Paricon Technologies

Flex connector

Measurement Results

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Objective

The objective of these measurements is to determine the RF performance of a Paricon Technologies flex connector. Measurements in both frequency and time domain form the basis for the evaluation. Parameters to be determined are differential insertion loss and return loss in the range from 50 MHz to 20 GHz.

Methodology

Frequency domain measurements were acquired with a VNA (vector network analyzer - HP8722C). The instrument was calibrated up to the end of the feed cables. The cables were then connected to the test fixture and the response measured from one side to the other.

Time domain measurements are obtained via Fourier transform from VNA tests. These measurements reveal the type of discontinuities at the interfaces plus contacts and establish bounds for digital signal risetime.

Test procedures

To determine insertion loss a measurement of an arrangement of PCB to PCB only is performed. This measurement then serves for normalization of measurements taken with a flex and its connectors inserted. As a comparison, a reference trace on the PCB only is also evaluated.

Setup

A signal is fed to PCB connectors on a PCB with 50 Ohm microstrip lines. The PCB is connected via Pariposer material to a flex circuit, which in turn again via Pariposer connects to another PCB with connectors. Fig. 1 shows an example of this PCB, the connector and part of the flex circuit:

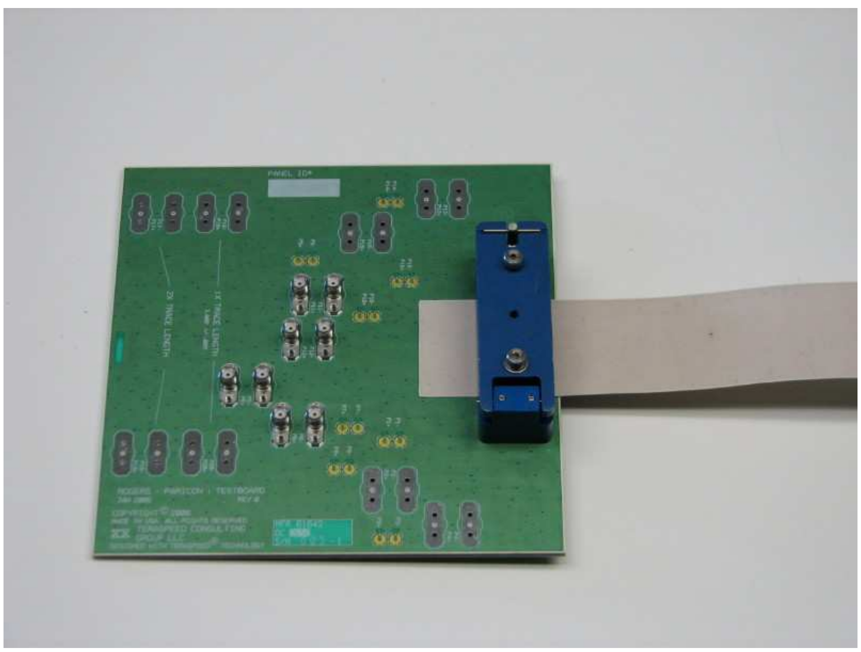

Fig. 1 Flex connector test arrangement

Port assignments are as shown in Fig. 2:

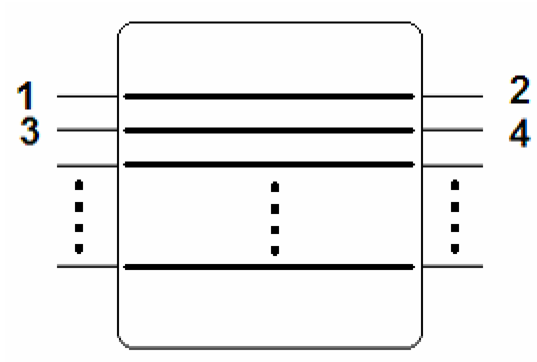

Fig. 2 Microstrip line flex connector and port assignments

Connections to the VNA are made with high quality coaxial cables with K connectors. The differential properties are extracted from a sequence of several measurements during which two of the four ports are connected to 50 Ohm terminations while response on the other two ports is being recorded.

Measurements

Time domain

TDR reflection measurements are shown in Fig. 3 for a total of 4 differential pairs:

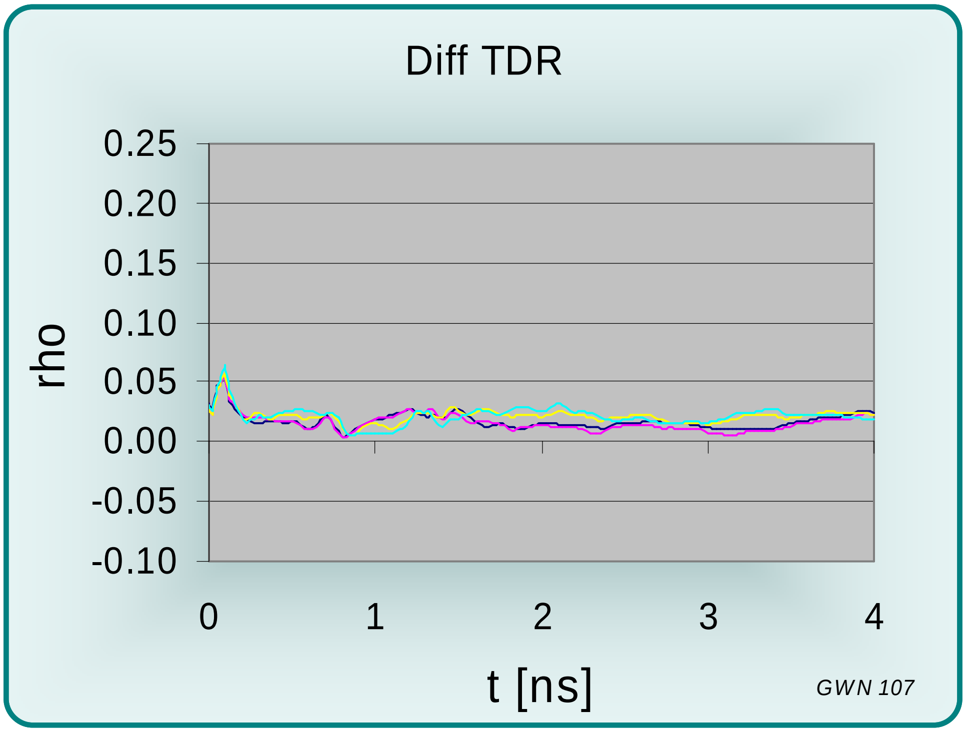

Fig. 3 TDR signal from the flex connector

The reflected signals from the complete assembly include the responses from the connectors and the PCBs. The first peak near 0 ns is due to the SMA to PCB connector. The corresponding impedances are shown in Fig. 4:

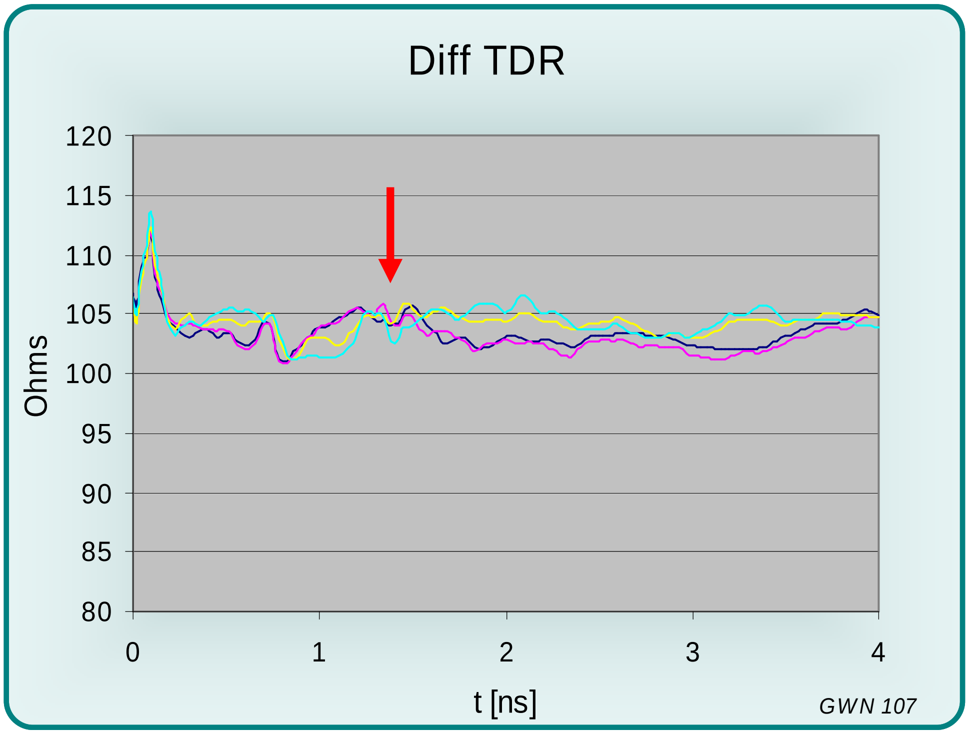

Fig. 4 TDR signal from the assembly

The impedance levels are slightly above 100 Ohms. The first flex connector is located at 1.4 ns (red arrow). This connector produces no distortion in the passing signal since it leaves no distinguishable signature in the TDR response. The other end of the assembly is not visible in the graph and is just beyond the recorded range. This is unavoidable because of the limited 5 ns span of the VNA. While it is possible to shift the response to show this interconnect, it too did not leave any noticeable imprint.

The TDT performance for a step propagating through the pin arrangement was also recorded (see Fig. 5).

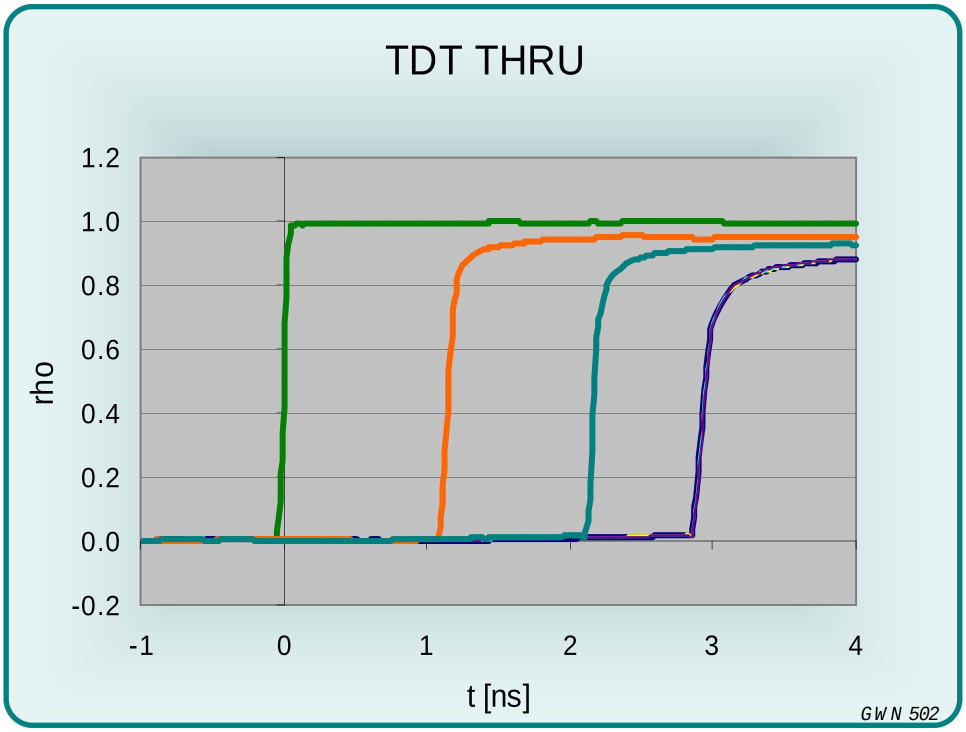

Fig. 5 TDT measurement

The TDT measurements for transmission show total contribution to risetime from all components for three different lengths of flex circuit (1.5", 5", 10"). The 10-90% risetime values for the flex circuit connection are 125, 200 and 250 ps (10%-90%) and 75, 80 and 125 ps (20%-80%) for the 1.5", 5" and 10" connections, respectively. The trace on the far left is the system response which has a risetime of 25 ps.

The excellent signal integrity of the Paricon connector is demonstrated by the following TDR trace:

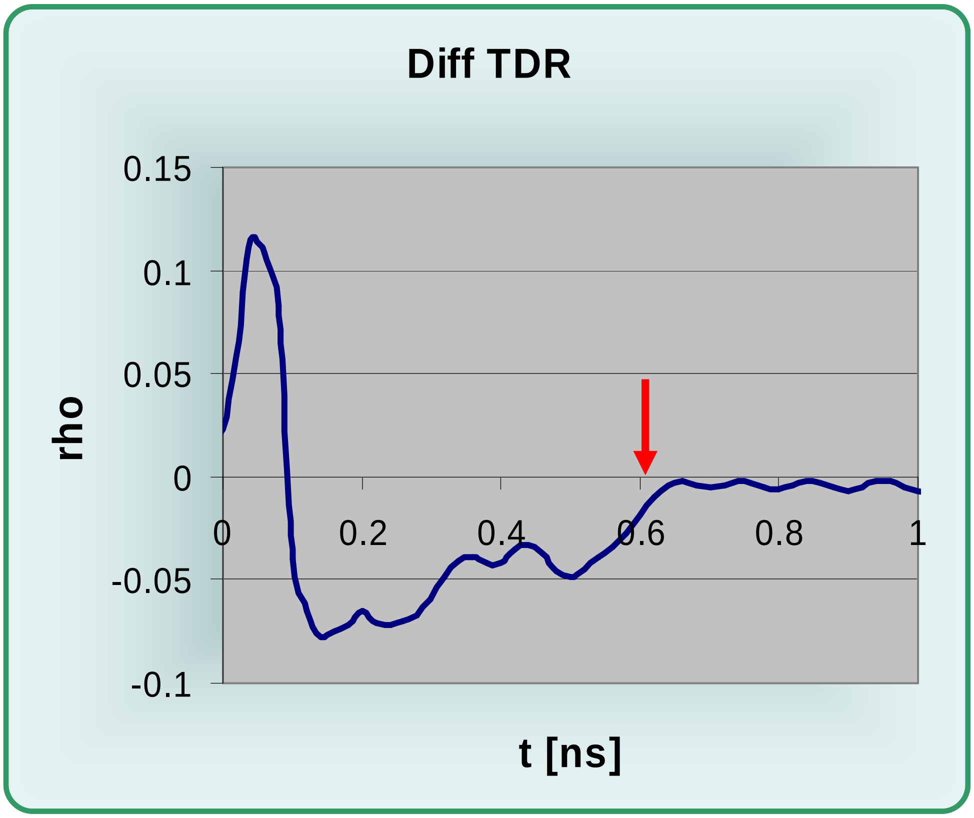

Fig. 6 Differential TDR of a short connection

This differential TDR response shows the launch into a 1.5” long flex circuit on the left side. The probe at the end of the coax cable is slightly inductive, hence an upward peak occurs at the left edge of the graph. From there on the trace shows the reflections as the signal travels through the flex circuit until it reaches the Pariposer connection to the PCB (red arrow). This connection shows no contribution to the TDR response, underlining the performance of the Pariposer material.

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Frequency domain

An insertion loss measurement is shown in Fig. 6 for the frequency range of 50 MHz to 20 GHz for the complete PCB to connector/flex/connector to PCB arrangements.

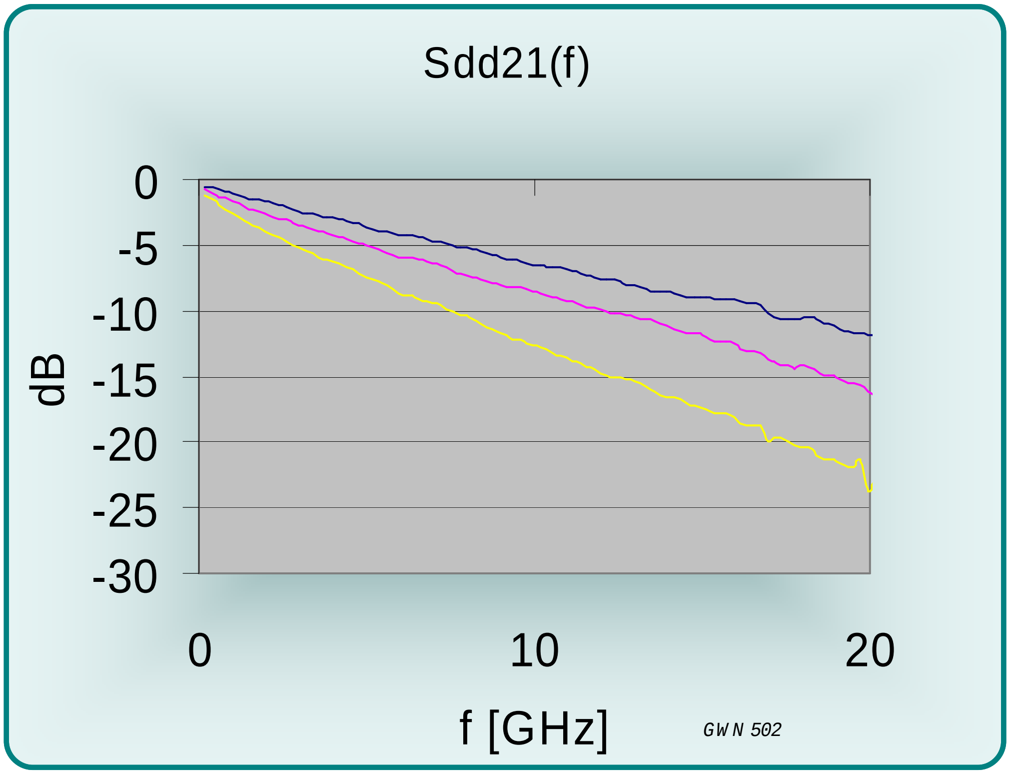

Fig. 7 Insertion loss S21 (f)

The graph shows the total loss of the arrangement for flex lengths of 1.5”, 5” and 10”. Naturally, loss increases with increasing flex length. To extract the flex performance, a measurement of a PCB control trace of appropriate length was subtracted out. The resulting S21 for the three different flex types is shown below:

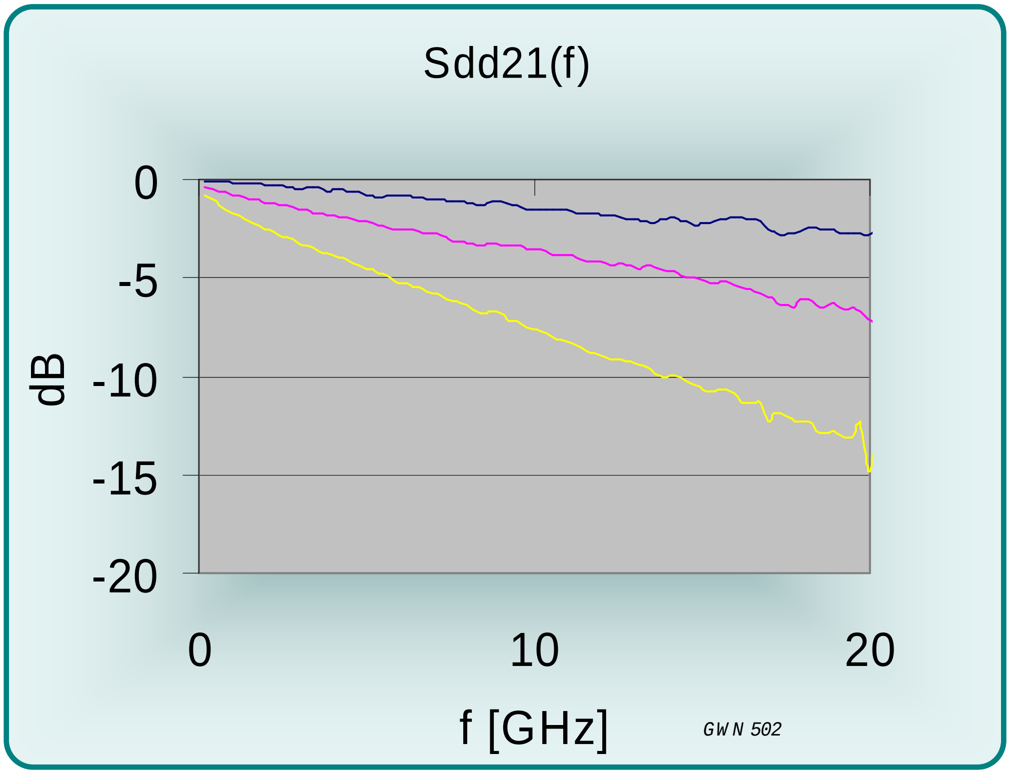

Fig. 8 Normalized insertion loss S21 (f)

Insertion loss is less than 3 dB to 21.3 GHz, 7.5 GHz and 2.8 GHz for the three different lengths, shortest to longest, respectively.

An estimate of flex cable loss per 1” length was made by curve fitting the result for the longest flex connector and then reducing that result to the desired 1” length. The corresponding graph is shown below:

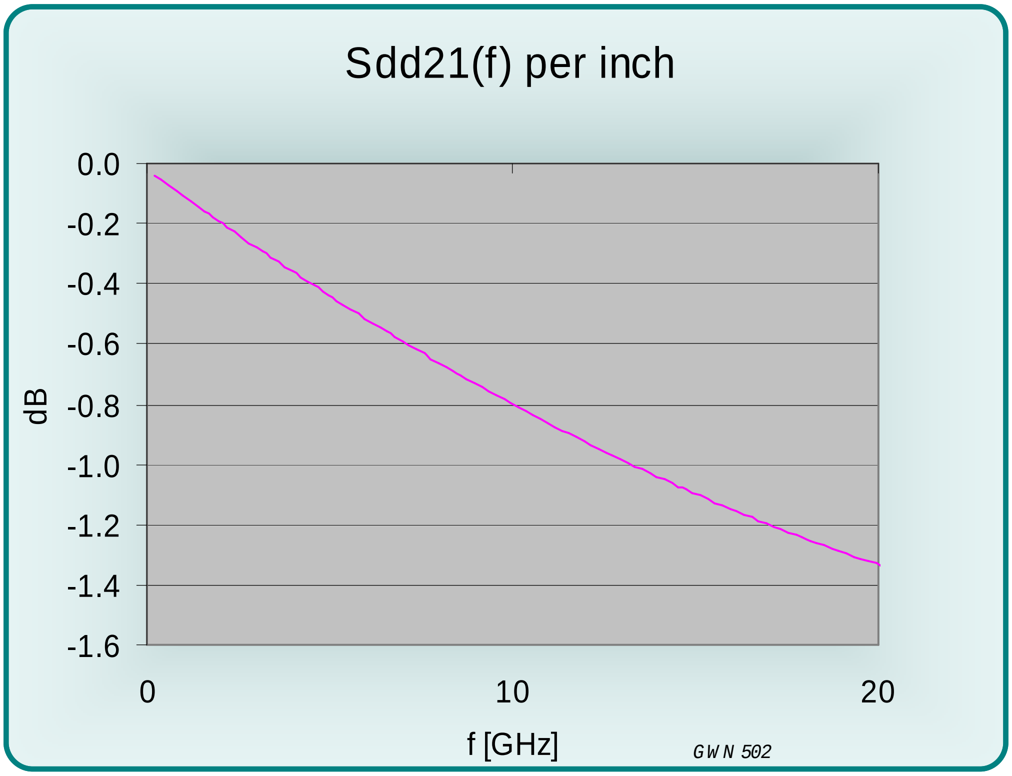

Fig. 9 Flex insertion loss per inch of cable

As a reference the common mode insertion loss and the return loss for the longest flex connector are graphed below:

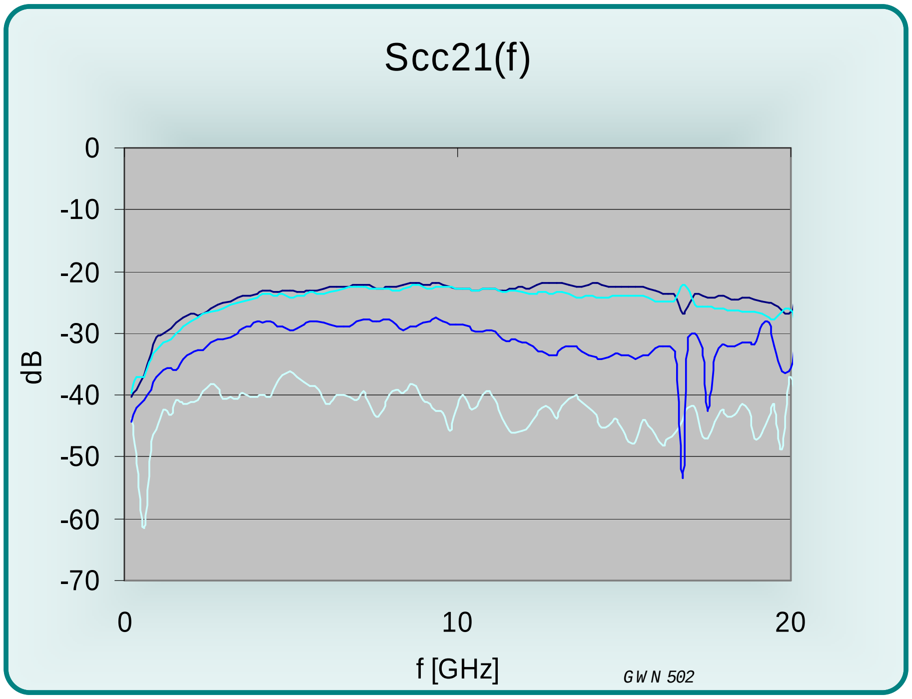

Fig. 10 Common mode insertion loss

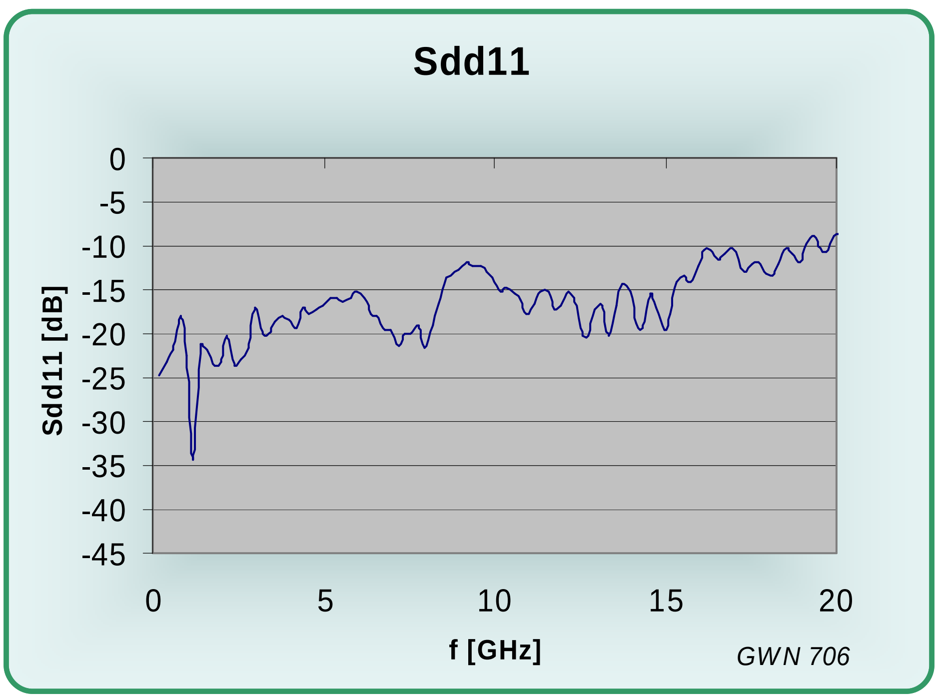

Fig. 9 Return loss as a function of frequency