음향광학 가변필터 위한 임피던스 매칭 네트워크 설계의 정확도 향상 방법

웬탄닷, 오치충, 백승범, 홍종필
충북대학교

ntdat@cbnu.ac.kr, trung@cbnu.ac.kr, sbbaek@chungbuk.ac.kr, jphong@cbnu.ac.kr

Accuracy Improvement of Impedance Matching Network Design for Acousto-Optic Tunable Filters

Thanh Dat Nguyen, Chi Trung Ngo, Seungbum Baek, and Jong-Phil Hong
Chungbuk National Univ.

요 약

This paper presents a method of improving accuracy in designing impedance matching network for Acousto-Optic Tunable Filters (AOTF) by considering the effect of wire connection. The measured gain S21 of implemented impedance matching network has a BW-6dB of 49% from 17.54 to 28.95 MHz by applying this method.

Ⅰ. 서 론

Electrical impedance matching (IM) network is an essential design block that is implemented between a transducer and an RF signal source of AOTF devices. IM networks have a function of maximizing the power transfer from an RF signal source to a transducer by complex conjugate matching the input impedance of transducer and the output impedance of RF signal source to improve the performance of AOTF devices[1]. However, wire connection causes the mismatch between simulation results and measurement results of IM network. Therefore, the power transfer from the RF signal source to the transducer is significantly degraded. This paper presents an accurate method of designing IM network by pointing the effect of wire connection on IM network design and including this effect in the design of IM network.

Ⅱ. 본 론

Figure 1 shows an IM network measurement setup that is usually adopted in the design of IM network. It is assumed that the output of AOC is directly connected to one port of IM circuit, and the other port of IM circuit is directly connected to impedance analyzer. And the design procedure of IM network is as follow:

- Step 1: Measure and extract output impedance data of AOC
- Step 2: Design IM network
- Step 3: Measure the output impedance of AOC with IM network

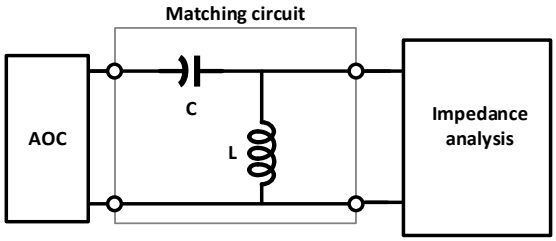
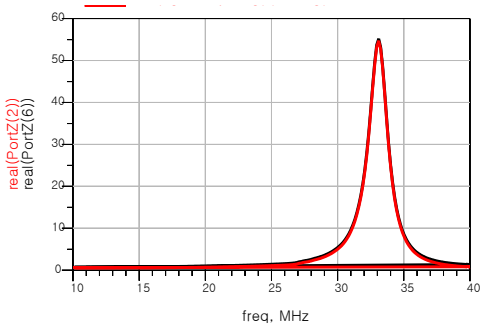


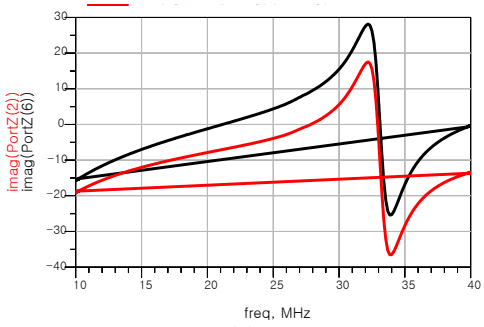
Figure 1. Conventional impedance matching network measurement setup.

However, in the real measurement setup, there are wire connection between AOC and IM network, and IM network and Impedance analyzer. Figure 2 shows measurement results of the real part and imaginary part of output impedance with and without wire connection. As shown in Figure 2(a), the effect of wire connection on the real part of output impedance of AOC is negligible, but the effect of wire connection on the imaginary part of output impedance of AOC is significant as shown in Figure 2(b). The imaginary part of output impedance of AOC increases from 3.4 mS at 10MHz to 13.1 mS at 40MHz. This measurement results show that wire connection adds a significant amount of inductance to the output impedance of AOC.

A correct matching measurement setup is proposed and shown in Figure 3. Red lines represent the wire connection. A pair of wire connection is connected between AOC and matching circuit, and the other is connected between matching circuit and impedance analyzer. Based on this impedance matching measurement setup, the proposed design procedure of IM network is as follow:



(a)



(b)

Figure 2. (a) Measured real part of output impedance of AOC, (b) measured imaginary part of output impedance of AOC.

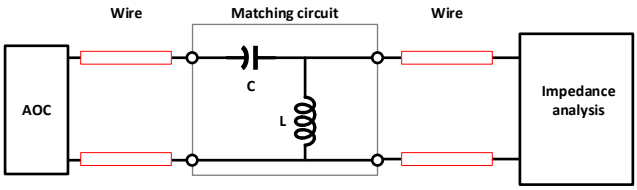


Figure 3. Proposed impedance matching network measurement setup.

- Step 1: Measure and extract output impedance data of AOC with wire connection
- Step 2: Design IM network
- Step 3: Measure the output impedance of AOC with IM network including wire connection

Based on the proposed method, an impedance matching network is implemented. Figure 4 shows the implemented impedance matching network with a size of 20x40cm^2. Figure 5 shows measurement results of the gain S21 of IM networks. Compared with the gain S21 of IM network designed without wire connection effect (red line), the gain S21 of IM network designed with wire connection effect (blue line) increases from 2.8 dB at 28.95 MHz to 9 dB at 17.54 MHz.

Figure 4. Implemented impedance matching network.

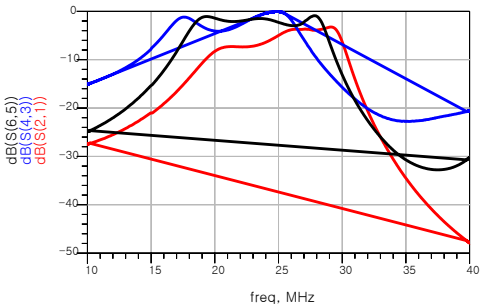


Figure 5. Measurement results of the gain S21 of impedance matching network.

Ⅲ. 결 론

An accurate impedance matching circuit is implemented by applying a correct method of measuring output impedance of AOC and a correct impedance matching network measurement setup. Therefore, the mismatch between simulation results and measurement results is minimized. This decreases time, and cost in implementing real products.

ACKNOWLEDGMENT

This work was supported by the Civil Military Technology Development Program of the Institute of Civil Military Technology Cooperation funded by the Ministry of Trade, Industry and Energy, and Defense Acquisition Program Administration (17-CM-DP-02). This research was also supported by the MSIT(Ministry of Science and ICT), Korea, under the Grand Information Technology Research Center support program (IITP-2021-2020-0-01462) supervised by the IITP (Institute for Information & communications Technology Planning & Evaluation).

참 고 문 헌

[1] Goutzoulis A.P. “Design and Fabrication of Acousto-Optic Devices,” Dekker, 1994.