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ADVANCED RF & MICROWAVE ANTENNA TRAINING LAB MAT20

Features X Band Microwave Antenna Training Lab:

* Microwave Trainer ith 22 Antennas like Parabolic dish, Patch arrays, Horn , Slots, Helices, Dipole, Monopole etc.
* X Band DRO stabilized antenna transmitter and receiver
* Microwave power meter receiver with 0.1dB resolution
* 70 dB dynamic range.
* Directional Coupler, Slotted Line for VSWR/ Return Loss.
* Stepper motor antenna rotator with 1 degree resolution
* RS232 interface with polar/cartesian plotting software
* Microstrip & aperture antennas
* All antenna gain, return loss and pattern plot provided
* 1000 location Frequency and level storage in receiver
* Ability to transfer Digital signal over microwave.

1. X band DRO Transmitter

Frequency : X Band Dielectric Resonator stabilized MESFET source on microstrip
Accuracy : 0.1%
Modulation : CW/ASK(DC-15 KHz) Ext
RF Level : 0dBm typical
Output Z : 50 ohms with SMA connector

2. X Band DRO Receiver

Frequency : X Band Microwave receiver power meter
Accuracy : 0.1%
Sensitivity : -70dBm typical
Input Z : 50 ohms with SMA connector

3. Signal Analyser/Stepper motor controller

Measure : Microwave power level in dBm& dBu
Resolution : 0.1dB
Demod : Digital out
PC interface : RS 232 to PC for antenna Plotting
Display : 16x2 backlit LCD for angular Position & power level
Rotation : 0-359 deg Stepper Motor with reduction gearbox
Control : Menu, Enter, Escape, Up & Down
Angle : User selectable steps of 1, 5, 10, 45 degrees
Memory : 1000 memories for storing positions and RF levels
Auto Mode : Automatic rotation in user steps with Datalogging
Indication : Beep on reaching the selected Position
Power Supply : 100-240V AC, 50-60 Hz

Features 0.005 - 2 GHz Antenna Training Lab:

* Antenna Training System with over 35 Antennas
* PLL transmitter and receiver 0.005-2 GHz.
* 50 KHz step size with measurement in 0.1 dB resolution
* 110 dB dynamic range.
* Directional Coupler for VSWR/ Return Loss.
* Stepper motor antenna rotator.
* 1 degree resolution stepper motor
* RS232 interface with polar/cartesian plotting software
* Microstrip antennas
* All SMA connectors, Teflon RG316 Cables
* All antenna gain, return loss and pattern plot provided
* 1000 location Frequency and level storage in receiver

4. PLL Synthesized Digital RF Transmitter

Frequency range : 5-2000 MHz PLL in 3 ranges
Step size : 0.05, 0.1, 0.25, 0.5, 1, 10,100 MHz
Accuracy: 0.01%
Display: 16X2 Backlit LCD
Controls: Menu, Enter, Escape, Up & Down
Memory : 1000 frequency store/recall
Modulation FM: Internal 1KHz/ External Microphone
RF Level: 0dBm (FCC complied)
Attenuator : 20dBX2 (external SMA(M)-SMA(F)
Output Z: 50 ohms SMA
Auto mode: Tracking operation with receiver
Power Supply : 100-240V AC, 50-60 Hz

5. PLL Synthesized Digital RF Receiver

Frequency : 5-2000MHz PLL
Step size: 0.05,0.1, 0.25, 0.5, 1,10,100 MHz
Accuracy: 0.01%
Display : 16X2 Backlit LCD
Memory: 1000 frequency & level store/ recall
Measure : RF power in dBuV, dBm, pW, nW, dBr- dB relative
Resolution: 0.1dB
Dynamic range: 110 dB (70dB log +40dB attenuator)
Input Z : 50 ohm SMA
Speaker : Inbuilt for Audio
PC interface: RS 232 to PC for antenna plotting
Auto mode: Gain/SWR bandwidth with Tx & polar/cartesian plots with Stepper.
Demodulation : FM out
Down converter: 39MHz out for spectrum analyser
RSSI : RF power level Fading analysis
Power Supply : 100-240V AC, 50-60 Hz

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Regd. Off: 504, Nilgiri, Barakhamba Road, New Delhi-110001, India
Works i & ii: 4/32 & 4/46, Site-4, Industrial Estate Sahibabad, UP-201010, India
amitec@amitecltd.com, www.amitecltd.com
+91-120-4371276, +91-98118-39949, +91-98101-93153

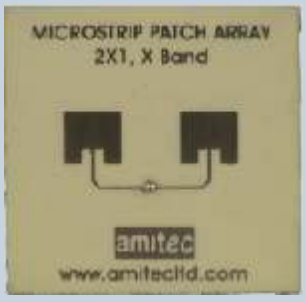
6. Patch Microstrip circularly polarized

S11 : >10dB
Bandwidth : 10.5 ± 0.1GHz
Gain : 4dB
Beamwidth : E plane 10°
Beamwidth : H Plane 20°
Polarisation : Circular
Front to Back Ratio : >10dB
Substrate : Ceramic based
Connector : SMA

7. Patch Microstrip

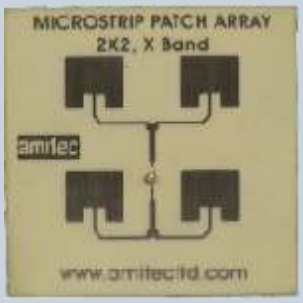
S11 : >10dB
Bandwidth : 10.5 ± 0.1GHz
Gain : 6dB
Beamwidth : E plane 10°
Beamwidth : H Plane 20°
Polarisation : Linear
Front to Back Ratio : >10dB
Substrate : Ceramic based
Connector : SMA

8. Patch Microstrip Array 2x1



S11 : >10dB
Bandwidth : 10.5 ± 0.1GHz
Gain : 6dB
Beamwidth : E plane 10°
Beamwidth : H Plane 20°
Polarisation : Linear
Front to Back Ratio : >10dB
Substrate : Ceramic based
Connector : SMA

9. Patch Microstrip Array 4x1



S11 : >10dB
Bandwidth : 10.5 ± 0.1GHz
Gain : 10dB
Beamwidth : E plane 10°
Beamwidth : H Plane 20°
Polarisation : Linear
Front to Back Ratio : >10dB
Substrate : Ceramic based
Connector : SMA

10. Patch Microstrip Array 4x4

S11 : >10dB
Bandwidth : 10.5 ± 0.1GHz
Gain : 11dB
Beamwidth : E plane 10°
Beamwidth : H Plane 20°
Polarisation : Linear
Front to Back Ratio : >10dB
Substrate : Ceramic based
Connector : SMA

11. Parabolic Dish

S11 : >10dB
Bandwidth : 10.5 ± 0.5GHz
Gain : 16dB
Beamwidth : E plane 10°
Beamwidth : H Plane 20°
Polarisation : Linear
Front to Back Ratio : 25dB
Diameter : 300mm
Weight : 500g

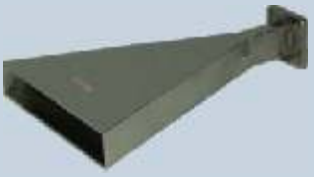
12. Conical Horn

S11 : >6dB
Bandwidth : 8.2- 12.4 GHz
Gain : 10dB
Beamwidth : E plane
Beamwidth : H Plane
Polarisation : Linear
Connector : SMA

13, 14. Pyramidal Horn- 2 Nos.

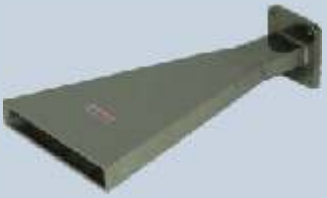
S11 : >20dB
Bandwidth : 8.2- 12.4 GHz
Gain : 16dB
Beamwidth : E plane 20°
Beamwidth : H Plane 22°
Polarisation : Linear

15. E Plane Sectoral Horn



S11 : >15dB
Bandwidth : 8.2- 12.4 GHz
Gain : 13dB
Beamwidth : E plane 20°
Beamwidth : H Plane 80°
Polarisation : Linear

16. H Plane Sectoral Horn



S11 : >15dB
Bandwidth : 8.2- 12.4 GHz
Gain : 10dB
Beamwidth : E plane 100°
Beamwidth : H Plane 22°
Polarisation : Linear

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17. Dielectric Rod

S11 : >6dB
Bandwidth : 10.5 ± 0.5GHz
Gain : 1dB
Beamwidth : E plane 50°
Beamwidth : H Plane 60°
Polarisation : Linear
Front to Back Ratio : 0dB
Connector : SMA

23, 24. Helix (RHCP) -2 Nos

S11 : >6dB
Bandwidth : 10.3 ± 0.5GHz
Gain : 16dB
Beamwidth : E plane 40°
Beamwidth : H Plane 40°
Polarisation : Circular RH
Front to Back Ratio : >10dB
Connector : SMA

18, 19, 20. Waveguide to Coax adapter X 3 Nos

S11 : 10dB
S12 : 1.5dB
Frequency : 8.2-12.4 GHz
Connector : SMA

25. Broadband Matched Termination

S11 : >25dB
Bandwidth : 8.2 -12.4 GHz
Waveguide Flange : WR90

21. Multi Hole Directional Coupler

S41 Coupling : 10dB
S34 Directivity : 30dB
S21 Insertion Loss : <1.5dB
Bandwidth : 8.2 -12.4 GHz
Waveguide Flange : WR90

26. Precision Slotted Line

S11 : >20dB
S12 : <1dB
Resolution : 0.05mm using vernier
Coupling factor : - 20dB
Waveguide Flange : WR90
Probe Connector : SMA

22. Fixed Short

S11: >60dB
Flange: UG39/U

27. Microwave absorber

Absorber : EM Lossy PU Foam Cones
Reflection : -40dB @10GHz
Fire retardancy : As Per NRL USA-8093 Standard complying Tests No.1,2 and 3 with zero halogen means
Equivalent RCS : -30dBsm 8-40GHz

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28. Monopole

S11 : >6dB
Bandwidth : 10.5 ± 0.5GHz
Gain : 1dB
Beamwidth : E plane 80°
Beamwidth : H Plane 180°
Polarisation : Linear
Front to Back Ratio : 0dB
Substrate : Ceramic based
Connector : SMA

29. Dipole

S11 : >6dB
Bandwidth : 10.5 ± 0.5GHz
Gain : 2dB
Beamwidth : E plane 60°
Beamwidth : H Plane 180°
Polarisation : Linear
Front to Back Ratio : 0dB
Substrate : Ceramic based
Connector : SMA

30. Slot WG narrow wall

S11 : >10dB
Bandwidth : 10.5 ± 0.1GHz
Gain : 4dB
Beamwidth : E plane 60°
Beamwidth : H Plane 60°
Polarisation : Linear
Front to Back Ratio : 10dB

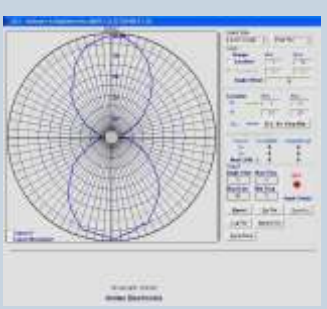
31. Slot WG broad wall

S11 : >10dB
Bandwidth : 10.5 ± 0.1GHz
Gain : 4dB
Beamwidth : E plane 60°
Beamwidth : H Plane 60°
Polarisation : Linear
Front to Back Ratio : 10dB

32, 33. Helix (LHCP)-2 Nos

S11 : >6dB
Bandwidth : 10.5 ± 0.5GHz
Gain : 16dB
Beamwidth : E plane 40°
Beamwidth : H Plane 40°
Polarisation : Circular LH
Front to Back Ratio : >10dB
Connector : SMA

34. Windows Software



RS232 interface with polar plotting software with log, linear cartesian and polar plots, Multiple pattern overlay, Double cursor measurement, Zoom, Colour editing, 1000 location editor, Absolute/Relative,3dB/10dB beam-width measurement

35. Attenuator

Attenuation : 20dB

36. SMA-SMA Adapter

Frequency : DC-12 GHz
Used with waveguide to Coax adapter for measuring return loss of antennas.

37. RG 316 cable

Low Loss RG 316 Teflon Cable

38. Stepper motor controlled antenna Monopod

Mount : Waveguide WR90 E or H, 1/2" BSW
Offset : Adjustable for phase center
RCS : Low Non magentic, non conductive, low dielectric
Non-radiating monopod for transmitting Antenna

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39. Waveguide Stands- 2 Nos.

Waveguide Stands : E & H plane WR90 Mount

40. Accessories

Students activity manual, Teachers reference manual, M4X20 Screw & Nut, Screw driver, Measuring tape, Spanner, SMPS, RS232 Lead

E-Manual: Installation Video for ease of Learning

List of Experiments:

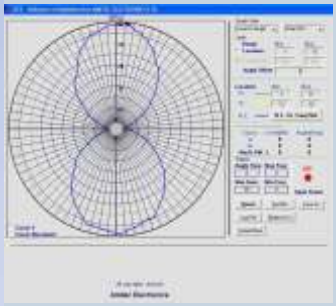
1. To measure the variation of field strength of radiated wave, with distance from transmitting antenna.
2. To plot the radiation pattern of an omnidirectional antenna.
3. To plot the radiation pattern of a directional antenna
4. To measure axial ratio and cross polarisation discrimination of vertically horizontally and circularly polarized antennas.
5. To measure the VSWR of the antenna
6. To demonstrate that transmitting and receiving patterns of an antenna are equal and hence confirm the reciprocity theorem of antennas
7. To plot the radiation pattern (E & H Plane Polar & Cartesian Plots on Log/Linear scale of an antenna on PC.
8. To measure the ANTENNA PARAMETERS (directivity, gain, beam width (Half Power/10dB), front to back ratio, plane of polarization, cross polarization discrimination, side lobe level and its angular position from polar plot, VSWR/return loss) of Dipole antenna.
10. To measure antenna parameters of Horn (E, H, Pyramidal) & open waveguide antenna.
11. To measure antenna parameters of conical Horn antenna
12. To measure antenna parameters of monopole antenna
13. To measure antenna parameters of Slot(Narrow Wall & Broad Wall) Antenna
14. To measure antenna parameters of Parabolic dish antenna
15. To measure antenna parameters of Patch array antenna
16. To measure antenna parameters of Helix (RHCP & LHCP) antenna. To measure the cross polarization discrimination for circular polarisation.
17. To setup microwave data communication link.

Dimensions:56X45X36cm.Weight: 18kg.
Warranty: 3 yrs

41. Stepper Motor Controller Unit

Display: 16X2 backlit LCD
Rotation: 0-359 degrees
Resolution: 1 degree.
Angular steps: 1, 5, 10, 45^0
Memory: 1000 angular position store/recall
Auto mode: Automatic rotation with receiver
Mode: CW/CCW rotation, Fast Slow speed modes
Power Supply: 100-240V AC, 50-60 Hz

42. Software

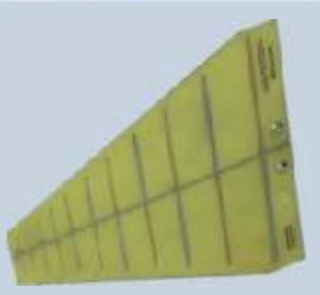


RS 232 interface with polar plotting with log, linear cartesian and polar plots, Vi, Vr & Return loss plots, Multiple pattern overlay, Double cursor, Zoom, Colour editing, 1000 location editor, Absolute/Relative, 3dB/10dB beam-width, Gain, Front to back, Side lobe level and position, Plot rotate, File-edit, save, get.

43. Directional Coupler

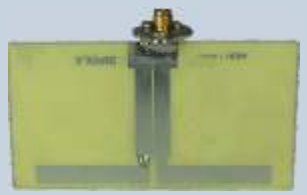
Bandwidth: 0.1 - 2 GHz
Insertion S_{12} : 1.5 $\pm$ 0.5 dB
Coupling S_{13}: 20 $\pm$ 2dB
Isolation S_{14}: 20 $\pm$ 2dB
Directivity S_{23}: 15 $\pm$ 3dB
Impedance : 50 Ohms
Connector : SMA
Usage: Antenna forward & reverse power & VSWR measurements.

44, 45. Microstrip Log Periodic Dipole Array



S11: >10dB
Bandwidth: 1500 $\pm$ 500 MHz
Gain: 6dBi
Beamwidth : E plane 60^0
Beamwidth : H Plane 80^0
Polarisation : Linear
Front to Back Ratio: 6dB
Connector : SMA

46,47. Microstrip Dipole



F_c :1..5 $\pm$ 0.1 GHz
S_{11} : 10 $\pm$ 2dB
Polarisation : Linear
X Pol discrimination : 20dB
Gain : 2dBi
Feed: Microstrip balun
Impedance : 50 Ohms
Connector : SMA

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48. Microstrip Yagi

F_c : 1.5 ± 0.1 GHz
S_{11} : 10 ± 2dB
Polarisation : Linear
Gain : 4dBi
Feed : Microstrip balun
Impedance : 50 Ohms
Connector : SMA

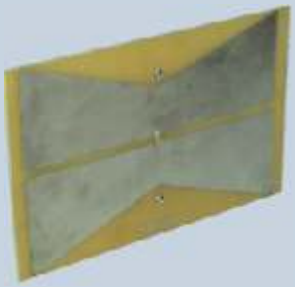
49. Microstrip Patch Inset Fed

F_c : 1.5 ± 0.1 GHz
S_{11} : 10 ± 2dB
Polarisation : Linear
Gain : 5dBi
Impedance : 50 Ohms
Connector : SMA

50. Log Spiral

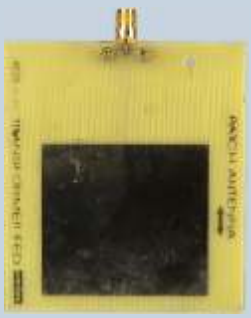
S11: >10dB
Bandwidth: 1.5 ± 1.0GHz
Gain: 2dBi
Beamwidth : E plane 80°
Beamwidth : H Plane 120°
Polarisation : Circular
Front to Back Ratio: 0dB
Connector : SMA

51. Batwing



S11: >10dB
Bandwidth: 1850 ± 50 MHz
Gain: 6dBi
Beamwidth : E plane 40°
Beamwidth : H Plane 60°
Polarisation : Linear
Front to Back Ratio: 10dB
Connector : SMA

52. Microstrip Patch Transformer Fed



F_c :1.5 ± 0.1 GHz
S_{11} : 10 ± 2dB
Polarisation : Linear
Gain : 5dBi
Impedance : 50 Ohms
Connector : SMA

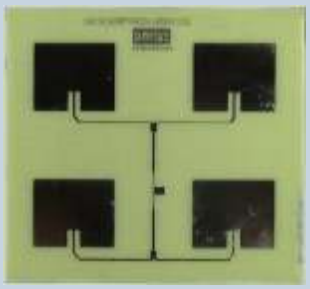
53. Microstrip Slot

S11: >10dB
Bandwidth: 750 ± 20 MHz
Gain: 2dBi
Beamwidth : E plane 60°
Beamwidth : H Plane 180°
Polarisation : Linear
Front to Back Ratio: 0dB
Connector : SMA

54. Circular Polarized Patch Array 2 X 2

F_c :1.5 ± 0.1 GHz
S_{11} : 10 ± 2dB
Polarisation : Circular
Gain : 7dBi
Impedance : 50 Ohms
Connector : SMA

55. Microstrip Patch Array 2 X 2



F_c :1.5 ± 0.1 GHz
S_{11} : 10 ± 2dB
Polarisation : Linear
Gain : 9dBi
Impedance : 50 Ohms
Connector : SMA

57. Parabolic Dish

S11: >10dB
Bandwidth: 1850 ± 50 MHz
Gain: 6dBi
Beamwidth : E plane 40°
Beamwidth : H Plane 60°
Polarisation : Linear
Front to Back Ratio: 10dB
Connector : SMA

58. Biconical

S11: >10dB
Bandwidth: 600 ± 300 MHz
Gain: 2dBi
Beamwidth : E plane 60°
Beamwidth : H Plane 180°
Polarisation : Linear
Front to Back Ratio: 0dB
Connector : SMA

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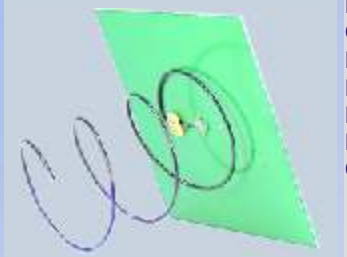
59, 60. Endfire & Broadside phased array

S11: >10dB
Bandwidth: 800 ± 50 MHz
Gain: 3dBi
Beamwidth : E plane 60°
Beamwidth : H Plane 120°
Polarisation : Linear
Front to Back Ratio: 0dB
Connector : SMA

61, 62. Helix LHCP & RHCP



S11: >10dB
Bandwidth: 750 ± 100 MHz
Gain: 4dBi
Beamwidth : E plane 60°
Beamwidth : H Plane 120°
Polarisation : Circular RH
Front to Back Ratio: 6dB
Connector : SMA

63. Square Loop

S11: >10dB
Bandwidth: 600 ± 50 MHz
Gain: 2dBi
Beamwidth : E plane 80°
Beamwidth : H Plane 120°
Polarisation : Linear
Front to Back Ratio: 0dB
Connector : SMA

64. Quad

S11: >10dB
Bandwidth: 600 ± 50 MHz
Gain: 4dBi
Beamwidth : E plane 60°
Beamwidth : H Plane 80°
Polarisation : Linear
Front to Back Ratio: 6dB
Connector : SMA

65. Log Periodic Dipole Array

S11: >10dB
Bandwidth: 600 ± 300 MHz
Gain: 4dBi
Beamwidth : E plane 60°
Beamwidth : H Plane 80°
Polarisation : Linear
Front to Back Ratio: >6dB
Connector : SMA

66. Folded Dipole

S11: >10dB
Bandwidth: 600 ± 200 MHz
Gain: 2dBi
Beamwidth : E plane 70°
Beamwidth : H Plane 180°
Polarisation : Linear
Front to Back Ratio: 0dB
Connector : SMA

67. Discone

S11: >10dB
Bandwidth: 600 ± 300 MHz
Gain: 0dBi
Beamwidth : E plane 60°
Beamwidth : H Plane 180°
Polarisation : Linear
Front to Back Ratio: 0dB
Connector : SMA

68. Conical Horn

S11: >10dB
Bandwidth: 1850 ± 50 MHz
Gain: 6dBi
Beamwidth : E plane 40°
Beamwidth : H Plane 60°
Polarisation : Linear
Front to Back Ratio: 10dB
Connector : SMA

69. Stacked Yagi

S11: >10dB
Bandwidth: 700 ± 100 MHz
Gain: 4dBi
Beamwidth : E plane 60°
Beamwidth : H Plane 80°
Polarisation : Linear
Front to Back Ratio: >6dB
Connector : SMA

70, 71. Crossed Dipole

S11: >10dB
Bandwidth: 700 ± 50 MHz
Gain: 2dBi
Beamwidth : E plane 90°
Beamwidth : H Plane 180°
Polarisation : Circular LH& Circular RH
Front to Back Ratio: 0dB
Connector : SMA

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amitec@amitecltd.com, www.amitec.co, www.amitecltd.com

72. Yagi 3el

S11: >10dB
Bandwidth: 700 ± 100 MHz
Gain: 4dBi
Beamwidth : E plane 60°
Beamwidth : H Plane 80°
Polarisation : Linear
Front to Back Ratio: >6dB
Connector : SMA

73. Yagi 4el

S11: >10dB
Bandwidth: 700 ± 50 MHz
Gain: 5dBi
Beamwidth : E plane 60°
Beamwidth : H Plane 80°
Polarisation : Linear
Front to Back Ratio: >6dB
Connector : SMA

74. Sleeve

S11: >10dB
Bandwidth: 750 ± 20 MHz
Gain: 2dBi
Beamwidth : E plane 70°
Beamwidth : H Plane 180°
Polarisation : Linear
Front to Back Ratio: 0dB
Connector : SMA

75. Monopole

S11: >10dB
Bandwidth: 600 ± 300 MHz
Gain: 1dBi
Beamwidth : E plane 70°
Beamwidth : H Plane 180°
Polarisation : Linear
Front to Back Ratio: 0dB
Connector : SMA

76,77. Dipole L/2, L/4

S11: >10dB
Bandwidth: 600 ± 300 MHz
Gain: 2dBi
Beamwidth : E plane 70°
Beamwidth : H Plane 180°
Polarisation : Linear
Front to Back Ratio: 0dB
Connector : SMA

78. Coaxial Slotted Line

S11: >15dB
S12: <2dB
Resolution: 0.05mm using vernier
Coupling : -20dB typical
Connector : SMA
Residual VSWR : <1.2
Velocity propagation : $1.818X10^8$m/s
Wavelength/360° phase : 60.5mm at 3GHz
Total Length : 200mm

79. Antenna azimuth positioner

Rotation: 0-359 degree Azimuth
Resolution: 1degree
Mount: 1/2" BSW Cube
Offset: Adjustable for phase center
RCS: Low Non magentic, non conductive, low dielectric
Motor: Stepper Motor with heavy duty reduction gearbox

Accessories

1) Transmitter antenna mounting stand.
2) Whip antenna
3) All necessary connectors & Teflon RF cables.
4) Students activity & Teachers reference Manual
5) Software CD
6) Antenna Kit
7) Voltage Probe
8) Power Divider (2 way)
9) RS232 Lead
10) SMA-SMA lead 30cm X3
11) SMA-SMA lead 1.5m X2
12) Measuring Tape

E-Manual: Installation Video for ease of Learning
Dimension : 56X 45 x 54 cms. Weight : 23 Kg
Warranty: 3 yrs.

Areas of Experimentation and scope of study

* Inverse square law of propagation.
* Radiation pattern of an Omni and directional antenna.
* Vertical, Horizontal and Circularly polarized antennas.
* Polarization discrimination linear & circular antennas
* Resonant and non-resonant antenna.
* Reciprocity of antenna.
* Current distribution of an antenna.
* Antenna parameters:
* Radiation pattern E & H Plane - Polar & Cartesian Plots
* Directive gain, beam width (Half Power/10dB), front to back ratio, plane of polarization, side lobe level & angle.
* Antenna resonance, VSWR and bandwidth using directional coupler and adjust the antenna.
* Comparative study of antennas.
* Significance of parasitic element dimensions.
* Construct antenna using antenna kit
* Voice communication link using antennas. Plus lot more.

Mfd by: Amitec Electronics Ltd.
Regd. Off: 504, Nilgiri, Barakhamba Road, New Delhi-110001, India
Corp. Office & Unit I: 4/32, Site-4, Industrial Estate, Sahibabad, NCR Delhi-201010, India
Unit II: 4/46, Site-4, Industrial Estate, Sahibabad, NCR Delhi-201010, India
amitec@amitecltd.com, www.amitec.co, www.amitecltd.com