

# AAU-Cubesat, Initialization- and Shutdown Sequence

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## **Abstract**

This document describes the initialization sequence of the AAU-Cubesat when it is deployed from the P-POD, and it describes the shutdown and restart sequence for the satellite. The document is maintained by Lars Alminde from the PSU-software group and comments should be sent to **[lalm00@control.auc.dk](mailto:lalm00@control.auc.dk)**.

# Chapter 1

## Initialization and Shut-down Operation of the AAU-Cubesat

### 1.1 Initialization Sequence

The following describes the initialization sequence of the satellite in a number of steps:

#### Step 1: Satellite released from P-POD

- Kill switch released
- 0.3s hardware delay
- PSU is booted

#### Step 2: 5 min delay

- PSU delays 5min to allow the cubesats from the P-POD to get clear of each other

#### Step 3: Antenna Deployment

- PSU deploys antennas
- The PUSH-TO-TALK signal is asserted, but basic beacon is not yet transmitted, since COM is not yet powered up

#### Step 4: COM and OBC boot up

- PSU powers COM and basic beacon begins to transmit
- PSU powers OBC with boot-port set for PROM

#### Step 5: OBC boot sequence

- PSU and OBC goes through the specified (see next section) boot sequence, until a successful boot has occurred

#### Step 6: PSU enters WDT mode

- PSU begins to work as external Watch-Dog-Timer for the OBC (see next section)

#### Step 7: PSU awaits beacon off signal

- PSU continues to transmit basic beacon until BASIC\_BEACON\_OFF signal is received from OBC.

#### NOTES:

- CAM and ACS is not booted up during initialization - DHS must do this manually

### 1.2 OBC boot sequence and WDT Operation

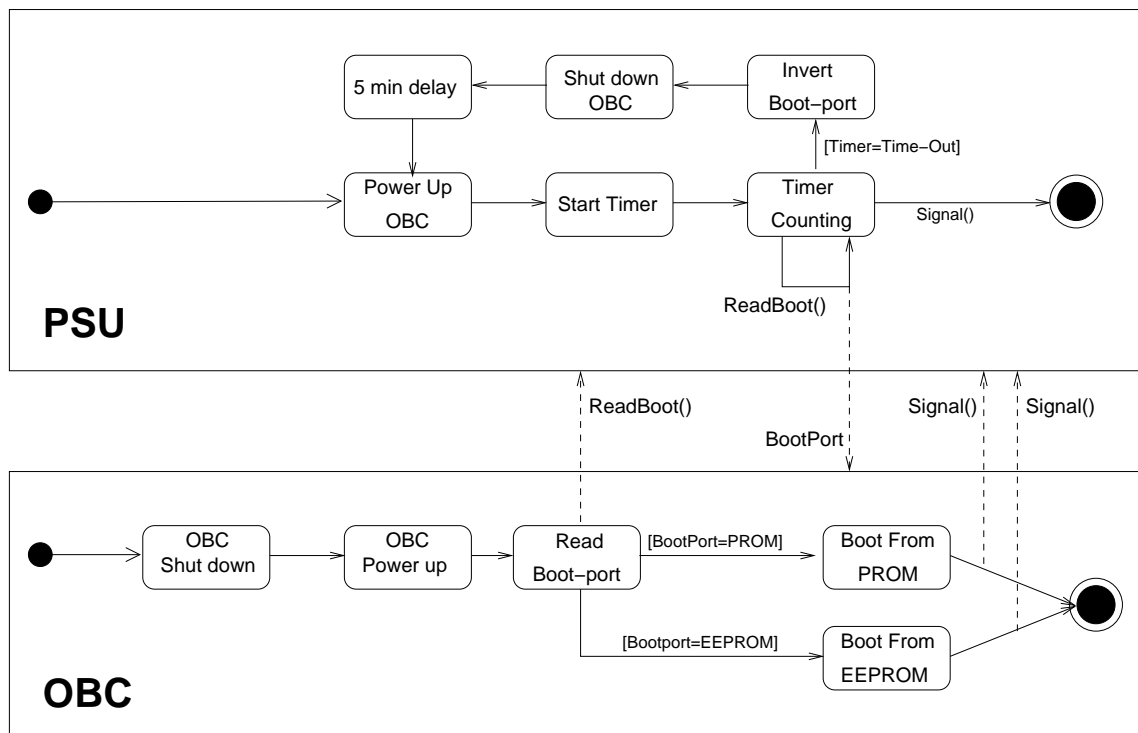
*The following documentation on the OBC boot sequence and WDT operation is taken from the report of group 01gr509 and slightly modified to accommodate recent changes.*

The purpose of this interface is that the OBC needs an external subsystem to help it select the boot-mode for the OBC. Further the OBC needs an external watchdog. Since it is the PSU that must cycle the OBC power in case of a malfunction of the OBC, then the PSU has been chosen to implement this functionality.

The physical interface consists of a boot-selection port which is simply a connection from an output port on the PSU digital hardware to the OBC. Further, the I<sup>2</sup>C-bus is used for both the watchdog functionality and to set the value of the boot-selection port.

### Boot Sequence Algorithm

When the satellite is deployed in space or if the OBC has malfunctioned and as a result been shut down by the PSU a special boot-sequence is initiated by both PSU and OBC in order for the OBC to select whether it is to boot from PROM or EEPROM, and in order to control if the boot succeeded. The algorithm is specified in figure 1.1.



**Figure 1.1:** The Boot Sequence interaction between the PSU and the OBC specified in UML

The **Signal()** command is sent through the I<sup>2</sup>C-bus and is specified to be an empty message to the PSU with module number 29. The **ReadBoot()** operation is the action of directly reading the value of the boot pin on the OBC. The time-out period is specified to be 10 seconds. In the block on the figure where it says: "Shut Down OBC" this operation is equivalent to a shutdown and initialization sequence of the satellite.

### External Watchdog Timer

When the OBC is successfully booted the timer on the PSU continues to run and is reset every time the PSU receives an empty message on the I<sup>2</sup>C-bus with module number 29. If the DHS fails to call the command before the timer has expired then the PSU initiates a reboot and initialization sequence. The WDT time out period is set to 10 seconds.

### Selection of Boot Mode

The DHS can at anytime change the value of the boot-selection-port by means of commands sent through the I<sup>2</sup>C-bus. These commands are empty messages with module number 31 to select PROM or module number 30 to select EEPROM.

The DHS can also read the current value of the boot-selection-port from the data-structure on the OBC which holds PSU housekeeping information, and which is updated by the PSU task on the OBC.

## 1.3 Shutdown and Reboot

After deployment the satellite can be reset due to the following events:

1. Failed OBC boot sequence
2. Overcurrent protection is activated for OBC

3. DHS request PSU to shutdown and initialize (e.g. to boot in new mode)
4. PSU internal WDT assertion
5. PSU internal brown-out situation

If any of these events happens then the following sequence will be carried out:

**Step 1: Subsystem shutdown**

- Power to all subsystems is turned off

**Step 2: PSU controller reboots**

- The PSU reboots (SW-reset for cases 1,2 and 3 - HW-reset for points 4-5)

**Step 3: Initialization sequence starts**

- The previous described initialization sequence is initiated

**NOTES:**

- If shutdown is due to point 4 or 5 then step 1 and 2 are interchanged
  - During initialization the 5min delay now serves to cool systems down in case the malfunction was due to a thermal phenomena
  - During initialization the OBC will be booted in the mode (PROM/EPROM) corresponding to the value of the boot port before the shutdown, unless the shutdown was due to point 4 or 5 in which case this information is lost and the OBC will be booted in PROM mode.
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