Acta Physicae Superficierum · Vol II · 1990

PROGRAMMABLE SURFACE ACOUSTIC WAVE OSCILLATOR

DIETER SEHMISCH, DIETMAR THUROW and ERICH TRZEBA

Institute of Electrical Communication, University of Technology, Dresden-8027, Germany

ABSTRACT. A programmable surface acoustic wave (SAW) delay line oscillator with a wide range of frequency variation is presented. The device consists of an amplifier with SAW delay line and a special phase shifter used as feedback elements. The delay line applied in this oscillator can be of single mode or multimode type. A number of frequencies within a given range may be adjusted by the programmable control circuit.

BASIC PRINCIPLES

The delay line oscillator consists of an amplifier, a SAW delay line and a phase shifter. The phase shifter is controlled by a special unit. The delay line comprises two unweighted interdigital transducers on a piezoelectric substrate. To perform the controlled oscillator, single mode and multimode delay lines with center frequencies of about 75 MHz were applied. A two-stage amplifier with wide bandwidth is utilized to compensate the insertion loss of the delay line and the phase shifter. The phase shifter (Fig. 1) is based on single-sideband amplitude modulation according to the phase shifting method [1], [2].

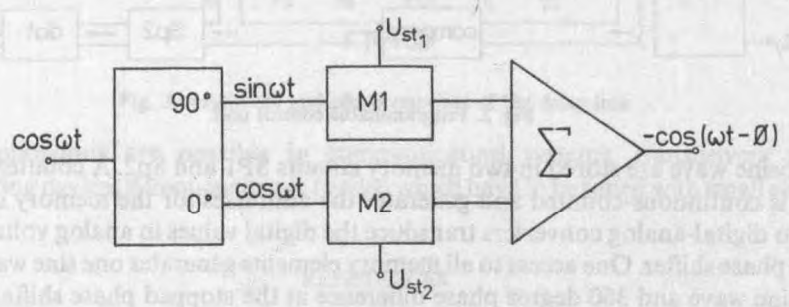

Fig. 1. Phase shifter.

Applying audio and carrier frequency suppression by means of a double balanced modulator, by additional selection, addition or subtraction of side frequencies remaining we get the modulated signal

$$u_{\mathrm{mod_{SSB}}} = k \cos(\omega_h (\mp) \omega_n) t \tag{1}$$

If audio frequencies are replaced by sine or cosine proportional d.c. voltages, respectively,

$$U_{\mathrm{St1}} = U_{\mathrm{St}} \sin \varphi \tag{2}$$

$$U_{\mathrm{St2}} = U_{\mathrm{St}} \cos \varphi \tag{3}$$

a phase shifted r.f. signal results after passing the SSB modulator

$$u_h(t) = k \cos(\omega t (\mp) \varphi) \tag{4}$$

To suppress the carrier or the high frequency signal not out of phase, respectively the stages M1 and M2 are performed as diode double balanced mixer or active integrated mixer. For the suppression of the second side band or the signal with opposite phase shifting, respectively, a summation stage in the form of a transformer or integrated difference amplifier is used.

PROGRAMMABLE CONTROL UNIT

To control and programme the frequency of the oscillator a programmable control unit was developed (Fig. 2). The actual levels of a sine wave and

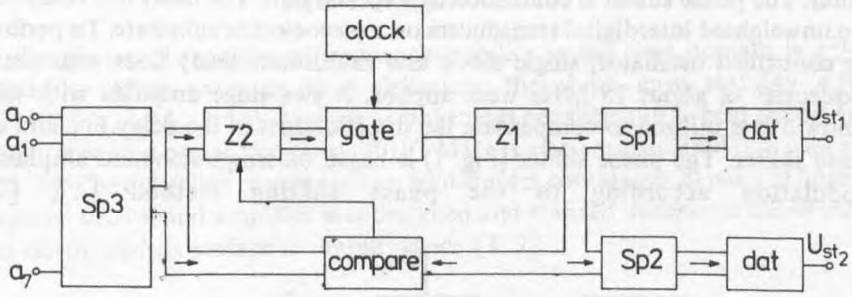

Fig. 2. Programmable control unit.

a cosine wave are stored in two memory circuits SP1 and Sp2. A counter circuit Z1 is continuous-counted and generates the addresses for the memory circuits. Two digital-analog converters transduce the digital values in analog voltages for the phase shifter. One access to all memory elements generates one sine wave, one cosine wave and 360 degree phase difference at the stopped phase shifter. If the clock for the counter circuit Z1 is broken, the voltages U_{St1} and U_{St2} are constant and proportional to actual levels of a sine wave and a cosine wave.

The frequency of the oscillator is programmable. That is why the addresses for the memory circuits Sp1 and Sp2 which correspond to the phase to generate various frequencies are stored in another memory circuit Sp3. In a comparison circuit the addresses stored in Sp3 are compared with the addresses generated with the counter Z1. If both addresses are equal a second counter circuit Z2 is degraded. If a multimode delay line is used the mode of the frequency has to be tuned and stored in Sp3. The counter circuit Z2 is set with the value of this mode. If the wanted frequency is tuned, a gate circuit stops the clock for the counter circuit Z1. If various addresses of Sp3 are accessed, various frequencies can be tuned. If the used delay line is a single mode delay line the counter circuit Z2 is not needed and the memory circuit Sp3 needs not so much capacity.

RESULTS

The above described digital programmable wide band oscillator has been tested. If used a multimode SAW delay line, frequencies with a range of 2.6 MHz of a medium frequency of 76 MHz were generated (Fig. 3). This corresponds to a relative frequency change of 3.4%.

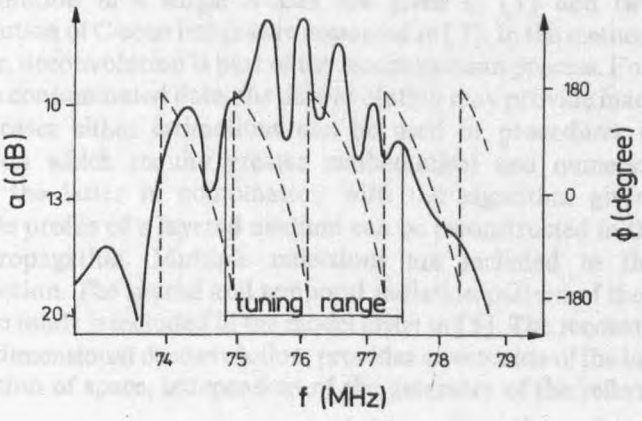

Fig. 3. Amplitude and phase response of the delay line.

Applications are possible in communication systems, transceivers and measuring devices if frequencies are needed which have to be tuned with small steps.

REFERENCES

[1] Brauer, M., *Single-sideband modulation*, Berlin 1985.
[2] Delay line oscillator, DE-OS HO3B 5/18 052732690.