MICROWAVE SOLAR RADIOMETER AT 2800 MHz

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Received May 18, 1971
(Communicated by Dr. K. R. Ramarathan, F.A.Sc.)

ABSTRACT

A Dicke-type microwave radiometer has been developed for daily measurement of solar flux at 2800 MHz. The antenna system, consists of a 5 foot parabolic dish with horn feed, is equatorially mounted and is capable of tracking the sun for about 8 hours each day. The dynamic range of the radiometer is such that even strong solar bursts (flux $= 10,000 \times 10^{-22}$ Watts m$^{-2}$ Hz$^{-1}$) can be recorded by using the receiver in the AGC mode.

The calibration procedure and the errors involved in the measurement of the solar flux are briefly discussed. Some sample records of solar bursts made by means of this equipment are presented.

INTRODUCTION

It is well known that microwave radiation emitted by the sun in the centimeter wavelength region is usually classified into three categories: (1) the quiet sun component which is observed in the absence of sunspots, (2) the slowly varying component which is associated with sunspots and (3) the transient or burst component associated with solar flares (Kundu, 1965). At the time of solar flares electromagnetic radiation including X-rays and corpuscular radiation are also emitted. The flare-time X-radiation produces extra ionization in the lower ionosphere and causes fade-out in the long distance shortwave radio communication. The solar corpuscular radiation is responsible for the polar-cap blackouts and geomagnetic storms. Thus, the measurements of flare-time electromagnetic and corpuscular radiations are important for the study of solar-terrestrial relationships. So far as solar X-rays are concerned, they are absorbed in the earth’s atmosphere and hence it is impossible to study them directly with ground-based techniques. But it has been shown from rocket and satellite measurements of solar X-rays and simultaneous ground-based microwave solar flux measure-
ments, that there is often a close relationship between the microwave bursts at 10.7 cm waves and X-rays that are emitted at the time of solar flares; sometimes there is agreement even in fine structure details of their time profiles (Kundu, 1965). In order to study the physics of solar flares, sudden ionospheric disturbances, and their relationships, a Dicke-type microwave radiometer at 2800 MHz similar to the one being used in Canada (Medd and Covington, 1958) has been set up recently at the Physical Research Laboratory, Ahmedabad. The present paper describes the experimental set up and discusses sample recordings made with this radiometer. The calibration procedure and errors involved in the measurements of solar flux are also explained.

**PRINCIPLE OF OPERATION**

Figure 1 shows the block diagram of the Microwave Radiometer at 2800 MHz. If changes of the order of 10% in the solar flux are to be measured, the sensitivity $\Delta T$ of the system should at least be $20^\circ$ K. To achieve this, a Dicke-type switching system was incorporated in the receiver. Here, the receiver input is continuously switched between the antenna and a noise source at a rate of one KHz. This way the antenna noise temperature is