Date: 22 OCT 2008
M T W T F S S

# Hertz Antenna



## Introduction:

* The 1st ata that operates on above 2MHz signal and having a Physical length of ½ wavelength of applied frequency.
* The 2nd name of Hertz ata is Dipole.
* The ata w/c is operating < 2MHz is Marconi ata. ( $\frac{\lambda}{4} \leq$ Marconi $< \lambda/2$ )
* Hertz ata normally can't be grounded while Marconi ata grounded necessary. Not necessary be ½ wave ( $\lambda, 2\lambda, 3\lambda, 4\lambda, 5/8\lambda$ ) are also used.

## Construction:

* Typically length of ½ wave dipole, assuming that conductor diameter is much less than length of ata, i.e 95% of ½ wavelength measured in free space.

As

$$\lambda = \frac{c}{f}$$

Here

$$L = 95\%\left(\frac{\lambda}{2}\right) = 0.95\left(\frac{\lambda}{2}\right)$$

$$L = 0.95 \times \frac{1}{2} \times \frac{c}{f}$$

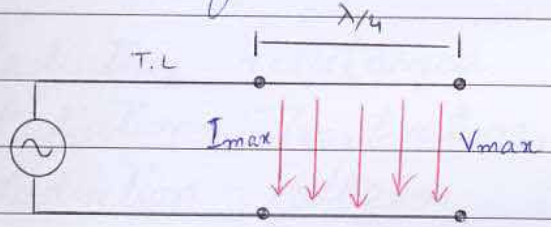
$$L = 0.95 \times \frac{1}{2} \times 3\times10^{8} \times \frac{1}{f}$$

$$L = \frac{142.5\,(m)}{f} \quad ; \quad L = \frac{468}{f}\,(ft)$$

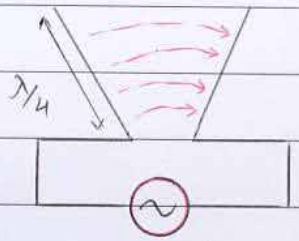
Date: 22 OCT 2008
M T W T F S S

## Analysis:

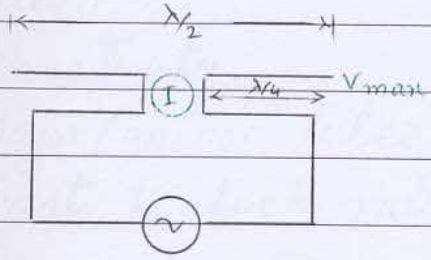
* Halfwave dipole may be considered as an open ckted length of a ‖ wire line having voltage maximum at open end, a current maximum 1 quarter wave length from end & a very high standing wave ratio causing some radiations from open end.



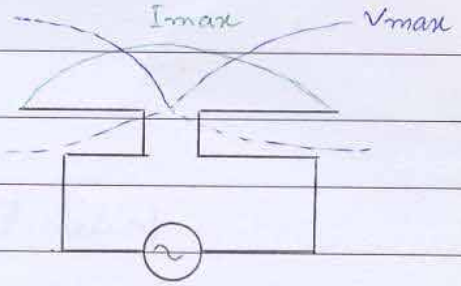

(1)




(2)




(3)




(4)

## ISOTROPIC Radiator

* Only a theoritical abstraction.
* It can't be physical reliazed.
* Isotropic radiator comparing actual ata design performance of different configurations.
* Its radiation pattern acts as a sphere.



Date: 22 OCT 2008
M T W T F S S

Q. Calculate length of half wave dipole for an operating frequency is 20 MHz?

$$L = \frac{142.5}{20} = 7.13 \text{ m}.$$

# Characterization of Antenna

(1) Radiation resistance.
(2) Radiation Temprature.
(3) Radiation Pattern.
(4) Beam width.
(5) Gain
(6) Directivity.
(7) Major/minor lobes.
(8) Front to back ratio. (Fwd - Bwd ration)

## (1) Radiation Resistance:

* The portion of an ata i/p impedance i.e result of power radiated into a space is called "radiation resistance" ($R_r$).

Therefore

$$R_r = \frac{P}{I^2}$$

where 'I' is effective rms value of ata.
'P' is total radiated power of ata.

* Due to high power txmr, arcing effect occurs (known Corona Discharge).

Date: 22 OCT 2008
M T W T F S S

* Due to arcing effect Lump resistance occurs i.e denoted by $R_d$.
* If these losses are represented by one lump value of resistance ($R_d$) and sum of $R_d$ & $R_r$ is called ata total resistance. ($R_T$)

$$R_T = R_r + R_d$$

* The ata efficiency can be represented as P-txd ~~into~~ over P-input

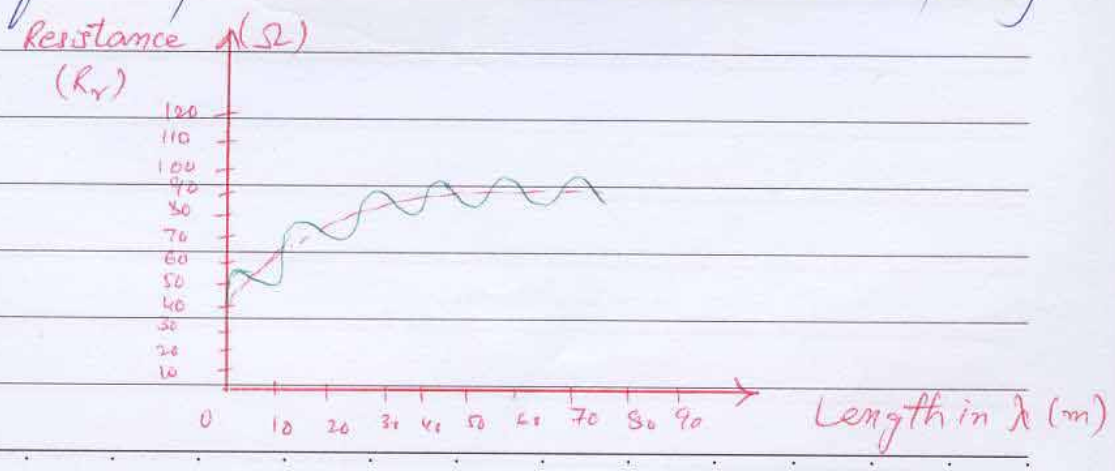
$$\eta = \frac{P_{Transmit}}{P_{Input}} = \frac{P_t}{P_i} = \frac{P_r}{P_t}$$

$P = I^2R$

$$\eta = \frac{P_r}{P_t} = \frac{I^2R_r}{I^2R_T} = \frac{R_r}{R_r + R_d}$$

## Effect of Antenna Length:

* The $R_r$ varies with ata length.
* For a $\frac{1}{2}$ wave ata $R_r$ at $I_{max}$ is $\simeq 73\Omega$ at centre.
* For $\frac{1}{4}$ wave ata $R_r \simeq 36.6\Omega$ at $I_{max}$.
* These are free space values i.e ata is completely isolated.



Date: 23 OCT 2018
M T W T F S S

* The $R_r$ of ata is a good indicator of strength of Em field radiated by Txr ata or being received by rxr ata.

Therefore,

$$R = 80\pi^2 \left( \frac{L_{eff}}{\lambda} \right)^2$$

where

$L_{eff}$ := Effective length of ata in metre

and $\lambda$ := wavelength of radiation.

* $R = 80\Omega \approx 73\Omega$ For $\frac{\lambda}{2}$ dipole ata.
* The $R_r$ is determined by the geometry of ata, not by the material of w/c it is made.
* It can be viewed as equivalent resistance to a resistor in same circuit.
* $R_r$ is caused by the radiation reaction of conduction electrons in ata.
* when an AC electrifield applied on an ata, electrons are accelrated & hence emits em radiation.

Date: 23 OCT 2008
M T W T F S S

## (2) Radiation Temprature: ($T_A$)

* According to law of Physics all bodies having temprature is > absolute 0K, will radiate energy.
* An ata temprature is also associated with $R_x$.
* Absolute Temprature is measure of effective temprature integrate over entire ata pattern.
* An ata is like a lens. Its noise contribution are dedicated by, what the ata is looking.
* If the ata is pointed at very cool portion of sky, thermal noise is less introduced. But if ata is pointed at very warm/hot portion of sky, thermal noise is greater.

$$P \propto T$$

$$P = KTB$$

where

'K' is Boltz's man constant.
'B' is Band width of given type ata.
'T' is absolute temprature of ata.

* The actual contribution of Earth thermal emission to a absolute temprature ($T_A$) may consist of many terms i.e. radiated components from land/sea/atmosphere/cosmic backgrounds.
* The component are fns of ata radiation patterns i.e. $(\gamma, \theta, \phi)$. These components becomes very important for Satellite Comm link (i.e Up/down link Budgeting).