

RFL-MMTLT

Motorised Transmission Line Training System



FEATURES

- 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
- Analysis of reflection coefficients, VSWR and Impedance for LOAD, OPEN and SHORT termination
- Smith Chart Analysis

SPECIFICATIONS

MICROSTRIP TRANSMISSION LINE

- Frequency - 250MHz to 1500MHz
- Type of device - Passive
- Characteristics impedance - 50 Ω
- Source Type - PLL Synthesizer
- Power - +9dBm
- Copper thickness - 1oz (35um)
- Power handling capacity - +30dBm
- Detector Type - Dual Log Type
- Output Array Storage - 580 points on self memory
- Operational Mode - PC & Panel mode
- 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 Modes

- Standing Wave

- Transmission Line Parameter
- Incident & Reflected Wave
- Smith chart
- S Parameter (S11, S21, S22, S12)

Graphs

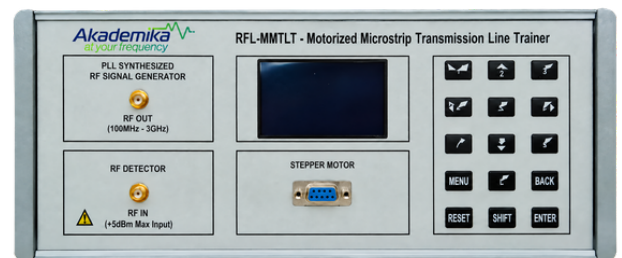
- Incident Wave; Reflected Wave, Standing Wave, Smith chart, VSWR, Impedance and S-parameters
- Graph comparison facility

Software

- Compatible with Windows 10

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.

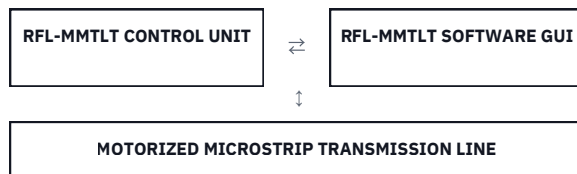


Transmission Line Control Unit



Microstrip Transmission Line Trainer

FUNCTIONAL BLOCK



MEASUREMENTS WITH MMTLT

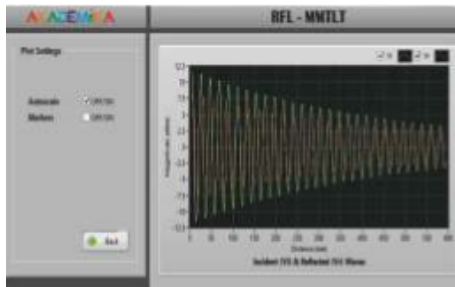
1) Standing Wave Pattern



Standing wave @900MHz under OPEN Condition

- Graph shows standing wave characterization graph 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 (V_i) & reflected waves (V_r) of Microstrip Transmission line

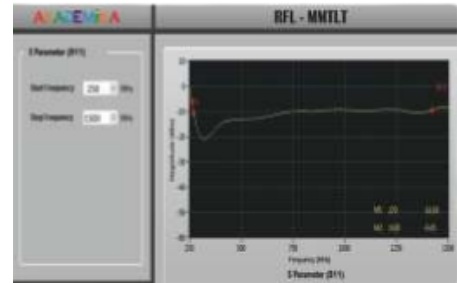
- Graph shows the incident and reflected waves of Transmission line. The Yellow line is Incident wave and Red line is reflected wave for short or open terminations. This means that in open or short conditions all the power is reflected back to source.

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



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

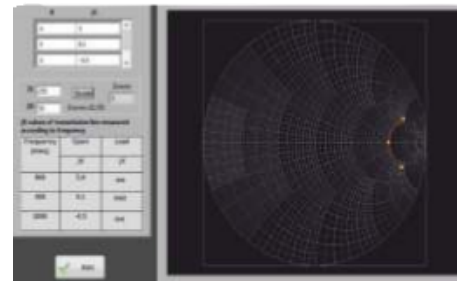
4) S-Parameters (S_{11} or S_{22})



S_{11} of Microstrip Transmission 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 represents 11 how much power is reflected from the port1, and hence is known as the reflection coefficient (sometimes written as gamma: or return loss. If $s = 0$ dB, then all the power is 11 reflected from the port1 and nothing is transmitting. If $S = -10$ 11 dB Then 90% power is delivered to the port1 and only 10% is the reflected power from port1.

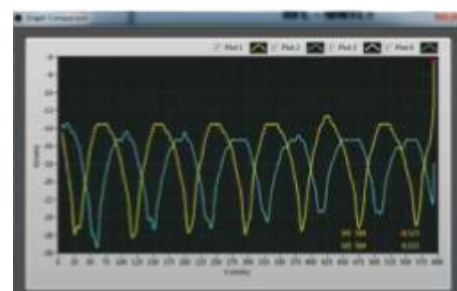
5) Smith chart



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

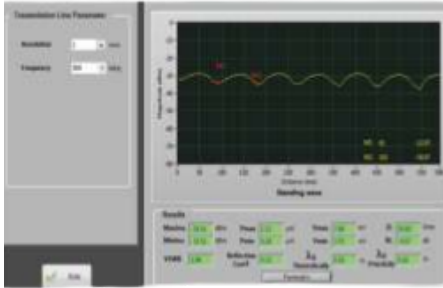


Plot Comparison OPEN Vs SHORT Termination

- Graph shows the Standing Wave of the Microstrip Transmission Line with OPEN termination (Yellow)

Vs SHORT termination(Blue). It is clearly seen that there is a Phase Shift of 180° between the peaks of OPEN and SHORT condition.

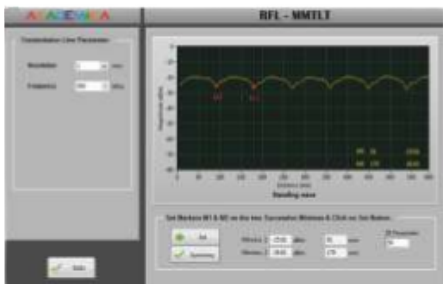
7) Standing Wave Pattern for LOAD



Standing wave @900MHz under Load Condition

- Graph shows standing wave characterization graph for perfectly matched load condition. An input frequency of 900MHz is given to the Transmission Line we can see that return loss value is -9.6 dB which is closer to -10dB standard value of Return loss

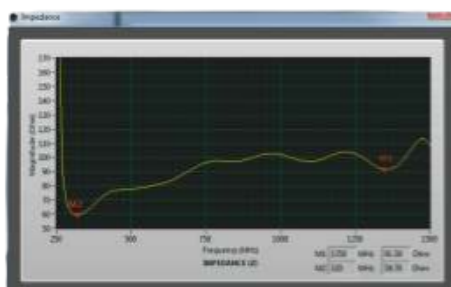
8) Guided Wavelength



Guided Wavelength @900MHZ

- Graph shows Guided Wavelength at 900MHz frequency with load condition and calculated by any adjacent combination of minima. Graph shown 2nd minima Marker (M1) =91mm and 3rd minima marker (M2) =179mm then using equation $\lambda_g = 2 \times (3rd \text{ minima} - 2nd \text{ minima})$ we got guided wavelength is 176mm which is closer to theoretically guide wavelength of 166mm at 900MHz frequency.

9) Impedance



Impedance of Microstrip Transmission line

- Graph shows impedance of microstrip transmission from 250MHz to 1500MHz freq range Line and its show an Impedance of 59 Ohms at 320MHz and varies with change in frequency

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) - 01no
- Power Cord - 01nos
- Software on Pendrive - 01nos
- Manual - 01nos

EXPERIMENTS

- 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 UNKNOWN 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 & 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