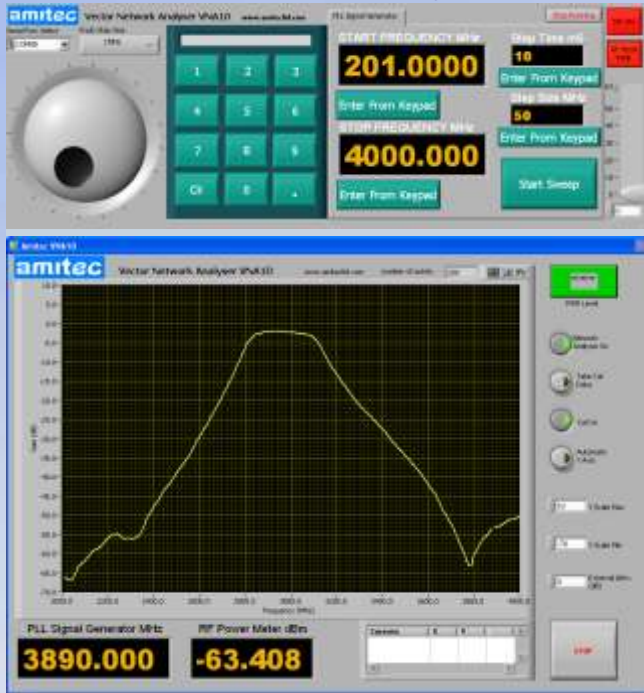


### Features

- \* 0.2-4 GHz PLL microwave Signal Generator.
- \* 1KHz Frequency Step size and Accuracy.
- \* 1 MHz-4 GHz RF Power meter with -70dBm sensitivity.
- \* PC control, display and analysis in real time.
- \* 0.2-4 GHz Directional Coupler with 15dB directivity.
- \* 1-4 GHz Slotted Line with low VSWR.
- \* 25 different MIC modules provided.
- \* Gold SMA connectors on low loss ceramic substrate.
- \* Wide power range +20dBm to -70dBm.
- \* High measure speed at all power levels.
- \* Measurement in dBm & dB relative.
- \* Teflon cables are provided for low loss interconnects.

### 1. Microwave PLL Vector Network Analyser



### Technical Specifications:

#### Microwave PLL Signal Generator

- Start Frequency : 200.000MHz
- Stop Frequency : 4000.000MHz
- Step Size : 1KHz to 4GHz adjust in 1KHz step
- Step Time : 10ms to 1s adjustable
- Frequency Control : Keypad & Rotary Knob
- Frequency Jitter : <1ps
- Phase Noise : -80dBc/Hz at 10KHz Offset
- RF Level : +20 dBm typical
- Attenuator : 0-60dB adjustable in 1dB steps
- Output Z : 50 ohms
- Connector : Gold plated SMA
- Timebase : Internal TCXO/ External for Sync

#### Microwave Power Meter

- Frequency range : 1MHz to 4 GHz
- Power range : -70dBm to 0dBm
- Resolution : 0.01 dB
- Measurement : dBm, dB With Digital Display
- Relative Offset : +20.0 to -70.0dBm
- Impedance : 50 Ohms

#### Network Analyser

- Display : Frequency vs Power level Plot
- Function : Automatic Calibration with Display Normalisation, Marker, PAN, Zoom, Autoscaling
- Calibration Data : Stored in EEPROM

### 2. Microstrip Couplers : Unfolded Lange Coupler



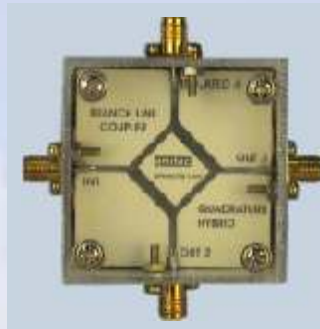
- $F_c$ :  $3.0 \pm 0.2$  GHz
- Insertion  $S_{12}$ :  $1.5 \pm 0.5$  dB
- Coupling  $S_{13}$ :  $6 \pm 2$  dB
- Isolation  $S_{14}$ :  $20 \pm 2$  dB
- Directivity  $S_{23}$ :  $14 \pm 2$  dB
- Impedance : 50 Ohms
- Connector : SMA
- Substrate : Ceramic

### 3. Microstrip Couplers : Folded Lange Coupler



- $F_c$ :  $3.0 \pm 0.2$  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
- Substrate : Ceramic

### 4. Microstrip Couplers : Branch Line Quadrature Hybrid



- $F_c$ :  $3.0 \pm 0.2$  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
- Substrate : Ceramic

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



- $F_c$ :  $3.0 \pm 0.2$  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
- Substrate : Ceramic

### 6. Microstrip Couplers : Coupled Line Directional



- $F_c$ :  $3.0 \pm 0.2$  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
- Substrate : Ceramic

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### 7. Microstrip Bandpass Filter Tapped Hairpin



Order: 7  
 $F_c = 3.0 \pm 0.1$  GHz  
 Bandwidth: 100MHz  
 Insertion Loss  $S_{12}$ : 1.5dB  
 Return Loss  $S_{11}$ : 15 dB  
 Stop Band  $S_{12}$ : 20dB  
 Impedance: 50 Ohms  
 Connector: SMA  
 Substrate: Ceramic

### 8. Microstrip Low Pass Filter Open Stub



Order: 7  
 $F_c = 3.0 \pm 0.1$  GHz  
 Insertion Loss  $S_{12}$ : 1.5dB  
 Return Loss  $S_{11}$ : 15 dB  
 Stop Band  $S_{12}$ : 20dB  
 Impedance: 50 Ohms  
 Connector: SMA  
 Substrate: Ceramic

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



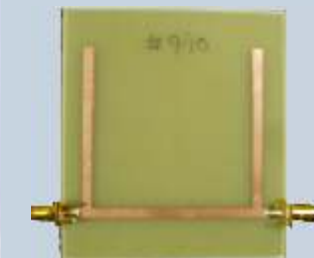
Type: Stepped Impedance  
 Order: 7  
 $F_c = 3.0 \pm 0.1$  GHz  
 Insertion Loss  $S_{12}$ : 1.5dB  
 Return Loss  $S_{11}$ : 15 dB  
 Stop Band  $S_{12}$ : 20dB  
 Impedance: 50 Ohms  
 Connector: SMA  
 Substrate: Ceramic

### 10. Microstrip Filter : Band Pass Edge Coupled



Type: Edge Coupled  
 Order: 5  
 $F_c = 3.0 \pm 0.1$  GHz  
 Insertion Loss  $S_{12}$ : 1.5dB  
 Return Loss  $S_{11}$ : 15 dB  
 Stop Band  $S_{12}$ : 20dB  
 Impedance: 50 Ohms  
 Connector: SMA  
 Substrate: Ceramic

### 11. Microstrip Filter : Band Stop



Type: Folded Line/Butterfly  
 Order: 3  
 $F_c = 3.0 \pm 0.1$  GHz  
 Insertion Loss  $S_{12}$ : 1.5dB  
 Return Loss  $S_{11}$ : 15 dB  
 Stop Band  $S_{12}$ : 20dB  
 Impedance: 50 Ohms  
 Connector: SMA  
 Substrate: Ceramic

### 12. Microstrip Switch : PIN Diode SPST Switch



$F_c = 3.0 \pm 0.5$  GHz  
 Insertion Loss: 1.5 dB  
 Return Loss : 20 dB  
 Isolation : 20dB  
 Impedance : 50 Ohms  
 Connector : SMA  
 Substrate : Ceramic

### 13. Microstrip Modulator : PIN Diode Variable Attenuator



$F_c = 3.0 \pm 1$  GHz  
 Insertion Loss : 1.5 dB  
 Isolation : 10dB  
 Return Loss : 10 dB  
 Attenuation : 0-20dB  
 Control Voltage : 0-15V  
 Impedance : 50 Ohms  
 Connector : SMA  
 Substrate : Ceramic

### 14. Microstrip PIN Diode Switchable Attenuator



$F_c : 3.0 \pm 1$  GHz  
 Insertion Loss : 1.5dB  
 Isolation : 20dB  
 Attenuation : 20dB  
 Impedance : 50 Ohms  
 Connector : SMA  
 Operating Current : 35mA  
 Operating Voltage : 15V DC  
 Substrate : Ceramic

### 15. Microstrip Amplifier : HJFET Low Noise Amplifier



Device : Hetero Junction N Channel FET  
 $F_c : 3.0 \pm 1$  GHz  
 Gain : >15dB  
 1dB Compression : 10dBm  
 Noise Figure : 0.5dB  
 Impedance : 50 Ohms  
 Connector : SMA  
 Operating Current : 35mA  
 Operating Voltage : 15V DC  
 Substrate : Ceramic

### 16. Microstrip Amplifier : MMIC InGaP HBT Amplifier



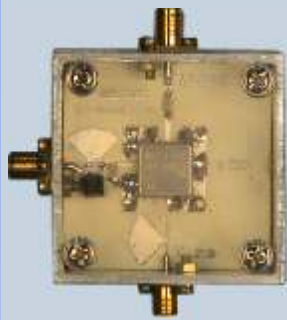
Device : InGaP HBT  
 $F_c : 3.0 \pm 1$  GHz  
 Gain : >15dB  
 1dB Compression : 10dBm  
 Noise Figure : 3.5dB  
 Impedance : 50 Ohms  
 Connector : SMA  
 Operating Current : 35mA  
 Operating Voltage : 15V DC  
 Substrate : Ceramic

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### 17. Microstrip VCO : Voltage Control Oscillator



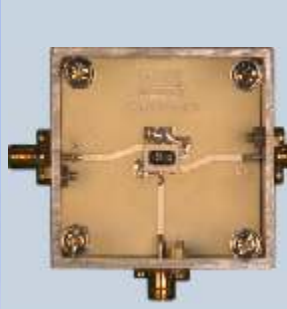
$F_c$ : 2.9 ± 0.9 GHz  
 Output Power : +5dBm  
 Phase Noise : -130dBm @ 1MHz  
 Harmonics : -20dBc  
 Tuning Voltage : 0.5-20V  
 Connector : SMA  
 Substrate : Ceramic

### 22. Microstrip Tapered Line Transformer



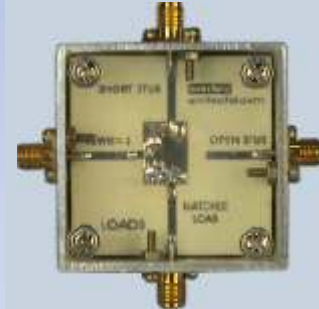
$F_c$ : 3.0 ± 0.5 GHz  
 Return Loss : 10 dB at 3GHz  
 VSWR = 3 at DC  
 Load : 150 Ohms  
 Connector : SMA  
 Substrate : Ceramic

### 18. Mixer



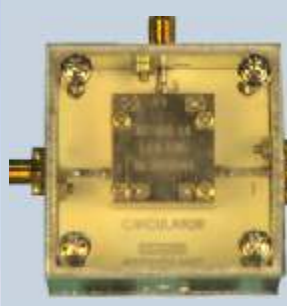
Freq Lo/RF : 1.6 - 6 GHz  
 Freq IF : DC-2GHz  
 Conversion Loss : 8dB  
 LO Drive Level : +7dBm  
 LO/RF  $S_{11}$  : -20 ± 2dB  
 LO/RF  $S_{12}$  : -15 ± 2dB  
 Connector : SMA  
 Substrate : Ceramic

### 23. Microstrip Loads : Mis-matched/matched loads



$F_c$ : 3.0 ± 0.2 GHz  
 Return Loss : 20/6/0/0 dB  
 Load : Quarter wave matched, VSWR 3, Open & Short Stubs  
 Connector : SMA  
 Substrate : Ceramic

### 19. Circulator



$F_c$ : 3.0 ± 0.1 GHz  
 Insertion Loss : <1dB  
 Isolation : >20dB  
 Impedance : 50 Ohms  
 $S_{11}$  : -15 ± 2dB  
 Connector : SMA  
 Substrate : Ceramic

### 24. Microstrip Wilkinson Equal Power Divider



$F_c$ : 3.0 ± 0.2 GHz  
 Isolation : 15 ± 2dB  
 Insertion Loss : 3.5 dB ± 0.5dB  
 Amplitude Unbalance : 0.5dB  
 Phase Unbalance : <5 degrees  
 Connector : SMA  
 Substrate : Ceramic

### 20. Microstrip Resonator : Ring resonator



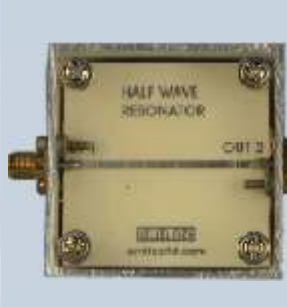
Ring Resonator  
 $F_c$ : 3.0 ± 0.1 GHz  
 $S_{11}$  : -4 ± 1dB  
 $S_{12}$  : -4 ± 2dB  
 Q : 50 typical  
 Connector : SMA  
 Substrate : Ceramic

### 25. Microstrip Wilkinson Unequal Power Divider



$F_c$ : 3.0 ± 0.2 GHz  
 Isolation = 15 ± 2dB  
 Insertion Loss = 3.5 dB ± 0.5dB  
 Amplitude Unbalance: 3dB  
 Phase Unbalance : <10 degrees  
 Connector : SMA  
 Substrate : Ceramic

### 21. Microstrip Half Wave Resonator



$F_c$ : 3.0 ± 0.1 GHz  
 $S_{11}$  : -2 ± 1dB  
 $S_{12}$  : -20 ± 2dB  
 Q : 50 typical  
 Connector : SMA  
 Substrate : Ceramic

### 26. Directional Coupler



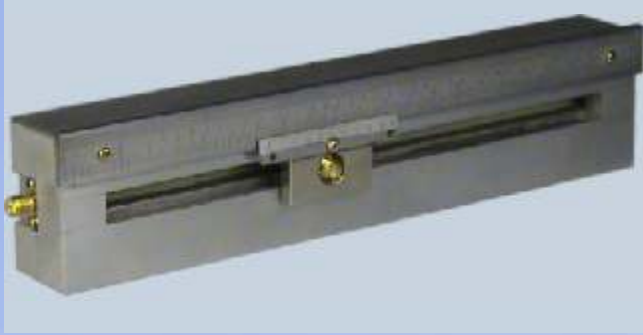
$F_c$ : 3.0 ± 1 GHz  
 Insertion  $S_{12}$  : 1 + 0.5 dB  
 Coupling  $S_{13}$  : 10 ± 2dB  
 Isolation  $S_{14}$  : 20 ± 2dB  
 Directivity  $S_{23}$  : 15 ± 3dB  
 Impedance : 50 Ohms  
 Connector : SMA

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### 27. Coaxial Slotted Line



S11: >15dB  
 S12: <2dB  
 Resolution: 0.05mm using vernier  
 Coupling : -20dB typical  
 Connector : SMA  
 Residual VSWR : <1.2  
 Velocity propagation :  $1.818 \times 10^8$  m/s  
 Wavelength/360° phase : 60.5mm at 3GHz  
 Total Length : 200mm

### 28. Microstrip Antennas : Patch Inset Fed



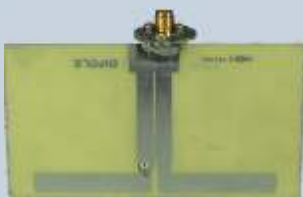
Microstrip Patch Inset Fed  
 $F_c: 1.5 \pm 0.15$  GHz  
 $S_{11}: 8 \pm 2$  dB  
 Polarisation : Linear  
 Gain : 5dBi  
 Impedance : 50 Ohms  
 Connector : SMA  
 Substrate : Ceramic

### 29. Microstrip Antennas: Log Periodic Array



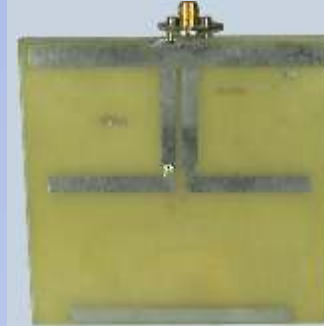
S11: >10dB  
 Bandwidth:  $1500 \pm 500$  MHz  
 Gain: 6dBi  
 Beamwidth : E plane 60°  
 Beamwidth : H Plane 80°  
 Polarisation : Linear  
 Front to Back Ratio: 6dB  
 Connector : SMA

### 30. Microstrip Antennas : Dipole



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

### 31. 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

### 32. Standard Accessories



50 Ohms Matched Termination SMA(M) - 4 Nos, Short termination SMA(M), Teflon based RG316 cables 4 nos SMA(M)-SMA(M), SMA(F)-SMA(F), Software- RF Unit converter, AppCAD, E-Manual / Installation Video for ease of Learning

### Scope of Experiments

- \* Properties of Directional Coupler: Measurement of coupling factor, Directivity, return loss of a load, main line insertion loss, isolation, VSWR of ports.
- \* Measurement of S11, S12, S21, S22 parameters of microstrip components
- \* To measure the VSWR(return loss) of microstrip inset fed patch antenna.
- \* Properties of Branch Line Coupler: Measurement of coupling factor, return loss of a load, main line insertion loss, isolation, VSWR of ports.
- \* Properties of Hybrid Ring Rat race Coupler: Measurement of Power division or Decoupling between Sum and Diff arms of a rat race coupler, Measurement of Insertion loss S21 & S41, Measurement of Return Loss/ impedance match at ports 1 & 4 - S11, S44, measurement of Isolation between ports 1 & 3 - S13, Measurement of Phase difference in output arms 2&4 as 180Deg.
- \* 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: 56 X48 X 36, Weight: 20 Kg, Warranty: 3 yrs.

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