

### Features

- \* PLL synthesized source & receiver 5-2000MHz
- \* High dynamic range of 110dB with -105dBm sensitivity of receiver and +0dBm source
- \* Complete S parameter measurement using directional coupler & coaxial slotted line
- \* 25 Different microstrip modules provided
- \* Windows software for graphical analysis
- \* Gold plated SMA connectors
- \* Power measurement resolution of 0.1dB on LCD
- \* Teflon/Silver based RG316 SMA-SMA cables for unmatched repeatability
- \* Close conformity to simulation/design data

### 1. PLL Synthesized Signal Source



#### Technical Specifications:

Frequency range :	5-2000 MHz PLL synth. 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 individual frequencies be stored
RF Level :	0dBm typical
Level Accuracy :	±2dB
Attenuator :	40dB (external SMA-SMA)
Output Z :	50 ohms
Connector :	Gold plated SMA

### 2. PLL Synthesized Receiver



#### Technical Specifications:

Frequency range :	5-2000 MHz PLL synth. in 3 ranges
Step size :	0.05, 0.1, 0.25, 0.5, 1, 10, 100MHz
Accuracy :	0.01%
Display :	16X2 Backlit LCD
Memory :	1000 frequencies & levels be stored
<b>Measurements :</b>	<b>RF level measurement in dBuV / dBm / pW / dBr with 0.1dB resolution</b>
Sensitivity :	-105dBm
Dynamic range :	110 dB (70dB log. + 40dB attenuator)
RS232 interface :	To PC for plotting software
Auto mode :	Interfacing with source
Input Z :	50 ohm Gold plated SMA connector

### 3. Dual Directional Coupler



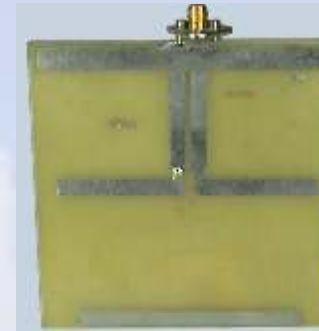
$F_c$  :  $1.5 \pm 1$  GHz  
 Insertion  $S_{12}$  :  $1.5 \pm 0.5$  dB  
 Coupling  $S_{13}$  :  $20 \pm 2$  dB  
 Isolation  $S_{14}$  :  $20 \pm 2$  dB  
 Directivity  $S_{23}$  :  $15 \pm 3$  dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 4. Coaxial Slotted Line



$S_{11}$  : >15dB,  $S_{12}$  : <1.5dB  
 Resolution: 0.05 mm / 0.15degree at 1.5GHz) using vernier  
 Coupling factor:-20dB  
 Connector : SMA  
 Residual VSWR : <1.2  
 Velocity propagation :  $1.818 \times 10^8$  m/s  
 Wavelength/360° phase : 121mm at 1.5GHz  
 Total Length : 200mm

### 5. Microstrip Antennas : Yagi



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

### 6. Microstrip Antennas : Patch Inset Fed



Microstrip Patch Inset Fed  
 $F_c$  :  $1.5 \pm 0.1$  GHz  
 $S_{11}$  :  $10 \pm 2$  dB  
 Polarisation : Linear  
 Gain : 5dBi  
 Impedance : 50 Ohms  
 Connector : SMA

### 7. Microstrip Antennas : Patch Transformer Fed



Microstrip Patch Transformer Fed  
 $F_c$  :  $1.5 \pm 0.1$  GHz  
 $S_{11}$  :  $10 \pm 2$  dB  
 Polarisation : Linear  
 Gain : 5dBi  
 Impedance : 50 Ohms  
 Connector : SMA

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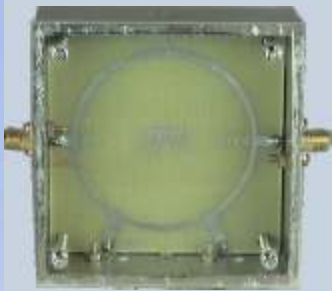
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### 8. Microstrip Couplers : Branch Line



Branch Line Couplers  
 $F_c: 1.5 \pm 0.2$  GHz  
 Insertion  $S_{12}, S_{14}$  : 3.5 dB  
 Isolation  $S_{13}$  : 15dB  
 Bandwidth : 150 MHz  
 Phase Shift  $S_{24}$ :  $90^\circ$   
 Impedance : 50 Ohms  
 Connector SMA

### 9. Microstrip Couplers : Hybrid ring rat race



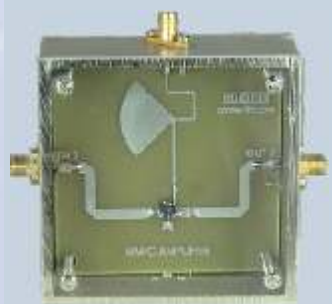
Hybrid Ring Rat race coupler  
 $F_c: 1.5 \pm 0.2$  GHz  
 Insertion  $S_{12}, S_{14}$  : 3.5 dB  
 Isolation  $S_{13}$  : 15dB  
 Bandwidth : 150 MHz  
 Phase Shift  $S_{24}$ :  $180^\circ$   
 Impedance : 50 Ohms  
 Connector SMA

### 10. Microstrip Couplers : Directional Coupler



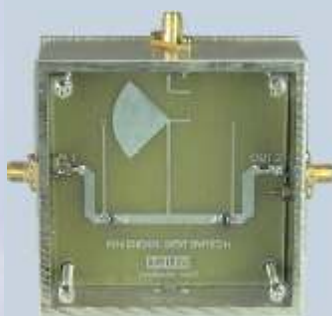
Microstrip Coupled line Directional coupler  
 $F_c: 1.5 \pm 0.2$  GHz  
 Insertion  $S_{12}$  :  $1.5 \pm 0.5$  dB  
 Coupling  $S_{13}$ :  $15 \pm 2$  dB  
 Isolation  $S_{14}$ :  $20 \pm 2$  dB  
 Directivity  $S_{23}$ :  $12 \pm 2$  dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 11. Microstrip Amplifier : MMIC Amplifier



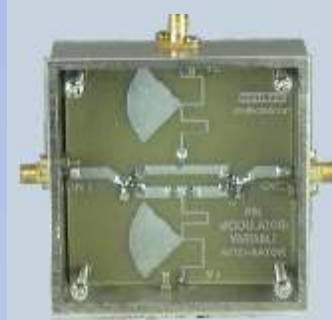
MMIC Amplifier  
 $F_c: 1.5 \pm 1$  GHz  
 Gain  $S_{12}$  : 18 dB  
 Noise Floor : 3.5dB  
 1dB Compression : 10dBm  
 Bandwidth : 1 GHz  
 Impedance : 50 Ohms  
 Connector SMA

### 12. Microstrip Switch : PIN Diode Switch



SPST PIN diode switch  
 $F_c = 1.5 \pm 0.5$  GHz  
 Insertion Loss: 1.5 dB  
 Return Loss = 20 dB  
 Isolation : 20dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 13. Microstrip Modulator : PIN Diode Modulator



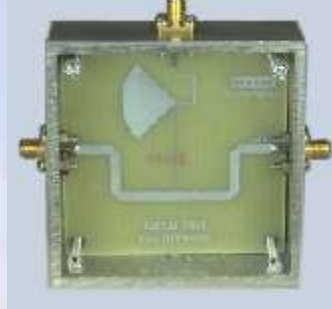
PIN Diode Modulator  
 $F_c = 1.5 \pm 1$  GHz  
 Insertion Loss: 1.5 dB  
 Isolation: 10dB  
 Return Loss = 10 dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 14. Microstrip Power Divider : Wilkinson resistor



Wilkinson chip resistor type 2 way  
 $F_c = 1.5 \pm 0.2$  GHz  
 Isolation =  $15 \pm 2$  dB  
 Insertion Loss =  $3.5$  dB  $\pm$  0.5dB  
 Connector : SMA

### 15. Microstrip Bias Network : Radial Stub (DC Injector)



Type : Radial stub  
 $F_c = 1.5 \pm 0.5$  GHz  
 Insertion Loss : 0.5dB  
 Isolation : 30dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 16, 17. Microstrip Antennas : Dipole - 2 Nos



Microstrip Dipole  
 $F_c : 1.5 \pm 0.1$  GHz  
 $S_{11}$  :  $10 \pm 2$  dB  
 Polarisation : Linear  
 X Pol discrimination : 20dB  
 Gain : 2dBi  
 Feed: Microstrip balun  
 Impedance : 50 Ohms  
 Connector : SMA

### 18. Microstrip Matching : Tapered Transformer



Microstrip Matching  
 Type : Tapered & Multisection transformer  
 $F_c = 1.5 \pm 0.1$  GHz  
 Load : 150 Ohms  
 Return Loss  $S_{11}$  : 6 dB or VSWR=3 at DC  
 Return Loss  $S_{11}$  : >10 dB at VSWR<2 at 1.5GHz  
 Impedance : 50 Ohms  
 Connector : SMA

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### 19. Microstrip Filter : Low Pass Stepped Impedance



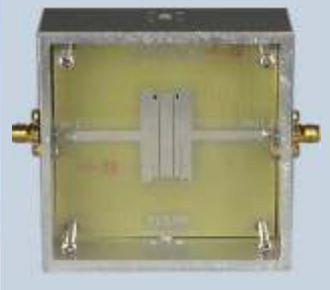
Low Pass Filter  
 Type : Stepped Impedance  
 Poles : 7  
 Pass Band : DC - 1.5GHz  
 Pass Band Loss  $S_{12}$  : 1.5dB  
 Pass Band Return Loss  $S_{11}$  : 15 dB  
 Stop Band Loss  $S_{12}$  : >20dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 20. Microstrip Filter : Low Pass Open Stub



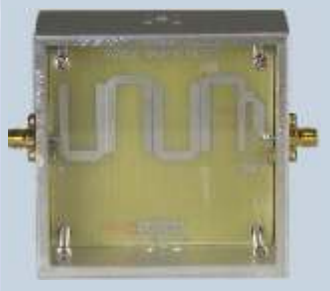
Low Pass Filter  
 Type : Open Stub  
 Poles : 7  
 Pass Band : DC - 1.5 GHz  
 Pass Band Loss  $S_{12}$  : 1.5dB  
 Pass Band Return Loss  $S_{11}$  : 15 dB  
 Stop Band Loss  $S_{12}$  : >20dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 21. Microstrip Filter : Band Pass Interdigital



Band Pass Filter  
 Type : Interdigital  
 Poles : 5  
 $F_c = 1.5 \pm 0.1$  GHz  
 Bandwidth : 1GHz  
 Insertion Loss  $S_{12}$  : 1.5dB  
 Return Loss  $S_{11}$  : 15 dB  
 Stop Band  $S_{12}$  : >20dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 22. Microstrip Filter : Tapped Hairpin



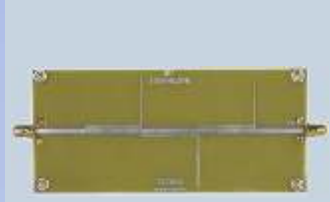
Band Pass Filter  
 Type : Interdigital  
 Poles : 5  
 $F_c = 1.5 \pm 0.1$  GHz  
 Bandwidth : 1GHz  
 Insertion Loss  $S_{12}$  : 1.5dB  
 Return Loss  $S_{11}$  : 15 dB  
 Stop Band  $S_{12}$  : >20dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 23. Microstrip Filter: Band Pass Parallel Edge coupled



Band Pass Filter  
 Type : Parallel edge coupled  
 Poles : 5  
 $F_c = 1.5 \pm 0.1$  GHz  
 Bandwidth : 0.1GHz  
 Insertion Loss  $S_{12}$  : 1.5dB  
 Return Loss  $S_{11}$  : 15 dB  
 Stop Band  $S_{12}$  : >20dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 24. Microstrip Filter : Band stop Filter



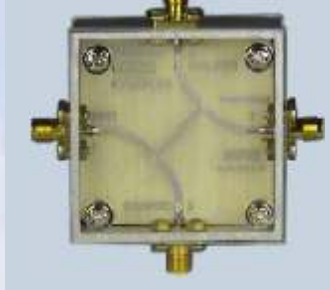
Band Stop Filter  
 Type : L resonator  
 Poles : 3  
 $F_c = 1.5 \pm 0.1$  GHz  
 Bandwidth : 0.1GHz  
 Insertion Loss  $S_{12}$  : 1.5dB  
 Return Loss  $S_{11}$  : 15 dB  
 Stop Band  $S_{12}$  : >20dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 25. Microstrip Couplers : Unfolded Lange Coupler



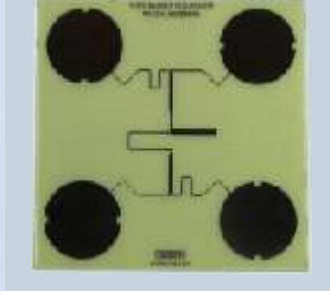
$F_c : 1.5 \pm 0.2$  GHz  
 Insertion  $S_{12}$  :  $1.5 \pm 0.5$  dB  
 Coupling  $S_{13}$  :  $6 \pm 2$  dB  
 Isolation  $S_{14}$  :  $20 \pm 2$  dB  
 Directivity  $S_{23}$  :  $14 \pm 2$  dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 26. Microstrip Couplers : Folded Lange Coupler



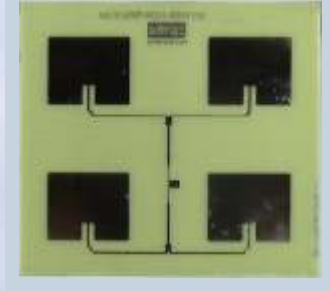
$F_c : 1.5 \pm 0.2$  GHz  
 Insertion  $S_{12}$  :  $1.5 \pm 0.5$  dB  
 Coupling  $S_{13}$  :  $6 \pm 2$  dB  
 Isolation  $S_{14}$  :  $20 \pm 2$  dB  
 Directivity  $S_{23}$  :  $14 \pm 2$  dB  
 Impedance : 50 Ohms  
 Connector : SMA

### 27. Circular Polarized Patch Array 2 X 2



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

### 28. Microstrip Patch Array 2 X 2



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

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### 29. Microstrip Resonator : Ring resonator



Ring Resonator  
 $F_c: 1.5 \pm 0.1$  GHz  
 $S_{11}: -2 \pm 1$  dB  
 $S_{12}: -20 \pm 2$  dB  
 $Q: 50$  typical  
 Connector : SMA

### 30. Microstrip Loads : Unmatched/matched loads



Matched & Unmatched Loads  
 $F_c = 1.5 \pm 0.2$  GHz  
 Return Loss = 20/6/0/0 dB  
 Load : Quarter wave matched, VSWR 3, Open & Short Stubs  
 Connector : SMA

### 31. Standard Accessories



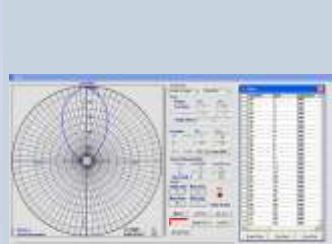
50 Ohms Matched Termination SMA(M) - 4 nos, Short & Open termination SMA(M), Teflon based RG316 cables 4 nos SMA(M)-SMA(M), DC - Mains Power supply adapter, E-Manual / Installation Video for ease of Learning, Microwave Freeware Software

### 32. Manual Antenna Rotator



Low RCS Transmitting tripod, Low RCS Receiving tripod, Connecting cables RG316 SMA - 1.5m - 2 Nos, Goniometer with 1 degree resolution

### 33. Antenna Plotting Software



RS232 interface for plotting with log, linear cartesian and polar plots,  $V_i$ ,  $V_r$  & Return Loss plots, Multiple pattern overlay, Double cursor, Zoom, Colour editing, 1000 location editor, Absolute/Relative, 3dB/10dB band-width, Gain, Front to back, Plot rotate, File- edit, save,

### 34. Microstrip Fabrication Kit



MIC Fabrication Kit with it 5 Boxes and 10 SMA connectors.  
 Scalpel Blade, Single sided copper clad bare board, Copper Foil adhesive tape.

### Scope of Experiments

- \* Properties of Directional Coupler
  - i) Measurement of coupling factor.
  - ii) Measurement of Directivity.
  - iii) Measurement of return loss of a load.
  - iv) Main line insertion loss, isolation, VSWR of ports.
- \* Measurement of  $S_{11}$ ,  $S_{12}$ ,  $S_{21}$ ,  $S_{22}$  parameters of microstrip components
- \* 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 Standard dipole (or printed dipole), microstrip inset fed patch antenna, microstrip transformer fed patch antenna and Yagi antenna(printed).
- \* Properties of Branch Line Coupler
  - i) Measurement of coupling factor.
  - ii) Measurement of return loss of a load.
  - iii) Main line insertion loss, isolation, VSWR of ports.
- \* Properties of Hybrid Ring Rat race Coupler
  - i) Measurement of Power division or Decoupling between Sum and Diff arms of a rat race coupler.
  - ii) Measurement of Insertion loss  $S_{21}$  &  $S_{41}$ .
  - iii) Measurement of Return Loss/ impedance match at ports 1 & 4 -  $S_{11}$ ,  $S_{44}$ .
  - iv) Measurement of Isolation between ports 1 & 3 -  $S_{13}$ .
  - v) Measurement of Phase difference in output arms 2 & 4 as 180 Deg.
- \* To measure gain, isolation, VSWR of ports of mmic amplifier.
- \* To measure Insertion loss, isolation and VSWR of port microwave SPST PIN diode switch.
- \* To measure Insertion loss, isolation and VSWR of port microwave SPST PIN diode Modulator. Operation of PIN diode modulator. Study of square wave modulation of PIN modulator.
- \* Measurement of power division and isolation characteristic of a microstrip 3 dB power divider.
- \* To measure isolation, VSWR of ports of Radial stub.
- \* To measure attenuation, isolation, VSWR of ports of Attenuator.
- \* To measure VSWR of ports of 50 ohms microstrip line, Matched load, open stub, Short Stub, mismatch.
- \* Low pass filter characteristics insertion loss, pass band, port VSWR
- \* Measurement of resonance characteristics of a microstrip ring resonator and determination of dielectric constant of the substrate.

**Dimension: 55 X45 X36, Weight: 20 Kg, Warranty: 3 yrs.**

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