

## BY ANSHARI RSRW

- IMD has a network of 56 Radiosonde Radiowind (RS/RW) stations.
- 62 stations in the upper air network of IMD having pilot balloon observations around 540 stations taking pilot wind observations only.

### Elements of observations

- In Radiosounding:-
  1. Temperature
  2. Humidity / Dew point temperature
  3. Pressure / Height
  4. Wind Direction
  5. Wind Speed
- In Pilot Balloon Observations:-
  1. Wind Direction
  2. Wind Speed

### Measurement

- |                              |                          |
|------------------------------|--------------------------|
| 1. Temperature--             | Thermistors (Rod/Bead)   |
| 2. Humidity / Dew point temp | Hygristor (LiCl, C, Cap) |
| 3. Pressure / Height         | Press sensor, GPS height |
| 4. Wind Direction            | Tracking with GPS        |
| Wind Speed                   | Tracking with GP         |

### GPSonde includes the following subsets:

- Temperature and humidity sensor boom
- 3D GPS Module
- Transmitter
- Microprocessor board
- Battery pack

GPS antenna for satellite reception and 400Mhz antenna for ground transmission.

### Sounding Systems

- Radiosounding:-
  1. GPS based radiosounding systems
  2. Radiotheodolite based sounding systems
  3. Radiosonde Ground equipment using optical theodolite for wind observations.
  4. Satellite derived profiles

- **Wind only (Pilot Balloon) Observations:-**

1. **Optical Theodolites**
2. **Wind Profilers**
3. **SODAR**
4. **LIDAR**
5. **Pilot Sonde**

#### **GPS based Sounding Systems**

- **GPS based radiosounding systems are latest in sounding.**
- **Fully Automatic.**
- **User Friendly.**
- **Auto tracking of balloon (transmitter)**
- **Auto detection.**
- **Minimum human interference.**
- **Very Light and portable type systems.**
- **Easy to maintain.**

#### **GPS**

- The Global Positioning System (GPS) is a space-based global navigation satellite system (GNSS) that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites.
- It is maintained by the United States government and is freely accessible by anyone with a GPS receiver with some technical limitations.
- Originally intended for military applications but in the 1980s the government made the system available for civilian use. It consist of 24 satellites placed into the orbit.
- Using messages received from a minimum of four visible satellites, a GPS receiver is able to determine the times sent and then the satellite positions corresponding to these times sent.
- While in upper air wind observations the latitude and longitude values obtained at each second is used for computing the drift of balloon by converting geographic co-ordinates to units electronic map (UTM) co-ordinates viz. North and East components (Northings and Eastings).
- **Receiver System is a ground instrument for reception of data from Sonde. It consists of following:**
- **Decoder Board , 400 MHz Receiver Board ,, GPS Board (14 channel)**
- **Power Supply Board 12V , Barometer Board**

#### **Antennae**

**There are three antennas for signal reception. They are:**

### **GPS ANTENNA:**

TRIMBLE BULLET GPS antenna is providing GPS signals from GPS Satellite to the SR2K2 which will be used as a reference GPS ground station for differential processing (DGPS).

### **400 MHz ANTENNA(VERTICAL):**

Omnidirectional active antenna with built-in low noise preamplifier. Its small size makes installation easy either on horizontal or vertical support. This antenna is used to receive the signal from  $0^{\circ}$  -  $45^{\circ}$  and  $135^{\circ}$  -  $180^{\circ}$ .

### **TURNSTILE ANTENNA:**

It is a hemispherical antenna used to avoid silent zone, when the sonde attains elevation between  $45^{\circ}$  -  $135^{\circ}$ . The tracking of sonde which is being a major difficulty in the existing systems has thus been overcome. The antenna is capable to receive signals from within the range of 500 kms. All the antennas may be disconnected when not in use to prevent damage from lightning.

### **TEMPERATURE:**

Temperature sensor consists in a thermistor chip wrapped into a glass ball. Its tiny size (0.9 x 2 mm) allows response time around 1 to 1.3 second. Temperature sensor is led on a layer processed against humidity and solar radiations.

Boom end is painted with a special white coating to reduce solar radiation effects.

### **HUMIDITY:**

Humidity sensor consists in a capacitor of which value is directly proportional to relative humidity. It is composed of three components:

- a) Basic layer as an electrode
  - b) A dielectric of which characteristics vary along with Relative Humidity.
  - c) A short response porous electrode as the second electrode of the capacitor.
- A cap is provided for protecting the sensor from rain and mechanical damage.

### **PRESSURE:**

Pressure is calculated from GPS altitude, temperature and humidity according to the barometric equation (Laplace Law).

### **GPS WIND FINDING:**

3D GPS module provides the position of the sonde (latitude, longitude and altitude) as well as speed components (North-South, East-West and Z). These data are correlated to time. Position is calculated every second by triangulation method between 4 or more satellites. Velocity is not calculated from the difference between two positions but directly issued from Doppler. Differential GPS is used to compare the data in order to clear satellite disturbances and eventual interferences and thus most accurate data are obtained.

**Raditheodolite based Systems**

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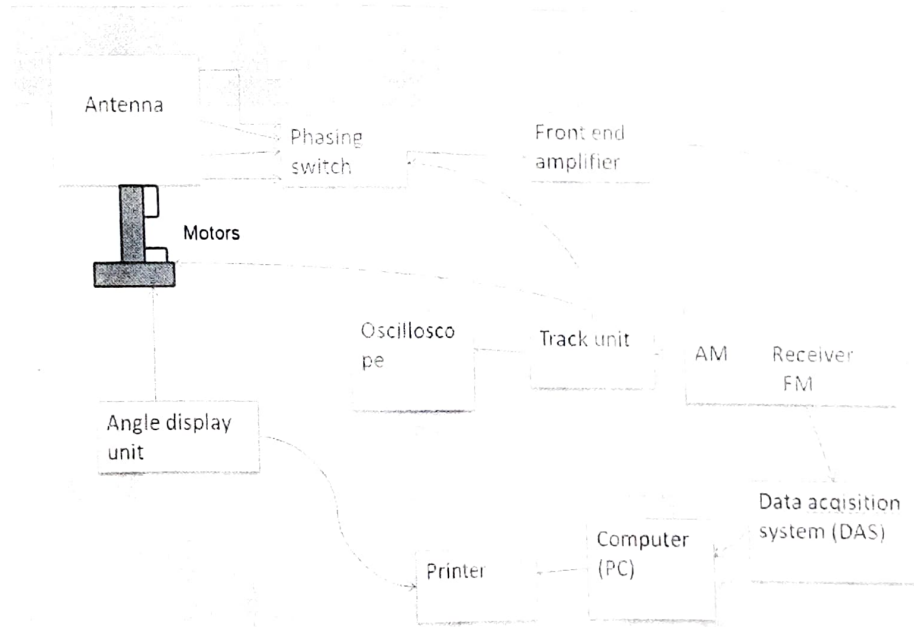
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## **Raditheodolite based Systems**

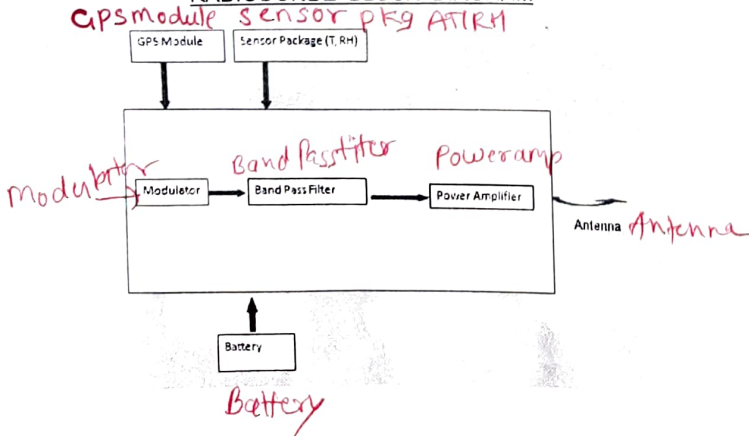
IMD uses following type of radiotheodolite based systems-

1. IMS-1500 radiotheodolite
2. SAMEER make radiotheodolites
3. Radiosonde Ground Equipment (RSGE)

S. No.	Parameter	SAMEER	IMS	RSGE	GPS
1.	Carrier freq	401 (390-410)	1680 ( 1669.57-1700 )	401 (395-406)	403 (400-406)
2.	IF	33	110	10.7	--
3.	Tracking technique	Lobe switching	Conical scanning	helical	GPS
4.	Balloon tracking	Manual	Automatic	Manual	Automatic



**RADIOSONDE BLOCK DIAGRAM**



### Wind Profiler

- In case of upper wind observations, Wind Profilers are capable to provide hourly or more frequent wind speed and direction values as a function of altitude.
- A wind profiler is a type of weather observing equipment that uses radar to detect the wind speed and direction at various elevations above the ground.
- Readings are made at different heights above sea level, up to the extent of the troposphere.
- Above this level there is inadequate water vapour present to produce a radar "bounce."

### Advantage of GPS

- ❖ It is evident from GPs based RS/RW ascent that the flight termination in most of the cases is balloon burst.
- ❖ The GPS receiver does not lose the signal while ascending.
- ❖ The data availability depends mainly on the quality of balloon in all weather conditions.
- ❖ Whereas, the presently used PB observations using optical theodolites are heavily dependent on weather conditions.
- ❖ With optical theodolites, we get more data in clear weather and the data availability decreases with adverse weather.
- ❖ We get less data or no data when it is urgently required by the forecaster.
- ❖ The average height of PB balloon observations even after modernization of PB network, by providing each station a good quality optical theodolite system has an increase of just 0.5 to 1 km only and some stations have no change in their status of maximum height coverage.
- ❖ It is mainly because of weather constraints.
- ❖ The use of GPS based system in PB observations is expected to remove all these constraints.

### SODAR system

- ❖ SODAR (Sonic Detection And Ranging), is a meteorological instrument which measures the scattering of sound waves by atmospheric turbulence. SODAR systems are used to measure wind speed at various heights above the ground of the lower layer of the atmosphere.

Sodar systems are like RADAR (radio detection and ranging) systems except that sound waves rather than radio waves are used for detection.

### Pilot Balloon(Only Wind) Obsns

Various techniques for PB observations:-

1. Optical theodolite
2. Wind Profiler
3. SODAR
4. LIDAR
5. Pilot sonde

### Major Wind Profiler Networks in the World

NOAA Profiler network, USA == 35 UHF profiler (32 @ 404 MHz, 3 @449 MHz  
 JMA Wind Profiler network, Japan = 31 profilers @ 1357 MHz  
 WINPROF, ECMWF network = 21 WPR, 2 SODAR (19 LT WPs-14 Vaisala 3 Degreane  
 make)

- ❖ 5 Nos. of Tropospheric type of Wind profilers at;  
*New Delhi, Allahabad, Mangalore, Machhilipatnam and Balasore.*
- ❖ 2 Nos. of Boundary layer type of wind profilers at; *Agra and Jaipur.*
- ❖ The biggest advantage of the wind profiler is that it continuously monitors the direction and speed of the wind without any break point or gap which makes it one of the accurate and efficient equipment in the field of environmental sciences and whether forecasting.
- ❖ It can prevent many fatal disastrous affect that can occur in the situation of storm and ocean imbalance.
- ❖ As it can measure the wind direction and speed above the sea level so it can easily detect from the speed of the wind about tidal waves and far storms that can hit the area in few hours.
- ❖ Very useful in reporting and alarming the flight situations which can prevent the major crashes. The flight reporting center can inform the pilot on cockpit in time about the upcoming air pockets that can pressurize the aircraft.
- ❖ This is done when the wind radar profilers measure the intensity turbulence and wind speed and inform the atmospheric stability to choose the appropriate action.
- ❖ Hence an important tool for NOWCASTING.

ADVANCED UPPER AIR TECHNIQUES:

Q-4(A) Fill in the blank:

- a) The IMS-1500 radiostheodolite radiosounding system operates on the frequency
  - i. 403 MHz ✓
  - ii. 840 MHz
  - iii. 1680 MHz
- b) Which of the following parameter is not directly observed in general in RS/RW ascent?
  - i. Relative Humidity
  - ii. Pressure ✓
  - iii. Height a. m. s. l.
- c) The SAMEER make radiostheodolite antenna has \_\_\_ dipoles.
  - i. 12
  - ii. 24
  - iii. 32 ✓
- d) Which of the following is not a parameter observed in radiosounding?
  - i. Temperature
  - ii. Humidity
  - iii. Solar radiation ✓
- e) IMD has a network of Stations in its RS/RW upper air network.
  - i. 39
  - ii. 56 ✓
  - iii. 62
- f) The Temperature sensor in GPS based radiosounding is of
  - i. Resistive type
  - ii. Digital IC
  - iii. Capacitive type ✓
- g) Which of the following upper air observing system is fully automatic in operation?
  - i. SAMEER make radiotheodolite
  - ii. GPS based ✓
  - iii. Optical based
- h) The observation of pressure in radiosounding are based on the measurement of
  - i. Drift of balloon
  - ii. Geo-potential height ✓
  - iii. Atmospheric humidity