schematic

(continued overleaf)

The solution:

A new platform design includes timers which limit data transmission to times when satellites are within radio communication range. As the result of a reduced power requirement, data-collection platforms now can be equipped with significantly lighter battery packages.

How it's done:

The platform includes two timers, one for generating time windows synchronized in time with the orbit of the satellite and the second for generating time windows synchronized with the spin of the Earth. A first signal is generated at a time when the satellite is expected to be in radio range and is used to turn on the platform receiver. At this point, communication from the satellite to the platform is enabled. The satellite then transmits an interrogation command, to which the platform responds by briefly turning on its transmitter to transmit the data. After a period of time sufficient for communication, the platform receiver is turned off, thus conserving battery power.

The platform, as shown in the block diagram, contains an orbit timer and a spin timer. The times T_1 through T_8 are determined by the relative position of the platform with respect to the moving satellite from the well-known equations of motion. Once T_1 through T_8 are determined, they are programmed into the hardware.

In this configuration, time T_1 is the start or leading edge of the orbit-day intersection window, while T_2 is the end or trailing edge of that window. Similarly, T_3 and T_4, respectively, define the orbit-night intersection. Times T_1 and T_2 set and reset, respectively, the first flip-flop, causing a pulse of 10 minutes duration at the flip-flop output. This pulse defines the day intersection window. Similarly, T_3 and T_4 initiate the second flip-flop, defining the night intersection. In a similar manner, the outputs of the spin timer, T_5 and T_6 and T_7 and T_8, initiate their respective flip-flops, also defining day and night intersections, respectively.

The pulses appearing at the AND gate outputs are fed to an OR gate, which turns on transistor Q_1. The turned-on transistor energizes a relay, which connects the battery power to the receiver. When an interrogation command is received from the satellite, a pulse is generated by a pulse-forming network, turning on transistor Q_2. Q_2 energizes the second relay, turning on the transmitter for a designated time duration. The transmitted data includes the information collected by the platform as well as the received signal from the satellite to pinpoint the exact location of the platform.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Goddard Space Flight Center
Code 207.1
Greenbelt, Maryland 20771
Reference: TSP74-10088

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
Goddard Space Flight Center
Code 204
Greenbelt, Maryland 20771

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