ANDØYA SPACE CENTER

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FLIGHT REQUIREMENT PLAN

ICI-4 Campaign

January/February 2015

Administration page

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Record of changes

Issue	Date	Detail of Changes
Version 1	28/01/2015	Version 1
Version 2	11/02/2015	Several changes in Chapter 3, 4, 5, 6 and 7

DISTRIBUTION LIST

Internal

Andøya Space Center	20

External

CNRS/LPP	3
JAXA	2
University of Alberta	2
University of Oslo	5
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1 INTRODUCTION

The ICI-4 project includes design, production, integration and launch of one sounding rocket. The scientific instruments are built and delivered by the research institutions involved.

Andøya Space Center (ASC) manages the technical part of the project as well as the launch operation. The payload is built and qualified by ASC.

The ICI-4 payload will be launched on a two-stage rocket motor configuration, a VS30 as the first stage and an Improved Orion as the second.

The launch operation will be conducted from Andøya Space Center in February 2015.

2 CAMPAIGN OBJECTIVES

The main objective is to investigate the micro-physics of plasma instabilities and turbulence phenomena associated with polar cap patches being pulled into the night-time aurora, referred to as auroral blobs.
The auroral blob phenomenon is created when polar cap patches, islands of high electron density plasma, exit the polar cap at night, i.e. when they are entering the night-time auroral oval.
The ingredients are high density F-region plasma structures, imposed by auroral precipitation, field aligned currents and flow shears. This appears to be the most violent situation for GNSS scintillations in the Scandinavian Arctic sector. This is a highly complex region of the auroral ionosphere driven by tail reconnection.

3 OPERATION

3.1 Schedule of operations

Arrival of campaign personnel	25.01-04.02.2015
Pre-flight meeting	08.02.2015
Practice countdown	08.02.2015
Launch period	09-22.02. 2015
Launch window	17 – 22 UTC

3.2 Launch criteria

The ICI-4 payload will be launched when there are auroral blobs/and or substorm auroral activity across the nominal trajectory.

Detailed diagnostics of launch conditions will be provided by the CUTLASS HF radar, EISCAT Svalbard Radar (ESR), EISCAT UHF radar at Ramfjordmoen, and by all-sky imagers at the Kjell Henriksen Observatory (KHO) , the Johan Sverdrup Station at Ny-Ålesund, the University of Tromsø field station in Skibotn and at ALOMAR at Andøya.

3.3 Optimal launch conditions:

1) Clear sky **and a polar cap patch entering the substorm auroral activity** situated over the nominal trajectory.

2) EISCAT radars record **a patch entering the auroral activity situated above the** nominal trajectory.

3.4 Minimal launch conditions:

Substorm auroral activity and F-region plasma structures above the rocket trajectory.

4 PERSONNEL

4.1 Organizations involved in the campaign

Organization	Abbreviation	Communication
Andøya Space Center AS P. O. Box 54 N-8483 Andenes, Norway Mail: kjell@rocketrange.no	ASC	Phone: +47-76 14 44 00 Fax: +47-76 14 44 01
Norwegian Space Centre P.O. Box 113 - Skøyen N-0212 Oslo, Norway Mail: bo.andersen@spacecentre.no	NSC	Phone: +47 22 51 18 00 Fax: +47 22 51 18 01
Research Council of Norway P. O. Box 564 N-1327 Lysaker, Norway Mail: info@forskningsradet.no	NFR	Phone: +47 22 03 70 00 Fax: +47 22 03 70 01
Institute of Space and Astronautical Science Japan Aerospace Exploration Agency 3-1-1, Yoshinodai, Sagamihara, Kanagawa 229-8510, JAPAN Mail: saito@stp.isas.jaxa.jp Mail: abe@isas.jaxa.jp	ISAS/JAXA	Phone: +81-427-59-8176 Fax: +81-427-59-8176
University of Oslo Postboks 1048, Blindern 0316 Oslo, Norway Mail: j.i.moen@fys.uio.no	UiO	Phone: +47-22 85 64 28 Fax: +47-22 85 64 22
Laboratoire de Physique des Plasmas Ecole Polytechnique route de Saclay F-91128 Palaiseau Cedex France Mail: matthieu.berthomier@lpp.polytechnique.fr	LPP	Phone: +33 1 44 27 92 86 Fax: +33 1 48 89 44 33
Department of Physics 4-181 CCIS University of Alberta Edmonton, AB, T6G 2E1, Canada Mail: ian.mann@ualberta.ca	UofA	Phone: +1-780-492-6882 Fax: +1-780-492-0714

4.2 Participating personnel

Name	Organization	Function	Arrival	Location
Jøran Moen	Univ. of Oslo	Principal Investigtor	06.02.15	ASC
Andre Spicher	Univ. of Oslo		06.02.15	ASC
Hilde Lynnebakken	Univ. of Oslo		06.02.15	ASC
Tore Andrè Bekkeng	Univ. of Oslo	PhD student/experimenter	25.01.15	ASC
Espen Trondsen	Univ. of Oslo	Payload Engineer	25.01.15	ASC
Yoshifumi Saito	JAXA (Japan)	Experimenter	26.01.15	ASC
David Miles	UofA(Canada)	Experimenter	26.01.15	ASC
Charles Nokes	UofA(Canada)	Experimenter	04.02.15	
Takumi Abe	JAXA (Japan)	Experimenter	28.01.15	ASC
Matthieu Berthomier	LPP(France)	Experimenter	12.02.15	ASC
Alexis Jeandet	LPP(France)	Experimenter	26.01.15	ASC
Malik Mansour	LPP(France)	Experimenter	26.01.15	ASC
Rainer Kirchhartz		Motor support	26.01.15	ASC
Thaddäus Stromsky		2nd stage Ign. System support	26.01.15	ASC
Martin Rainold	DLR	Motor support	26.01.15	ASC

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4.3 Payload responsibility

Principal Investigator	Jøran Moen, University of Oslo
Project Manager Payload	Gudmund Hansen, ASC
Payload Manager	Geir Lindahl, ASC
Payload Engineer	Trond Aksel Olsen, ASC

4.4 Range responsibility

Head of Operation/Campaign Director	Kjell Bøen
Range Safety Officer	Benny Lysfjord/Morten Larsen
Hazard Area Clearance	Benny Lysfjord
Telemetry Supervisor	Tore Kristiansen
Pad Supervisor	Hans Arne Eilertsen

5 PAYLOAD INFORMATION

5.1 List of scientific instruments

1) Fixed Bias Langmuir Probe (FBP) – ISAS/JAXA.
2) Low Energy Particle spectrometer (LEP) – ISAS/JAXA.
3) Multi Needle Langmuir Probe (mNLP) – University of Oslo.
4) Digital Sun Sensors (DSS) – University of Oslo.
5) Sounding Rocket Attitude Detection System (SRADS2) – University of Oslo.
6) Electric Field Instrument (E-field) – University of Oslo.
7) AC/DC Magnetom. (SwiMM) – LPP, France
8) Flux Gate Magnetometer (FGM) – University of Alberta, Canada

5.2 Description of scientific instruments

5.2.1 Fixed Bias Langmuir probe (FBP)

Responsible scientist: Dr. Takumi Abe (ISAS/JAXA)

The main objective of this instrument is to monitor the small-scale perturbation of the electron density along the rocket trajectory. Such a density perturbation is thought to reflect various meso- or micro-scale phenomena such as the plasma irregularity, instability, and wave-particle interaction. The measured density variation will be compared with other parameters simultaneously obtained from other instruments on the rocket.

A spherical probe with a diameter of 2 cm is adopted as a detector for the electron density measurement, and is put on the top of payload zone of the rocket. In ICI-4, two circular probes with a diameter of 2 cm are additionally adopted to monitor the local ion density. A surface of the probe is coated with gold. The electron and ion probes are biased with a positive voltage of +4 V and a negative voltage of -3 V, respectively, with respect to the rocket potential. The electron and ion currents incident to the probe are amplified and subsequently transferred to the telemetry system. Two levels of DC current gain are prepared so that the probe can measure in a wide range of the plasma density.

5.2.2 Low Energy Particle experiment (LEP)

Responsible scientist: Dr. Yoshifumi Saito (ISAS/JAXA)

LEP consists of two sensors ESA and ISA. ESA measures the electron distribution function in the energy range between 10eV and 10keV while ISA measures the ion distribution function in the energy range between 10eV/q and 10keV/q. The ESA and ISA sensors are top-hat type electrostatic analyzers with a pair of flat disks that works as a collimator at the entrance and toroidal electrodes inside. The inner toroidal electrode is supplied with high voltage swept between 0V and +3kV (ESA)/-3kV (ISA). The electrons/ions coming through the collimator are attracted down toward the inner electrode by the action of the applied potential. Only the electrons/ions with specific energy range can further travel down to the exit of the electrodes. The electrons/ions passing through the electrode enter to Micro-Channel Plate (MCP) and are intensified to detectable charge pulses. Finally, the charge pulses are received by annular discrete anodes that are divided into 16 parts. The positions where the charge pulses are detected correspond to the incident azimuthal directions of the electrons/ions. The following table summarizes the specifications of ESA and ISA.

ESA

	Energy Range:	10eV-10keV
	Energy Step:	32
	FOV:	360°X 4.5°（22.5°X4.5°/ CHANNEL）
	g-factor:	$3.0X10^{-4}$ cm^2str (/ 22.5 deg.)
	Time Resolution:	16 msec / 16 energy steps (32 msec / 32 energy steps)

ISA

	Energy Range:	10eV/q-10keV/q
	Energy Step:	32
	FOV:	360°X4.5°（22.5°X4.5°/ CHANNEL）
	g-factor:	$3.0X10^{-4}$ cm^2str (/ 22.5 deg.)
	Time Resolution:	16 msec / 16 energy steps (32 msec / 32 energy steps)

5.2.3 Multi-Needle&Sphere Langmuir Probe

Responsible scientist: Tore André Bekkeng (UIO)

The experiment consists of a combination of in total eight miniaturized cylindrical and spherical Langmuir probes. The probes are mounted between the knee-joints on the E-field booms and the E-field probe, close to the knee-joints. The probes have a total length of ~50 mm. The cylindrical and spherical probes are biased at individual potentials, and sampled simultaneously. The electron density is calculated using the linear relationship between the bias of the probes and the square of the current collected by the cylindrical probes. The electronics consists of an eight-channel data acquisition unit populating three units in the UiO instrument stack.

5.2.4 Digital Sun Sensor (DSS)

Responsible scientist: Dr. Jan Kenneth Bekkeng (UIO)

The one-axis digital Sun sensor (DSS) is based on a pinhole line camera. The Sun sensor utilize an imaging sensor with a mask (pinhole) placed in front of it. The image sensor used is a high speed CMOS linear array with 2048 x 1 pixels. A pinhole of diameter 200 µm is placed ~4 mm in front of the linear image sensor, giving the Sun sensor a field of view (FOV) of approximately 120 degrees.
The sensor is mounted with the one-dimensional pixel array parallel to the nominal spin axis of the rocket. The Sun illuminates different pixels depending on the Sun angle; i.e. the angle between the spin axis and the pointing vector to the Sun. The near infrared (NIR) filter in front of the pinhole transmits wavelengths above 780 nm only. This filter is included to remove visible light sources and thereby detect only the infrared radiation from the Sun.

5.2.5 SRADS2

Responsible scientist: Dr. Jan Kenneth Bekkeng (UIO)

The SRADS2 (Sounding Rocket Attitude Determination System v2) instrument is a new integrated instrument building on the legacy DSS (UiO Sun Sensor), IRU (UiO Inertial Reference Unit), MAG (UiO Student Magnetometer).
The instrument combines internal and external 3-axis magnetometers, a new sun sensor based on a position sensitive device (PSD) and a commercial, high quality MEMS 3-axis rate gyro. The instrument populate one unit in the UiO instrument stack in addition to the small gyro unit integrated on top of the stack, a separate sun sensor and a boom-mounted magnetometer.

5.2.6 Electric Field and Wave Experiment (E-field)

Responsible scientist: Dr. Jan Kenneth Bekkeng (UIO)

Four 45 mm diameter E-field probes are used to measure 3D E-field in both AC and DC components. The probes are mounted on the tips of the four front booms. The instrument consists of two differential channels measuring the field between two opposite mounted probes in addition to four channels with single ended measurements of all four probes relative to the payload. This instrument has a new electronics, based on the version used on earlier ICI-flights. The pre-amplifiers are removed and the earlier separate AC- and DC channels are now combined in one covering the whole bandwidth from DC to ~8.6 kHz. The electronics is populating two units in the UiO instrument stack.

5.2.7 Sensor for Wideband Magnetic Field Measurement (SwiMM)

Responsible scientist: Dr. Matthieu Berthomier (LPP).

Triaxial Magnetic Antenna
It will consist in three perpendicular search-coil antennas with mounting hardware, to measure the X, Y and Z-components of the magnetic field. The magnetic antenna has measure the magnetic field components of magnetic waves from a few Hz to ~20 kHz with high sensitivity.

Main Electronic Box
This box contains all the electronic functions to amplify search coil antenna signal, measure continuous magnetic field, convert and filter this signals and transfer them to rocket telemetry system. To measure DC magnetic field we use four three axis commercial magneto-resistances (AMR) spaced by 8cm, sampled with 24bits resolution. Inherent limitation from AMR sensors are reduced by using set/reset technic and some algorithms,. The shearc-coil amplifier is based on ASIC technology to ensure a good resolution and bandwidth without increasing too much the power consumption.

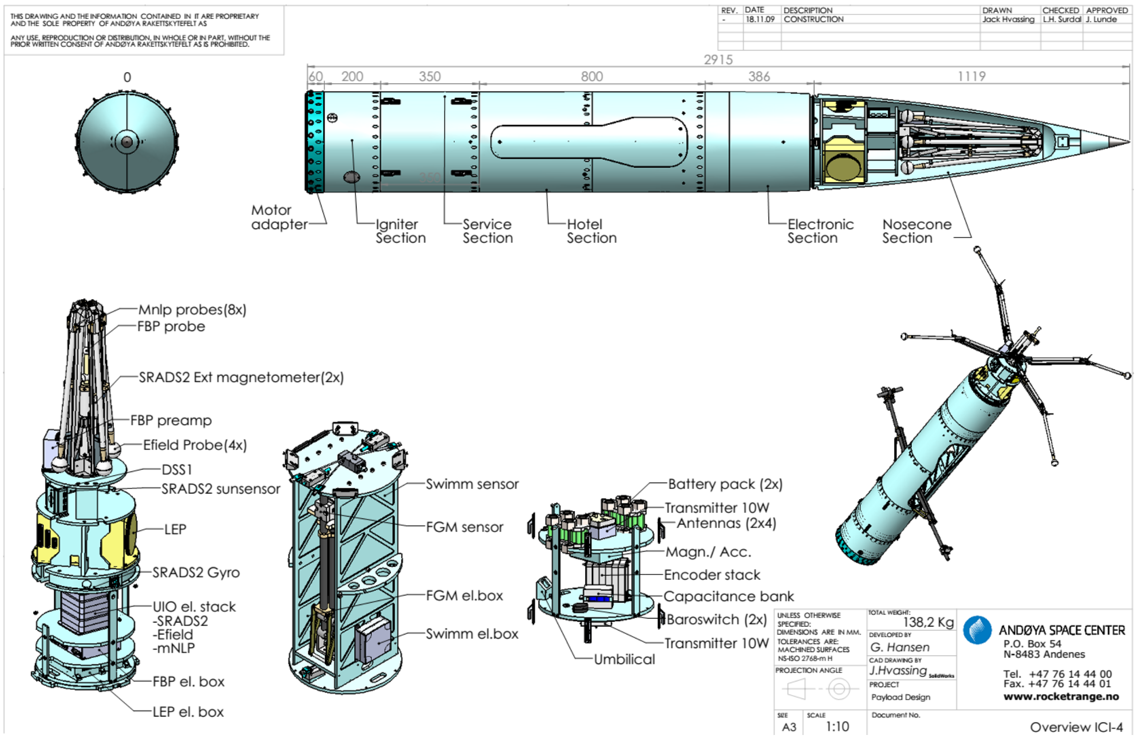
5.2.8 Fluxgate magnetometer (FGM)

Responsible scientist: Professor Ian Mann (University of Alberta)

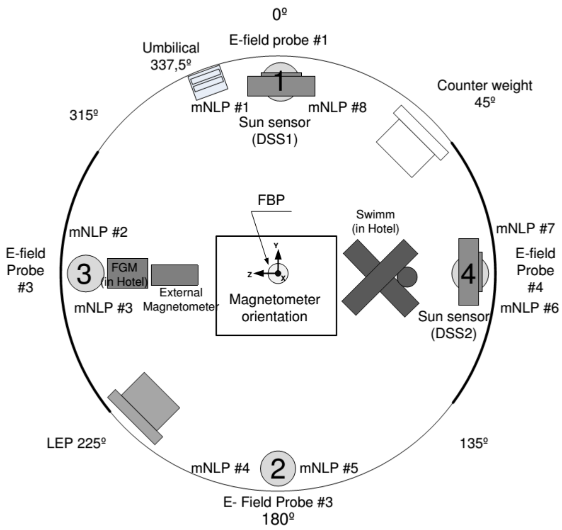
The fluxgate magnetometer (FGM) has three, orthogonally aligned magnetometer channels. The FGM Sensor refers to one three-axis sensor mounted at the boom end. The FGM Sensor is composed of a mounting block, two permalloy ring cores, two drive windings, and three sense coils. The FGM Electronics refers to one set of electronics which drives the FGM Sensor, digitises the result and creates the data product. The FGM Electronics is composed of analog filters and digitizers for three axes, an FPGA, and support electronics. The FPGA controller generates a drive signal which periodically saturates and un-saturates the ring-cores. This modulates the core permeability in each magnetometer channel creating an “error signal” composed of current pulses which correspond to the local magnetic field strength. The error signal is converted to a voltage and digitized in phase with the drive signal essentially creating a synchronous detector. The FPGA then uses two mixed PWM signals to create a high-precision current source to servo the magnetic field at the sensor head towards zero field. The output data for each magnetometer channel is then the appropriately scaled sum of the PWMs and the error signal.

5.3 Composition of payload

5.3.1 Overview of complete payload



5.3.2 Orientation & Attitude orientation



As seen from the front

5.4 Payload telemetry set up

5.4.1 Video specifications

		Video 1	Video 2
Transmission Frequency	MHz	2 259,50	2 279,50
Transmitter Power	W	10	10
IF Bandwidth	KHz	10 000	10 000
Video Bandwidth	KHz	6 000	6 000
Modulation		True FM	True FM
Antenna System		Stub	Stub
Transmission Polarization		Linear	Linear
PCM-Code		RNRZ	RNRZ
Bit Rate	bit/s	3 333 333	3 333 333
Digital Word Input Impedance		HCT	HCT
Analog Word Input Impedance	ohm	> 1 000	> 1 000
Analog Resolution	bits	12	12
Word Length	bits	8	8
Word Rate	words/s	416 666	416 666
Words/Frame		144	144
Frames/Format		64	64
Frame Rate	frames/s	2 893,5	2 893,5
Format Rate	format/s	45,2112223	45,2112223

5.4.2 PCM Format, Main Frame Channel Assignments

PCM Format: Video No. 1

TX Frequency	:	2 259,5 MHz	Code:	:	RNRZ
Bit Rate	:	3 333,333 Kbit/s	8 Bit Words/Frame	:	144
Frame Rate	:	2893,5 Frames/s	Frames/Format	:	64
Format Rate	:	45,2 Format/s			

Main Frame Channel Assignments Date: 7 January 2015

8-bit	16-bit	Inst.	Instrument	Description	Com.	Comment
0		ASC	Sync. (1110 1011) EB	FrameSync_MSB	1:1	
1	0	ASC	Sync. (1001 0000) 90	FrameSync_LSB	1:1	
2		ASC	Framecounter / Events	SFID_LSB [0-5]bit	1:1	
3	1	ASC	Status Bits	HK opt word	1:1	
4		UiO	multi Needle Langmuir Probe	MNLP1_MSB	3:1	
5	2	UiO	multi Needle Langmuir Probe	MNLP1_LSB	3:1	
6		UiO	multi Needle Langmuir Probe	MNLP2_MSB	3:1	
7	3	UiO	multi Needle Langmuir Probe	MNLP2_LSB	3:1	
8		UiO	multi Needle Langmuir Probe	MNLP3_MSB	3:1	
9	4	UiO	multi Needle Langmuir Probe	MNLP3_LSB	3:1	
10		UiO	multi Needle Langmuir Probe	MNLP4_MSB	3:1	
11	5	UiO	multi Needle Langmuir Probe	MNLP4_LSB	3:1	
12	6	UiO	multi Needle Langmuir Probe	MNLP5_MSB	3:1	

13		UiO	multi Needle Langmuir Probe	MNLP5_LSB	3:1	
14		UiO	multi Needle Langmuir Probe	MNLP6_MSB	3:1	
15	7	UiO	multi Needle Langmuir Probe	MNLP6_LSB	3:1	
16		UiO	multi Needle Langmuir Probe	MNLP7_MSB	3:1	
17	8	UiO	multi Needle Langmuir Probe	MNLP7_LSB	3:1	
18		UiO	multi Needle Langmuir Probe	MNLP8_MSB	3:1	
19	9	UiO	multi Needle Langmuir Probe	MNLP8_LSB	3:1	
20		JAXA	Fixed Bias Probe	FBP_EL_MSB	1:1	
21	10	JAXA	Fixed Bias Probe	FBP_EL_LSB	1:1	
22		JAXA	Fixed Bias Probe	FBP_EH_MSB	1:1	
23	11	JAXA	Fixed Bias Probe	FBP_EH_LSB	1:1	
24		DLR	Motor Pressure	MotorPres_MSB	1:1	
25	12	DLR	Motor Pressure	MotorPres_LSB	1:1	
26						
27	13					
28						
29	14					
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31	15					
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33	16					
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43	21					
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47	23					
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49	24					
50		UofA	Fluxgate Magnetometer	FGM_HK_MSB	1:1	
51	25	UofA	Fluxgate Magnetometer	FGM_HK_lSB	1:1	
52		UiO	multi Needle Langmuir Probe	MNLP1_MSB	3:1	
53	26	UiO	multi Needle Langmuir Probe	MNLP1_LSB	3:1	
54		UiO	multi Needle Langmuir Probe	MNLP2_MSB	3:1	
55	27	UiO	multi Needle Langmuir Probe	MNLP2_LSB	3:1	
56		UiO	multi Needle Langmuir Probe	MNLP3_MSB	3:1	
57	28	UiO	multi Needle Langmuir Probe	MNLP3_LSB	3:1	
58	29	UiO	multi Needle Langmuir Probe	MNLP4_MSB	3:1	

59		UiO	multi Needle Langmuir Probe	MNLP4_LSB	3:1	
60		UiO	multi Needle Langmuir Probe	MNLP5_MSB	3:1	
61	30	UiO	multi Needle Langmuir Probe	MNLP5_LSB	3:1	
62		UiO	multi Needle Langmuir Probe	MNLP6_MSB	3:1	
63	31	UiO	multi Needle Langmuir Probe	MNLP6_LSB	3:1	
64		UiO	multi Needle Langmuir Probe	MNLP7_MSB	3:1	
65	32	UiO	multi Needle Langmuir Probe	MNLP7_LSB	3:1	
66		UiO	multi Needle Langmuir Probe	MNLP8_MSB	3:1	
67	33	UiO	multi Needle Langmuir Probe	MNLP8_LSB	3:1	
68		UiO	Potentiometers SubCOM	Potentiometers_MSB	1:1	
69	34	UiO	Potentiometers SubCOM	Potentiometers_LSB	1:1	
70		ASC	Temperature Magnetometer	AccMagTemp_MSB	1:1	
71	35	ASC	Temperature Magnetometer	AccMagTemp_LSB	1:1	
72		JAXA	Low Energy Particle Exp.	LEP ch1/ch9_MSB	1:1	
73	36	JAXA	Low Energy Particle Exp.	LEP ch1/ch9_LSB	1:1	
74		JAXA	Low Energy Particle Exp.	LEP ch2/ch10_MSB	1:1	
75	37	JAXA	Low Energy Particle Exp.	LEP ch2/ch10_LSB	1:1	
76		JAXA	Low Energy Particle Exp.	LEP ch3/ch11_MSB	1:1	
77	38	JAXA	Low Energy Particle Exp.	LEP ch3/ch11_LSB	1:1	
78		ASC	HK Magnetometer	MagX_MSB	1:1	
79	39	ASC	HK Magnetometer	MagX_LSB	1:1	
80		JAXA	Low Energy Particle Exp.	LEP ch4/ch12_MSB	1:1	
81	40	JAXA	Low Energy Particle Exp.	LEP ch4/ch12_LSB	1:1	
82		JAXA	Low Energy Particle Exp.	LEP ch5/ch13_MSB	1:1	
83	41	JAXA	Low Energy Particle Exp.	LEP ch5/ch13_LSB	1:1	
84		JAXA	Low Energy Particle Exp.	LEP ch6/ch14_MSB	1:1	
85	42	JAXA	Low Energy Particle Exp.	LEP ch6/ch14_LSB	1:1	
86		ASC	HK Magnetometer	MagZ_MSB	1:1	
87	43	ASC	HK Magnetometer	MagZ_LSB	1:1	
88		JAXA	Low Energy Particle Exp.	LEP ch7/ch15_MSB	1:1	
89	44	JAXA	Low Energy Particle Exp.	LEP ch7/ch15_LSB	1:1	
90		JAXA	Low Energy Particle Exp.	LEP ch8/ch16_MSB	1:1	
91	45	JAXA	Low Energy Particle Exp.	LEP ch8/ch16_LSB	1:1	
92		UiO	multi Needle Langmuir Probe	MNLP HK_MSB	1:1	
93	46	UiO	multi Needle Langmuir Probe	MNLP HK_MSB	1:1	
94		ASC	HK Magnetometer	MagY_MSB	1:1	
95	47	ASC	HK Magnetometer	MagY_LSB	1:1	
96		UofA	Fluxgate Magnetometer	X High_MSB	1:1	
97	48	UofA	Fluxgate Magnetometer	X High_LSB	1:1	
98		UofA	Fluxgate Magnetometer	X low_MSB	1:1	
99	49	UofA	Fluxgate Magnetometer		1:1	
100		UiO	multi Needle Langmuir Probe	MNLP1_MSB	3:1	
101	50	UiO	multi Needle Langmuir Probe	MNLP1_LSB	3:1	
102		UiO	multi Needle Langmuir Probe	MNLP2_MSB	3:1	
103	51	UiO	multi Needle Langmuir Probe	MNLP2_LSB	3:1	
104	52	UiO	multi Needle Langmuir Probe	MNLP3_MSB	3:1	

105		UiO	multi Needle Langmuir Probe	MNLP3_LSB	3:1	
106		UiO	multi Needle Langmuir Probe	MNLP4_MSB	3:1	
107	53	UiO	multi Needle Langmuir Probe	MNLP4_LSB	3:1	
108		UiO	multi Needle Langmuir Probe	MNLP5_MSB	3:1	
109	54	UiO	multi Needle Langmuir Probe	MNLP5_LSB	3:1	
110		UiO	multi Needle Langmuir Probe	MNLP6_MSB	3:1	
111	55	UiO	multi Needle Langmuir Probe	MNLP6_LSB	3:1	
112		UiO	multi Needle Langmuir Probe	MNLP7_MSB	3:1	
113	56	UiO	multi Needle Langmuir Probe	MNLP7_LSB	3:1	
114		UiO	multi Needle Langmuir Probe	MNLP8_MSB	3:1	
115	57	UiO	multi Needle Langmuir Probe	MNLP8_LSB	3:1	
116		JAXA	Fixed Bias Probe	FBP_I1L_MSB	1:1	
117	58	JAXA	Fixed Bias Probe	FBP_I1L_LSB	1:1	
118		ASC	HK Accelerometer	AccZ_MSB	1:1	
119	59	ASC	HK Accelerometer	AccZ_LSB	1:1	
120		JAXA	Fixed Bias Probe	FBP_I1H_MSB	1:1	
121	60	JAXA	Fixed Bias Probe	FBP_I1H_LSB	1:1	
122		JAXA	Fixed Bias Probe	FBP_I2L_MSB	1:1	
123	61	JAXA	Fixed Bias Probe	FBP_I2L_LSB	1:1	
124		JAXA	Fixed Bias Probe	FBP_I2H_MSB	1:1	
125	62	JAXA	Fixed Bias Probe	FBP_I2H_LSB	1:1	
126		ASC	HK Accelerometer	AccX_MSB	1:1	
127	63	ASC	HK Accelerometer	AccX_LSB	1:1	
128		UofA	Fluxgate Magnetometer	Y High_MSB	1:1	
129	64	UofA	Fluxgate Magnetometer	Y High_LSB	1:1	
130		UofA	Fluxgate Magnetometer	Y low_MSB	1:1	
131	65	UofA	Fluxgate Magnetometer		1:1	
132		JAXA	Low Energy Particle Exp.	LEP status_MSB	1:1	
133	66	JAXA	Low Energy Particle Exp.	LEP status_LSB	1:1	
134		ASC	HK Accelerometer	AccY_MSB	1:1	
135	67	ASC	HK Accelerometer	AccY_LSB	1:1	
136		UofA	Fluxgate Magnetometer	Z High_MSB	1:1	
137	68	UofA	Fluxgate Magnetometer	Z High_LSB	1:1	
138		UofA	Fluxgate Magnetometer	Z low_MSB	1:1	
139	69	UofA	Fluxgate Magnetometer		1:1	
140		ASC	Format Counter	Format counter_MSB	1:1	
141	70	ASC	Format Counter	Format counter_LSB	1:1	
142		ASC	Housekeeping	ASC_HK_SubCom_MSB	1:1	
143	71	ASC	Housekeeping	ASC_HK_SubCom_LSB	1:1	

SubCom channels:

Master

Word : 50 (MSB), 51 (LSB) **FGM HK SubCom**
Samples/s : 45,2 **FGM House Keeping**

0	UofA	FGM HK1	1:64	
1	UofA	FGM HK2	1:64	
2	UofA	FGM HK3	1:64	
3	UofA	FGM HK4	1:64	
4	UofA	FGM HK5	1:64	
5	UofA	FGM HK6	1:64	
6	UofA	FGM HK7	1:64	
7	UofA	FGM HK8	1:64	
8	UofA	FGM HK9	1:64	
9	UofA	FGM HK10	1:64	
10				
11				
12	ARR	Flight Time MSB	1:64	
13	ARR	Flight Time LSB	1:64	
14	ARR	Digital Status Microcontroller MSB	1:64	
15	ARR	Digital Status Microcontroller LSB	1:64	
16	ARR	Digital Status CPLD-A MSB	1:64	
17	ARR	Digital Status CPLD-A LSB	1:64	
18	ARR	Digital Status CPLD-B MSB	1:64	
19	ARR	Digital Status CPLD-B LSB	1:64	
20	ARR	Temperature PCB	1:64	
21	ARR	Current Battery pack A	1:64	
22	ARR	Current Battery pack B	1:64	
23	ARR	Plenum Pressure	1:64	
24	ARR	Auxiliary	1:64	
25	ARR	Regulated Voltage A	1:64	
26	ARR	Regulated Voltage B	1:64	
27	ARR	Unregulated Voltage A	1:64	
28	ARR	Unregulated Voltage B	1:64	
29	ARR	Current Pulse Measurement	1:64	
30	ARR	Current Pulse Measurement	1:64	
31	ARR	Current Pulse Measurement	1:64	
32	ARR	Current Pulse Measurement	1:64	
.				
..				
63				

Word : 68 (MSB), 69 (LSB) **Potentiometers_SubCom**
Samples/s : 1446 **Potentiometers**

0	UIO	Potentiometer Top	1:2	
1	UIO	Potentiometer Bot	1:2	

Word : 92 (MSB), 93 (LSB) **MNLP HK_SubCom**
Samples/s : 180,84375 **MNLP Housekeeping**

0	UIO	MNLP Bias 1	1:16	
1	UIO	MNLP Bias 2	1:16	
2	UIO	MNLP Bias 3	1:16	
3	UIO	MNLP Bias 4	1:16	
4	UIO	MNLP Bias 5	1:16	
5	UIO	MNLP Bias 6	1:16	
6	UIO	MNLP Bias 7	1:16	
7	UIO	MNLP Bias 8	1:16	
8	UIO	MNLP DAC1 PowerReg	1:16	
9	UIO	MNLP DAC2 PowerReg	1:16	
10	UIO	MNLP DAC1 RangeReg	1:16	
11	UIO	MNLP DAC2 RangeReg	1:16	
12	UIO	MNLP Temp Power/Interface	1:16	
13	UIO	MNLP Temp Digital	1:16	
14	UIO	MNLP Temp Analog	1:16	
15	UIO			

Word : 142 (MSB), 143 (LSB) **ASC HK SubCom**
Samples/s : 45,2 **ASC House Keeping**

Frame	**Inst.**	**Description**	**Com.**	**Comment**
0	ASC	Pressure	1:64	
1	ASC	U-mon Battery	1:64	
2	ASC	U-mon External	1:64	
3	ASC	U-mon Battery Pack #1	1:64	
4	ASC	U-mon Battery Pack #2	1:64	
5	ASC	I-mon - Charge	1:64	
6	ASC	I-mon - Main	1:64	
7	ASC	I-mon - TX 1	1:64	
8	ASC	I-mon - TX 2	1:64	
9	ASC	I-mon - PCM encoder	1:64	
10	ASC	I-mon - mNLP	1:64	

11	ASC	I-mon - SRADS2	1:64	
12	ASC	I-mon - DSS1	1:64	
13	ASC	I-mon - E-field	1:64	
14	ASC	I-mon - Swimm	1:64	
15				
16	ASC	I-mon - FGM	1:64	
17	ASC	I-mon - FBP	1:64	
18				
19	ASC	I-mon - LEP	1:64	
20	JAXA	LEP MCP	1:64	
21	JAXA	LEP SV fix	1:64	
22	JAXA	LEP Sweep	1:64	
23	JAXA	LEP mesh	1:64	
24	ASC	I-mon - ASC_ACC_MAG	1:64	
25				
26	ASC	Temperature POWER	1:64	
27	ASC	Temperature PUSEK	1:64	
28	ASC	Temperature AMON	1:64	
29	ASC	Temperature TIMER	1:64	
30	ASC	Temp TX1	1:64	
31	ASC	Temp TX2	1:64	
32	ASC	Temp Batt1	1:64	
33	ASC	Temp Batt2	1:64	
34				
35				
36				
37	ASC	Microswitches	1:64	
38	ASC	Squib Commands	1:64	
39	ASC	Squib Nosecone V-belt1 brd A	1:64	
40	ASC			
41	ASC	Squib Nosecone V-belt2 brd A	1:64	
42	ASC			
43	ASC	Squib Nosecone Tiplock brd A	1:64	
44	ASC			
45	ASC	Squib Door 1 brd A	1:64	
46	ASC			
47	ASC	Squib Door 2 brd A	1:64	
48	ASC			
49	ASC	Squib Boom TOP brd A	1:64	
50	ASC	Squib Boom TOP brd B	1:64	
51	ASC	Squib Boom BOT brd A	1:64	
52	ASC	Squib Boom BOT brd B	1:64	
53				
54				
55	ASC	Timer Capasitor 1	1:64	
56	ASC	Timer Capasitor 2	1:64	

57	ASC	Timer Capasitor 3	1:64	
58	ASC	Timer Capasitor 4	1:64	
59	ASC	Timer Capasitor 5	1:64	
60	ASC	Timer Capasitor 6	1:64	
61	ASC	Timer Mode Status	1:64	
62	ASC	Format generation Time bit 23- 15	1:64	
63	ASC	Format gen. Time bit 15 - 0	1:64	

Status Bits:

Word 2 (MSB), 3 (LSB) **SFID_LSB 6bit LSB + 2 Status Bits**
ASC

STATUS	Bit	Description	Comment
MSB	15	PUSEK_AUX	
	14	PUSEK_TAKEOFF	
	13	Frame Counter MSB	
	12	Frame Counter	
	11	Frame Counter	
	10	Frame Counter	
	9	Frame Counter	
	8	Frame Counter LSB	
	7		
	6		
	5		
	4		
	3	Master/Slave bit	1= Master frame, 0= Slave frame
	2		
	1	PUSEK_AUX	
LSB	0	PUSEK_TAKEOFF	

Word 132 (MSB), 133 (LSB) **LEP status**
Low Energy Particle Detector, House Keeping
JAXA

STATUS	Bit	description	Comment
MSB	15	Sweep Start Flag	start
	14	HV On/Off	On
	13	Safety On/Off	On
	12	Motor DRV On/Off	On
	11	Extention Finish	Finish
	10	Retract Finish	Finish
	9	Calibration On/Off	On
	8	CFG Error	Error
	7	Overflow	Overflow
	6	ROM protect	non-protect
	5	Sweep Number Bit 4	-
	4	Sweep Number Bit 3	-
	3	Sweep Number Bit 2	-
	2	Sweep Number Bit 1	-
	1	Sweep Number Bit 0	-
LSB	0	Even/Odd frame	Odd Frame

Word 142(MSB), 143 (LSB) **ASC HK SubCom**
Frame 37 **ASC House Keeping**
Microswitches

STATUS	Bit	Description	Comment
MSB	15	Nose Cone	LOW = Open = Released
	14	Door 1	LOW = Open = Released
	13	Door 2	LOW = Open = Released
	12		
	11		
	10		
	9		
	8		
	7		
	6		
	5		
	4		
	3		
	2		
	1		
LSB	0		

Word 142(MSB), 143 (LSB) **ASC HK SubCom**
Frame 38 **ASC House Keeping**
Squib COMMAND

STATUS	Bit	Description	Comment
MSB	15	Nosecone V-belt1 bridge A	High for 100 ms when fired
	14		
	13	Nosecone V-belt2 bridge A	High for 100 ms when fired
	12		
	11	Nosecone tiplock bridge A	High for 100 ms when fired
	10		
	9	Door 1 bridge A	High for 100 ms when fired
	8		
	7	Door 2 bridge A	High for 100 ms when fired
	6		
	5	BOOM TOP bridge A	High for 100 ms when fired
	4	BOOM TOP bridge B	High for 100 ms when fired
	3	BOOM BOT bridge A	High for 100 ms when fired
	2	BOOM BOT bridge B	High for 100 ms when fired
	1		
LSB	0		

Word	142(MSB), 143 (LSB)		**ASC HK SubCom**
Frame		61	**ASC House Keeping**
			Timer Mode Status

STATUS	Bit	Description	Comment
MSB	15	Tim_Baro_1	Baro. Switch 1 is activated
	14	Tim_Baro_2	Baro. Switch 2 is activated
	13	Tim_Baro_1_or_2	Baro. Switch 1 or 2 are aktivert
	12	Tim_HK_OFF	The timer turns off the payload
	11	Tim_Stop	The timer is finish, and have stopped
	10	Tim_Wait_on_Baro	The timer takes a break until Baro 1 or 2 is activated
	9	Tim_ON	The timer is turned on by the umbilical cable
	8	Tim_HK_OFF_CMD	The timer turns off the payload in 1 second
	7	Tim_Running	The timer is running
	6		
	5		
	4		
	3		
	2	Timer LEP-ESA Dep. Start	High for 1000ms when active
	1	Timer LEP-ESA HVPS On	High for 1000ms when active
LSB	0		

5.4.3 PCM Format, Slave Frame Channel Assignments

PCM Format: Video No. 2

TX Frequency	:	2 279,5 MHz	Code	:	RNRZ
Bit Rate	:	3 333,333 Kbit/s	8 Bit Words/Frame	:	144
Frame Rate	:	2893,5 Frames/s	Frames/Format	:	64
Format Rate	:	45,2 Format/s			

Main Frame Channel Assignments Date: 27 September 2013

8-bit	16-bit	Inst.	Instrument	Description	Com.	Comment
0		ASC	Sync. (1110 1011) EB	FrameSync_MSB	1:1	
1	0	ASC	Sync. (1001 0000) 90	FrameSync_LSB	1:1	
2		ASC	Framecounter / Events	SFID_LSB [0-5]bit	1:1	
3	1	ASC	Status Bits	HK opt word	1:1	
4						
5	2					
6		LPP	Swimm	LF1_MSB	6:1	
7	3	LPP	Swimm	LF1_LSB	6:1	
8		LPP	Swimm	LF2_MSB	6:1	
9	4	LPP	Swimm	LF2_LSB	6:1	
10		LPP	Swimm	LF3_MSB	6:1	
11	5	LPP	Swimm	LF3_LSB	6:1	

12		UIO	E-field	SE1_MSB	6:1	
13	6	UIO	E-field	SE1_LSB	6:1	
14		UIO	E-field	SE2_MSB	6:1	
15	7	UIO	E-field	SE2_LSB	6:1	
16		UIO	E-field	SE3_MSB	6:1	
17	8	UIO	E-field	SE3_LSB	6:1	
18		UIO	E-field	Diff1_MSB	6:1	
19	9	UIO	E-field	Diff1_LSB	6:1	
20		UIO	E-field	Diff2_MSB	6:1	
21	10	UIO	E-field	Diff2_LSB	6:1	
22		UIO	E-field	Diff3_MSB	6:1	
23	11	UIO	E-field	Diff3_LSB	6:1	
24		UIO	SRADS2	DSS2_X_MSB	2:1	
25	12	UIO	SRADS2	DSS2_X_LSB	2:1	
26		UIO	SRADS2	DSS2_Y_MSB	2:1	
27	13	UIO	SRADS2	DSS2_Y_LSB	2:1	
28		UIO	DSS1	DSS1_X_MSB	2:1	
29	14	UIO	DSS1	DSS1_X_LSB	2:1	
30		LPP	Swimm	LF1_MSB	6:1	
31	15	LPP	Swimm	LF1_LSB	6:1	
32		LPP	Swimm	LF2_MSB	6:1	
33	16	LPP	Swimm	LF2_LSB	6:1	
34		LPP	Swimm	LF3_MSB	6:1	
35	17	LPP	Swimm	LF3_LSB	6:1	
36		UIO	E-field	SE1_MSB	6:1	
37	18	UIO	E-field	SE1_LSB	6:1	
38		UIO	E-field	SE2_MSB	6:1	
39	19	UIO	E-field	SE2_LSB	6:1	
40		UIO	E-field	SE3_MSB	6:1	
41	20	UIO	E-field	SE3_LSB	6:1	
42		UIO	E-field	Diff1_MSB	6:1	
43	21	UIO	E-field	Diff1_LSB	6:1	
44		UIO	E-field	Diff2_MSB	6:1	
45	22	UIO	E-field	Diff2_LSB	6:1	
46		UIO	E-field	Diff3_MSB	6:1	
47	23	UIO	E-field	Diff3_LSB	6:1	
48		LPP	Swimm	Swimm DC_MSB	1:1	
49	24	LPP	Swimm	Swimm DC_LSB	1:1	
50		LPP	Swimm	Swimm DC_MSB	1:1	
51	25	LPP	Swimm	Swimm DC_LSB	1:1	
52		LPP	Swimm	Swimm DC_MSB	1:1	
53	26	LPP	Swimm	Swimm DC_LSB	1:1	
54		LPP	Swimm	LF1_MSB	6:1	
55	27	LPP	Swimm	LF1_LSB	6:1	
56		LPP	Swimm	LF2_MSB	6:1	
57	28	LPP	Swimm	LF2_LSB	6:1	

58		LPP	Swimm	LF3_MSB	6:1	
59	29	LPP	Swimm	LF3_LSB	6:1	
60		UIO	E-field	SE1_MSB	6:1	
61	30	UIO	E-field	SE1_LSB	6:1	
62		UIO	E-field	SE2_MSB	6:1	
63	31	UIO	E-field	SE2_LSB	6:1	
64		UIO	E-field	SE3_MSB	6:1	
65	32	UIO	E-field	SE3_LSB	6:1	
66		UIO	E-field	Diff1_MSB	6:1	
67	33	UIO	E-field	Diff1_LSB	6:1	
68		UIO	E-field	Diff2_MSB	6:1	
69	34	UIO	E-field	Diff2_LSB	6:1	
70		UIO	E-field	Diff3_MSB	6:1	
71	35	UIO	E-field	Diff3_LSB	6:1	
72		UIO	SRADS2	Rate_SubCom_MSB	2:1	
73	36	UIO	SRADS2	Rate_SubCom_LSB	2:1	
74		UIO	SRADS2	Mag_Int_Subcom_MSB	2:1	
75	37	UIO	SRADS2	Mag_Int_Subcom_MSB	2:1	
76		UIO	SRADS2	Mag_Ext_Subcom_MSB	2:1	
77	38	UIO	SRADS2	Mag_Ext_Subcom_LSB	2:1	
78		LPP	Swimm	LF1_MSB	6:1	
79	39	LPP	Swimm	LF1_LSB	6:1	
80		LPP	Swimm	LF2_MSB	6:1	
81	40	LPP	Swimm	LF2_LSB	6:1	
82		LPP	Swimm	LF3_MSB	6:1	
83	41	LPP	Swimm	LF3_LSB	6:1	
84		UIO	E-field	SE1_MSB	6:1	
85	42	UIO	E-field	SE1_LSB	6:1	
86		UIO	E-field	SE2_MSB	6:1	
87	43	UIO	E-field	SE2_LSB	6:1	
88		UIO	E-field	SE3_MSB	6:1	
89	44	UIO	E-field	SE3_LSB	6:1	
90		UIO	E-field	Diff1_MSB	6:1	
91	45	UIO	E-field	Diff1_LSB	6:1	
92		UIO	E-field	Diff2_MSB	6:1	
93	46	UIO	E-field	Diff2_LSB	6:1	
94		UIO	E-field	Diff3_MSB	6:1	
95	47	UIO	E-field	Diff3_LSB	6:1	
96		UIO	SRADS2	DSS2_X_MSB	2:1	
97	48	UIO	SRADS2	DSS2_X_LSB	2:1	
98		UIO	SRADS2	DSS2_Y_MSB	2:1	
99	49	UIO	SRADS2	DSS2_Y_LSB	2:1	
100		UIO	DSS1	DSS1_X_MSB	2:1	
101	50	UIO	DSS1	DSS1_X_LSB	2:1	
102		LPP	Swimm	LF1_MSB	6:1	
103	51	LPP	Swimm	LF1_LSB	6:1	

104		LPP	Swimm	LF2_MSB	6:1	
105	52	LPP	Swimm	LF2_LSB	6:1	
106		LPP	Swimm	LF3_MSB	6:1	
107	53	LPP	Swimm	LF3_LSB	6:1	
108		UIO	E-field	SE1_MSB	6:1	
109	54	UIO	E-field	SE1_LSB	6:1	
110		UIO	E-field	SE2_MSB	6:1	
111	55	UIO	E-field	SE2_LSB	6:1	
112		UIO	E-field	SE3_MSB	6:1	
113	56	UIO	E-field	SE3_LSB	6:1	
114		UIO	E-field	Diff1_MSB	6:1	
115	57	UIO	E-field	Diff1_LSB	6:1	
116		UIO	E-field	Diff2_MSB	6:1	
117	58	UIO	E-field	Diff2_LSB	6:1	
118		UIO	E-field	Diff3_MSB	6:1	
119	59	UIO	E-field	Diff3_LSB	6:1	
120		LPP	Swimm	Swimm HF_MSB	1:1	
121	60	LPP	Swimm	Swimm HF_LSB	1:1	
122		ASC	Housekeeping	ASC_HK_SubCom_MSB	1:1	
123	61	ASC	Housekeeping	ASC_HK_SubCom_LSB	1:1	
124		ASC	Format Counter	Format counter_MSB	1:1	
125	62	ASC	Format Counter	Format counter_LSB	1:1	
126		LPP	Swimm	LF1_MSB	6:1	
127	63	LPP	Swimm	LF1_LSB	6:1	
128		LPP	Swimm	LF2_MSB	6:1	
129	64	LPP	Swimm	LF2_LSB	6:1	
130		LPP	Swimm	LF3_MSB	6:1	
131	65	LPP	Swimm	LF3_LSB	6:1	
132		UIO	E-field	SE1_MSB	6:1	
133	66	UIO	E-field	SE1_LSB	6:1	
134		UIO	E-field	SE2_MSB	6:1	
135	67	UIO	E-field	SE2_LSB	6:1	
136		UIO	E-field	SE3_MSB	6:1	
137	68	UIO	E-field	SE3_LSB	6:1	
138		UIO	E-field	Diff1_MSB	6:1	
139	69	UIO	E-field	Diff1_LSB	6:1	
140		UIO	E-field	Diff2_MSB	6:1	
141	70	UIO	E-field	Diff2_LSB	6:1	
142		UIO	E-field	Diff3_MSB	6:1	
143	71	UIO	E-field	Diff3_LSB	6:1	

SubCom channels:

Slave

Word : 122 (MSB), 123 (LSB) **ASC HK SubCom**
Samples/s : 45,2 **ASC House Keeping**

Frame	Inst.	Description	Com.	Comment
0	ASC	Temperature PUSEK	1:64	
1				
.				
..				
...				
61				
62	ASC	Format generation Time bit 23- 15	1:64	
63	ASC	Format gen. Time bit 15 - 0	1:64	

Word : 72 (MSB), 73 (LSB) **Rate SubCom**
Samples/s : 723,4 **SRADS2 Gyro**

0	UIO	Rate Roll	1:4	
1	UIO	Rate Pitch	1:4	
2	UIO	Rate Yaw	1:4	
3	UIO	Rate_HK	1:4	

Word : 74 (MSB), 75 (LSB) **Mag_Int_SubCom**
Samples/s : 723,4 **SRADS2 Internal Magnetometer**

0	UIO	Mag Internal X	1:4	
1	UIO	Mag Internal Y	1:4	
2	UIO	Mag Internal Z	1:4	
3	UIO	Mag Internal HK	1:4	

Word : 76 (MSB), 77 (LSB) **Mag_Ext_SubCom**
Samples/s : 723,4 **SRADS2 External Magnetometer**

0	UIO	Mag External X	1:4	
1	UIO	Mag External Y	1:4	
2	UIO	Mag External Z	1:4	
3	UIO	Mag External HK	1:4	

5.5 Cable diagram

Umbilical Cable

Table 1, Umbilical Plug Nr. 1 in Payload

PIN Payload Connector	Signal Name	Pin/Wire Nr. in Umbilical Cable from Launcher to Blockhouse
1	External 28V	
2	External 28V	
3	External 28V	
4	External 28V	
5	INT on/off	
6	External 28V	
7	External 28V	
8	External 28V	
9	External 28V	
10	TX on/off	
11	Data UMB	
12	Format Counter Run	
13	Data UMB return	
14	Timer Run	
15	Encoder 2 UMB data return	
16	EXP1 on/off	
17	Encoder 2 UMB data	
18	EXP2 on/off	
19	External 28V return	
20	External 28V return	
21	External 28V return	
22	External 28V return	
23	External 28V return	
24	External 28V return	
25	External 28V return	
26	External 28V return	

Table 2, Umbilical Plug Nr. 2 in Payload

PIN Payload Connector	Signal Name	Pin/Wire Nr. in Umbilical Cable from Launcher to Blockhouse
1	Charge Relay/UMB power	
2	*Not Connected*	
3	Charge Relay return	
4	*Not Connected*	
5	Charge Relay return.	
6	EXP3 on/off	
7	*Not Connected*	
8	*Not Connected*	
9	*Not Connected*	
10	Charge Current Batt 1	
11	Charge Current Batt 1 return	
12	Charge Current Batt 2	

13	Charge Current Batt 2 return	
14	*Not Connected*	
15	*Not Connected*	
16	*Not Connected*	
17	*Not Connected*	
18	*Not Connected*	
19	*Not Connected*	
20	*Not Connected*	
21	*Not Connected*	
22	*Not Connected*	
23	*Not Connected*	
24	*Not Connected*	
25	*Not Connected*	
26	*Not Connected*	

6 VEHICLE AND PERFORMANCE DATA

6.1 General

The ICI-4 is a two stage, unguided and fin stabilized vehicle carrying a 356 mm diameter, 2915 mm long and 135,9 kg payload to an altitude of about 356 km.

The motor stages are connected by an interstage adapter and separated by drag forces at first stage burnout at 26 seconds, while the second stage motor and the payload are connected by an adapter section (RADAX joint) without any separation system.

Each motor has 4 fins which impart a roll rate which will spin the vehicle to reduce dispersion in vase of trust misalignment and achieve flight stability throughout the gyroscopic effect.

Second stage motor ignition is initiated at 32.0 seconds after lift-off by an onboard system (Second Stage Ignition Unit) delivered by DLR.

6.2 Weights and physical properties

6.2.1 Vehicle dimensions

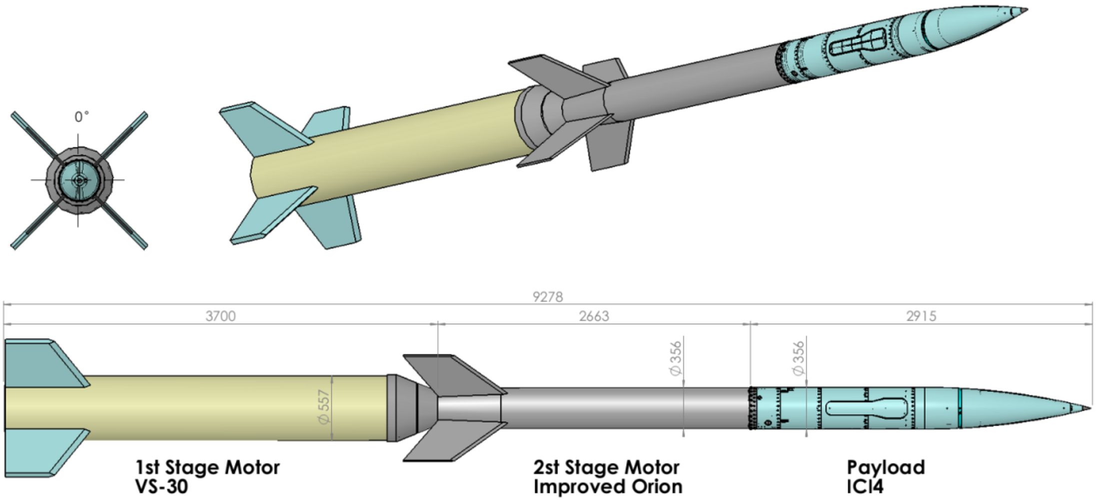
Section	Length (mm)	Diameter (mm)	Station at aft end (mm)
Tangent ogive (4:1)	1419	356	1419
Payload cylindrical part	1496	356	2915
IO motor cylindrical part	2095	356	5010
IO motor conical part	564	356/277	5574
VS30/IO adapter	403	277/557	5977
VS30 motor	3297	557	9274

6.2.2 Vehicle physical properties

Section	Mass (kg)t	Cg (mm from section base)	I_{yy} (kgm^2)	I_{xx} (kgm^2)
Payload *)	135,0	1200	60.9	2.19
IO motor at ignition	424.5	1461	236.5	11.0
IO motor at burnout	134.5	1088	98.7	6.4
VS30 motor at ignition **)	1239.3	1858	1132.71	71.511
VS30 motor at burnout **)	340.8	1570	554.37	35.25

*) Including motor attachment ring
**) Including VS30/IO adapter

6.3 Sketch of vehicle



6.4 Vehicle data

Item	First stage	Second stage
Type	VS-30	Imp. Orion
Total impulse (vacuum)	2 327 kNs	618.2 kNs
Specific impulse (vacuum)	258.2 s	204 s
Nominal Thrust (vacuum)	99.7 kN	77.4 kN
Burning time	20.65 sec	21.86
Total Action Time (TAT)	30.48 sec	26.0 sec

6.5 Flight events

Based on payload weight 135.9 kg and 83° launch elevation the following flight events are calculated:

Event	Flight time (s)	Altitude (km)	Range (km)	Velocity (m/s)
0	0	0	0	0
Burnout/IO separation	26.0	14.354	3.184	969.0
Ignition IO	32.0	20.189	4.677	887.1
Burnout IO	57.9	66.683	18.051	2372.6
Nosecone separation	60.0	71.430	19.487	2353.1
Door release	62.0	75.913	20.852	2334.7
Boom release	64.0	80.357	22.216	2316.4
LEP Deployment	66.0	84.764	23.578	2298.1
High Voltage LEP on	180.0	274.404	98.783	1324.7
Apogee	309.1	348.048	180.593	662.5
Impact	589.5	0	361.043	1864.3

6.6 Predicted trajectory altitude and range versus time

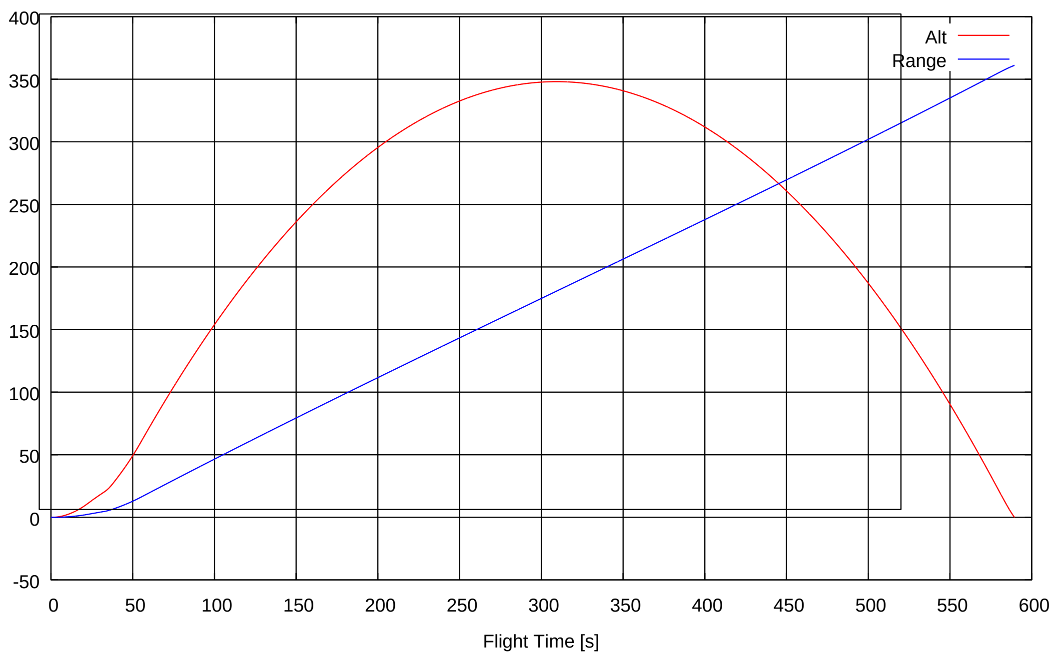


Figure 1: Plot of altitude and range vs time of ICI4 launched in 83° elevation.

6.7 Predicted velocity and acceleration versus time

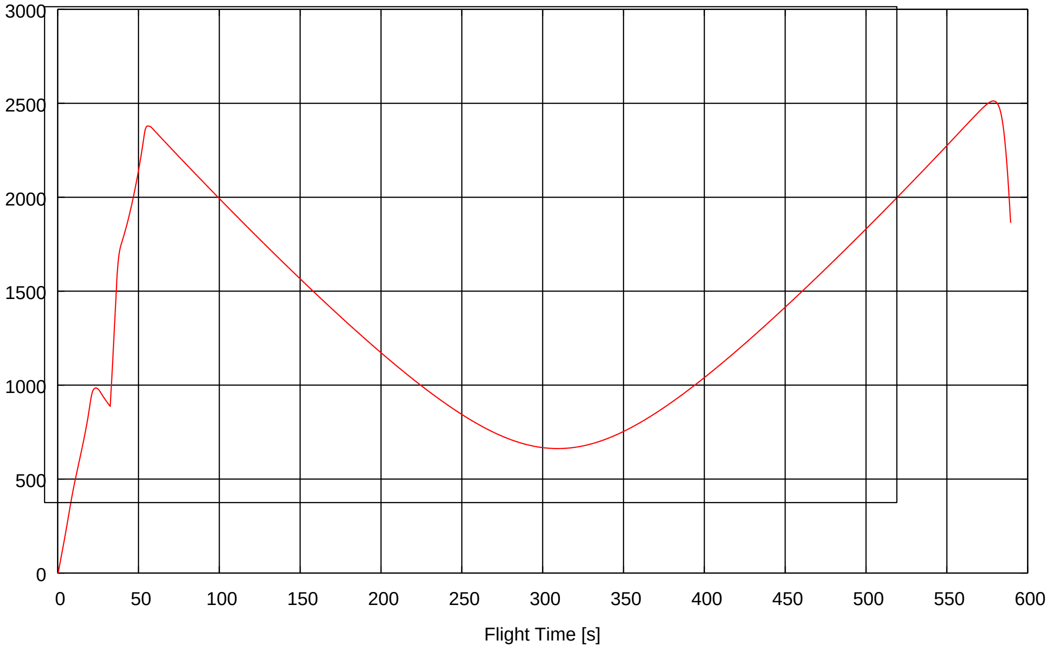


Figure 2: Plot of velocity vs time of ICI4 launched in 83° elevation.

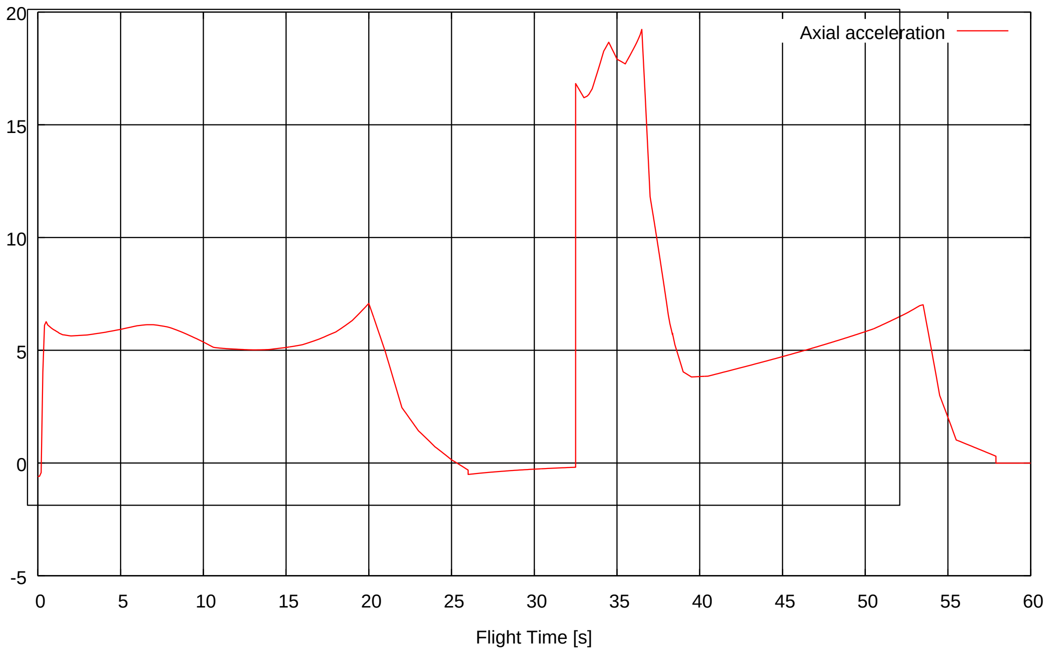


Figure 3: Plot of axial acceleration vs time of ICI4 launched in 83° elevation.

6.8 Spin rate & fin settings

Target final spin rate	:	4 rps
Fin settings	:	VS30: 36 minutes
		IO: 24 minutes

6.9 Nominal launcher settings

Elevation	:	83 – 84 degrees
Azimuth	:	330 - 340 degrees

7 EXPLOSIVES/PYROTECHNICS

7.1 Rocket motors

Item	First stage	Second stage
Type	VS-30	Imp. Orion
Safety classification	UN 1.3 C	UN 1.3 C
Diameter	557 mm	356 mm
Length	3,710 mm	2,666 mm
Motor weight	1,219.4 kg	445.8 kg
Propellant weight	885.5 kg	290 kg

7.2 Igniters

Item	First stage	Second stage
Type	MG/KAP pellets	Alcojet
Explosive weight	213.3 grams (NEQ)	90 grams (NEQ)
Safety classification	UN 1.3 C	UN 1.3 C

7.3 Initiators

Item	First stage	Second stage
Quantity	2	2
Type	N/A	PSEMC 7900-1
Bridgewire resistance	1.05 ± 0.1Ohm	1.1 ± 0.1Ohm
No fire current	1.0A, 5 min, 1W	1.0 A
All fire current	2.5 A	3.0 A
Pyrotechnic charge	1720 mg composite charge	Classified

7.4 Payload pyrotechnics

The following pyrotechnics are involved:

Type	Part	Quantity	Application
Power cartridge	PC 117	1	Front releaser, nosecone
Power cartridge	PC 117	2	V-belt separation, nosecone
Power cartridge	PC 117	2	Hotel door release, wire cutters
Guillotine	HLX 2800	2	Booms release (Front/Hotel)

The guillotine cutters are delivered by Pacific Scientific, CA, USA. Delivered to ASC 04.06. The pressure cartridges are delivered by High Shear Technology, USA. Delivered to ASC 04.14.

Holex 2800 – performance

Bridgewire Resistance	:	0.66 ± 0.08 ohms
Leadwire-To-Case resistance	:	2 Mega Ohm min. (@ 500 VDC)
All Fire Current	:	1.5 Amps minimum for 20 milliseconds
Recommend All Fire Current	:	5 Amps
No Fire Current	:	0.5 Amps Max.

PC 117– performance

Bridgewire Resistance	:	1 ± 0.1 Ohm
Insulation Resistance	:	2 Mega Ohms minimum (@t 500 VDC)
All Fire	:	3.5 Amps minimum
Recommended All Fire	:	> 5 Amps/ 4ms
No Fire	:	1 Amp maximum for 5 minutes

8 TELEMETRY SUPPORT

8.1 Experimenters Room - PCM-Decoder Setup for Flight

Decoder display

PC #	Function / Experiment	Location	Decoder System	Screens	Display
1	Payload Manager	Exp. room	VTS Netacquire	4	Numerical / Graphical / Binary
2	Payload Engineer, mNLP	Exp. room	VTS(3)	2	Numerical / Graphical / Binary
3	LEP, FBP	Exp. room	VTS(2)	2	Numerical / Graphical / Binary
4	SWIMM	Exp. room	VTS(1)	2	Numerical / Graphical / Binary
5	E- field, SRADS2, DSS1	Exp. room	Win Eidel(UIO)	1	Numerical / Graphical / Binary
6	FGM	Exp. room	Win Eidel(Narom)	1	Numerical / Graphical / Binary

8.2 Telemetry Station

The Main TM station at ASC will be used with the 20 foot SA antenna and the 10 foot EMP mobile antenna. The telemetry data together with IRIG-B timing and operation intercom voice, will be recorded at the Apogee Labs Digital recorder, at the Heim Digital recorder and at the Wideband Duigital recorder.

The telemetry data will also be recorded at one NetAquire Decom. The AGC readings will be recorded at both ACU’s, at a PC utilizing an Advantech USB-4711A logger and at the Dataq DI710 recorder.

8.3 Data collection

The payload control will be in Exp. room. The payload telemetry signals are routed to the Exp room from the Telemetry station

The TM readout will be in Telemetry station and Exp. Room. The most important playback of the data will be available as soon as possible after launch.

8.4 CD-ROM

A number of CD-ROMs containing all data relevant to this campaign will be recorded at the range at the end of the campaign.

Responsibility: ASC

TM data format: Eidel Binary format
A binary data file with header information, time information etc. according to the description enclosed in chapter 4.4.2 (PCM format) of this Flight Requirements Plan.
Format readable by “MATHLAB” from NetAquire Decom.

Distribution: One CD-ROM will be distributed free of charge to each organisation according to the table below. Extra copies will be charged at cost.

Organisation	No of CDs	TM data format		Comments/requirements
		Eidel		
TBD	TBD	X		

8.5 Data Recording,

Heim recorder

Ch. 1 TM link 1 from Best Source Selector (BSS) 1. BSS Input from Predect Combined Antenna 1, Antenna 2 and ACQAID.
Ch. 2 TM link 2 from BSS 2. BSS Input from Predect Combined Antenna 1, Antenna 2 and ACQAID.
Ch. 3 Pre-detect combined regenerated NRZ-L and Clock from receiver 9 and 10, (ACQAID) TM link 1.
Ch. 4 Pre-detect combined regenerated NRZ-L and Clock from receiver 11 and 12, (ACQAID) TM link 2.
Ch. 5 Pre-detect combined regenerated NRZ-L and Clock from Receiver 1 and 2, TM link 1, antenna 1.
Ch. 6 Pre-detect combined regenerated NRZ-L and Clock from Receiver 3 and 4, TM link 2, antenna 1.
Ch. 7 Pre-detect combined regenerated NRZ-L and Clock from Receiver 5 and 6, TM link 1, antenna 2.
Ch. 8 Pre-detect combined regenerated NRZ-L and Clock from Receiver 7 and 8, TM link 2, antenna 2.

IRIG-B timing,
Operation intercom

Apogee Labs Recorder

Ch. 1 TM link 1 from Best Source Selector (BSS) 1. BSS Input from Predect Combined Antenna 1, Antenna 2 and ACQAID.
Ch. 2 TM link 2 from BSS 2. BSS Input from Predect Combined Antenna 1, Antenna 2 and ACQAID.
Ch. 3 Pre-detect combined regenerated NRZ-L and Clock from Receiver 1 and 2, TM link 1, antenna 1.
Ch. 4 Pre-detect combined regenerated NRZ-L and Clock from Receiver 3 and 4, TM link 2, antenna 1.
Ch. 5 Pre-detect combined regenerated NRZ-L and Clock from Receiver 5 and 6, TM link 1, antenna 2.
Ch. 6 Pre-detect combined regenerated NRZ-L and Clock from Receiver 7 and 8, TM link 2, antenna 2.

IRIG-B timing,
Operation intercom

Wideband recorder

Ch. 1 TM link 1 from Best Source Selector (BSS) 1. BSS Input from Predect Combined Antenna 1, Antenna 2 and ACQAID.
Ch. 2 TM link 2 from BSS 2. BSS Input from Predect Combined Antenna 1, Antenna 2 and ACQAID.
Ch. 3 Pre-detect combined regenerated NRZ-L and Clock from Receiver 1 and 2, TM link 1, antenna 1.
Ch. 4 Pre-detect combined regenerated NRZ-L and Clock from Receiver 3 and 4, TM link 2, antenna 1.
Ch. 1A Pre-detect combined video from Receiver 1 and 2, TM link 1, antenna 1.
Ch. 2A Pre-detect combined video from Receiver 3 and 4, TM link 2, antenna 1.
Ch. 3A Pre-detect combined video from Receiver 5 and 6, TM link 1, antenna 2.
Ch. 4A Pre-detect combined video from Receiver 7 and 8, TM link 2, antenna 2.

IRIG-B timing,
Operation intercom

NetAquire Decom

Processed data from TM-link 1 and TM-link 2 from both antennas via BBS.

9 RANGE SUPPORT

9.1 Tracking

In order to monitor the trajectory in real time the Trajectory and Position System (TPS) is used. This system utilizes all available tracking information from telemetry antennas, as well as slant range based on measurements of the Doppler displacement in the telemetry signal.

Preliminary trajectory will be calculated after flight.

Responsibility: ASC

9.2 Meteorological support

The following information are available from meteorological sensors at the range:

- Wind speed and direction (7sensors at 18, 33, 48, 63, 78, 98 and 108m MSL).
- Temperature
- Humidity
- Air pressure

In addition the following meteorological support is available:

- Standard weather forecasts from the DNMI.
- Terminal Aerodrome Forecast (TAF) for all air fields in Northern Norway, including Andøya Air Force Base (ENAN)
- Numerical prognoses for
    * Cloud coverage
    * Temperature
    * Wind conditions
    * Precipitation
    * Air pressure
    * Sea state (wave height and sea current)

9.3 Recovery operation

Not applicable.

10 USER REQUIREMENTS

The following services and facilities will be required:

Communication set up

Exclusive line or dedicated line 2)	No of lines	From - to	Purpose
N/A			

Notes:
1 The communication lines will be arranged by the range as requested by the user.
2 Independent of the range’s switchboard.

10.1 Temperature control

The payload will be boxed with Styrofoam.

10.2 Gas for purging

The LEP instrument under the nosecone should be continually flushed with an amount of approximately 2 liters/minute of N_2 gas (instrument quality), on the launcher.

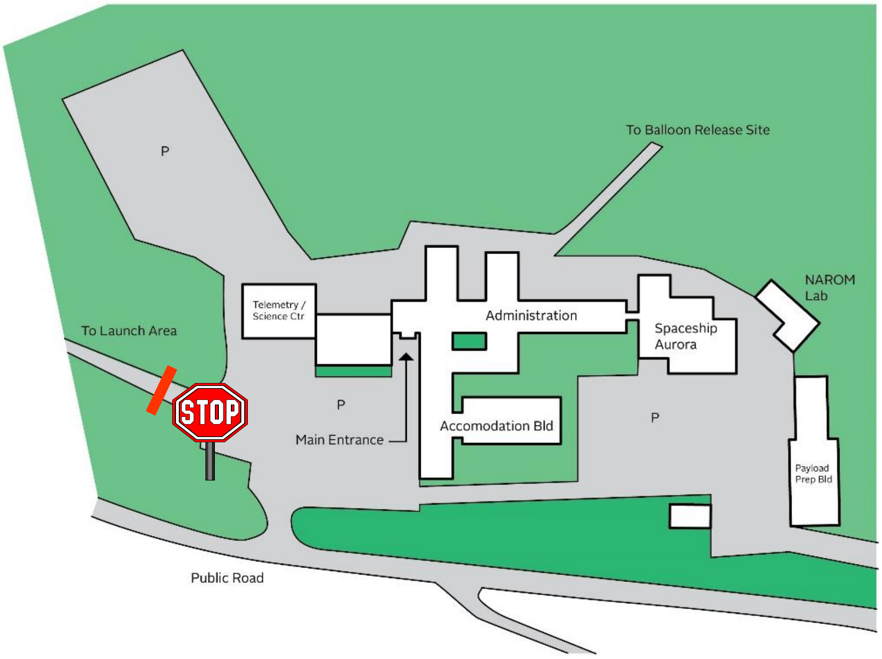
Type of gas	Amount	User
Nitrogen Plus	12 bottles	Payload team

10.3 Ground-based instruments

Instrument	Requested instruments	Comment

11 SAFETY

11.1 General Safety Regulations for the Launch Area



The sketch above shows the lay-out of the Control Center Area and shows also the access road to the Launch Area (lower left corner).

Launch Area is during campaigns classified as an Explosive Area and thus, classified as a Hazard Area with various restrictions depending on what kind of activities are in progress. Only authorized personnel directly involved in motor- or other necessary preparation activities are allowed to enter the Launch Area.

11.1.1 Access to Launch Area

All campaign participants and visitors staying in the Launch Area shall wear a valid badge for the Launch Area, se picture (in addition to the ASC badge). Badges for the Launch Area are administrated by the Range Control.

Range Control shall at all times be have control of who are present in the Launch Area. All entry and departure from the area shall be registered in Range Control. Use the phone located in locker by the gate to communicate with Range Control when going in or out of the area.

11.2 Signals

Signal	Explanation
Read rotating light at the Parking lot exit	Do not start or operate motor vehicles, all roads are closed
Red flashing light at the gate towards the Launch Area	Radio Silence Lifted status. Do not enter the Launch Area
Red light above Block House exit door	Radio Silence Lifted status. Do not enter the Launch Pad
Radio Silence on green background on the countdown screens	Radio Silence status. All payload systems switched OFF. Launch Aerea crew permitted to enter the Launch Pad
Radio Silence Lifted (on red background) on the countdown screens	Radio Silence Lifted status. Payload systems and onboard TM transmitters can be or are switched ON. Forbidden to enter the Launch pad