

ART-XC control at early mission phase

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1. Document “Initial data for the first sessions of ART-XC” describes the switching-on and first tests of hardware on orbit
2. ART-XC EGSE software for real-time data link and analysis

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Document “Initial data for the first sessions of ART-XC” is included to document “Program of mission operations for 6 months” (SRG flight plan to L2) supported by Roman Krivonos with common table of time scheduling of S/C orbit, status and instrument operations.

BKU performs automatic switching of electronics sets in various situations, including errors and emergency situation, thus, in the Ground contact, we can meet with any possible configuration of devices (working sets) and conditions.

So, we must be ready to issue commands for any current configuration.

In this document we describe:

- Prepared sets of command sequences for any hardware configuration in orbit;
- Switch on and first tests procedure of ART-XC subsystems (thermo control, detectors, star tracker).

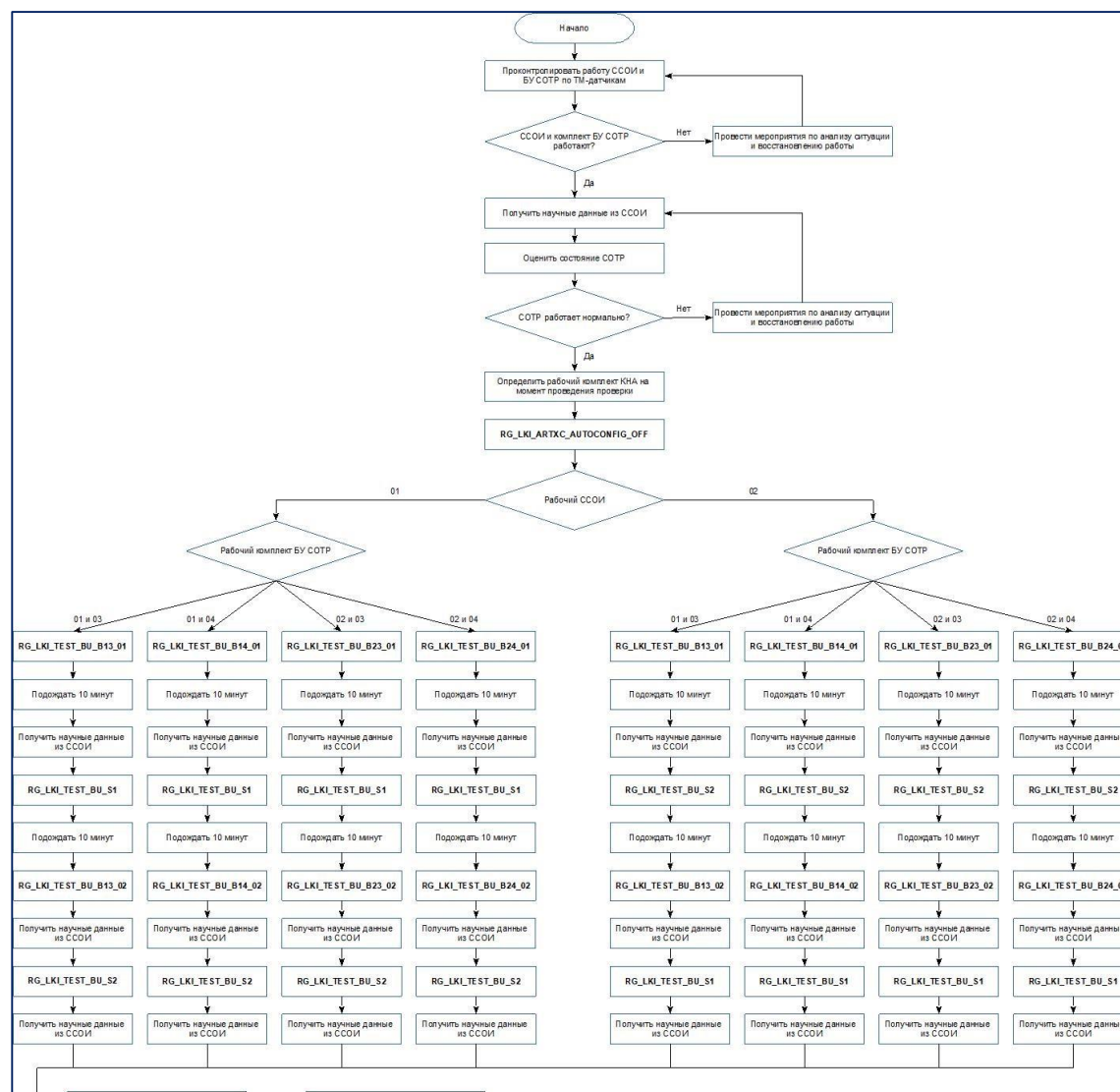
This document has been sent to NPOL as required.

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	subsystem					
	SSOI 1	SSOI 2	BU SOTR 1	BUSOTR 2	BUSOTR 3	BUSOTR 4
Configuration (combination)	+		+		+	
			+			+
				+	+	
				+		+
		+	+		+	
			+			+
				+	+	
				+		+

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Flow chart of operations and command sets for Ground contact session



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1. **RG_LKI_TEST_BU_B24_02**
1. //ЛКИ ART-XC: Проверка работы резервного БУ СОТР завершение (рабочие БУ СОТР 02 и 04)
2. 12.04.2019 10:45:00 ART SEANCE KK=3473 //Разрешение выключения приборов КНА
3. 12.04.2019 10:45:10 ART SEANCE KK=3405 //Выключение БУ СОТР 01
4. 12.04.2019 10:45:20 ART SEANCE KK=3407 //Выключение БУ СОТР 03
5. //Проконтролировать выключение БУ СОТР 01 и 03 через 200с
6. 12.04.2019 10:50:20 ART SEANCE KK=3474 //Запрет выключения приборов КНА
2. **RG_LKI_TEST_URD_01**
7. //ЛКИ ART-XC: Проверка работы УРД01
8. 12.04.2019 12:00:00 ART SEANCE KK=3431 //Включить УРД01
9. 12.04.2019 12:05:00 ART SEANCE
KK=3452,0000,0000,0002,AC00,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,4020,AC02,9824
//Выдвинуть БКИ в поле зрения детектора
10. //Проконтролировать прохождение команды
11. 12.04.2019 12:17:00 ART SEANCE
KK=3452,0000,0000,0002,B000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,4020,B002,A024
//Выдвинуть БКИ из поля зрения детектора
12. //Проконтролировать прохождение команды
13. 12.04.2019 12:29:00 ART SEANCE
KK=3452,0000,0000,0002,3800,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,4020,3802,B024
//Закончить наблюдения
14. //Проконтролировать прохождение команды
15. 12.04.2019 12:31:00 ART SEANCE
KK=3452,0000,0000,0002,3C01,000A,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,4021,3C0D,B83B //Набор шумового спектра
16. //Проконтролировать прохождение команды
17. 12.04.2019 12:35:00 ART SEANCE
KK=3452,0000,0000,0002,1800,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,4020,1802,7024
//Подготовка к выключению питания
18. //Проконтролировать прохождение команды

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The Star Tracker BOKZ-MF switching on and test perform at 6...9 days of flight.

Details of ST testing should be specified and provided by NPOL.

The total number of test procedures for ART-XC subsystems – 9

The total time for all of tests – 6...8 Ground contact sessions

We need about 2 hours (at least 1 Ground contact) before open cover of ART-XC to test the thermo-control electronics.

After opening cover we need about 7 hours for tests of detectors, this may takes 4-5 Ground contact sessions.

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Need to share the time of Ground contact sessions for ART-XC and eROSITA

eROSITA need to be sent about 50 commands for each camera box (detector) with confirmation and control by operator,

It takes about 20 seconds to each cycle (command + confirmation) in S/C “direct data control” mode.

So, we need : $7 \text{ camera} \times 50 \text{ command} \times 20 \text{ seconds} = 7000 \text{ seconds}$ or $\sim 2 \text{ hours}$

It will be impossible to send commands to ART-XC simultaneously in the same time.

So, we need to share (separate) our command sessions to avoid of collisions of operations.

ART-XC needs 3-4 Ground contact sessions with manual control operations, after that we can operate automatically using time-tagged commands, stored and issued by BKU, so we need to upload BKU (some minutes) and after start automatic control, eROSITA at this time can be operated “manually” totally 3-4 Ground contact sessions.

Obviously, it is need to reserve 2 Ground contact sessions for engineering and technological operations.

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Modification of ART-XC EGSE for real-time data link and analysis

16 May 2018 - meeting at NPOL specialists IKI-MPE and Flight Mission Control Center on providing access to “real-time” data of the S/C and Instruments during commissioning period.

NPOL specialists demonstrated possibilities of data access which can be used.

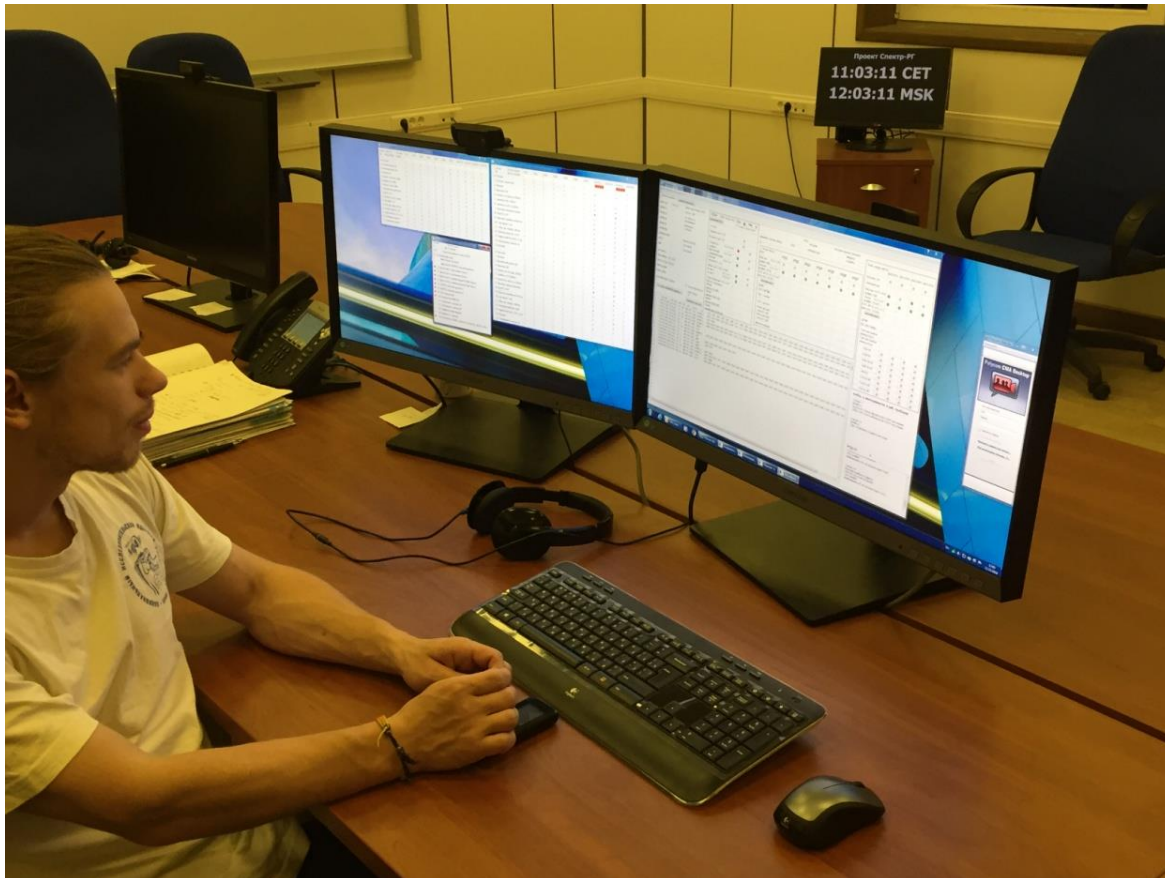
June 2018 - IKI have received software library and some source codes.

We tested it on the base of IKI Center of science data.

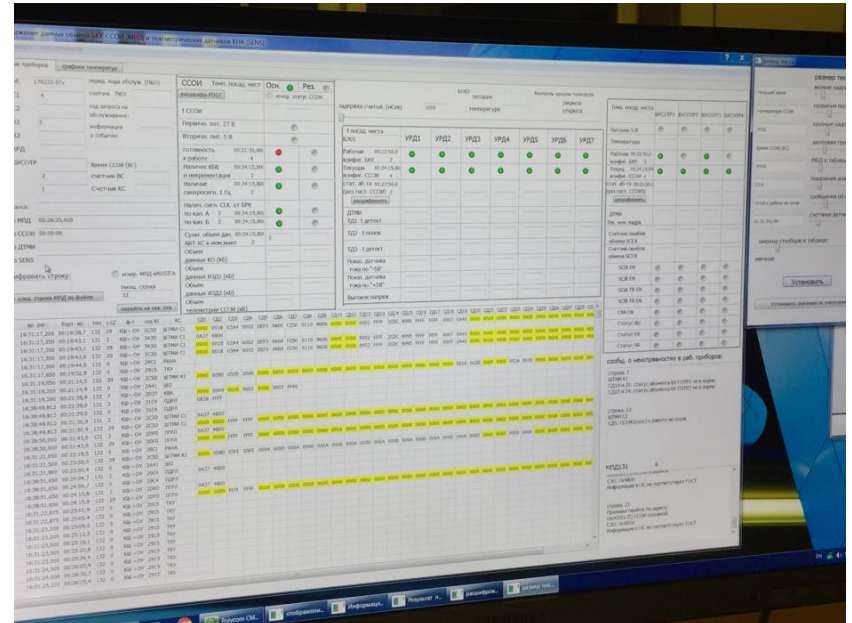
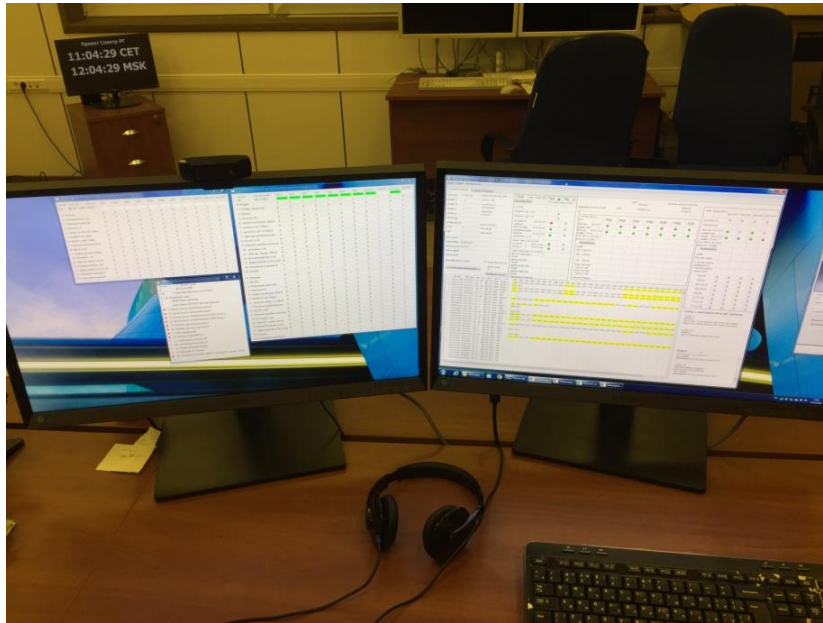
After that we modified (extended) the ART-XC EGSE software to use new way to get data.

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ART-XC EGSE software is developed using Qt framework technology
Socket connection and “signal-slot” technology to receive data from server
Program consist of 3 flows (threads): to receive, processing and visualization of data



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We successfully performed some tests to receive data by replaying old data-files stored on the NPOL server.

New ART-XC EGSE software is ready to receive “real-time” data during the next complex tests (seances 21,23,42,44).

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Applicability

EGSE software can be used in flight during first Ground contact sessions to provide on-line (real-time) control and test of the instrument.

After commissioning phase IKI scientific ground segment facilities will be use for long-term operations and regular control.

EGSE software should be used in case of any emergency and error situations.

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