Multichannel Registration in a Wide Wavelength Range with RATAN-600

A. Storozhenko, V. Bogod, S. Shlenzin, A. Pervakov, A. Ripak, V. Khaikin, M. Lebedev, and N. Ovchinnikova

St.Petersburg Branch of SAO RAS, St.Petersburg, Russia,
acs-work@mail.ru,

Abstract. This work considers the issues of architecture of the existing solar spectral polarization complex SSPK-16 and its modernization.

Keywords: telescopes; techniques: radar astronomy

DOI:10.26119/978-5-6045062-0-2_2020_405

Understanding the processes leading to the occurrence of solar activity requires recording the radiation flux of the active region structure in a large dynamic range from signals at the level of the quiet Sun about 0.001 s.f.u. (Bogod et al. 1999) to powerful events with a brightness temperature of up to 10^7 K. To solve the problem, complete overlapping of the frequency range of a radio telescope with a high spectral resolution (Bogod 2011) in a large dynamic range, in 2016, the SSPK-16 solar spectral-polarization complex was developed and put into operation. SSPK-16 provides data logging with a period of 5 Hz, in some configurations up to 30 Hz, but, for observations of fast processes (Nakariakov & Melnikov 2009; Yasnov et al. 2017; Zaitsev & Kislyakova 2012), as well as for solving problems of tracking observations (Storozhenko et al. 2019), it is necessary to increase the time resolution of the registration system up to 0.01 - 0.001 seconds. Compare to the previous system (Bogod et al. 2011) SSPK-16 includes - radiometer with next key features:

– large dynamic range, from registration of signals at the level of limiting sensitivity of about 0.1 K to registration of powerful events corresponding to 10^6 K, due to the function of dynamic adjustment of the signal attenuation coefficients in the measuring channels of the system;
– the ability to work in full power mode for one of the polarization;
– high-precision temperature stabilization (up to the 0.1 degrees) of the radiometer modules using Peltier elements;
– work in different modes of the radiometric complex and their dynamic switching.

Radiometer implements circuits with two levels of frequency resolution, which work simultaneously.The first level of frequency resolution divides the total system range from 3 to 18 GHz into 10 bands of 1500 MHz. The second level of frequency resolution divides the total system range from 3 to 18 GHz into 80 bands of 100 MHz. The total number of channels at the radiometer output is 90, considering the switching of the measured circular R/L polarization - 180. Radiometer SSPK-16 provides ample opportunities for signal attenuation in various channels. Acquisition and control system is built in the 16 place rack with form factor LTR/EU16 and equipped with modules LTR43, LTR114, LTR24. The characteristics of the main ADC(LTR114) of acquisition system limit the maximum switching frequency of the R/L polarization. L-Card equipment is made according to the principles of modular architecture, which makes it possible to easily change the composition of the crate LTR/EU16 modules. To increase the time resolution of the data received from the SSPK-16, it is proposed to upgrade the system by replacing the LTR114 modules with high-speed LTR24 modules. This solution will require to equip the acquisition system with an additional LTR/EU16 crate. Note that L-Card supports synchronization of acquisition modules between crates by means of LTR43 modules (Garmanov 2020), which exchange synchronization signals during the measurement process. Accuracy of data flow synchronization between crates is not worse than 10-50μs.

The modernization project is currently underway after the completion of this project, the temporary resolution of the SSPK-16 system will be increased to values of 500μs-3ms.

Acknowledgements. This work was supported by the RFBR grant: 18-29-21016, 18-02-00045, 18-52-34004.

Bibliography

Bogod, V. M. 2011, Astrophysical Bulletin, 66, 190

Bogod, V. M., Alesin, A. M., & Pervakov, A. A. 2011, Astrophysical Bulletin, 66, 205

Bogod, V. M., Fu, Q., & Yasnov, L. V. 1999, ESA SP, 448, 1041

Garmanov, A. V. 2020, LTR Crate system user manual, L-CARD LTD, https://www.lcard.ru/

Nakariakov, V. M. & Melnikov, V. F. 2009, Space Science, 149, 119

Storozhenko, A. A., Lebedev, M. K., Ovchinnikova, N. E., & Khaikin, V. B. 2019, in SSZF-2019, Saint-Petersburg, Pulkovo

Yasnov, L. V., Bogod, V. M., Gofman, A. A., & Stupishina, O. M. 2017, Astrophysical Bulletin, 72, 63

Zaitsev, V. V. & Kislyakova, K. G. 2012, Izvestiya vuzov. Radiofizika, 55, 473