

Hybrid servo system minimizes hunting

by C. V. Rajaraman
ISRO, Trivandrum, India

Although the shunt comparator circuit of Vojnovic¹ is simple and tends to reduce the overshoot and hunting problems inherent in a high-speed digital servo system, difficulties may arise when the servomechanism is continually called upon to follow small changes in position. Digital subtraction circuits, on the other hand, will increase system stability but are more expensive and very complex. But the two most popular techniques for synthesizing the control circuit—the no-shunt comparator method and the aforementioned subtractor method—can be combined to form a hybrid system that is more accurate than the first and less complex and costly than the second.

As shown in the figure, A_1 and A_2 compare lines 5–12 (the coarse bits) of a 12-bit command input with their feedback-data counterparts, which are derived from the motor position by a shaft encoder. Comparing the coarse

bits in this manner enables the system to converge quickly on the desired position.

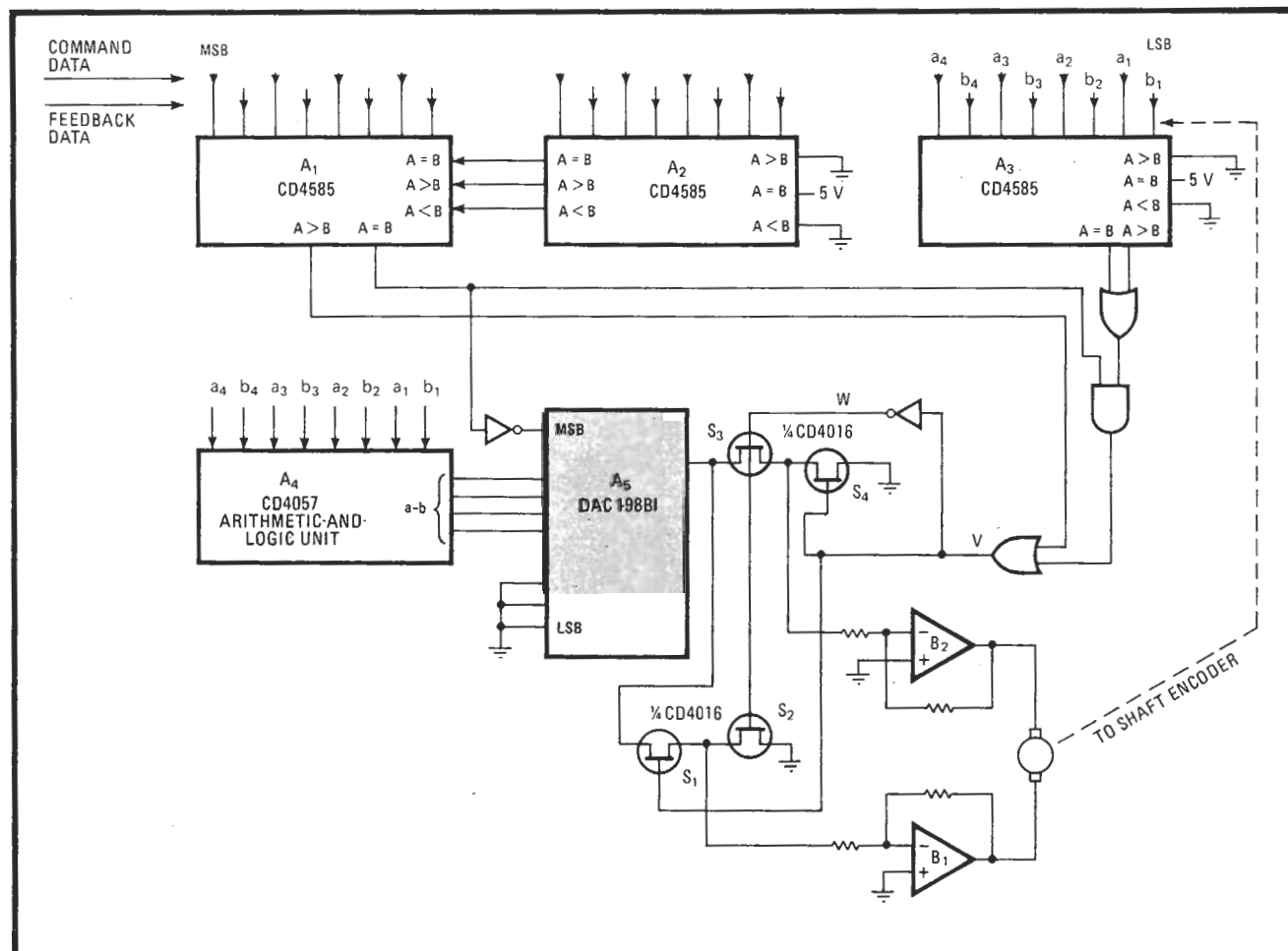
At the same time, the low-order (fine) bits of the command word are compared by A_3 , and A_4 is programmed to find $a \sim b$, the difference between the two 4-bit binary words. The $a \sim b$ result is then transformed into an equivalent analog signal by the digital-to-analog converter, A_5 . Using the d-a converter allows a precise voltage to be applied to the motor, instead of the constant-magnitude (logic 1) signal that a comparator-type circuit would generate whenever there was an $a \sim b$ offset of any value. Thus the motor has little tendency to overshoot its intended mark.

As for transferring the voltage from the converter to the motor, V moves high either when the coarse-bit comparison yields $A = B$ and the state between the fine bits are such that $A = B$ or $A > B$, or when just the coarse-bit comparison yields $A > B$.

Under these conditions, S_1 and S_4 turn on, and operational amplifier B_1 moves high to drive the motor. Under any other bit-comparison condition, W moves high and turns on S_2 , S_3 , and B_2 , to drive the motor in the other direction. □

References

1. B. Vojnovic, "Shunt comparator stabilizes high-speed digital servo," *Electronics*, March 16, 1978, p. 149.



End of search. Comparators and subtractor in servo position motor without oscillations. Comparison of high-order bits enables motor to converge on desired location. Fine-bit comparison with a d-a converter resolves precise feedback voltages to minimize overshooting.