NASA TECH BRIEF
*NASA Pasadena Office*



# Combined Sun-Acquisition and Sun Gate-Sensor System for Spacecraft Attitude Control

## The problem:

The on-course navigation of spacecraft flying interplanetary missions depends upon the proper orientation of a spacecraft on its various axes. The Sun is used as a celestial reference for pitch-and-yaw axis attitude control. Currently used Sun gate sensors, however, are sensitive to changes in solar intensity, and they do not operate over the intensity changes required for outer-planet missions. The acquisition sensors are also sensitive to stray light reflected from planets and from portions of the spacecraft. As a result, attitude control is not as effective as desired.

## The solution:

A new arrangement combines the acquisition and gate functions and reduces the sensitivity, so that attitude control is effective regardless of changes in solar intensity over a range of 900 to 1.

## How it's done:

A schematic representation of a 360° one-axis system is shown in Figure 1. There are five photoconductive

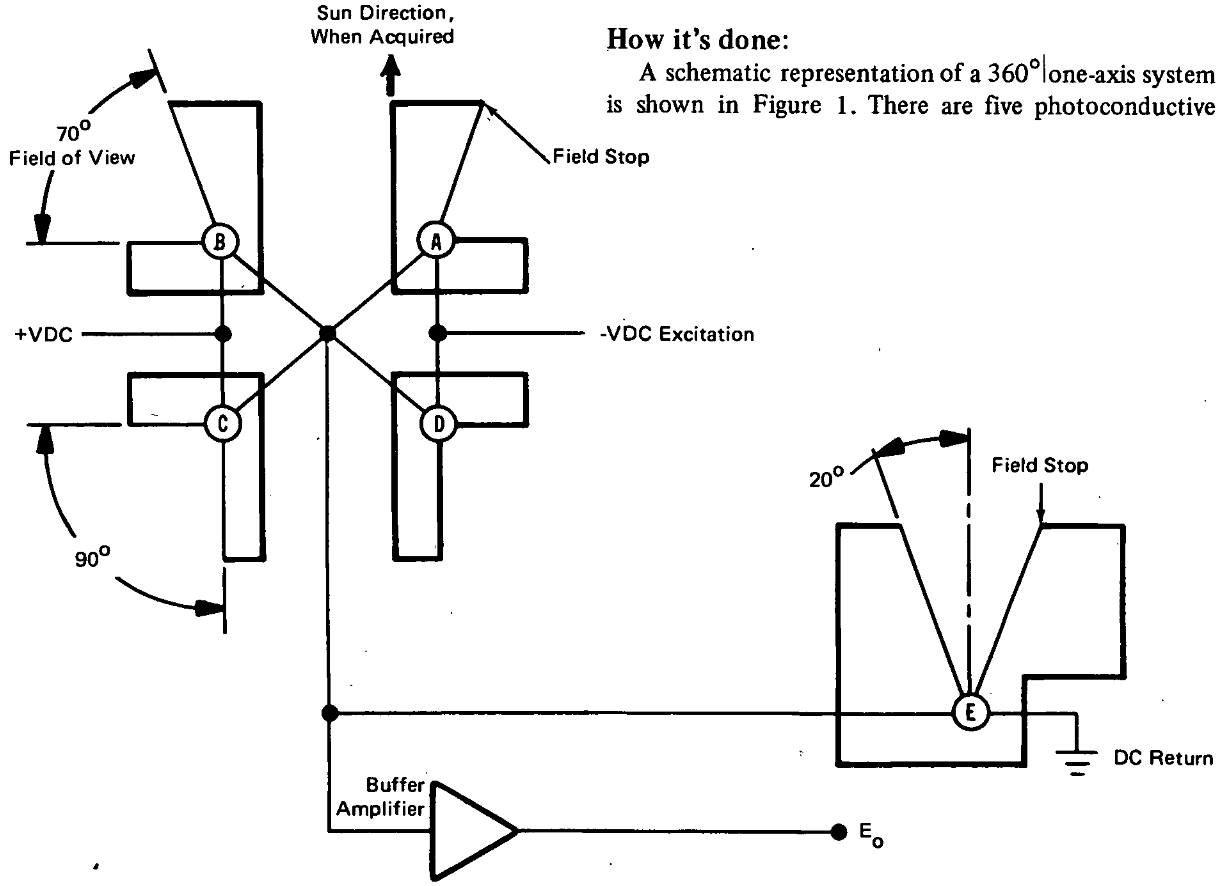


Figure 1. A Schematic of a 360° One-Axis System

(continued overleaf)

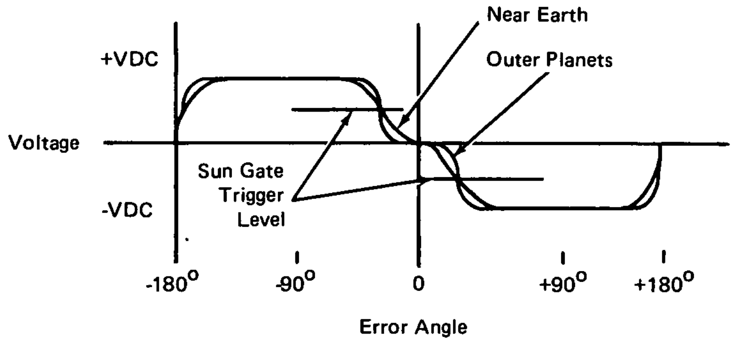


Figure 2. Output Characteristics

detectors labelled A through E, all electrically interconnected. The detectors are excited by positive and negative dc voltages to obtain sense polarities for actuating the proper gas jets. The output voltage characteristics are shown in Figure 2. The field of view of each acquisition detector (A, B, C, and D) is determined by its field stop, which is integral to the sensor assembly. The field of view of the gate detector (E) is determined by the slit through which it admits sunlight. In this type of detector, illumination reduces the resistance of the cell.

The detectors are so positioned that, regardless of spacecraft orientation at any instant of interest, at least one detector is illuminated by the Sun. If it is assumed that either detector A or D is illuminated, its resistance will be low, while the resistance of the other unilluminated detectors will be high. The voltage at the junction of the four detectors then will go negative.

On the other hand, when either detector B or C is illuminated, $E_0$ goes positive. Either positive or negative inputs to the buffer amplifier will result in the firing of the gas jets, in the proper sense to bring about spacecraft reorientation.

A Sun acquired condition occurs whenever the gate detector (E) is sufficiently illuminated to cause the absolute voltage level of the output to become less than the present trigger level shown in Figure 2. The illumination of detector E at a proper level will produce a very low resistance path to ground, placing the buffer amplifier at zero input. Since the outputs from any of the acquisition sensors then are shorted out, this prevents the reception of stray light, such as reflections from planets, by those detectors, from causing a false indication that the Sun has not been acquired. Direct light from the Sun does not reach the acquisition detectors under this condition because of the field-stop configuration.

## Notes:

1. The described system may be applicable to aircraft navigation as well.
2. No additional documentation is available. Specific questions, however, may be directed to:

   Technology Utilization Officer
   NASA Pasadena Office
   4800 Oak Grove Drive
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   Reference: B73-10460

## Patent status:

NASA has decided not to apply for a patent.

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