

SYSTEMS FOR PRELAUNCH TEST AND INFLIGHT CALIBRATION OF THE PODSOLNUH DEVICE OF THE GRANAT PROJECT

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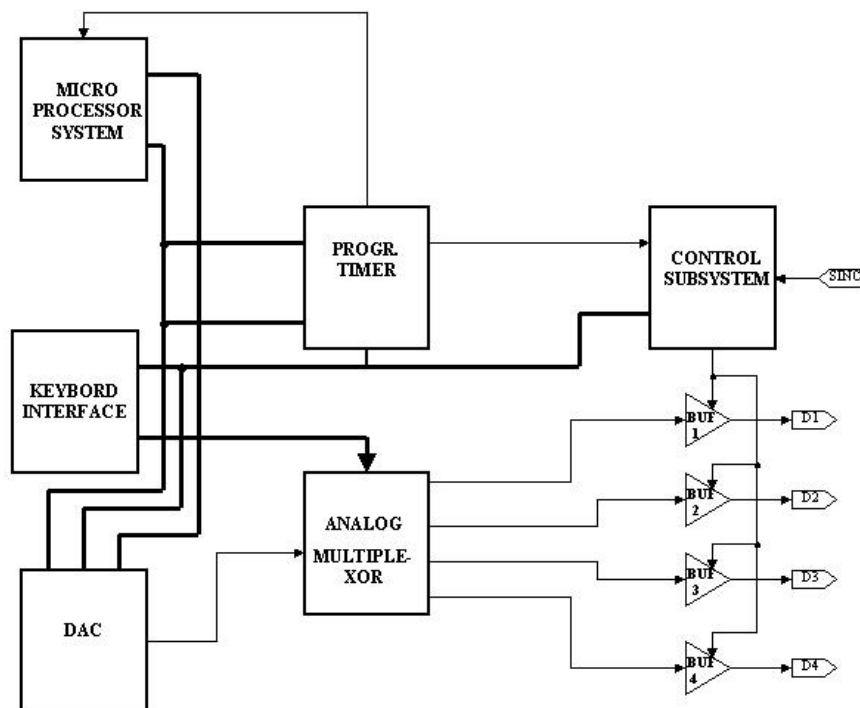
Introduction

The Podsolnuh device is intended mainly to perform amplitude and intensity analysis of the input signals from the detector system which are previously processed by the input subsystem of the system for analog-to-digital conversion (ADC) and estimation of their parameters and also to perform real-time analysis of the input pulse intensity in correlation with the diffuse X-ray background, thus providing high-fidelity identification of X-ray bursts [1, 2]. This system requires ground-based adjustment and testing as well as periodic verification of its accuracy and performance in flight.

Structure and operation base of the systems

1. System for ground-based calibration and testing

The system for ground-based calibration and testing (GBCT) contains the following main blocks (Fig.1): microprocessor subsystem, programmable timer, control subsystem, ADC, analog multiplexor, keyboard with interface, output buffers and communication block for external test equipment.



This system works in two main operation modes. The first one is used for calibration and testing of: 1- input device system for separation of the pulses caused by X-ray and charged particles; 2 - subsystems for analog-to-digital conversion and amplitude and intensity analysis.

The keyboard is used to set up the code of the required operation mode after which the system is set up either in autonomous mode or in testing mode using an external test equipment in order to be synchronized with the onboard control systems.

Upon decoding of the mode code, the programmable timer is started, providing the frequency of the signals entering outputs D1, D2, D3, and D4. In sequence with the same frequency the ADC provides 32 analog amplitudes corresponding to the operation levels of the amplitude analyzer. Via the analog multiplexor these signals are successively fed to the buffer amplifiers. The circuitry of these amplifiers allows them to provide analog output signals with maximum parametric likeliness to those of the gas-filled counters.

After a given time interval the parameters of the output buffer amplifiers are changed to simulate pulses obtained in charged particle detection. At the end of this time interval the system is automatically stopped and the light indicator announces the end of the test.

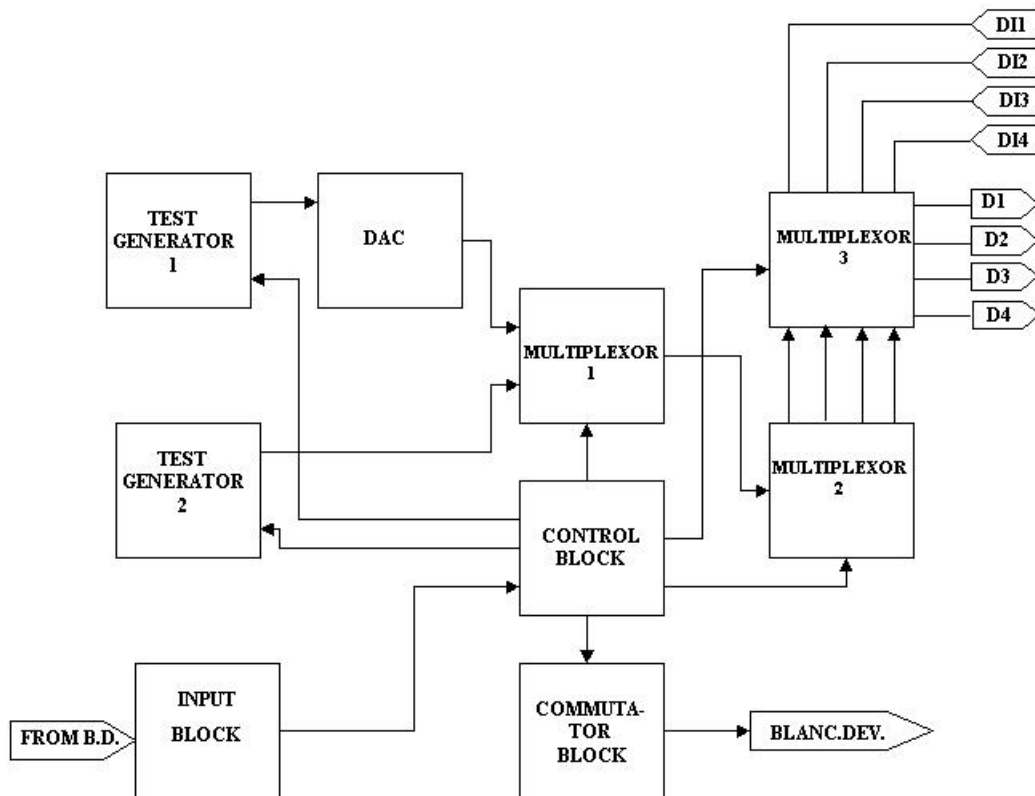
By this test the differential and integral non-linearity of the ADC and the amplitude analyzer can be evaluated. There is a possibility of varying the main frequency to test the amplitude and intensity analyzer at different accumulation times.

The second main operation mode is used for testing and calibration of the block for adaptive determination of the accumulation times of both analyzers and the system for high-fidelity identification of X-ray bursts. In this mode DAC operates with constant amplitude of the output signals.

On starting the system, during fixed time intervals, the constant frequency of the output signals simulates the diffuse X-ray background. Then, the frequency is varied by an algorithm defined by a code set from the keyboard. Thus we may simulate X-ray bursts with different characteristics. This mode provides for the verifications of the accuracy with which the accumulation times of the amplitude and intensity analyzer are determined in function of the input pulses and the fidelity of X-ray burst identification.

2. System for inflight calibration and testing

The Podsolnuh device is supplied with an electronic system for inflight verification of the performance and accuracy of the above-described system. It is set in operation by a command from the onboard system. The testing proceeds in three main stages.



During the first stage the blinking devices of the four detectors are switched on via the communication block and Fe 55 isotope is introduced in the view field. After storing of one amplitude spectrum the amplitude analyzer (AA) provides a signal to reswitch the system to the next operation mode.

The blinking devices are switched off and multiplexor 3 switches off the outputs of the detector amplifiers, thus switching the signals entering from test generator 1 to the pulse of the system for ADC and input signal parameter calibration. The test generator provides 8 amplitudes corresponding to predefined channels of the amplitude analyzer. By multiplexor 2 the signals are fed to multiplexor 3 at equal time intervals, thus simulating the successive performance of the four detectors. When one spectrum is stored, the amplitude analyzer reswitches the system into the next operation mode.

Here, test generator 1 is switched off and test generator 2 is switched on. This mode activates the intensity analyzer and the device for adaptive determination of the accumulation times of the two analyzers [3]. The signals are with constant amplitude. During a given time interval their frequency simulates the frequency of the X-ray background after which, during the next time intervals, it varies by a defined algorithm, thus simulating various thresholds of reswitching of the accumulation times of the adaptive system.

Upon completion of the test stage the device automatically feeds an "End of test" signal and is switched off electrically. The data stored during the test is transmitted to the onboard telemetric system. The obtained data provides to perform express evaluation of the test system. Based on the results from this analysis, adequate corrections can be introduced during the interpretation of the data obtained from the device.

The system for prelaunch test and inflight calibration of the PODSOLNUH X-ray telescope provides reliable ground tuning and stable inflight control of its measurement functions.

References

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Текст към фигури:

Fig. 1. Flow-chart of the system for ground based calibration and testing of the Podsolnuh device

Fig. 2. Flow-chart of the system for inflight calibration and testing of the Podsolnuh device.

Abstract

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The main purpose of the Podsolnuh experiment is the study of X-ray bursts, X-ray pulsars, and the location of variable X-ray sources within the energy range of 2-25 KeV as well as the study of their temporal structure.

The operation principles and the technical characteristics of the electronic system for ground-based calibration and tuning of the input circuitry, analog-to-digital converter, amplitude analyzer, intensity analyzer and the independent system for registration and estimation of X-ray bursts are described.

The test system generates successive input signals to the four detectors and according to the operation mode their parameters are changed.

The calibration device is a part of the electronic system for ground-based calibration and tuning; it simulates the signals from the onboard command systems with high-fidelity.

In flight, this device gives the possibility for periodical testing and estimation of the operability and accuracy of the the Podsolnuh unit.