RF TEST FOR KNU IP BPM COLD MODEL

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Abstract. We tested the KNU IP BPM using a network analyzer. The measured frequencies of two dipole modes agreed within 11 MHz. Coupling of the output ports (Q_{ext}) seems to be reasonable, but internal quality factor (Q_{0}) was unexpected small value. We think that 20 um as the roughness of cavity wall may be the reason of the strong power loss on the cavity wall.

INTRODUCTION

In KNU as collaborator with ATF, the work for IP BPM has been performed since September 2006. The fabrication of cold model was completed and the main properties of IP BPM cold model was measured with a network analyzer. Two types of IP BPM cold model were fabricated. The reason to consider two types is to test for brazing. The difference between two types is alloy hom pattern.

Figure 1 shows the fabricated IP BPM cold model which consists of one rectangular sensor cavity with four ports and one cylindrical reference cavity with one port. The roughness for each cavity component is as follow: ( ~20 um for cavity wall and ~50 um for coupling slot and waveguide)

![FIGURE 1. KNU IP BPM cold model. Sensor cavity and reference cavity were made from copper and stainless steel, respectively.](image-url)
Experimental setup for the measurement

Experimental setup is shown in Fig.2. In the figure, jig to adhere each piece is shown. Bal seal is used to fix the feedthrough. Not used feedthrough was terminated during measurement. The obtained data by measurement was saved in the disk and ansoft designer program (student version which is free) analysis the saved data file. This procedure is shown in Fig.3. To obtain main parameter from measured S parameter, we used the following relation;

\[ Q_L = \frac{f}{\Delta f}, \beta = \frac{1-S_{11}}{S_{11}}, Q_0 = \frac{S_{21}}{1-S_{21}}, Q_{ext} = \frac{Q_L}{\beta}. \]

FIGURE 2. Experimental setup for the measurement.

FIGURE 3. Measured S parameter for x port. Left figure was obtained by a network analyzer and right figure was obtained by ansoft designer from saved network analyzer data.

The result of test for cold model

The design value of KNU IP BPM is compiled in table1. The measurement result for reflection and transmission are compiled in table 2 and table 3, respectively.
As shown in tables, the measured frequencies of two dipole modes agreed within 11 MHz but internal quality factor $Q_0$ is unexpected small value. Roughly we think that 20 µm roughness of cavity wall make power loss so strong. Figure 4 shows the simulation result to check the small internal value. In this simulation, we use stainless steel as cavity material to consider large roughness value. From the result of simulation, we observed the tendency of significant reduction of $\beta$, $Q_0$. But it is difficult to consider the degree of relation between roughness and material conductivity.

![Figure 4. Simulated S parameter to check the effect of roughness.](image)
The measurement for reference cavity

In case of reference cavity, since feedthrough for reference cavity couldn’t be fixed tightly, it causes some problem in measurement for S parameter. However we could obtain Fig.5 after average and smoothness of the data in a network analyzer. Since we can’t use tuning pin in reference cavity which is made from stainless steel, the dimension of reference cavity was fabricated with smaller size than determined dimension by simulation. Therefore, the frequency of monopole mode is measured as 25 MHz higher.

**FIGURE 5.** Measured S parameter for reference cavity.

**CONCLUSION**

Until now, we describe the result of the measurement for KNU IP BPM. The measured frequencies of two dipole modes agreed within 11 MHz. But β and Q₀ were measured as so small value. Roughly we conjecture that 20 μm roughness causes small β and Q₀ value. But confirmation have to be performed. For reference cavity, we will measure S parameter again with the jig which can fix the feedthrough to reference cavity.