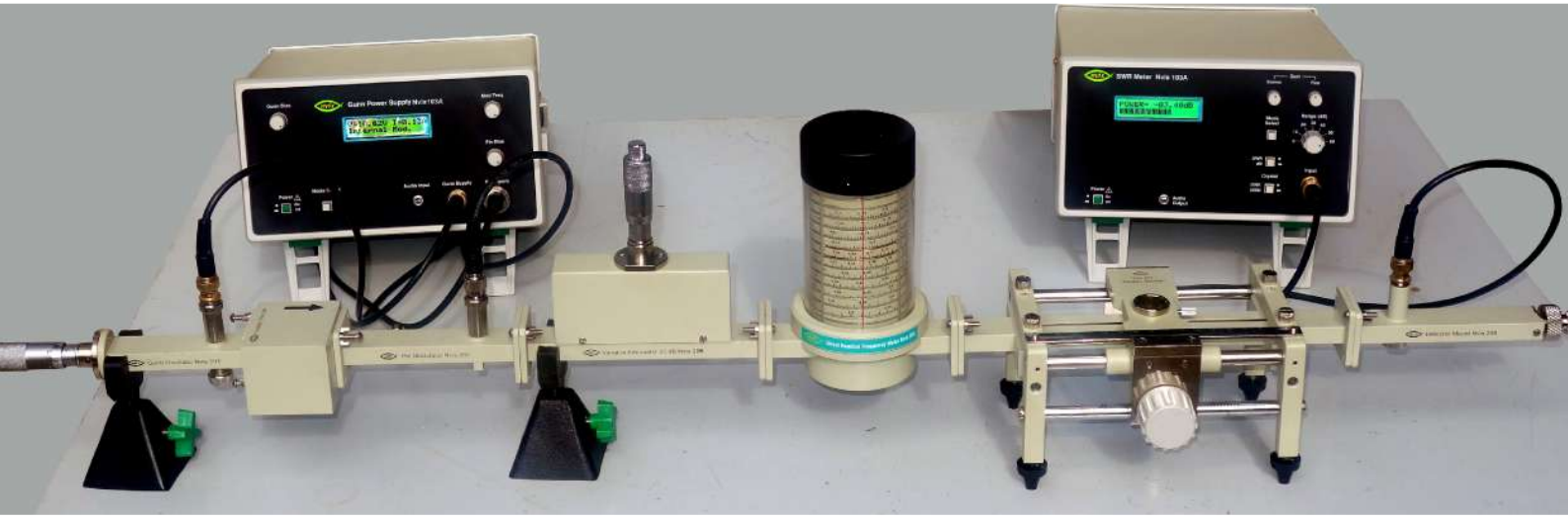
Microwave Test Bench Series

Nvis 9000 Series



The Nvis 9000 series of Microwave Test Benches are precision made microwave systems, which use standard type rectangular wave-guide components to illustrate the essential elements of this field for study.

The equipment consist of :

- A selection of wave-guide components
- The Power Supply for the microwave source
- A detector
- A meter, which monitors the detector output
- A Demo Video CD
- Audio Communication
- Provided with PC to PC communication in Gunn based Benches
- Wall Chart

These Training Benches are completely self-contained & provide the means to allow students to carry out practical work at extremely low cost. A comprehensive manual containing extensive microwave theory and a progressive series of assignments is supplied with the platform.

Wall Chart

Microwave Test Bench Series

Nvis 9000 Series

Microwave Test Bench Nvis 9000

(Klystron Based)

Experiments that can be performed

- Study of the characteristics of klystron tube and to determine its electronic tuning range
- To determine the frequency & wavelength in a rectangular waveguide working on TE_{10} mode
- To determine the standing wave ratio and reflection coefficient
- To measure an unknown impedance with Smith Chart
- To study the square law behaviour of a microwave crystal detector
- To study the voice communication by using microwave test bench
- To study the variable attenuator

Microwave Test Bench Nvis 9001

(Gunn Based)

Experiments that can be performed

- To study the V-I characteristics of Gunn Diode
- To study the voice communication by using microwave test bench
- To study the following characteristics of Gunn Diode
  - Output power and frequency as a function of voltage
  - Square wave modulation through Pin Diode
- To determine the frequency & wavelength in a rectangular waveguide working on TE10 mode
- To determine the standing wave ratio and reflection coefficient
- To measure an unknown impedance with Smith Chart
- To study the square law behaviors of a microwave crystal detector
- To study the PC to PC data communication
- To study the variable attenuator

Microwave Test Bench Nvis 9002

(Klystron/Gunn Based)

Experiments that can be performed

- Study of the characteristics of Klystron tube and to determine its electronic tuning range
- To determine the frequency in a rectangular waveguide working on TE10 mode
- To measure the polar pattern and the gain of following antennas
  - Standard Gain Horn - Pick up horn
  - Slotted Broad Wall - Slotted Narrow Wall
  - Dielectric Antenna - E-plane Sectorial Horn
  - H-Plane Sectorial Horn - Pyramidal Horn - Parabolic Dish
- To study the square law behaviour of a microwave crystal detector.
- To study the voice communication by using microwave test Bench.
- To study the variable attenuator

Microwave Test Bench Series

Nvis 9000 Series

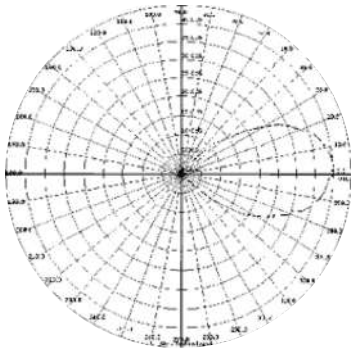
Microwave Test Bench Nvis 9002A

(Klystron Based/Gunn based)

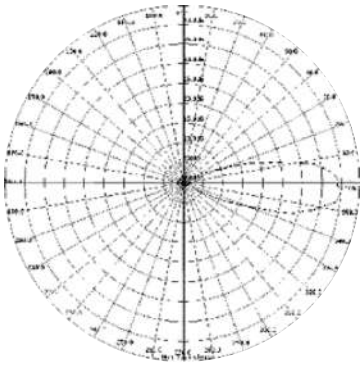
To study the variable attenuator

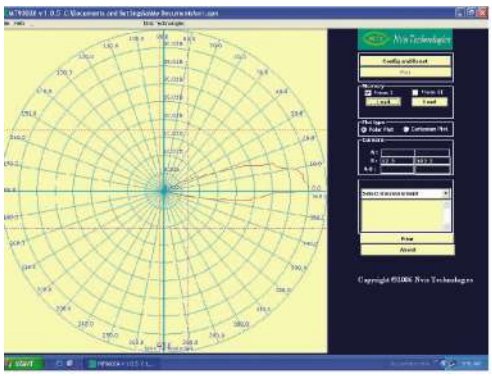
All the experiments of Nvis 9002 can be performed in this model using PC interfaced Motorized unit.

Radiation pattern of Pickup Horn Antenna



Radiation pattern of Horn Antenna





Application software window

Features

- Microcontroller Based High Precision DC Stepper Motor Automatic Zero Point setting
- Built-in DC Power Supply
- Instant Plotting of radiation Pattern
- Resolution : 1°
- RS232 data link to PC
- Software running under Windows 98
- PC Based Motorized Unit

Technical Specifications

Microwave Input	: From Gunn / Klystron source
Detector	: With BNC output
Antenna Rotation	: 360° (1° Resolution)
Power Supply	: 230V ±10%, 50Hz
Power Consumption	: 22V A (approximate)

Accessories :

Mains Cord

BNC-BNC Cable

RS-232 Cable

Radiation Pattern Plotting Software

Microwave Test Bench Series

Nvis 9000 Series

Microwave Test Bench Nvis 9003

(Gunn Based)

Experiments that can be performed

- To study the V-I characteristics of Gunn Diode
- To study the following characteristics of Gunn Diode
  - Output power and frequency as a function of voltage
  - Square wave modulation through Pin Diode
- To determine the frequency & wavelength in a rectangular waveguide working on TE_{10} mode
- To determine the standing wave ratio and reflection coefficient
- To study the square law behaviour of a microwave crystal detector
- To study the resonant cavity
- Measurements of Dielectric constant.(Solid and liquid)
  - Low-loss solid dielectrics- Liquid dielectrics or solutions
- To study the phase shift measurements by using phase shifter
- To study the variable attenuator

Microwave Test Bench Nvis 9004

(Klystron/Gunn Based)

Experiments that can be performed

- Study of the characteristics of klystron tube and to determine its electronic tuning range
- To determine the frequency & wavelength in a rectangular waveguide working on TE10 mode
- To determine the standing wave ratio and reflection coefficient
- To measure an unknown impedance with Smith Chart
- To study the square law behaviour of a microwave crystal detector
- Study of attenuators (fixed and variable type)
- Study of Tee
  - E Plane Tee - H Plane Tee - Magic Tee
- Study the function of multihole directional coupler by measuring the following parameters.
  - Main line & Auxiliary line VSWR
  - Coupling factor and directivity and Isolation
- Study of circulators/Isolator

Microwave Test Bench Nvis 9005

(Gunn Based)

Experiments that can be performed

- To determine the frequency & wavelength in a rectangular waveguide working on TE10 mode
- To study the following characteristics of Gunn Diode
  - Output power and frequency as a function of Bias Voltage
  - Square wave modulation through PIN diode
- To determine the Standing Wave-Ratio and Reflection Coefficient
- To measure an unknown Impedance with Smith chart
- To study V-I characteristics of Gunn Diode
- To measure the gain of a waveguide horn antenna
- Study the function of multi-hole directional coupler by measuring the following parameters :
  - To Measure main-line and auxiliary-line VSWR
  - To Measure the coupling factor and directivity and isolation.
- Study of Magic Tee
- To study the square law behaviour of a microwave crystal detector

Technology Learning Software Microwave

Microwave Fundamentals

Microwave Fundamentals software is very powerful tool to understand core concept of Microwave Technology, throw high quality Simulation, rich theoretical content and attractive animated diagrams.

It covers following topics.

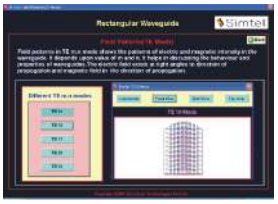
Electromagnetic Wave

Basics of Electromagnetic waves

Wave Guide

Rectangular Wave Guide

TE Modes, TM Modes, Field Patterns, Power Flow.



Circular Wave Guide

TE Modes, TM Modes, Field Patterns, Power Flow.

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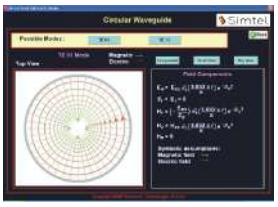


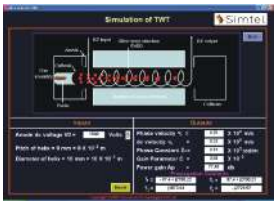
Microwave Components

Microwave Cavities, Microwave Hybrid Circuits

Directional Coupler, Circulator and Isolator

Microwave Tubes

Velocity Modulation, Klystron, Magnetron, Traveling Wave Tube



Microwave Active Components

Gunn Diode, IMPATT Diode, TRAPATT Diode, Tunnel Diode

Microwave Test Bench Series

Nvis 9000 Series

List of Benchwise Components

Sr. No.	Code	Description	Required Quantity for Benches					
			9000	9001	9002	9003	9004	9005
1	Nvis-249	Band Pass Filter	-	-	-	-	-	-
2	Nvis-225	Coaxial WIG Adaptor	-	-	2	-	-	1
3	Nvis-250	Cooling Fan	1	1	1	1	1	1
4	Nvis-229	Cross Directional Coupler 20 dB	-	-	-	-	1	-
5	Nvis-209	Detector Mount	1	1	1	1	1	1
6	Nvis-243	Dielectric Antenna	-	-	1	-	-	-
7	Nvis-248	E-H Tee	-	-	-	-	-	-
8	Nvis-232	E-Plane Bend	-	-	-	-	1	2
9	Nvis-244	E-Plane Sectoral Horn	-	-	1	-	-	-
10	Nvis-221	E-Plane Tee	-	-	-	-	1	-
11	Nvis-219	Fixed Attenuator 10 dB	-	-	-	-	1	1
12	Nvis-217	Fixed Attenuator 3 dB	-	-	-	-	1	-
13	Nvis-218	Fixed Attenuator 6 dB	-	-	-	-	1	-
14	Nvis-224	Fixed Short	1	1	-	-	-	1
15	Nvis-205	Frequency Meter (Direct Readout)	1	1	1	1	1	1
16	Nvis-255	Frequency Meter (Micro Meter Type)	-	-	-	-	-	-
17	Nvis-201	Gunn Oscillator	-	1	-	1	-	1
18	Nvis-101	Gunn Power Supply	-	1	-	1	-	1
19	Nvis-233	H-Plane Bend	-	-	-	-	1	1
20	Nvis-245	H-Plane Sectoral Horn	-	-	1	-	-	-
21	Nvis-222	H-Plane Tee	-	-	-	-	1	-
22	Nvis-211	Helical Antenna	-	-	-	-	-	-
23	Nvis-257	High Pass Filter	-	-	-	-	-	-
24	Nvis-204	Isolator	1	1	1	1	1	1
25	Nvis-203	Klystron Mount	1	-	1	-	1	-
26	Nvis-237	Liquid Dielectric Cell	-	-	-	1	-	-
27	Nvis-258	Low Pass Filter	-	-	-	-	-	-
28	Nvis-223	Magic Tee	-	-	-	-	1	1
29	Nvis-212	Matched Termination	1	1	-	-	2	1
30	Nvis-210	Movable Short	1	1	-	-	1	1
31	Nvis-228	Multi Hole Directional Coupler 10 db	-	-	-	-	1	1
32	Nvis-226	Multi Hole Directional Coupler 3 db	-	-	-	-	1	-

Sr. No.	Code	Description	Required Quantity for Benches					
			9000	9001	9002	9003	9004	9005
33	Nvis-227	Multi Hole Directional Coupler 6 db	-	-	-	-	-	-
34	Nvis-247	Parabolic Dish	-	-	1	-	-	-
35	Nvis-238	Phase Shifter	-	-	-	1	-	-
36	Nvis-240	Pick Up Horn Antenna	-	-	1	-	-	-
37	Nvis-202	Pin Modulator	-	1	-	1	-	1
38	Nvis-235	Precision Movable Short	-	-	-	1	-	-
39	Nvis-246	Pyramidal Horn	-	-	1	-	-	1
40	Nvis-214	Radiation Pattern Turn Table	-	-	1	-	-	-
41	Nvis-220	Slide Screw Tuner (S.S. Tuner)	1	1	-	-	1	1
42	Nvis-241	Slotted Broad Wall	-	-	1	-	-	-
43	Nvis-242	Slotted Narrow Wall	-	-	1	-	-	-
44	Nvis-207	Slotted Section	1	1	-	1	1	1
45	Nvis-236	Solid Dielectric Cell	-	-	-	1	-	-
46	Nvis-102	Solid State Klystron Power Supply	1	-	1	-	1	-
47	Nvis-239	Standard Gain Horn Antenna	-	-	1	-	-	1
48	Nvis-230	Three Port T Circulator	-	-	-	-	1	-
49	Nvis-231	Y Circulator	-	-	-	-	1	-
50	Nvis-208	Tunable Probe	1	1	-	1	1	1
51	Nvis-206	Variable Attenuator 20 db	1	1	1	1	1	1
52	Nvis-103	VSWR Meter	1	1	1	1	1	1
53	Nvis-213	Wave Guide Stand	4	4	2	4	4	4
54	Nvis-216	Wave Guide Twist	-	-	1	-	-	-
55	Nvis-234	Wave Guide Cavity Resonator	-	-	-	1	-	1
1	Nvis-215	Pair of Bend to connect the Antenna	-	-	1	-	-	-
2		BNC to BNC Cable	2	2	2	2	2	2
3		Coaxial Cable N to N	-	-	1	-	-	1
4		N-Type to TNC Cable	-	1	-	1	-	1
5		Op. Manual	1	1	1	1	1	1
6		Mains Cord	2	2	2	2	2	2
7		Smith Chart	1	1	-	-	1	1
8		Teflon, Nylon, Ebonite, Perspex, Wax in 10, 20, 30 mm length each (S.Dielectrics)	-	-	-	1 Set	-	-

Microwave Component Technical Specification

Nvis 201 **Gunn Oscillator**

Gunn Oscillators are used to generate the microwave signal and its Micrometer is used to tune the output frequency of Gunn oscillator.

Band	X
Frequency(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Pushing Factor	--
Bias Voltage max.	10V
Normal Power Output	10mW
Temp. Coefficient	--
Output Connection	BNC(F)
Frequency Adjustment	By Micrometer

Nvis 216 **Waveguide Twist**

Waveguide Twist is used to change the plane of Polarization of a wave Guide transmission line . Twist is made from a section of waveguide which has been precisely twisted. 900 twist is a standard available model.

Band	X
Frequency(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
VSWR	1.09 At 10.5GHz
Return Loss	-26.9dB At 10.5GHz

Microwave Test Bench Series

Nvis 9000 Series

Nvis 212 **Matched Termination**

Matched terminations are used to terminate the waveguide transmission line operating at low average power. The loads are carefully designed to absorb all the applied power and VSWR of matched termination is low. These are used in the measurement of reflection coefficient and where the matched load is required.

Band	X
Frequency(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
VSWR	1.03 At 10.5GHz
Return Loss	-33dB At 10.5GHz
Av. Power	2W
Type	Fixed

Nvis 210 **Movable Shorts /**
Nvis 235 **Precision Movable Short**

Movable shorts are used to obtain a phase reference in the calibration of various experimental setups .These are also used to vary the effective plane of reflection and therefore the phase of reflected wave. Movable shorts are used to measure the impedance of a device. Movable shorts are of two types one has no provision to record position of short in the waveguide and other type of movable short is precision movable short in which position of short can be accurately recorded from micrometer.

Band	X
Frequency(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Reflection Coefficient	0.98

Nvis 238 **Phase Shifter**

Many applications require phase shift to be introduced between two given position in a waveguide system. It consists of a dielectric slab or vane specially shaped to minimize reflection effect. Phase shifter are used to change the effective electrical length of transmission line without changing its physical length. They are particularly useful in microwave bridge circuit where the phase and amplitude must be adjusted independently.

Band	X
Frequency(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
VSWR	1.15 At 10.5GHz
Return Loss	-23.1 At 10.5GHz
Calibration Accuracy	±2.5°

Nvis 208 **Tunable Probe**

Tunable probes are very useful devices to measure the SWR and Impedances. Tunable probe is consists of a crystal detector and a small wire antenna in coaxial housing. Its depth of penetration into the slotted section is variable.

Band	X
Frequency(GHz)	8.2-12.4
Detector	IN23
Output connector	BNC(F)
Type	Tunable

Microwave Test Bench Series

Nvis 9000 Series

Nvis 220 **Slide Screw Tuners**

Slide Screw Tuner is a very useful component in a microwave laboratory. It is mainly used for Impedance measurement. Its tuner can be adjusted for low and high impedance position.

Band	X
Frequency(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Max. VSWR	20 : 1.02

Nvis 203 **Klystron Mount**

Klystron mounts are used to transmit microwave power from reflex klystron tube to rectangular waveguide. Klystron mounts are designed by a section of waveguide, one end of waveguide is fitted with a movable short plunger. A small hole on the broad wall of waveguide is provided through which coupling pin of reflex klystron tube enters into the waveguide. By moving plunger (matching the impedance of klystron tube and waveguide) maximum output can be achieved.

Band	X
Frequency(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U

Nvis 202 **Pin Modulator**

Pin diode modulators are used to provide amplitude or pulse modulation in wide range of microwave to study many applications. These modulators uses PIN diode which is mounted across the waveguide line with RF isolated DC bias lead passing to an external TNC(F)

Band	X
Frequency(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Bias Voltage	0-12 Vpp
Output Connector	TNC(F)

Nvis 205 **Direct Reading Frequency Meter**

Direct Reading frequency meters are used to measure the microwave frequency accurately. There long scale length and numbered calibration marks provide high resolution which is particularly useful when measuring frequency difference of small frequency changes.

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Calibration Accuracy	± 2%
Calibration Increment	5 MHz
Max. VSWR	1.28 At 10.5GHz
Return Loss	-18.2 At 10.5GHz

Microwave Test Bench Series

Nvis 9000 Series

Nvis 205A **Digital DRF Meter (Optional)**

Direct Reading frequency meters are used to measure the microwave frequency accurately. Digital Display LCD provides high resolution which is particularly useful while measuring frequency difference of small frequency changes.

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Calibration Accuracy	± 2%
Calibration Increment	5MHz
Max. VSWR	1.28 At 10.5GHz
Return Loss	-18.2 At 10.5GHz

Nvis 206 **Variable Attenuator**

10 dB / 20 dB

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
VSWR Max.	1.25 At 10.5GHz
Av. Power	2 W
Return Loss	-19.23 At 10.5GHz

Nvis 225 **Wave Guide Adaptor**

Adaptors transform waveguide impedance to coaxial impedance. Adopters consist of a short section of waveguide with a probe transition mounted on broad wall. Power can be transmitted in either direction. Each adaptor covers the 50% of the waveguide.

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Connector	N Type (F)
VSWR Max.	1.12 At 10.5GHz
Return Loss	-24.5 At 10.5GHz

Nvis 217-219 **Fixed Attenuators**

Attenuators are required to adjust power or attenuate the power flowing in waveguide.There are two type of attenuators fixed and variable. Fixed attenuators available in various range like 3dB,6dB,10dB etc. These attenuators are calibrated at center frequency of respective frequency band. By Variable attenuators power can be adjusted for different level.

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
VSWR Max.	1.06 At 10.5GHz
Av. Power	2W
Accuracy	± 0.5 dB
Return Loss	-31 dB At 10.5GHz

Nvis 232 **E-Plane Bends**

In measurements it is often necessary to bend a waveguide by some angle. Waveguide bends in E and H plane of 90° is normally available. Waveguide bends designed by a section of rectangular waveguide and flange.

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
VSWR Max.	1.25 At 10.5GHz
Return Loss	-25.7 dB At 10.5GHz

Nvis 233 **H Plane Bends**

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
VSWR Max.	1.06 At 10.5GHz
Return Loss	-31 dB At 10.5GHz

Nvis 229 **Cross Directional Coupler**

Cross Directional Coupler consists of two waveguide sectional joint at (90°) with the coupling element mounted into the common broad wall.

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Coupling (dB)	20 dB
Directivity (Min)	25 dB
Coupling Accuracy	± 1 dB

Nvis 226, Nvis 253, Nvis 228
Multihole Directional Coupler

Directional coupler are designed to measure incident and reflected power values and also provide a signal path to a receiver or perform other desirable operation. In its most common form, the directional coupler is a four fort waveguide junction consisting of a primary main waveguide and a secondary auxiliary waveguide. These are available in 3, 6,10, 20, 40 dB coupling.

For 10 dB

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
VSWR Max.	1.06 At 10.5GHz
Return Loss	-31 dB At 10.5GHz
Coupling (dB)	10.1 ± 0.6
Directivity (Min)	46.0 dB (3%)

Microwave Test Bench Series

Nvis 9000 Series

Nvis 236 **Solid Dielectrical Cell**

These are used to measure dielectric constant of any solid material these consists of a cavity for keeping the sample and micrometer to read the position of sample.

Band	X
Frequency Range (GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Max. Length of cell	100 mm
Plunger Movement	25 mm

Nvis 237 **Liquid Dielectrical Cell**

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Max. Length of cell	200 mm
Plunger Movement	65 mm

TEE

Tees are used to combine power from two input or divided the microwave power from one input to two output lines. Tee is an intersection of three waveguides in the form of alphabet T.

Nvis 221 **E Plane Tee**

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Max. Length of cell	200 mm
Plunger Movement	65 mm

Nvis 223 **Magic Tee /** Nvis 248 **E-H Tee**

Band	X
Frequency Range	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U

Nvis 222 **H Plane Tee**

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U

Nvis 209 **Wave Guide Detector Mount**

The crystal detector can be used for the detection of microwave signal. At low level of microwave power, the response of each detector approximates to square law characteristics and may be used with a high gain selective amplifier having a square law meter calibration.

Band	X
Frequency Range(GHz)	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Detector	IN21(any equivalent)
Output Connector	BNC (F)

Microwave Test Bench Series

Nvis 9000 Series

Nvis 204 **Ferrite Isolator,** Nvis 230 **T Circulator,** Nvis 231 **Y Circulator**

The ferrites isolators and circulators are matched 2 port and 3 port devices respectively, which offer low insertion loss and high isolation over 1GHz band width. An isolator is a 2 port device which allows signals from port 1 to port 2 & provides maximum attenuation for transmission from port 2 to 1. A circulator is a three port device which has a peculiar property of coupling power to the adjacent port clockwise

Band	X
Frequency Range	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Max. VSWR	1.15
Min. Insertion Loss	0.46 dB
Min. Isolation	20 dB
Return Loss	22.4

Nvis 255 **Micrometer Type Frequency Meter**

Micrometer type frequency meters are consists of a microwave cavity with plunger and a section of waveguide. It consists of a micrometer to measure its position for measuring frequency.

Band	X
Frequency Range	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Max. VSWR	1.15
Calibration Accuracy	± 2 %
Calibration Increment	10 MHz

Nvis 239-247 **Waveguide Antennas**

There are several types of microwave antennas like standard Gain, Pyramidial horn, Pick up horn, Dielectric antenna, Parabolic dish antenna etc. these are used to radiate microwave energy in the air and to receive the energy from air.

Frequency Range(GHz)	Flange Designation	Waveguide Type	Antennas Type	Gain
8.2-12.4 GHz	UG-39/U	WR-90	Pyramidal	16
8.2-2.4 GHz	UG-39/U	WR-90	Pick Up	10
8.2-12.4 GHz	UG-39/U	WR-90	E-Section	15
8.2-12.4 GHz	UG-39/U	WR-90	H-Section	15
8.2-12.4GHz	UG-39/U	WR-90	Parabolic dish	--
8.2-12.4GHz	UG-39/U	WR-90	Standard Gain	--
8.2-12.4GHz	UG-39/U	WR-90	Dielectric Antenna	--

Nvis 207 **Slotted Section**

Slotted section is used to measure various measuring parameter in microwave. for example to determine VSWR, phase and impedances. These consists of a slot in center of waveguide in which we can connect a probe and probe can be moved in slot and position of probe can be measured by its Varnier scale. The travel of probe carriage is more than three times of half wavelength.

Band	X
Frequency Range	8.2-12.4
Waveguide	WR-90
Flange	UG-39/U
Residual VSWR	1.01
Slope (dB)	± (0.2dB)

Subject to change - Version 2.0

Designed & Manufactured in India by

Nvis Technologies Pvt. Ltd.

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