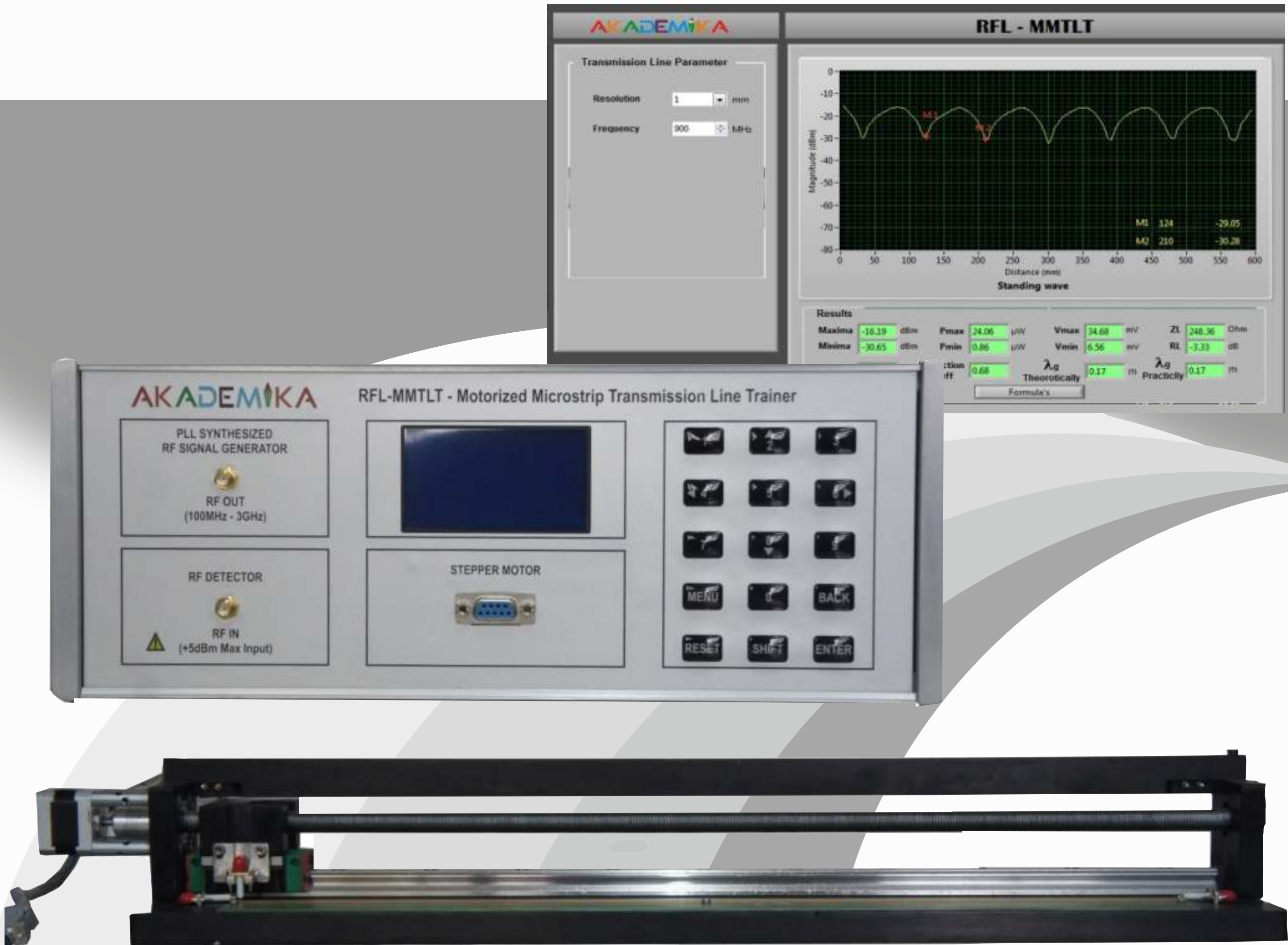
RFL- MMTLT

Motorized Microstrip Transmission Line Trainer

- 50 Ω Microstrip Transmission line
- 1mm Sensing Probe Resolution
- Standing wave pattern at various frequencies
- Guided Wavelength Measurement
- Characterization of Different LOADS (OPEN, SHORT, LOAD)
- Characterization of Unknown LOAD Vs Frequency
- S-Parameters (S_{11}, S_{21}, S_{12}, S_{22}) Measurement
- Analysis of reflection coefficients, VSWR and Impedance for LOAD, OPEN and SHORT termination
- Smith Chart Analysis



RFL- MMTLT

AKADEMIKA'S RFL-MMTLT is a new concept to teach the transmission line theory. The kit primarily focuses on Minima and Maxima Measurement for various loads condition as well as various frequencies. Probe/Sensing motion along the transmission line having standard hardening Ball screw arrangement

Microstrip Transmission Lines

Microstrip is a type of electrical transmission line which can be fabricated using printed circuit board technology, and is used to convey microwave-frequency signals. It consists of a conducting strip separated from a ground plane by a dielectric layer known as the substrate. Microwave components such as antennas, couplers, filters, power dividers etc. can be formed from microstrip, with the entire device existing as the pattern of metallization on the substrate. Microstrip is thus much less expensive than traditional waveguide technology, as well as being far lighter and more compact

Microstrip lines are also used in high-speed digital PCB designs, where signals need to be routed from one part of the assembly to another with minimal distortion, and avoiding high cross-talk and radiation

Transmission line Terminated with LOAD (Z0)

For maximum transfer of energy into a transmission line from a source or from a transmission line to a load (the next stage of an amplifier, an antenna, etc.), the impedance of the source and load should match the characteristic impedance of the transmission line. In general, then, Zo is the target for input and output impedances of devices and networks.

Let's review what happens when transmission lines are terminated in various impedances, starting with a Zo load. Since a transmission line terminated in its characteristic impedance results in maximum transfer of power to the load, there is reflected signal

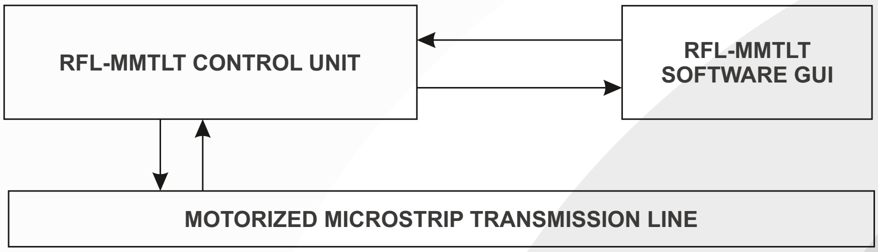
Transmission line Terminated with SHORT

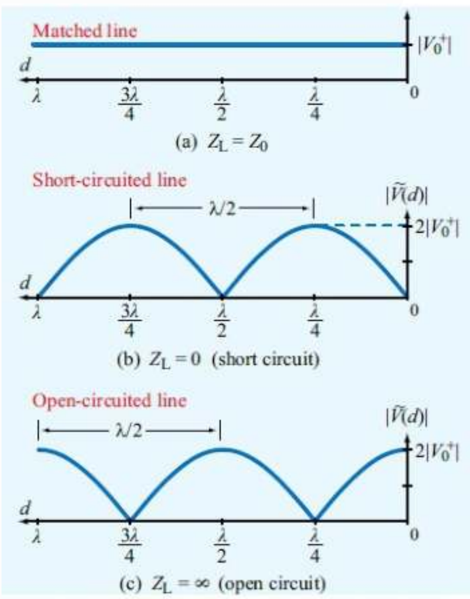
When Transmission line is terminated by short circuit then purely reactive elements cannot dissipate any power, and there is nowhere else for the energy to go, a reflected wave is launched back down the line toward the source. Our reflected and incident voltage (and current) waves will be identical in magnitude but traveling in the opposite direction.

Voltage Standing wave ratio (VSWR)

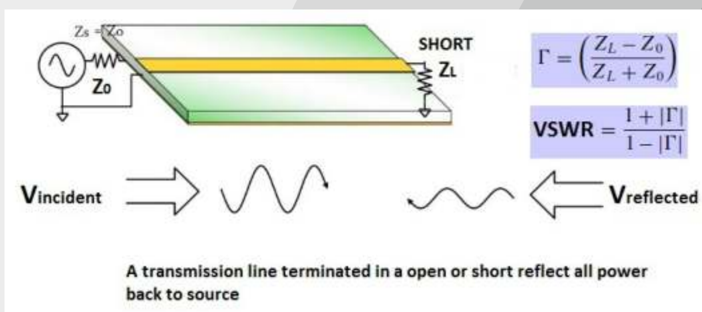
In radio engineering and telecommunications, standing wave ratio (SWR) is a measure of impedance matching of loads to the characteristic impedance of a transmission line or waveguide. Impedance mismatches result in standing waves along the transmission line, and SWR is defined as the ratio of the partial standing wave's amplitude at an antinode (maximum) to the amplitude at a node (minimum) along the line

FUNCTIONAL BLOCK

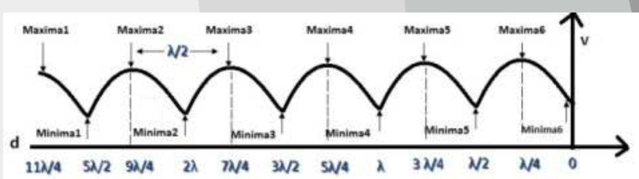




Standing Waves Pattern



Standing-waves for matched, short, and open cases.



Multiple Harmonics in Sanding- waves for OPEN

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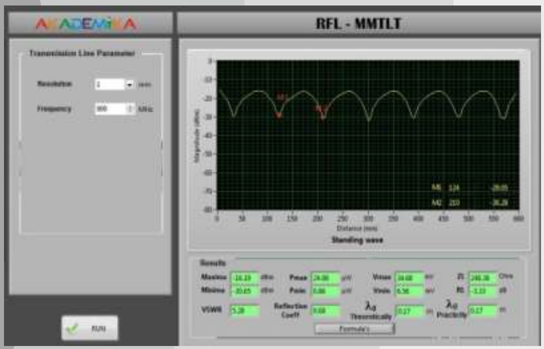
KEY MEASUREMENT PARAMETERS

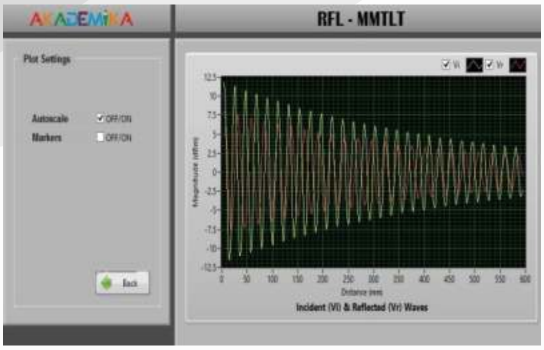
1. Standing Wave Pattern



Standing wave @900MHz under OPEN Condition

Graph shows standing wave characterization for OPEN termination condition. An input of 900MHz is given to the Transmission Line we observe 7 harmonics in above graph and 60% power is reflected back to source.

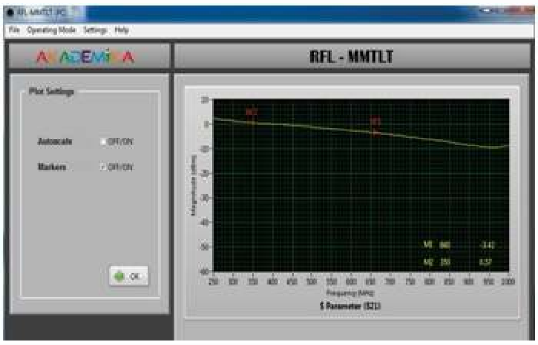
2. Incident Vi and Reflected Vr Power



Incident (Vi) and reflected waves (Vr) of MicrostripTransmission line

Graph shows the incident and reflected waves of Transmission line. The Yellow line is Incident wave and Red line is reflected wave for short or open terminations. This means that in open or short conditions all the power is reflected back to source.

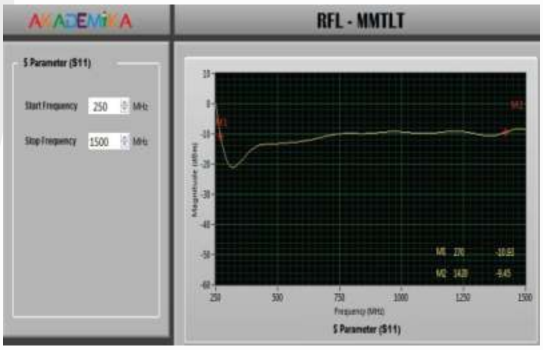
3.Insertion Loss (S_{21} or S_{12})



S_{21} of Microstrip Transmission Line

Graph Shows the insertion loss of transmission line is 0.5dB at 350 MHZ which means very less power is coupled from port 2 to port 1

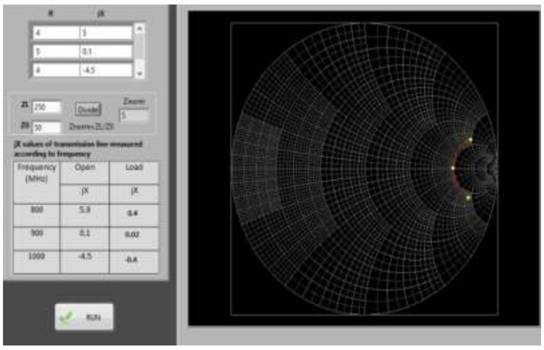
4. S-Parameters (S_{11} or S_{22})



S_{11} of MicrostripTransmission Line

Graph shows the operating frequency of the Microstrip transmission line is from 270MHz to 1420MHz in which the S_{11} has values below -10dB through the entire band.S_{11} represents how much power is reflected from the port1, and hence is known as the reflection coefficient If S_{11}=-10 dB Then 90% power is delivered to the port 1 and only 10% is the reflected power from port 1.

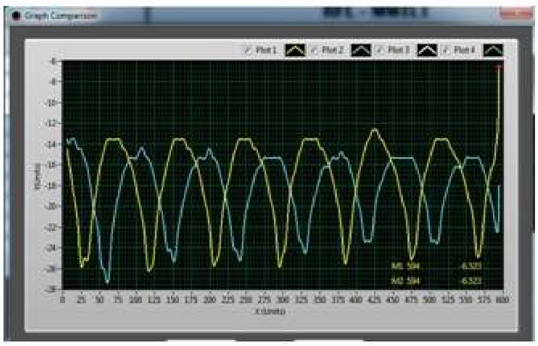
5. Smith chart



Normalized Impedance for open termination

Graphs shows the normalized impedance is plotting on smith chart for open termination

6.Open Vs Short Termination Standing wave



Plot Comparison OPEN Vs SHORT termination

Graph shows the Standing Wave of the Microstrip TransmissionLine with OPEN termination (Yellow)Vs SHORT termination(Blue). It is clearly seenthat there is a Phase Shift of 180° between the peaks of OPEN and SHORT condition.

RFL- MMTLT Motorized Microstrip Transmission Line Trainer

TECHNICAL SPECIFICATION

Microstrip Transmission Trainer	
Frequency	250MHz TO 1500MHz
Type of Device	Passive
Characteristics Impedance	50 Ω
Source Type	PLL Synthesizer
Power	+9dBm
Copper Thickness	1oz (35um)
Resolution	150KHz
Power Handling Capacity	+30dBm
Detector Type	Dual Log Type
Output Array Storage	580 points on self memory
Operational Mode	PC & Panel mode
Compatible T.M.I	VNA, Spectrum Analyzer with T.G.
Transmission Line Length	590mm
Sensing Probe Resolution	1mm
Probe Output	dBm/ uW/ mV
Directional Coupler	
Frequency	20 to 3000 MHz
Number of Port	3
Result/graph Plotting	S11, Z, VSWR
Impedance	50 Ω
Minimum Return Loss(S11)	-30dB
Power Handling	1W
Temperature Range	0 to 55

Experimental Mode

- Standing Wave
- Transmission Line Parameter
- Incident & Reflected Wave
- Smith chart
- S Parameter (S_{11}, S_{21}, S_{22}, S_{12})

Software

Compatible to , Windows 8 & Windows 10

Graphs

- Incident & reflected Wave, Standing Wave, Smith chart, VSWR, Impedance and S-parameters.
- Graph comparison facility

DELIVERABLES

- Transmission line - MODULE assembly : 01nos
- Transmission line –Control Unit : 01nos
- Directional Coupler : 01nos
- SMA (M) to SMA (M) 50 ohm RG316 cable 50cm : 03nos
- SMA (M) to SMA (M) 50 ohm RG316 cable 50cm : 03nos
- Calibration Kit OPEN, SHORT, LOAD : 01nos
- 9 pin D type male to female cable : 01nos
- USB cable (Male A to Male B) : 01nos
- Power Cord : 01nos
- Software on CD : 01nos
- Manual : 01nos

TUTORIALS

- Observation of standing wave pattern at various frequency
- Analysis of minima and maxima creation at various frequency
- Analysis of various load condition on Microstrip transmission line
- Determination of UNKOWN LOAD Impedance Characterization.
- Determination of unknown frequency characterization using transmission
- Measurement of S-Parameters for Microstrip Transmission Line
- Plotting a Normalized Impedance on the Smith Chart

Experiments Using Vector Network Analyzer (VNA)

- Return Loss and VSWR measurement of Micro strip Transmission Line
- Impedance Analysis of various loads condition in microstrip transmission line
- Measurement Reflection coefficient and transmission coefficient of microstrip transmission line
- Measurement of multiple harmonics in microstrip transmission line

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