

THE STATE TIME AND FREQUENCY SERVICE IN THE USSR

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ABSTRACT

The paper describes the existing metrological distribution system for the USSR users working in the field of precise time and frequency measurements. The characteristic of the standard system, its location as well as the technique and means of mutual comparisons are given. The accuracies obtained by independent clock time scales and their inter-comparisons are quoted in the paper. The structure and description of the USSR time signals, their frequency of emission, and their metrological characteristics are given. The problems of astronomical determination of time are considered.

INTRODUCTION

At present, standard frequency and precise time signals are used in many fields of science and technology. The necessity of providing equal and accurate separate measurements is the main feature of numerous applications. In the Soviet Union these are provided by the USSR State time and frequency service. The time service was established in 1947 principally for astronomical determination of the time and frequency of the State standards. At present, the time service is also engaged in measurement technology covering our country's requirements in the field of time and frequency measurement.

The System of Standards

The State standard producing precise time and frequency for the National time scale is the basis of the USSR State time and frequency service. In addition to the State standard, the standard system includes also secondary standards which are kept in metrological institutes of Irkutsk, Novosibirsk, Kharkov and other cities. By their characteristics these standards only insignificantly yield to the State standard. They provide frequency, determined by the USSR State standard, with an error of the order of 1×10^{-12} .

The main function of the standard system operation is to coordinate the time scale of the State standard with the time scales of secondary and working standards. At the present time, the error of such coordination is of the order of not more than a few microseconds for the most remote standards. This value is periodically defined more precisely to the tenth parts of a microsecond with the aid of portable clock time transfers.

The System of Time Signal Emission.

LF- and HF- range stations are the basic means for standard frequency and time signal emissions in the system of the State time and frequency service.

At present, there are three LF- radio stations in the State time service. They are as follows: RBU, Moscow - 66 2/3 kHz; RTZ, Irkutsk - 50 kHz and RB-166, Irkutsk - 200 kHz. Normally, these stations transmit standard frequency and time signals all day and all night on the schedule and program determined for each year. Recently, the error of time signal emission was substantially reduced by means of facility modifications at these stations. Currently, the frequency error is of the order of 7×10^{-11} .

Short-wave radio stations (Moscow, Irkutsk, Novosibirsk, Tashkent) are primarily used for time signal emission with a medium accuracy. Fluctuations of time dissemination do not permit these stations to be used for time signal emissions with an error of less than 10^{-9} in frequency and 300 μ s in time. Nevertheless, such accuracy meets the requirements of the majority of today's users.

The systematic comparison of time scales kept by the standards in Moscow and Kharkov are carried out with the aid of a meteoric synchronization line. The long-term usage of this channel showed that the error of the time scales compared is less than 1 μ s.

Great expectations exist for the accuracy of standard frequency and time signal emissions provided by the use of television channels. At the present time, signals are transmitted from the USSR State standard on the first program of All-Union TV-broadcasting. These signals are transmitted in the 6th line during the display of the clock face and other studio broadcasting. They contain information for current time and standard frequency (1 MHz). For the present, the requirements of many organizations in

Leningrad, Moscow, Kharkov, Kiev and other cities are covered by means of this system of time signal emission. Comparison of the USSR standard with the DDR standard was twice performed via TV in 1975. Processing the results of the comparisons showed that such a comparison method yields an accuracy of not worse than 1 to 2 μ s.

The Astronomical Determination of Time.

The astronomical determination of time is of significant importance in the USSR State time and frequency service. The calculation of Universal time is presently performed on the results of astronomical observations of 10 USSR observatories and 9 observatories of other countries.

On the basis of these data, the Metrological Center of the time service issues monthly bulletins giving departures of Universal time scale from the Atomic time scale.

The existing structure of the State time service provides the technology to disseminate the metrological service of the National economy for time and frequency measurements. Thus, on the base of secondary standards, which are distributed over the territory of the USSR, the certification of the most accurate time and frequency measurements and their periodical calibrations are carried out.

The metrological control and calibration of high accuracy measurement equipment (frequency meters, generators, clocks) is effected by a number of State controlled laboratories which are equipped with standard measurement facilities and disposed practically in all big cities of the USSR.

QUESTION AND ANSWER PERIOD

DR. WINKLER:

Now, before we ask the questions, I would like to ask for your understanding that in view of the difficulty of communication -- English for a foreigner is a very difficult language when it is transmitted through a microphone. We will have a translator translate the question for Mr. Sazhin and then he will answer.

DR. REINHARDT:

Victor Reinhardt, NASA.

You didn't mention what type of standards do you use as primary standards and the secondary standards in your standard plot?

MR. SAZHIN:

The primary standards of the USSR is the next paper that Mr. Iljin will be delivering.

TRANSLATOR:

He said that the secondary standards are almost the same as the primary standards- but a little smaller.

SGT. OSTROWSKI:

Sergeant Ostrowski, Newark Air Force Station.

I have a question about the Loran service. Does it disseminate precise time information?

MR. SAZHIN:

Yes, in Moscow we don't receive the Loran signal. We receive its signals in Leningrad and in Nikolay and other cities on the edges of our country. We do not use it for time comparison between our standards, but we use it for comparison with standards of other countries.

MR. RUEGER:

I would like to know how you handle the leap second, or are you transmitting in atomic time scale for your time signals?

MR. SAZHIN:

With our broadcast, it is the same as other countries. Our coordination with BIH is the same.

DR. WINKLER:

Is it the same UTC system as the International system?

MR. SAZHIN:

Since 1972.

DR. WINKLER:

Yes. Beginning in 1972.

