SS SONDE 01 : Radiosonde

SS SONDE 01 Radisonde (GPS Aerological Meteorological Sounding System) can accomplish the measurement of the five meteorological elements viz. temperature, air pressure, humidity, wind direction and wind speed with accuracy comparable with the best in the industry. High speed data processing terminal automatically records and process the meteorological data and print reports needed to predict the weather accurately for research of boundary layer and weather prediction. It possible to choose a free frequency slot in the frequency band, also in noisy conditions, it shall be possible to tune the radiosonde transmitter to any frequency within the frequency band. Frequency range is limited so that inadvertent tuning to unauthorized frequency is prevented. In addition to manual tuning, the system is capable of tuning the radiosonde automatically to a predefined value within the range. The design and construction of the radiosonde is such that no physical, electrical or chemical hazards are presented to operators, other personnel, or to any unskilled labour who requires access to the radiosonde preparation room. The design is also free from projections that may cause hazard to humans or animals during preparation or on landing. The radiosonde and de-reeler design enables a balloon launch in wind speeds up to 35m/s. The suspension string between the radiosonde and balloon is 30 meters or more to eliminate possible temperature errors caused by the balloon. The suspension string uncoils slowly enough to prevent the sonde from hitting the ground when released. Humidity sensor is designed in such a way that the risk of ice formation on the humidity sensor is minimized. Both humidity and temperature sensors are mounted externally so that air that has previously been in contact with the radiosonde body does not affect the measurement. Both, humidity and temperature sensors are mounted so that thermal conduction from the radiosonde body does not affect the measurement. It is ensured that the sensor in-flight position in relation to sonde body is the same in every radiosonde i.e., the position will not be altered by the user. Both, humidity and temperature sensors have fast recovery from high humidity conditions or a cloud so that cloud top is reliably detected. Radiosonde are calibrated before delivery. Calibration data is stored in the radiosonde and is read automatically by the ground equipment during radiosonde preparation.

Salient Features

- Availability of raw and processed data during sounding.
- High quality PTU and wind data with error detection and correction.
- Low power consumption insuring long battery life (upto 2 hours flight with dry cells).
- Digital data transmission which consumes less power.
- Radiosonde frequency adjustable within the range 403MHz ± 3MHz to avoid any interference.
- The shelf life of the radiosonde, including battery is greater than 24 Months.

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Technical Index

MODEL	SS SONDE 01
Temperature Sensor	
Type	Bead Thermistor
Measuring Range	+60°C ~ -90°C
Endurable Error (Standard Deviation)	±0.3°C (+60°C ~ -80°C) ±0.5°C (-80 ~ -90°C)
Resolution	0.1°C
Response time	1S
Humidity Sensor	
Type	Thin – Film Capacitor
Measuring Range	0%RH ~ 100%RH
Endurable Error (Standard Deviation)	±5%RH
Resolution	0.1%RH
Response time	1.5S
Pressure and Geopotential Height	**Derived from GPS Heights**
Measurement Range	1100hPa ~ 1hPa
Endurable Error (Standard Deviation)	±1.0hPa (100hPa ~ 1100hPa) ±0.5hPa (1hpa ~ 100hPa)
Resolution	0.1hPa
Wind Detection (Derived from GPS Signals)	
Measurement Range of Wind Speed	0 ~ 150 m/s
Wind Speed Accuracy	0.15 m/s
Wind Speed Resolution	0.1 m/s
Measurement Range of Wind Direction	0° ~ 360°
Wind Direction Accuracy	2°
Wind Direction Resolution	0.1°
Positional accuracy	10m
Dimensions and Weight	
Weight with Dry Cell Batteries	<200g
Dry Cell Batteries	6V,9V
Operating time	≥140min

Transmitter	
Working Frequency	403MHz ± 3MHz (Adjustable)
Output Power	100mW ~ 200mW (Average Power)
Transmission Range	>250 km.
Modulation Mode	GFSK
Modulation Speed	1200bps
Transmitting Time Interval	1s

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SS SONDE GRS 01 : Ground Receiving System

Introduction

In the past few years many countries has rapidly developed and adopted Upper-air operational system, GPS sounding systems. Our group company M/s. S S Micro Electronics Technology (P) Ltd. has also developed Indigenous Upper-air operational system, GPS sounding systems. This system is used to measure the meteorological elements as temperature, air pressure, humidity, wind direction, wind speed and altitude etc. from ground to around 40 Km in the aerological atmosphere directly and accurately. Radar tracking on ground is not used in this system, but it employs a high precision GPS to automatically track the sounding of the balloon. As a result of this automaticity the accuracy of the system improves significantly.

System Components and Features

The Ground Receiving System (SS SONDE GRS 01) developed by S S Micro Electronics Technology (P) Ltd. mainly consists of directional UHF antenna (hereinafter referred to as antenna), ground receiver, ground check box, local GPS, sounding software and terminal computer, color printer, UPS etc.

The system is automated so that operator action is not needed after a sounding is initiated. Initiating a sounding includes balloon filling, radiosonde preparation, system startup, surface observation entry and balloon launch. In control of the terminal computer the antenna automatically tracks the flying radiosonde. The receiving module of the ground receiver receives the signals from antenna and demodulates the received signals into temperature data, humidity data, pressure data, longitude, latitude and height as well as other signals and sends them to the terminal computer through serial port time per second. The sounding software completes the editing of the original data detected and makes all the reports as per the user requirement. Terminal computer is used for data collection, data processing, data verification, system fault monitoring, alarming and so on. The ground test box is used to check whether the checked radiosonde works well or not.

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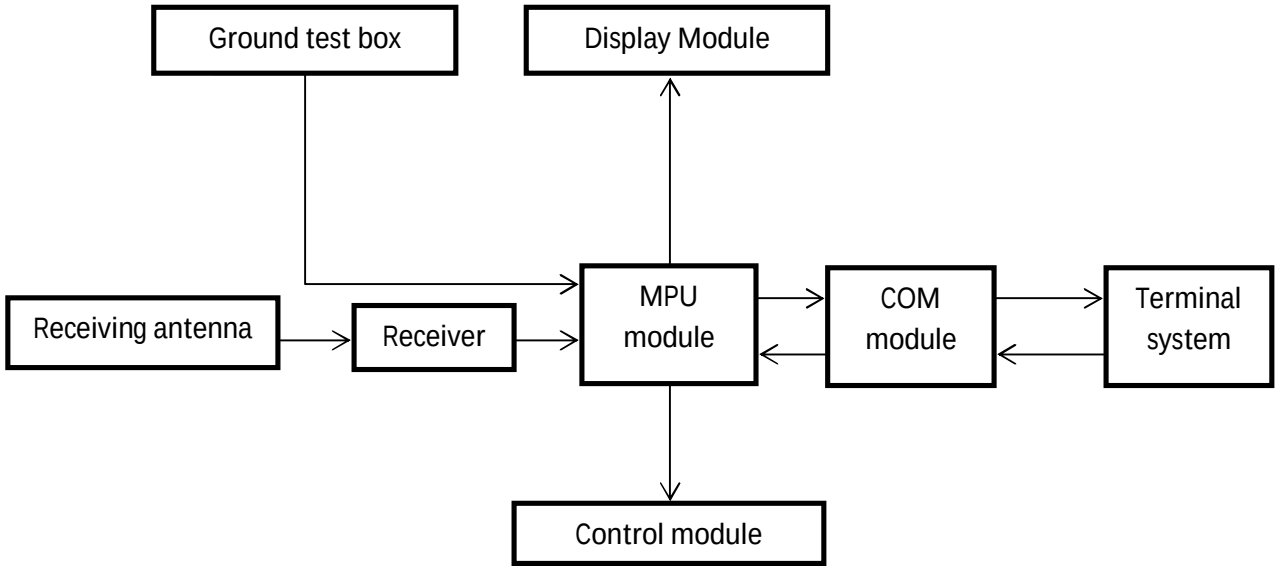
For reliable data transfer from the radiosonde to the ground station, digital modulation with efficient error detection and correction method is used. To improve reliability and to minimize the need for maintenance, the system contains no moving parts other than cooling fans in the indoor equipment. When installed the design and construction of the system is such that no physical, electrical or chemical hazards are presented to operators, other users of the room, or to any unskilled labour who requires access to the room. The UPS has a capacity for running the complete sounding system for 2 hours. Rating and frequency of the UPS input voltage will be chosen to match the available mains voltage i.e. Input voltage range 200 to 240 VAC and Operating frequency between 50-60Hz.

Principle Block Diagram of Ground Receiving System:



Antenna

The antenna is a directional UHF antenna to receive radiosonde signals in the 400-406MHz meteorological band. The antenna consists of one segment for horizontal direction and one segment for upwards direction. The antenna switches controls to make the selection between horizon and upwards according the positioning data from the local GPS and radiosonde. The antenna is able to reliably receive the radiosonde signal at elevation angle of 5 degrees or lower. The system is capable of maintaining telemetry when radiosonde is directly above the receiving antenna. The output signal of antenna is sent for further processing to receiver after being pre-filtered and amplified by LNA. Antenna has no moving parts and any control, such as direction control, is automatic and fully electronic. Antenna cables are at least 30 meters in length.

Specification:

- Operating Frequency 400～406 MHz
- The Omni-directional antenna
  - Type of Polarization Vertical Polarization
  - Antenna Gain >3.5dBi
  - Beam Width 360°
  - Antenna Standing Wave Ratio <1.5
- The directional Antenna
  - Type of Polarization Linearly Polarization
  - Antenna Gain >1.5dBi
  - Beam Width >50° (3dB)
  - Antenna Standing Wave Ratio <1.5
- Filter
  - Band Width 403±6MHz (3dB)
  - Standing Wave <2
  - Insertion Loss <2dB
  - Switches Module
  - Isolation between each Channel <-18dB
  - Insertion Loss <1dB
- LNA
  - Gain >22dB
  - Noise Figure <1
  - Operating temperature range -40°C～+85°C（outdoor equipment）
  - Operating humidity range 0 to 100%RH （outdoor equipment）
  - Maximum wind speed ≥65m/s （outdoor equipment）

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Ground Receiver

Ground receiver demodulates the signals under the control of terminal computer and then sends the demodulated data to the terminal computer directly.

When the signals are received by antenna input into the receiver, they are first amplified, mixed and detected, and then these digital signals are sent to the terminal computer for further processing. The system has a real-time spectrum display that shows the frequency occupation in the meteorological band (400.15-406 MHz or 1668.4-1700 MHZ) so that operator can choose a frequency in an unoccupied and noise-free slot. It is possible to tune the frequency within the range. It is possible to limit the usable frequency range in the ground system so that inadvertent tuning of radiosonde to unauthorized frequency is prevented. The system is able to receive and correctly process transmissions from the radiosonde when other radiosondes of similar type are operating at a frequency separation of +/- 200 kHz and beyond 10 km distance from the receiver. It shall be possible to transfer processed data via Ethernet local area network (LAN) using TCP/IP, WMO SOCKET and WMO FTP protocol.

Specification:

- Working Frequency 403MHz±3MHz (Adjustable)
- Receiving Sensitivity ≤-115dBm; (includes pre-field amplifier)
- Receiving Bandwidth 60kHz ~ 100kHz

Ground Check Box

As recommended by the WMO CIMO Guide No 8, radiosonde measurement accuracy should always be checked in a controlled environment before the radiosonde is launched to prevent the launch of faulty radiosondes and to improve calibration accuracy by adjusting for small changes in calibration that may have occurred when the radiosonde was transported to the launch site and during storage. The ground check box is used to check the accuracy of the radiosonde sensors. The ground check box includes one high precision humidity sensor and one temperature sensor as humidity and temperature reference. When checking before releasing, the temperature and humidity sensor of the radiosonde are put into a standard chamber where the reference sensors of the ground check box are fixed, and then system will compare the data of the radiosonde and the same of the ground check box, if the difference between radiosonde sensor and references is beyond the set tolerance, the system will inform the operator to change another one.

Specification:

- Operating conditions
  - Humidity 0~100 %RH
  - Temperature 0～+50°C

- Temperature sensor
  - Accuracy 0.2°C
  - Resolution 0.01°C
- Humidity sensor
  - Accuracy 2%RH
  - Resolution 0.1%RH

Power AC, 220V/50Hz

Sounding Software

The software of GPS sounding system is in charge of controlling and testing and monitoring ground receiving equipment.

System control, monitoring and data collecting

- The sounding software can run in Windows/Linux operating system. The operating version shall be fully supported along with licensed version.
- All operator actions are through a single user interface.
- Antenna tracking & control mode manual/auto.
- Failure locating, displaying and warning.
- Real-time displaying the GPS working state.
- Real-time recording, restoring initial information of GPS and air sounding.
- Real-time measuring the power voltage and inbox temperature of radiosonde.
- Produce standard and significant level points. Significant level (Maximum/Minimum temperature, humidity, freezing level, tropopause, last level reached and balloon burst) data is stored for generation of reports and messages for transmission to network.
- Generates traditional alphanumeric coded meteorological messages as specified in the latest WMO Manual on codes. TEMP, PILOT, CLIMATTEMP including national practices as applied in India.
- Produces data sets in BUFR format as specified in the latest WMO Manual on codes.

- Meteorological messages are coded automatically and as soon as sufficient amount of data has accumulated. For example TEMP part A is coded immediately after data from surface to 100hPa level is received and processed. The complete TEMP report including all parts will then be coded after the sounding is finished.
- Possibility to transfer any of the produced data sets or the complete sounding data file automatically to another computer without operator intervention. The data transfer will take place immediately after sufficient amount of data is collected also during sounding. The data transfer will be via local area network (LAN).
- The system software includes diagnostics capabilities to detect faults and malfunctions in any of the system components. The results of the diagnostics are recorded into log files and any detected malfunction will be reported to the user either on the system main display or with indicator lights on the faulty unit. The fault detection will be at module level (line-replaceable unit).
- Facility to manually enter surface observation data (pressure, temperature, humidity, wind, cloud code, present weather, past weather etc) before launch.
- The computer clock is synchronized to the GPS time.
- Near real-time graphical display for checking sounding data during ascent.
- System time and the flight time after balloon launch will be displayed continuously during a sounding.
- Sounding data will be stored in near-real time to prevent data loss in case of power break or similar failure.
- For comparison purposes it is possible to compare vertical profiles from the data archived in graphical form.
- It is possible to print out data either in numerical (tabular) and graphical format.
- Prior to and during a sounding it is possible to view the status of the GPS signals received locally and by the radiosonde.
- A display is provided to show the position in kilometers of the radiosonde from the point of launch to the current position at any time during the flight. This display is operator selectable and the flight track will be displayed as a continuous line.

- It is possible to re-run the sounding data using different computing parameters. It is possible to code new messages and new data sets based on the new data from a re-ran sounding.
- It is possible to initiate message coding and data transfer both manually and automatically. The system incorporates user adjustable parameters to define the time or criteria for automatic message coding and data transfer.
- Software generates following plots: Stuve thermodynamic diagram, Tephigram. Plot of pressure versus temperature, geopotential height & humidity. Wind speed and direction, Balloon track with time & Total precipitable water vapours.
- CLIMATE TEMP (MONTHLY) as per department requirement can be prepared.

Terminal Computer

The sounding software is installed on the terminal computers or tough books. The terminal computer / tough book are window based systems which are used to control the antenna with the help of sounding software. All the graphs and plots in real time can be seen on the screen of the terminal computer / tough book. The computer machine is general purpose desktop type, available off the shelf in open market. All sounding data will be stored into single data file to preserve data integrity and to make it easy to manipulate archived sounding data. The terminal computer / tough book are generally the latest configuration available in the market with a minimum configuration of hard disk space for storage of at least 1000 soundings. The system computer is equipped with a 21" or larger flat display. The terminal computer / tough book also comes with a printer to take the print outs of the necessary messages and reports of charts. For a uninterrupted sounding during power shutdown the terminal computer / tough book also includes a UPS with a minimum 120 minutes backup at full load.

Environmental Conditions

- Operating temperature range, indoor equipment: +10 to +50°C
- Operating humidity range, indoor equipment: 90% non-condensing
- Outdoor equipment temperature range: -40 to +50°C
- Outdoor equipment humidity range: 30 to 100%
- Maximum wind speed (outdoor equipment): 65m/s
- Rain sealing: Weather Resistant