ONBOARD COMPUTER - NCU-SWIP INTEGRATION TESTING

INTRODUCTION

The main objectives of the integration testing are:

1. Test the link between the NCU-SWIP and Onboard PC (OBC)
   1.1. Check the pinout of the RS-422 cable connectors.
   1.2. Check if the communication is successful (data are transferred in both directions between the OBC and SWIP).
2. Test all the sensors and the NCU-SWIP as a whole system.
3. Test OBC software.

1. THE COMPOSITION OF THE TEST BED

The scheme of the test bed is shown in Fig. 1. The test bed consists of the following components:

1. **NCU-SWIP**
   1.1. Power supply.
   1.2. DPU – main control module of the SWIP.
   1.3. PMTomo.
   1.4. ETPEDP.
   1.5. MRM and MRMx.
   1.6. ETPEDP Simulator and PMTomo Simulator – generate stimuli for PMTomo and ETPEDP probe.
2. **OBC**
   2.1. CPU-1433 – single board computer.
   2.2. HE104+DX –Power supply unit for CPU-1433.
   2.3. Operating system – Linux.
   2.4. Data acquisition and handling software.
1. **Additional equipment and tools**
   1.1. External DC Power supply HY3002C.
   1.2. External DC Power supply HY3005.
   1.3. UPS Powercom BNT-500A.
   1.4. MAIBICommandSimulator – software simulator of the OBC used by the NCU-SWIP developers to control NCU-SWIP and display all the data transferred between OBC and NCU-SWIP.
   1.5. RS-422 sniffer – used to monitor the traffic between OBC and NCU-SWIP.
   1.6. Terminal – used by operator to control the test process, displays debug information, generated by the OBC.
   1.7. Control station – connected through the network to the control station and receives all the scientific and service payload data accumulated by OBC during the tests.

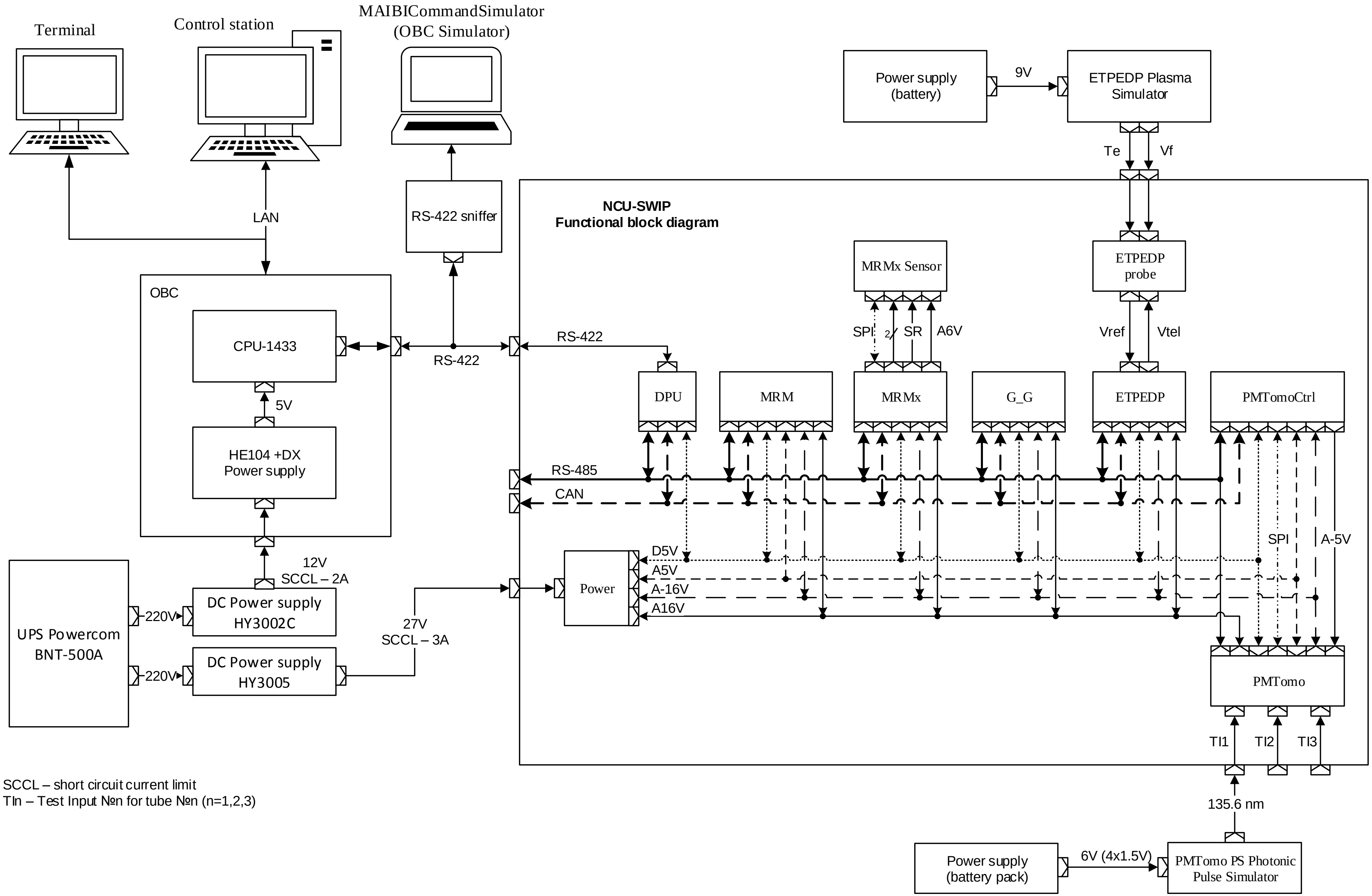

Figure 1. The scheme of the test bed

2. TEST PLAN

Test process consists of the following steps:

1. Preparation for the testing (preparatory operations):
   1.1. Visually check the composition of the system and the presence of the all necessary equipment and tools.
   1.2. Disconnect SWIP and OBC from the power supplies if they are connected.
   1.3. Visually inspect the SWIP, OBC and accessories for faults or external damage.
   1.4. Check the RS422 communication cable for the SWIP and OBC (pinout).
   1.5. Check the settings of SWIP and OBC power supplies (short-circuit current limit, voltage).
   1.6. Build test bed according to the scheme.
   1.7. Check the reliability of the mechanical connection between the SWIP and OBC.
   1.8. Turn on the OBC power supply (HY3002C) first.
   1.9. Check the OBC function parameters (current, voltage, connection settings).
2. Perform test. Test is carried out according to the sequence shown in Fig. 2.

SWIP has several operation modes that differ from each other by the data collection rate (rate at which OBC has to request data from the SWIP. Test plans for these modes are the same. Test process described here is for the Default operation mode.

At each step of the test OBC requests the data from the NCU-SWIP using special SWIP commands and save all data in the log. The log contains all the commands that OBC sends and corresponding responses from the NCU-SWIP.

There are stimuli applying to the sensors during the test. The SWIP rotation is a stimulus for the G_G, MRM, MRMx. The ETPEDP Simulator and PMTomo Simulator generate stimuli for ETPEDP and PMTomo respectively.

Test process is controlled manually by the operator through the terminal connected to the OBC. Operator can change the states of the scientific complex and control when and what request should be transmitted from the OBC to NCU-SWIP. Additional debug information generated by the OBC software is displayed in the terminal.

Conclusions about functionality of the SWIP, its sensors and OBC software are based on the analysis of the log content, debug information generated by the OBC and shown in the terminal and information sniffered by the MAIBICommandSimulator.

3. ASSUMPTIONS AND LIMITATIONS

Non-redundant version of OBC is used during this test.

Another limitation is that the version of PMTomoSimulator used for tests can be connected only to one of the tubes and can affects only the channel measuring the number of photons with the wavelength of 135.6nm.

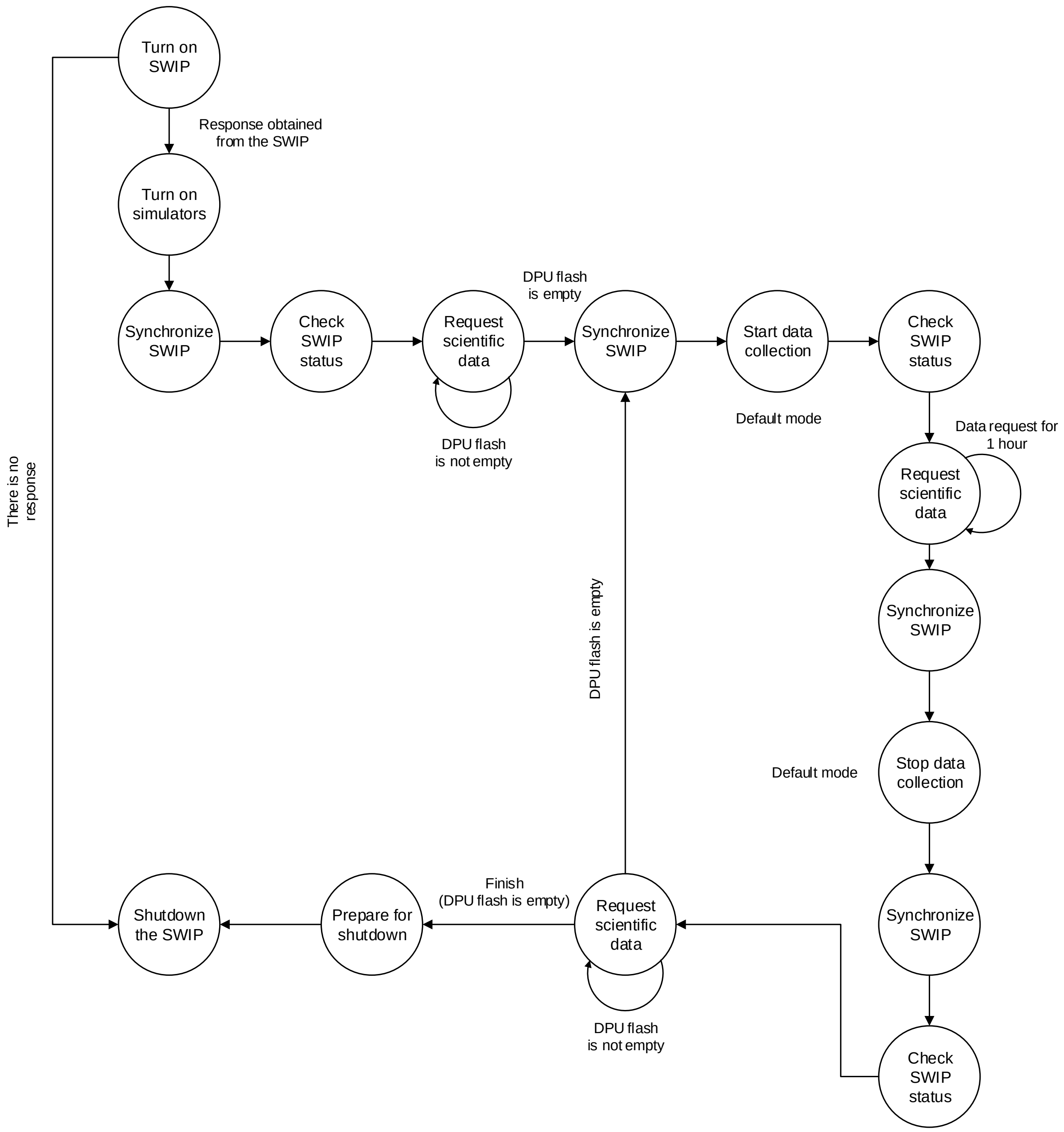

Figure 2. Function test sequence

4. TEST RESULTS, ACHIEVEMENTS AND CURRENT STATUS

4.1 OBC

The bug related to the pinout of the RS-422 connector was detected at the early phase of the test. It had been successfully fixed and communication between OBC and SWIP had been established. Other minor bugs were detected in the software (wrong message checksum calculation, absence of some entries in the log) that had been also fixed successfully. In Default mode OBC software operates as expected and generates requests to the SWIP at the required rate. All commands and responses are logged as expected and transmitted to the control station for analysis.

4.2 NCU-SWIP

NCU-SWIP operates as expected and according to its specification. Communication between SWIP and OBC is stable. SWIP successfully receives input commands from the OBC, executes it and transmit corresponding responses.

Power Supply module is stable. All the sensors of the SWIP (G_G, ETPEDP, MRM, MRMx) operate and generate data as expected and according to the specification.

ETPEDP Simulator and PMTomo Simulator operate as expected but its performance depends on the quality of the power supply.

LUTOS (NCU-SWIP operating system) operates as expected.

5. CONCLUSIONS AND FURTHER WORK

5.1 Achievements

1) Communication between SWIP and OBC is established.
2) OBC successfully and at the required rate transmits requests (commands) to the SWIP.
3) The SWIP successfully gets the commands, executes it and send corresponding messages in response.
4) OBC successfully saves the commands for the SWIP and data requested (responses) in the log and transmits it to the control station for further analysis.

5.2 Further work

1) There is a minor problem connected with the fact that sometimes OBC doesn't receive responses to data requests in data collection state. This problem requires a more detailed investigation.
2) OBC software modernization to improve the information content of the log, improve functions to process the obtained scientific and housekeeping information before its transmission to the control station.
3) NCU-SWIP software and PMTomo Simulator modernization.