



# **ALL INDIA RADIO: KOLKATA**

**4 WEEKS (3<sup>RD</sup> JANUARY 2011 TO 31<sup>ST</sup>  
JANUARY 2011) VOCATIONAL TRAINING  
REPORT**

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## **PREFACE**

The organization "PRASAR BHARATI" [BCI], All India Radio, Kolkata has given us an opportunity to do a 4 week vocational training on "Radio communication system or transmission systems of All India Radio".

The total system of transmission is so too vast that it is very difficult to write a report on this, in limited pages. Keeping in view of overall idea of AM & FM transmission systems, which we have got from the training of AIR, an attempt has been made to produce a report with full information & brief idea.

The total report is divided into 4 main parts with several sub parts. The report also contains much necessary information as foot note. The first introductory part is given to the report because, without clear idea of these topics it is difficult to us to understand the broadcasting & transmission parts.

All the topics have been illustrated with clear diagram or block diagrams which we have got from the manuals of A.I.R transmission system.

We are grateful to all the members and teachers of A.I.R, & especially to Mr. A. Roychadhuri, who have helped us to do this training.

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## **ACKNOWLEDGEMENT**

We would like to acknowledge, first & foremost, the contribution of Mr. A. Roychadhuri (Head of training cell, A.I.R Kolkata) without whose initiative & vision, our training wouldn't have been possible.

We would also like to acknowledge the contribution of all the teachers and engineers who have helped us to grasp the contents of this training in a lucid & comprehensive manner, thereby giving us an insight into the modes of conduct & operations that AIR is associated with.

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## **HISTORY of AIR**

Before 1927, a number of amateur radio associations had been permitted to broadcast on very low power in various parts of INDIA. The idea of a regular service took shape in the form of an agreement between the government of India & the Indian broadcasting company limited, under which a license for the construction of two stations at Mumbai & Kolkata respectively was granted. The Mumbai station was inaugurated on July 23, 1927 & Kolkata station on August 26 of the same year.

We should remember that the name of Kolkata's All India Radio office is "AKASHBANI BHABAN" which name is given by a great poet of Bengal Kavi Guru Rabindranath Tagore.

At the time of independence, there were 9 AIR stations of which 6 in Delhi, Kolkata, Mumbai, Chennai, Lucknow & rest 3 are in Pakistan.

After independence the AIR was a organization of ministry of information & broadcasting. But now AIR is also driven by a organization named "PRASAR BHARATI". It is the 80 years glorious journey of All India Radio.

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## **CENTRE OF TRAINING**

**AKASHBANI BHABAN (CONTROL ROOM): FOR BROADCASTING & STUDIO**

**GOLF GREEN (DDK) FM TRANSMITTER: FM TRANSMISSION**

**HPT AMTOLA (CHANDI): MEDIUM WAVE (100x2KW & 10x2 KW) TRANSMISSION**

**HPT AMTOLA: MEDIUM WAVE (100KW) TRANSMISSION & SHORT WAVE (50 KW) TRANSMISSION**

## **INTRODUCTION TO COMMUNICATION**

**Telecommunication** is the transmission of signals over a distance for the purpose of communication. In modern times, this process typically involves the sending of electromagnetic waves by electronic transmitters, but in earlier years it may have involved the use of smoke signals, drums or semaphore. Today, telecommunication is widespread and devices that assist the process, such as the television, radio and telephone, are common in many parts of the world. There are also many networks that connect these devices, including computer networks, public telephone networks, radio networks and television networks. Computer communication across the Internet is one of many examples of telecommunication.

**In a broadcast system** a central high-powered broadcast tower transmits a high-frequency electromagnetic wave to numerous low-powered receivers. The high-frequency wave sent by the tower is modulated with a signal containing visual or audio information. The antenna of the receiver is then tuned so as to pick up the high-frequency wave and a demodulator is used to retrieve the signal containing the visual or audio information. The broadcast signal can be either analogue (signal is varied continuously with respect to the information) or digital (information is encoded as a set of discrete values).

**Basic elements:** Each telecommunication system consists of three basic elements:

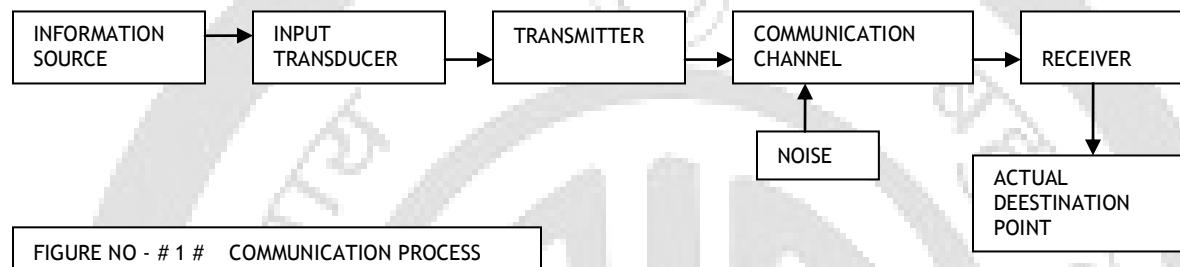
- A transmitter that takes information and converts it to a signal
- A transmission medium over which the signal is transmitted
- A receiver that receives the signal and converts it back into usable information

*For example, consider a radio broadcast: In this case the broadcast tower is the transmitter, the radio is the receiver and the transmission medium is free space. Often telecommunication systems are two-way, and a single device acts as both a transmitter and receiver, or transceiver. For example, a mobile phone is a transceiver.*

Telecommunication over a phone line is called point-to-point communication because it is between one transmitter and one receiver. Telecommunication through radio broadcasts is called broadcast communication because it is between one powerful transmitter and numerous receivers. Point-to-point communication can be classified as either simplex or duplex communication. In simplex communication information travels in only one direction across the communication channel. In duplex communication information travels in both directions.

**Communication** is simply the process of conveying message at a distance or communication is the basic process of exchanging information.

The block diagram of communication process is briefly shown below:-



**Information source** is to produce required message which has to be transmitted.

**Input transducer** is a device which converts one form of energy to another form of energy. It converts information source to a electrical signal.

**Transmitter** is a combination of electronic devices which is used to process electrical signal from different aspects. It is used to transmit the signal.

**Communication channel** is the medium (e.g. optical fiber, free space etc.) through which the message travels transmitter to receiver.

**Noise** is unwanted signal which tend to interfere with the required signal.

**Receiver** reproduces the message signal in electrical form from distorted received signal.

**Destination** is the final stage which is used to convert an electrical message signal into its original form.

### What is Modulation?

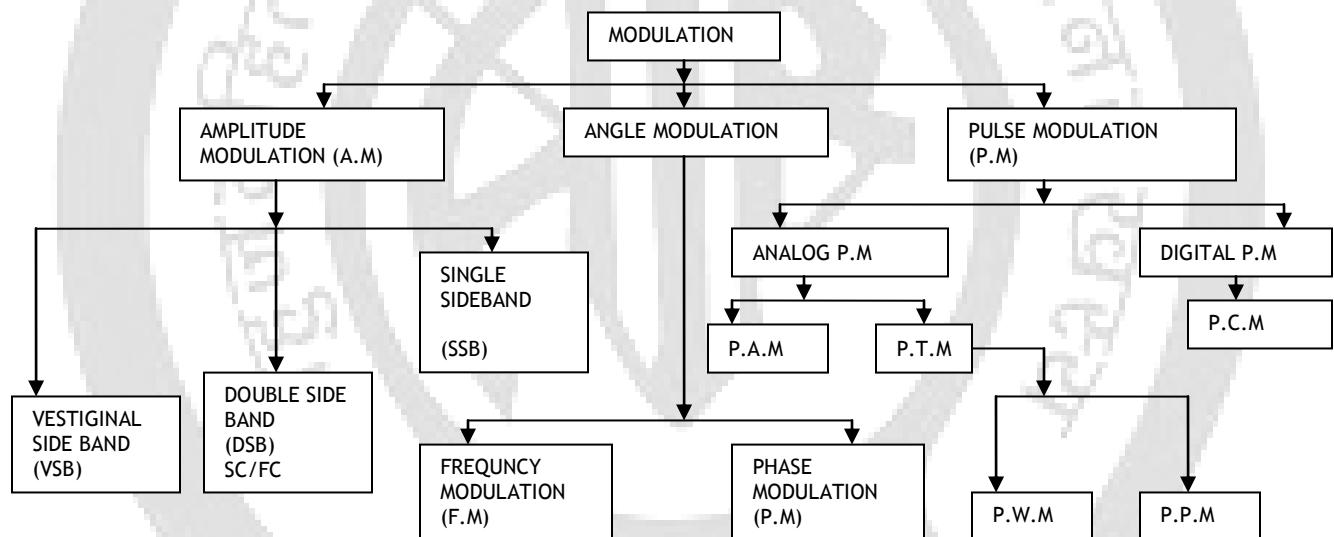
Modulation may be defined as a process by which some characteristics of a signal known as carrier is varied according to the instantaneous value of another signal known as modulating or base band signal.

- The signals containing intelligence or information to be transmitted are called modulating signal.
- The carrier frequency always greater than base band signal frequency.

## **Necessity of Modulation:-**

- **To reduce antenna height:** we know that when free space is used as transmitting medium (i.e. channel) then message is transmitted & received by antenna. But antenna height must be practical. We know that antenna height ( $l$ ) = (wave length) / 4= velocity of light/(4\*frequency). Now we know that audio frequency which is transmitted from radio station that is near about 5 KHz & we know that velocity of light = $3 \times 10^8$  mt/s, so antenna height becomes 5 km which is too big. So modulation is done where audio frequency is transmitted to a radio frequency carrier of 4 MHz, so antenna height is reduced by it.
- **To remove interference:**-Another reason for not radiating modulating signal itself is that the frequency range of audio signal is 20 Hz to 20 KHz .In radio broadcasting, there are several radio stations. In case there is no modulation, all these radio stations transmit audio signals in the range of 20 Hz to 20 KHz. Due to this transmission over same range, as a result the programs of all station will get mixed up.
- **To reduce noise:** The effect of noise can be minimized by using modulation techniques.

## **TYPES OF MODULATION:-**



■ Here in A.I.R mainly A.M & F.M is required.

## **AMPLITUDE MODULATION:**

Amplitude modulation may be defined as a system in which the maximum amplitude of the carrier wave is made proportional to the instantaneous value of the modulating or base band signal.

Modulation index ( $m_a$ ) = base band signal  $|X_t|_{\max}$  / maximum carrier amplitude (A).

Power of A.M wave:

$P_c$ =carrier power,  $P_t$ =total power

$$P_t = P_c (1+m_a^2/2)$$

$$\text{Efficiency (n)} = 100 X_t^2 / (X_t^2 + A^2)$$

Several types of A.M:

- I) DSB-SC II) DSB-FC III) VSB IV) SSB.

### **FREQUENCY MODULATION:**

Frequency modulation is that type of angle modulation in which the instantaneous frequency ( $w_i$ ) is varied linearly with a message or base band signal  $X(t)$  about an un modulated carrier frequency ( $w_c$ ).

Here modulation index ( $m_f$ ) = frequency deviation/modulation frequency.

### **COMPARISON OF AMPLITUDE MODULATION & FREQUENCY MODULATION:**

#### **ADVANTAGE:**

- A. F.M broadcasts operate in the upper VHF & UHF frequency ranges at which there happens to be less noise than in the MF & HF ranges occupied by AM broadcasts.
- B. Standard Frequency allocation provides a guard band between commercial FM stations. Due to this, there is less adjacent -channel interference than AM.
- C. It is possible to reduce noise still further by increasing the frequency deviation in case of FM. But it is impossible to increase frequency deviation in case of AM.
- D. The amplitude of the FM wave is constant. It is thus independent of modulation depth, whereas in AM, modulation depth governs the transmitted power. This permits the use of low level modulation in FM transmitter & use of efficient class-c amplifiers in all stages following the modulator. Further since all amplifiers handle constant power, the average power handled equals the peak power. In AM transmitter the maximum power is four times the average power. Finally in FM, all the transmitted power is useful whereas in AM , most of the power is carrier power which does not contain any information.
- E. FM receivers may be fitted with amplitude limiters to remove the amplitude variations caused by noise.

This makes FM reception a good deal more immune to noise than AM reception.

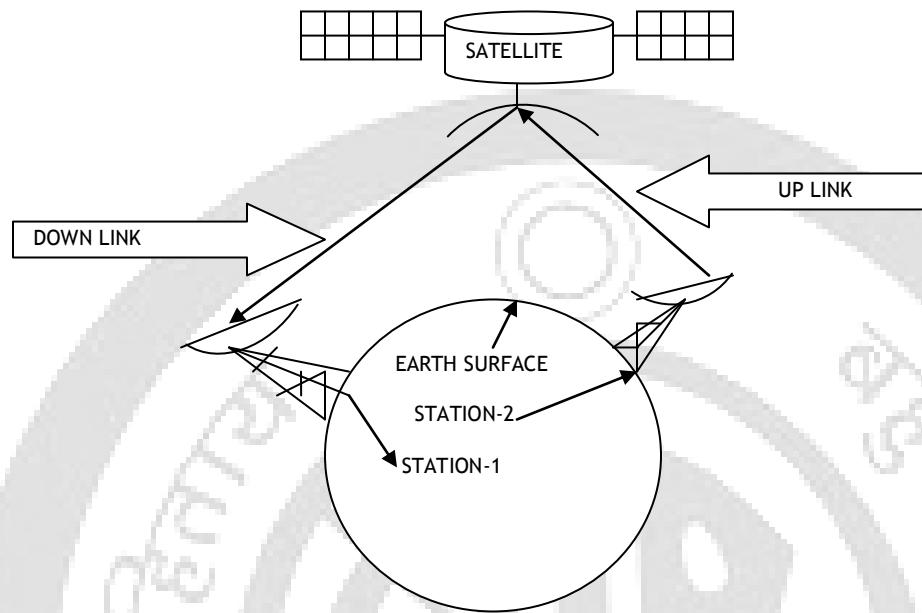
#### **DISADVANTAGE:**

- A. A much wider channel (200 kHz) is required for FM. Where AM broadcast can be done in 10 kHz.
- B. FM transmitting & receiving equipments are more complex & costly than the equipments of AM.

## **SATELLITE COMMUNICATION**

A **communications satellite** (sometimes abbreviated to **Comsat**) is an artificial satellite stationed in space for the purposes of telecommunications. Modern communications satellites use geostationary orbits or low polar Earth orbits. For fixed services, communications satellites provide a technology complementary to that of fiber optic submarine communication cables. They are also used for mobile applications such as communications to ships and planes, for which application of other technologies, such as cable, are impractical or impossible.

## **SCHEMATIC DIAGRAM OF SATELLITE COMMUNICATION**



**History:** The first satellite equipped with on-board radio-transmitters was the Soviet Sputnik 1, launched in 1957. The first American satellite to relay communications was Project SCORE in 1958, which used a tape recorder to store and forward voice messages. It was used to send a Christmas greeting to the world from President Eisenhower. NASA launched an Echo satellite in 1960; the 100-foot aluminized PET film balloon served as a passive reflector for radio communications. Courier 1B, (built by Philco) also launched in 1960, was the world's first active repeater satellite. The first truly geostationary satellite launched in orbit was the following Syncrom 3, launched on August 19, 1964. It was placed in orbit at 180° east longitude, over the International Date Line. It was used that same year to relay television coverage on the 1964 Summer Olympics in Tokyo to the United States, the first television transmission sent over the Pacific Ocean. Shortly after Syncrom 3, Intelsat I, aka Early Bird, was launched on April 6, 1965 and placed in orbit at 28° west longitude. It was the first geostationary satellite for telecommunications over the Atlantic Ocean. On November 9, 1972, North America's first geostationary satellite serving the continent, Anik A1, was launched by Telesat Canada, with the United States following suit with the launch of Westar 1 by Western Union on April 13, 1974.

**Geostationary orbits:** A satellite in a geostationary orbit appears to be in a fixed position to an earth-based observer. A geostationary satellite revolves around the earth at a constant speed once per day over the **equator**. The geostationary orbit is useful for communications applications because ground based antennas, which must be directed toward the satellite, can operate effectively without the need for expensive equipment to track the satellite's motion. Especially for applications that require a large number of ground antennas (such as direct TV distribution), the savings in ground equipment can more than justify the extra cost and onboard complexity of lifting a satellite into the relatively high geostationary orbit.

**Low-Earth-orbiting satellites:** A low Earth orbit typically is a circular orbit about 400 kilometers above the earth's surface and, correspondingly, a period (time to revolve around the earth) of about 90 minutes. Because of their low altitude, these satellites are only visible from within a radius of roughly 1000 kilometers from the sub-satellite point. In addition, satellites in low earth orbit change their position relative to the ground position quickly. So even for local applications, a large number of satellites are needed if the mission requires uninterrupted connectivity. Low earth orbiting satellites are less expensive to position in space than geostationary satellites and, because of their closer proximity to the ground, require lower signal strength (Recall that signal strength falls off as the square of the distance from the source, so the effect is dramatic). So there is a trade off between the number of satellites and their cost. In addition, there are important differences in the onboard and ground equipment needed to support the two types of missions.

### The advantages of satellite communication:

- 1) The quality of reception is quite good, & the system is most reliable & flexible.
- 2) The band width is very large.
- 3) A geostationary satellite can cover approximately  $\frac{1}{3}$  rd of earth's surface.
- 4) Satellite can provide signal to terrestrial uncovered area or pockets like mountain & valley region.
- 5) The cost of transmitting information through satellite is independent of distance involved.
- 6) It can be used in two way communication.

### The disadvantages of satellite communication

- 1) The cost of installation is too high.
- 2) The system requires high o/p power of earth station transmitters & sensitive receivers.

### A block diagram of satellite communication is given below:-

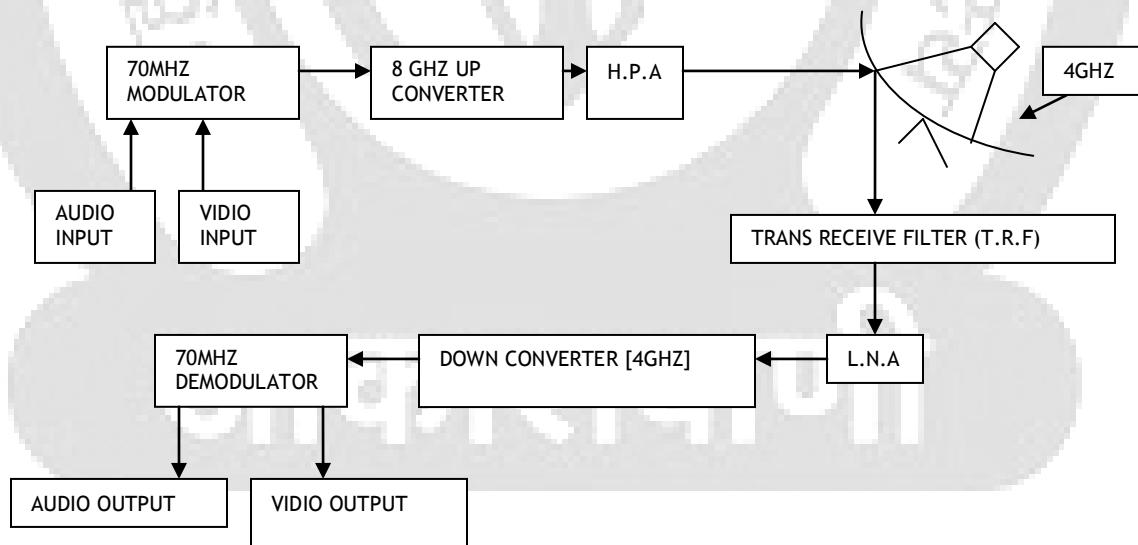


FIGURE: SATELLITE EARTH STATION UPLINK & DOWNLINK CHAIN

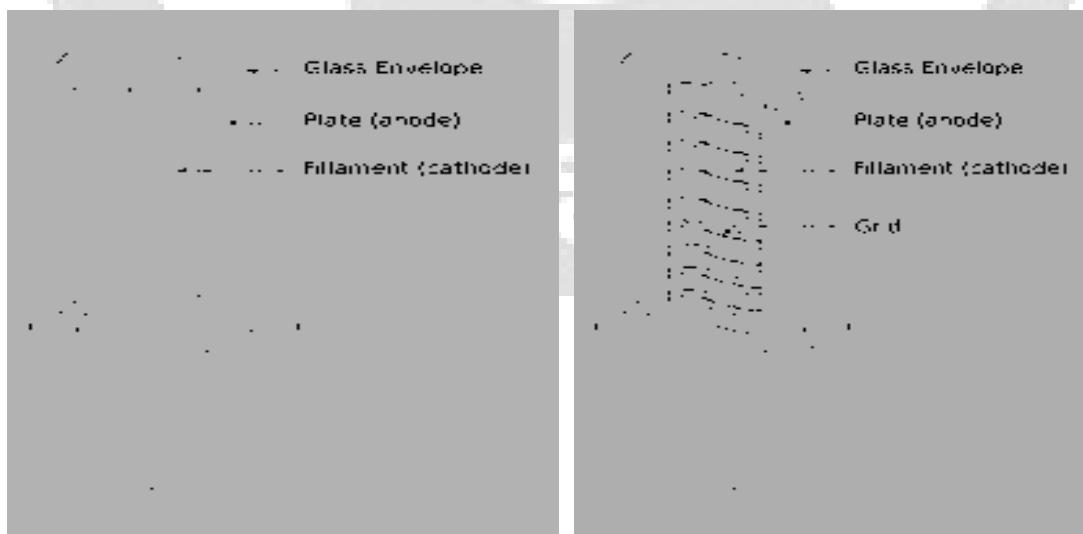
NOTE:

- Now Doordarshan & A.I.R used INSAT series.
- INSAT is a INDIAN geostationary satellite.
- The uplink frequency range is 6~8 GHZ.
- The down link frequency range is 2~4 GHZ.
- Here 70MHZ modulator & demodulator are used.
- A.I.R-KOLKATA transmits FM-GOLD, RAINBOW, KOL-A, B, C, and DOORDARSHAN programs by satellite communication.
- By satellite communication A.I.R also can cover the hill, valley area.

### **INTRODUCTION TO VACUUM TUBE USED IN AIR**

A vacuum tube consists of arrangements of electrodes in a vacuum within an insulating, temperature-resistant envelope. Although the envelope is classically glass, power tubes often use ceramic and metal. The electrodes are attached to leads which pass through the envelope via an air tight seal. On most tubes, the leads are designed to plug into a tube socket for easy replacement.

The simplest vacuum tubes resemble incandescent light bulbs in that they have a filament sealed in a glass envelope which has been evacuated of all air. When hot, the filament releases electrons into the vacuum: a process called thermionic emission. The resulting negatively-charged cloud of electrons is called a space charge. These electrons will be drawn to a metal plate inside the envelope, if the plate (also called the anode) is positively charged relative to the filament (or cathode). The result is a flow of electrons from filament to plate. This cannot work in the reverse direction because the plate is not heated and cannot emit electrons. This very simple example described can thus be seen to operate as a diode: a device that conducts current only in one direction. The vacuum tube diode conducts conventional current from plate (anode) to the filament (cathode); this is the opposite direction to the flow of electrons (called electron current). The vacuum tube is a *voltage-controlled device*, which means that the relationship between the input and output circuits is determined by a transconductance function. The solid-state device most closely analogous to the vacuum tube is the JFET, although the vacuum tube typically operates at far higher voltage (and power) levels than the JFET.



**Tetrode:** When triodes were first used in radio transmitters and receivers, it was found that they had a tendency to oscillate due to parasitic anode to grid capacitance. Many complex circuits were developed to reduce this problem (e.g. the Neutrodyne amplifier), but proved unsatisfactory over wide ranges of frequencies. It was discovered that the addition of a second grid, located between the control grid and the plate and called a **screen grid** could solve these problems. A positive voltage slightly lower than the plate voltage was applied to it, and the screen grid was bypassed (for high frequencies) to ground with a capacitor. This arrangement decoupled the anode and the first grid, completely eliminating the oscillation problem. An additional side effect of this second grid is that the Miller capacitance is also reduced, which improves gain at high frequency. This two-grid tube is called a **tetrode**, meaning four active electrodes.

**Direct and indirect heating:** Many further innovations followed. It became common to use the filament to heat a separate electrode called the cathode, and to use this cathode as the source of electron flow in the tube rather than the filament itself. This minimized the introduction of hum when the filament was energized with alternating current. In such tubes, the filament is called a heater to distinguish it as an inactive element.

**Cooling:** All vacuum tubes produce heat while operating. Compared to semiconductor devices, larger tubes operate at higher power levels and hence dissipate more heat. The majority of the heat is dissipated at the anode, though some of the grids can also dissipate power. The tube's heater also contributes to the total, and is a source that semiconductors are free from. **Caution should be used in handling heated tubes**, as the temperature of the glass may be high enough to easily and quickly burn the skin, even with smaller and lower-power tubes.

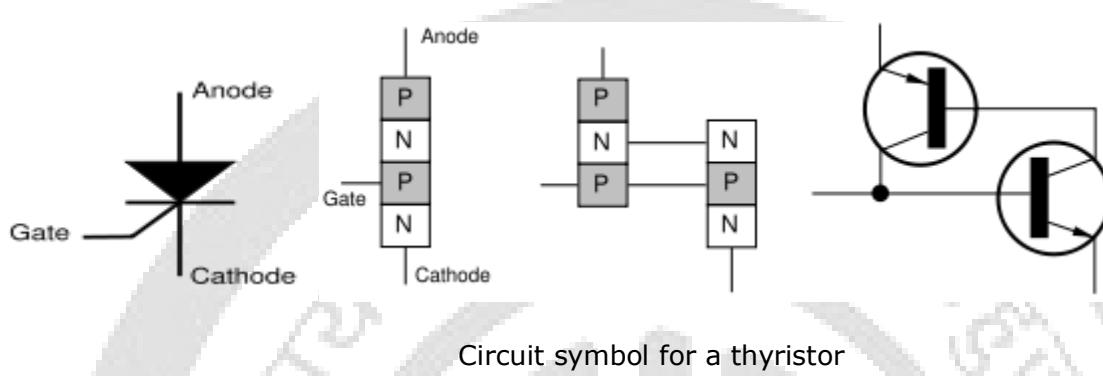
In order to remove generated heat, various methods of cooling may be used. For low power dissipation devices, the heat is radiated from the anode - it often being blackened on the external surface to assist. Natural air circulation or convection is usually required to keep power tubes from overheating. For larger power dissipation, forced-air cooling (fans) may be required.

High power tubes in large transmitters or power amplifiers are liquid cooled, usually with de-ionized water for heat transfer to an external radiator, similar to the cooling system of an internal combustion engine. Since the anode is usually the cooled element, the anode voltage appears directly on the cooling water surface, thus requiring the water to be an electrical insulator. Otherwise the high voltage can be conducted through the cooling water to the radiator system; hence the need for de-ionized water. Such systems usually have a built-in water conductance monitor which will shut down the high tension supply (often kilovolts) if the conductance gets too high.

## **INTRODUCTION TO THE THYRISTOR**

The **Thyristor** is a solid-state semiconductor device with four layers of alternating N and P-type material. They act as a switch, conducting when their gate receives a current pulse, and continue to conduct for as long as they are forward biased.

Some sources define silicon controlled rectifiers and thyristors as synonymous; others define SCRs as a subset of thyristors.



### **Function:**

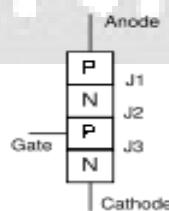
The thyristor is a four-layer semi conducting device, with each layer consisting of an alternately N-type or P-type material, for example P-N-P-N. The main terminals, labeled anode and cathode, are across the full four layers, and the control terminal, called the gate, is attached to p-type material near to the cathode. (A variant called a SCS Silicon Controlled Switch brings all four layers out to terminals.) The operation of a thyristor can be understood in terms of a pair of tightly coupled Bipolar Junction Transistors, arranged to cause the self-latching action.

Thyristors have three states:

1. Reverse blocking mode -- Voltage is applied in the direction that would be blocked by a diode
2. Forward blocking mode -- Voltage is applied in the direction that would cause a diode to conduct, but the thyristor has not yet been triggered into conduction
3. Forward conducting mode -- The thyristor has been triggered into conduction and will remain conducting until the forward current drops below a threshold value known as the "holding current"

### **Function of the gate terminal:**

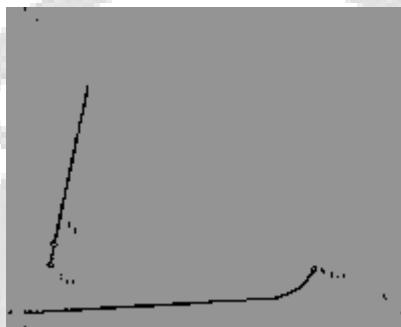
The thyristor has three p-n junctions (serially named J<sub>1</sub>, J<sub>2</sub>, J<sub>3</sub> from the anode).



Layer Diagram of Thyristor

When the anode is at a positive potential  $V_{AK}$  with respect to the cathode with no voltage applied at the gate, junctions  $J_1$  and  $J_3$  are forward biased, while junction  $J_2$  is reverse biased. As  $J_2$  is reverse biased, no conduction takes place (Off state). Now if  $V_{AK}$  is increased beyond the breakdown voltage  $V_{BO}$  of the thyristor, avalanche breakdown of  $J_2$  takes place and the thyristor starts conducting (On state). If a positive potential  $V_G$  is applied at the gate terminal with respect to the cathode, the breakdown of the junction  $J_2$  occurs at a lower value of  $V_{AK}$ . By selecting an appropriate value of  $V_G$ , the thyristor can be switched into the on state immediately. It must be noted that  $V_G$  need not be applied after the avalanche breakdown has occurred. Hence  $V_G$  can be a voltage pulse, such as the voltage output from a UJT oscillator. These gate pulses are characterized in terms of **gate trigger voltage** ( $V_{GT}$ ) and **gate trigger current** ( $I_{GT}$ ). Gate trigger current varies inversely with gate pulse width in such a way that it is evident that there is a minimum gate charge required to trigger the thyristor.

**Switching characteristics:** In a conventional thyristor, once it has been switched on by the gate terminal, the device remains latched in the on-state (i.e. do not need a **continuous** supply of gate current to conduct), providing the anode current has exceeded the **latching current** ( $I_L$ ). As long as the anode remains **positively biased**, it cannot be switched off until the anode current falls below the **holding current** ( $I_H$ ).



**V - I Characteristics:** A thyristor can be **switched off** if the external circuit causes the anode to become **negatively biased**. In some applications this is done by switching a second thyristor to discharge a capacitor into the cathode of the first thyristor. This method is called **forced commutation**.

After a thyristor has been switched off by forced commutation, a finite time delay must have elapsed before the anode can be positively biased in the off-state. This minimum delay is called the **circuit commutated turn off time** ( $t_Q$ ). Attempting to positively bias the anode within this time causes the thyristor to be self-triggered by the remaining charge carriers (holes and electrons) that have not yet recombined. For applications with frequencies higher than the domestic AC mains supply (e.g. 50Hz or 60Hz), thyristors with lower values of  $t_Q$  are required. Such **fast thyristors** are made by diffusing into the silicon heavy metals ions such as gold or platinum which act as charge combination centers. Alternatively, fast thyristors may be made by neutron irradiation of the silicon.

**Applications:** Thyristors can be used as the control elements for phase angle triggered controllers, also known as phase fired controllers.

Thyristors can also be found in power supplies for digital circuits, where they can be used as a sort of "circuit breaker" or "crowbar" to prevent a failure in the power supply from damaging downstream components. The thyristor is used in conjunction with a zener diode attached to its gate, and when the output voltage of the supply rises above the zener voltage, the thyristor conducts, shorting the power supply output to ground (and in general blowing an upstream fuse).

## **SOME FACTS ABOUT ISDN LINE:**

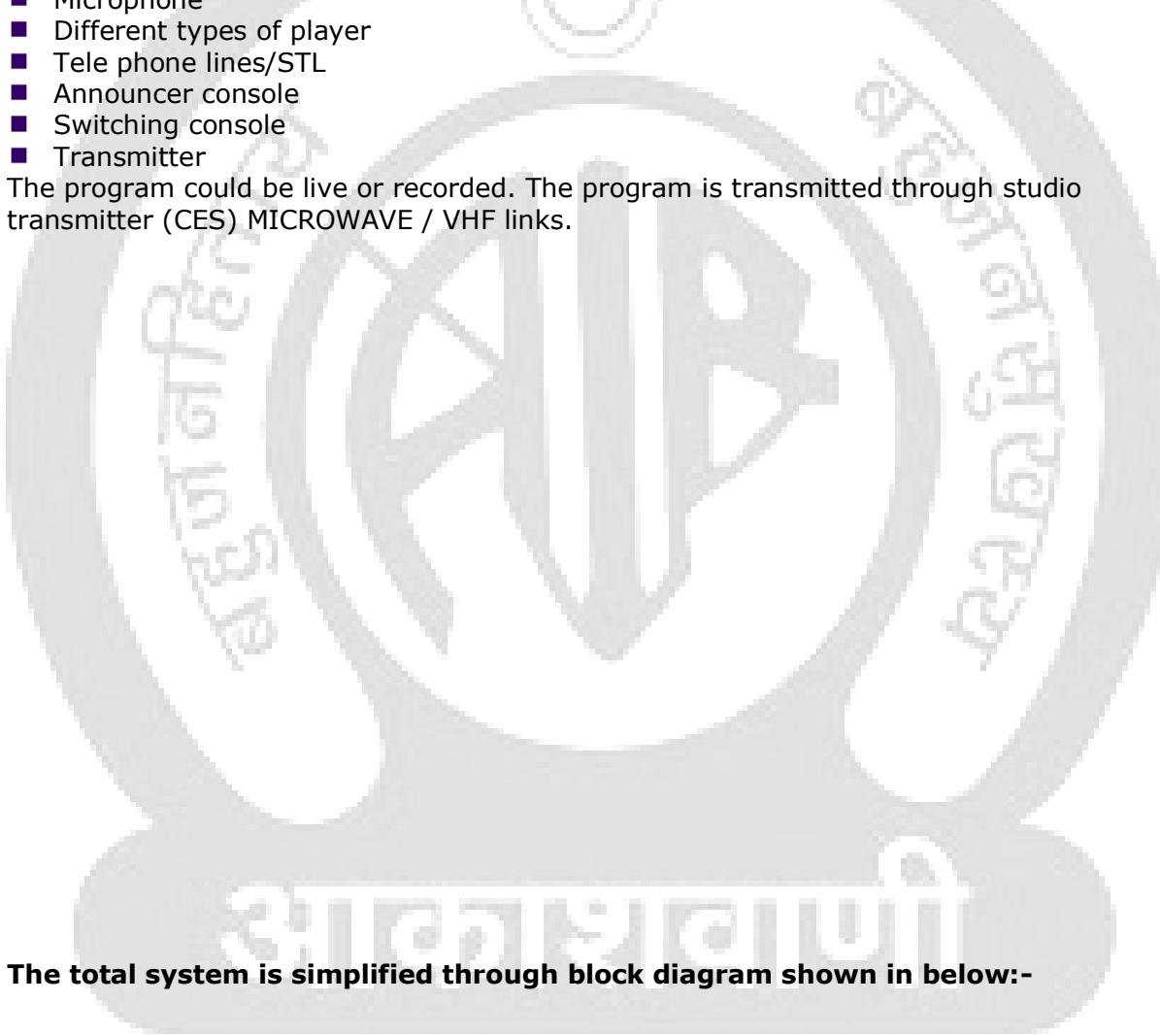
**Integrated Services Digital Network (ISDN)** is a circuit-switched telephone network system, designed to allow digital transmission of voice and data over ordinary telephone copper wires, resulting in better quality and higher speeds than that which is available with the PSTN system. More broadly, ISDN is a set of protocols for establishing and breaking circuit switched connections, and for advanced call features for the user. In a videoconference, ISDN provides simultaneous voice, video, and text transmission between individual desktop videoconferencing systems and group (room) videoconferencing systems.

### **BROADCASTING CHAIN IN ALL INDIA RADIO STATION**

The broadcast of any program from source to listener involves use of

- Studios
- Microphone
- Different types of player
- Tele phone lines/STL
- Announcer console
- Switching console
- Transmitter

The program could be live or recorded. The program is transmitted through studio transmitter (CES) MICROWAVE / VHF links.



**The total system is simplified through block diagram shown in below:-**

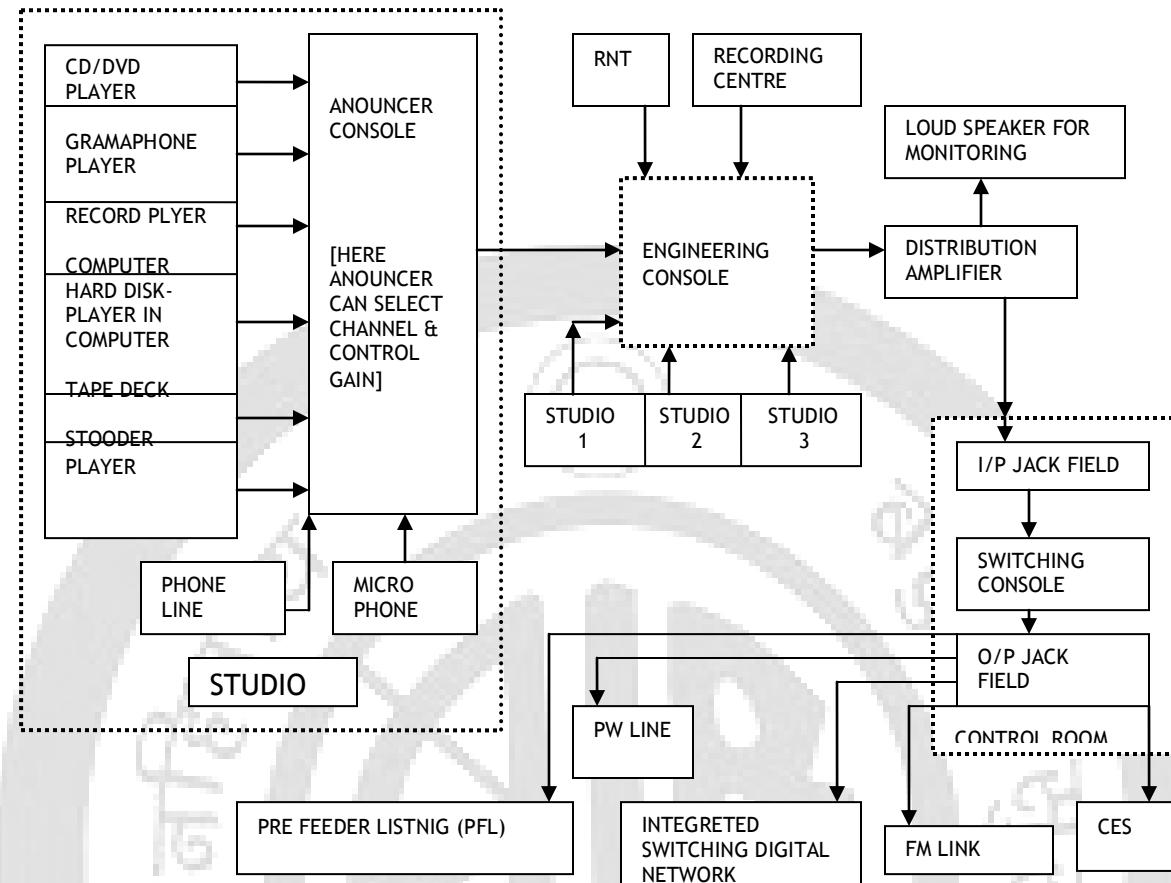


FIGURE: SIMPLIFIED BLOCK DIAGRAM OF BRODCASTING CHAIN OF A.I.R IN AKASHBANI BHABAN

**STUDIO CENTRE:** The studio comprises of one or more studios, recording or dubbing room, a control room & other ancillary room like battery room, AC rooms, switch gear room, DG room, R/C room, waiting room, service room, tape library etc.

**BROADCAST STUDIO:** A broadcast studio is an acoustically treated room. It is necessary that the place where a program for broadcast purposes is being produced should be free of extraneous noise. This is possible only if the area of room is insulated from outside sound. Further, the microphone which is the 1<sup>st</sup> equipment that picks up the sound is not able to distinguish between wanted & unwanted signals & will pick up the sound not only from artists & instruments but also reflections from walls marring the quality & clarity of the program.

**SOME STUDIO OPERATIONAL REQUIREMENTS:** Many technical requirements of studio like minimum noise level, optimum reverberation time etc. are normally made at the time of installation of studio. However for operational purpose, certain basic minimum facilities are required for smooth transmission of programs & proper control.

These requirements are:

- Program in studio may originate from a microphone or a tape deck or a compact disk or by computer hard disk or a R-dat.
- Facility to fade in /out the program smoothly & control the program level with in prescribed limits.
- Facility to mentoring to check the quality of sound production.
- Facility to mix the program.
- Visual signaling system between studio announcer & control room should also be provided.
- If the programs from various studios are to be fed to more than one transmitter, a master switching facility is also required.

**MIXING:** The instantaneous use for mixing purpose is:

- Microphone, which normally provides a level of -70 dbm.
- Turntable which may provides an o/p 0 db.
- Tape deck, CD, R-DT may provide a level of 0 dbm.

Audio mixing is done in two ways:

- Required equipments are selected & then o/p is mixed before fading to an amplifier this is called low level mixing.
- Low level o/p of each equipment is pre-amplified & then mixed. This is called high level mixing

The 1<sup>st</sup> & foremost requirement is that we should be able to select the output of any of these equipments at any moment & at the same time should be able to mix o/p of two or more equipments.

**ANNOUNCER CONTROL:** Most of the studios have an attached booth, which is called transmission booth or announcer console or **engineering console**. It is used to mixing, control the gain level, channeling the program. Then it is fed to the distribution amplifier.

**RADIO ON DEMAND (R.O.D):** Here a listener can request for any song which he wants to here in A.I.R programs can request through phone line by song -code no. When a listener dials the song code it goes to the computer of A.I.R which finds the song & gives the actual time to play the song or music. The total system is monitored by computer.

**LIVE REQUEST:** A listener can request a for a music or song directly to the announcer then the announcer finds the music by a computer software (D.B.M.S SYSTEM) & play the music.

**CONTROL ROOM:** For 2 or more studios set up, there would be a provision for further mixing which is provided by a control console manned by engineers. Such control is known as **switching console**.

### SWITCHING CONSOLE

PROGRAM INPUT	NUMBER OF CHANNELS	6channels (4 channels with direct programme source & 2 channels will be fed to remote programmer selector scheme)
	LEVEL	0 dbu(nominal) 20 dbu(max)
	IMPEDENCE	600 ohms (balanced)
	GAIN CONTROL	3 steps gain control with positions for -10 dbu, 0 dbu, & -10 dbu i/p levels respectively

PROGRAM OUTPUT	NUMBER OF CHANNELS	2 channels (4 extended)
	LEVEL	4 dbu (nominal) + 20 dbu (maximum)
	IMPEDENCE	50/600 ohms (balanced)
AUXLARY OUTPUTS	NUMBER OF CHANNELS	4 master o/p channel
	IMPEDENCE	600 ohms (balanced)
	LEVEL	0 dbu(nominal) 14 dbu(max)
	FREQUENCY RESPONSE	1db (40HZ to 15KHZ)
	OVER LOAD MERGIN	Channel input 20 db, channel feeder 20 db, master feeder 20 db
	DISTORTION	< 0,1 % at 1 KHZ (nominal)
	SNR	Better than 80 db (22 HZ to 22 KHZ)
	CROSS TALK	60 db
	PWER SUPPLY	230 V single phases A.C. consumption<=50 W

#### **NEED FOR SWITCHING CONSOLE:**

- To level quantization & level control.
- Quality monitoring.
- Switching of different sources of transmission link news, o.b's, other satellite based relays, live broadcast from recording studio.
- Signaling to sources location.
- Communication link between control room & different studios.

#### **CAPTIVE EARTH STATION**

It is used to uplink the program from A.I.R. Here parabolic C-band antenna is used whose diameter is nearly about 3.6 meter.

Some time this antenna can down link the Delhi based program from satellite.

The total block diagram is shown in next page:-

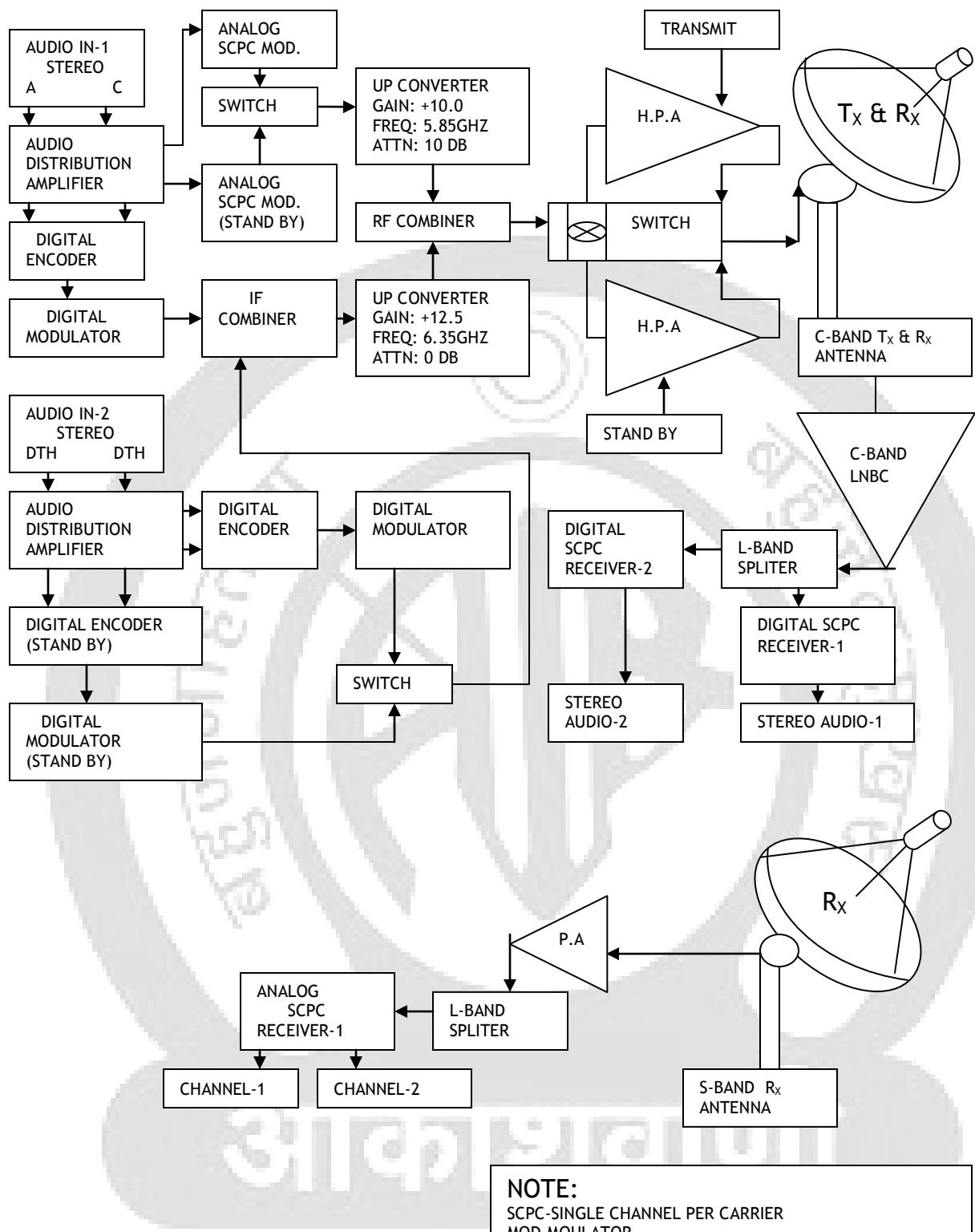


FIGURE: AKASH BANI, KOLKATA CAPTIVE EARTH STATION (C.E.S)

## **BRIEF DESCRIPTION OF CAPTIVE EARTH STATION:**

- Here in captive earth station **Stereo audio input** is used but all the signal A.I.R wants to send in satellite are not stereo (mono) so, two input can be given to each audio input.
- The o/p of audio in is fed to a **Distribution amplifier** which can amplify the signal. The o/p of **D.A** is divided in two part .Both o/p are analog signal.
- One analog signal is fed to the analog **Single Carrier per Channel (S.C.P.C) modulator** which is used to modulate the AM signal. Here a stand by SCPC - MODULATOR is used which can be regulated by a switch. The o/p of this is given to the **Analog Up Converter** of tuning frequency 5.85 GHZ.
- Another o/p of **distribution amplifier (D.A)** is now given to a digital encoder to convert the analog signal to a digital signal. The o/p of digital encoder is then connected to digital modulator for digital modulation. In the other hand some to transmit A.I.R programs through the DTH line at first the DTH lines are connected to **Audio in**. The o/p of audio in is then given to the **Distribution amplifier** .The o/p of D.A is fed to **Digital encoder**. The o/p of digital encoder is then connected to **Digital modulator** for digital modulation. Both encoder o/p (i.e. DTH & digital signal) is now combined by intermediate frequency combiner. The IF combiner o/p is now send to the digital up converter of tuning frequency of 6.35 GHZ.
- Both the o/p of digital & analog up converter o/p is combined by a RF combiner. Here we know that AM signal has two side bands, by RF combiner we can send digital & analog signal in each side band of AM. Then the mixture of analog & digital signal is amplified by a **H.P.A (High Pass Amplifier)**. Then the signal is unlinked by a c-band parabolic or dish antenna. This antenna can be used as up & down link in both case. Here signal is down linked to monitoring the signal in switching console. It is received by a digital receiver.
  - We know that DTH is received by ku-band but here A.I.R transmit the DTH based Kolkata's program in c-band because the cost of ku-band transmitter is too high so it is impossible to set up ku-band transmitter in all state. A.I.R have a ku-band transmitter in Delhi .The Delhi based A.I.R station down linked all the DTH program of all state & then it is transmitted by their ku-band transmitter.
  - A.I.R (Kolkata) used a s-band antenna to DN-link the Delhi based news, Hindi channel & Vivid Bharati program. They need this program to send it some time in Kolkata based program. Here s-band antenna is a receiving antenna.

## **INTRODUCTION TO RADIO NETWORKING TERMINAL (R.N.T)**

The various All India Radio stations spread through out the nation are required to relay certain programs that are originating from Delhi. Similarly they are certain programs which are originating from capital stations are relayed by the other stations in that region. In order to link Delhi & capital stations with other AIR stations, RN through INSAT is not only cost effective but also provide the good technical quality as compared to DOT line & SW linkage. The Radio Networking Terminal located at AIR stations to receive s-band & c-band transmission. The programs thus received after processing are fed to the transmitter for broadcast process. The programs thus received after processing are fed to the transmitter for broadcast purposes. Thus RNT acts as ground terminal for satellite signal receiving.

### **The RNT consists of:**

#### **OUTDOOR UNIT**

It consists of some parts written below->

- S-band parabolic dish antenna.
- Low noise amplifier (LNA) &
- Front end converter (FEC)

#### **INDOOR UNIT**

It consists of some parts written below->

- Passive frequency translator
- Active frequency translator
- Synthesized active unit
- Demodulator unit &
- Power supply.

### **OUTDOOR UNIT**

**S-BAND PARABOLIC DISH ANTENNA:** The 12 ft parabolic dish antenna collects the RN carriers transmitted by the satellite & feed them to feed mounted LNA unit .The prime focus reflector is used for RNT. The gain of antenna is 36.5 dbi. A helical feed of 2.5 turns capable of giving circularly polarized wave is used. Circular polarization of INSAT broadcasting used as it does not require any adjustment of feed or polarization matching.

**Parabolic antenna used for RNT:** there are 2 types of Parabolic Reflector->

- 1) **Prime focus type:** when the feed is placed at focus of parabolic reflector is called Prime focus type. It is simple & low cost so generally it is used as RNT.
- 2) **Cassegrain feed:** it consists of a feed sub reflector along with the main reflector.

#### **ANTENNA SPECIFICATION:**

- Type: parabolic aluminum wire mesh
- Feed system: prime focus
- Reflector diameter: ~3.66 meter
- Weight:250 kg
- Gain: 36.5 dB at 2575 kHz
- Operating band: s- band
- Feed impedance: 50ohms
- Focal length:0.4 meter
- Axial ratio: 3.5dB
- Steer ability in elevation: 45° to 80°
- Steer ability in azimuth: 30°
- Feed return loss: 15 dB
- Pointing: manual
- Pointing accuracy: better than ± 5°
- Axial ratio:3.5 dB

**S-BAND LOW NOISE AMPLIFIER (LNA):** In the augmented RNT, the signal received by 12 ft parabolic dish antenna. Parabolic dish antenna is fed to the LNA mounted near the feed point. It contains two LNA PCB's to have 100 % redundancy. Any LNA can be selected by means of RF switch which is controlled by a switch in control room or where the indoor units are located.

**FRONT END CONVERTER:** The FEC has also got two chains for redundancy. Any one chain can be selected by RF switch provided at its input. The s-band signals received after LNA are down converted to the IF at 70 MHz nominal. The LO input to the mixer is 2505 MHz at 7 dbm.

### **INDOOR UNIT**

**PASSIVE FREQUENCY TRANSLATOR:** The passive translator splits the combined nominal IF of 70 MHz & 92 MHz components. It does not contain any active device so it is called a passive translator. It is nothing but a wide band (9 MHz) pass filter. The 52 & 92 MHz o/p are each further divided into two channels by means of power divider.

**ACTIVE FREQUENCY TRANSLATOR:** The function of FTA is to boost the RN carriers & translate them all to 52 MHz band. Redundancy this unit incorporates 2 channels each for 52 MHz & 92 MHz band signals. The 52 MHz band signals coming from FTP are amplified in IF amplifier having a gain of 50 dB. Then the o/p is divided into three o/p using power divider. The 92 MHz band signals coming from FTP are also amplified in 50 dB. IF amplifier then converted into 52 MHZ band after beating with 40 MHz oscillator. The o/p of mixer is passed through a band pass filter & further divided into three outputs.

**SYNTHESIZED TRANSLATOR UNIT:** This unit consists of 6 modules of synthesized frequency translator. Each module takes the 52 MHz IF. Any of the channels in the 47.56 MHz band can be selected by using the front panel thumb wheel switches. Synthesizer is used as a variable local oscillator.

**DEMODULATOR UNIT:** The function of the demodulator unit is to extract the audio content from the sub carrier fed to it. This unit consists of 6 plug-in demodulators. The demodulator has a band pass filter in the first stage & is tuned to 5.5 MHz. after BPF the sub carrier is amplified & then demodulated in a PLL (PHASE LOCKED LOOP) frequency demodulator circuit.

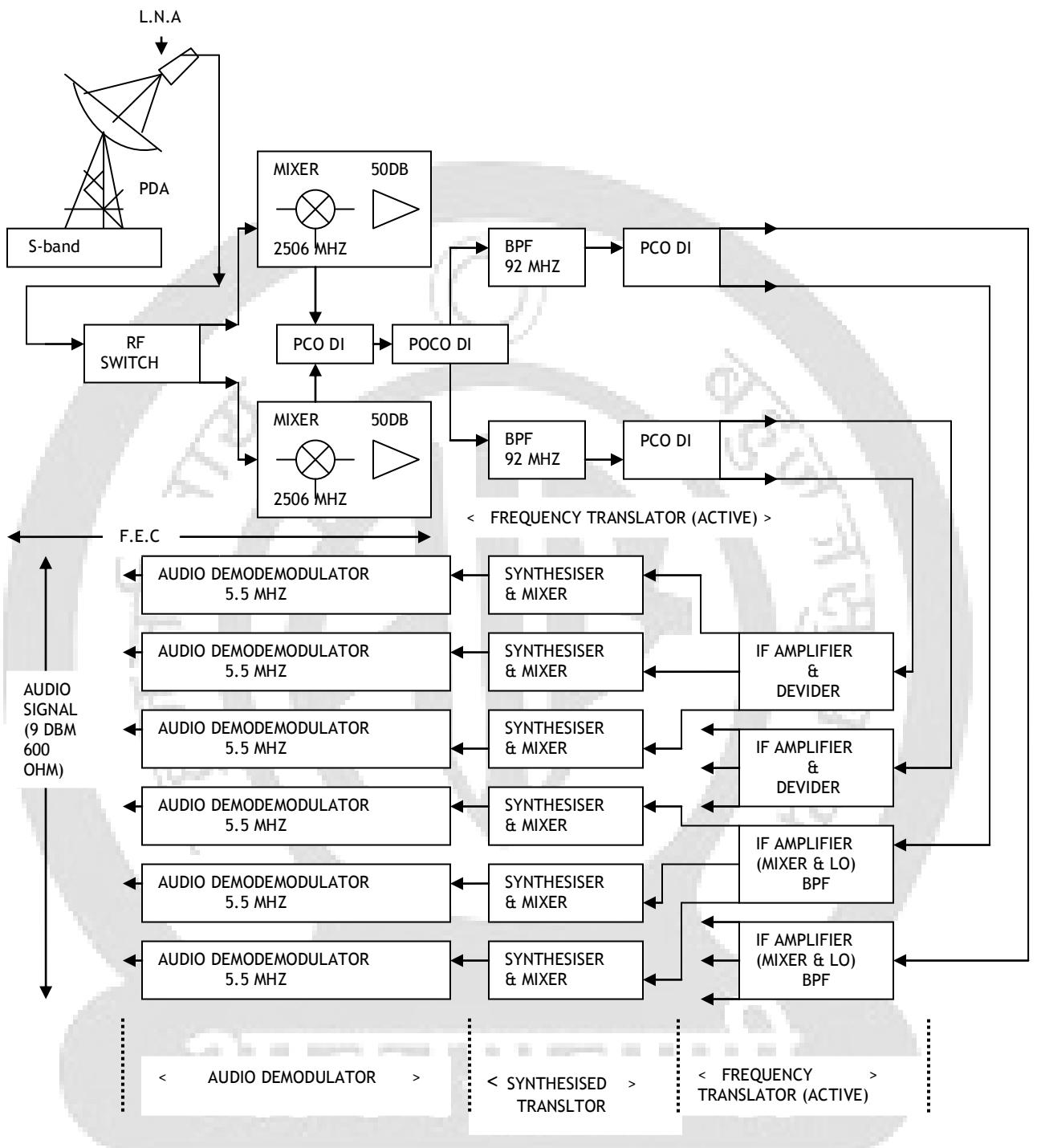


FIGURE: BLOCK DIAGRAM OF S-BAND RADIO NETWORKING TERMINAL (RNT)

## **HMB-144 50 KILO WATT (BEL) SHORTWAVE TRANSMITTER**

The transmitter can be broadly divided by following blocks:

- 1) RF chain
- 2) AF chain
- 3) Power supplies
- 4) control system & tuning system
- 5) Control circuits interfacing.

**## The total system of short wave transmitter has a similarity to MW transmitter. Here RF & AF chain, power supplies, control circuits are totally similar to the MW transmitter. ##**

In short wave transmission two types of frequencies are used, they are:

WAVE LENGTH	FREQUENCY	TIME
60meter	4820KHz	Night time
41meter	7210KHz	Day time

**A question can occur that, why lower frequency is transmitted during night time?**

Actually ionosphere of earth broadly divided into 4 different dense layer, these are D, E, F1, and F2 (in DAY TIME). But in NIGHT TIME the two upper layers F1 & F2 are merged as a result a single layer F is created & also the lower layer that is D layer is vanished. As a result in night there is only 2 layers they are: F & E. so in night if high frequency like 7210 KHz is transmitted towards the ionosphere, is not at all reflected back to earth, so during night some what lower frequency that is 4820 KHz is utilized for long distance or broadcasting.

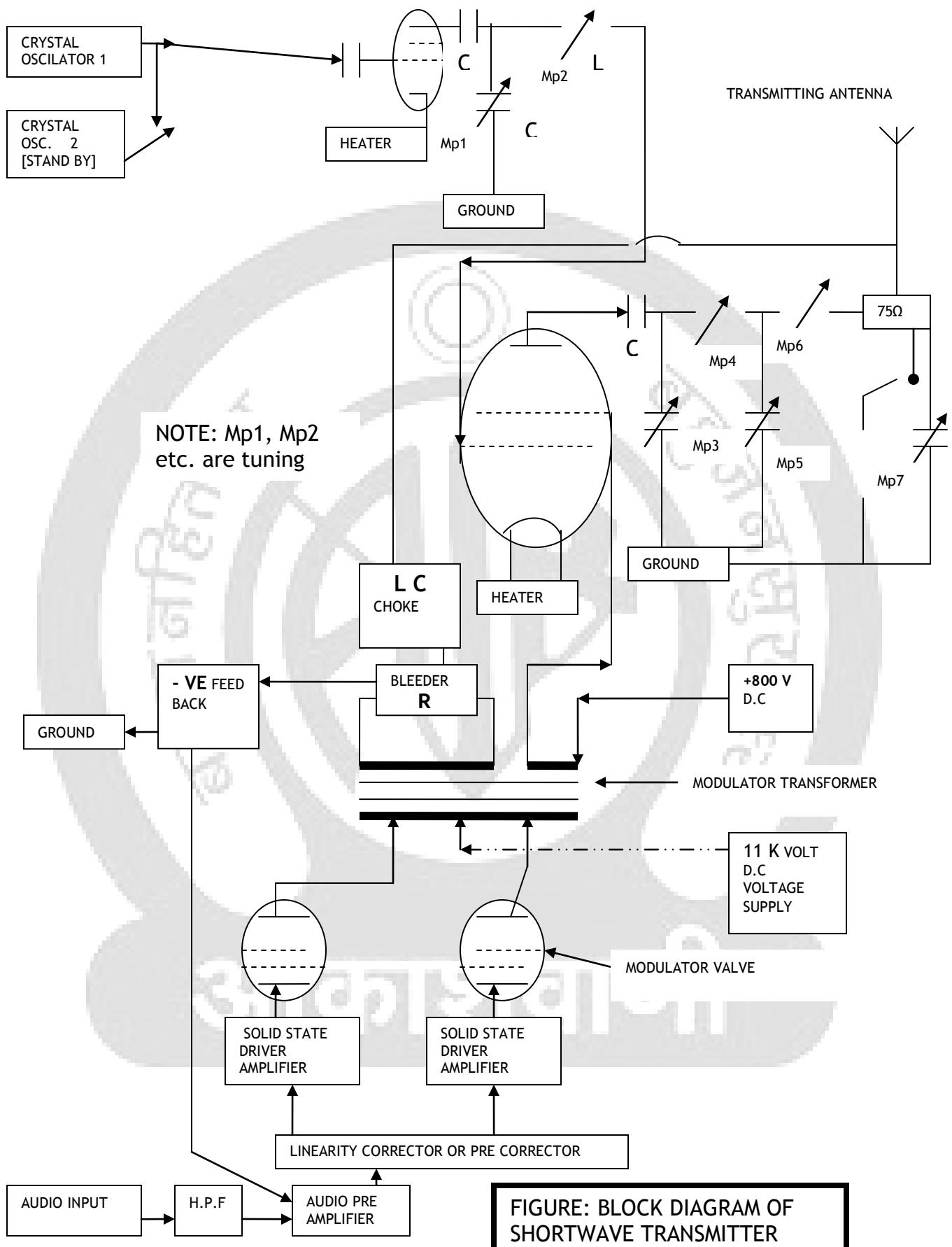
Now in a short wave transmitter 2 frequencies are used. So a tuning system is required. When we change a carrier frequency from crystal oscillator, due to change of carrier frequency some capacitance & inductance get change. To maintain this we need tuning. There are 7 steps of tuning. We have to set 7 different tuning values by which the variable capacitor & inductor value can be changed. In figure of HMB-144 50 KILO WATT (BEL) SHORTWAVE TRANSMITTER We can see that there are some variable inductor & capacitor they are Mp1, Mp2..... Mp7 by which, we can tune the change of inductance & capacitance. This change is done by motor system.

After tuning of frequency the antenna is changed by a key system. The antenna is changed because, while carrier frequency is changed then the wave length is also become changed. So we have to set the feeder line to a right antenna.

The feeder line is several times stub matched before it reaches to the short wave antenna. So here no ATU unit is required.

Other control circuits & power supply techniques are totally similar to the medium wave transmitter.

**The block diagram of "HMB-144 50 KWATT (BEL) SHORT WAVE TRANSMITTER "is shown in next page:--**



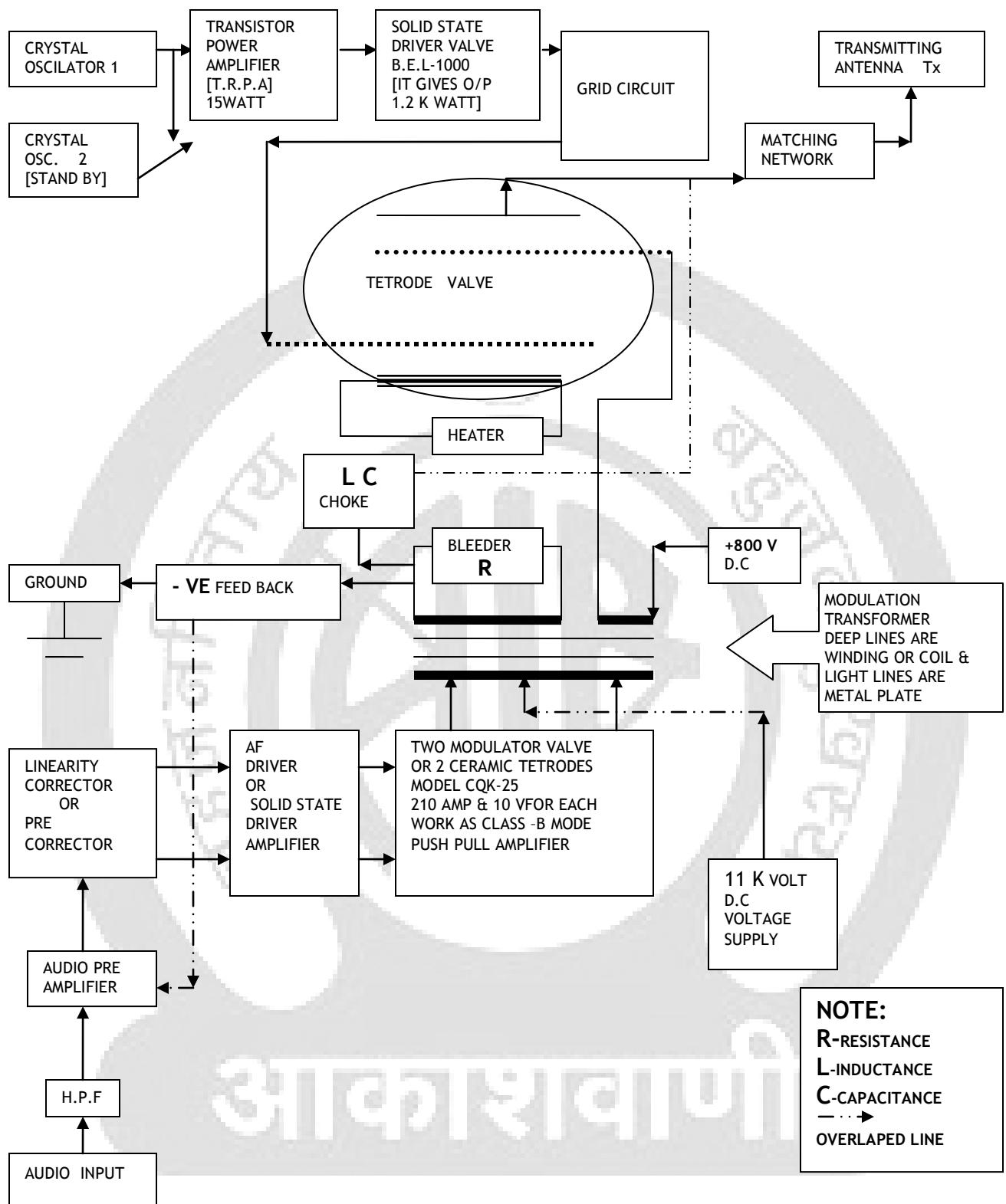


FIGURE: BLOCK DIAGRAM OF 100\*2 K.WATT (MEDIUM WAVE) TRANSMITTER  
[BHARAT ELECTRONICS LTD.(B.E.L)- H.M.B-140]

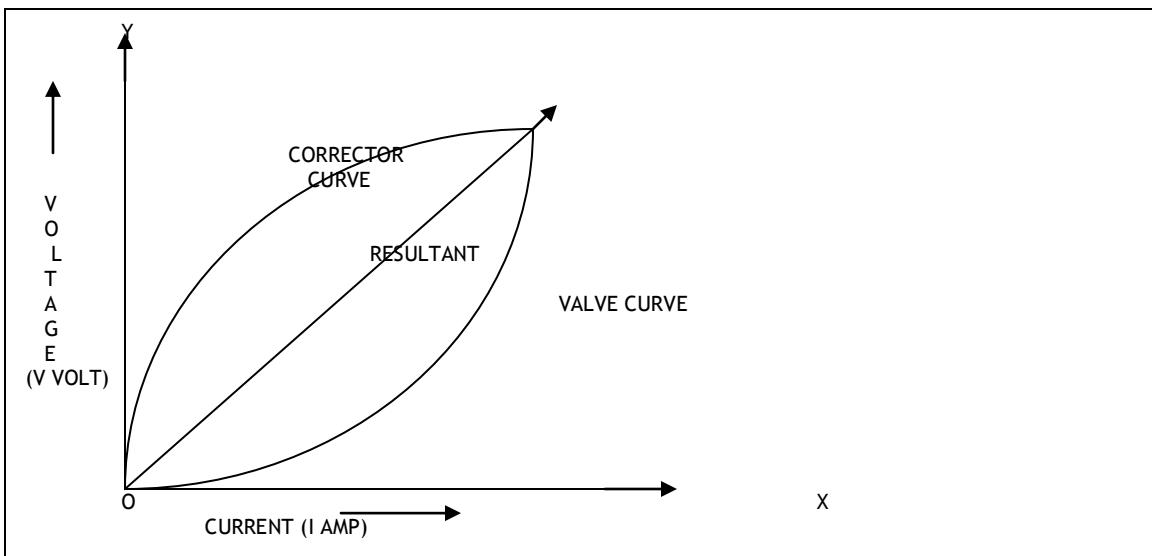
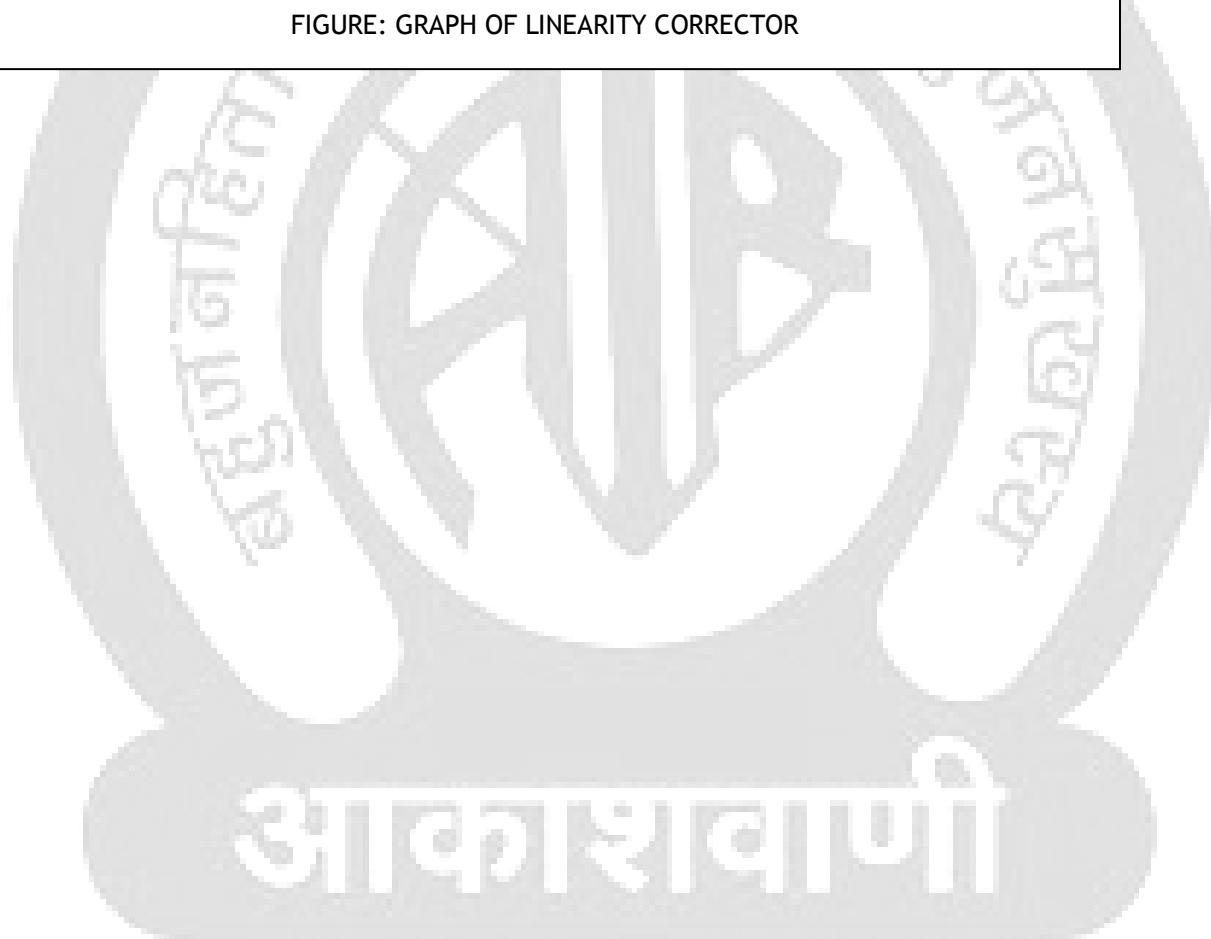


FIGURE: GRAPH OF LINEARITY CORRECTOR



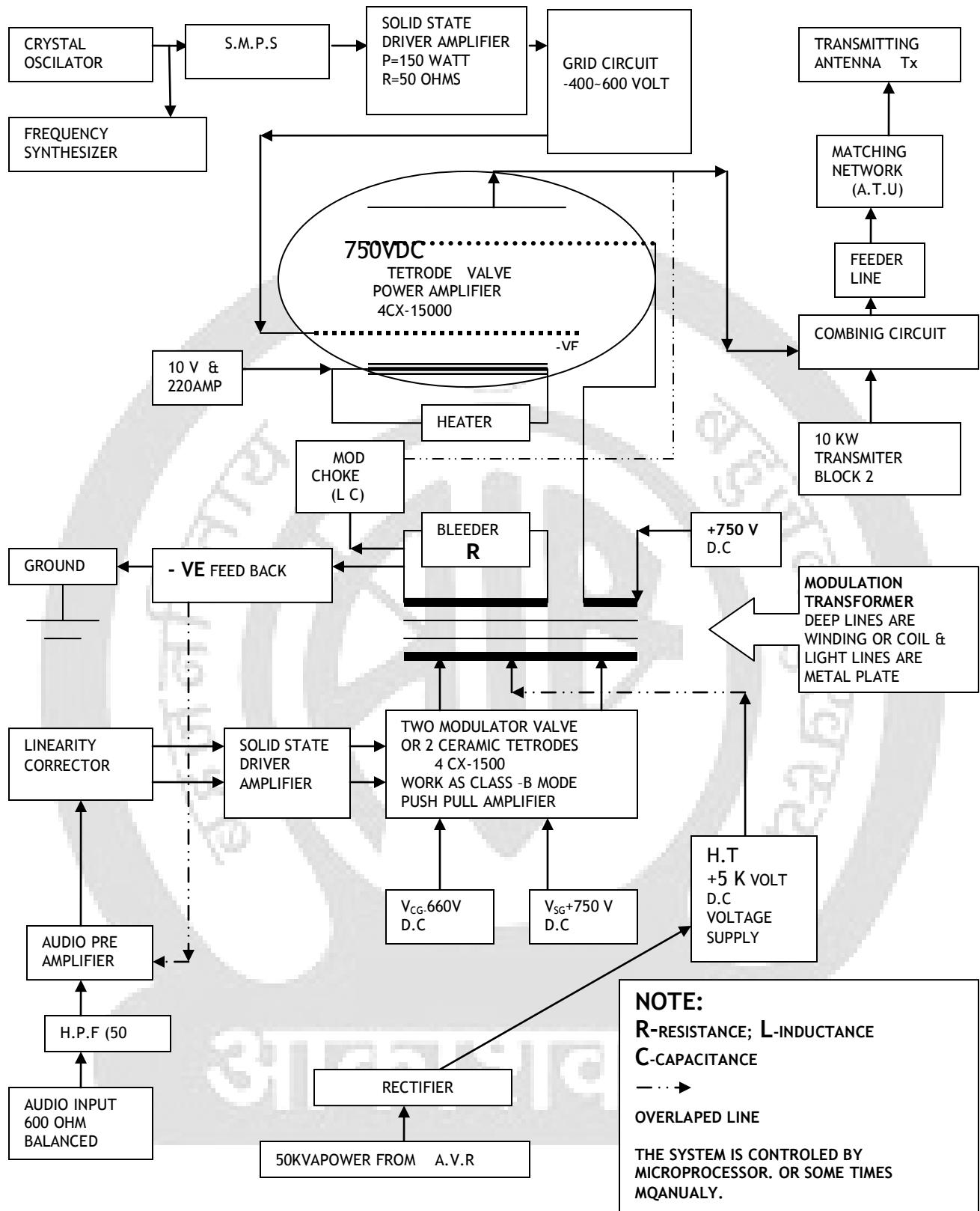


FIGURE: BLOCK DIAGRAM OF 10\*2 K.WATT (MEDIUM WAVE) TRANSMITTER  
[BHARAT ELECTRONICS LTD.(B.E.L)- H.M.B-163]

## **10 KW MW TRANSMITTER (HMB-163)**

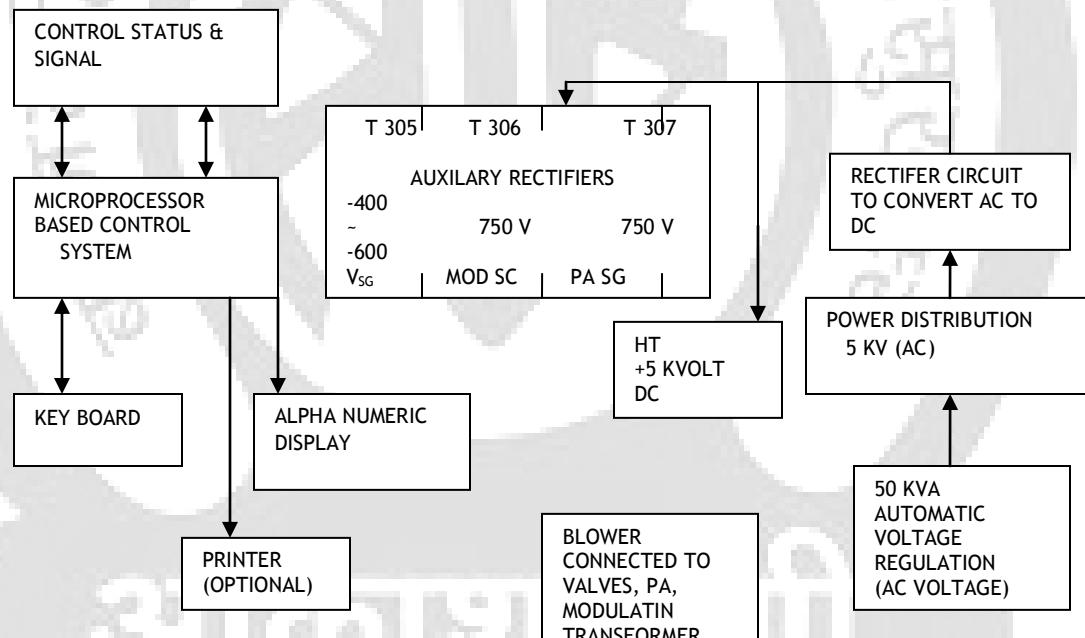
### SOME FEATURES:

- ✓ Identical type of valves both for power amplifier 7 modulators.
- ✓ Except the final stage, all other stages are solid state operated.
- ✓ Valves are ceramic metal tetrode permits full range operation up to 110 MHZ.
- ✓ Power amplifier is in class -c amplitude modulated which is one of the oldest & most popular modulation technique used in India & else where in the world.
- ✓ Microprocessor based control system with self diagnostic facility.
- ✓ Efficiency is better than 50 %.
- ✓ A compact & modulator system with every thing in a single cabinet.

The transmitter can be broadly divided by following blocks:

- 1) RF chain
- 2) AF chain
- 3) Power supplies
- 4) Micro processor based control system
- 5) Control circuits inter facing.

\*\*\*These blocks are totally same as 100\*2 KW HMB-140 transmitters, described once before. \*\*\*



**FIGURE: BLOCK DIAGRAM OF CONTROL SYSTEM & POWER SUPPLY**

## **F.M TRANSMISSION**

The objective of All India Radio is achieved by educating & entertaining the people with a view of creating awareness among them about the nation's potential for development its problem & soliciting their participation in the implementation of government's policies plans & programs.

From AKASBANI BHABAN (STUDIO) to the GOLFGREEN (FM TRANSMISSION CENTER) one most useable signal flow is shown below as a block diagram:-

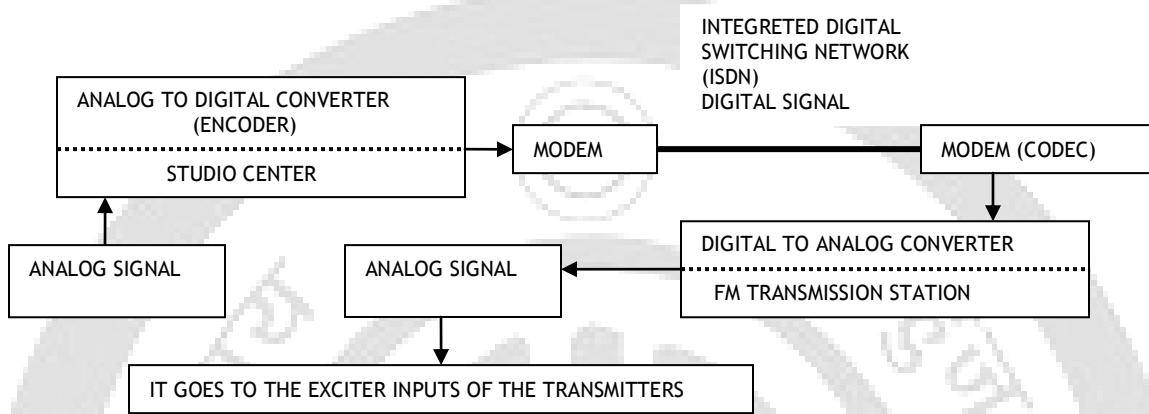


FIGURE: BLOCK DIAGRAM OF STUDIO TO FM TRANSMISSION STATION CHAIN

### **WHY WE NEED F.M TRANSMISSION?**

The frequency bands allocated to broadcasting in MW & SW frequency ranges are fully saturated, hence it becomes practically impossible to select an interference free channel for a new broadcasting station, because it is mandatory for all the countries of world to follow the rules & regulations framed by International Telecommunication Union (I.T.U), an complex body of United Nations, for all matters relating to telecommunication including broadcasting.

### **The following major reasons can be attributed to the growth of F.M transmission:**

- 1) Sufficient frequencies are not available in other broadcasting bands (LW, MW, and SW).
- 2) VHF/FM service provides high quality broadcasting.
- 3) VHF/FM band provides a uniform coverage during day & night.
- 4) VHF/FM service is less susceptible to interference & man made noise.
- 5) Less energy is needed in providing VHF/FM service from MF service.
- 6) AM service on LW, MW, and SW frequency bands is subjected to the vagaries of ion phonic disturbance.
- 7) VHF/FM service is having capacity of providing stereo service.
- 8) VHF/FM service has the capacity to carry auxiliary signal/service without causing any disturbance to normal broadcast.

Keeping all these factors in view, the inter-ministerial group appointed by the Ministry of Information & Broadcasting recommended the FM transmitter to transmission of F.M.

### **INTRODUCTION TO THE FM TRANSMITTERS:**

Now it is known to us that there is over crowding in AM broadcast bands & shrinkage in the nighttime service area due to fading, interference etc. FM broadcasting offers several advantages over AM such as uniform day & night coverage, good quality listening & suppression of noise, interference etc All India Radio has gone for FM broadcasting using modern FM transmitter incorporating state-of-art technology.

**The configuration of the transmitter being used in the network is:**

- 3 kW Transmitter
- 2x3 kW Transmitter
- 5 kW Transmitter
- 2x5 kW Transmitter

#### **SALIENT FEATURES OF BEL/GCEL\*FM TRANSMITTER:**

1. Completely solid state.
2. Forced air cooled with the help of rack-integrated blowers.
3. Parallel operation of two transmitters in passive exciter standby mode.
4. Mono or stereo broadcasting.
5. Additional information such as SCA signals & radio traffic signals (RDS) can also be submitted.
6. Local/remote operation
7. Each transmitter has been provided with a separate power supply.
8. Transmitter frequency is crystal controlled & can be set in steps of 10 kHz using a synthesizer.

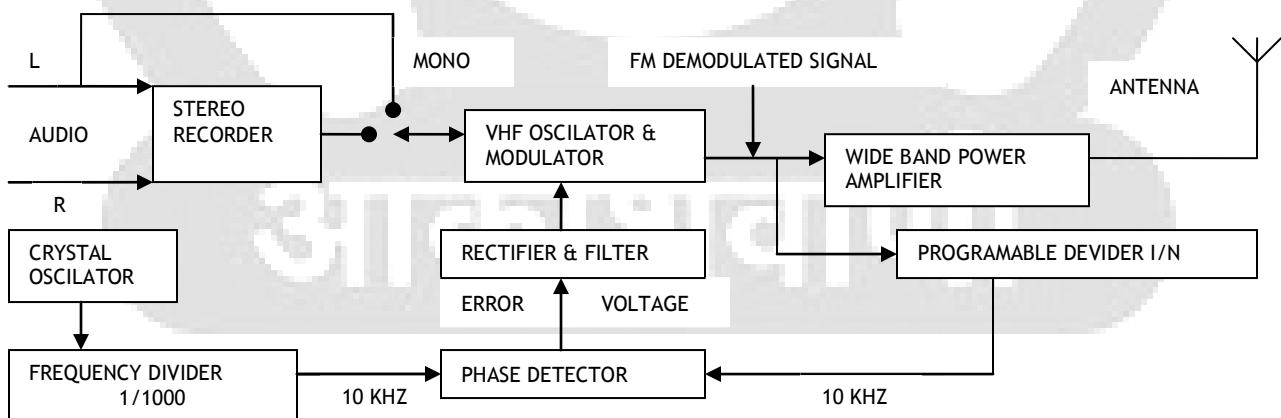
#### **MODERN FM TRANSMITTER:**

The left (L) & right (R) channel of audio signal are fed to stereo coder for stereo encoding. This stereo encoded signal or mono signal (either left or right channel audio) is fed to VHF oscillator & modulator. The FM modulated output is amplified by a wide band power amplifier & then fed to antenna for transmission.

Voltage controlled oscillator (VCO) is used as VHF oscillator & modulator. To stabilize its frequency a portion of FM modulated signal is fed to a programmable divider, which divides the frequency by a factor 'N' to get 10kHz frequency at the input of a phase & frequency comparator (phase detector). The factor 'N' is automatically selected when we get the station carrier frequency. The other input phase detector is a reference signal of 10 kHz generated by a crystal oscillator of 10MHz & divided by a divider (1/1000).The output phase detector is an error voltage, which is fed to VCO for correction of its frequency through rectifier & low pass filter.

**BEL-BHARAT ELECTRONICS LIMITED & GCEL-GUJRAT COMMUNICATION ELECTRONICS LIMITED.**

**Block diagram of modern FM transmitter is shown below:-**



**FIGURE: BLOCK DIAGRAM OF MODERN FM TRANSMITTER**

<b>TRANSMITTER USED BY ALL INDIA RADIO ( FM STATION)</b>	
TRANSMITTER OF	COMPANY NAME
FM-GOLD	NAUTEL(AMERICA)
FM-RAINBOW	<b>GCEL</b> -GUJRAT COMMUNICATION ELECTRONICS LIMITED
IGNOU (INDIRA GANDHI NATIONAL OPEN UNIVERSITY)	BROADCAST ELECTRONICS(GERMANY)

<b>SEVERAL TYPES OF FREQUENCIES &amp; ITS NAMES</b>	
FREQUENCY	NAME
15 KHZ	MONO FREQUENCY
19 KHZ	PILOT FREQUENCY
38 KHZ	STEREO FREQUENCY
57 KHZ	RADIO DATA SYSTEM (RDS) /RADIO PAEGING SYSTEM
67 KHZ	STEREO CHANNEL AUTHORIZATION (SCA)-1
76 KHZ	STEREO CHANNEL AUTHORIZATION (SCA)-2

## **2x3 KW FM TRANSMITTERS**

### **INTRODUCTION:**

This transmitting system consists of two 3 KW fm TRANSMITTER A & b operating in parallel in active standby mode .the o/p powers of two transmitters are combined in combining unit. Both Transmitters are fitted in a single rack.

### **PASSIVE EXCITER STANDBY OPERATION:**

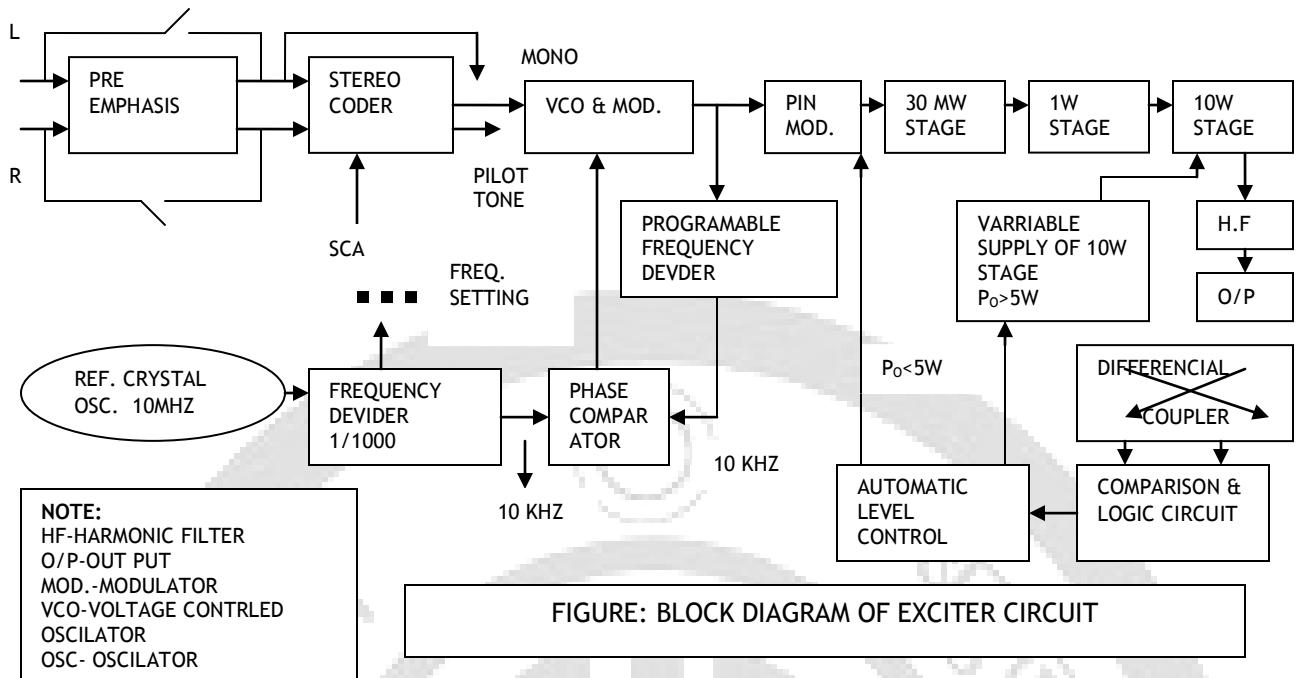
The AF switch feeds to the audio signal to the selected exciter. The o/p of the exciter is a FM signal at a nominal level of 10 W. At a time one exciter is energized by the control circuit called "switch on control circuit". The stand by exciter is inactive but its main power is ON. When the selected exciter fails, the stand by exciter is automatically selected & the defective one is terminated by DUMMY LOAD with the help of control circuit & RF switch. This is called "passive exciter standby" mode operation.

### **EXCITER:**

Exciter type SU-115 is a low power FM transmitter with low nominal o/p power. It can be used for mono or stereo transmission over a short distance. But in this transmitter, exciter has used to drive two 3 KW transmitters A & B.

Exciter can give three o/p powers of 30 mW, 1W & 10 W by means of internal links & switches. The transmitter is of the order of 10 to 12 W. Other main features of the exciter are:-

- a) Carrier frequency can be set in steps of 10 KHZ, with the help of BCD switches.
- b) Output power is stabilized by automatic level control circuit & is not affected by mismatch (**VSWR>1.5**) temp or AC fluctuations.
- c) Carrier frequency is stabilized by comparison with a 10 MHz crystal oscillator via phase locked loop and programmable frequency dividers.
- d) It can be operated locally or from a remote location with a Remote/Local switch.
- e) Additional information such as traffic radio, **SCA (subsidiary Channel Authorization)** & **RDS (Radio Data System)** signal can also be transmitted.



### SWITCH-ON CONTROL UNIT:

It is a separate module which controls the overall working of transmitter A and can be termed as its "Brain". The "Switch-on Control unit" performs the following main functions:

1. Switching ON and OFF of selected Exciter, VHF power Amplifiers and Blowers.
2. Indication of switching and operating status of the system by LEDs.
3. Operation of the transmitter in passive exciter standby mode.
4. Providing a reference voltage  $U_{ref}$  for automatic regulation of output power of the transmitter under adverse operating conditions.
5. Adjustment of output power of the transmitter.
6. Evaluation of fault signals provided by individual units and generation of an overall "sum fault" signal.
7. Metering of Incident and Reflected power levels.

### ADAPTER UNIT:

"ADAPTER" is a passive unit which controls transmitter B for its parallel operation with transmitter-A in active stand by mode. All the control wiring from switch on control unit is extended via the adapter unit to transmitter-B. If adapter unit is not in its position, transmitter -B cannot be energized.

### TRANSMITTER 'A':

Transmitter 'A' comprises of two identical VHF Power amplifiers, each capable of giving an output of 1.5 KW.

Simplified block diagram of 2x3 KW FM Transmitter (TX A or B) is shown in Fig. Output of the Exciter is split up into four equal parts in two steps, with the help of three power couplers. Two such outputs of the Exciter drive two VHF Power Amplifiers type Vu-315. Their outputs are passed through separate harmonic filters (Low Pass Filters with cut-off frequency of 110 MHz) to remove the harmonics. Two 1.5 KW outputs are then combined in output power coupler to get an output of 3 KW.

### TRANSMITTER 'B':

It is identical to transmitter 'A'.

### **COMBINING UNIT:**

Two types of combining units are available-BEL and GCEL.BEL combining unit has more features than GCEL combining unit, therefore its control circuit is also more complicated than GCEL. But both use 3 dB quadrature coupler to combine two 3 KW o/p powers of transmitter A & B. Either or both the transmitters (in parallel operation) can be selected on antenna or dummy load by manual change of U-links on the front panel of combining unit.

### **DUMMY LOAD:**

The dummy load is the of 10 KW rating. BEL dummy load is cooled by circulation of water. A fan has also can be provided as alternative of water for forced air cooling. Dummy load supplied by M/S GCEL is slightly different. It is cooled by forced air cooling only.

### **REJECT LOAD:**

Reject load acts as an absorber resistance for the combiner in the combining unit. Whenever two powers are combined, an absorber resistance is required to dissipate the unbalanced power. Reject load is oil cooled.

### **POWER AMPLIFIER:**

This amplifier is the basic module in the transmitter. It has a broadband design so that no tuning is required for operation over the entire FM broadcast band. RF power transmitters of its o/p stages are of plug in type, which is easy to replace, & no adjustments are requiring after replacement. Each power amplifier gives an o/p 1.5KW. Depending on the required configuration of transmitter o/p of several such amplifiers is combined to get the desired o/p power of the transmitter. For instance for a 3KW set up 2 power amplifiers are used whereas For a 2x3 set up  $2 \times 2 = 4$  amplifiers are needed. The amplifier needs an i/p power of 2.5 to 3 KW & consists of a driver stage (o/p 30W) followed by PA stage (120 W). The amplification from 120 W to 1500 W in the final stage is achieved with the help of eight 200W stages. The o/p of all these stages is combined via coupling networks to give the final o/p of 1.5KW. A monitor in each amplifier controls the power of driver stage depending on the reference voltage produced by switch on control unit. Since this reference voltage is the same for all VHF amplifiers being used, all of them will have the same output power.

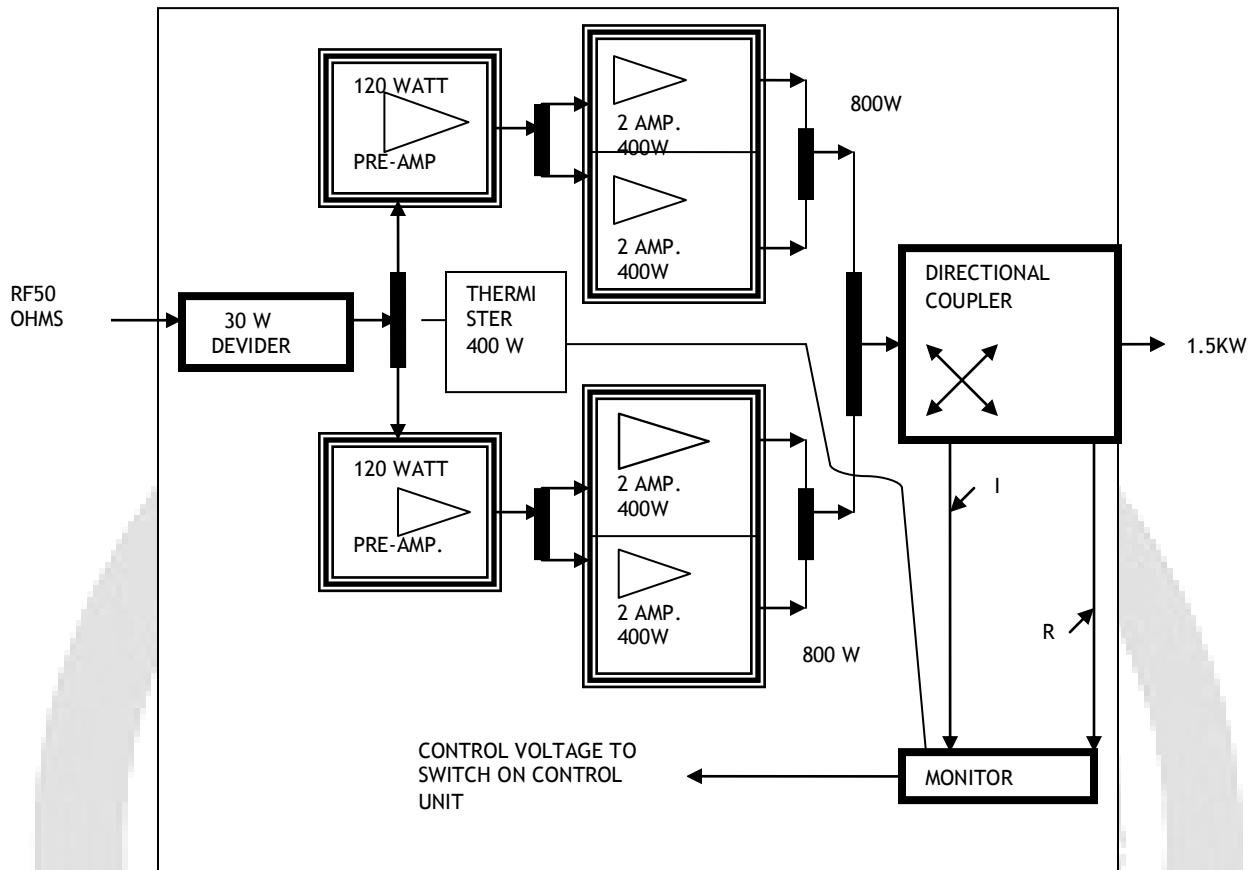


FIGURE: BLOCK DIAGRAM OF 1.5 KW AMPLIFIER

Each amplifier has ammeter for indicating the forward & reflected voltages & transistors currents. Also a fault is signaled if the heat sink temperature or the VSWR exceeds the prescribed limits. In both cases the amplifier power is automatically reduced to protect the transistors.

#### **POWER SUPPLY SYSTEM:**

The FM transmitter requires power supply connection. An AVR of 50 KVA capacity has been provided for this purpose. Each transmitter has been provided with a separate power supply through power distribution panels 'A' & 'B'. This panel supplies 3 phase AC power to transformer trolley 'A', single phase AC power to exciter 'A', blower 'A' etc & various DC supplies for the working of control system. Power distribution in panel-B is identical to panel-A.

#### POWER CONSUMPTION BY SEVERAL TYPES OF TRANSMITTERS:

FREQUENCY RESPONSE	POWER CONSUMPTION BY SEVERAL TYPES OF TRANSMITTERS			
	3 KW	5 KW	3X2 KW	5X2 KW
87.5 TO 100 MHZ	5100W	8500W	10200W	17000W
100 TO 108 MHZ	5320 W	8860W	10640 W	17720W

### **POWER REDUCTION IN CASE OF AMPLIFIER OR TRANSISTOR FAILURE:**

When an amplifier module or a push pull stage in an amplifier module fails due to the failure of any one transistor, the o/p gets reduced according to the formula given below:-

$$P = P_0 [(M-N) / M] 2$$

Where  $P_0$ =nominal power,  $P$ = reduced power available at antenna,  $M$ = total no amplifier modules or push pull o/p stages in the circuit,  $N$ =no of faulty amplifier or push-pull o/p stages.

The power consumed in absorber resistor is calculated according to this formula:-

$$P_{\text{absorber}} = P_0 - P_n$$

Where  $P_n$  is faulty partial power, which in case of failure of an entire amplifier module equals 1250 W.

### **BLOWER CONTROL CIRCUIT:**

Heat sinks of RF power transistors of power amplifiers are forced air cooled with the help of two blowers which can be operated either in active standby or passive standby mode with the help of a switch.

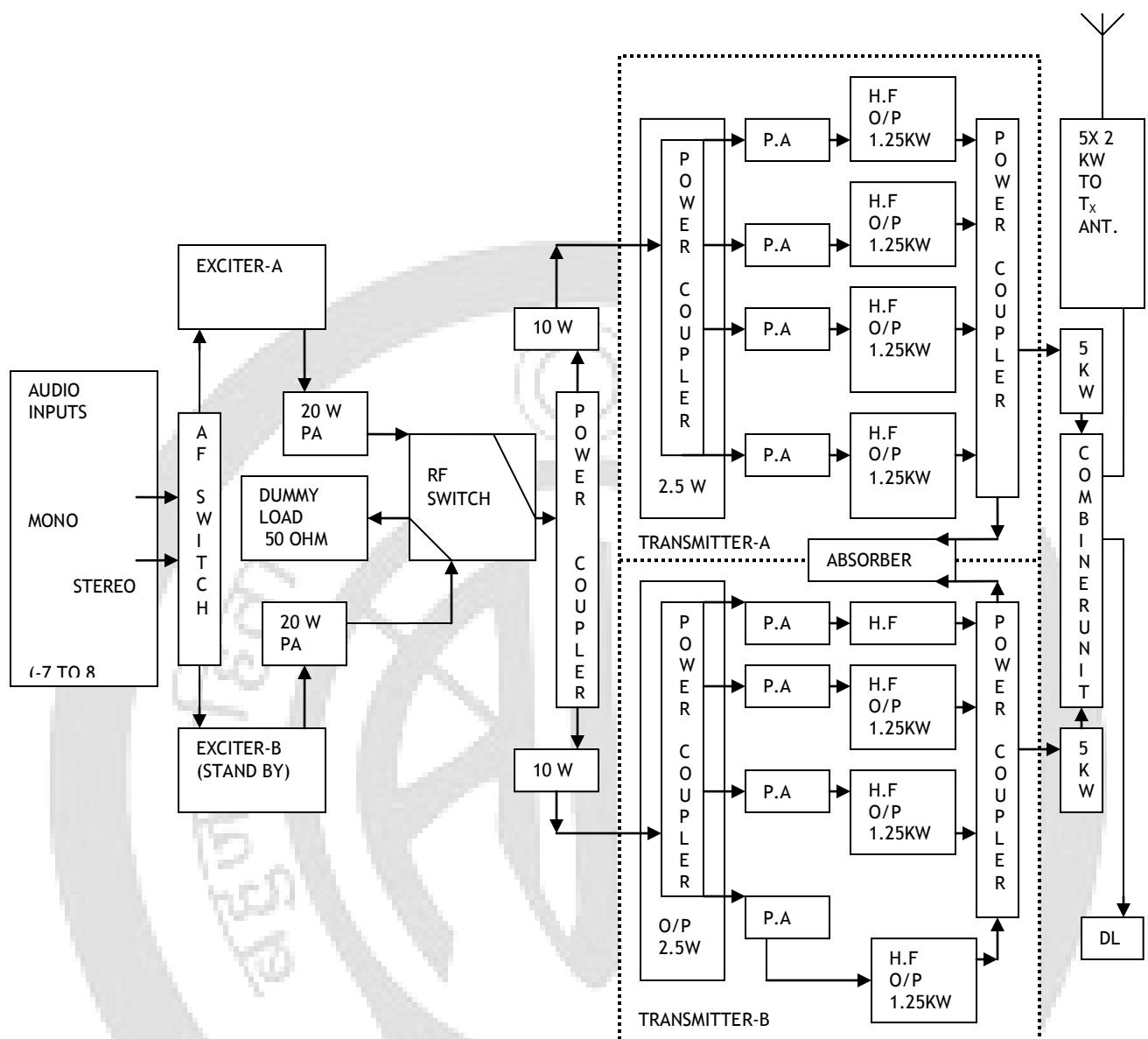
### **GENERAL REMARKS:**

Two 3 KW FM transmitters operate in parallel in active standby mode. The combined o/p power is about 5.5 to 5.7 KW as there are some losses in the combiner. If one transmitter fails then the o/p become  $1/4^{\text{th}}$  of general power o/p.

The total system of 2x5 KW transmitters is totally same as 2x3KW transmitters. Here only the number of power amplifier is different.

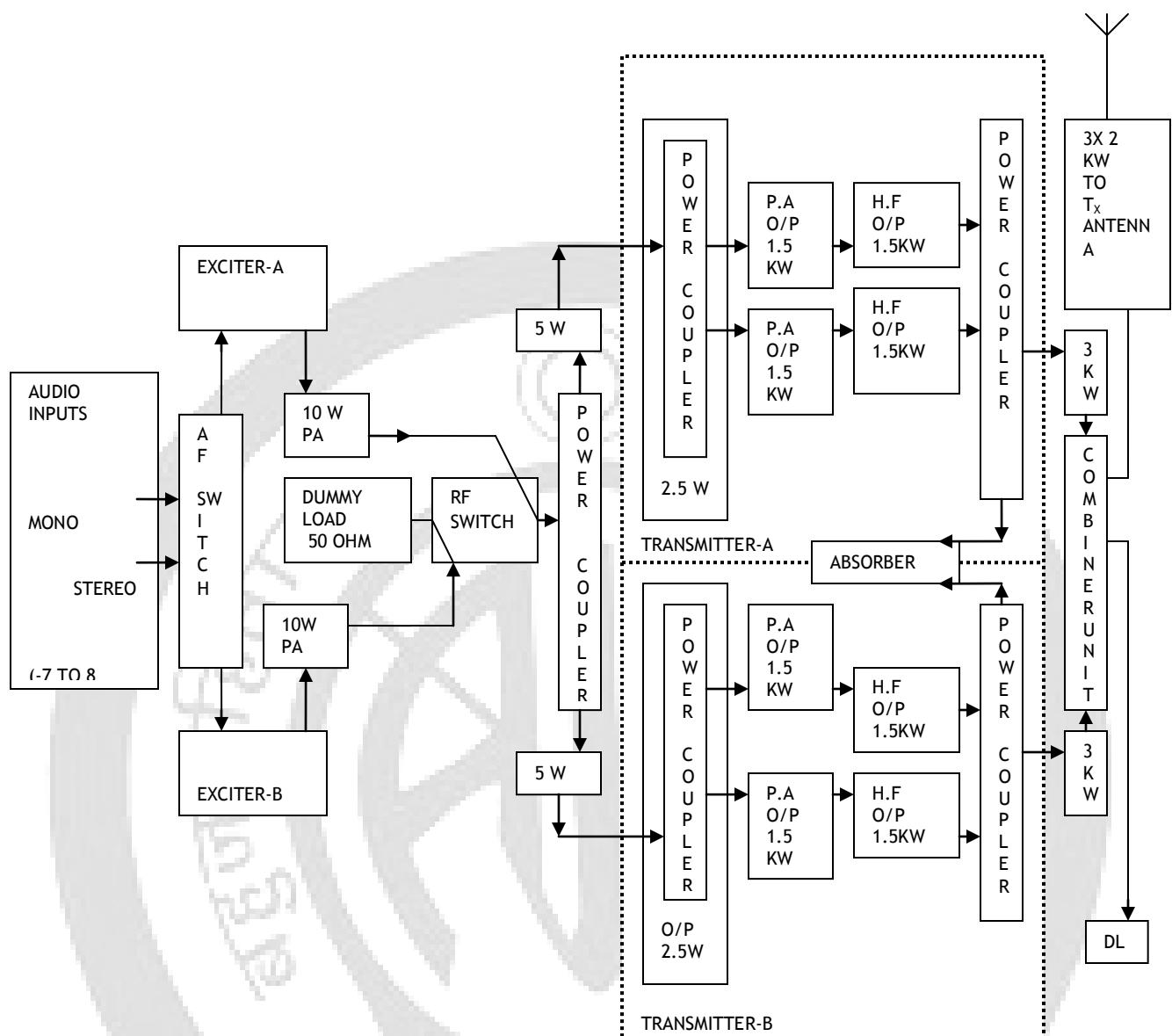
Now AIR also use new 20 KW transmitter which is built by a American company (NAUTEL).it is totally microprocessor based & its power amplifiers are made of MOSFET circuits. Here no hybrid combining circuit is used. The combining circuit is called STAR-combiner. A question can occur in our mind that what is star combiner. Actually all the outputs of power amplifiers are combined here once by star combiner.

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**NOTE:**  
 PA-POWER AMPLIFIER  
 D.L-DUMMY LOAD  
 H.F-HARMONIC FILTER  
 I/P-INPUT  
 O/P-OUT PUT  
 ANT.-ANTENNA

FIGURE: BLOCK DIAGRAM 2 x 5 KW F.M TRANSMITTER



**NOTE:**  
 PA-POWER AMPLIFIER  
 D.L-DUMMY LOAD  
 H.F-HARMONIC FILTER  
 I/P-INPUT  
 O/P-OUT PUT

FIGURE: BLOCK DIAGRAM 2 x 3 KW F.M TRANSMITTER

## **INTRODUCTION TO ANTENNA SYSTEM FOR FM TRANSMITTER**

The antenna for FM transmission consists of:

1. Supporting tower
2. Main antenna:- mainly two types written below
  - a) Pole type &
  - b) Panel type
3. Feeder cable

**TOWER:** A tower of good height is required for monitoring the FM antenna since the coverage of transmitter is proportional to the height of tower. For a 100m height, the coverage is about 60m. Whenever new towers are to be provided generally they are of 100m heights since beyond this height, there is steep rise in their prices because of excessive wind load on the top of the tower. At some places the exciting tower of DOORDARSHAN has also been utilized for mounting FM antenna. Provision has also been made on the AIR towers for top mounting of TV antenna below FM antenna.

**ANTENNA:** The main requirements of the antenna to be used for FM transmitter are:

- Wide band usage from 88 to 108 MHz.
- Omni directional horizontal pattern of field strength.
- Circular polarization for better reception.
- High gain both vertical & horizontal signal.
- 2° beam tilt below horizontal.
- Sturdy design for maintenance free service.

**POLE TYPE ANTENNA:** The pole type antenna is mounted on one of the four faces of the tower. This system will give a field pattern with range of 3 dB. The antenna is mounted in such a direction in which it is required to enhance the signal. The important parameters for antenna are:

1. weight: 200kg
2. VSWR: 1.4:1
3. Gain: 56Db
4. Rating of each dipole: 5kW

**PANEL TYPE ANTENNA:** the panel type antenna is to be used on TV tower. DOORDARSHAN have provided an aperture for FM antenna on their towers. The size of this section is 2.4 x 2.4 m & its height is different at different places. The antenna system is envisaged for FM broadcasting consists of total of 16 panels. For omni-directional pattern 4 panels are mounted on each side of the tower. Ladders for mounting these panels have already been provided on 4 sides of tower.

Each panel consists of-

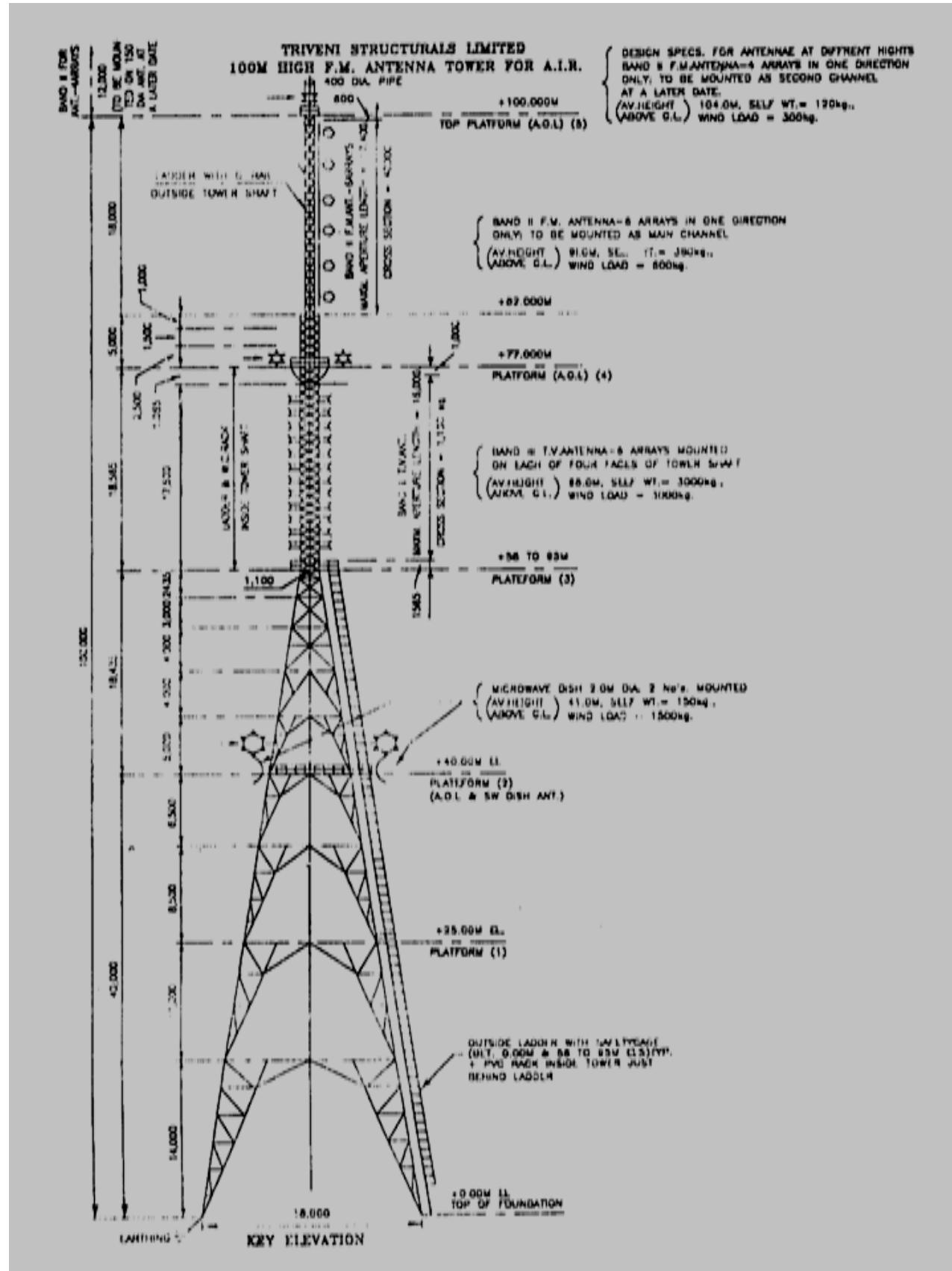
1. Reflector panel.
2. Two numbers of horizontal dipoles.
3. Two numbers of vertical dipoles.

The capacity of each dipole: 2.5kW.

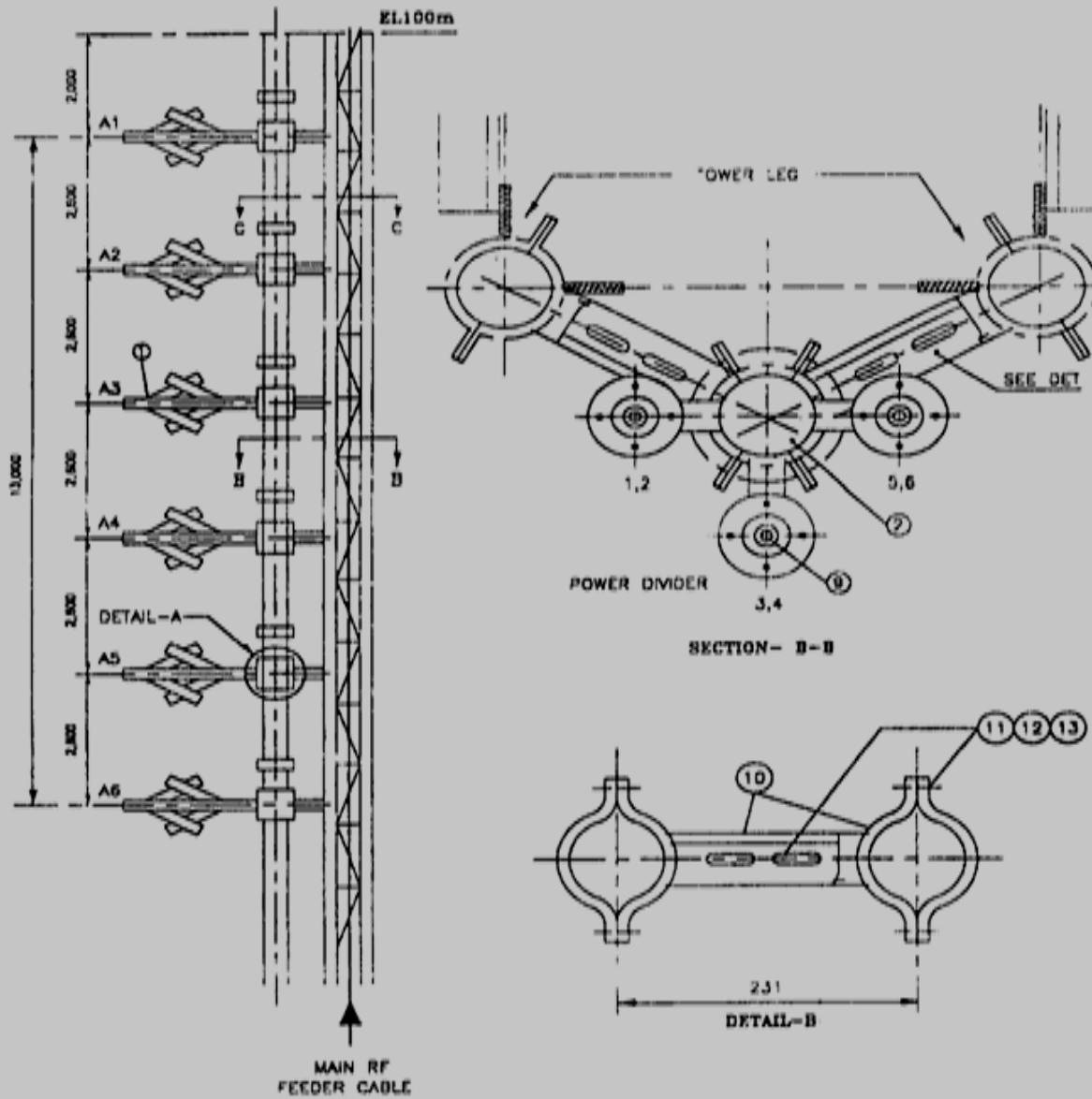
Each panel is able to transmit power: 10kW

The dipoles are made of steel tubes. Since each panel consists of 4 dipoles, there are total 64 dipoles for all 16 panels. This antenna gives an omni directional pattern when the panels are mounted on all 4 faces.

**FEEDER CABLE:** For connecting the o/p power of transmitter to the dipoles through the power divider, a 3" dia feeder cable has been used. This cable is of hollow type construction & has to be handled very carefully. Weight of cable is 2.5kg /mt. Attenuation loss 0.44dB/100m length. No standby cable is provided.



## POLE TYPE ANTENNA



**TABLE OF CHANNEL & THEIR FREQUENCY, POWER, INSTALATION.**

CHANNEL	LINK FREQUENCY	RF FREQUENCY	POWER	SITUATED AT	TRANSMITTING ANTENNA HEIGHT(H) / DIAMETER(D)	TYPE(WAVE )
KOLKATA-A (A.M)	I) 103 MHZ II) 4127.2 MHZ (L) L=LEFT	657 KHZ	200 KW	AMTOLA (CHANDI) 24 SOUTH PARGANA	MAST (H) 122MT	MEDIUM WAVE
KOLKATA-B (A.M)	97 MHZ	1008 KHZ SHORT WAVE I)7210 KHZ II)4820 KHZ	100 KW 50 KW	AMTOLA 24 SOUTH PARGANA	MAST (H) ~ 140 MT	MEDIUM & SHORT WAVE
KOLKATA-C VIVID BHARATI (A.M)	I) 101 MHZ II) 4127.2 MHZ(R) R=RIGHT	1323 KHZ	20 KW	AMTOLA (CHANDI) 24 SOUTH PARGANA	MAST (H) 120MT	MEDIUM WAVE
MOGRA-HPT (SBS)	48.6 MHZ (A)	594 / 1134 KHZ	-----	MOGRA	MAST -----	MEDIUM WAVE
LPT-COSSIPORE	PW LINE-6191	-----	-----	COSSIPORE	MAST -----	MEDIUM WAVE
FM GOLD	I) 104 MHZ II) 91 MHZ III)P W LINE I)5999 II)6000 III)6002	100.2 MHZ	10 KW	GOLF GREEN KOLKATA	PARABOLIC REFLECTOR (D) 3.6 MT (C-BAND)	SPACE WAVE
FM RAINBOW	I)102.4 MHZ II) DIGITAL LINE 20434 III) PW LINE 8513	107 MHZ	10 KW	GOLF GREEN KOLKATA	PARABOLIC REFLECTOR (D) 3.6 MT (C-BAND)	SPACE WAVE
GHYAN VANI	-----	105.4 MHZ	10 KW	GOLF GREEN KOLKATA	PARABOLIC REFLECTOR (D) 3.6 MT (C-BAND)	SPACE WAVE
DTH (DIRECT TO HOME)	-----	I)53.1 MHZ II)4126.8MHz	-----	KOLKATA- CAPTVE EARTH STATION (CES)	PARABOLIC REFLECTOR (D) 3.6 MT (C-BAND)	SPACE WAVE
CBS DN-LINK FREQUENCY(TRA NSPONDER-C11)	-----	4128.8 MHZ	-----	-----	-----	-----
NATIONAL NEWS CHANNEL(TRANS PONDER-C11)	-----	4117.6 MHZ	-----	-----	-----	-----

## ALLOCATION OF FREQUENCY BAND FOR BRODCASTING

<b>BAND NAME</b>	<b>FREQUENCY RANGE</b>	<b>CHANNEL SPACING</b>	<b>USE</b>	
MEDIUM WAVE	300 ~ 3000KHZ	9 KHZ	KOLKATA-A VIVID BHARATI	
	531 ~ 1602 KHZ			
SHORT WAVE	3 ~ 30 MHZ	-----	KOLKATA-B	
INTERNATIONAL BAND	3900 ~ 4000 KHZ 5900 ~ 6200 KHZ 7100 ~ 7300 KHZ 9500 KHZ ~ 9900 KHZ 11650 ~ 12050 KHZ 13600 ~ 13800 KHZ	-----	-----	
TROPICAL BAND	2300 ~ 2490 KHZ 3200 ~ 3400 KHZ 4750~ 4995 KHZ	5 KHZ	-----	
VERY HIGH FREQUEWNCY(V.H.F) 30 ~ 300 MHZ	BAND-1	40 ~ 68 MHZ	7 MHZ	TV CHANNEL# 1-4
	BAND-2	88 ~ 108 MHZ	100 KHZ	FM SOUND BRODCASTING
	BAND-3	174 ~ 230 MHZ	7 MHZ	TV CHANNEL-#5-12
ULTRA HIGH FREQUENCY(U.H.F) 300 ~ 3000 MHZ	BAND-4	470 ~ 670MHZ	8 MHZ	TV CHANNEL-#21-37
	BAND-5	606 ~ 798 MHZ	8 MHZ	TV CHANNEL-#38-61

S.H.F 3 ~ 30 MHZ	S-BAND	2.5 ~2.7GHZ(DL)	TO TRANSMITT AIR PROGRAMES TO OTHER TRANSMITTING STATION FROM AKASHBANIBHABAN.
	C-BAND	3.7~4.2GHZ(DL) 5.9~ 6.8GHZ(UL)	
	EX C-BAND	4.5 ~ 4.85GHZ(DL) 6.725 ~ 7.025 GHZ(UL)	
	KU BAND	10.7 ~ 11.7GHZ & 12.5 ~ 12.75 GHZ(DL) 12.75 ~ 13.25 GHZ & 13.75 ~ 14.5 GHZ (UL)	

NOTE:

- 69 ~87 MHZ Frequency is used by Indian defense & army services.
- 109 ~ 173 MHZ is used by Indian navy.
- So many frequency gap or band in V.H.F & U.H.F is used by Indian science, space & nuclear research centre.
- Some abbreviated form in table DL-down link, UL-uplink.

## **CONCLUSION**

The objective of All India Radio is achieved by educating & entertaining the people with a view of creating awareness among them about the nation's potential for development its problem & soliciting their participation in the implementation of government's policies plans & programs. As public broadcaster dedicated to nation building, ALL INDIA RADIO has contributed very significantly to the socio-economic development & cultural integration. It provides a mix of informative, educative & entertaining fare as news service, external service, National channel, Commercial channel, AIR internet service, AIR music on phone, Air news on phone, Digital Audio Broadcasting (now in Delhi).It helps people not only increase their general knowledge & education but also helps to know our country & its lifestyle.

The eastern region AIR headquarters is AKASHBANIBHABAN, KOLKATA which is the main centre to controlling the entire recording, dubbing, editing, & live programs like talk-show.

Some most popular FM channels like FM-GOLD (103MHz) & FM-RAINBOW (102.4MHz) are transmitted from here. A private channel IGNOU also transmits their educational programs from here. Very few of us know that all the private FM channels are also transmitted from DDK-transmitter.

AIR also transmits programs like VIVID BHARATI, CAL- A, CAL-B etc. The fore cast of weather of these channels is very helpful for farmers & fishermen. So all the programs of this channel are too popular & helpful. The AIR also serves educational programs for students.

Now a days AIR also used modern technologies like DTH (Direct to Home) SERVICE, ISDN to transmit their programs. They also plan to start Digital Radio Service shortly.

So as a Indian I also hope that the next journey of AIR will be glorious to serve our nation & people of every stage of our country.



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