

THE SHAPER OF MODULATING SQUARE WAVES

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The displacement of measured value of the resonant frequency of centers of microwave spectral lines of some rotational and rotationally vibrational transitions of asymmetric top molecules was observed. The shaper of zero-based square-waves eliminating of such displacements was designed and tested in a hybrid microwave spectrometer.

The Stark modulation in microwave spectroscopy has many advantages, but sometimes the values of frequency of spectral lines centers measured by this method were displaced. The careful analysis of such spectral lines has shown, that the displacement of their resonant frequencies is caused by a displacement of zero level of modulating square-waves. It was confirmed by dependence of the resonant

frequency of transition $s_{4_{32}}-s_{4_{22}}$ 28543,079 MHz (ethanol, gauche form) on magnitude of displacement of zero level of square-wave (fig. 1). As it follows from this figure, even a little change of voltage of zero level of zero-based square-wave displaces measured value of frequency of a spectral line center on a few megahertz.

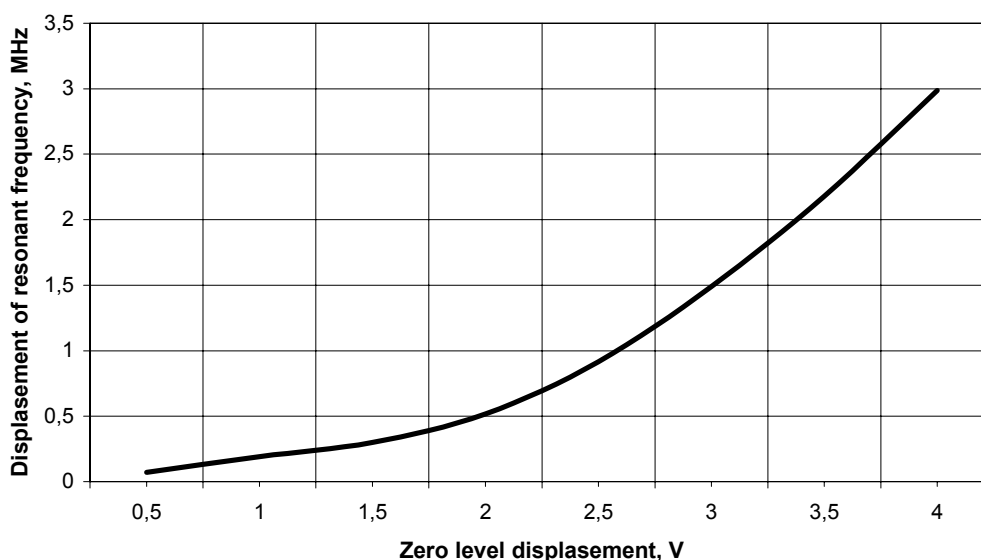


Fig. 1 A curve of dependence of displacement of resonant frequency of transition $s_{4_{32}}-s_{4_{22}}$ 28543,079 MHz of spectral line of gauche-ethanol molecule on magnitude of voltage of displacement of zero level of modulating square wave

The purpose of the present paper was working out the square-wave shaper with minimum displacement of a zero level. In well-known analogs of such shaper [1-3] a displacement of zero level sometimes reaches too high values, because of use of high-voltage bipolar transistors in output stages of shaper. Switchover of such transistors into state of saturation requires the particular shape and power of controlling impulses with necessity of high-voltage uncoupling. However even residual voltage of collector-emitter transition of the bipolar transistors in the opened state creates a displacement of zero level of square wave. Therefore special monitoring and compensation of such displacement is required. The presented shaper of modulating square waves (SMSW) is constructed on the basis of modern MOSFET-transistors having low values of resistance of a conducting drain-source channel in an opened state [4]. The control of the transistors is carried out by a special chip of high voltage, high-speed power MOSFET and IGBT drivers with dependent high and low side referenced output channels [5].

The shaper consists of the following functional blocks (fig. 2):

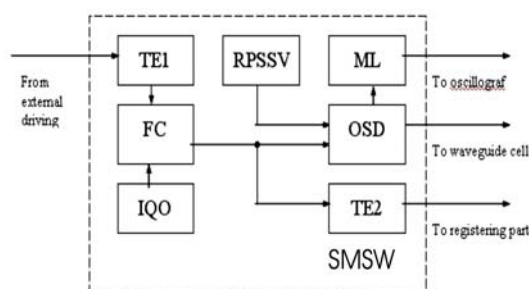


Fig. 2. Functional diagram of shaper of modulating square waves.

- Regulated power source of stabilized voltage RPSSV;
- Internal quartz oscillator IQO;
- Frequency converter FC;
- Input and output threshold elements TE1, TE2;
- Output shaping device OSD;
- Measuring limiter ML.

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During the process of testing of the shaper the value of voltage of zero level displacement was measured by oscilloscope by instrumentality of amplitude limiter ML (R7, R6, D2).

The use in the shaper of modern element base has allowed to reduce a voltage of zero level displacement up to values, at which its influence to an accuracy of measurement of spectral lines centers frequencies becomes negligible. It is confirmed by record of spectral line mentioned above (fig. 4).

Thus, necessity for monitoring and compensation of a zero level displacement of modulating impulses for separate transitions has disappeared and it enables to realize continuous record of a spectrum in an automatic mode.

Moreover, range of operating frequencies has essentially extended, that enables to select an optimum relation of sensitivity and resolution of the measuring equipment at the record of spectral lines.

SMSW stably works in a frequency range from 20 Hz up to 600 kHz and in all range of operating frequencies has the following characteristics:

- Amplitude of output impulses $0 \div 100$ V;
- Off-duty factor 2;
- Duration of front of impulses, no more than 300 ns;
- Duration of cutoff of impulses, no more than 250 ns;
- Loading capacitance, not less than 1000 pF;
- Displacement of a zero level, no more than 10 mV.

- [1] Radiospectrometer with electrical molecular modulation. Int. of AS of Azerb. SSR, part of PTMS, 1979, № 1 pp.100-107.
- [2] Ch. Townes, A. Shavlov Radiospectroscopy., 1959. p.756.
- [3] C.O. Britt. Solit state microwave spectrometer. Rev. Sci. Instrum , 1967, v. 38, № 10, p.1496-1501.
- [4] SMPS MOSFET IRF830A, Data Sheet № PD-91878C, International Rectifier, 05/2000.
- [5] High and low side driver IRF2104(s), Data Sheet № PD-60046-O, International Rectifier, 02/15/2001.

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MODULYASIYAEDİCİ İMPULSLARIN FORMALAŞDIRICISI

Asimmetrik fırfıra tipli molekulların bəzi fırlanma və rəqsi fırlanma keçidlərinin rezonans tezlikli mikrodalğalı spektral xətlərinin mərkəzlərinin ölçülən qiymətlərinin sürüşməsi müşahidə olunmuşdur. Bu sürüşmənin yaranma səbəblərini aradan qaldırmağa imkan verən modulyasiyaedici unipolyar impulsları formalaşdırın qurğu hazırlanmış və hibrid spektrometrin tərkibində sınaqdan çıxarılmışdır.

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ФОРМИРОВАТЕЛЬ МОДУЛИРУЮЩИХ ИМПУЛЬСОВ

Обнаружено смещение измеряемого значения резонансной частоты центров микроволновых спектральных линий некоторых вращательных и вращательно-колебательных переходов молекул типа ассиметричного волчка. Разработан, изготовлен и испытан в гибридном спектрометре формирователь модулирующих электрических импульсов, устраняющий причины возникновения таких смещений.

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