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New Unidirectional IDT and OFC Sensers and Wide-band Filters Using UIDT

新構造一方向性すだれ状電極と一方向性ＯＣＦ構造センサー・広帯域フィルタの解析と実験

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1. Introduction

Surface acoustic waves(SAWs) have been applied in various electronic devices, e.g., different kinds of filters, stable high frequency oscillators, real time signal processing devices, convolvers and matched filters used in spread spectrum communication systems.

OFC is the use of orthogonal frequencies to encode a signal, which spreads the signal bandwidth in a manner similar to a fixed M-ary frequency shift signal. Also, a pseudo noise (PN) sequence can be added for additional coding. The OFC technique provides a wide bandwidth spread spectrum signal with all the inherent advantages obtained from the time-bandwidth product increase over the data bandwidth. To obtain the large time-bandwidth with low loss, the high coupling and UIDT are required. Also the zero TCF materials are very important for the matched filter systems.

In this papers, we propose the new configuration of the internal reflection type of unidirectional IDT with the high transduction using high coupling substrates of SiO_2/YX-$LiNbO_3$[1,2] with k^2=0.3 and zero Temperature Coefficient of Frequency(TCF). The above UDT and substrates are applied to the low loss wide band filter, Tags[3] and Sensors[4]. The calculation results show the large wide-band width and very low insertion filters, tags and sensors without the degradation of the pulse response over the temperature by zero TCF substrates.

2. New configuration of Unidirectional Interdigital Transducers Using Floating Electrodes

Fig. 1 shows the shorted floating λ/4 electrode type UIDT. The gaps between the + electrode and floating electrode are λ/8, and floating and –electrode are 3λ/8. The transduction efficiency is higher than in the case of the UDT reflective electrodes, because the electric fields are applied between electrodes and the floating electrodes. The calculation results of UIDT are shown in Fig.2. Good directivity and high transductions are obtained. The narrow gaps of λ/8 could be wider by change of the electrode width.

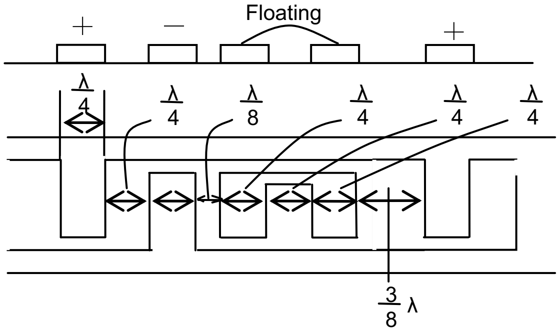

Fig.1 UIDT with shorted floating electrodes .

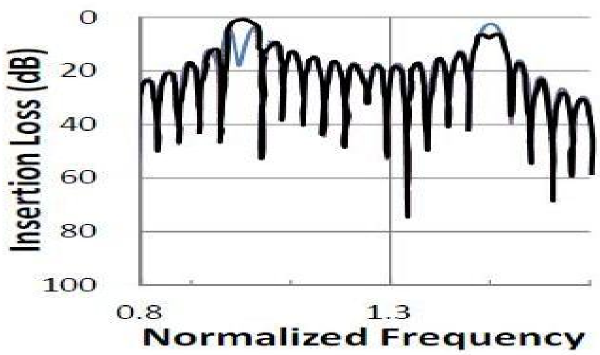

Fig.2 UIDT frequency response

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3 . OFC Systems

OFC is similar to M-ary FSK. Fig.3.(a) shows the chip frequency responses of seven carries. Each chips keep the OFC condition. Figure 3(b) shows the coding by shuffling the chips shown in the stepped chip signal.

Figure 4 shows the OFC devices using the UIDT. The devices are one of the wide band filters with the chip carrier frequency allowed to the f1,f2,...of M-ary.

Figure 5 shows the frequency characteristics of OFC–OFC(each pairs of 12) device with UIDT. The results show the very small insertion loss of about 3.0dB.

Figure 6 shows the parallel connected OFC using UIDT. In this case, no propagating interference of each channel will be performed.

Figure 7 shows the 12pairs UIDT-OFC frequency characteristics using parallel sending unidirectional transducers with sending pair number of Ns=12 and receiving pair number of Nr=2, aperture of W=22λ.

4 . Experimental results of New UDIDT

Experimental results of UIDT of the configuration of Fig. 1 are shown in Fig.8. UIDT is as follows, sending electrode length of 16λ,aperture of 15λ,substrate of 128° Y-X $LiNbO_3$., and receiving electrode of conventional IDT of 3λ. The experimental results show the good agreement of theoretical ones. The UIDTs have high transduction efficiency.

5 . Conclusion :

We proposed the new configuration of UIDT with shorted floating electrodes and the experimental results show good agreement of theoretical ones. Also, the calculation results of the very wide band OFC devices using UIDT showed good frequency response and the very low loss devices. We are now taking the experiments of the OFC devices.

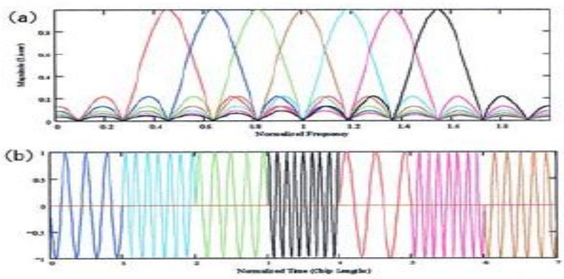

Fig.3(a):Orthgonal frequency characteristics(b):Coding by shuffling the chips.

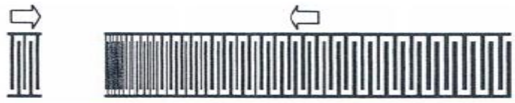

Figure 4 Schematic drawing of seven chips OFC SAW ID tag.

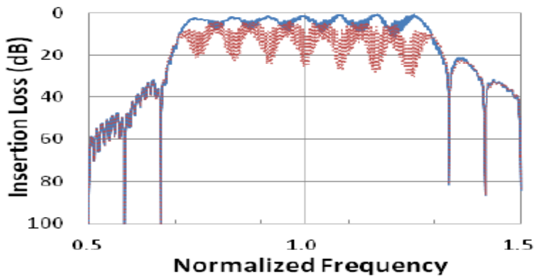

Figure 5 OFC-OFC total frequency characteristics using UIDT with sending pair number Ns=12 and receiving pair number of Nr=12

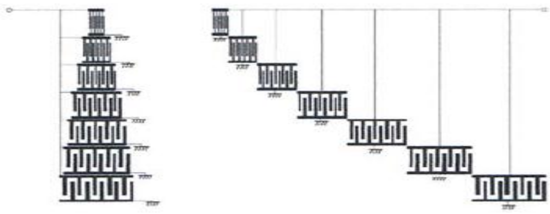

Figure 6 OFC devices using parallel sending UIDT

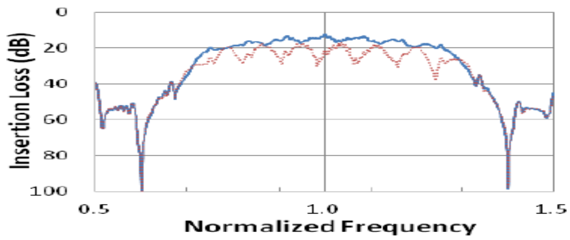

Figure 7 2-pairs-OFC frequency charactericties using parallel UIDT with sending pair number Ns=2 and receiving pair number of N=12, amd aperture W=22

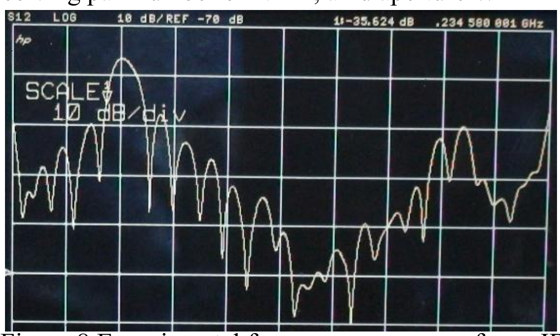

Figure 8 Experimental frequency response of new IDT

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