CHANDRA
X-ray Center   60 Garden St., Cambridge Massachusetts 02138 USA

Date: January 10, 2022
From: Gregg Germain
To: ACIS Operations Team
Subject: Report on the November 6, 2022 1DPAMZT Red Limit Violation

___

1 Abstract

On November 6, 2022, 14:31z the Chandra 1DPAMZT thermistor registered a violation of its 42.5 degree C. Warning High limit, which tripped the ACIS thermal monitor in the OBC. The maximum value reached was 42.553 C. This memo describes the cause of the violation and the solutions undertaken to prevent another occurrence.

2 Introduction

The ACIS Digital Processor Assembly (DPA) box – houses several PC boards:

    2 redundant BEP (Back End Processor) boards

    6 FEP (Front End Processor) boards

There are two temperature sensors on each of the two BEP boards. Only one BEP is enabled at any given time. Their MSIDs are:

    tmp_bep_pcb
    tmp_bep_osc

Of the 6 FEP boards, only 2 of them are instrumented: FEPs 0 and 1. Each of these two boards have 5 temperature readouts available:

 tmp_fep0_mong   tmp_fep1_mong
 tmp_fep0_pcb   tmp_fep1_pcb
 tmp_fep0_actel   tmp_fep1_actel
 tmp_fep0_ram   tmp_fep1_ram
 tmp_fep0_fb   tmp_fep1_fb

The MSID 1DPAMZT represents the value of a thermistor attached to the -Z panel of the DPA box. 1DPAMYT represents the value of a thermistor attached to the -Y panel of the DPA box.

1DPAMZT is used as a conservative proxy for the thermal state of the DPA and its contents.

In addition to the DPA box there exists the Detector Electronics Assembly (DEA) box which is instrumented with a thermistor on the -Z panel of the box: 1DEAMZT

3 The Violation

All 14 MSIDs of the DPA and the one MSID of the DEA registered mission highs during this event (all values in degrees Centigrade):

MSID	Max Value	Caution High	Warning High
Max 1DPAMZT:	**42.55**	40.50	42.50
Max 1DPAMYT:	38.74	37.50	40.50
Max 1DEAMZT:	38.15	40.50	42.50
Max bep_pcb:	42.78	44.0	49.00
Max bep_osc:	41.03	42.0	47.00
Max tmp_fep0_mong:	47.72	48.0	53.00
Max tmp_fep0_pcb:	44.72	45.0	50.00
Max tmp_fep0_actel:	46.92	47.0	52.00
Max tmp_fep0_ram:	46.02	46.0	51.00
Max tmp_fep0_fb:	41.99	43.0	48.00
Max tmp_fep1_mong:	49.04	49.0	54.00
Max tmp_fep1_pcb:	46.02	46.0	51.00
Max tmp_fep1_actel:	48.19	48.0	53.00
Max tmp_fep1_ram:	47.61	48.0	53.00
Max tmp_fep1_fb:	42.88	43.0	48.00

4 Cause of the Violation

On DOY 2022:310:11:27:39.872, ACIS completed the observation Obsid 27530. This observation utilized all 6 FEPs. When the Stop Science was issued the FEPs stopped clocking but were left powered on, as is normally the case.

Following the Stop Science there was an unusually long idle time, of 10,948.3 seconds or 3 hours 2.4 minutes, between that Stop Science and the start of the next science run. During most of this idle time the spacecraft pitch was ~163 degrees.

This next science run was an inbound ECS measurement, Obsid 45091.

The combination of the already high temperature from Obsid 27530, the high pitch of ~163 degrees, and the fact that 6 FEPs were powered on conspired to cause the violation at 2022:310:14:31:58.146. The inbound ECS measurement started just before the violation at 2022:310:14:30:08.152.

As can be seen in the plots at the end of this document, the pitch had already started down at the point of the violation but it was not enough to avoid the violation.

5 The 1DPAMZT Thermal Model did not Predict the Violation

The 1DPAMZT violation was not predicted by the 1DPAMZT thermal model because the model was not well calibrated for the situation where 6 FEPs were powered on but not clocking. So the temperature increase during the long dwell was not predicted. There is not enough calibration data available for calibrating this situation.

6 The Solution

The solution implemented was to set the 1DPAMZT model parameters for the 4, 5 and 6 FEPs powered on but not clocking condition (4xx0, 5xx0, 6xx0) to match their clocking counterparts. In addition the 1DEAMZT x5x0, x6x0 power state values were modified to match their clocking counterparts. This is a conservative solution as the models should predict values higher than the telemetry will report.

With these changes the 1DPAMZT Thermal Model will report a planning limit violation and the weekly load can be adjusted to avoid any limit violations.

In addition, the ACIS Load Review software has been enhanced to detect long idle dwells between observations and report these dwells to the reviewer.

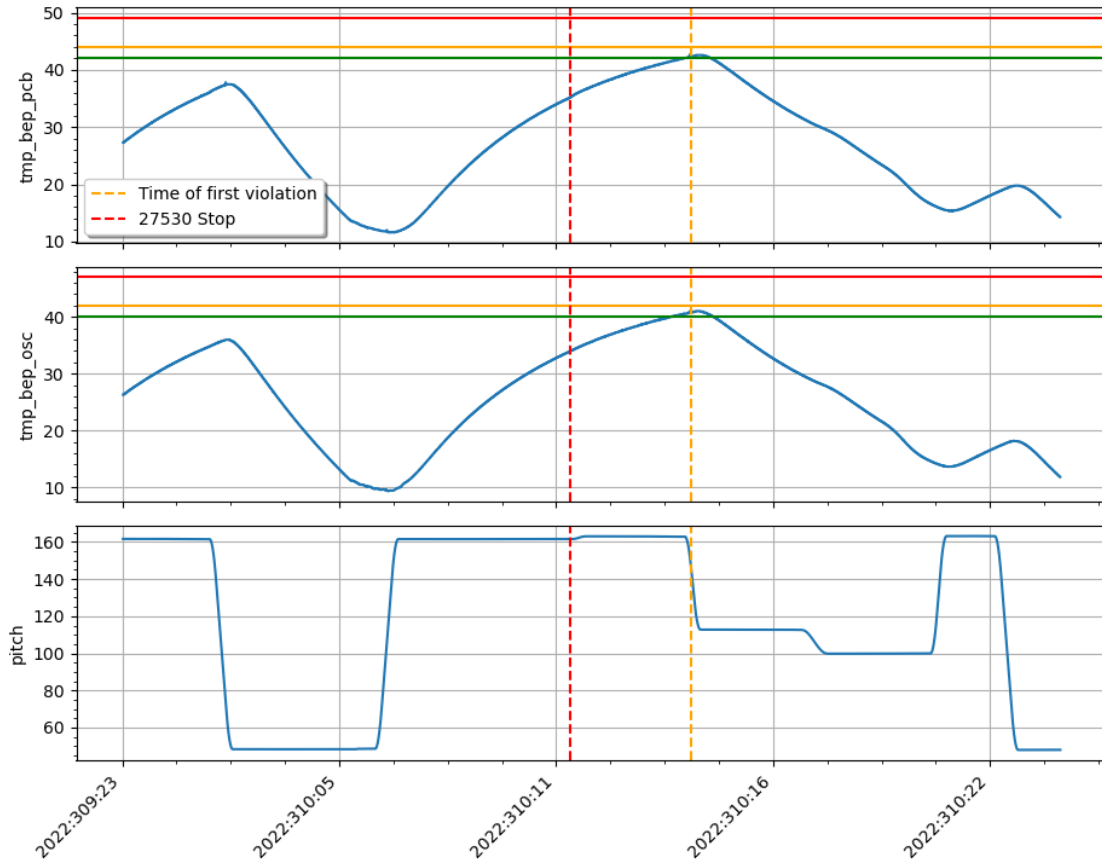MSID Plots for 1DPAMZT Warning High Violation:

1DPAMZT 1DPAMYT 1DEAMZT pitch

First Violation at: 2022:310:14:31:58.146
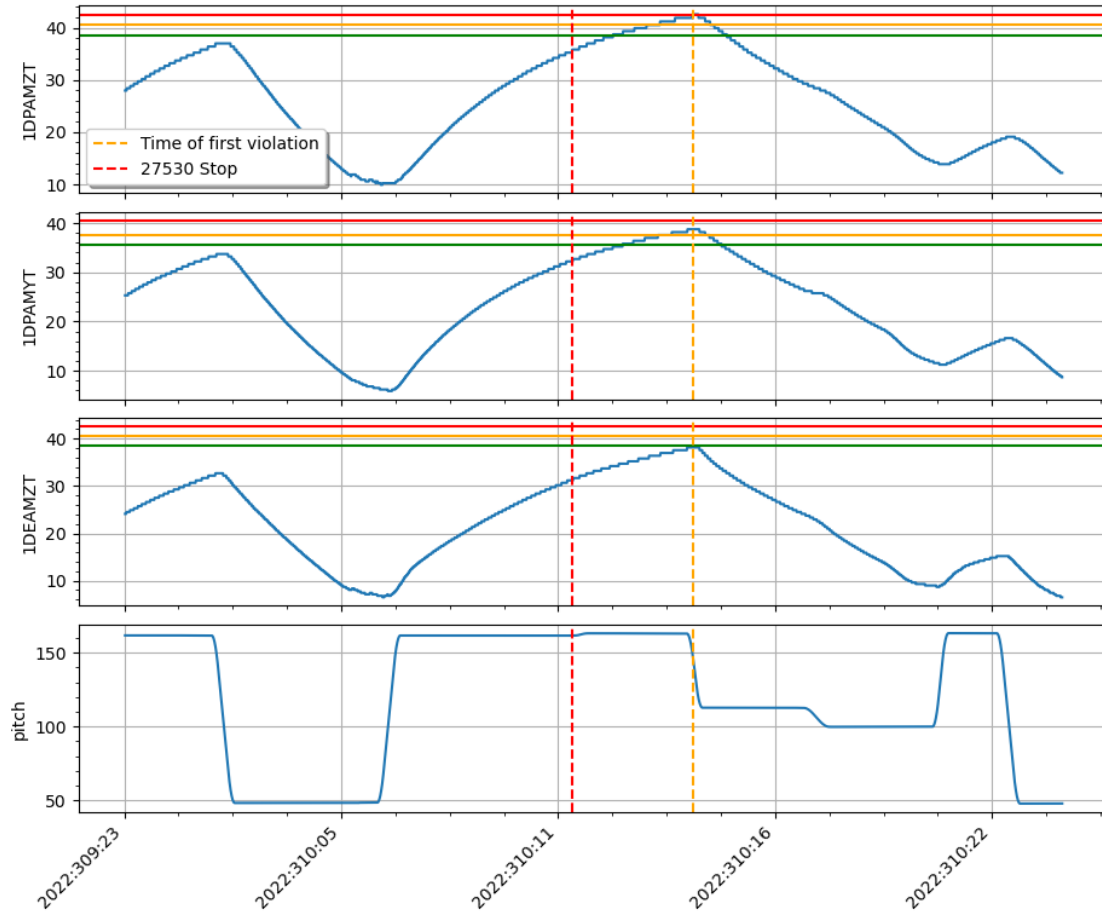
MSID Plots for 1DPAMZT Warning High Violation:

tmp_bep_pcb tmp_bep_osc pitch

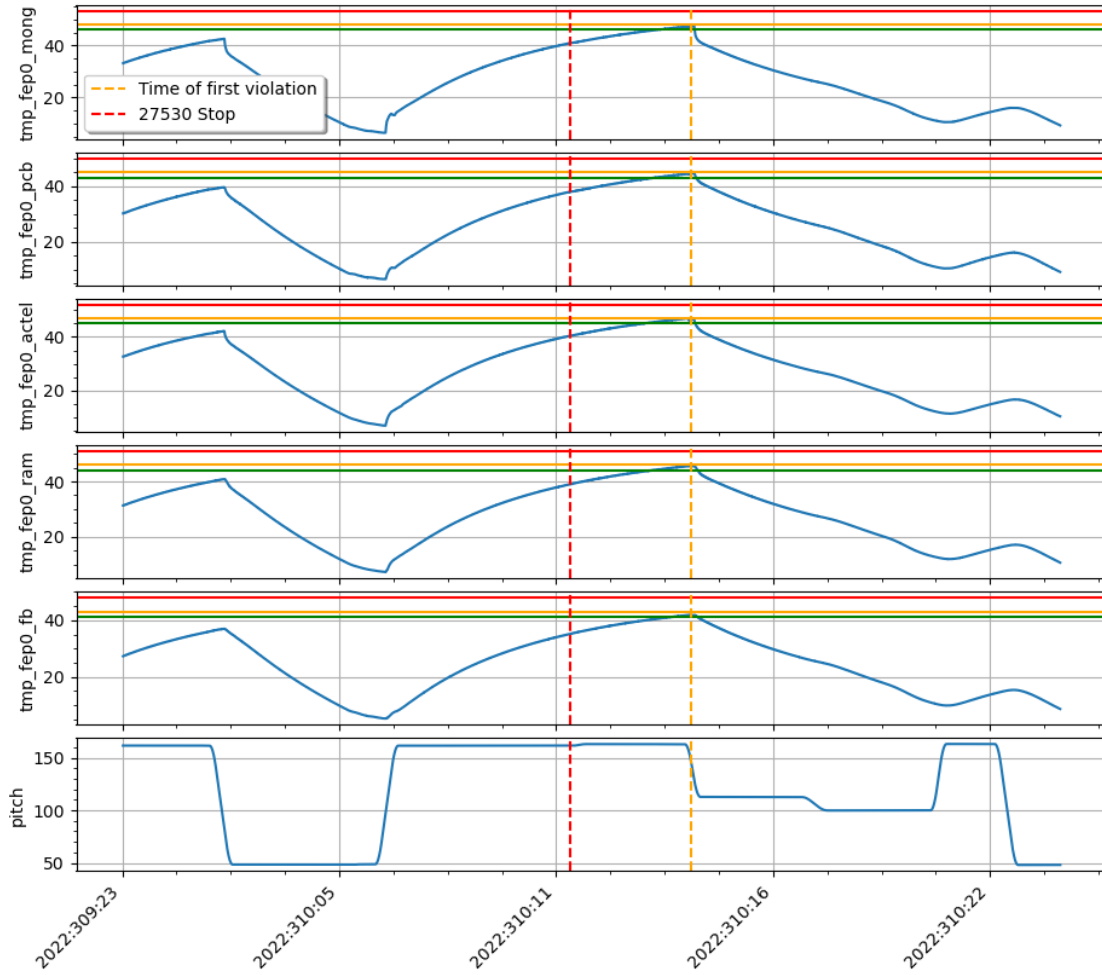First Violation at: 2022:310:14:31:58.146

MSID Plots for 1DPAMZT Warning High Violation:

tmp_fep0_mong tmp_fep0_pcb tmp_fep0_actel tmp_fep0_ram tmp_fep0_fb pitch

First Violation at: 2022:310:14:31:58.146

MSID Plots for 1DPAMZT Warning High Violation:

tmp_fep1_mong tmp_fep1_pcb tmp_fep1_actel tmp_fep1_ram tmp_fep1_fb pitch

First Violation at: 2022:310:14:31:58.146