DAΦNE TECHNICAL NOTE
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BANDWIDTH MEASUREMENTS OF THE DAFNE LONGITUDINAL KICKERS

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1. INTRODUCTION.

In both DAFNE rings cavity type kickers are used in the longitudinal feedback systems [1]. The bandwidth required to kick each bunch independently from the next one is half the RF frequency in case of *by one* filling. A wider bandwidth could be useful to make the response of the system faster and more balanced over all the oscillation frequencies of the coupled bunch modes. However, beyond a given limit the wider is the BW the less is the system efficiency [2] because of the shunt impedance reduction.

The desired BW has been obtained strongly loading the cavity by 6 special ridged waveguides, connected via a transition to coaxial line, to matched loads.

Small reflections occurring in correspondence of the waveguide to coaxial transition region can modify the loading of he cavity, either increasing or reducing the actual BW, depending on the phase of incoming and reflected field recombination. For the same reason the ceramic vacuum feedthrough mounted directly on the kicker ports represents a little discontinuity to the field propagation and may affect the system characteristics in terms of BW and efficiency.

2. MEASUREMENT RESULTS.

In 1997, before the installation in the rings, we measured the frequency response of the 2 longitudinal kickers and a 240 MHz (-3 dB) BW was found.

During the last machine shutdown (10-13 June 2002) the measurement has been repeated including feedthroughs, circulators, loads and cables.

The measurement has been performed according to the scheme shown in Fig. 1. The output signal of the network analyzer, after by 3 splitting, feeds in phase and with the same amplitude the 3 input ports of the cavity. Then the signals from the kicker output ports are recombined and their sum signal is observed at the network analyzer input port.

Three circulators are used to isolate the amplifiers respect to the cavity power coming from the beam. Their contribution to the system response has been evaluated as well, looking at the difference between a first measurement in which they are not included and a second in which they are.

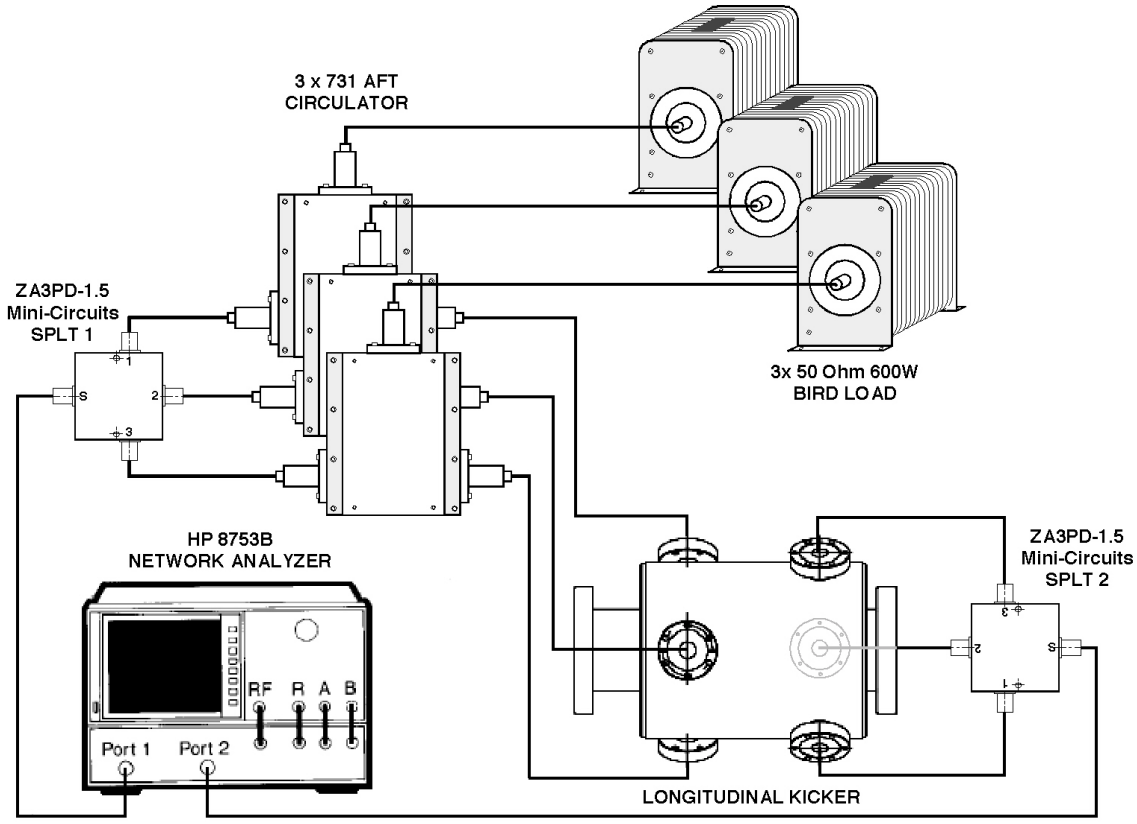

Figure1: Layout of measuements.

In Figs. 2 and 3 are shown the plots obtained from the transmission response measurements, respectively including and not including the circulators. Since the results are very similar for the two cases, it is reasonable to conclude that the circulators do not change the response of the system.

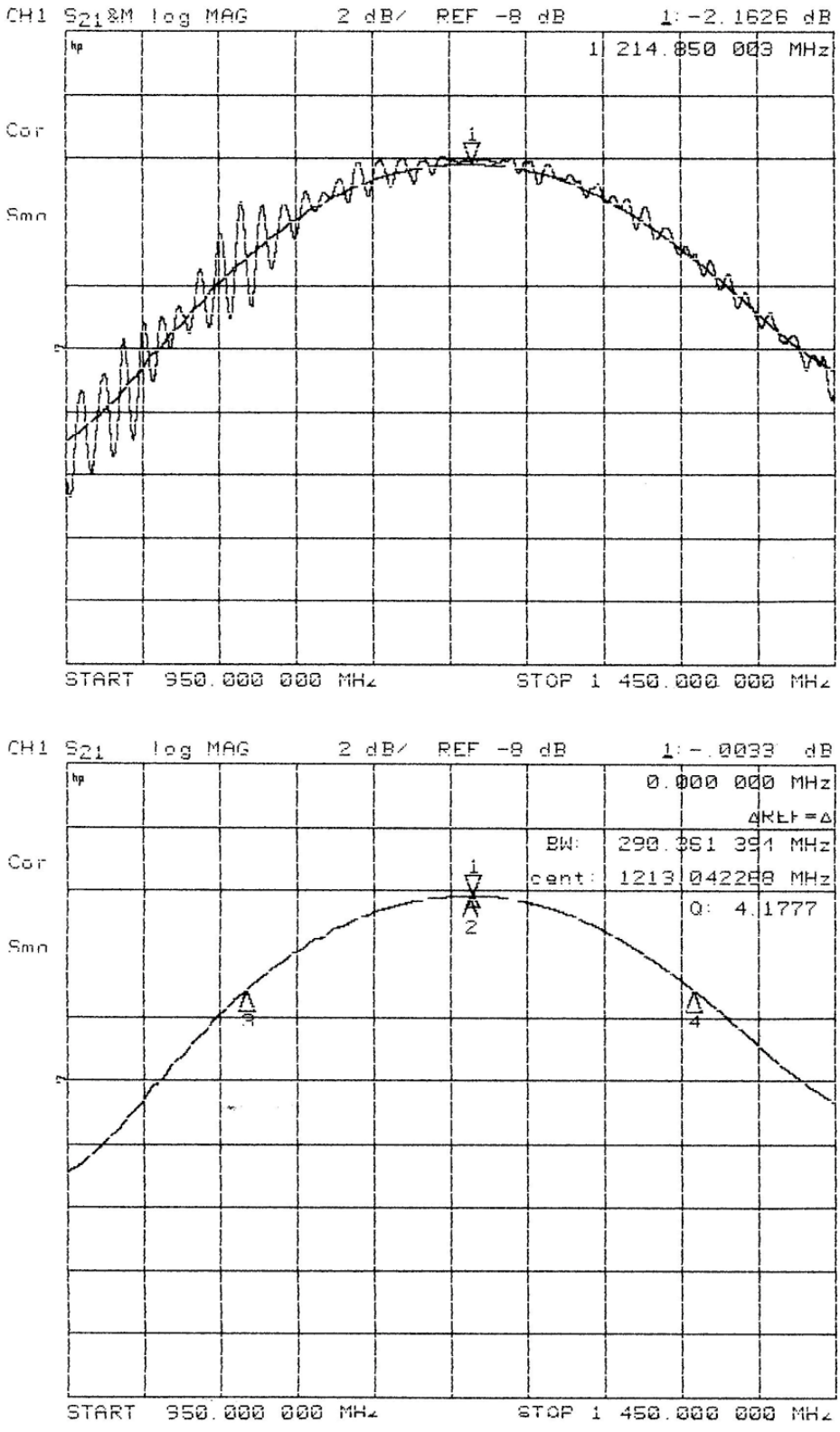

Figure 2: Measured transmission response with the circulators not included.

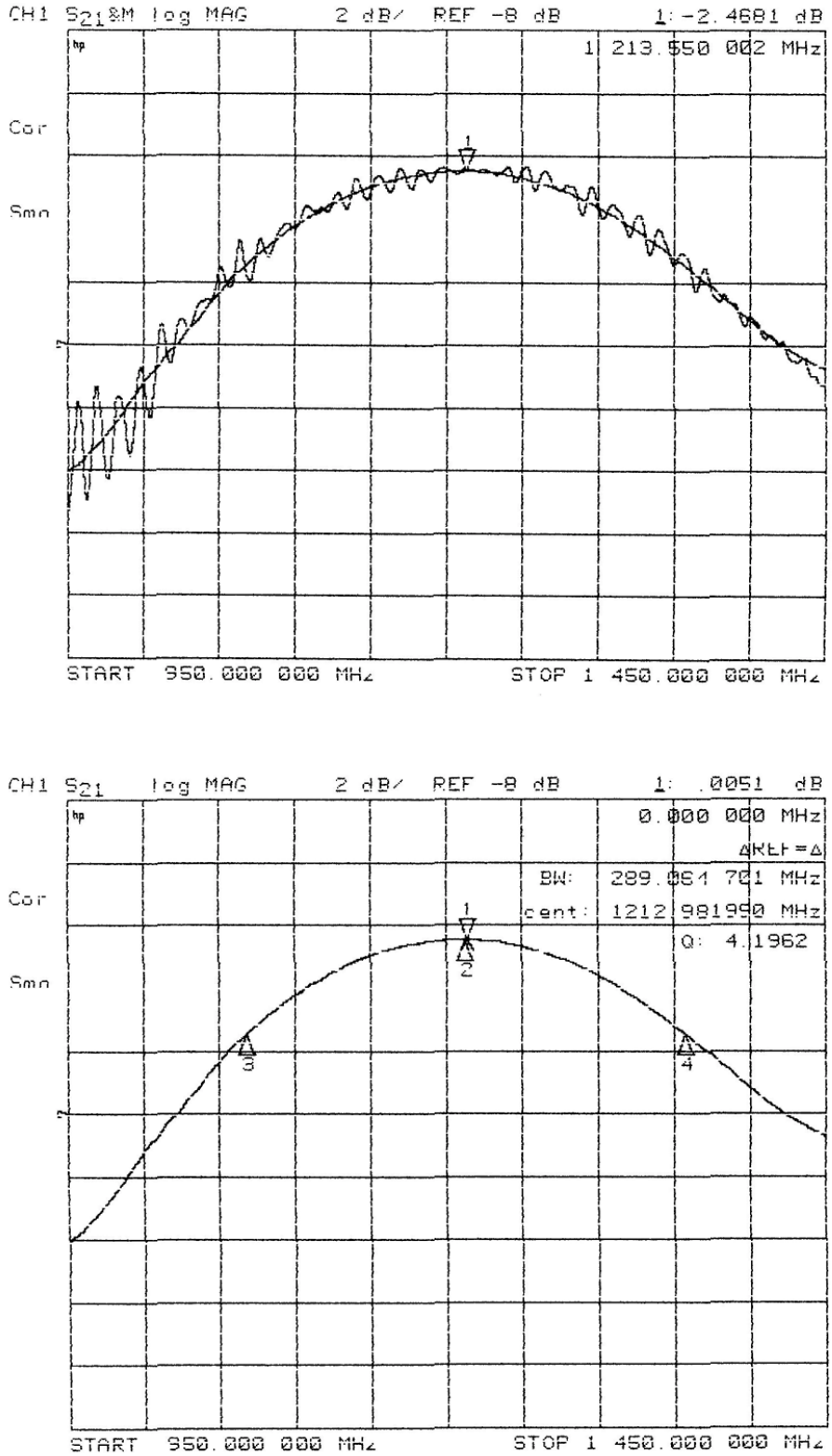

Figure 3: Measured transmission response with the circulators included.

The cavity response results distorted by a low frequency oscillation due to some discontinuity (feedthroughs or connectors not perfectly matched), combined with the long cable used for measurement. Therefore, the bandwidth has been measured on the smoothed trace shown in the lower part of Figs. 2 and 3. Resulting BW is about 290 MHz, while for the bare cavity without ceramic feedthroughs we had measured about 240 MHz. Measurements results are the same for both rings.

If we assume that ratio R/Q is a constant, the peak value of shunt impedance is expected to be 500 Ω instead of 600 Ω. This value has to be used for evaluation of gain-damping of the longitudinal feedback.

3. REFERENCES

[1] R. Boni, A. Gallo, A. Ghigo, F. Marcellini, M. Serio, M. Zobov: "A Waveguide Overloaded Cavity as Longitudinal Kicker for the DAFNE Bunch-by-Bunch Feedback System", Particle Accelerators, 1996, Vol. 52, pp. 95-113, 1996.

[2] A. Gallo, A. Ghigo, F. Marcellini, M. Migliorati, L. Palumbo, M. Serio: "Simulations of the Bunch-by-Bunch Feedback Operation with a Broadband RF Cavity as Longitudinal Kicker", G-31, 29/4/1995