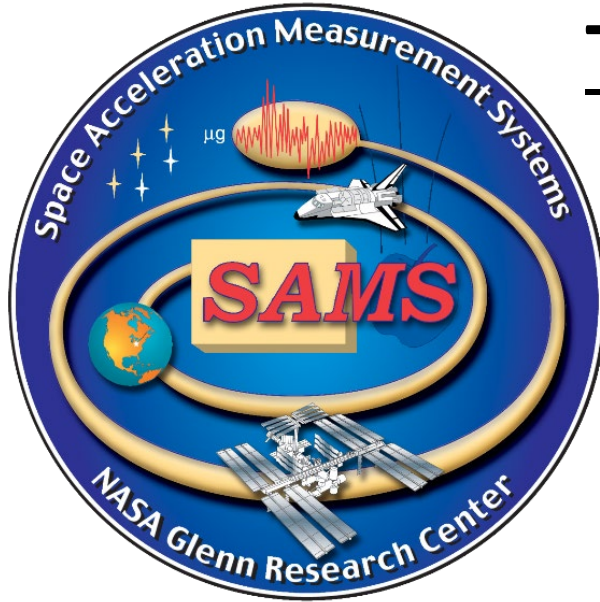




Title: POIWG 53
Splinter Session
**Space Acceleration Measurement System
(SAMS)**

Author: Ken Hrovat

Affiliation: Voyager Space

October 25, 2023





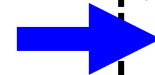
Space Acceleration Measurement System (SAMS)

Outline

1. SAMS Customer Support
2. Overview of SAMS (and MAMS)
3. Microgravity Acceleration Measurement System (MAMS)
4. SAMS Topology
5. More Overview
6. Summarize SAMS Measurements Over ~ the Past Year

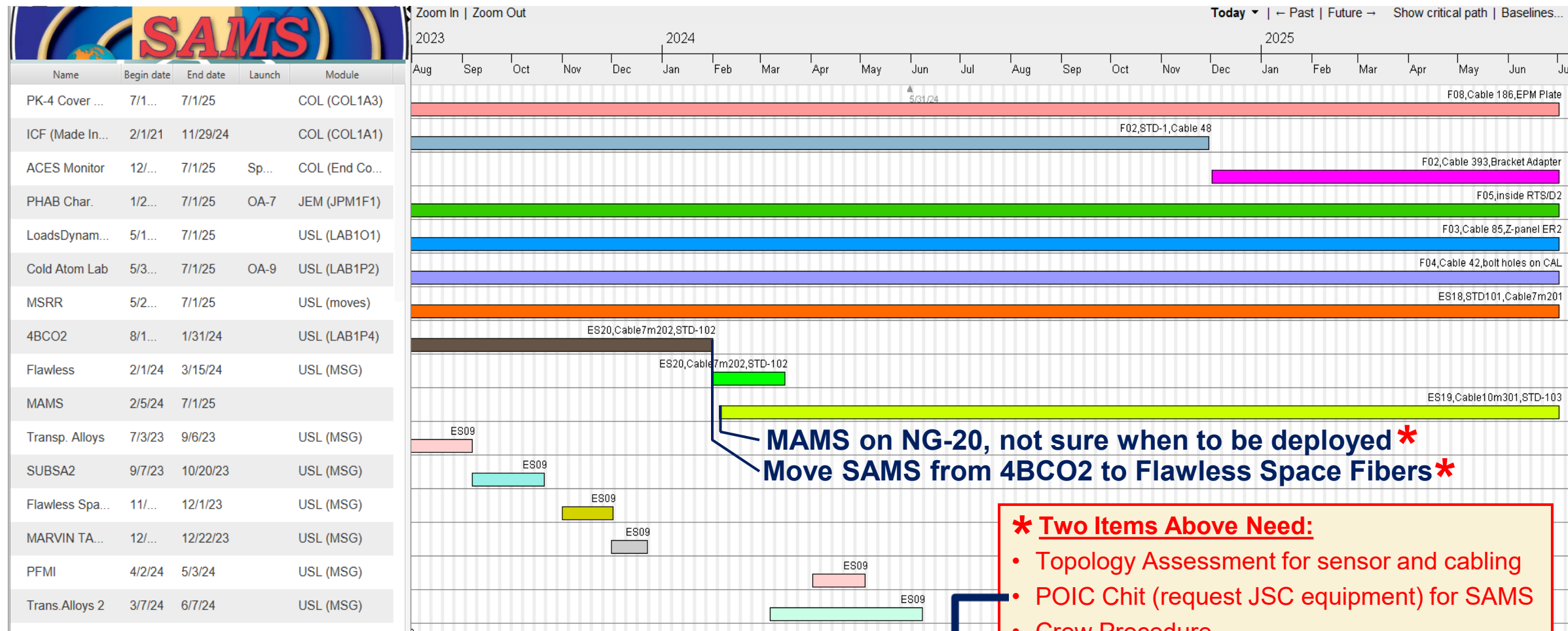
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Customer Support: View by Payload

Mention Halley's note about flight notes system to keep POIC cognizant of upcoming science runs so SAMS can be recovered quickly (if needed).



NOT SHOWN: dedicated TSH sensors es05 in CIR & es06 in FIR

* Two Items Above Need:

- Topology Assessment for sensor and cabling
- POIC Chit (request JSC equipment) for SAMS
- Crew Procedure

Chit also needed for SAMS support for MSRR



Chits for 3 Sets of Borrowed JSC Assets (through life of station)

At SAMS team meeting on 2023-09-14, we discussed following as forward plan:

SAMS Sensor	SAMS EE	EE Location	Payload	Sensor Location	EE to TSH-ES Cable	Notes
TSH-ES S/N 18	EE-F05	ER-2 (LAB101)	MSRR & KERMIT	LAB103	7-meter, S/N 201	Already deployed.
TSH-ES S/N 19 ¹	EE-F02	ER-1 (LAB102)	MAMS	LAB104	10-meter, S/N 301 ²	To be deployed with MAMS.
TSH-ES S/N 20	EE-F05	ER-2 (LAB101)	Flawless Space Fibers	LAB1S2	7-meter, S/N 202	To be moved from 4BCO2.

Each of the 3 SAMS TSH sensor heads listed above needs:

1. Female-to-female RJ-45 coupler.
2. Network cable to extend from near Sensor Location to 20-port switch in US Lab.
3. A port on the 20-port switch in US Lab.
4. Cable routing path from Topology for:
 - a. Network cable from near Sensor Location to 20-port switch in US Lab.
 - b. Power cable from EE Location to Sensor Location.

TSH-ES S/N 20 only needs Topology feedback as we re-route cables (Topology request already submitted) for a yet-to-be-drafted crew procedure. Need topology feedback and crew procedure in time for Flawless Space Fibers (FSF) support.

TSH-ES S/N 19 needs the 4 bullets enumerated above in time for MAMS support along with its deployment after arriving on NG-20. Topology request for sensor and cabling, similar to FSF request.

TSH-ES S/N 18 needs no actions (besides maybe extended POIC chit for JSC network assets) as we want to keep as-is for duration of MSRR/KERMIT needs for SAMS.

¹ TSH reported found & stowed @ JLP1A1_G on GMT 055 of 2022.

² We might swap this 10m cable for MAMS with shorter, 7m cable from FSF or from MSRR if deemed necessary by topology or other considerations.



Overview

Component	 Quasi-Steady MAMS	 Vibratory	 Transient
Frequency	$0 \leq f < 0.01 \text{ Hz}$	$0.01 \leq f \leq 300 \text{ Hz}$	broadband
Magnitude	μg 's (or less) peak	tens to thousands μg_{RMS}	tens of mg's peak
Primary Sources	gravity gradient & rotational effects: not at center of mass drag: function of altitude, attitude, day/night, etc. vehicle: venting water or air	equipment: pumps, fans, centrifuges, compressors, etc. crew: ergometer or treadmill exercise vehicle: structural modes	vehicle: thrusters, dockings crew: pushoffs & landings, drawer/door closings, experiment setup equipment: machinery startup

SAMS Capabilities and Services:

- measure the local vibratory regime in **all 3 ISS labs** **SAMS**
- goal is continuous, **24x7** operations (*CIR, FIR, and MSG turn on/off as needed*)
- measurement frequency range: **$0.01 < f < 200 \text{ Hz}$**

As of 10/6/2023, SAMS had collected **over 735,000 sensor hours (nearly 19 terabytes)** of data on ISS.

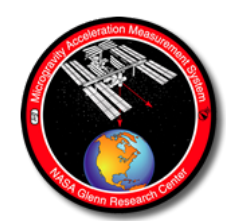
For questions, email: hrovatk@zin-tech.com AND/OR pimsops@grc.nasa.gov



Overview

Component	Quasi-Steady	Vibratory	Transient
Frequency	$0 \leq f < 0.01$ Hz	$0.01 \leq f \leq 200$ Hz	broadband
Magnitude			
Primary Sources			
SAMS Capabilities			
> measure			
> goal is to			
> measure			

Note: Archived SAMS data has as-measured mean (average) value intact, but that component is *not accurate*. Do not use the mean value of SAMS data with any degree of confidence. A first step in our in-house data processing and analysis chain is to demean (**subtract the mean**) on per-axis basis. Just about all SAMS analysis results are derived from *demeaned data*.



Microgravity Acceleration Measurement System (MAMS)



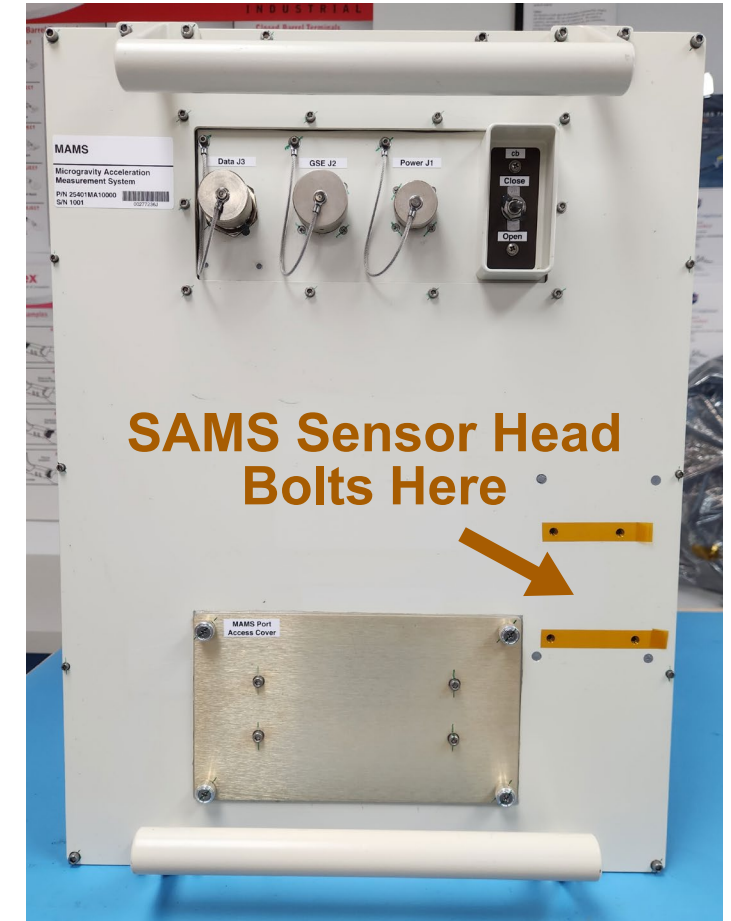
Old MAMS Hardware
photo

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- **Ken Hrovat**, MAMS Operations & Analysis
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New MAMS Hardware
FIT photo



Microgravity Acceleration Measurement System (MAMS)

Capabilities:

- Provides centralized measurement of the quasi-steady (low-frequency, low magnitude) portion of the acceleration spectrum (below 0.01 Hz) to complement SAMS (> 0.01 Hz).
- Designed for continuous, 24x7 measurement similar to SAMS.
- Measurements can be mapped mathematically to an arbitrary location. This assumes that the space station is a rigid body at low-frequencies.

History & Future:

- Launched on STS-100/6A on April 19, 2001 with nearly flawless, nearly continuous operation on the ISS from GMT 2001-05-03 to 2017-04-22. MAMS collected over 217,615 sensor hours (5 TB) of data in that span. Currently on the ground being re-furbished at ZIN Technologies (now Voyager Space) in Cleveland, Ohio.
- Customers are anybody interested in the quasi-steady environment, and we have heard from at least 3 high-profile payloads wanting MAMS support already: ZBOT-NC, Cold Atom Lab and GTCS.
- Manifested on NG-20 (**Increment 70!**), to be located in ER-6 (LAB1O4).



Topology: SAMS Sensor Locations

2023-10-12

National Aeronautics and Space Administration (NASA) Glenn Research Center



Version # Increment 68
Generated On 2022-05-13

Increment: 68

SAMS Sensor Head Locations

- 2 SE F02, COL1A1, ER3, Seat Track
 - 3 SE F03, LAB1O1, ER2, Lower Z Panel
 - 4 SE F04, LAB1P2, ER7, Cold Atom Lab Front
 - 5 SE F05, JPM1F1, ER5, Inside RTS/D2
 - 8 SE F08, COL1A3, EPM, near PK-4
 - 9 TSH-ES09, LAB1S2, MSG
 - 5 TSH-ES05, LAB1S3, CIR
 - 6 TSH-ES06, LAB1S4, FIR
 - 18 TSH-ES18, LAB1O3, MSRR, KERMIT *hard-wired*
 - 20 TSH-ES20, LAB1P4, ER11B, 4BCO2 *hard-wired*
- TSH-ES03, -ES19, stowed spares

LEGEND:

Sensor that does not move

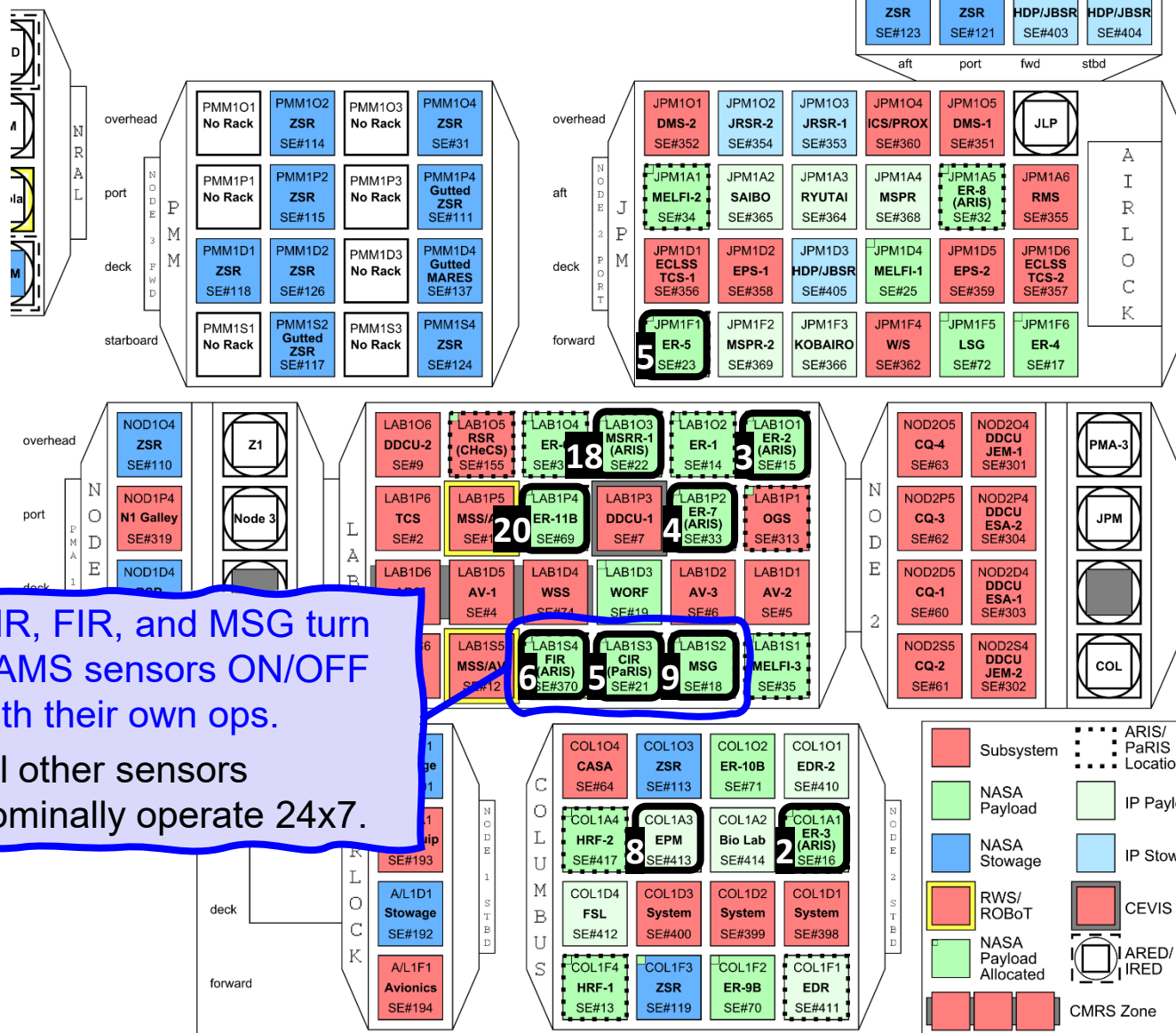
Sensor that has moved or may move

Sensor that has never moved

Stowed or not currently connected

MSG sensor gets installed for some payloads

- CIR, FIR, and MSG turn SAMS sensors ON/OFF with their own ops.
- All other sensors nominally operate 24x7.





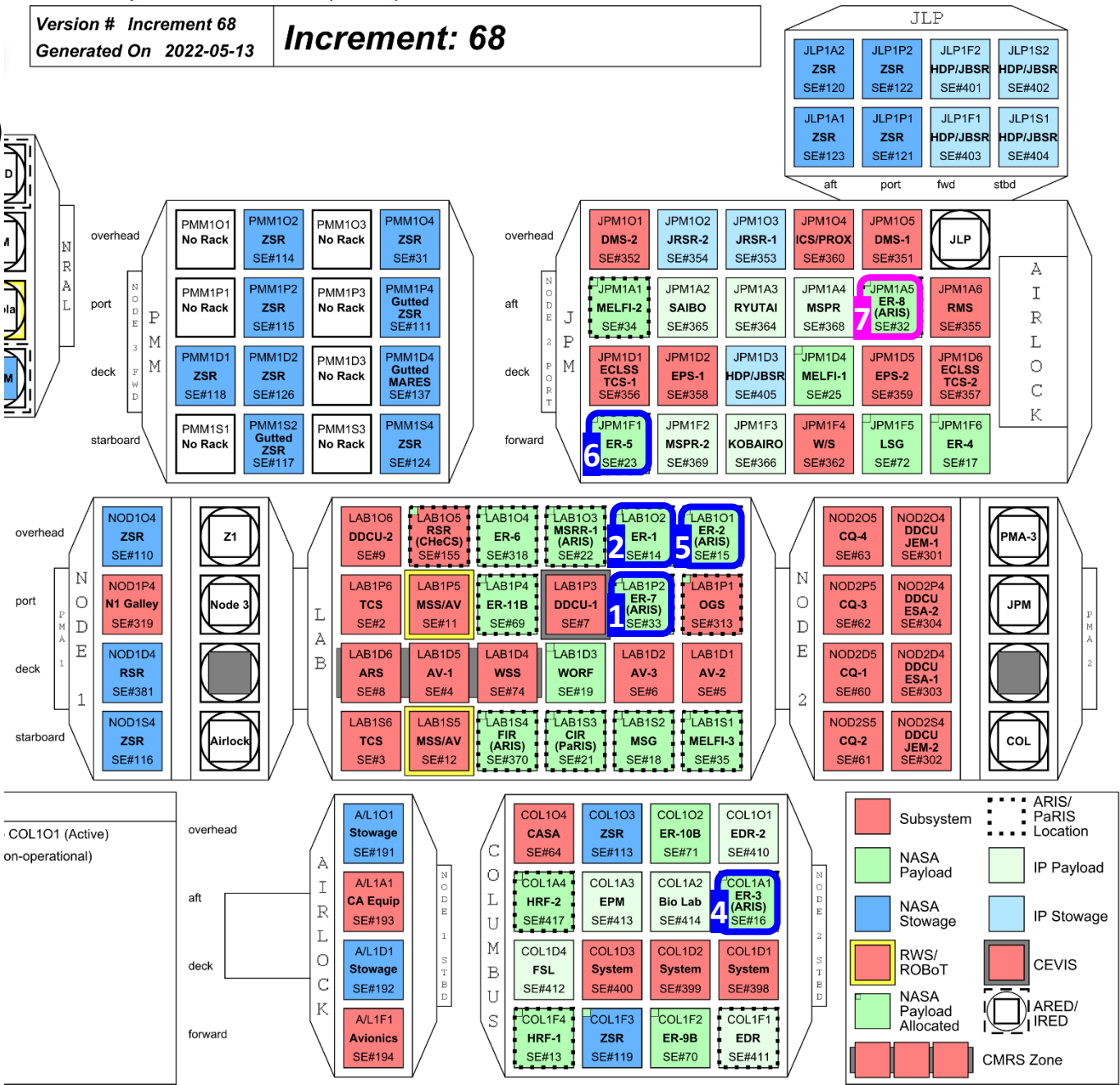
Version # Increment 68
Generated On 2022-05-13

Increment: 68

Topology: SAMS Electronics Enclosure (EE) Locations 2023-10-12

Code	EE	Location	Rack	Type
1	EE-F01	LAB1P2	ER7	embedded
2	EE-F02	LAB1O2	ER1	RTS/D1
6	EE-F06	JPM1F1	ER5	RTS/D2
4	EE-F04	COL1A1	ER3	embedded
5	EE-F05	LAB1O1	ER2	embedded
7	EE-F07	JPM1A5	ER8	embedded

As of GMT 2023-10-12, this EE is not hosting any sensors and is not powered





More Overview

If I want to...	then...
download SAMS data	visit https://gipoc.grc.nasa.gov/pims/pub/pad -- <i>e.g. use the vibration measurements recorded by SAMS in your own models or correlate with your results</i>
read the binary acceleration data files	visit the link shown just below here to see <i>how you can start working with acceleration data</i> https://gipoc.grc.nasa.gov/pims/plots/user/mohan/how2read_pad_binary_files.html
browse daily summary “roadmap” plots	visit https://gipoc.grc.nasa.gov/pims/roadmap -- <i>these roadmap plots show patterns, structure and boundaries in both time and frequency; these are updated daily</i>
browse acceleration handbook pages	visit https://gipoc.grc.nasa.gov/wp/pims/handbook -- <i>these are a collection of PDF files that briefly quantify & qualify various events, activities and various aspects of the microgravity acceleration environment</i>
monitor vibratory environment, near real-time	visit https://gipoc.grc.nasa.gov/wp/pims/current-real-time/



raw data, as-measured

More Overview

Why use spectrograms for near real-time monitoring?

