Equivalent-circuit Model on Z_0=50 ohm

Complete Coaxial Spring Probe

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Description:

It is indispensable matter to give performance simulation on PCB patterning by using SPICE simulator or like HSPICE prior to designing circuit wiring for PCB mounting LSI on high speed/frequency signal band width of SHF (Super-high Frequency) application. In order to meet with the demand of simulation for PCB circuit patterning and wiring including LSI and IC socket, this report found a parametric value of equivalent circuit composed by passive element focused on 10 GHz band width for a coaxial spring probe "SER P/N: MD0102-00 be used" being used for 1.0mm pitch Complete Z_0=50 ohm Coaxial Probe Socket, by measuring S Parameter using Network Analyzer.

1. S Parameter Measurement:

As shown on Fig.1, the coaxial structured probe pins are measured with a loop measurement and S parameter by using the Agilent Technologies' PNA Series Network Analyzer. S Parameter of Complete Z_0=50 ohm Coaxial Probe is measured as same structure of IC socket using GGB Pico Probe being adjustable to touch to measuring pad location as a composition of test instruments known performance.

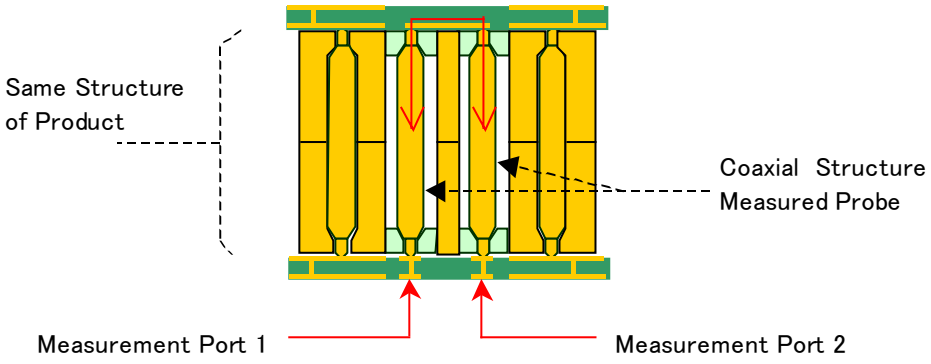


Fig. 1: S Parameter Measurement

2. Optimization for Equivalent Circuit:

S Parameter data measured by a method like Fig.1 is applied to circuit simulation software ADS (Agilent) and introduce an optimization of passive component element in equivalent circuit shown Fig.2. The equivalent circuit of Fig.2 is configured as symmetrically same 2 parts of spring probe component port.

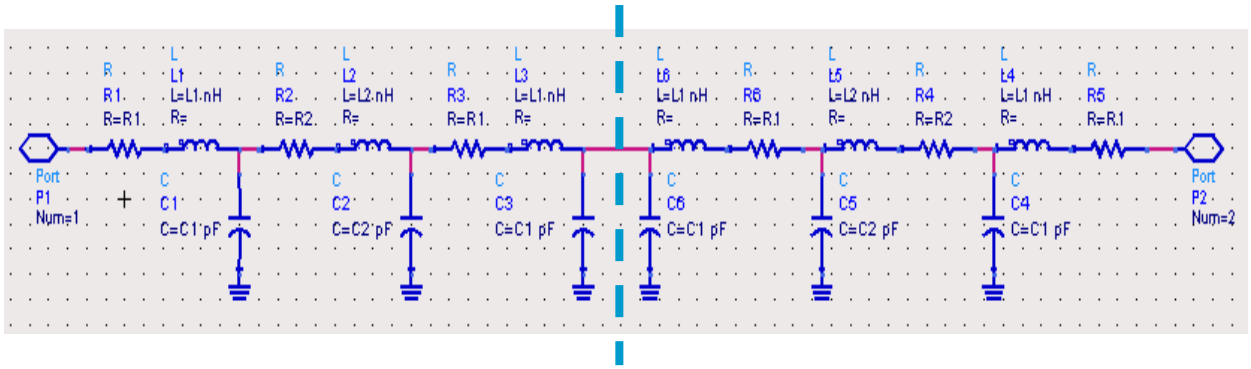


Fig. 2: Equivalent Circuit Model

2-1. Result on Optimization.

Table 1 is the circuit elements value optimized by ADS using actual measurement data and equivalent circuit above. Also Fitting results are shown on Fig. 3 as below

C1(=C4)	C2(=C5)	C3(=C6)	R1(=R5)	R2(=R4)	R3(=R6)	L1(=L4)	L2(=L5)	L3(=L6)
0.364pF	0.001pF	0.364pF	0.005Ω	0.001Ω	0.005Ω	0.317nH	0.598nH	0.317nH

Table 1: Equivalent Circuit Element

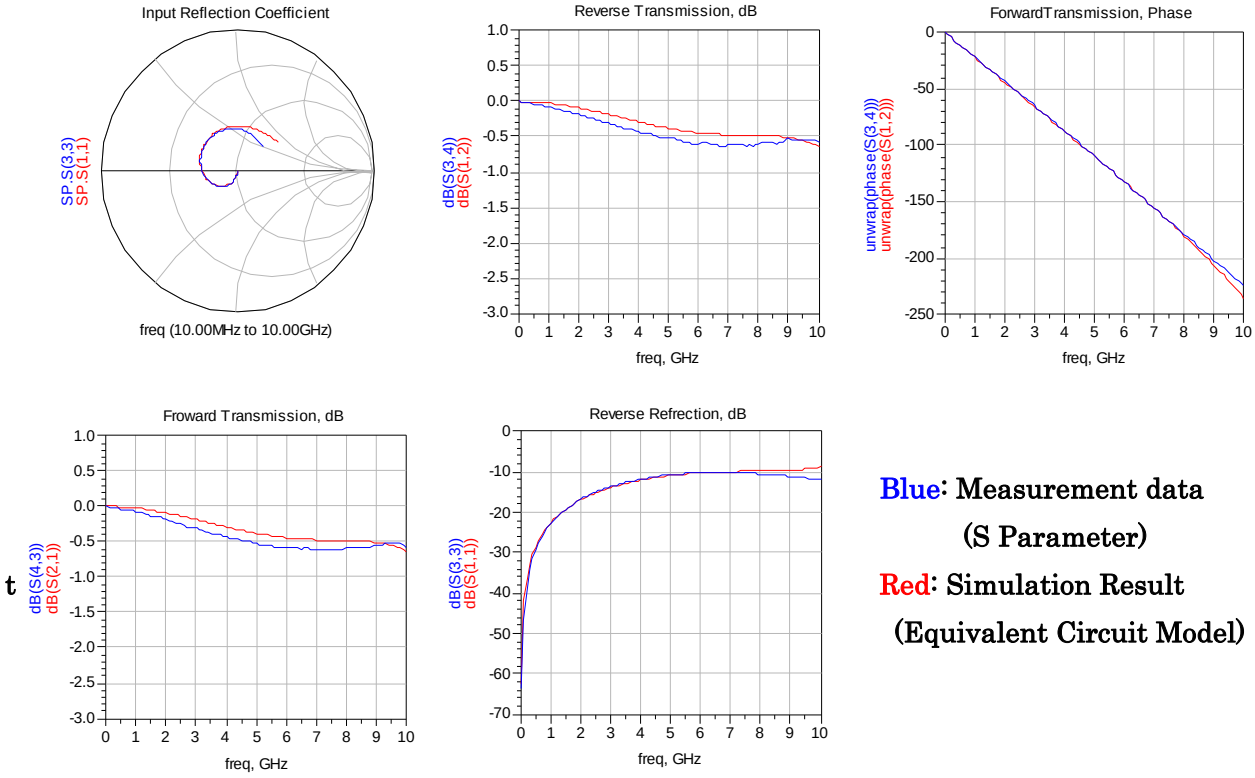
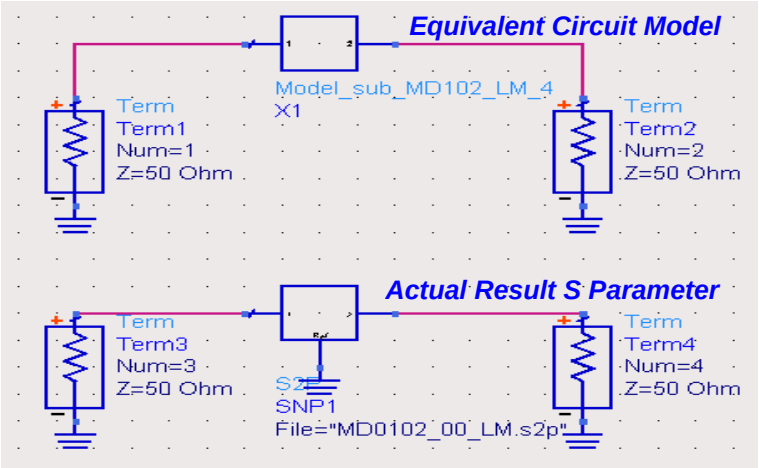


Fig. 3: Result of Optimization with Simulation Software

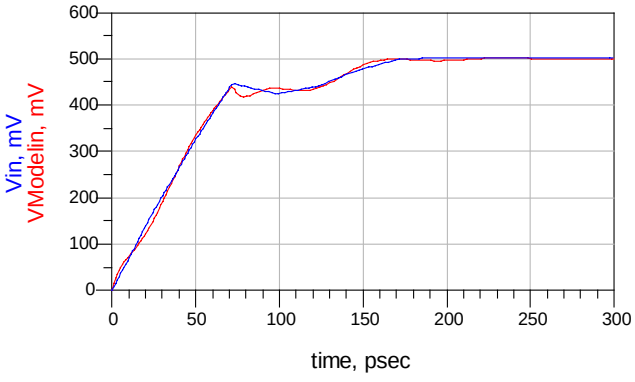


Simulation Circuit

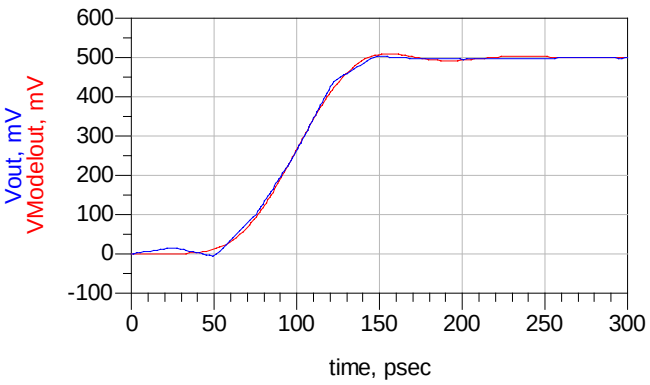
2-2. Simulation on time domain:

Time domain simulations results (TDR/TDT) based on the parameter optimized by ADS are shown on below. Rise time of input pulse was taken 75pico seconds being equivalent to 10GHz.

TDR

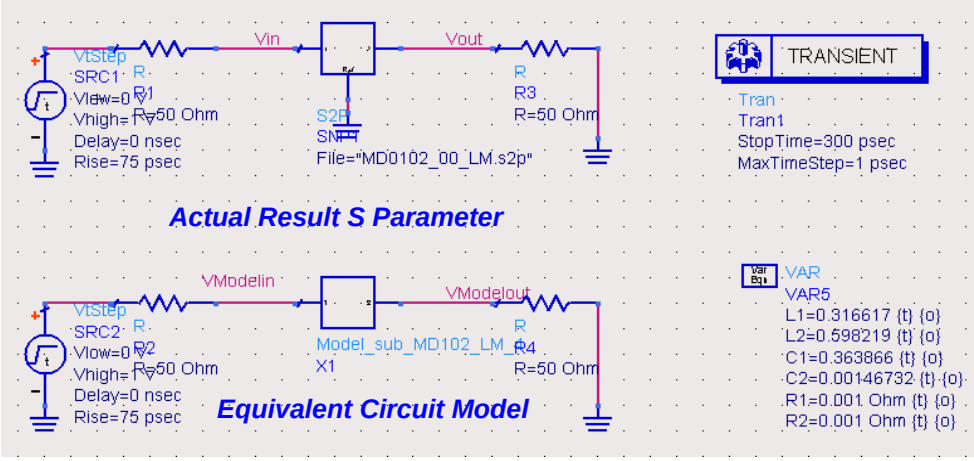


TDT



Blue: Measurement Result (S Parameter)

Red: Simulation Result (Equivalent Circuit Model)



Time Domain Simulation Circuit

3. Consideration.

Performance and characteristics on this measurement for pair of complete coaxial probe on Fig1 were -0.5dB through -0.6dB for the worst at the frequency around 10GHz on Transmission Performance. Effectiveness of a complete coaxial structure socket compare with non-coaxial IC socket, even the same contact probe pins are used, are appeared about 1dB "@10GHz" in Insertion Loss and about -4dB "@10GHz" in Return Loss deference.

Based on the compared result of the actual S parameter, the simulation optimized circuit number is able to obtain maximum 0.2dB difference with the actual data of Insertion Loss. It is meaning of getting proper correlation including a phase.