attenuation level presented in Fig. 16 is equal to 50 dB, whereas we have found it equal to 68 dB! (Fig. 2).

Nevertheless, a method of the synthesis of filters with the reduced number of transmission zeros is very interesting. The procedure of tuning such filters may turn out to be easier in relation to the filters realizing elliptic characteristics especially for the high number of cavities.

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## Reply to Comments on "Analysis and Realization of *L*-Band Dielectric Resonator Microwave Filters"

V. Madrangeas, M. Aubourg, P. Guillon, S. Vigneron, and B. Theron

In the above paper [1], we applied the 3-D finite element method to design and to realize an *L*-band dielectric resonator filter.

The authors comments concerning the elliptic filters is correct but in microwave, most people use the word "elliptic" instead of "quasi elliptic" or "pseudo elliptic," see for example [2]–[6], ...

The Fig. 16 in our paper [1], shows the transmission and reflection responses for the 6 pole filter. In Fig. 17 [1], we present the result of the wideband frequency sweep for this filter. The measurements have been realized using a Hewlett-Packard 8510 Network Analyzer.

We first notify that the curve of the Fig. 16 [1] has been drawn after a calibration procedure. This calibration is indicated by the notation "C" at the left of the screen. In this case, the marker 1 gives an in band insertion losses equal to 0,3 dB and a return loss equal to 25 dB. The resonant frequency of the filter is 1.4635 GHz (and not 1.4635 MHz).

On the other hand, no calibration has been realized before measuring $S_{21}$ parameter on the Fig. 17 [1]. There is not "*C*" at the left of the screen. In this case, the interconnecting cables and adaptors (as well as the instrument itself) introduce variations in magnitude and phase that can mask the actual performances of the device under test. So, it isn't possible to calculate the midband insertion losses. Furthermore, it is better to determinate the resonant frequency and the insertion losses on a narrow-band because there are the same number of measurement points in the sweep on a narrow-band as on a wide-band.

We must also note that Marker 2-1 (1,336 GHz) on Fig. 17 [1] indicates the difference of frequency between the Marker 1 (resonant frequency of the filter) and the Marker 2 (resonant frequency of the first spurious mode). We would only show here the position of the nearest spurious mode. So Figs. 16 and 17 [1] represent the responses of the same filter but on a different band width.

It is fair to find a difference between the matrix of normalized coupling and obtained filter characteristics for many reasons.

At first, the calculation of the matrix of normalized coupling are realized without taking into account the losses.

On top of that, in theory, we have only considered a coupling between the resonant elements 1 and 2, 2 and 3, 3 and 4, 4 and 5, 5 and 6, 1 and 4, 3 and 6 (Fig. 15 [1]).

In fact, in practice, there is a coupling between the dielectric resonator (DR) 1 and the DR 2, and between the DR 3 and the DR 5 for this type of dielectric resonator microwave filters. This unknown couplings can modify the stop band attenuation level.

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## Comments on "Authors' Response"

Slawomir Bialas and Adam Abramowicz

However, the resonant frequency of the filter presented in Fig. 17 is clearly higher than 1.56 GHz we must agree that the Figs. 16 and 17 in the paper[2] represent the responses of the same filter and it is better to determine the resonant frequency and the insertion losses in the narrow-band.

It quite often happens that microwave people use the word "elliptic" instead of "quasi-elliptic" or "pseudo-elliptic" but this should not be accepted as the norm. Besides, among suggested papers [2]–[5] (in the authors' reply) only in the paper [2] and [3] the word "elliptic" denotes "quasi-elliptic" or "pseudo-elliptic" filters. In the

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[2] *et al., IEEE Trans. Microwave Theory Tech.,* vol. 40, no. 1, pp. 120–127, Jan. 1992.

paper [2] and [4] the fourth degree elliptic filters (correctly labelled) are presented. The fourth and sixth degree filters (correctly labelled) are shown in [5].

The authors of the subject paper have given two reasons (losses and spurious couplings) for a difference between the matrix of normalized couplings and the obtained filter characteristics.

First, as it is well known [1], [2], there are two main effects of losses: the introduction of a certain loss in the passband and the rounding-off of the peaks of infinite loss in the attenuation band. Since the quality factor of dielectric reasonators is quite high ($Q_0$ = 6500) the influence of the losses cannot explain 20 dB discrepancy between the stopband attenuation level of the theoretical and the practically realized filter.

Second, the presence of spurious couplings between the resonators 1 and 3, 2 and 4, 4 and 6, 3 and 5, 1 and 5, 1 and 6, 2 and 5, 2 and 6 can significantly change the filter characteristics but the question is how big these couplings are. As usual it is expected that spurious couplings are considerably smaller than the relevant ones. To verify possible changes of the filter characteristic we have performed a computational experiment, in which couplings between the resonators 1 and 3, 2 and 4, 4 and 6, 3 and 5 have been taken into account (couplings between resonators 1 and 5, 1 and 6, 2 and 5, 2 and 6 are negligible because of a distance between resonators). The normalized coupling matrix (Fig. 1) is shown below:

The obtained filter characteristic is presented in Fig. 2. Even addition of such big spurious couplings as listed in the matrix (underlined elements) does not modify the filter characteristic in the way suggested by the authors in their reply. It is worth noting that changes of signs of spurious couplings can only transform the characteristic into its mirror image with respect to the midband frequency. Therefore, the presence of spurious couplings cannot justify the differences between theoretical and obtained characteristics.

| | | | | | |
|---|---|---|---|---|---|
| 0 | 0.9026 | 0.03 | -0.03 | 0 | 0 |
| 0.9026 | 0 | 0.6506 | 0.03 | 0 | 0 |
| 0.03 | 0.6506 | 0 | 0.5918 | 0.03 | -0.03 |
| -0.03 | 0.03 | 0.5918 | 0 | 0.6506 | 0.03 |
| 0 | 0 | 0.03 | 0.6506 | 0 | 0.9026 |
| 0 | 0 | -0.03 | 0.03 | 0.9026 | 0 |

Fig. 1.

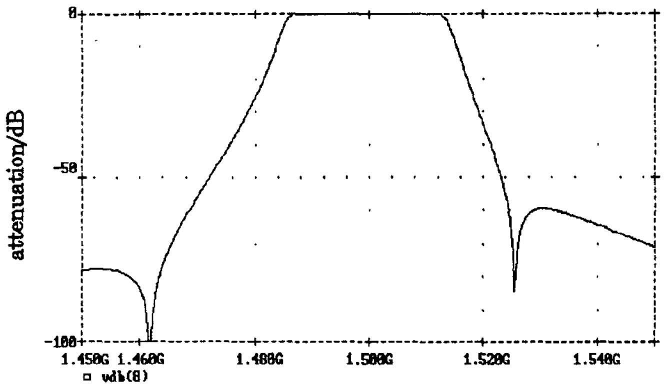


Fig. 2. Wide band frequency response of the normalized coupling matrix.

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