PARM
Full Mission Simulation Review (FMSR)

Tohoku U. / U. Tokyo / Nagoya U. / U. Electro-Communications / JAXA

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Jul 2, 2018  Ver 1
1.0 Mission Concept and Interfaces

Name of Presenter
Status of action items at ISTR

1. Timer event of MED HV ON is changed to be 62.0s after launch

   Open. It is not reflected on RS-XN 2019 Mission Timeline (2nd Draft). Please reflect.
Status of questions at STR

1. Could you show us the following? It is necessary to decode the TLM data to get the PARM data stream.
   a. The RockSat-XN telemetry word assign table
   b. The data format of the file which will be sent to us at the testing and at the launch

   Closed. PARM has received the format.

2. What is the status of PARM dedicated testing at the Wallops and the launch site?
   
   Open? It seems to be OK if time allows.

3. How is the launch condition decided?
   
   Open. Can we have a meeting dedicated for the launch condition with Wallops and other teams at Wallops August activities?

4. What is allowable tolerance of weight, position of CG of PARM at the top deck?
   
   Open. PARM and UiT teams have received the tolerance for the overall deck. But it is remained unclear how two teams adjust the mass properties to keep the specified tolerance.
Status of questions at Jan 10, 2018 meeting

1. It will be necessary to make the additional machining to the PARM aft. deck and the top deck. Who shall machine them, PARM or Wallops? If PARM, when will the flight deck come to Japan? If Wallops, what is the due date of sending the drawing to the Wallops (Chris)?

Closed.
PARM aft. deck: PARM makes necessary machining (thread cutting, cutout of the deck) and gluing. Flight deck (not dummy) has been received by PARM.
Nosecone deck: PARM makes necessary machining and gluing. Flight deck (not dummy) has been received by PARM.
Status of CDR questions

1. What is the latest timing of payload access by PARM team (for removal of non-flight items) before launch?

Open.
The PARM mission will transit a region of Pulsating Aurora (PsA) with instruments that can provide high-time resolution observations:

To understand:
the loss of the Earth’s radiation belts
due to precipitation of high-energy magnetospheric electrons during PsA

To imply:
the impact of high-energy electrons on the Earth’s atmosphere, for example, the possible loss of ozone (O$_3$)
Launch Conditions: Requirement from Science

It would be better to identify PsA clearly from the ground by using all-sky camera at Andøya at the time of launch:

To meet this launch criteria, we expect the following possible launch conditions which will be discussed with the project manager:

1. **New moon periods** to prevent contamination from moonlight (New moon in Jan 2019 is “Jan 4 – Jan 11”)

2. **Active geomagnetic condition** (just after aurora substorm)

3. **Morning side**, which is a hotspot of PsA

4. **Good weather conditions**, i.e., clear sky, to observe PsA optically at one of our ground-based optical observation sites (clear sky is not always necessary at Andøya)
Early morning launch may solve the problem?

Latteck and Strelnikova, JGR, 2015
On-site monitoring of launch conditions

We plan to deploy a high-speed camera in Andøya that is capable of detecting pulsating aurora. We are also able to monitor status of aurora over Tromsø by watching realtime display of our all-sky cameras. The data are refreshed every 30 sec:

http://nordlys.nipr.ac.jp/acaaurora/Tromso/
What are the minimum and comprehensive success criteria?

Minimum Success:
• Identification of temporal variations of precipitating electrons, optical emissions and electric current during PsA (Note that good weather condition at Andøya is not always necessary).

Nominal Success:
• Identification of temporal modulations of precipitating electrons in a wide energy range from tens keV to MeV energy during PsA

Extra Success:
• Identification of inverse energy dispersion that is a definitive evidence for the electron precipitation in the wide energy range
• Identification of the minimum altitude of PsA
Mission Overview: Concept of Operations

Start of HEP / MED
Right after the open of nose cone at ~70 km alt.

Precipitating electrons
Along the magnetic field-line

Emission layer of PsA
(ranges from 95 to 105 km)

The Arase satellite measures magnetosphere

Field-of-view of AIC

Magnetic field lines

Ground-based supporting all-sky aurora camera

Electric current caused by PsA observed by the AFG
# RS-XN 2019 Mission Timeline (2\textsuperscript{nd} Draft)

## 1.7 Mission Time Line

### 46.018 Koehler

<table>
<thead>
<tr>
<th>Event</th>
<th>Time (sec)</th>
<th>Z sigma Low Altitude (km)</th>
<th>Nominal Altitude (km)</th>
<th>Z sigma High Altitude (km)</th>
<th>Nominal Range (km)</th>
<th>Velocity (m/s)</th>
<th>Nominal Q (psf)</th>
<th>Mach NO.</th>
<th>Flight Elevation (deg)</th>
<th>Event Control</th>
<th>Timer Type</th>
<th>Dwell Time (sec)</th>
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<td>PSU: TE-R Activate Lidar Laser Diodes</td>
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<td>UPR: TE-R Activate Lidar Laser Diodes</td>
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<td>CTU: TE-2</td>
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<td>TBD</td>
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<td>TBD</td>
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<td>TBD</td>
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Please change this to 62.0.
Payload Location

[2018.4.10 from Chris]
Request for the delivery timing of TE-2 is changed.

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<th>Event</th>
<th>Time On</th>
<th>Dwell</th>
<th>Event Description</th>
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<tr>
<td>GSE 1</td>
<td>T-600 sec</td>
<td>1200sec</td>
<td>Start on the instruments.</td>
</tr>
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<td>GSE 2</td>
<td>T-570 sec</td>
<td>1170sec</td>
<td>Start on the instruments.</td>
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<tr>
<td>TE-1</td>
<td>T+30 sec</td>
<td>10 sec</td>
<td>PARM sequence timer start</td>
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<tr>
<td>TE-2</td>
<td>T+62 sec</td>
<td>10 sec</td>
<td>MED HVPS ramp up</td>
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<tr>
<td>TE-3</td>
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<td>Currently not used</td>
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<td>TE-R</td>
<td>T+60 sec</td>
<td>10 sec</td>
<td>HEP HVPS ramp up</td>
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## Pin Assignments: Power

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<tr>
<th>Power Connector--Customer Side</th>
<th>Pin</th>
<th>Function</th>
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<tr>
<td></td>
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<td>GSE 1</td>
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<tr>
<td></td>
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# Pin Assignments: Telemetry

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Updated Power Budget

- Preliminary estimates on power usage for each subsystem

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Voltage (V)</th>
<th>Current (A)</th>
<th>Time On (min)</th>
<th>Amp-Hours</th>
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<td>AFG</td>
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<td>0.07</td>
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<td>AIC</td>
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<td>COMMON-E</td>
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<td>0.06</td>
<td>20</td>
<td>0.02</td>
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Total (A*hr): 0.24

Over/Under 0.76
Detailed Weight Budget (1/2)

- Values are preliminary
- Allowable value = 20+/-0.75 lbs.
  (9.07+/-0.34kg)

- Weight of payload deck is 3.425 lbs.

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Total Weight (lbf)</th>
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<tbody>
<tr>
<td>AIC-S</td>
<td>1 kg (2.2 lbs)</td>
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<tr>
<td>AIC-E</td>
<td>1 kg (2.2 lbs)</td>
</tr>
<tr>
<td>MED</td>
<td>2.8 kg (6.2 lbs)</td>
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<tr>
<td>COMMON-E</td>
<td>1 kg (2.2 lbs)</td>
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<tr>
<td>Harness</td>
<td>0.7 kg (1.5 lbs)</td>
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<tr>
<td>Deck plate</td>
<td>1.6 kg (3.425 lbs)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8.1 kg (17.9 lbs)</strong></td>
</tr>
<tr>
<td><strong>Over/Under</strong></td>
<td><strong>(0.97 kg (2.1 lbs))</strong></td>
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Harness weight is very rough.
Detailed Weight Budget (2/2)

- Values are preliminary

Requirement from the Rocket:
Total weight including the deck:
21 +/- 0.5 lbs
(= 9.53 +/- 0.22kg)

<table>
<thead>
<tr>
<th>Weight Budget</th>
<th>PARM on the top deck</th>
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<tbody>
<tr>
<td><strong>Subsystem</strong></td>
<td><strong>Total Weight (lbf)</strong></td>
</tr>
<tr>
<td>HEP-S</td>
<td>1.5 kg (3.3 lbs)</td>
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<tr>
<td>HEP-E</td>
<td>1 kg (2.2 lbs)</td>
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<tr>
<td>AFG</td>
<td>2 kg (4.4 lbs)</td>
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<tr>
<td>Harness</td>
<td>1 kg (2.2 lbs)</td>
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<td><strong>Total</strong></td>
<td>5.5 kg (12.1 lbs)</td>
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<tr>
<td><strong>Over/Under</strong></td>
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Deck weight is NOT included.
Harness weight is very rough.
## User Guide Compliance: Summary

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Status/Reason (if needed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center of gravity in 1&quot; plane of plate?</td>
<td>Within 1&quot; currently</td>
</tr>
<tr>
<td>Weight 30.0 +/- 1.0 (15.0 +/- 0.5) lbs?</td>
<td>30 lbs (sum of both decks)</td>
</tr>
<tr>
<td>Max Height &lt; 10.75” (5.13”)</td>
<td>245 mm (9.65”) excl. deck thickness for the PARM lower plate 285 mm (11.22”) for the top plate</td>
</tr>
<tr>
<td>Bottom of deck has flush mount hardware?</td>
<td>YES</td>
</tr>
<tr>
<td>Within Keep-Out Zone</td>
<td>YES</td>
</tr>
<tr>
<td>Using &lt; 10 A/D Lines</td>
<td>No</td>
</tr>
<tr>
<td>Using/Understand Parallel Line</td>
<td>Yes, 300kbps</td>
</tr>
<tr>
<td>Using/Understand Asynchronous Line</td>
<td>No</td>
</tr>
<tr>
<td>Using X GSE Line(s)</td>
<td>YES, GSE 1 and GSE 2</td>
</tr>
<tr>
<td>Using X Non-Redundant PWR Lines (TE-1, TE-2, TE-3)</td>
<td>YES, TE-1 and TE-2</td>
</tr>
<tr>
<td>Using X Redundant Power Lines (TE-R)</td>
<td>YES, TE-R</td>
</tr>
<tr>
<td>Using &lt; 1 Ah</td>
<td>0.27Ah</td>
</tr>
<tr>
<td>Using &lt;= 28 V</td>
<td>Yes, 300 V</td>
</tr>
<tr>
<td>Using RF (If yes, list frequency and TX Power)</td>
<td>No</td>
</tr>
<tr>
<td>Using deployable?</td>
<td>No</td>
</tr>
<tr>
<td>Whole team consists of US Persons</td>
<td>No</td>
</tr>
<tr>
<td>Using ITAR and/or Export Controlled hardware</td>
<td>NO</td>
</tr>
</tbody>
</table>
2.0 Final Design Description

Name of Presenter
Major changes from ISTR

PARM has no major changes from ISTR.
Instrument accommodation

PARM lower deck

- AIC-E
- COMMON-E
- FOV (AIC)
- AIC
- MED
- FOV (MED)
- AIC
- MED
Instrument accommodation

For detail, please see a drawing in pdf format.
Instrument accommodation

Top deck

Dimension of the deck supports may not be correct.
Proposed instrument accommodation

Top deck

For detail, please see a drawing in pdf format.
Instruments

- PARM consists of four instruments: HEP, AIC, MED, and AFG
- They are controlled by COMMON electronics unit which has electrical interfaces to the Wallops system
Design Overview: Functional Block Diagram

Inter-instrument interface:
Communication: LVDS
Power: bus
System Overview: Electrical Design: Common_E

“Common_E” Block Diagram

- **HEP I/F**: MFS, ENA, BCL
- **AIC I/F**: MFS, ENA, BCL
- **AFG I/F**: MFS, ENA, BCL
- **MED I/F**: MFS, ENA, BCL

- **DC/DC**: 28V to 5V (0.2A)
- **Fuse 2A**: +28V Power (+/- 6V)(0.7A)
- **AIC_I/F**: +28V PS (0.35A)
- **AFG I/F**: +28V PS (0.15A)
- **MED I/F**: +28V PS (0.25A)

- **Serial to Parallel**
- **FPGA Cyclone2**
- **RS232C Convert**
- **Read Strobe 1**
- **(Read Strobe 2)**

- **Timing Generate**
- **FIFO**
- **5V_Te-RA, RB, 1, 2**
- **5V**
- **3.3V**

- **FET Switch**
- **Filter Dumpin g**
- **Fuse 2A**: +28V Power (+/- 6V)(0.7A)

- **HEP I/F**: +28V PS (0.3A)
- **+28V Power (+/- 6V)(0.7A)
System Overview: Electrical Design: HEP
System Overview: Electrical Design: AIC

AIC

AIC-S

CCD Electronics

Digital (BT656)

12V power

Analog video

CTL (SPI)

AIC-E

Binning Double_Buffer

FPGA

5V/3.3V power

DC/DC

28V

Remote Controller (non flight)

CHECKOUT BOX (non flight)

Common electronics

GSE-2 Power Timer TE_1

TLM

CONNECTORS
System Overview: Electrical Design: MED

MED

- **APD board**
  - APD
  - Temp. sensor

- **Analog board**
  - CSA
  - Shaper
  - Lower discr.
  - P/H

- **FPGA board**
  - ADC

- **HV board incl. LVPS (DC/DC)**

---

- **HV distrib. board**
  - APD
  - Temp. sensor

- **CSA/shaper/peak hold**

- **Discr. Level X5**

- **SGNL X5**

- **RST X5**

- **Temp. X5**

- **DAC**

- **ADC**

- **ADC**

- **C/O, F/S connector**

- **FPGA**

- **CTRL MON**

- **DC/DC**

- **HV (-300 V max)**

- **3.3V +/- 12V**

- **+28V**

---

- **GSE**

- **TLM**

- **TLM**

- **PARM Common Elec.**

- **LVDS**

- **FPGA**

- **TIMER**

- **LVDS**
System Overview: Electrical Design: MED

(-200V approx.)

HV hot pad → 10MΩ → APD (50pF) → 10nF → C2 → Signal pad (preamp)

10nF → R2 → 10MΩ → Signal Gnd pad (preamp)

HV return pad

2-lead FLATPACK

AD590

V+ pad → V- pad
System Overview: Electrical Design (AFG)

AFG

sensor×3

Check out connector

Cal in

feedback

AMP

BFP

Phase detection

∫

ASIC chip

FPGA

DATA

TLM

DC/DC 12V
DC/DC 3.3V
DC/DC 1.25V

28V

2018 FMSR 35
Hazardous Mechanical Items:

• PARM has no mechanically hazardous items onboard.
Hazardous Electrical Items:

- Identify any high voltage items/components
- Identify any operational hazards with your electrical design
Hazardous Electrical Items:

- HEP and MED have high-voltage power supplies (HVPSs) inside.
  - Maximum output voltage: 300V
  - Typical / maximum output current: 0.0 / 2.5mA.
  - They are turned on by timer signal.
  - They can be turned on under the atmospheric pressure, but we need special care for turning off.
  - HEP and MEP have their own dedicated safety connectors. If it is mated to them, only low voltage is generated even when HVPS is turned on. In this case, turning off the sensor power is safe.
  - For flight, the flight connectors must be mated instead of the safety ones.
  - In Wallops and the launch site, PARM will turn on HVPS with high-level. In this case, HVPS will be turned off by using dedicated GSEs which is directly connected to HEP and MED.
Special Requests

• Please describe any special requests of the rocket and/or Wallops that are required for minimum and/or comprehensive mission success

• *Examples include but are not limited to:*
  – *Extra volume*
  – *Extra weight*
  – *High voltage*
  – *Extra telemetry*
  – *Faster sampling*
  – *Special environmental considerations*
System Overview: Special Requests

- **Telemetry**
  - 300kbps for PARM is necessary

- **Field of view (FOV)**
  - FOV of HEP shall include upward direction (topward in reference frame of the rocket)
  - There shall be no obstacles in FOV of AIC and MED
    - We would like to have the tip of AIC (lens hood) located beyond the stay out zone for 10 mm.

- **Electrical connection between the decks**
  - Electrical connection (dedicated harness) is necessary between the top deck (where HEP and AFG are mounted) and PARM lower deck. Twisted pairing of communication lines are necessary, since PARM inter-subsystem communication uses LVDS-based serial data transfer with a little bit high bit rate.

- **Use of high voltage**
  - HEP and MED use high voltages during the observation
    - Maximum output voltage: 300V
    - Typical / maximum output current: 0.0 / 2.5mA.

- **Nose cone jettison**
  - Lower than altitude of 70km is necessary

- **Non-magnetized material for the top deck**
  - AFG wants to have non-magnetized material for the deck where AFG is mounted. For example, aluminum alloy is preferred material.
Special Requests

Attitude of the rocket during the flight
- In order to capture the geomagnetic field direction (upward) in FOV of HEP, the spin axis direction of the rocket should point almost upward throughout the mission (almost unchanged during the flight).

Non-flight item
- HEP, AIC, and MED have non-flight items (dust covers). They shall be removed just before nose cone integration to the rocket.
- HEP, AIC, MED, and AFG have F/S and/or check-out connectors. Flight connectors shall be mated to all of them during flight.

Heater control at ground tests when there is a risk of dew condensation

Verification of PARM functions in Wallops and the launch site
Functional testing dedicated to PARM during integration testing at Wallops and the launch site operation is requested. Please see ‘PARM_TestingOperation180509.pdf’.
3.0 Integrated Subsystem Testing Status

Name of Presenter
Integrated Subsystem Testing Status

- **Mechanical fit check**
  - nosecone deck: completed
  - PARM aft. deck: completed

- **Fabrication of flight harnesses and connectors**
  - Length adjustment: completed
  - Connector potting: to be done

- **Electrical interface check**
  - HEP – COMMON-E: ongoing
  - AIC – COMMON-E: completed
  - MED – COMMON-E: ongoing
  - AFG – COMMON-E: completed
  - COMMON-E – dummy board (rocket simulator): completed

- **Measurement and adjustment of mass properties**
  - Nosecone deck: to be done
  - PARM aft deck: to be done
Integrated Subsystem Testing Status

1.0 HEP and COMMON-E

This will verify following items:
   Timer signals from COMMON-E are received properly by HEP-E.
   Data from HEP are received properly by COMMON-E
Test was completed on June 6th with success.

Verified items:
✓ With TE-1 signal, timer counter was preset properly.
✓ With TE-RA or TE-RB, high voltage was powered on and ramped up properly.
✓ Obtained data from COMMON-E was analyzed. We verified that HEP data properly received (Both of data packets and HK packets.)
1.0 AIC – Common-E

This will verify that the electrical interface between AIC and Common-E works as designed to satisfy the Wallops system interface.

Test was completed on June 6th with great success in ISAS/JAXA.

Additional tests will be conducted in the first week on July.

Examples of image data obtained in this test.
Integrated Subsystem Testing Status

MED and COMMON-E
Ongoing

PARM/MED

Aft deck

PARM/COMMON-E

75%
Integrated Subsystem Testing Status

1.0 AFG and COM-E

This will verify following items:
- Timer signals from COMMON-E are received properly by AFG-E.

Test was completed on June 6th with great success.

Verified items:
- With TE-1 signal, timer counter was preset properly.
- Obtained data from COMMON-E was analyzed. We verified that AFG data properly received.
4.0 Full Mission Simulation Results

Name of Presenter
Subsystem Design: COMMON-E

- **Power and data of subsystem**
  - 5.6 W (28V x 0.2A)
  - 0.5 kbps (generated by COMMON-E)

- **Electrical interface to Wallops**
  - Yes (power, timer, and data)
  - COMMON-E is the only subcomponent which has the electrical interface to Wallops.

- **Hardware used**
  - COMMON-E is just an electronics.

- **Subsystem Weight:**
  - 1.0 kg

- **Other**
  - COMMON-E design is FINAL.
  - Weight and power consumption are estimated values. Only minor changes could be expected.
Subsystem Design: COMMON-E

Interface to Wallops

Power Line Interface

GSE_1/_2 Power Input

Connect to DCDC_Converter

Timer Line Interface

TE-RA,-RB
TE-1,-2,-3
Subsystem Design: COMMON-E

Interface to Wallops

Parallel Read Strobe

Parallel Data Interface

Telemetry
Parallel Data
(Parallel Bit 1 (MSB) to Bit 16 (LSB))

1-B9 to 1-B16
COMMON-E

- Quick Status
  
  **Completed**
  - Circuit drawing
  - PCB layout (design)
  - Components assembling
  - Chassis manufacturing
  - Fit check to the deck
  - Interface testing with Rocket simulator (built by PARM)

**Items to be done**
- Interface testing with PARM subsystem (ongoing): to be completed by the 1st week of July
- Component potting: to be completed by the 2nd week of July
- Environmental testing: to be completed by the 3rd week of July
COMMON-E

- Test results
  Functional testing: ongoing
  Weight: 0.9kg
  Power: 0.06A
  Reference DATA (Fig. COM-E_1)
  Result of Test (Fig. COM-E_2_1 ~ 2_4)
  Frame_Sync, Sub_Sync, FrameCounter and HK_Status • • • OK
## COMMON-E

### Common-E Telemetry (Reference)

<table>
<thead>
<tr>
<th>PARM data stream to Wallops system</th>
<th>1word = 1 696 bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MEDD</td>
</tr>
<tr>
<td>2</td>
<td>HEP</td>
</tr>
<tr>
<td>3</td>
<td>HEP</td>
</tr>
<tr>
<td>4</td>
<td>HEP</td>
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<tr>
<td>31</td>
<td>HEP</td>
</tr>
<tr>
<td>32</td>
<td>HEP</td>
</tr>
</tbody>
</table>

**Fig. COM-E_1**
COMMON-E

Fig. COM-E_2_1 (HEP)

Fig. COM-E_2_2 (AIC)
COMMON-E

Fig. COM-E_2_3 (MED)

Fig. COM-E_2_4 (AFG)
COMMON-E

COMMON—E Electrical Evaluation

Power Supply (28V)

COMMON-E Check Box (Interface dummy of Wallops system)
COMMON-E

Common-E Check Box Block Diagram
Subsystem [HEP] Power/Weight/etc

- Power and data of subsystem
  - 6.7 W (28V x 0.24 A)
  - 163.2 kbps = [1270 × event packet (16byte) + 5 × HK packets (16byte)] / 1s
    Even packet: 8 energy (num of SSDs) x 11bit + 8 trig info x 1bit + 1 time x 12bit
    In case that event rate is 100 events / 0.05 sec
    → Events with the duration of 0.6 sec can be downlinked

Hardware used
- Silicon detectors
- Charge sensitive preamplifier (Hybrid IC)

- Subsystem Weight: Total 2.8 kg
  - HEP-S: 1.4 kg
  - HEP-E: 1.2 kg
  - Harness: 0.2 kg

- Other
  - HEP design is FINAL.
  - Weight and power consumption are measured values. For weight, there may be a small change.
Subsystem [HEP] HEP-S drawings
Subsystem [HEP] HEP-E drawings
Subsystem [HEP] Quick status

• HEP-S
  – Silicon detectors: Evaluation is finished.
  – Analog board which readout the Si detectors is tested with calibration pulse. Function test is OK.
  – All mechanical items are machined. All hardware is in house.

• HEP-E
  – The manufacturing work of the PCB was completed.
  – FPGA design was finished and verified with tests.
  – All mechanical items are machined. All hardware is in house.

• Things to be done
  – Calibration test with electron beam facility
  – Environmental tests. (Vibration and thermal cycle)
Subsystem [HEP] Test plan and status

• HEP Unit level:
  – Function tests
    • Silicon detector test with radioactive isotope (RI) [board-level]
    • Analog board (preamp+shaper) test with calibration pulse
    • TLM/TE tests for digital board
    • Test High-voltage (300V) power supply unit with HEP-E.
    • Combination test analog board and digital board [unit-level]
  – Performance tests
    • Gamma-ray measurements with RI [unit-level]
    • Electron measurements in the vacuum (including end-to-end test of high voltage supply unit.).
  – Environmental tests
    • Vibration (sine, random) [unit-level]
    • Temperature test
    • Function (TLM/TE) tests after vibration./temperature tests

• PARM level:
  – Function tests (PWR/TIMER/TLM)

Current status
Scheduled in July 9-13
Scheduled in July 16-20
Subsytem [HEP] Results

- Eight silicon detector was evaluated with a general readout system.
- Results: noise level meet the requirement
  → Energy of an electron can be measured with the required level.

  Radioactive isotope (\(^{241}\text{Am}\))

  Gamma-ray

  600 \(\mu\)m thick silicon detector

  Measured spectrum

  60 keV gamma-ray

  Calibration pulse to measure electrical noise level

  \(\Delta E \approx 4\) keV

  ✓ Energy resolution is \(~ 4\) keV and meets the requirement.
Subsystem Design: AIC specifications

✓ Drawing/model/sketch of subsystem

- **Power and data of subsystem**
  - 3.7 W
  - 81.92 kbps (science data) + 0.512 bps (HK data)

- **Electrical interface to Wallops**
  - No (interface to COMMON-E)

- **Hardware used**
  - Electronics, CCD, optical lens, optical filter

- **Subsystem Weight:**
  - 2.0 kg (1.0kg for AIC-S, 1.0kg for AIC-E)

- **Other**
  - Weight and power consumption are measured values using a flight model.

AIC-S with a non-flight lens cap

AIC-E
Subsystem Design: AIC

- Mechanical interface on the deck

Final design
Subsystem: AIC Quick status

Quick status
- FM CCD electronics (WAT-910BD): delivered
- FM filter (Andover/Schott RG665): delivered
- FM Lens (Space com. HF3.5M-2): will be delivered by the end of March
- FM: lens and CCD electronics delivered
- AIC-S FM mechanical case delivered.
- AIC-S CCD board and connectors: assembled in the FM case.
- AIC-E electronics, case and cables: fabricated
- Others: Vacuum epoxy delivered
- Test data acquisition performed
- Test for calibration performed
- Electrical interface test between AIC-S and AIC-E, as well as AIC-E and common-E: tested and confirmed acquisition data is correct
- Vibration and vacuum test will be carried out in mid July.
Subsystem: AIC test results

- Test results
  - CCD digital data were checked by the electrical interface test between AIC-S and AIC-E, and also AIC-E and common-E. We confirmed correct data was acquired.
  - Weight and power of were measured for FM of AIC-S and AIC-E as shown in previous page, and verified that these satisfies the required specifications.
  - Sensitivity calibration carried out: Calibration data showed AIC has good performance for pulsating auroral emission: linear response for 2 – 150 kR intensity with S/N of 9 – 250 with exposure time of 0.067 sec and high-gain mode.
  - We verified the mechanical interface on a test with great success.
Subsystem Design: AIC

AIC-E and AIC-E on a deck

AIC-S on a vibration test jig

AIC – Common-E interface test
Subsystem: MED

- Power and data of subsystem
  - 5.0 W (incl. DC/DC efficiency)
  - 25.6 kbps (science data) + 3.2 kbps (HK data)
    - Science data: (16-energy bin x 5-detectors x 8-bit (counter depth) + 32-bit (Time) / (0.625-ms x 42)
    - HK: (Time, temperature, HV-monitor, 64byte/(0.625ms x 4x8)

- Interface
  - Mechanical: mounted on the aft deck with M5 screws
  - Electrical (with PARM/COMMON-E):
    9-pin D-sub connectors for TLM and PWR

- Hardware used
  - Avalanche Photodiodes
  - Amp boards (HIC charge-amp, shaper, peak holder, etc)
  - Digital boards (FPGA, ADC, etc), Power boards (DC/DC, HV, etc)

- Subsystem Weight: Total 2.8 kg

- Other
  - MED design is assumed to be FINAL.
  - Minor changes is possible if any problems are found during final tests
Subsystem: MED

• Quick status
  Completed
  • All subcomponents have been fabricated and assembled
  • Fit check to the deck
  • Function (CMD/TLM) check in connection with GSE
  • Electron/X-ray beam test

Ongoing (will be completed in July)
  • Environmental tests (thermal/vibration)
  • IF test with COMMON-E
  • Final calibration
Subsystem: MED

- Quick status
  Completed
  - Electron/X-ray beam test ➔ Success (expected pulse height distributions were obtained)

Electron spectra (up to 20 keV)

Radio Isotope test

Electron beam test
Subsystem: MED

- Quick status
  Completed
- Function (CMD/TLM) check in connection with GSE ➔ success
Subsystem Design: AFG (Drawings)

AFG-S
Subsystem Design: AFG (Drawings)
Subsystem Design: AFG

- Drawing/model/sketch of subsystem
- Power and data of subsystem
  - 1.96 W (28V x 0.07A)
  - 12.5 kbps
    - 1250(bit/0.1s) = 26bit(header) + 24bit(counter) + 20bit(data) * 3(components) * 20(samples/0.1s)
- Hardware used
  - sensors
- Subsystem Weight: Total 2.0 kg
  - AFG-S: 0.3 kg
  - AFG-E: 1.5 kg
  - Cable: 0.2 kg
- Other
  - AFG design is FINAL.
  - Weight and power consumption are estimated values. Only minor changes could be expected.
Subsystem: AFG

- Quick Status
  
  **Completed**
  
  - Components assembling
  - Fit check to the deck
  - Function (TLM) check in connection with GSE

- **Items to be done**
  
  - Functional testing (ongoing)
  - Environmental testing
  - Calibration test

Fit check to the deck
**Subsystem: AFG**

- **Quick Status**
  - **Completed**
    - Function (TLM) check in connection with GSE

![Screenshot of data showing TE-1 signal was preset properly](image)

- With TE-1 signal was preset properly.
5.0 Project Management Update

Name of Presenter
Project Schedule

**Items to be done in July**
- Preparation of the export documents
- Interface testing complete
  - HEP – COMMON-E
  - MED – COMMON-E
- Potting / gluing the components
- Assembling of each subsystem in flight configuration
- Environmental testing (subsystem level)
- Integrated interface testing

**Items to be done in August**
- Packing
- Shipping to Wallops
August Operations

- Please see PARM_TestingOperation180701.pdf (RockSat-XN / PARM testing operation) for detail explanation.
- For HEP and MED, a testing with full HVPS output for noise level checking is necessary at least once. In this case, we need:
  - Mating the flight connector to the instruments
  - PARM dedicated GSE should be connected to the PARM in order to HVPS ramping down safely.
  - After the testing, the safe connector is mated instead.
- For AIC, checking the focus properties both before and after the vibration testing will be done. During the testing, turning off of the room light is requested.
- For AFG, noise and offset level checks are planned. In this testing, (almost) all the instruments should be installed into the rocket. Then, rocket system, COMMON-E, and AFG are turned on. Then, each instruments is turned on each by each. AFG continuously monitor the magnetic field strength/orientation and its variations to identify the source where the artificial magnetic field is generated.
Management

Team organization chart:

PI
Asamura

Supervisor
Fujii

Science
Miyoshi

HEP
Mitani
Namekawa
Hasegawa
Saito

AIC
Sakanoi
Fukizawa
Yagi
Hino

MED
Sugo
Kawashima
Takaki
Kasahara

AFG
Nomura
Teramoto

COMMON-E
Asamura

Ground
observation
Hosokawa
Monetary budget

We have a fund from Japanese Government (JSPS) which covers until March 2020, including launch fee, travel expense, hardware development, and environmental testings.

Deposit:
USD2,000 has been paid.

Remaining sum of RockSat-XN program fee:
USD23,000 has been paid.
Launch Procedures

- Please see PARM_TestingOperation180701.pdf (RockSat-XN / PARM testing operation) for detail explanation.

1. What will need to be done with your experiment hardware prior to sequence testing in Norway in January 2019?
2. How much time will these operations take?
3. What type of access will you need to your experiment?
   - PARM GSE connection / disconnection
   - Flight / Safe connector mating / unmating
   - Non-flight item removal
4. How many people do you expect to send to Norway to support launch?
   - 3-6 for rocket activities
   - 1-3 for ground-based observations
FMSR To FSTI

For FSTI, We have several items to be done before Full Sequence Testing and Integration

Has your team registered on the website (due July 3)?
Yes. 5 persons have been registered. For discussing the launch conditions, we plan to send one more person. But, since the detail of the meeting (date/time etc.) is unclear, we would like to have a ZOOM meeting at Wallops for the launch condition discussions in order to include the team members who are not joining the Wallops integration testing.
Has your team reviewed the check-in procedure on the website?
Yes. But there are some questions:
• 1.1, 13.1, RS-XN 10.0 (P/F sheet)
  Weight of the PARM aft deck specified shall be 20 +/- 0.75lbs.
• 2(?)
  Center of gravity of the deck is not measured, right?
• 9.3, 9.4
  Does this testing just measure the voltage and current? Nothing is applied to the subsystem. Right?
• 10
  Before turning on the subsystem, we would like to measure output voltages of the GSEs without connecting the GSEs to the subsystem, for example, by using a break-out-box. Is this possible?
What is the ‘RS-XN Sequence Sheet’?

What is AI and DI?

We need a data stream acquired during the testing in order to verify the instrument behavior.
Conclusion

- Mass properties of the nosecone deck. It is unclear how two teams (UiT and PARM) adjust the mass properties to keep the specified tolerance.
- For the check-in of UiT, do you plan to use dummy nosecone deck? When will UiT’s instruments be installed onto the flight deck which is handled by PARM now?
- We will ship the instruments to Wallops. For the check-in, will Wallops personnel bring the instruments and other belongings to Refuge Inn? (What we have to do is to go to Refuge Inn?)
- In Wallops and Refuge Inn, can we borrow and use IPA (isopropyl alcohol)? We would like to use IPA for cleaning (with wipes).
- For launch condition discussions, can we have a ZOOM meeting in Wallops in order to include team members who are not joining the Wallops integration testing?
Conclusion

• We will send the PARM instrument package plus ground support equipment to Wallops (Mr. Max King or Mr. Keith Koehler).
  — For PARM (flight instruments), it will be an ordinal exportation/importation.
  — For the ground support equipment, we plan to use ATA Carnet, since it will be return to Japan within a year.