Model Viva Questions for “**communication lab**”
Class: **V SEM (ET&T)**
Title of the Practical: **Performance of Gunn Diode & Gunn Oscillator**

Q1 What is Gunn Diode ?
A1 a Gunn diode, also known as a transferred electron device (TED), is a form of diode used in high-frequency electronics
Q2 Explain structure of Gunn diode?
A2 It is somewhat unusual in that it consists only of N-doped semiconductor material, whereas most diodes consist of both P and N-doped regions. In the Gunn diode, three regions exist: two of them are heavily N-doped on each terminal, with a thin layer of lightly doped material in between.
Q4What is Gunn?
A4 the Gunn diode is named for the physicist J.B. Gunn who, in 1963, produced the first device based upon the theoretical calculations of Cyril Hilsum.
Q5 Explain – Why Multiple Gunn diodes in a series circuit are unstable?
A5 Multiple Gunn diodes in a series circuit are unstable, because if one diode has a slightly higher voltage drop across it, it will conduct less current, and the voltage drop will rise further. In fact, even a single diode is internally unstable, and will develop small slices of low conductivity and high field strength which move from the cathode to the anode. It is not possible to balance the population in both bands, so there will always be thin slices of high field strength in a general background of low field strength.
Q6What is the application of Gunn diode?
A6-1 Negative resistance behavior can be used to amplify 2Common use is a high frequency and high power signal source
Q7 Can Gunn diodes can serve as microwave frequency generators
A7 By virtue of their low voltage operation, Gunn diodes can serve as microwave frequency generators for very low powered (few-mill watt) microwave transmitters.
Q8what is the use of Gunn diode?
A8 1 a Gunn diode as relaxation oscillator 2. As negative resistance oscillators 3. Gunn diode as hot electron injectors: graded gap injector and resonant tunneling injector.
Q9 State Gunn effect?
A9 Gunn effect was discovered • by J.B Gunn in IBM : 1963 of Above some critical voltage, corresponding to an electric field of 2000~4000 V/cm the current in every spectrum (GaAs) became a fluctuating function of time”.
Q10explain Operation of the Gunn diode?
A10 the operation of the Gunn diode can be explained in basic terms. When a voltage is placed across the device, most of the voltage appears across the inner active region. As this is particularly thin this means that the voltage gradient that exists in this region is exceedingly high. It is found that when the voltage across the active region reaches a certain point a current is initiated and travels across the active region. During the time when the current pulse is moving across the active region the potential gradient falls preventing any further pulses from forming. Only when the pulse has reached the far sides of the active region will the potential gradient rise, allowing the next pulse to be created. It can be seen that the time taken for the current pulse to traverse the active region largely determines the rate at which current pulses are generated, and hence it determines the frequency of operation.

Title of the Practical: **Performance of Klystron & Reflex klystron tubes. / Measurement of characteristics of klystron tube & Gunn Oscillator**

Q1 Define Klystron?
A1 It was discovered in 1939 that a toroidal cavity made of conductive material called a cavity resonator surrounding an electron beam of oscillating intensity could extract power from the beam without actually intercepting the beam itself.
Q2Who invent klystron?
A2 the Varian brothers called their invention a klystron?
Q3Explain reflex klystron?
A3Another invention of the Varian brothers was the reflex klystron tube. In this tube, electrons emitted from the heated cathode travel through the cavity grids toward the repeller plate, then are repelled and returned back the way they came (hence the name reflex)through the cavity grids. Self-sustaining oscillations would develop in this tube, the frequency of which could be changed by adjusting the repeller voltage.
Q4Can we use reflex klystron as a voltage-controlled oscillator?
A4 this tube operated as a voltage-controlled oscillator.
Q5Explain Performance of klystron?
A5: - A klystron is a specialized linear-beam vacuum tube (evacuated electron tube). Klystrons are used as amplifiers at microwave and radio frequencies to produce both low-power reference signals for super heterodyne radar receivers and to produce high-power carrier waves for communications and the driving force for modern particle accelerators
Q6 Explain working of klystron?
A6 Klystrons amplify RF signals by converting the kinetic energy in a DC electron beam into radio frequency power. A beam of electrons is produced by a thermionic cathode (a heated pellet of low work function material), and accelerated by high-voltage electrodes (typically in the tens of kilovolts). This beam is then passed through an input cavity. RF energy is fed into the input cavity at, or nears, its natural frequency to produce a voltage which acts on the electron beam. The electric field causes the electrons to bunch: electrons that pass through during an opposing electric field are accelerated and later electrons are slowed, causing the previously continuous electron beam to form bunches at the input frequency. To reinforce the bunching, a klystron may contain additional "buncher" cavities. The RF current carried by the beam will produce an RF magnetic field, and this will in turn excite a voltage across the gap of subsequent resonant cavities. In the output cavity, the developed RF energy is coupled out. The spent electron beam, with reduced energy, is captured in a collector.
Q7explain the floating drift tube klystron?
A7 the floating drift tube klystron has a single cylindrical chamber containing an electrically isolated central tube. Electrically, this is similar to the two cavity oscillator klystron with a lot of feedback between the two cavities. Electrons exiting the source cavity are velocity modulated by the electric field as they travel through the drift tube and emerge at the destination chamber in bunches, delivering power to the oscillation in the cavity. This type of oscillator klystron has an advantage over the two-cavity klystron on which it is based. It only needs one tuning element to effect changes in frequency. The drift tube is electrically insulated from the cavity walls, and DC bias is applied separately. The DC bias on the drift tube may be adjusted to alter the transit time through it, thus allowing some electronic tuning of the oscillating frequency. The amount of tuning in this manner is not large and is normally used for frequency modulation when transmitting.
Q8 In klystron what is the use of collector?
A8 after the RF energy has been extracted from the electron beam, the beam is destroyed in a collector. Some klystrons include depressed collectors, which recover energy from the beam before collecting the electrons, increasing efficiency. Multistage depressed collectors enhance the energy recovery by "sorting" the electrons in energy bins.
Q9 State some use of klystron?
A9 Klystrons produce microwave power far in excess of that developed by solid state. In modern systems, they are used from UHF (hundreds of MHz) up through hundreds of gigahertz (as in the Extended Interaction Klystrons in the CloudSat satellite). Klystrons can be found at work in radar, satellite and wideband high-power communication (very common in television broadcasting and EHF satellite terminals), medicine (radiation oncology), and high-energy physics (particle accelerators and experimental reactors). At SLAC, for example, klystrons are routinely employed which have outputs in the range of 50 megawatts (pulse) and 50 kilowatts (time-averaged) at frequencies nearing 3 GHz Popular Science's "Best of What's New 2007" included a company Global Resource Corporation using a klystron to convert thehydrocarbons in everyday materials, automotive waste, coal, oil shale, and oil sands into natural gas and diesel fuel.
Q10what is optical klystron?
A10 In an optical klystron the cavities are replaced with undulators. Very high voltages are needed. The electron gun, the drift tube and the collector are still used.

Title of the Practical: **Study of Magnetron**

Q1Define magnetron?
A1 a magnetron is a high power microwave oscillator in which thepotential energy of an electron cloud near the cathode is convertedinto r.f. energy in a series of cavity resonators.
Q2 what types of Frequency agile magnetrons are found?
A2 Frequency agile magnetrons fall into four classes 1 Dither Magnetrons (D), 2 Tunable/Dither Magnetrons (T/D) 3 Accutune(tm) Magnetrons (A) 4 Accusweep (tm) Magnetrons (As)
Q3Define Beacon magnetrons?
A3 Beacon magnetrons are small conventional magnetrons with peak power output less than 4 kW and average power output of less than 5 watts. Typically, they weigh 8 ounces.
Q4Define cavity magnetron?
A4 the cavity magnetron is a high-powered vacuum tube that generates microwaves using the interaction of a stream of electrons with a magnetic field.
Q5Explain working of cavity magnetrons?
A5 All cavity magnetrons consist of a hot cathode with a high (continuous or pulsed) negative potential by a high-voltage, direct-current power supply. The cathode is built into the center of an evacuated, lobed, circular chamber. A magnetic field parallel to the filament is imposed by a permanent magnet. The magnetic field causes the electrons, attracted to the (relatively) positive outer part of the chamber, to spiral outward in a circular path rather than moving directly to this anode. Spaced around the rim of the chamber are cylindrical cavities. The cavities are open along their length and connect the common cavity space. As electrons sweep past these openings, they induce a resonant, high-frequency radio field in the cavity, which in turn causes the electrons to bunch into groups. A portion of this field is extracted with a short antenna that is connected to a waveguide (a metal tube usually of rectangular cross section). The waveguide directs the extracted RF energy to the load, which may be a cooking chamber in a microwave oven.
Q6 the magnetron is a self-oscillating device or not?
A6The magnetron is a self-oscillating device requiring no external elements other than a power supply.
Q7What is the tuner?
A7 the tuner is the device which provides some magnetrons with the ability to vary from the basic frequency determined by the anode.
Q8Name types of tuners?
A8 Tuners fall into three basic categories:
_ Capacitive
_ Inductive
_ Combination of both
Q9 Define cathode of a magnetron?
A9 the cathode of a magnetron is the part which makes the magnetron an active device
Q10 Why magnetic circuit associated with the magnetron is necessary?
A10 the magnetic circuit associated with the magnetron is necessary to provide the crossed field type of operation which provides for the synchronization of the electron trajectories.

Title of the Practical: **Study of isolators, directional couplers, slotted lines& block diagram of basic microwave bench / assembling the microwave bench.**

Q.1What is range of precision attenuator?
A2.The rang of precision attenuator is 0 to 50 dB.
Q.2 Define Backward wave oscillator?
A2 Backward wave oscillator (BWO) is a microwave continuous wave (CW) oscillator with excellent tuning capability and frequency coverage range.
Q.3What is functions of SWR indicator?
A2 the function of SWR is a measure of mismatch between the load and the Transmission line.
Q.4What is the function of slotted line?
A4 a coupling probe moving along the waveguide can be used to detect the standing wave pattern present inside the waveguide. It is basically used for measuring the standing wave ratio.
Q.5List the type of tunable detector?
Ans. Tunable detector is three types:-
(1)Tunable waveguide detector (2) Tunable co- axial detector (3) Tunable probe detector
Q6 How can we assemble the microwave bench?
A6The experimental setup for micro-wave frequencies at C-band requires a microwave source to produce microwave power. A varactor tunned oscillator (VTO 8430) of Avantek is used which supplies microwave power to a maximum level of 10 mW at frequencies from 4.3 GHz to 5.8 GHz. A +15 Volts DC power supply has been used as source power supply. Temperature of VTO may raise while in use, so an electrical fanis used to cool it. The block diagram of experimental setup is shown in Fig.1.

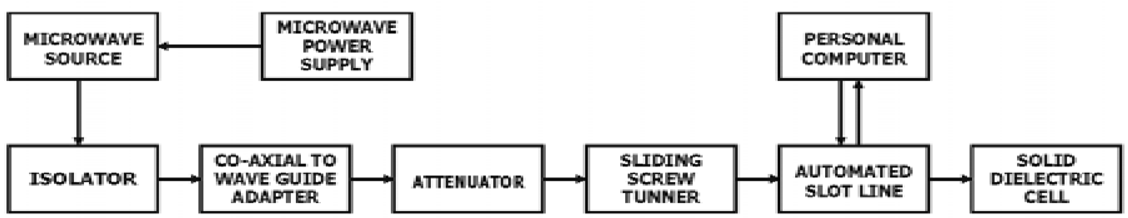


Fig.1- Block Diagram of C-Band Microwave Bench

Fig.1Block Diagram of C-Band Microwave Bench The other components shown in the block diagram are isolator, co-axial connector, attenuator, sliding screw tuner, slotted line section , detector probe and a dielectric cell .In this setup all the components are assembled and microwaves are generated by VTO and are propagated through rectangular waveguide to the dielectric cell. The attenuator is used to keep the desired power in line. A slotted section with tunable probe containing 1N23C crystal with the square low characteristics has been used to measure power (current) along the slotted line. The crystal detector is connected to the micro ammeter and to the PC to read and record the measured power.
Q7 why we use Isolator?
A7 In electrical engineering, a disconnector or isolator switch is used to make sure that an electrical circuit can be completely de-energized for service or maintenance. Such switches are often found in electrical distribution and industrial applications where machinery must have its source of driving power removed for adjustment or repair.
Q8What is Optical isolator?
A8An optical isolator, or optical diode, is an optical component which allows the transmission of light in only one direction. It is typically used to prevent unwanted feedback into an optical oscillator, such as a laser cavity.
Q9 what is Bi-directional coupler?
A9A directional coupler where the isolated port is not internally terminated. Such a coupler is used to form a reflectometer,
Q10 explain Power dividers and directional couplers?
A10 Power dividers and directional couplers are passive devices used in the field of radio technology. They couple part of the transmission power in a transmission by a known amount out through another port, often by using two transmission lines set close enough together such that energy passing through one is coupled to the other.

Title of the Practical: **Performance of VSWR meter/ Measurement of Standing wave ration (VSWR).**

Q1 Full form of VSWR?
A1 Voltage standing wave ratio.
Q2Explain VSWR?
A2 Voltage Standing Wave Ratio is the ratio of the voltage maximum (antinode) to the adjacent voltage minimum (node) on a transmission line.
Q3Explain Indirect measurement of VSWR?
A3 Indirect measurement of VSWR-Indirect measurement of VSWR means observation of some other parameters than the voltage standing wave itself (eg using a voltage probe).Indirect measurement has become the most common way of measuring VSWR, the term VSWR is often used to mean the "notional" result of an indirect measurement wrt a nominal Zo rather than that which would be measured on a practical transmission line. That gives rise to the use of the term VSWR as a means of qualifying a tolerance range for a load impedance, eg a transmitter might be specified for a nominally 50Ω load with VSWR<1.5.
Q4 what is Breune VSWR Bridge?
A4most common and quite an ingenious device for indirect measurement of VSWR in its simplicity and usefulness is the Breune VSWR Bridge.
Q5 what is SWR meter?
A5 the SWR meter or VSWR (voltage standing wave ratio) meter measures the standing wave ratio in a transmission line.
Q6 There are many sources of errors in VSWR meters, the most common ones are 1accuracy of the impedance at which the detectors null; 2scale shape (ie the relationship between scale markings and meter current); 3diode voltage drop (related to previous item); 4balance of both detectors; 5length of the sampler; 6power calibration; 7frequency sensitivity / compensation accuracy; 8insertion VSWR (the VSWR caused by insertion of the sampler element in a line, related to the coupling and the accuracy of Zo of the sampler section; 9loss (loss in the sampler section); 10detector / meter response to modulated waveforms;
Q6explain directional SWR meter?
A6 A directional SWR meter measures the magnitude of the forward & reflected waves by sensing each one individually, with directional couplers. A calculation can then be performed to arrive at the SWR.
Q7Can we use SWR with an impedance bridge circuit ?
A7 SWR can also be measured using an impedance bridge circuit. The bridge is balanced (0 volts across the detector) only when the test impedance exactly matches the reference impedance. When a transmission line is mismatched (SWR > 1:1), its input impedance deviates from its characteristic impedance; thus, a bridge can be used to determine the presence or absence of a low SWR.
Q8state limitations of SWR meter?
A8 Note that an SWR meter does not measure the actual impedance of a load (i.e., the resistance and reactance), but only the mismatch ratio. To measure the actual impedance, an antenna analyzer or other similar RF measuring device is required. Note also that for accurate readings, the SWR meter must be matched to the line impedance, usually 50 or 75 ohms. To accommodate multiple impedances, some SWR meters have switches on the rear, to select the resistance appropriate for the sense lines. An SWR meter should be connected to the line as close as possible to the antenna: All practical transmission lines have a certain amount of loss, which causes the reflected wave to be attenuated as it travels back along the line. Thus, the SWR is highest closest to the load, and only improves as the distance from the load increases when not actually measuring SWR, it is best to remove the more usual types of passive SWR meter from the line. This is because the internal diodes of such meters can generate harmonics when transmitting,
and intermodulation products when receiving. Because active SWR meters do not usually suffer from this effect, they can normally be left in without causing such problems.
Q9 explain Coaxial Dynamics?
A9 Coaxial Dynamics, founded in 1969 in Cleveland, Ohio, is a manufacturer of a broad range of products for the Amateur radio and other electronics-based industries such as Radio and Television Broadcasting.
Q10state about signal source of VSWR meter?
A10 the voltage component of a standing wave in a transmission line consists of forward wave superimposed on the reflected wave. The signal source is generally set to a fixed frequency and is tuned up for a good output voltage.

Title of the Practical: **Measurement of frequency of microwave**.

Q1Explain Microwaves?

A1 Microwaves are electromagnetic waves with wavelengths ranging from as long as one meter to as short as one millimeter, or equivalently, with frequencies between 300 MHz (0.3 GHz) and 300 GHz.

Q2 what are the Microwave frequency bands?

A2The microwave spectrum is usually defined as electromagnetic energy ranging from approximately 1 GHz to 100 GHz in frequency, but older usage includes lower frequencies. Most common applications are within the 1 to 40 GHz range.

Q3Explain any one method of Microwave frequency?

A3 Microwave frequency can be measured by either electronic or mechanical techniques. Frequency or high frequency heterodyne systems can be used. Here the unknown frequency is compared with harmonics of a known lower frequency by use of a low frequency generator, a harmonic generator and a mixer. Accuracy of the measurement is limited by the accuracy and stability of the reference source.

Q4What is MASER?

A4A maser is a device similar to a laser, which amplifies light energy by stimulating the emitted radiation. The maser, rather than amplifying light energy, amplifies the lower frequency, longer wavelength microwaves.

Q5What are the uses?

A5 Uses:-1. Communication2. Radar3. Radio astronomy4. Navigation5. Power

Q6What is radio waves?

A6 electromagnetic waves longer (lower frequency) than microwaves are called "radio waves".

Q7what is the use of microwaves in radar?

A7 Radar uses microwave radiation to detect the range, speed, and other characteristics of remote objects. Development of radar was accelerated during World War II due to its great military utility. Now radar is widely used for applications such as air traffic control, weather forecasting, navigation of ships, and speed limit enforcement

Q8explain working of microwave oven?

A8 A microwave oven passes (non-ionizing) microwave radiation (at a frequency near 2.45 GHz) through food, causing dielectric heating by absorption of energy in the water, fats and sugar contained in the food. Microwave ovens became common kitchen appliances in Western countries in the late 1970s, following development of inexpensive cavity magnetrons. Water in the liquid state possesses many molecular interactions which broaden the absorption peak. In the vapor phase, isolated water molecules absorb at around 22 GHz, almost ten times the frequency of the microwave oven.

Q9 in industrial processes where we use Microwave heating?

A9 Microwave heating is used in industrial processes for drying and curing products.

Q10why we use microwave in spectroscopy?

A10 Microwave radiation is used in electron paramagnetic resonance (EPR or ESR) spectroscopy, typically in the X-band region (~9 GHz) in conjunction typically with magnetic fields of 0.3 T. This technique provides information on unpaired electrons in chemical systems, such as free or transition metal ions such as Cu(II). The microwave radiation can also be combined with electrochemistry, microwave enhanced electrochemistry.

Title of the Practical: **Measurement of guide wavelength./Measurement of guided power**

Q.1 what are the methods for measurement of power?

A1 (a) Measurement of low power (0.01mW-10mW) by Bolometer technique.(b) Measurement of medium power (0.01W-10W) by calorimetric technique.(c) Measurement of high power (>10W) by calorimetric wattmeter.

Q.2what happens to value of resistance when temperature increases in Baretters?

A2When temperature increases than their resistance is also increases.

Q.3What limitation of baretter & thermistors?

A3. Barraters and thermistor, both are limited in their power handling ability to about 10mW, so that powers greater than 10mW can not be measured with them directly.

Q.4 defines attenuation?

A4. Attenuation is the ratio of Input power to the output power and is normally expressed in decibels.

Q.5Which device is used for measurement of high power?

A5 Calorimetric watt meter.

Q6state definition of guide wavelength?

A6 Guide wavelength is defined as the distance between two equal phase planes along the waveguide. The guide wavelength is a function of operating wavelength (or frequency) and the lower cutoff wavelength, and is always longer than the wavelength would be in free-space.

Q7what is the use of guide wavelength?

A7 Guide wavelength is used when you design distributed structures in waveguide. For example, if you are making a PIN diode switch with two shunt diodes spaces 3/4 wavelength apart, use the 3/4 of a guide wavelength in your design.

Q8define group delay?

A8 the group delay of rectangular waveguide components is a function of the frequency you are applying. Near the lower cutoff, the group delay gets longer and longer, as the EM wave ping-pongs down the guide, and can easily be 10X the free-space group delay. But at the upper end of a waveguide's band, the group delay approaches the free-space group delay.

Q9 what is Wavelength?

A9 it is the length between the crest and a crest and a trough and a trough.

Q10what is the wavelength of ultrasound?

A10 Ultrasound has wavelengths shorter than 17 millimeters at Standard Temperature and Pressure (STP). Waves longer than 17 mm are classified as sound waves

Title of the Practical: **Measurement of reflection coefficient**.

Q1Explain reflection coefficient?

A1The reflection coefficient is used in physics and electrical engineering when wave propagation in a medium containing discontinuities is considered. A reflection coefficient describes either the amplitude or the intensity of a reflected wave relative to an incident wave. The reflection coefficient is closely related to the transmission coefficient.

Q2In terms of telecommunications, what is the definition of the reflection coefficient A2In telecommunications, the reflection coefficient is the ratio of the amplitude of the reflected wave to the amplitude of the incident wave. In particular, at a discontinuity in a transmission line, it is the complex ratio of the electric field strength of the reflected wave (E^-) to that of the incident wave (E^+). This is typically represented with a Γ (capital gamma).

Q3 Why Reflection coefficient is used in feeder testing?

A3 Reflection coefficient is used in feeder testing for reliability of medium.

Q4 why we use reflection coefficient in semi permeable membranes?

A4 the reflection coefficient in semi permeable membranes relates to how such a membrane can reflect solute particles from passing through. A value of zero results in all particles passing through.

Q5 How can we are displayed reflection coefficient graphically?

A5 the reflection coefficient is displayed graphically using a Smith chart.

Q6What is the expression for absolute magnitude of the reflection coefficient?

A6 the absolute magnitude of the reflection coefficient can be calculated from the standing wave ratio, SWR:

$$|\Gamma| = \frac{SWR-1}{SWR+1}$$

Q7What is the use of reflection coefficient in high power electrical drives?

A7The reflection coefficient characterizes an amplitude of voltage reflections between motor and inverter.

Q8The reflection coefficient is given by

$$RC = \left|\frac{Z_1 - Z_2}{Z_1 + Z_2}\right| = \frac{SWR - 1}{SWR + 1} ,$$

What is Z_1 &, Z_2?

A8 reflection coefficient (RC): 1. the ratio of the amplitude of the reflected wave and the amplitude of the incident wave. (188) 2. At a discontinuity in a transmission line, the complex ratio of the electric field strength of the reflected wave to that of the incident wave. (188) Note 1: The reflection coefficient may also be established using other field or circuit quantities. Note 2: The reflection coefficient is given by

$$RC = \left|\frac{Z_1 - Z_2}{Z_1 + Z_2}\right| = \frac{SWR - 1}{SWR + 1} ,$$

Where Z_1 is the impedance toward the source, Z_2 is the impedance toward the load, the vertical bars designate absolute magnitude, and SWR is the standing wave ratio.

Q9 Define The reflectivity of light?

A9 the reflectivity of light from a surface depends upon the angle of incidence and upon the plane of polarization of the light. The general expression for reflectivity is derivable from Fresnel's Equations. For purposes such as the calculation of reflection losses from optical instruments, it is usually sufficient to have the reflectivity at normal incidence. This normal incidence reflectivity is dependent upon the indices of refraction of the two media.

Q10 In terms of load define reflection coefficient?

A10 reflection coefficient this is the ratio of reflected wave to incident wave at point of reflection. This value varies from -1 (for short load) to +1 (for open load), and becomes 0 for matched impedance load.

Title of the Practical**: Measurement of cutoff wavelength (TE10 mode) Using C=2/(m/a) + (n/b)=2a**

Q1.What is the two boundary conditions must be met in a waveguide for a wave to travel down the guide?
A1 Two boundary conditions must be met in a waveguide for a wave to travel down the guide: 1 the electric field must terminate normally on the conductor (the tangential component of the electric field must be zero). 2 The magnetic field must lie entirely tangent along the wall surface. (The normal component of the magnetic field must be zero).
Q2 Can TEM waves are conducted in a waveguide?
A2 TEM waves cannot be conducted in a waveguide.
Q3 what is the most common wave used in waveguides
A3 the most common wave used in waveguides is the TE_{10}, meaning transverse electric.
Q4 what denotes the subscript TE_{ab} of the waveguide.
A4 the subscript TE_{ab} denotes the number of half cycles which appear in the a and b dimensions of the waveguide.
Q5 what is the velocity of a TEM wave in air
A5 the velocity of a TEM wave in air is: $c = \lambda f$.
Q6state cut off frequency?
A6 In physics and electrical engineering, a cutoff frequency, corner frequency, or break frequency is a boundary in a system's frequency response at which energy flowing through the system begins to be reduced (attenuated or reflected) rather than passing through.
Q7what is the definition of cut off frequency in electronics?
A7 In electronics, cutoff frequency or corner frequency is the frequency either above or below which the power output of a circuit, such as a line, amplifier, or electronic filter has fallen to a given proportion of the power in the pass band. Most frequently this proportion is one half the pass band power, also referred to as the 3dB point since a fall of 3dB corresponds approximately to half power.
Q8 state definition of cutoff wavelength?
A8 the maximum wavelength that will propagate in an optical fiber or waveguide. The cutoff frequency is found with the characteristic equation of the Helmholtz equation for electromagnetic waves, which is derived from the electromagnetic wave equation by setting the longitudinal wave number equal to zero and solving for the frequency. Thus, any exciting frequency lowers than the cutoff frequency will attenuate, rather than propagate.
Q9what is miller effect?
A9 In electronics, the Miller effect accounts for the increase in the equivalent input capacitance of an inverting voltage amplifier due to amplification of the capacitance between the input and output terminals.
Q10state angular frequency?
A10 In physics, angular frequency ω (also referred to by the terms angular speed, radial frequency, circular frequency, orbital frequency, and radian frequency) is a scalar measure of rotation rate. Angular frequency (or angular speed) is the magnitude of the vector quantity angular velocity .

Title of the Practical: **Study of E-plane, H-plane and Magic Tee's.**

Q1What is Waveguide?

A1Waveguide is a huge topic for anyone studying microwave engineering, entire books have been written on the topic! Waveguides are metallic transmission lines that are used at microwave frequencies, typically to interconnect transmitters and receivers (transceivers) with antennas.

Q2What are advantages Waveguide over coax?

A2Waveguide has a number of advantages over coax, micro strip and strip line. It is completely shielded (excellent isolation between adjacent signals can be obtained), it can transmit extremely high peak powers and it has very low loss (often almost negligible) at microwave frequencies. One disadvantage of waveguide is its high cost. Manufacturing volumes are low, and waveguide materials such as copper and silver are relatively expensive. Other disadvantages include unwieldy size and mass.

Q3Name the Waveguide components

A3 All manner of waveguide components exist, including circulators, isolators, attenuators, loads, mixers, amplifiers

Q4 what is broadwall coupler?

A4 broadwall coupler, a better type of waveguide coupler than the cross-guide. It has much more directivity than the ones above, but it is a lot bigger.

Q5What is a magic tee?

A5 a magic tee (or magic T or hybrid tee) is a hybrid or 3dB coupler used in microwave systems. It is an alternative to the rat-race coupler. In contrast to the rat-race, the three-dimensional structure of the magic-tee makes is less readily constructed in planar technologies such as microstrip or stripline.

Q6Explain origination of magic tee?

A6 The magic tee was originally developed in World-War II, and first published by W. A. Tyrell (of Bell Labs) in a 1947 IRE paper Robert L. Kyhl and Bob Dicke independently created magic tees around the same time period.

Q7 Explain Structure of magic tee?

A7The magic tee is a combination of E and H plane tees. Arm 3 forms an H-plane tee with arms 1 and 2. Arm 4 forms an E-plane tee with arms 1 and 2. Arms 1 and 2 are sometimes called the side or collinear arms. Port 3 is called the H-plane port, and is also called the Σ port, sum port or the P-port (for Parallel). Port 4 is the E-plane port, and is also called the Δ port, difference port, or S-port (for Series). There is no one single established convention regarding the numbering of the ports.

Q8 Explain operation of magic tee?

A8The name magic tee is derived from the way in which power is divided among the various ports. A signal injected into the H-plane port will be divided equally between ports 1 and 2, and will be in phase. A signal injected into the E-plane port will also be divided equally between ports 1 and 2, but will be 180 degrees out of phase. If signals are fed in through ports 1 and 2, they are added at the H-plane port and subtracted at the E-plane port.[2] Thus, with the ports numbered as shown, and to within a phase factor.

Q9 what is the Magic in magic tee?

A9If by means of a suitable internal structure, the E-plane (difference) and H-plane (sum) ports are simultaneously matched, then by symmetry, reciprocity and conservation of energy it may be shown that the two collinear ports are also matched, and are magically isolated from each other.

Q10explain structure of magic tee?

A10 the magic tee is a combination of E and H plane tees. Arm 3 forms an H-plane tee with arms 1 and 2. Arm 4 forms an E-plane tee with arms 1 and 2. Arms 1 and 2 are sometimes called the side or collinear arms. Port 3 is called the H-plane port, and is also called the Σ port, sum port or the P-port (for Parallel). Port 4 is the E-plane port, and is also called the Δ port, difference port, or S-port (for Series). There is no one single established convention regarding the numbering of the ports.

Title of the Practical: **Performance of pin diode and pin modulator**

Q.1 Explain PIN diode?
A1 A PIN diode consists of a heavily doped P- type semiconductor material (P+) and heavily doped N-type semiconductor (N+) separated by a layer of extremely high resistivity intrinsic (or very lightly doped material) semiconductor material.
Q.2 List application of PIN diode?
A2 Application of PIN diode:-

1. PIN diode as a switch.
2. PIN diode as application Modulator.
3. PIN diode as a phase shifter.
4. PIN diode as a limiter.

Q.3List uses of PIN diode?
Ans. PIN diodes are useful as RF switches, attenuators, and photodetectors
Q.4 what material is used for PIN diode?
Ans. Silicon is widely used for PIN diode because of its power handling capacity and high resistivity in the intrinsic region and easy fabrication.
Q.5 what is frequency range for PIN diode?
Ans. Frequency range for PIN diode is up to about 100 MHz.
Q6 Explain operation of pin diode?
A6A PIN diode operates under what is known as high-level injection. In other words, the intrinsic "i" region is flooded with charge carriers from the "p" and "n" regions. Its function can be likened to filling up a water bucket with a hole on the side. Once the water reaches the hole's level it will begin to pour out. Similarly, the diode will conduct current once the flooded electrons and holes reach an equilibrium point, where the number of electrons is equal to the number of holes in the intrinsic region. When the diode is forward biased, the injected carrier concentration is typically several orders of magnitudes higher than the intrinsic level carrier concentration. Due to this high level injection, which in turn is due to the depletion process, the electric field extends deeply (almost the entire length) into the region. This electric field helps in speeding up of the transport of charge carriers from p to n region, which results in faster operation of the diode, making it a suitable device for high frequency operations.
Q7Define modulation?
A7 Modulation is a process whereby certain characteristics of an RF Carrier Wave are varied or modified in accordance with a message or information signal which may be analog or Digital in format.
Q8explain structure of PIN diode?
A8 the PIN diode consists of a semiconductor diode with three layers. The usual P and N regions are present, but between them is a layer of intrinsic material a very low level of doping. This may be either N-type or P-type, but with a concentration of the order of 13^13 cm^-3 which gives it a resistivity of the order of one k-ohm cm.The thickness of the intrinsic layer is normally very narrow, typically ranging from 10 to 200 microns. The outer P and N-type regions are then heavily doped.There is two ways in which the PIN diode can be realized. One is to fabricate the p-i-n diode in a planar structure, and the other is to use a mesa structure. When the planar structure is fabricated an epitaxial film is grown onto the substrate material and the P+ region is introduced either by diffusion or ion implantation. The mesa structure has layers grown onto the substrate. These layers have the dopants incorporated. In this way it is possible to control the thickness of the layers and the level of dopants more accurately and a very thin intrinsic layer can be fabricated if required. This is ideal for high frequency operation. A further advantage of the mesa structure is that it provides a reduced level of fringing capacitance and inductance as well as an improved level of surface breakdown.
Q9what is PIN diode characteristics?
A9 the main feature of the PIN diode is the intrinsic layer between the P-type and N-type regions. This enables it to provide properties such as a high reverse breakdown voltage, and a low level of capacitance. For microwave applications it offers carrier storage when it is forward biased.
It is found that at low levels of reverse bias the depletion layer become fully depleted. Once fully depleted the p-i-n diode capacitance is independent of the level of bias because there is little net charge in the intrinsic layer.
When the PIN diode is forward biased both types of current carrier are injected into the intrinsic layer where they combine. It is this process that enables the current to flow across the layer.
The particularly useful aspect of the PIN diode occurs when it is used with high frequency signals, the diode appears as a resistor rather than a non linear device, and it produces no rectification or distortion. Its resistance is governed by the DC bias applied. In this way it is possible to use the device as an effective RF switch or variable resistor producing far less distortion than ordinary PN junction diodes.
Q10what are the application of PIN diode?
A10 he PIN diode is used in a variety of different applications from low frequencies up to high radio frequencies. The properties introduced by the intrinsic layer make it suitable for a number of applications where ordinary PN junction diodes are less suitable.

In the first instance the diode can be used as a power rectifier. Here the intrinsic layer gives it a high reverse breakdown voltage, and this can be used to good effect in many applications.
Although the p-i-n diode finds many applications in the high voltage arena, it is probably for radio frequency applications where it is best known. The fact that when it is forward biased, the diode is linear, behaving like a resistor, can be put to good use in a variety of applications. It can be used as a variable resistor in a variable attenuator, a function that few other components can achieve as effectively. The PIN diode can also be used as an RF switch. In the forward direction it can be biased sufficiently to ensure it has a low resistance to the RF that needs to be passed, and when a reverse bias is applied it acts as an open circuit, with only a relatively small level of capacitance. Another useful application of the PIN diode is for use in RF protection circuits. When used with RF, the diode normally behaves like a resistor when a small bias is applied. Hover this is only true for RF levels below a certain level. Above this the resistance drops considerably. Thus it can be used to protect a sensitive receiver from the effects of a large transmitter if it is placed across the receiver input.

Title of the Practical: **Measurement of attenuation in db for a given component**

(Q.1) Define attenuation?
Ans. Attenuation is the ratio of Input power to the output power and is normally expressed in decibels.
(Q.2) what are two methods for measurement of power?
Ans. Two methods for measurement of power: - (a) Bolometer technique (low Power)
(b)Calorimetric technique (medium power)
(Q.3) what is draw back of power ratio method?
Ans. The draw back of this method is that the attenuation measured corresponds to two power position on the power meter with a square low crystal detector characteristic. Due to non-linear characteristics the two powers measured and the attenuation calculates will not be accurate particularly if the attenuation of the network is large and if the input power is low.
(Q.4) Define the range for medium power?
Ans. The range for medium power is 10mW to 10W.
(Q.5) which instrument is used for measurement of medium power?
Ans. Calorimetric technique
Q6Define attenuation constant?
A6 In telecommunications, the term attenuation constant, also called attenuation parameter or coefficient, is the attenuation of an electromagnetic wave propagating through a medium per unit distance from the source. It is the real part of the propagation constant and is measured in nepers per metre. A neper is approximately 8.7dB.
Q7 How can we calculate attenuation constant for copper?
A7The attenuation constant for copper (or any other conductor) lines can be calculated from the primary line coefficients.
Q8what is Attenuation coefficients?
A8 Attenuation coefficients are used to quantify different media according to how strongly the transmitted ultrasound amplitude decreases as a function of frequency. The attenuation coefficient (α) can be used to determine total attenuation in dB in the medium.
Q9what is the relation between earthquake and attenuation?
A9The energy with which an earthquake affects a location depends on the running distance. The attenuation in the signal of ground motion intensity plays an important role in the assessment of possible strong ground shaking. A seismic wave loses energy as it propagates through the earth (attenuation). This phenomenon is tied in to the dispersion of the seismic energy with the distance. There are two types of dissipated energy: 1geometric dispersion caused by distribution of the seismic energy to greater volumes 2 dispersion as heat.
Q10what is the effect of Attenuation in electromagnetic radiation ?
A10Attenuation decreases the intensity of electromagnetic radiation due to absorption or scattering of photons. Attenuation does not include the decrease in intensity due to inverse-square law geometric spreading. Therefore, calculation of the total change in intensity involves both the inverse-square law and an estimation of attenuation over the path.

Title of the Practical: Study **of wave-guide Horn-Antenna/ Measurement of radiation 7 diffraction through Horn - antenna's**

Q1Define horn antenna?
A1A horn antenna or microwave horn is an antenna that consists of a flaring metal waveguide shaped like a horn to direct the radio waves.
Q2 Where horn antennas are used?
A2 Horns are widely used as antennas at UHF and microwave frequencies, above 300 MHz.
Q3What are there uses?
A3 They are used as feeders (called feed horns) for larger antenna structures such as parabolic antennas, as standard calibration antennas to measure the gain of other antennas, and as directive antennas for such devices as guns, automatic, and microwave radiometers .
Q4What are their advantages?
A4 their advantages are moderate directivity (gain), low SWR, broad bandwidth, and simple construction and adjustment.
Q5 They can operate over a wide range of frequencies, why?
A5 since they don't have any resonant elements, they can operate over a wide range of frequencies, a wide bandwidth. The useable bandwidth of horn antennas is typically of the order of 10:1, and can be up to 20:1.
Q6Describe horn anteena?
A6 a horn antenna is used to transmit radio waves from a waveguide (a metal pipe used to carry radio waves) out into space, or collect radio waves into a waveguide for reception. It typically consists of a short length of rectangular or cylindrical metal tube (the waveguide), closed at one end, flaring into an open-ended conical or pyramidal shaped horn on the other end. The radio waves are usually introduced into the waveguide by a coaxial cable attached to the side, with the central conductor projecting into the waveguide. The waves then radiate out the horn end in a narrow beam. However in some equipment the radio waves are conducted from the transmitter or to the receiver by a waveguide and in this case the horn is just attached to the end of the waveguide.
Q7What happened if a simple open-ended waveguide were to be used as an antenna, without the horn?
A7 If a simple open-ended waveguide were to be used as an antenna, without the horn, the sudden end of the conductive walls causes an abrupt impedance change at the aperture, from the characteristic impedance of the waveguide to the impedance of free space, 377 ohms. When the microwaves hit the open end of the waveguide it acts as a bottleneck, reflecting most of the wave energy back down the guide toward the source, so only part of the power is radiated. It acts similarly to an open-circuited transmission line, or to a boundary between optical mediums with a high and low index of refraction. The reflected waves cause standing waves in the waveguide, increasing the VSWR, wasting energy and possibly overheating the transmitter. In addition, the small aperture of the waveguide (around one wavelength) causes severe diffraction of the waves issuing from it, resulting in a wide radiation pattern without much directivity.
Q8Define gain of horn anteena?
A8 Horns have very little loss, so the directivity of a horn is roughly equal to its gain The gain G
Of a pyramidal horn antenna is the ratio of the radiated power intensity along its beam axis to the intensity of an isotropic antenna with the same input power.
Q9Define waveguide?
A9 A waveguide is a structure which guides waves, such as electromagnetic waves or sound waves. There are different types of waveguide for each type of wave. The original and most common meaning is a hollow conductive metal pipe used to carry high frequency radio waves, particularly microwaves.
Q10 Define radiation pattern?
A10 the radiation pattern is a graphical depiction of the relative field strength transmitted from or received by the antenna. Antenna radiation patterns are taken at one frequency, one polarization, and one plane cut. The patterns are usually presented in polar or rectilinear form with a dB strength scale. Patterns are normalized to the maximum graph value, 0 dB, and directivity is given for the antenna. This means that if the side lobe level from the radiation pattern were down -13 dB, and the directivity of the antenna was 4 dB, then the side lobe gain would be -9 dB.

Title of the Practical: **Measurement of load impedance**

Q1Define input impedance of an electrical network?

A1 the input impedance of an electrical network is the equivalent impedance "seen" by a power source connected to that network. If the source provides known voltage and current, such impedance can be calculated using Ohm's Law. The input impedance is the Thévenin's equivalent circuit of the electrical network, modeled by an RL (resistor-inductor) or an RC (resistor-capacitor) combination, with equivalent values that would result in the same response as that of the network. It is also called Z11 in terms of Z-Parameters.

Q2Explain voltage bridging?

A2 Generally in audio and hi-fi systems, amplifiers has input impedance several orders of magnitude higher than their output impedance. This concept is also called voltage bridging or impedance bridging.

Q3Explain impedance matching?

A3 n RF systems, the input impedance of inputs, the characteristic impedance of the transmission line, and the load impedance all have to be equal (or "matched") to reduce signal reflections, which result in distortion and potential damage to the driving circuitry. This is known as a matched connection, and the process of correcting an impedance mismatch is called impedance matching.

Q4What is "ghosting", due to reflection?

A4In analog video circuits these reflections can cause "ghosting", where the time-delayed echo of the principle image appears as a weak and displaced image.

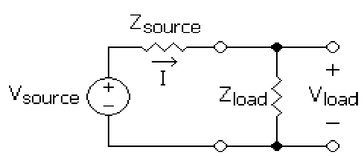
Q5 In circuits carrying high power, why matching the impedances are important?

A5In circuits carrying high power, matching the impedances is important for at least two reasons: 1.The maximum power at maximum efficiency will be transferred when the impedances are complex conjugate matched throughout the power chain, from the transmitter output, through the transmission line (a balanced pair, a coaxial cable, or a waveguide), to the antenna system, which consists of an impedance matching device and the radiating element(s). For maximum power, Zload =Zsource* (where * indicates the complex conjugate). 2. Failure to match impedances will create standing waves on the transmission line due to reflections. These will be periodic regions of higher than normal voltage. If this voltage exceeds the dielectric breakdown strength of the insulating material of the line then an arc will occur. This in turn can cause a reactive pulse of high voltage that can destroy the transmitter's final output stage. For reflection less matching $Z_{load} = Z_{source}$ (no complex conjugate).

Q6 Explain input impedance or load impedance by example?

A6The input impedance or load impedance of a circuit or electronic device is the impedance actually experienced by a signal which is connected to it.

For example, an amplifier with 100,000 ohms input impedance looks equivalent to a 100,000 ohm resistor to the signal coming into it.



Q7How can we match load impedence with source impedence?

A7 the idea of matching load impedance to source impedance stems from a principle, in which a generator supplies power to its load (R_L) via its own internal or source resistance (R_s). If we commence with R_L greater than R_s, more power will be dissipated in R_L than in R_s. As we decrease R_L, the power in both R_L and R_s will increase up to the point where, $R_L = R_s$ and equal power will be dissipated in each. Decreasing R_L further increases the power lost in R_s but the power in R_L is decreased. Clearly, maximum possible power is dissipated in R_L when $R_L = R_s$.

Q8What is the best solution for problem with matching system?

A8 the problem with this matching system of $R_L = R_s$ is that half the power is lost in the source. Imagine a power supply authority tolerating a system in which half the power they generate is lost in their own generating machines. The best system, from their point of view, is one in which R_s is the lowest.

Q9Why Reflections occur on a transmission line?

A9 Reflections occur on a transmission line if the line is not terminated in a resistance equal to its characteristic impedance, or if an impedance discontinuity occurs along the path of the line.

Q10How can we define Source resistance of an amplifier?

A10 Source resistance of an amplifier is equal to the AC plate resistance (or collector resistance in the case of the transistor) divided by the impedance ratio of the output coupling circuit.

Title of the Practical **Study of radiation pattern for different antennas**

(Q.1) Define antenna?

Ans. An antenna is basically a transducer. It converts radio frequency (RF) electrical current into an electromagnetic (EM) wave of the same frequency. An antenna is also known as aerial. An antenna can be defined in the following ways:

An antenna is a source or radiator of electromagnetic waves,

An antenna is a sensor of electromagnetic waves,

An antenna is an impedance matching device.

(Q.2) Define radiation pattern?

Ans. The energy radiated in a particular direction by an antenna is measured in a Terms of filed strength at a point which is at a particular distance from the

Antenna. Its unit is volt/meter or milli-volt/meter.

(Q.3)Define Directivity?

Ans.The directivity D of an antenna is given by the ratio of the maximum radiation intensity to the average radiation intensity Uav or at a certain distance from the antenna the directivity may be expressed as the ratio of the maximum to the average pointing vector.

(Q.4) Diff. between directivity &power gain?

Ans. Directivity gain – All practical antenna concentrate its radiated energy to more or less extent in certain preferred direction. The extent to which a practical antenna a concentrates it's radiated energy relative to that of some standard Antenna energy is termed as directive gain.

Power gain – it is defined as the ratio of 4λ times radiation, intensity to the total input power.

(Q.5) what is the value of radiation resistance for half wave dipole?

Ans. the radiation resistance (Rr) is thus defined as that factious resistance which, when substituted in series with the antenna, will consume the same power as is actually radiant.

Q6Explain antenna characteristics.

A6all antennas exhibit common characteristics. The study of antennas involves the following terms with which you must become familiar

Antenna Reciprocity The ability of an antenna to both transmit and receive electromagnetic energy is known as its reciprocity.

Antenna Feed Point Feed point is the point on an antenna where the RF cable is attached.

Directivity The directivity of an antenna refers to the width of the radiation beam pattern.

Q7 what is radiation pattern?

A7 a radiation pattern is a way of plotting the radiated energy from an antenna.

Q8 to plot this pattern, what types of graphs are used?

A8To plot the explain se pattern two different types of graphs, rectangular-and polar-coordinate graphs are used.

Q9Define main beam?

A9 the main beam (or main lobe) is the region around the direction of maximum radiation (usually the region that is within 3 dB of the peak of the main beam).

Q10Define sidelobes?

A10 sidelobes are usually radiation in undesired directions which can never be completely eliminated.

Title of the Practical: **Measurement of characteristic for different antennas/ Study of UHF & VHF Transmitters**

(Q.1)Define polarization?

Ans. The polarization of wave is defined as the direction of the electric field at a given point as a function of time the polarization of a composite wave is the direction of its electric field.

(Q.2)Define directivity?

Ans. The directivity D of an antenna is given by the ratio of the maximum radiation intensity u to the average radiation intensity u or at a certain distance from the antenna the directivity may be expressed as the ratio of the maximum to the pointing vector

(Q.3)Define directive gain and efficiency?

Ans.Directive gain: - The directive gain of an antenna is defined in a particular direction "as the ratio of the power density in that particular direction at a given distance, to the power density that would be radiated at the same distance by an isotropic antenna, radiating the same total power".

Efficiency: - The efficiency of an antenna is defined as the ratio of power radiated to the total input power supplies to the antenna and is denoted by η or κ.

(Q.4)Write salient features of Yagi-Uda antenna?

Ans. (a) it consists of a driven element, a reflector and one or more directors.

(b) Directors and reflector are called parasitic elements.

(c)Its radiation pattern is almost uni –directional and gives a gain of about 7db.

(d)Its band width is limited.

(Q.5)Write salient features of rhombic antenna?

Ans. (a) it is a long wire antenna and consists four non-resonant wires,

(b) It provides greater directivity than V antenna.

(c) Its band width is high.

(d) It is a HF non-resonant antenna,

(e)It is very useful for point to point communication.

Q6Define Beam Width?

A6 Beam Width the angular range of the antenna pattern in which at least half of the maximum power is still emitted is described as a „Beam With".

Q7Define effective aperture of an antenna?

A7 the effective aperture of an antenna is the area presented to the radiated or received signal. It is a key parameter, which governs the performance of the antenna.

Q8Define front-to-back ratio of an antenna?

A8 the front-to-back ratio of an antenna is the proportion of energy radiated in the principal direction of radiation to the energy radiated in the opposite direction. A high front-toback ratio is desirable because this means that a minimum amount of energy is radiated in the undesired direction.

Q8Define radiation pattern of an antenna?

A8The radiation pattern of an antenna is the geometric pattern of the relative field strengths of the field emitted by the antenna.

Q9 Explain Reciprocity applied to antennas?

A9 It is a fundamental property of antennas that the receiving pattern (sensitivity as a function of direction) is identical to the far-field radiation pattern. This is a consequence of the reciprocity theorem.

Q10What anteena is used for TV reception in our home?

A10 Yagi-Uda-antenna.

Q11Explain VHF band?

A11VHF (Very high frequency) is the radio frequency range from 30 MHz to 300 MHz. Frequencies immediately below VHF are denoted High frequency (HF), and the next higher frequencies are known as Ultra high frequency (UHF). The frequency allocation is done by ITU.

Q12Explain Ultra high frequency range?

A12 Ultra high frequency (UHF) designates a range of electromagnetic waves with frequencies between 300 MHz and 3 GHz (3,000 MHz), also known as the decimetre band or decimetre wave as the wavelengths range from one to Ten decimetres (10 cm to 1 metre). Radio waves with frequencies above the UHF band fall into the SHF (super high frequency) and EHF (extremely high frequency) bands, all of which fall into the microwave frequency range. Lower frequency signals fall into the VHF (very high frequency) or lower bands.