Development of Bandpass Filter for Ultra Wideband System

Hiroto Inoue† Shigemi Kurashima† Masahiro Yanagi† Takashi Arita† Hitoshi Ishida‡ Kiyomichi Araki‡
FUJITSU COMPONENT LIMITED† Tokyo Institute of Technology‡

1. Introduction

Since February 2002 when the FCC (Federal Communication Commission) in the United States authorized the civil use of UWB, the development race for commercializing UWB technology is heating up in Europe and Japan as well.

For mass production and commercialization, however, actually there are numerous problems which require further research and development, and the wideband bandpass filter is one of them.

In the chip sets to be provided by LSI manufacturers in 2005, the 3.1 GHz – 5 GHz frequency band, called “Mode 1”, will be used.

This paper reports on the development of wideband bandpass filters for 3.1 GHz– 5.1 GHz by cascade-connecting a short-circuiting stub to a band elimination filter using ring filters that have sharp band edge characteristics and stable pass band characteristics [1] [2] [3].

2. Design of wideband bandpass filter

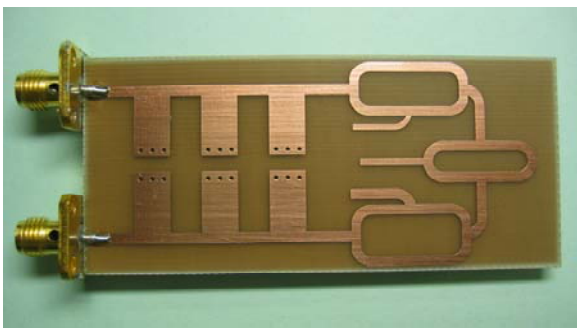
The present authors designed a wideband bandpass filter having a 3.1 – 5.1 GHz pass band using three stages of different ring filters in the 0.1 – 0.2 GHz pass band, and six stages of short-circuiting stub bandpass filters with λ/4 for attenuating the DC components and bands that cannot be blocked by the ring filters.

The central bandpass frequency of the designed ring filters is 4.1 GHz, and the stages are connected by a 50Ω strip line.

Fig. 1 shows a photo of the prototyped wideband bandpass filter. The size of this filter is 33 mm x 70 mm x 0.8 mm.

The high frequency substrate material that was used is FR-4 (copper foil, 18 μm) with a 4.2 dielectric constant, a 0.02 dielectric loss and 0.8 mm dielectric thickness.

Fig. 1 Wideband bandpass filter



3. High frequency characteristics of wideband bandpass filter

Fig. 2 shows the pass characteristics and the reflection characteristics of the prototyped wideband bandpass filter.

The insertion loss is relatively high, 5 – 6 dB, but the attenuation characteristics are 30 dB or more in a low band frequency of 3.1 GHz or less and 17 dB or more in the high band frequency of 5.1 GHz or more.

Attenuation per 100 MHz at the band edge is 10.5 dB in the low band and 8 dB or more in the high band.

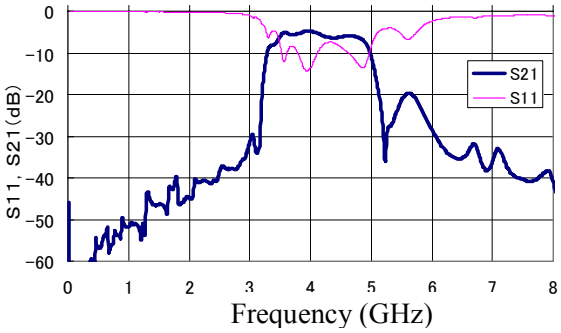


Fig. 2 High frequency characteristics of wideband bandpass filter

4. Conclusion

The present authors created a wideband bandpass filter where the specific band exceeds the target by 45% or more using a configuration of three stages of ring filter having different pass bands and six stages of λ/4 short-circuiting stub bandpass filters.

These filters implemented a 6 dB or less insertion loss in the pass bands, a 30 dB or more suppression in the blocking area of 3.1 GHz or less and 17 dB or more suppression in the block area of 5.1 GHz or more.

In future, we will attempt to continue downsizing and decreasing loss by using a high frequency circuit board with a high dielectric constant and low dielectric loss.

References

[1] Takao Nakagawa, Hitoshi Ishida, Kiyomichi Araki: “Design and development of ring filter (1)”, IEICE Conference 2003

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