Journal of Engineering and Applied Sciences 12 (Special Issue 4): 6719-6721, 2017
ISSN: 1816-949X

Microwave Radiometer Design for Ocean Remote Sensing

[1]Alaudeen Basha and [2]V. Vijayakumar
[1]Department of Information Technology, AMET University, Chennai, Tamil Nadu, India
[2]School of Computer science and Engineering, VIT University, Chennai, Tamil Nadu, India

Abstract: A multi-frequency, ground-based Micro Wave Radiometer (MWR) for ocean remote detecting has been planned and created in this study. It will be utilized on the seaward oil stage and give environmental soundings of physical temperature and fluid water vapor utilizing diverts in the oxygen reverberation band (6.8 GHz) and water vapor reverberation band (23.8 GHz). Alternate channels at 10.7, 18.7 and 37 GHz are utilized as environmental windows, each with double polarization. The estimations at different blends of these frequencies and polarization will get numerous geophysical parameters, for example, the ocean surface temperature, close surface wind speed, ocean ice sorts et cetera. The multi-frequency microwave radiometer is a 5 frequencies, 10 channels and straight polarization framework. The collector is working at aggregate power mode with super heterodyne style. In addition, an outright adjustment and a semi continuous alignment technique utilized as a part of the multi-recurrence MWR are exhibited and the relative outcome is additionally examined which ensured the high determination of the multi-frequency microwave radiometer system.

Key words: Absolute calibration, MWR, framework, utilized, exhibited, determination

INTRODUCTION

During the past few decades, there has been an expanding enthusiasm for passive microwave remote detecting for checking the climates and planetary surfaces, particularly for the perception of the planet earth. Microwave radiometers as an imperative piece of microwave remote detecting can be utilized to recover the profile of the air and the ocean surface temperature, the close surface wind speed, water vapor thickness, the fluid water substance of mists and rain and the ocean ice sorts (Zhang *et al*., 2010). It can likewise be utilized to screen the snow-water content and the spatial appropriation of soil-dampness content which are critical components for hydrology, farming and meteorology.

The fundamental reason for this multi-frequency microwave radiometer is for the sea remote detecting and air inquire about, particularly to establish the recovery model of sea saltiness. The total adjustment strategy, together with the semi ongoing alignment could control the pickup float of the instrument and empowers a high system determination. The multi-frequency MWR incorporates 5 frequencies of C-band, X-band, Ku-band, K-band and Ka-band and every recurrence has 2 channels of vertical polarization and flat polarization. The radio wires and the collectors are autonomous for each channel.

MATERIALS AND METHODS

System design: The multi-frequency MWR comprises of 6 units: the recieving wire units, the beneficiary units, the checking component unit, information procurement and system control unit, the alignment unit and the power supply unit. The multi-frequency MWR is an aggregate power sort microwave radiometer in view of a heterodyne beneficiary and the functional block diagram of it is shown in Fig. 1. This radiometer system can be worked under the information procurement and framework control unit to execute PC direction. And the data from the radiometer can be processed to provide near real-time results. Growth, optical and thermal studies on novel nonlinear optical crystal: Glycine Phthalic Acid (GPA) (Krishnan and Das, 2016).

The signal focused upon the antenna feeds is downconvertedby the single side band mixer into Intermediate Frequency (IF) signal and it is sent to the data acquisition andsystem control unit after processing by the band-pass filter, the detector and the integrator (Harrington *et al*., 1995). The calibration unit is used tocalibrate the gain and noise by means of noise injection andimplement temperature measurement of PT100.

Antenna unit: The 5 tapered folded horns are utilized as a part of the reception apparatus units to offer a low

Corresponding Author: Alaudeen Basha, Department of Information Technology, AMET University, Chennai, India

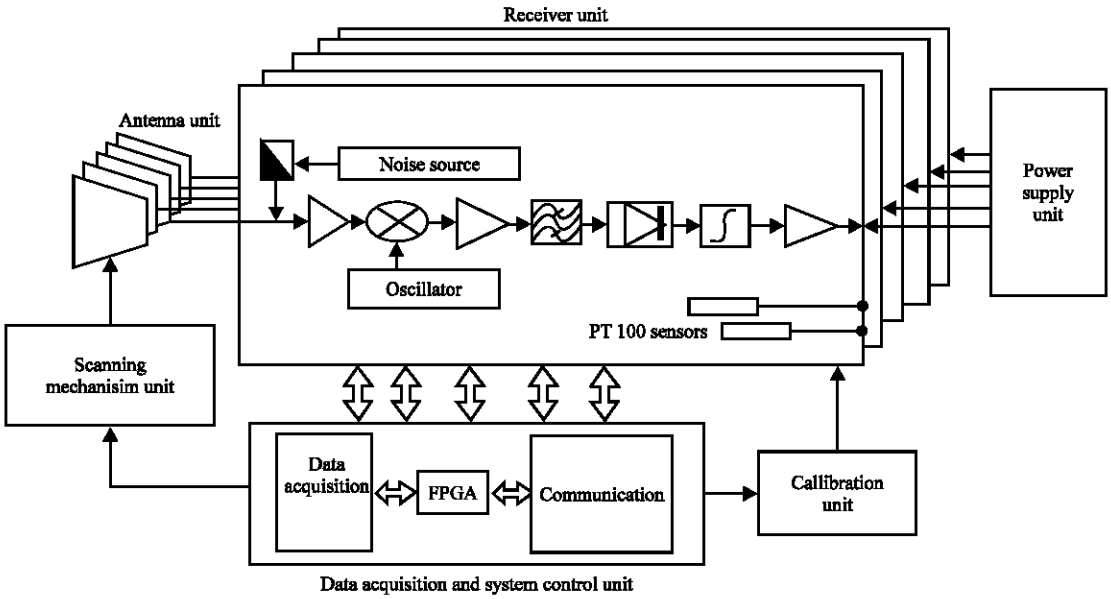

Fig. 1: Block diagram of multi-frequency MWR

cross polarization level and a rotationally symmetric beam pattern (Koupal *et al*., 2002). The antenna apertures are fixed by dielectric focal point to abbreviate the length of the radio wires and keep away from the corrosion of salt splash.

Calibration unit: There stays one vital trial of system adjustment to be done before putting the multi-frequency MWR into operation. The alignment unit will adjust in site by two point adjustment strategy utilizing blackbody at surrounding temperature and fluid nitrogen. The 5 temperature sensors are put in various areas to gauge the temperature of the surrounding condition and the estimation circuit is actualized utilizing platinum resistive thermometer PT 100 with four-line temperature estimation technique, the estimation exactness of which is under 0.02 K.

Data acquisition and system control unit: The analog signals output from the receiver units are digitalized by the AD converter and then sent to the CPU of this unit. The computer-controlled-gain-compensation technique is also used in the data acquisition and system control unit, which by analyzing outputs from reference loads to obtain compensations to the gains of signals from antennas, considering system fluctuation due to system gain and noise temperature variation during an sampling period (Skou and Divid, 2006). Also five DC power input relays are used to control the power supply of the entire system.

RESULTS AND DISCUSSION

Design of calibration: Calibration errors are the major source of inaccuracies inradiometric measurement, so the design of system calibrationis one of the most important technologies in the microwave radiometer system design. There are two kinds of calibrations used in the multi-frequency MWR, the absolute calibration and the noise injection calibration.

Absolute calibration: The absolute calibration is to terminate the radiometer inputs with two absolute calibration targets which are assumed to be ideal targets, meaning their radiometric temperatures are equal to their physical temperature. The structure of absolute calibration is shown in Fig. 2.

Noise injection calibration: The noise source is one of the noise injection calibration targets and the other is sum of the equivalent noise temperature of noise source and its heating chip which is used to heat the noise source. The accuracy of a calibration carried out with the noise injection calibration standard is comparable to the results obtained by a liquid nitrogen cooled load. But the advantage of the noise injection calibration is that this calibration can be automatically done at any time.

Calibration test: The brightness temperature resolutions for the multi-frequency MWR are tested under laboratory

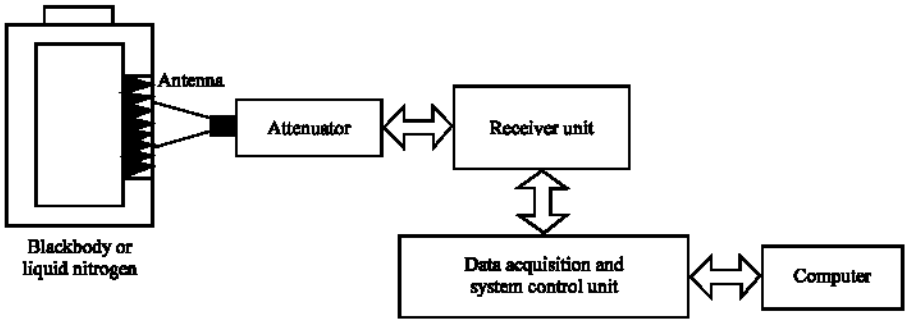

Fig. 2: Structure of absolute calibration

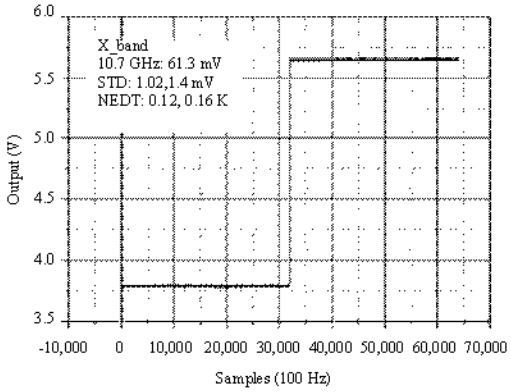

Fig. 3: Results of absolute callibration

Table 1: Result of resolution for horizontal channel of X-Band

Variables	Values	Values
Equivalent noise temperature (K)	82.00000	297.15000
Average output voltage (V)	3.79125	5.65045
Standard deviation (V)	0.00102	0.00140
Brightness temperature resolution (K)	0.11835	0.16220

conditions and about 70,000 data are collected in the test of absolute calibration, the result for the horizontal channel of the X-band receiver is shown in Fig. 3.

From Table 1, we can see that the brightness temperaturere solution is better than 0.2 K that is required in the technical specifications and the result has met the design requirement of the multi-frequency microwave radiometer.

CONCLUSION

The detailed sign and improvement of a ground-based multi-frequency microwave radiometer is exhibited and we likewise give a definite examination on multi-frequency MWR execution and alignment in this study and give the outcomes by looking at splendor temperature determination from the outright adjustment and the specialized detail. The test outcome well understands with the specialized requirement.

REFERENCES

Harrington, R.F., B.M. Grady and C.P. Hearn, 1995. Design and development of a microwave radiometer technology laboratory. Proceedings of the 2nd Topical Symposium on Combined Optical-Microwave Earth and Atmosphere Sensing, April 3-6, 1995, IEEE, Atlanta, Georgia, ISBN: 0-7803-2402-1, pp: 211-213.

Koupal, J., H. Michaels, M. Cumberworth, C. Bailey and D. Brzezinski, 2002. EPA's plan for moves: A comprehensive mobile source emissions model. Proceedings of the 12th International Workshop on CRC on-Road Vehicle Emissions, April 15-17, 2002, CRC, Pennsylvania, USA., pp: 1-14.

Krishnan, S. and S.J. Das, 2016. Growth, optical and thermal studies on novel nonlinear optical crystal: Glycine-Phthalic Acid (GPA). Optics Intl. J. Light Electron Optics, 127: 2509-2511.

Skou, N. and L.V. Divid, 2006. Microwave Radiometer Systems Design Andanalysis. 2nd Edn., Artech House, Norwood, Massachusetts, ISBN: 9781580539746, Pages: 222.

Zhang, Y., J. He and S. Zhang, 2010. Design and development of a ground-based microwave radiometer system. Prog. Electromagnet. Res. Symp. PIERS., 6: 66-70.