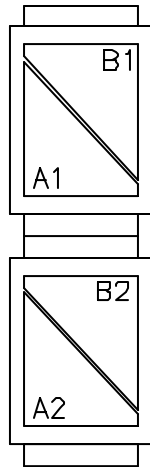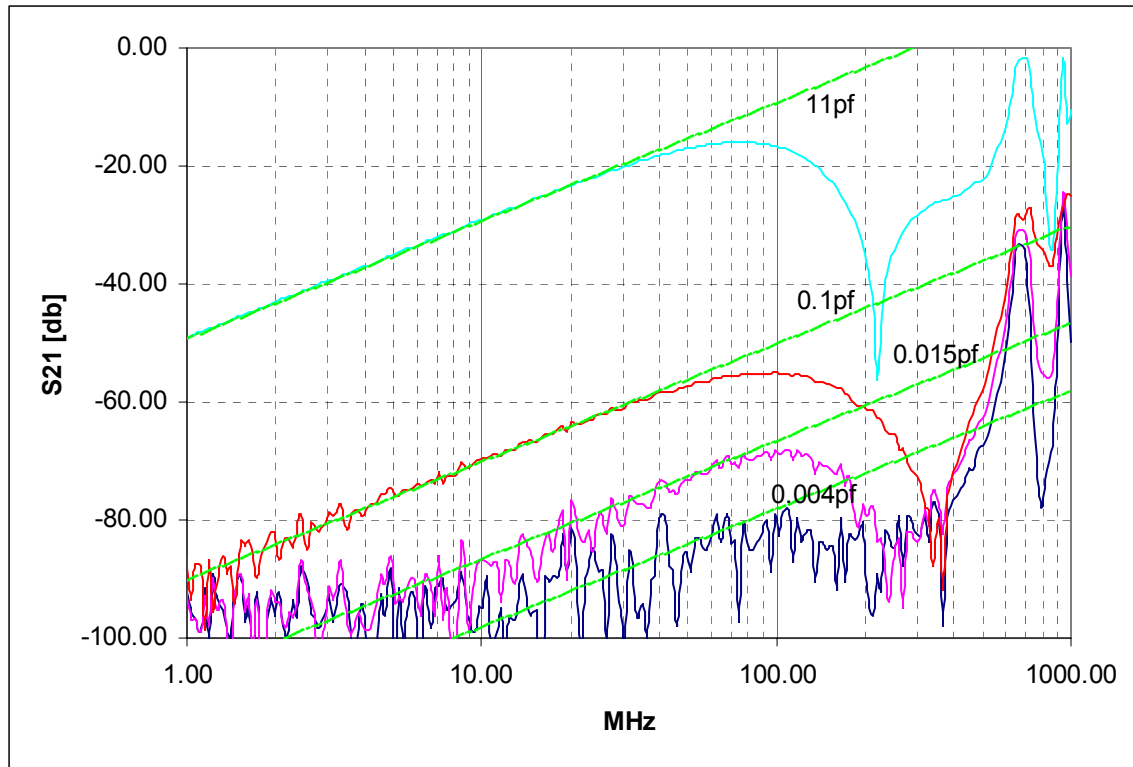# Coupling Between Adjacent BPM's

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Two MI8bpm's were connected and a network analyzer was used to measure the coupling (S21) between plates. The unused plates were terminated in 50Ω. Coupling was mostly capacitive below 50MHz.



Two MI8bpm's were connected end to end and coupling between the plates was measured with a network analyzer

Four coupling paths exist:

|  | Cap. | @53Mhz |  |
|---|---|---|---|
| Between plates in the same bpm | 11pf | -16.79db | .145 |
| Between the nearest plates (A1-B2) | 0.10pf | -56.54db | .00149 |
| Between a far plate and a near plate | 0.015pf | -71.03db | .000272 |
| Between the furthest plates (B1-A2) | 0.004pf | -77.74db | .000130 |

Measured coupling (S21) between plates of two adjacent MI8bpms. The straight lines indicate an equivalent coupling capacitance assuming a 50Ω load.

Consider the position measured from bpm2 with the coupled signals from bpm1. The worst case error occurs when the position makes A1 large and B2 small since these plates have the largest coupling.

>   A2' = A2 + CmA1 + CsB1     (Cs,m,l for small, medium, and large coupling)
>   B2' = B2 + ClA1 + CmB1

A 30mm position would make A/B = 2.28. For equal hor and ver position the beam would be 7mm from the wall of the 3.875" aperture of an MI8bpm.

>   Let                 A1 = A2,  B1 = B2, and  A = 2.28 B
>                       (42mm from the center)
>   At 53Mhz       Cl = 0.00149, Cm = 0.000272, Cs = 0.00013
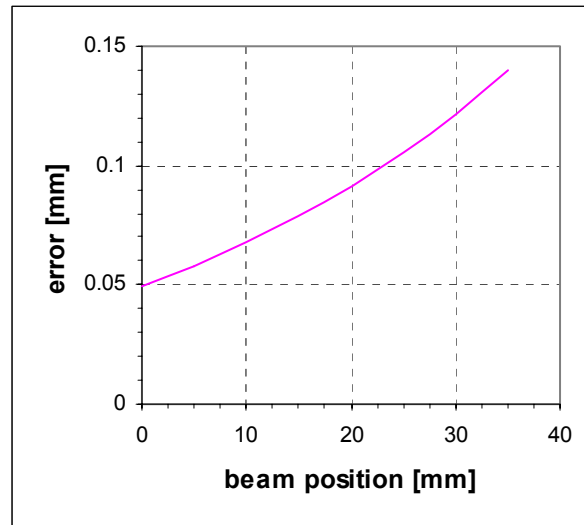>
>   A2' = (1 + 0.000272 + 0.00013/2.28) A
>   B2' = (1 + 0.00149 (2.28) + 0.000272) B

The sensitivity of an MI8bpm:

$$pos[mm] = 4.2 \frac{mm}{db} \left( 20 \log \frac{A}{B} \right)$$

at 53MHz with x=y=30mm

   Pos error = 4.2 * 20 (log A2'/B2' – log A/B) = -0.12mm



Calculated position error in bpm2 caused by coupling from bpm1 at 53MHz.  The beam
moves along the diagonal with equal horizontal and vertical position.