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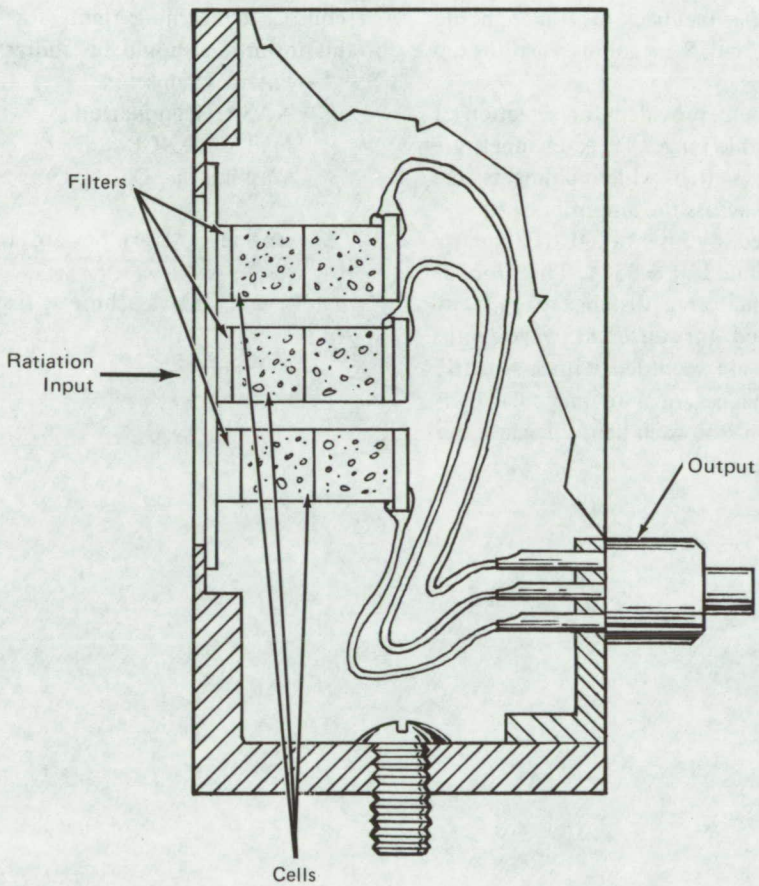
A Compact Spectroradiometer for Solar Simulator Measurements



The problem:

There is a need for a compact probe to monitor the spectral energy distribution of solar simulators and other high intensity sources.

The solution:

A compact spectral irradiance probe has been designed and built which uses a wedge filter in conjunction with the silicon cell and the operational amplifier. Its recording wavelength range is 400 to 750 nm from which 23 bands can be selected by an automatic stepping switch each having a 20-nm bandwidth.

How it's done:

The wedge filter, model VERIL B-60, used in this system is cut into three sections and split lengthwise into four parts. Two of these are cemented to form a double filter, thus making two sets of filters. One

(continued overleaf)

additional filter, a Schott BG-38, is included for the short wavelength section around the 400 nm range.

Radiation transmitted through the filters is picked up by silicon photovoltaic cells, which are a part of the photovoltaic readout assembly. Output of these cells varies linearly with wavelength. For example, at 700-nm wavelength with 20-nm band, a cell may have sensitivity of 0.5 A/W, giving a current of 18.55 μA. At 400 nm, this sensitivity is approximately 0.00267 A/W, giving an output of 100 nA. A schematic of irradiance probe is shown in the figure.

An operational amplifier with a minimum gain of 10^5 converts this cell current to an output voltage. The amplifier acts as an inverter such that the current tending to drive the amplifier input positive produces a negative output voltage. Because the desired amplifier output is 0.5 V, the amplifier feedback resistance should vary between 27 kilohms and 5 megohms for 700 nm and 400 nm, respectively.

Twenty-three channels are provided for selection of wavelength bands within this range. These channels are selected with a stepping switch which connects the proper feedback resistance across the amplifier.

The probe is calibrated by use of QL-108 quartz iodine standard lamp operated at 6.35 A. The probe is placed normal to irradiance at a distance of 43 cm. Channels are then selected for different wavelengths and their output voltages are recorded with a sensitive voltmeter. The solar irradiance equal to one solar constant should produce 500 mV on each band. Because the irradiances of solar and standard quartz lamp are known on each band, their ratios are fixed. Thus, at any given band, the ratio of 500 mV to recorded voltage set equal to the proper fixed ratio determines the irradiance scale. With this scale calibration, the overall system errors are of the order of ±5%.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Headquarters
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Reference: TSP72-10327

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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