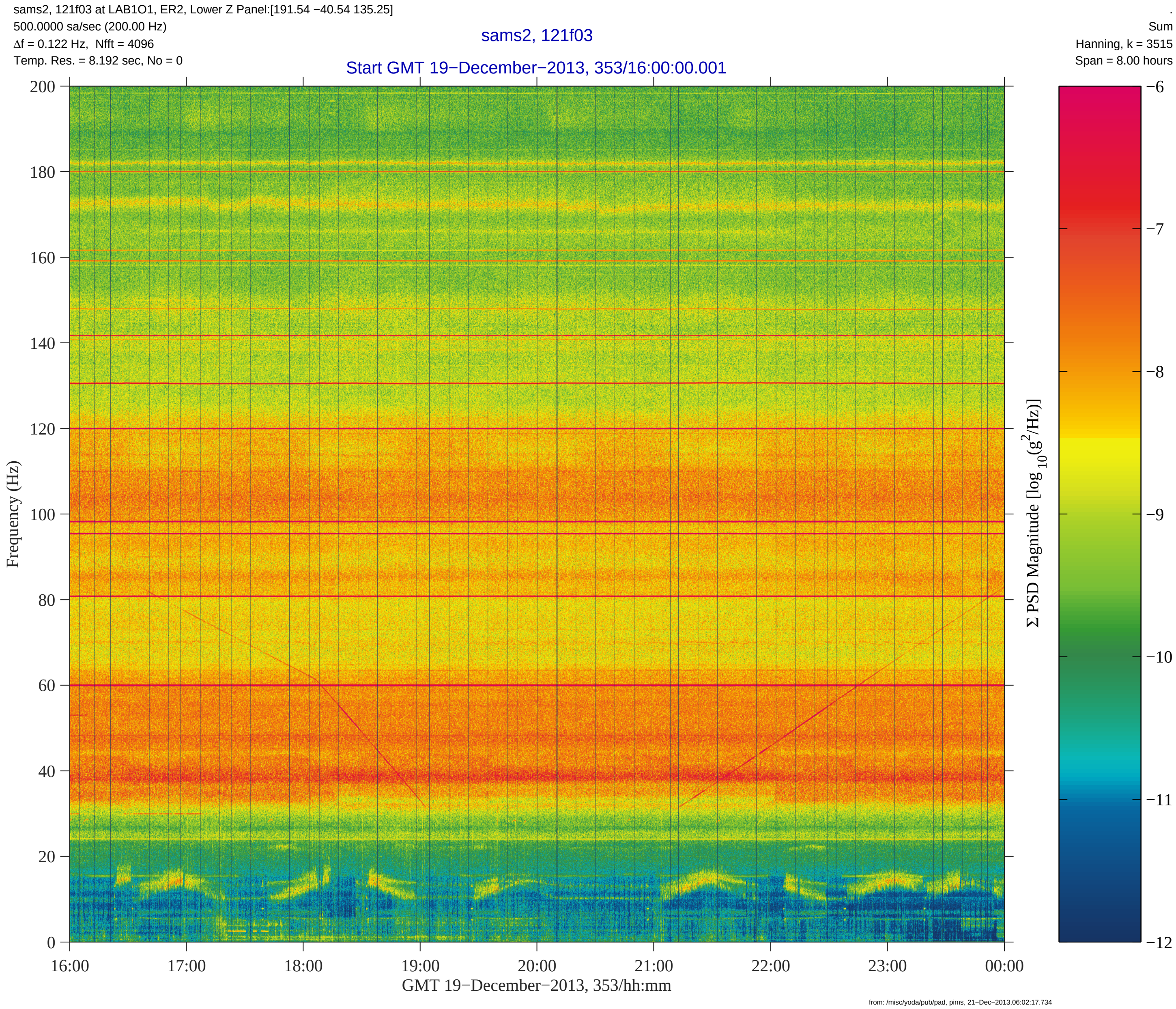
CMG Spindown and Spinup Qualify



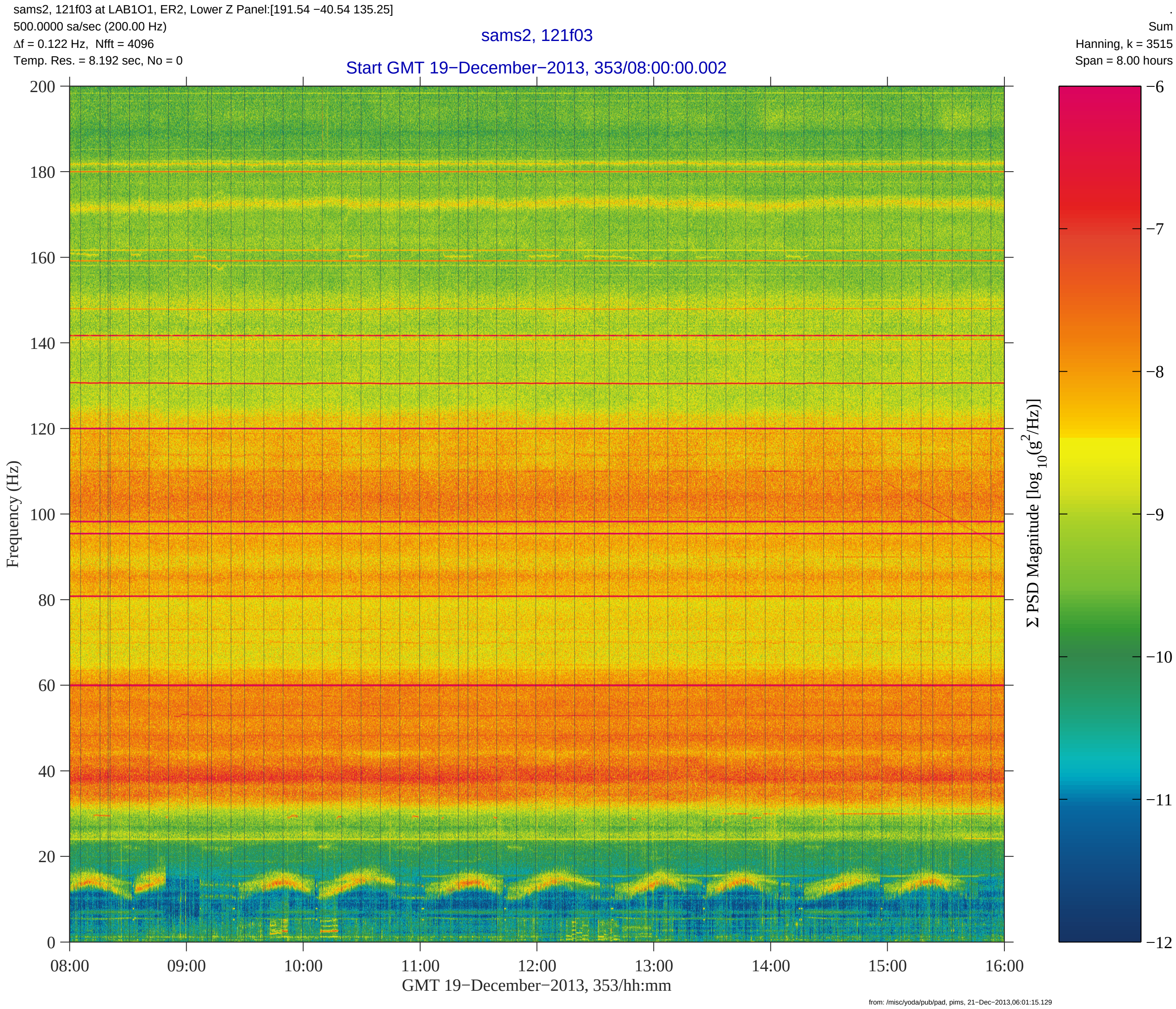
Description	
Sensor	SAMS 121f03 500.0 sa/sec, 200.0 Hz
Location	LAB1O1, ER2, Lower Z Panel
Plot Type	Spectrogram

Notes:

- This 8-hour spectrogram was computed from SAMS data measured in the US Lab.
- The time spans from GMT 19-Dec-2013 16:00 to GMT 20-Dec-2013 00:00, and the frequency ranges up to 200 Hz.
- Note the red, downward streaking trace on the left side of this plot that tapers out just after 19:00. This is the spectral signature of the spin down of CMG-1, one of four Control Moment Gyros on the ISS.
- Mission Control in Houston performed this spin down/up in preparation for 2 crew EVAs (spacewalks) needed to repair a failed pump belonging to one of the station's two external cooling loops, which are used to cool internal equipment.
- Notice the complementary red, slowly-upward streaking (linear) trace on the right side of the plot that begins just after 21:00. This is the spectral signature of the spin up of CMG-1.

Regime:	Vibratory
Category:	Equipment
Source:	CMG Spindown and Spinup

CMG Spindown and Spinup Qualify



Description	
Sensor	SAMS 121f03 500.0 sa/sec, 200.0 Hz
Location	LAB1O1, ER2, Lower Z Panel
Plot Type	Spectrogram

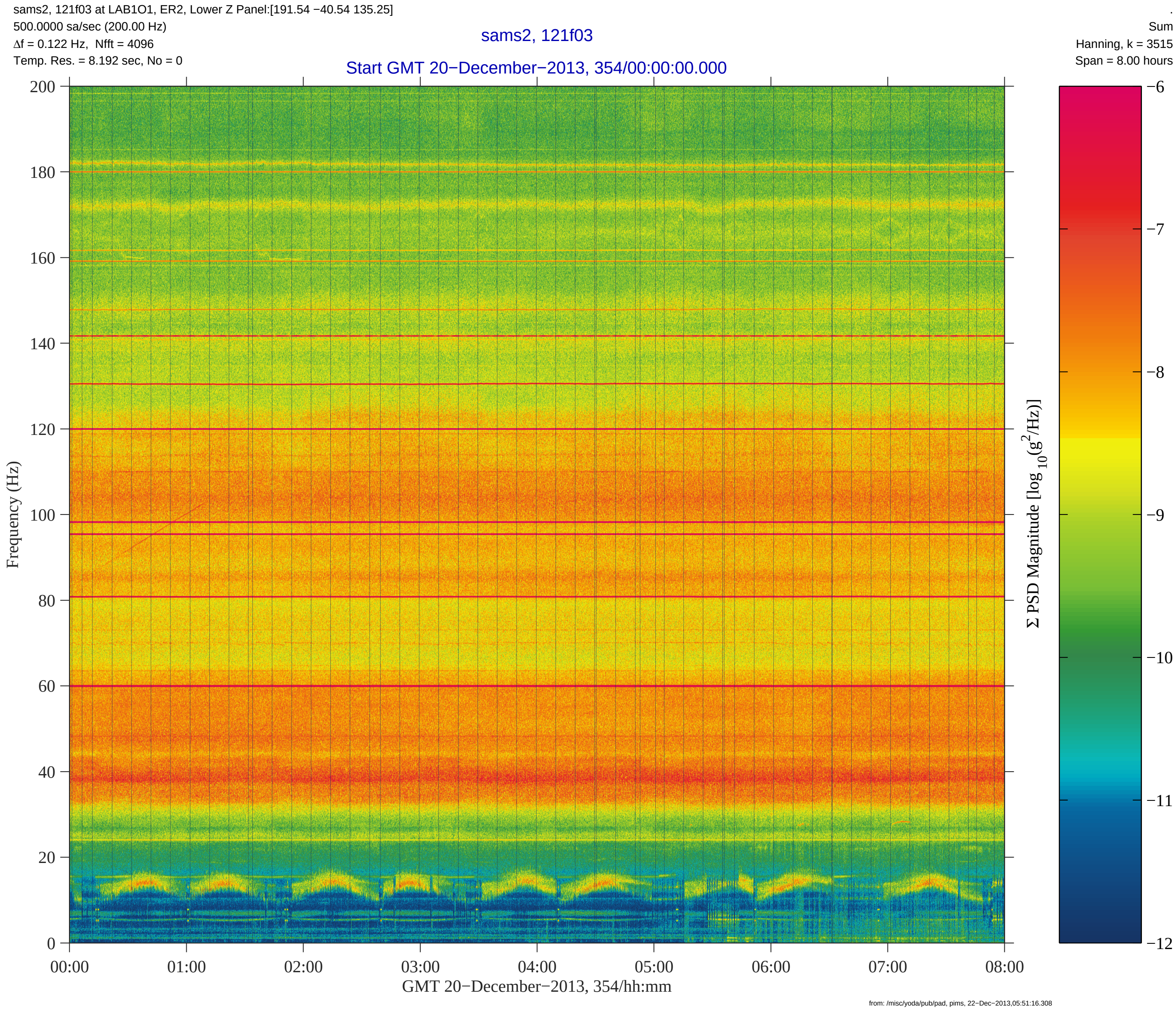
Notes:

- For completeness, and to see what more we can see with respect to the spin down part of this activity, this 8-hour spectrogram was computed from the same SAMS sensor data as the previous page.
- The time spans from GMT 19-Dec-2013 08:00 to GMT 19-Dec-2013 16:00.
- Note the red, downward streaking trace on the right side of this plot between about 15:00 and 16:00. This shows continuation of the spectral signature of the spin down of CMG-1. A prequel to the previous page.

Regime:	Vibratory
Category:	Equipment
Source:	CMG Spindown and Spinup

Glenn Research Center

CMG Spindown and Spinup Qualify



Description	
Sensor	SAMS 121f03 500.0 sa/sec, 200.0 Hz
Location	LAB1O1, ER2, Lower Z Panel
Plot Type	Spectrogram

Notes:

- Finally, to see what more we can see with respect to the spin up part of this activity, this 8-hour spectrogram was computed from the same SAMS sensor data as the previous 2 pages.
- The time spans from GMT 20-Dec-2013 00:00 to GMT 20-Dec-2013 08:00.
- Note the red, upward streaking trace on the left side of this plot before 01:00 or so. This shows continuation of the spectral signature of the spin up of CMG-1. A sequel to the first page.

Regime:	Vibratory
Category:	Equipment
Source:	CMG Spindown and Spinup

Glenn Research Center

US astronauts aboard the International Space Station (ISS) have completed two Extra Vehicular Activities (EVAs) to replace a failed Pump Module outside the station. The EVAs were necessitated by the failure of a component inside a pump belonging to one of the station's two external cooling loops, which resulted in one loop unusable for cooling of internal equipment. The space station's External Thermal Control System (ETCS) consists of two separate cooling loops – known as loop A and loop B – which both work together to transport heat away from electronic equipment and toward the external radiators, which in turn efficiently dissipate the unwanted heat into space. The ETCS loops use ammonia fluid as a coolant, while the Internal Thermal Control System (ITCS) cooling loops inside the ISS use water, in order to prevent a potential leak of toxic ammonia inside the ISS. For the ETCS, ammonia is pumped around each of the two loops by an externally located component known as the Pump Module (PM), with each loop having its own separate PM. The failure discussed here is in the Flow Control Valve (FCV) inside the Pump & Control Valve Package (PCVP) inside the loop A PM. The FCV controls the temperature of the ammonia in the cooling loops by mixing cool ammonia that is exiting the radiators with warm ammonia that has bypassed the radiators. However, the failure of the FCV means that it has allowed too much cool ammonia to enter loop A, which caused loop A to drop to a temperature that is far too low (around -32 degrees centigrade) for safe cooling operation. Maintaining stable ammonia loop temperatures (which is typically around 4 degrees centigrade) is important since if the temperatures in the external ammonia loops are allowed to get too low, then the water inside the IFHXs could freeze, causing the water pipes to crack (like a typical winter in Cleveland) and the IFHX to fail, which could potentially allow toxic ammonia from the external loops to enter inside the ISS. As a result of the FCV failure, loop A was "de-integrated" from all IFHXs, essentially meaning that loop A was no longer able to cool internal loads (however cooling of external loads via loop A remained, since external loads do not have IFHXs). Some heat loads were shifted to loop B, which continued to operate. However, since one cooling loop alone cannot handle all of the station's needs, several pieces of electronic equipment had to be shut down due to lack of adequate cooling for them.

Normally, analysis of this type of activity would include some specific, targeted way to quantify the impact of the disturbance source being described. Here, the disturbance source is the CMG and the disturbance is the streaking spectral signature (a slowly changing vibration) discussed on the previous pages. One way to quantify is to use Parseval's Theorem – see page 20 at this link:

http://pims.grc.nasa.gov/MMAP/PIMS_ORIG/MEIT/MEIT_pdfs/meit2004/Section_13.pdf

to attribute a portion of the root-mean-square (RMS) power measured by SAMS accelerometers to a specific disturbance. However, since the frequency of interest is varying ("streaking") with respect to time, it makes this quantification approach a bit of a challenge. For the first person to read this and submit a suggestion for how to best quantify the disturbance from the CMG spin down/up activity. The PIMS team at NASA will send that person one or more logo stickers (like the PIMS logo at the bottom left of this page) or a SAMS sticker (whichever stickers are available at the time of submission). Submit your suggestions to pimsops@grc.nasa.gov and include in that email a reference to the web page link that got you to this PDF document AND include your postal mail address to receive your sticker(s).