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ARIES
20 PIN SSOPTest Socket

Electrical Characterization
0.05 - 3.05 GHz

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Summary

Objective:
The measurements are used to extract an equivalent circuit for the Aries 20SSOP sockets in 50 Ω impedance environment. Moreover, the 1 dB bandwith of each socket was directly measured.

Methodology:
A custom fixture was first designed (P/N GTL-8400-TR-001 rev. C1). It allows the use of coplanar probes to make the measurements in a 50 Ω environment. A second fixture was fabricated to be placed inside the sockets (P/N GTL-8500-TR-001 rev. A1). It provides connections between the internal pins. This fixture is referred to as "surrogate package."

The Hewlett-Packard 8510 network analyzer was used to measure two-port s-parameters. The socket was measured under three conditions: open, shorted to ground and with adjacent pins connected together, and loop thru of adjacent pins with other pins shorted to fixture ground. The frequency range was 0.05-10.05 GHz.

Equivalent circuit models were extracted for the fixture and Aries socket separately. The effect of the Aries socket on the response is, therefore, readily available. All modeling was performed under HP MDS (microwave design system).

Equivalent-circuit model:
The equivalent-circuit topology is shown in Figure 1.

Element definitions:

L_1 & L_2:	self-inductance of one socket pin
R_1 & R_2:	resistors in parallel with L_1 & L_2 used to model high-frequency losses like skin-effect and loss tangent
C_{1a} & C_{2a}:	capacitance to ground of one socket pin (PCB side)
C_{1b} & C_{2b}:	capacitance to ground of one socket pin (package side)
M_{21}:	mutual-inductance between adjacent socket pins

C_{21a}: mutual-capacitance between adjacent socket pins (PCB side)
C_{21b}: mutual-capacitance between adjacent socket pins (package side)

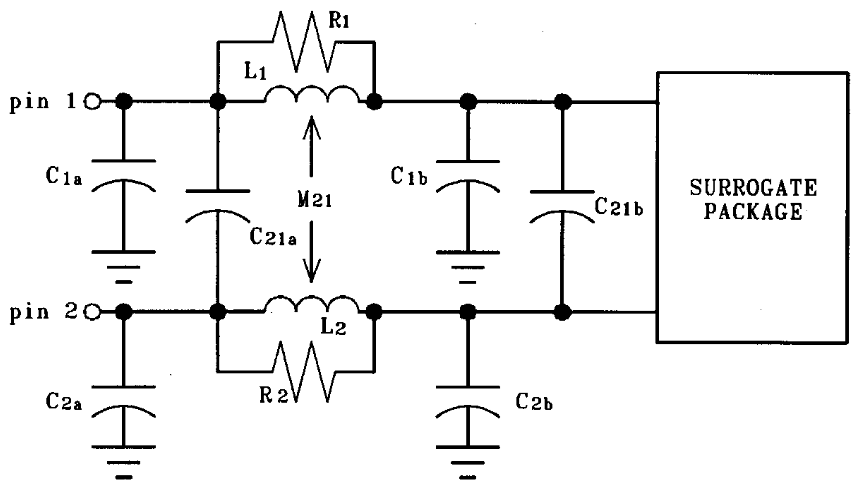


Figure 1 - Equivalent-circuit model

Element values:

Tables 1 & 2 shows the element values extracted form the s-parameter data.

Table 1: element values

socket	L_1 & L_2 (nH)	M_{21} (nH)	R_1 & R_2 (Ω)	C_{1a} & C_{2a} (pF)	C_{1b} & C_{2b} (pF)	C_{21a} (pF)	C_{21b} (pF)
fixture	1.35	0.15	750	0.15	0.46	0.02	0.02
fixture + Aries	1.35	0.20	750	0.20	0.59	0.06	0.03
Aries	<.01nH	0.05nH	<0.5 Ω	0.05pF	0.13pF	0.04pF	0.01pF

Observations:

1. The Aries socket has little effect on the response of the 50 Ω fixture. The self and mutual capacitance increase slightly. The mutual inductance increases by a small amount. The self-inductance remains constant in both cases.

2. The bandwidth of the socket was measured in a loop-thru and with a 50 Ω surrogate package. The results of the measurements are shown in table 2. The measured data can be found on pages 4 & 5.

Table 2: 1 dB bandwidth

config.	1 dB (GHz)
loop-thru	3.0
50 Ω surr	10.0

3. The inductive and capacitive crosstalk in a 50 Ω system is shown on table 3.

Table 3: Crosstalk limits

socket	10% inductive xtalk (GHz)	10% capacitive xtalk (GHz)
Aries	1.00	4.30

Background information:

Several types of two-port parameters are available for the characterization of electronic components. For example, for the characterization of BJTs Y and H-parameters are very useful. Z-parameters are also used extensively. These parameters require the use of **perfect** shorts and opens as standards at the measurement ports. At very high frequencies shorts and opens exhibit significant parasitics (inductance and capacitance). Therefore, Y, H and Z-parameter measurements are not valid at these frequencies.

At high frequencies a good resistor is much easier to implement than a good short or open. S-parameters (a.k.a. scattering parameters) use a resistor as their port standard. The value of this resistor is known as the port impedance. The most popular port impedance is 50 Ω (HP 8510 network analyzer).

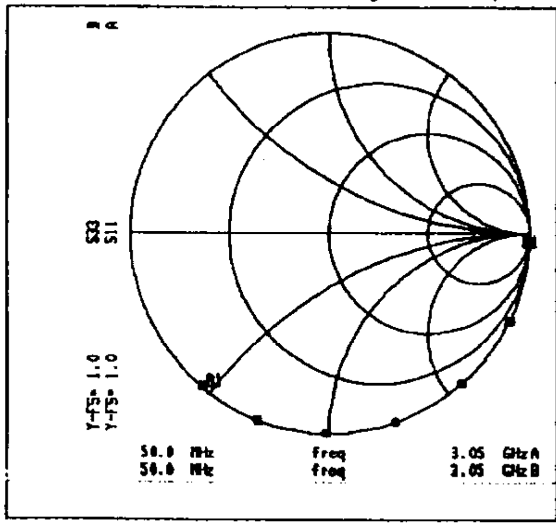
S-parameters show how voltage is distributed between the two measurement ports as a function of frequency. S_{11} is the ratio of the reflected energy to the incident energy at Port 1. S_{22} is the same ratio at Port 2. S_{21} is the ratio of the energy transmitted to Port 2 from Port 1. On a crosstalk measurement, a low number for s_{21} is desirable. On a transmission measurement, s_{21} should be as close to 0 dB as possible (i.e. all the energy is transmitted). Also s_{11} and s_{22} should be low (no energy reflected).

Appendix

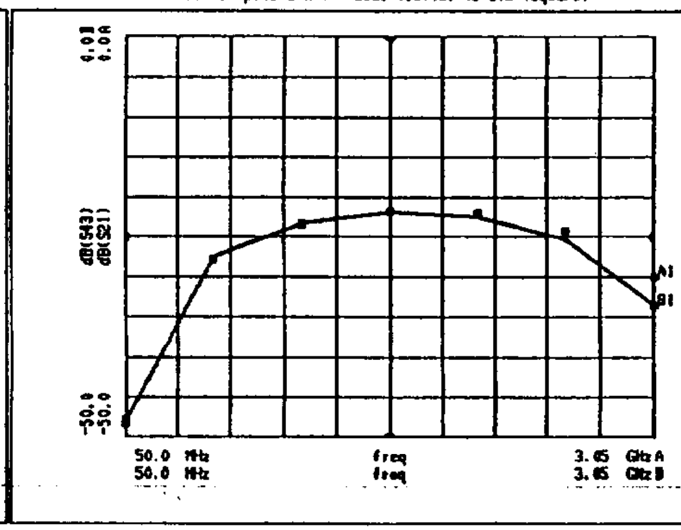
The following section shows the measured and simulated data on the 20 SSOP sockets.

SSOP20 socket - open measurement

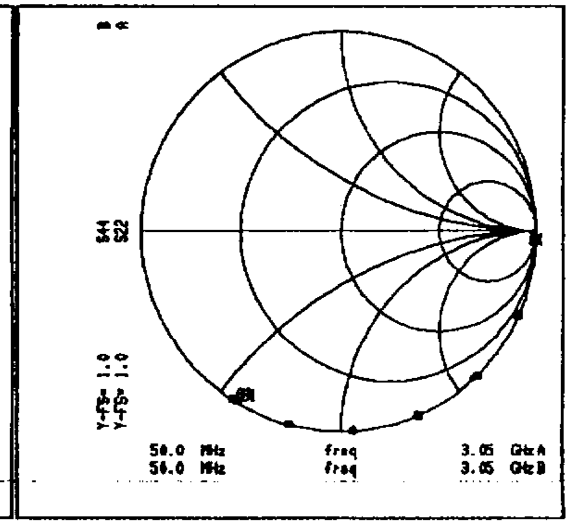
Reflection response of pin 3 - meas (triangle) vs sim (square)



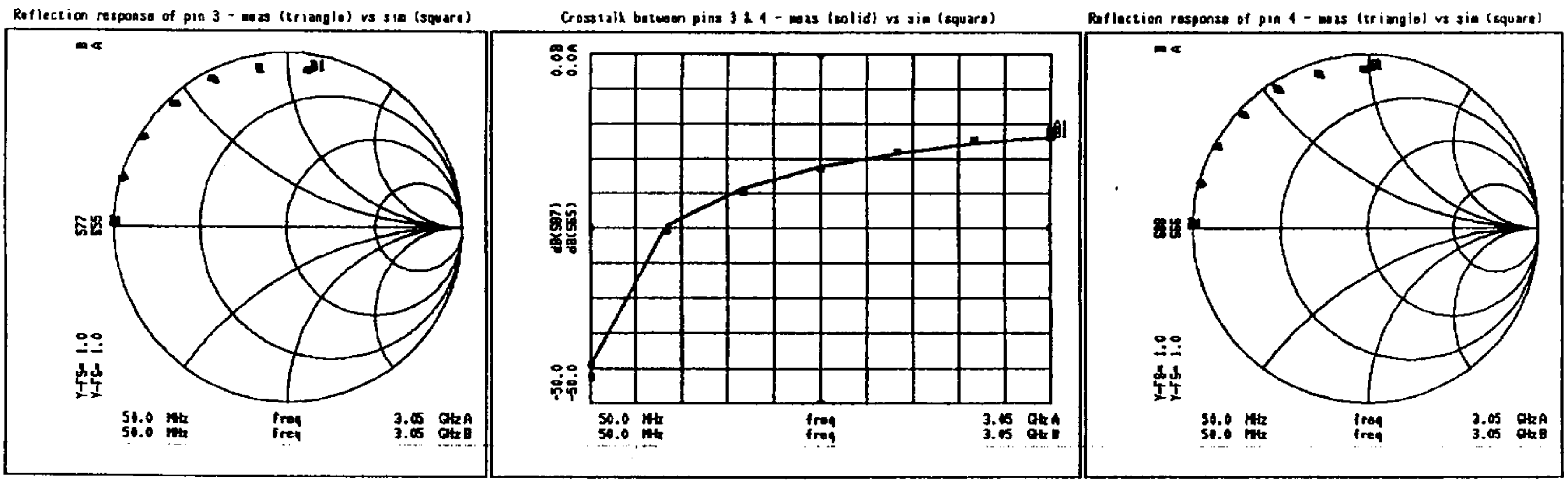
Crosstalk between pins 3 & 4 - meas (solid) vs sim (square)



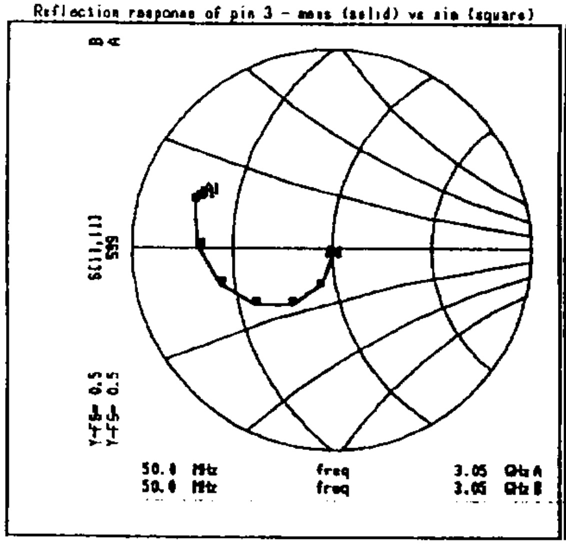
Reflection response of pin 4 - meas (triangle) vs sim (square)

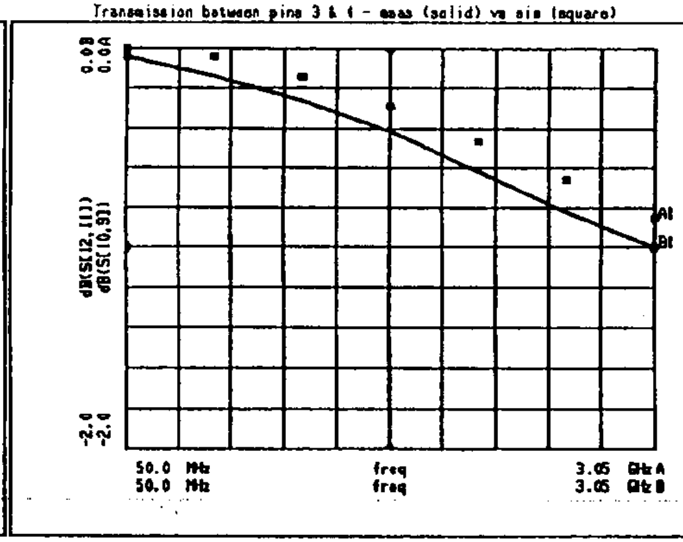


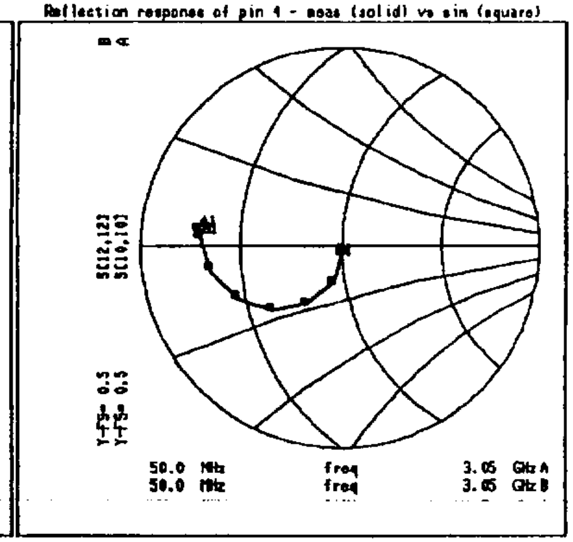
SSOP20 socket - shorted measurement



SSOP20 socket - thru measurement

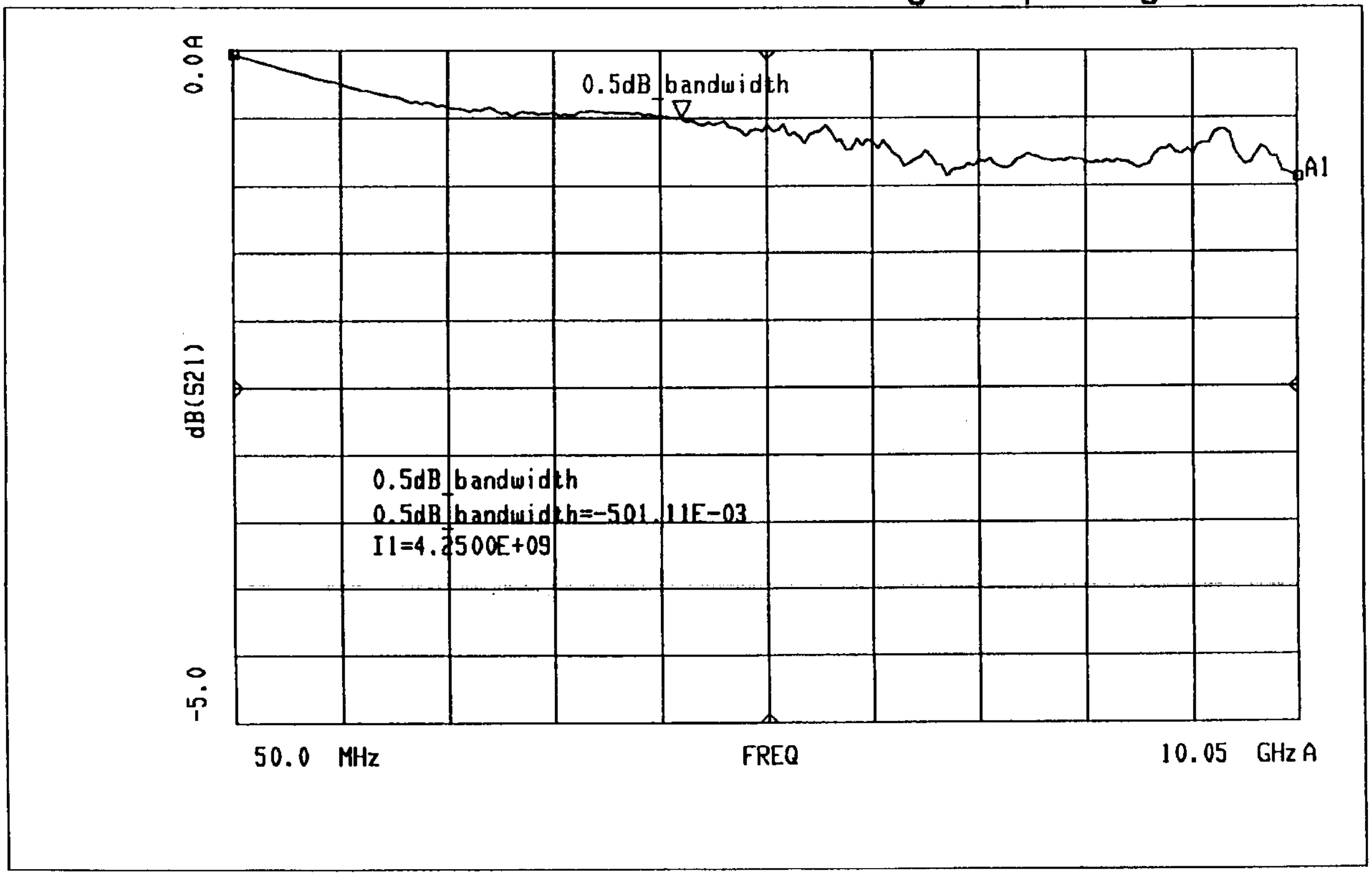






SSOP20 socket

Thru measurement w/ 50 ohm surrogate package



SSOP20 socket - Loop-thru measurement