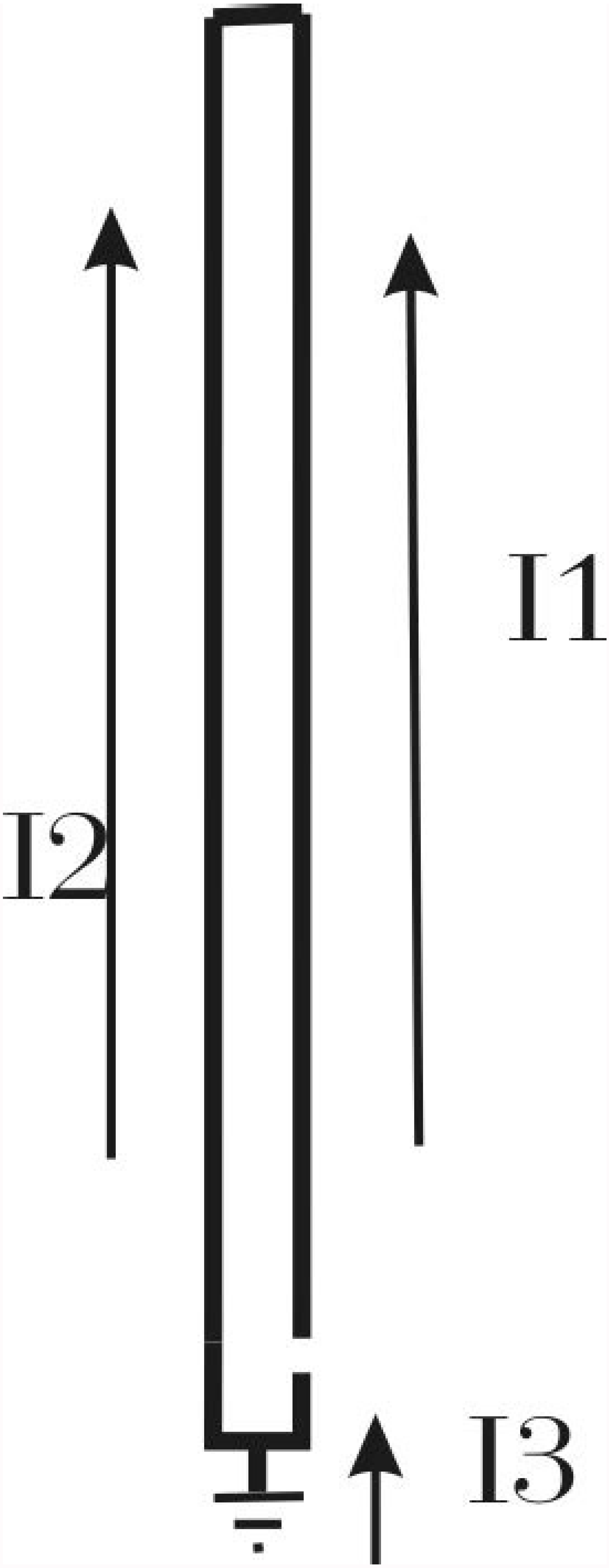
Antenna and wave propagation basics pdf online free pdf escape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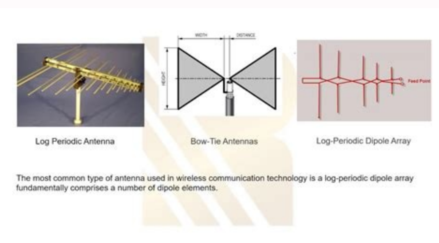


GUJARAT TECHNOLOGICAL UNIVERSITY

Electronics & Communication Engineering

B. E. SEMESTER: VI

Subject Name: **Antenna and Wave Propagation**

Sr. No	Course Content	Total Hrs.
1.	**Basic antenna concepts:** Definition and functions of an antenna, comparison between an antenna & transmission line, radio communication link with transmitting antenna and a receiving antenna, radiation patterns of antennas-field and power patterns, all antenna types.	3
2.	**Radiation of Electric dipole:** Potential functions and the electromagnetic field, Oscillating electric dipole-derivations for E and H field components in spherical coordinate systems, Power Radiated by a current element, Application to antennas, Radiation from quaterwave monopole and half wave dipoles, Derivation for radiation resistance, application of reciprocity theorem to antennas, equality of directional patterns and effective lengths of transmitting and receiving antennas, directional properties of dipole antennas,antenna feeding methods.	5
3.	**Antenna parameters and definitions:** beam area, beam width- Half-Power Beam width (HPBW)and First Null Beam width(FNBW) ,Polarisation,Radiation Intensity ,Beam Efficiency, Directivity and directive gain, radiation resistance, radiation efficiency, resolution, Antenna aperture-physical and effective apertures, effective height, transmission formula, antenna field zones, Transmission loss as a function of frequency.Antenna temperature and signal to noise ratio.	5
4.	**Arrays of point sources :** Expression for electric fields from two, three and N element arrays- linear arrays: Broad-side array and End-Fire array- Method of pattern multiplication- Binomial array-Horizontal and Vertical Antennas above the ground plane, Effect of ground on ungrounded antenna, Schelkunoff theorems for linear arrays, Dolph-Tchebysheff distribution for linear arrays.	6
5.	**Loop Antenna:** Small loop short magnetic dipole, comparison of far field of small loop and short dipole loop antennas, field pattern of circular loop antenna & radiation resistance of loop antenna, directivity of circular loop antennas	2

Physics 71 Lecture Notes

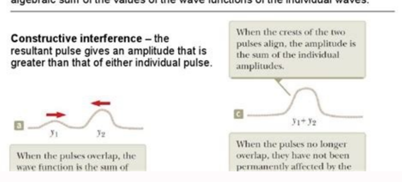
Chapter 15 Mechanical Waves

Topic 4.02: Reflection and Transmission
Boundary conditions
Interference
Standing Wave

Interference

Superposition principle – If two or more traveling waves are moving through a medium, the resultant value of the wave function at any point is the algebraic sum of the values of the wave functions of the individual waves.

Constructive interference – the resultant pulse gives an amplitude that is greater than that of either individual pulse.

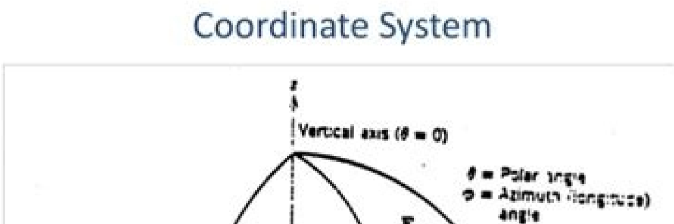


Fundamental Antenna Parameters

1. Radiation Pattern

An antenna radiation pattern is defined as "a graphical representation of the radiation properties of the antenna as a function of space coordinates. In most cases, the radiation pattern is determined in the far-field region. Radiation properties include radiation intensity, field strength, phase or polarization.

Coordinate System



Loading VisuewSorry, the view is currently unavailable. You can download the paper by clicking the button above. A person, who needs to convey a thought, an idea or a doubt, can do it by voice communication. The following illustration shows two individuals communicating. Here, communication occurs through sound waves. However, if two people wish to communicate who is at longer distances, we need to convert these sound waves into electromagnetic waves. The device, which converts the necessary information signal to electromagnetic waves, is known as antenna. What is an antenna? An antenna is a transducer, which converts electrical energy into electromagnetic waves and vice versa. An antenna can be used as a transmitting antenna or an incoming antenna. A transmission antenna is one, which converts electrical signals into electromagnetic waves and radiates them. An antenna received is one, which converts electromagnetic waves from the beam received into electrical signals. In bidirectional communication, the same antenna can be used for transmission and reception. The antenna can also be called an antenna. Plural is, antennas or antennas. Currently, the antennas have undergone many changes, according to their size and shape. There are many types of antennas depending on their wide variety of applications. The following photos are examples of different types of antennas. In this chapter, you will learn the basics of antenna, specifications and different types of antennas. Aerial need in the field of communication systems, whenever the need for wireless communication arises, the need for an antenna occurs. The antenna has the ability to send or receive the electromagnetic waves for a matter of communication, where you cannot expect to establish a wiring system. The following scenario explains that. Scenario to contact a remote area, thelt has to be established throughout the route along the valleys, the mountains, the tedious paths, the tunnels etc, to reach the remote location. The evolution of wireless technology has made this whole process very simple. Antenna is the key element of this wireless technology. In the image above, the antennas help communication to be established throughout the area, including the valleys and mountains. This process would obviously be easier than putting a wiring system across the area. Radiation Mechanism The only functionality of an antenna is energy radiation or reception. Antenna (if it transmits or receives or both) can be connected to the circuit in the station through a transmission line. The operation of an antenna depends on the radiation mechanism of a transmission line. A conductor, which is designed to carry current in large distances with minimal losses, is called as a transmission line. For example, a wire, which is connected to an antenna. A transmission line that leads the current with uniform speed, and the line being a straight line with infinite extension, does not radiate energy. For a transmission line, become a waveguide or radiate energy, has to be processed as such. If the power has to be irradiated, although current driving is with uniform speed, the wire line or transmission must be folded, truncated or finished. If this transmission line has current, which accelerates or slows down with a constant timing, then radiates the energy even if the wire is straight. The device or tube, whether bent or finished to radiate energy, is called as a waveguide. These are especially used for the transmission or reception of the microwave. This can be well understood by observing the following diagram − The diagram above represents a wave guide, which acts as an antenna. The power of the transmission line travels through the waveguide that has raidarri raidarri arap arutreba energy. the basic types of antennas can be divided into various types, depending on the physical structure of the antenna. the operating frequency ranges. the mode of applications etc. following physical structure are the types of antennas according to the physical structure. you will learn about these antennas in the later chapters. Wire antennas only antennas antennas antennas micro antennas antennas frequency of operation following are the types of antennas according to the frequency of operation. Very low frequency (vlf) low frequency (lf) medium frequency (mf) high frequency (hf) high frequency (vhf) ultra high frequency (uhf) super high frequency (shf) wave mode of following applications, are the types of antennas according to the modes of applications- the communications point-by-point transmission of radar applications communication communications satellite communication antenna-parameters theory discussed the basic communication parameters of antennas. wireless communication is made in the form of waves. Therefore, we need to take a look at the properties of the waves in communications. in this chapter, we will discuss the following parameters - the frequency frequency wavelength that corresponds to the vswr and reflecting the intensity of the radiation with of bandwidth of power now, we will learn them in detail. frequency according to the standard definition, "The repeat rate of a wave for a specific period of time is called frequency." simply, the frequency refers to the process of how often an event occurs. a periodic wave repeats after every second ti (time). the frequency of the periodic wave is nothing more than the period of time (t). mathematical expression mathematically, it is written as shown below. $$f = \frac{1}{t} $$ where f is frequencyeb lliw ,annetna na yb detaidar rewop ehT .tuptuo retteb a sreviled ,dehctam fi ecnadepmi esohw secived tnanoser hcus era sannetnA .seicneuqerf fo dnab worran niatrec ta tuptuo retteb sevig na hgihcta hsnM fo ytisseceN .rettimsnart eht ro reviecer eht dna annetna eht neewteb ecalp sekat refsnart rewop mumixam taht o hctam dna eht gnihctaM ecnadepmI ? eht t eht gnihton si skaep etaidemmi owt ro skaep evitisop etaidemmi owt neew A htgnelevaW $zHK}T2{}1{carf\ = f$,ycneuqerf dna sdnocesillim t2=T ,doirep emit ,oS .sdnocesillim t2 yreve retfa staeper evaw sihT .sdnocesillim ni emit tsniaga stlovillim V rof ereh dettolp si hcihw,evaw esis a stneserper evoba nevig erugif ehT .zH sa detaiverbba ,ztreH si ycneuqerf fo tinu ehT stinU .staeper evaw eht hcihw ta doirep emit eht si T .evradiate, if the prevention of the antenna corresponds to the impedance of the free space. For a receiving antenna, the antenna's output impedance must correspond to it input impedance of the receiver amplifier circuit. For a transmitting antenna, the antenna input impedance must correspond to the transmitter amplifier impedance, along with the impedance of the transmission line. Units The Unit of Impedance (Z) is ohms. Vswr and being able to reflect according to the default, the proposal of the mother tension and the mothers' tension in a permanent wave is known as reason wave to tension paten. Effective way. Instead, part of the power is reflected back. The main features are the term, which indicates that the incompatibility of impedance is VSWR. The VSWR means wave relationship in a tension. Also called SWR. The higher the incompatibility of impedance, the greater the value of the VSWR. The ideal value of VSWR must be 1: 1 for effective radiation. The reflected power is the waste power of power forward. Both reflected power and VSWR indicate the same thing. Bandwidth according to the standard definition, â € œA band of frequency in a wavelength, specified for the communication, it is known as bandwidth. The signal when transmitted or received is made in a variety of frequencies. This specific interval of frequencies is allocated to a specific sign, so that other signs will not interfere with its transmission. The bandwidth is the range of frequency between the highest and lower frequencies on which a signal is transmitted. The bandwidth once allocated, can not be used by others. The whole spectrum is divided into bandwidths to assign to different ,o£Ãrdap ,o£Ãrdap o£Ã§Ãinifed a moc odroca ed adnab ed arugral ed megatnecroP .atulosba adnab ed arugral ed adamahc res edop m©Âbmat ritucsid ed somabaca euq ,adnab ed arugral A ratio of absolute bandwidth to the center frequency of that bandwidth can be termed as percentage bandwidth.¢ÂÂÂ The particular frequency within a frequency band, at which the signal strength is maximum, is called as resonant frequency. It is also called as center frequency (fC) of the band. The higher and lower frequencies are denoted as fH and fL respectively. The absolute bandwidth is given by- fH - fL. To know how wider the bandwidth is, either fractional bandwidth or percentage bandwidth has to be calculated. Mathematical Expression The Percentage bandwidth is calculated to know how much frequency variation either a component or a system can handle. $$Percentage\ bandwidth = \frac{absolute\ bandwidth}{center frequency} = \frac{f_{H} - f_{L}}{f_{c}}$$ Where ${f_{H}}$ is higher frequency ${f_{L}}$ is lower frequency ${f_{c}}$ is center frequency The higher the percentage bandwidth, the wider will be the bandwidth of the channel. Radiation Intensity ¢ÂÂÂRadiation intensity is defined as the power per unit solid angle¢ÂÂÂ Radiation emitted from an antenna which is more intense in a particular direction, indicates the maximum intensity of that antenna. The emission of radiation to a maximum possible extent is nothing but the radiation intensity. Mathematical Expression Radiation Intensity is obtained by multiplying the power radiated with the square of the radial distance. $$U = r^{2} \times W_{rad}$$ Where U is the radiation intensity r is the radial distance Wrad is the power radiated. The above equation denotes the radiation intensity of an antenna. The function of radial distance is also indicated as Â¦Â. Units The unit of radiation intensity is Watts/steradian or Watts/radian2. Antenna Theory - Parameters Radiation intensity of an antenna is closely related to the direction of the beam focused and the efficiency of the beam towards that direction. In this chapter, let us have a look at the terms that deal with sihT .detaidar si rewop eht hcihw hguorht erutrepa na sah annetna)aera evitceffe ro(aera gnitaidar evitceffe eht fo oitar eht si ,annetna na fo ycneiciffe erutrepA ' ,noitinifed dradnats eht)sessol orez htiw annetna(annetna ciportosi na fo ytisnetni noitaidar eht si $}}0{_ihp\{$ .annetna tcejbus fo ytisnetni mumixam eht si $}}xam{_ihp\,ateht\(ihcar}„ Ë ъ Ë Ë Ë Ë ъ Ë nA '.ytivitcerid eht dellac si rewop latot eht emas eht gnitaidar ,annetna ecnerefer ro ciportosi na fo ytisnetni noitaidar eht ot annetna tcejbus eht fo ytisnetni noitaidar mumixam fo oitar ehT 'droci'must be effective with mother losses. The fanatic fan of the opening must also be taken into account, as the effectiveness of radiation depends on the opening area, physically in the antenna. MATHEMATIC EXPRESSION The mathematical expression for the opening efficiency is as follows - $$ \ varepsilon_ {a} = \ fac {a_ {eff}} {a_ {p}} $ \ varepsilon_ {A} $ © EFFICIENCY APPURTUE. $ {A_ {Eff}} $ © an effective area. $ {A_ {p}} $ © Ã nal fanatic. Efficiency of antenna according to the default definement, â € œ œEfire antenna is the reasons for the irradiated antenna pottery for the entrance power accepted by the antenna. If the irradia energy has given to your entrance with moms. The efficiency of an antenna explains how much an antenna is capable of delivering its output effectively with mother losses in the transmission line. This is called an antenna radiation efficiency factor. MATHEMATIC EXPRESSION The mathematical expression for antenna efficiency is given below - $$ \ et_ {e} = \ fac {p_ {rad}} {p_ {input}} $$ where $ \ Eta_ {e} $ © the efficiency of the antenna. $ {P_ {rad}} $ © the irradiated power. $ {P_ {input}} $ © the input power for the antenna. Gain according to the standard definition, â € œGain of an antenna is the reason for the intensity of radiation in a certain direction for the intensity of the radiation What would be obtained if the energy accepted by the antenna was radiated isotrically. It simply, the gain of an antenna takes into account the directivity of the antenna, along with its effective performance. If the energy accepted by the antenna has been irradiated isotropic (which means in all directions), the intensity of radiation we obtain can be taken as a reference. The term antenna gain describes how much energy is transmitted in the direction of peak radiation to that of an isotrral source. The gain is usually measured in dB. To the contradiction of the directivity, the gain of antenna leads to the losses that occur and therefore concentrates on efficiency. Mathematical Expression The gain equation, G is as shown below. $G = \eta_{e}D$ Where G is won from the antenna. \eta_{e}$ is the efficiency of the antenna. D is the direction of the antenna. Units The gain unit is decibels or simply dB. Antenna Theory - Near and distant fields After the antenna parameters discussed in the previous chapter, another important topic of consideration is the near field and the distant field regions of the antenna. The radiation intensity when measured closer to the antenna differs from what is far from the antenna. Although the area is far from the antenna, it is considered effective, since the radiation intensity is still high there. Nearby The field, which is closer to the antenna, is called the near field. It has an inductive effect and is therefore also known as inductive field, although it has some radiation components. Faraway field The field, which is far from the antenna, is called a distant field. It is also called the radiation field, as the radiation effect is high in this area. Many of the antenna parameters, along with the antenna direction and the antenna radiation pattern, are considered only in this region. Field Standard The field distribution can be quantified in terms of field intensity is referred to as field standard. This means that the irradiated power of the antenna when plotted, is expressed in terms of electric field, E (v/m). Thus, it is known as field pattern. If it is quantified in terms of power (W), then it is known as power standard. The graphical distribution of field or irradiated power will be as a function of spatial angles (θ, Ø) to the distant field. Space angles (θ, Ø) and radial distance (r) to the near field. The distribution of nearby and distant field regions can be well understood with the help of a diagram. The field pattern can be classified as − Reactive sobma sobma â noiger dleifraen gnitaidaR dna noiger as close. Radiant Field Region distant â € "Simply called the distant field. The field, which is very close to the antenna is reactive near the field or field-radiative where the radiation is not proud. The registration beside it can be called as radiating near the field or the Fresh Field as the predominant radiation and the angular distribution of the field, depends on the fanic distance of the antenna. The registration beside him is radiating from far away. In this record, the field distribution is independent of the distance of the antenna. The effective radiation standard is observed in this registration. Antenna Theory - Radiation Radiation Radiation is the term used to represent the emission or reception of the wave front in the antenna, specifying its Force. In any illustration, the outline designed to represent the radiation of an antenna is its radiation pattern. One can simply understand the function and the directivity of an antenna, taking a look at its radiation pattern. The energy when irradiated of the antenna has its effect on the nearby and distant field records. Graphically, the radiation can be loaned as a function of angular position and radial distance of the antenna. This is a mathematical function of the radiation properties of the antenna represented as a function of coordinates springs, and (îti, ã˜) and h (î Ã˜). Radiation pattern the energy radiated by an antenna is represented by the radiation pattern of the antenna. Radiation patterns are representatives of the distribution of energy radiated in the space, as a function of direction. Let's look at the standard of energy radiation. The figure given above shows the pattern of radiation from a dipole antenna. The energy that is being radiated is represented by the standards designed in a particular direction. The arrows represent radiation directions. Radiation patterns can be field patterns or energy patterns. The field patterns are plotted as a function of ELÃ © trico MagnÃ © tico MagnÃ © tico ElbareDisnoc A .ebol Ronim who osla si hcihw ,ebol kcab sa nwonk ni .ebol nwon nocerid eht ot otcaxe he hcihw ,ebol rehto si ereht erhw eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht eht rot to eht eht eht eht eht eht eht eht eht eht rot to eht eht eht eht eht sbol rot to eht rot to eht edet . 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Ylnommocro cimhtiragol if dettolp era yeht .sdleif your circtele fo edutingam eht fo unitcnuf to dettolp era snrettap reOp eht .elacs cimhtol energy is wasted here. Example If the antennas used in radar systems produce lateral wolves, target tracking becomes very difficult. That's because false targets are indicated by these lateral wolves. It's a mess to find out the real ones and identify the fake ones. Thus, the elimination of these lateral wolves is necessary in order to improve performance and save energy. Remedy. The irradiated energy, which is being wasted in such forms needs to be used. If these small wolves are eliminated and this energy is diverted to a direction (which is for the main wolf), then the antenna's direction increases what leads to the best antenna performance. Types of radiation patterns Common types of radiation patterns are − Omnidirectional pattern (also called non-directional pattern): The pattern usually has a donut shape in three-dimensional view. However, in two-dimensional view, it forms an eight-figure pattern. Pencil beam pattern - The beam has a sharp directional pencil shaped pattern. Blower beam pattern - The beam has a fan-shaped pattern. Beam pattern in shape - The beam, which is non-uniform and unstandard is known as beam in shape. A reference point for all these types of radiation is isotropic radiation. It is important to consider isotropic radiation even if it is impractical. Antenna Theory - Isotropic Radiation In the previous chapter, we passed the radiation pattern. To have a better analysis of the radiation of an antenna, a reference point is required. The radiation of an isotropic antenna fills this space. Definition Isotropic radiation is the radiation of a point source, radiating evenly in all directions, with the same intensity, regardless of the direction of the measurement. The improvement of the radiation pattern of an antenna is always evaluated using the isotropic radiation of this antenna. If the radiation is equal in allDireã mailã‚µes, DIREã §ãµES, rof PRIE o eS $$ ibd51.2 -)wbd(prie =)wbd(pre $$.)avitefe adaidar aicnªÃtop(PRE omoc adanimoned res edop ,acip³Ãrtosi anetna amu ed zev me ,aicnªÃrefer omoc adno aiem ed olopid odnamot adaluclac rof adaidarri aicnªÃtop a es zacife odaidarri redoP .o£Ã§Ãerid atrec me anetna a odnartnecnoc oda§Ãnacla rohlem ©Ã anetna ad ohnag O .anetna ad ohnag o moc otnuj ¡Ãratnemua PRIE o ,olugn¢Ã sotrec me adacof revitse o£Ã§Ãaidar a eS .acip³Ãrtosi o£Ã§Ãidnoc ed rotaf atneserper 'ue' e 2 ed rotaf mu ©Ã BD3 o edno ,IBD3 o ¡Ãres anetna ased ohnag O .rad edop anetna amu euq rohlem a ©Ã ,air¡Ãnigami ajes acip³Ãrtosi o£Ã§Ãaidar a arobme ,ohnag O .etnelaviuqe acip³Ãrtosi adaidarri aicnªÃtop ,©Ã otsi ,PRIE omoc adanimoned aires o£Ã§Ãaidar asse ,anetna ad acip³Ãrtosi adaidarri aicnªÃtop Ã etnelaviuqe ©Ã o£Ã§Ãaidar a edno ,acifÃcepse o£Ã§Ãerid amu me uo odal mu me rartnecnoc es arap atief ©Ã anetna amu ed adaidarri aigrene A .etnelaviuqe acip³Ãrtosi adaidarri aicnªÃtop ed odamahc ©Ã ,anetna ad omix¡Ãm ohnag od o£Ã§Ãerid an adavresbo ocip ed aicnªÃtop ed edadisned a rizudorp arap aidarri laciportosi anetna amu euq redop ed edaditnauq aã ,o£Ãrdap o£Ã§Ãinifed a moc odroca ed etnelaviuqe ocip³Ãrtosi odaidarri redoP .)orez adrep(bd0 ohnag ed odamahc res edop ele ,Bd ed somret mE .seµÃ§Ãerid sa sadot me 1 ed ohnag ed rotaf mu ret acifingis euq o ,edadinu ed ohnag met ocip³Ãrtosi rodaidar o ahnaG .D2 me otio ed arugif ad o£Ãrdap o artsuli 2 arugiF a e D3 me tunod ed amrof me o£Ãrdap o artsuli 1 arugiF A .lanoicerid-inmo uo ocip³Ãrtosi o£Ãrdap mu ed o£Ã§Ãaidar ed o£Ãrdap o martsom amica sadad sarugif sA .D2 me odazilausiv odnauq otio otio ed o£Ãrdap mu e D3 me odazilausiv odnauq assam ed amrof me o£Ãrdap mu iussoP .lanoicerid-inmo o£Ã§Ãaidar ed assap o£Ãn acip³Ãrtosi o£Ã§Ãaidar A .edadiviterid amugla moc aigrene sua aidarri anetna adot euqrop ,levÃssopmi etnemacitarp ©Ã acip³Ãrtosi o£Ã§Ãaidar asse ,otnatne oN .ocip³Ãrtosi rodaidar ed olpmexe mu ©Ã lautnop etnof A .acip³Ãrtosi o£Ã§Ãaidar omoc odicehnoc Ã ERP can be calculatedformula given above. Theory of the antenna - beam and polarization This chapter deals with the parameters of the radiated beam of the antenna. These parameters help us know about the beam specifications. Beam area According to the standard definition, "Ray area is the solid angle through which all the energy irradiated by the antenna would transmit if P (î¸, ã) kept its maximum value on © A and be zero elsewhere. The radiated beam of the antenna comes from an angle on the antenna, known as a solid angle, where the intensity of the power radiation is maximum. This solid beam angle is called the beam area. It is represented by © a. The intensity of the p radiation (î, â) should be kept constant and maximum at all the solid beam angle © a, its value being zero in other places. $$ Power \ Radiated = p (\ theta, \ phi) \ omega_ {a} \: Watts $$ beam angle is a set of angles between the half-power points of the main wolf. Mathematical expression The mathematical expression for the beam area is $$ \ omega_ {a} = \ int_ {0}^{2 \ pi} \ int_ {0}^{\ pi} p _ {\ pi} (\ theta, \ phi) d \ omega \ wattts $$ d \ omega = \ sin \ theta \ d \ theta \ d \ phi \ watt \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d \ d $ \ theta $ is the function of the angular position. $ \ Phi $ is the function of radial distance. Units Beam area unit is watts. Beam efficiency according to the standard definition, "Beam efficiency declares the proportion of the main beam area and the total area of the irradiated beam." The energy when radiated from an antenna is designed according to the antenna ''Directivity. The direction in which an antenna radiates more energy has maximum efficiency, while part of the energy is lost in the lateral wolves. The maximum energy irradiated by the beam, with minimal losses, can be called beam efficiency. Mathematical expression The mathematical expression for beam efficiency is â Â $ $ }bm{ _agemO \ $ beam area of the main beam. Ω_{A} is total solid beam angle (beam area). Antenna Polarization An antenna can be polarized depending upon our requirement. It can be linearly polarized or circularly polarized. The type of antenna polarization decides the pattern of the beam and polarization at the reception or transmission. Linear polarization When a wave is transmitted or received, it may be done in different directions. The linear polarizationof the antenna helps in maintaining the wave in a particular direction, avoiding all the other directions. Though this linear polarization is used, the electric field vector stays in the same plane. Hence, we use this linear polarization to improve the directivity of the antenna. Circular polarization When a wave is circularly polarized, the electric field vector appears to be rotated with all its components loosing orientation. The mode of rotation may also be different at times. However, by using circular polarization, the effect of multi-path gets reduced and hence it is used in satellite communications such as GPS. Horizontal polarization Horizontal polarization makes the wave weak, as the reflections from the earth surface affect it. They are usually weak at low frequencies below 1GHz. Horizontal polarization is used in the transmission of TV signals to achieve a better signal to noise ratio. Vertical polarization The low frequency vertically polarized waves are advantageous for ground wave transmission. These are not affected by the surface reflections like the horizontally polarized ones. Hence, the vertical polarization is used for mobile communications. Each type of polarization has its own advantages and disadvantages. A RF system designer is free to select the type of polarization, according to the system requirements. Antenna Theory - Beam Width In this chapter, we shall discuss about another important factor in the radiation pattern of an antenna, known as so sobma me setnegnat rahnesed wbnf ed oÃ§Ãacidnl .obol lapicnirp ues me ,oÃ§Ãaidar ed oÃrdap od solun exief od arugral ariemirp ed odamahc ©Ã euq ,lapicnirp exief O ed arof ed egnol ed adatic ,ralugna oÃ§Ãarapes a ©Ã WBNF o ,etnemselpmiS .olun exief od arugral ariemirp ed odamahc ©Ã ,lapicnirp obol oa etnecajda oicnºÃna oÃrdap oriemirp o ertne ralugna oÃ§Ãsnetxe Aâ ,oÃrdap oÃ§Ãinifed a moc odroca ed olun exief od arugral ariemirP .suarg uo sonaidar ©Ã WBPH ed edadinu A sedadinU .ortem¢Ãid ©Ã D .) aicnªÃuqerf/3.0 = »Â`(adno ed otnemirpmoc ©Ã $ adbmal \ $ edno $$ }d/{ _ adbmal \ 07 = moc :\ maeB :\ rewoP :\ flah $$' ©Ã aicnªÃtop aiem ed exief od arugral a arap acit¡Ãmetam oÃsserpxe A acit¡Ãmetam oÃsserpxE .WBPH on e lapicnirp obol on aicnªÃtop aiem ed sotnop artsom arugif A .riuges a amargaid od aduja a moc odidneerpmoc mebh res edop ossI .aicnªÃtop aiem ed exief od arugral ,WBPH omoc odanimoned ©Ã serotev siod sesse ertne olugnâ o ,sodal siod son ,lapicnirp obol on aicnªÃtop aiem ed sotnop so e oÃ§Ãaidar ed oÃrdap od megiro a ertne adahnesed ©Ã ahnil amu odnauq WBPH ed oÃ§ÃacidnI .anetna ad ovitefe oÃ§Ãaidar opmac on ,ocip ed aicnªÃtop ad %05 a roirepus ©Ã avitaler aicnªÃtop a lauq on olugn¢Ã o ©Ã aicnªÃtop aiem ed exief od arugral A .aicnªÃtop ed ocip o ©Ã euq ,adaidarri ©Ã aicnªÃtop ad etrap roiam a edno aer¡Ã a ©Ã exief od arugral a ,sarvalap sartuo mE .aicnªÃtop aiem ed exief od arugral a ©Ã ,lapicnirp exief od ocip od)Bd3- uo(%05 me iunimid oÃ§Ãaidar ed oÃrdap od olugnamra a lauq an ,ralugna oÃ§Ãarapes aâ ,oÃrdap oÃ§Ãinifed a moc odroca ed aicnªÃtop aiem ed exief od arugraL .)WBNF(olun exief od arugral ariemirp a e)WBPH(aicnªÃtop aiem ed exief od arugral a oÃs exief od arugral assed seµÃ§Ãaredisnoc siapicnirp saud sA .adaidarri ©Ã aicnªÃtop ad etrap roiam a edno ed arutreba ed olugn¢Ã o ©Ã exief od arugral A .anetna ad soxulf solep adaidarri etnatsnoc e amix¡Ãm aigrene a edno ,anetna ad lapicnirp exief o ©Ã lapicnirp obol o ,anetna amu ed oÃ§Ãaidar ed oÃrdap oN .arugral olun olun exief od arugral ariemirp omoc odicehnoc ©Ã setnegnat saud sasse ertne olugnâ O .lapicnirp exief oa laicnegnat ,oÃ§Ãaidar ed oÃrdap od megiro alep odna§Ãemoc evaw deviecer eht fo noitrop emos yln The evit ceffe eht sa nwonk ,langis eht seviecer ,annetna eht fo noitrop emos ylno saerehw ,sevaw citengamortcele gnimocni eht stnorfnoc ,gniviecer elihw annetna na foa elohw eh E$ .egatlov tiucric-nepo si $}co{_ V$ .htgnel evitceffe eht si $}e{_l$ erehW $$}}i{_E{ V{carf\ = }e{_l$$ =« si htgnel evitceffe rof noisserpxe lacitamehtam ehT noisserpxE lacitamehta M .slanimret reviving ta egatlov eht fo edutingam eht htiw hctam dluohs noitaziralop sih , er .annetna eht fo ycneiciffe noitaziralop eht enimreted ot desu si htgnel evitceff And annetnA htgnel evitceffE .ecnamrofrep sâannetna eht tuoba wonk ot su pleh sretemarap eseh T .tnatropmi osla was aera evitceffe dna htgnel evitceffe eht ,sretemarap annetna eht gnom AerA evitceff ♪ I'm not gonna get it ♪It is used because a part of the wave is dispersed while some dissipate as heat. Therefore, without considering losses, the area, which uses the mother energy obtained in the actual area, can be called effective area. The effective area is represented for $ a_ {Eff} $. Antenna Theory - Reciprocity An antenna can be used as an antenna transmitting and receiving antenna. As long as use, we can find a question whether antenna properties can change the extent that its mode of operation is changed. Fortunately, we don't need to worry about it. The properties of the antenna being immutable are called the ownership of reciprocity. Properties under reciprocity the properties of transmission and receipt of antenna that display reciprocity is the equality of directional patterns. Equality of directivity. Equality of effective lengths. Equality of antenna impedances. Let's see how they are implemented. Equality of Directional Patters The standard of radiation from the transmission antenna, which transmits to the antenna2 of receipt is equal to the radiation pattern of antenna2, if transmitted and the antenna1 receives the sign. Equal guidelines is the same to transmit and receive antennas, if the value of the directivity is the same for both cases, that is, the guidelines are the same, if calculated from the energy of the antenna or the Antenna antenna. Equality of effective lengths the value of the effective permanent opening is the same to transmit and receive antennas. Equality in the lengths of the transmitted antennas and receiving is maintained according to the wavelength value. Equality in the antenna impedances the impedance of a transmission antenna and the impedance of the entry of an antenna received is equal in an effective communication. These properties will not change, although the same antenna is operated as a transmitter or receiver. Therefore, the Tel ,rotcev gnitnyop if aedi raelc a evah ot rotcev gnitnyop fo noitavired .h dna eht nopu sdneped epedingam sdiped stied .evaw eht fo yticocev eht sa emas t hat ht ht htoch ht htoping eht œã... .ygrene fo tnuoma emas eht Eht EHT ETUBARIRTNOC MEHT FO HTB ,REVEWOH .evaw me nihtw Ht retaerg s e fo epotingam eht taht y ereh deton e tnintrop tnitni tnistni ytis ytisnet htah\$.)m/v(ytisnetni dleif citrcele suoenatnatsni eht $}e{tah\$.)2m/W(rotcev gnitnyop suoenatnatsni eht $}tah\$Ehw $ $}h{ttah\{tettehw $ $& Semit\ }e{tah\ = }s{tah\ $ sa 2010 ,rotcev gnitnyop suoenattsni eht ni citentamortcele eht htw detaicossa reOp eht tssed ot Is eht stinu .âœâœâœã... yb detneserper rotcev gnitnyop â€â€â.rotcev gnitnyop eht yb nevig nu rep emit tinu rep seirrac evaw taht ygrene ehtâ TUBLECT Rep refsnart ygrene Fo Eht Sevig Rotcev Gnitnyopâœâ€â's â€â'â'â´â´â Why .MIH Retfa deman saw of ECNEH DNA rep evaW ME eht fo ygrene eht sebircsed rotcev gnitnyoP rotceV gnitnyoP .rehto hcae ot selgna thgir ta era sdleif eht htoB .detacol yllatnozirob si evaw citengam eht elihw ,evaw ME fo noitagaporp eht ot lacitrev tneserp si evaw circtele ehT .evaw citengamortcelE na ni stnenopmoc dleif citengam dna cirtcele fo noitatneserper eht swohs erugif gniwollof ehT .srotcev eht htob ni deweiv eb nac hcihw ,tnatsni yna ta evaw eht redisnoC .sdleif citengam dna circtele htob sah evaw citengamortcele nA .meht ssucsid ot evah ew dna sevaw citengamortcele eseht htiw detaicossa era Rew DNA ybrene smrene smret eht ,erofereht .Noitamrofni Evicer ot Ro Timsnart Ot ygrene citentamortcele tanetna rotcev gnitnyop - yroeht annetna pass through the derivation of this Poynting vector, in a step-by-step process. Imagine that an EM Wave passes an area (A) perpendicular to the X axis along which the wave travels. Passing through A, in infinitesimal time (dt), the wave travels a distance (dx). $$dx = C\ dt$$ Where $$C = speed\ of\ light = 3\times 10^{8}m/s$$$$$$$volume, dv = Adx = AC\ dt$$$ Therefore, Energy transferred in time (dt) per area (A) is − $$S = \frac{Energy}{Time\times Area} = \frac{dW}{dt\ A} = \frac{\epsilon_{0}ACE^{2}\ dt}{dt\ A} = \epsilon_{0}C\:E^{2}$ Since $$\frac{E}{H} = \sqrt{\frac{\mu_{0}}{\epsilon_{0}}} \ then\ S= \frac{CB^{2}}{\mu_{0}}$$ Since then $$C = \frac{E}{H} \ then \ S = \frac{EB}{\mu_{0}}$$$$$$= \hat{S} = \frac{1}{\mu_{0}}(\hat{E}\hat{H})$. denotes the vector Poynting. The above equation gives us the energy per unit of time, per unit of area at any given time, which is called the Poynting vector. Theory of Antenna - The types of Antennas Antennas have to be classified to understand their physical structure and functionality more clearly. There are many types of antennas depending on the applications. Type of antenna Examples of applications Dipole antenna of antenna wire, Monopole antenna, propeller antenna, Loop antenna Personal applications, buildings, ships, automobiles, space crafts Apertura Antennas Ripple (opening), Horn antenna Applications mounted in Flush, aircraft, spacecraft Reflector Antennas Parabolic reflectors, communication of corner reflectors, satellite tracking, radio astronomy Antenca Used for high-frequency applications Micro strip Antennas in circular shape, rectangular shape metal patch above the ground plane Aeronave, spacecraft, satellites, missiles, cars, mobile phones etc. Array antenna Antennas, Yagi-Usti ,yllamroN .noitaredisnoc otni nekat eb osla dluohs elopid eht fo suidar dna htgnel eht ,ecneH .htgnelevaw eht ot lanoitroporp si tI .ecnatcaer eht fo edutilpma eht regral eht ,suidar eht rellams ehT .elopid eht fo htgnel dna suidar eht fo noitcnuf a si ecnadepmi tupni eht fo ecnatcaer ehT .annetna elopid ro elopid sa demret si enil noissimsnart hcus fo dne eht ,eriw tneb a hcus hguorht enod nehw ygrene fo noitaidar ehT elopiD .noitaidar retteb edivorp ot ecaps eerf fo ecnadepmi eht htiw sehctam ,ecnadepmi hgih sah HCIHW, Dne Nepo Eht .enil Noissimsnart Eht Fo Dne Eno Ta Ecnadepmi Wol Sah Ti, Ydaerla .annetna Elopid Evaw-Flah a Sa Stca Siht .ecnadepmi hgih edivorp ot tneb dna nepo tpek si fo din-eh. a fo enil noissimsnart a redisnoC .ecaps-eerf eht fo ecnadepmi eht htiw hctam dluohs enil noissimsnart eht fo dne nepo eht fo ecnadepmi eht ,ylevitceffe ecalp ekat ot noitaidar eht roF .noitaidaR sa nwonk si epacse lufesoprup sihT .erofeb naht ylevitceffe erom ,enil noissimsnart eht morf epacse ot seirt ygrene eht neht ,tneb si eriw eht fo dne enO fI .noitacinummoc sseleriw ot sdael sihT .epacse ot seirt ti ni rewop eht neht ,detcennoc ton si eriw siht fo dne eno fI .stiucric owt eseht neewteb eriw siht gnisu deviecer ro dettimsnart eb lliw noitamrofni eht neht ,stiucric ot detcennoc era enil noissimsnart fo sdne eht htob fI .dne rehto eht ot dne eno morf slevart hcihw ,rewop emos sah enil noissimsnart eht ro eriw ehT seniL noissimsnarT .senil noissimsnart eht ta kool a evah su tel tsrif ,sannetna eriw eseht fo aedi retteb a evah oT .sannetna desu ylediw dna nwonk llew era esehT .sannetna fo sepyt cisab eht era sannetna eriW eriW - yroehT annetnA .sretpahc gnimoc eht ni ,liated ni sannetna fo sepyt denoitnem-evoba eht ssucsid su tel nrettap noitaidar eht lortnoc ot sdeen nehw yltsom, snitacilpa niag hgih yrev rof desu yarra ediug evutols, yarra erutrepa, yarra hectap pirtap is about 72Ω. This is better understood with the help of the following figure. The figure shows the circuit diagram of a normal dipole connected to a transmission line. The current for a dipole is maximum in the center and at least at its ends. The voltage is minimal at its center and maximum at its ends. Types of wire antennas include half-wave dipole, half-wave bent dipole, full wave dipole, short dipole and infinitesimal dipole. All these antennas will be discussed in later chapters. Theory of Antenna - Half-Oat Dipole The dipole antenna is cut and bent for effective radiation. The length of the total wire, which is being used as a dipole, equals half the wavelength (i.e. l = λ/2). Such antenna is called the antenna middle wave dipole. This is the most widely used antenna because of its advantages. It is also known as Hertz antenna. Frequency range The frequency range in which the half-wave dipole operates is about 3KHz to 300GHz. This is mainly used in radio receivers. Construction and half-wave work Dipole It is a normal dipole antenna, where the frequency of its operation is half of its wavelength. Therefore it is called the middle-wave antenna dipole. The edge of the dipole has maximum voltage. This voltage is alternating (AC) in nature. At the positive peak of tension, electrons tend to move in one direction and at the negative peak, electrons move in the other direction. This can be explained by the numbers below. The numbers presented above show the work of a half-wave dipol. Fig. 1 shows the dipole when the induced loads are in a half positive cycle. Now the electrons tend to move to the load. Fig. 2 shows the dipole with induced negative charges. The electrons here tend to move away from the dipole. Fig 3 shows the dipole with the next positive cycle. Thus, the electrons again move to the load. The effectof this produces a variable field effectis irradiated in the same pattern produced in it. Therefore, the output would be an effective radiation following the cycles of the output voltage pattern. Thus, a half-wave dipole effectively radiates. The figure above shows the current distribution in the middle wave dipole. The direction of the middle wave dipole is 2,15dbi, which is reasonably good. Where, 'I represent isotropic radiation. Radiation pattern The radiation pattern of this half-wave dipole is omni-directional on H plane. It is desirable for many applications such as mobile communications, radio receivers etc. The above figure indicates the radiation pattern of a half-wave dipole on plane H and plane V. The radius of the dipole does not affect its impedance of entry into this half-wave dipole, because the length of this dipole is half-wave and is the first resonant length. An antenna works effectively at its resonant frequency, which occurs at its resonant length. Advantages The following are presented the advantages of the input impedance of antenna dipole of half wave "" is not sensitive. It combines well with the impedance of the transmission line. It has reasonable length. The antenna length corresponds to the size and direction. Disadvantages The following are presented the disadvantages of the middle-wave dipole antenna - it is not very effective due to the unique element. It can work better only with a combination. Applications The following are used the applications of the half-wave dipole antenna 'used on radio receivers. Used in television receivers. When employed with other people, used for wide variety of applications. Theory of the antenna - Folded middle wave dipole A folded dipole is an antenna, with two connected conductors on both sides, and bent to form a closed cylindrical shape, to which the feeding is given in the center. The length of the dipole is half the wavelength. Therefore, it is called a dipole antenna bent by half wave. Range ©Ã ©Ã arepo adno aiem ed odarbod olopid o euq me aicnªÃuqerf ed axiaf A gniwollof ehT segatnavdasiD .htgnerts langis eht sezimixam elopid dedlof ? si hcihw,annetna elopid dedlof evaw-flah fo nrettap noitaidar eht swohs erugif gniwollof ehT .sannetna elopid evaw-flah eht fo taht sa emas eht si selopid dedlof evaw-flah fo nrettap noitaidar ? 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One end is open circuit and the other end is powered with AC source. This dipole received this name because of its length. Frequency range The frequency range in which the short dipole operates is about 3kHz to 30MHz. This is mainly used in low frequency receivers. Construction and short-dipole work The short dipole is the dipole antenna with the length of the wire shorter than the wavelength. A voltage source is connected at one end while a dipole shape is made, i.e. the lines are finished at the other end. The circuit diagram of a short dipole with length l is shown. The actual size of the antenna does not matter. The wire that leads to the antenna should be less than a tenth of the wavelength. That's $$ l

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