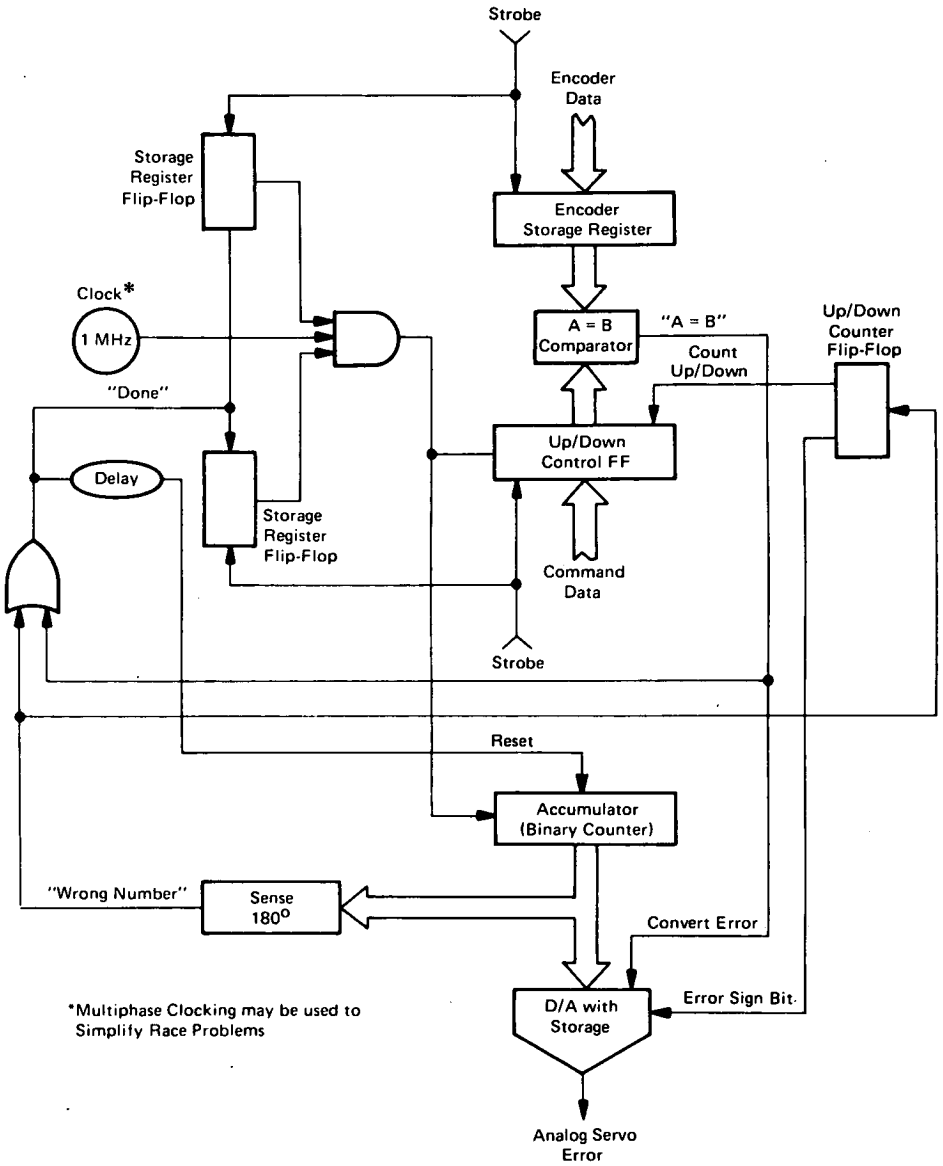
NASA TECH BRIEF

John F. Kennedy Space Center

Digital Servo Controller Behaves Like Synchro



Digital Servo Controller

(continued overleaf)

The problem:

The rotation of shafts supporting directional antennas requires a precise control for accurate angular positioning. The synchro-demodulator servo system has been a popular element for this type of control because of its unique inherent ability to "compute" the shortest distance between desired and actual positions, and because it can resolve unambiguously and monotonically all portions of its normal 360° travel. The synchro is generally very rugged, but has limited accuracy (±0.1°). In the world of digits (computer control, etc.) the synchro is unwieldy and interfacing is expensive.

The solution:

It is generally more accurate and simpler to interface with a digital encoder used as a shaft angle transducer. The encoder has been used for years to measure accurately the positional parameters of controlled devices with very high accuracy and reliability. A digital control system has been designed using digital shaft angle encoders.

How it's done:

The figure depicts a digital control system which provides error responses similar to synchros. The example is shown for BCD (binary coding), however, any common coding scheme can be similarly employed. The control system computes the correct error magnitude and direction using a "cut and try" routine, based on the fact that the correct error can never be greater than 180° and the incorrect error will always be greater than 180°.

A shaft encoder signals the present position of the controlled device. A parallel BCD word commands the desired position for the controlled device. By means of suitable clocks, both the encoder word and the desired word are strobed into two registers, generating a "loaded" signal. The "loaded" command initiates control action which allows the clock to increment or decrement (depending on mode of direction flip-flop, FF) the up/down counter (assumed for this example to be loaded with the desired position). Simultaneously, the previously cleared accumulator is also incremented, count for count with the up/down counter.

When the digital value of the up/down counter matches the previously stored encoder value, or when the accumulator count exceeds a value of 180°, the incrementing process is terminated, and one of two following operations is performed. If the accumulator exceeds 180°, all counters are reset, the cycle is terminated, and no new error data is transferred from the error digital to analog (D/A) converter. Additionally, the direction flip-flop for the up/down counter is toggled (the controller made the "wrong" assumption with regard to the error magnitude and direction, and upon doing so ignored the generated error command but "corrected" itself for the next try). If, on the other hand, the register comparator signaled the end of the cycle, the controller "knows" that to be a correct solution and the resulting accumulator count is transferred to the error D/A converter.

Note:

Requests for further information may be directed to:

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Reference: B73-10337

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:

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