Narrow Band Cavity Combline Filter Design and Implementation with EM Simulation

Taha Ahmed Özbey* (1), A. Çağrı Yapıcı (2), Volkan Hamurcu(3)
(1, 3) STM, Ankara, Turkey; e-mail: taozbey@stm.com.tr, STM, Ankara, Turkey; e-mail: vhamurcu@stm.com.tr
(2) The Başkent University, Ankara, Turkey, e-mail: cyapici@baskent.edu.tr

This paper represents combline cavity filter design and implementation by coupling matrix synthesis. Limited filter length, maximum possible out of band rejection and agile design is aimed. In order to do so, CAD tools and intuitive methods are used.

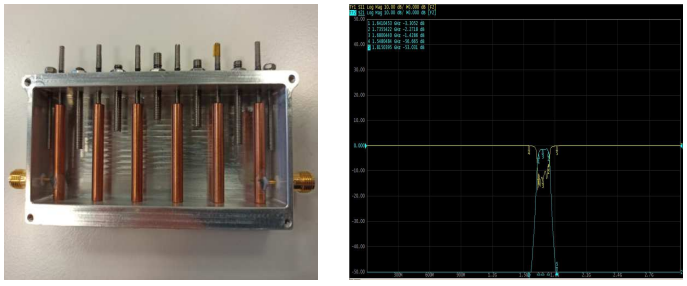
The design based on coupling matrix synthesis. In order to achieve high out of band rejection, coupling matrix is synthesized by chebyshev prototype element values. Desired filter response was at least 50 dB rejection, maximum 1 dB insertion loss and 100 MHz bandwidth at the 1687 MHz center frequency. Using the equation (1) order of the filter is determined. At least 6th order filter is needed. N+2 element coupling matrix generated by coupling matrix synthesis tool. First and last element of coupling matrix represents extended Q. The other elements of matrix represents coupling between resonators.

$$N > \frac{Rejection(dB) + ReturnLoss(dB) + 6}{20log_{10}(S + \sqrt{S^2 + 1})} \quad (1)$$

Here N represents filter order, S represents ratio between rejection bandwidth and filter bandwidth, can be defined as;

$$S = \frac{Reject\ Bandwidth}{Filter\ Bandwidth} \quad (2)$$

Resonator length is related to center frequency. Resonator length should be $\frac{\lambda_c}{4}$ for cavity combline filters. Instead of using $\frac{\lambda_c}{4}$ long resonator, shorter hollowed resonator is used to reduce filter height. Resonator, its hollow and tuning screw dimensions is determined by CST® simulation. Once resonance frequency is achieved, desired extended Q value is reached by changing tap feed height and tuning screw height. Since distance between resonators are fixed, desired coupling values is achieved by changing coupling screw length between the resonators. Designed filter is implemented and measured as seen in Figure 1. Filter dimensions are 91mm L, 20mm W, 49mm H.



(a) **(b)**

Figure 1. (a) Implemented filter, (b) measured filter response

Measurement results shows that filer response can be acceptable with respect to design goals. According to the VNA measurements Insertion loss is1.5 dB, 100 MHz Bandwidth and >50 dB Rejection.

References

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