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

MEMORANDUM

Date: October 1, 2003
From: Joe DePasquale
To: SOT/FOT
Subject: Justification for Proposed Changes to ACIS PSMC Red Thermal Limits

1 Introduction

Recent thermal analysis of the ACIS Power Supply and Mechanism Controller (PSMC) has shown an upward trend in temperature strongly correlated with Solar Array Angle (SAA). It has also been shown that this trend appears when the spacecraft is approaching perihelion. This memo is intended to be a summary of the thermal limit trips of the PSMC, specifically the mnemonic 1PIN1AT, and a justification for the increase of the thermal limits.

2 PSMC Thermal Limit Trips

Table 1 lists the 1PIN1AT thermal limit trips that occured in 2002/2003. These trips were all violations of the yellow high limit imposed by the ACIS Operations Team. The maximum temperature reached among the trips was 31.9 C at a SAA of approximately 50^o. The "Duration" column listed in table 1 is the amount of time spent above the yellow high limit for each individual trip. Figures A.1 to A.16 in appendix A depict the temperature curves for 1PIN1AT and 1PDEA[AB]T for each limit trip. Included in these plots is also the SAA in red and a brief summary of the limit trip. It is worth noting that 1PDEA[AB]T have not, as of yet, tripped any limit but they do correlate to the temperature rises seen in 1PIN1AT. It is also worth noting that 1PIN1AT is a thermistor on the wall of the PSMC, whereas 1PDEA[AB]T are temperature measurements of the electronics boards inside the PSMC.

Table 1: **ACIS PSMC (1PIN1AT) Limit Trips**

Trip #	Mnemonic	Date (DOY)	MAX T (C)	Duration (hr:min)	Pitch (deg)
1	1PIN1AT	2002-267	30.63	03:45	48.75
2	1PIN1AT	2002-295	30.63	02:25	51.38
3	1PIN1AT	2002-308	30.63	08:55	53.09
4	1PIN1AT	2002-313	30.63	05:00	46.82
5	1PIN1AT	2002-327	30.62	01:15	54.61
6	1PIN1AT	2002-342	31.90	13:40	50.94
7	1PIN1AT	2003-37	30.63	06:35	50.32
8	1PIN1AT	2003-49	31.90	07:55	49.08
9	1PIN1AT	2003-51	30.63	21:55	56.99

3 Recommended Limit Changes

In discussions with the MIT ACIS team, notably Bill Mayer and Bob Goeke, we agreed that the existing limits were set extremely conservatively to provide an early warning to changes in the thermal environment of the spacecraft. We also agreed that the existing limits have served their purpose in providing this early warning and we would want to avoid having limit trips become commonplace. The electronics boards have been tested to 70.0 C at Lockheed Martin and so there is a large margin for increase in limits. The current philosophy is to increase the limits enough that one would expect no trips through the next perihelion unless there is some new factor affecting the thermal environment, of which we would want to be aware. Thus, the proposed new limits will still provide an early warning to changes in the spacecraft. It is for this reason that the red limits are not set to the qualification limit of 70.0 C.

After analysis of these data and discussions with the MIT ACIS team, we recommend the following changes to the ACIS PSMC yellow and red high limits for 1PIN1AT, 1PDEAAT and 1PDEABT. We would like to increase the yellow high limit for 1PIN1AT from 30.0 C to 35.0 C. We would like to increase the yellow high limits for both 1PDEAAT and 1PDEABT from 50.0 C to 54.0 C. We would like to increase the red high limit for 1PIN1AT from 36.5 C to 40.0 C. We would like to increase the red high limits for both 1PDEAAT and 1PDEABT from 58.5 C to 59.0 C. For clarity, table 2 lists these proposed changes to the limit set (YH refers to Yellow High and RH refers to Red High).

Table 2: **ACIS PSMC Proposed Limit Changes**

Mnemonic	Current		New	
	YH(C)	RH(C)	YH(C)	RH(C)
1PIN1AT	30.0	36.5	35.0	40.0
1PDEAAT	50.0	58.5	54.0	59.0
1PDEABT	50.0	58.5	54.0	59.0

A PSMC Temperature Plots

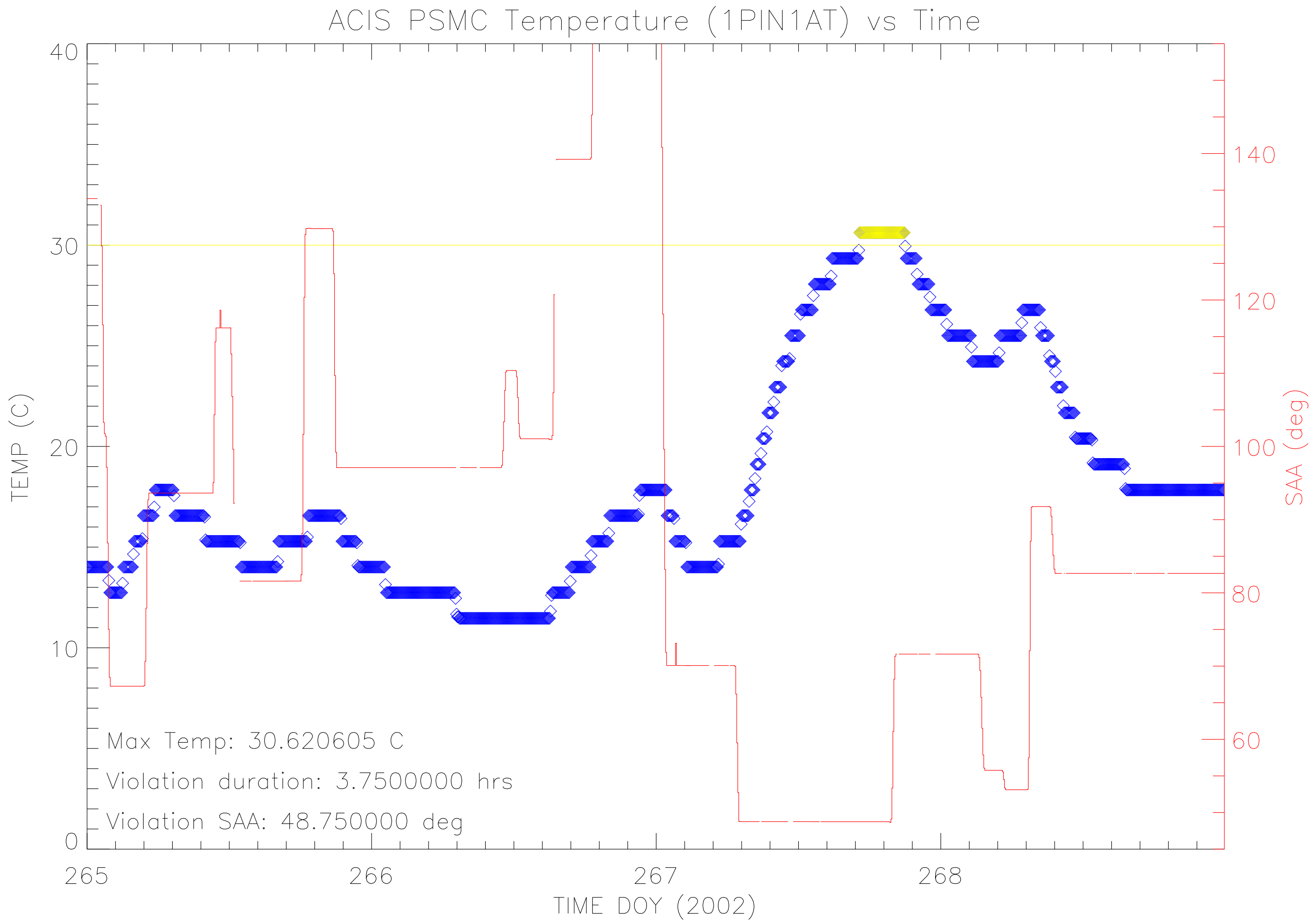

Figure A.1: Plot of temperature versus time for 1PIN1AT yellow high limit trip on day 267 of 2002. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time spent above the yellow limit regardless of temperature fluctuations above this level.

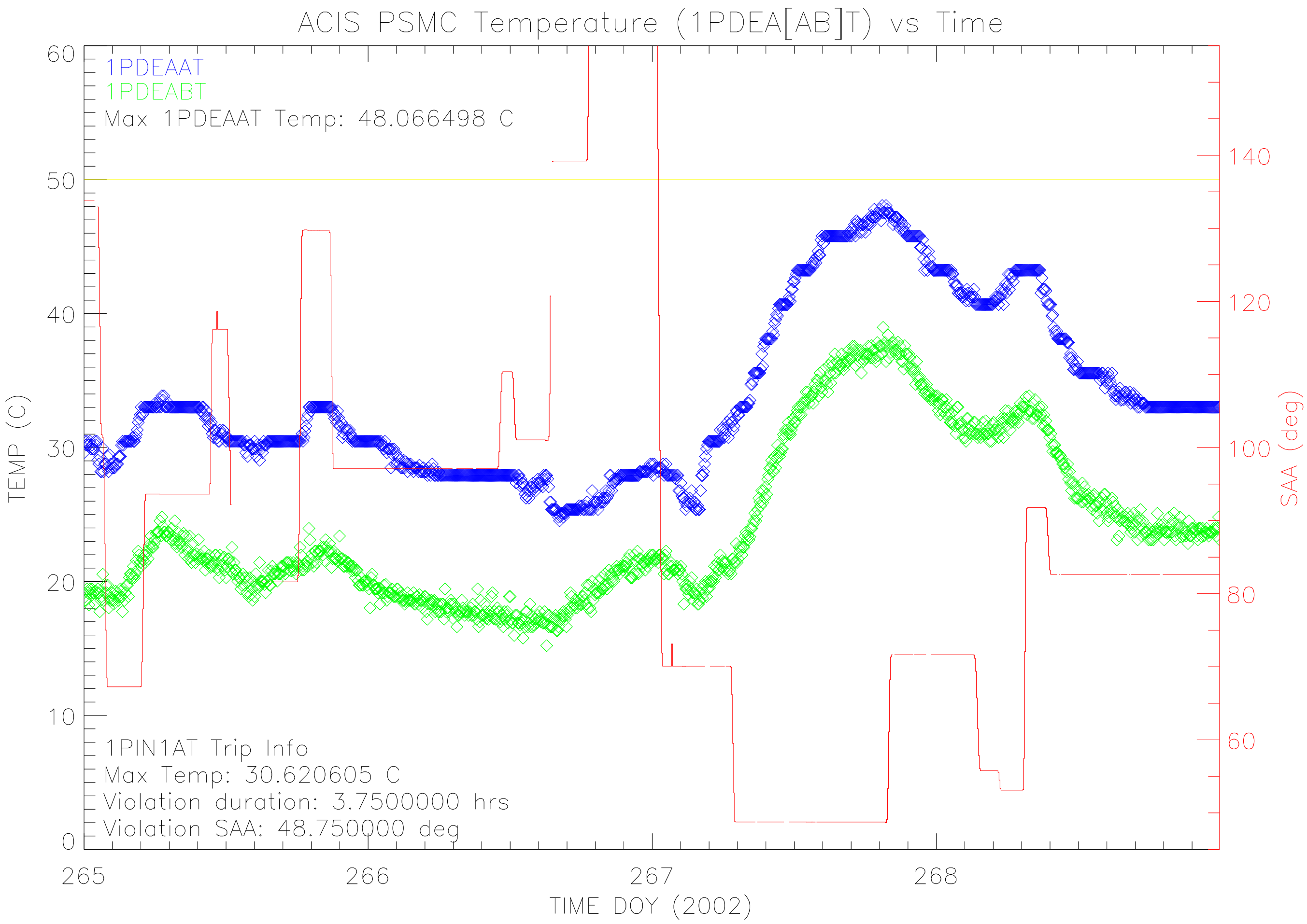

Figure A.2: Plot of temperature versus time for 1PDEA[AB]T during the 1PIN1AT yellow high limit trip on day 267 of 2002. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time that 1PIN1AT spent above the yellow limit regardless of temperature fluctuations above this level.

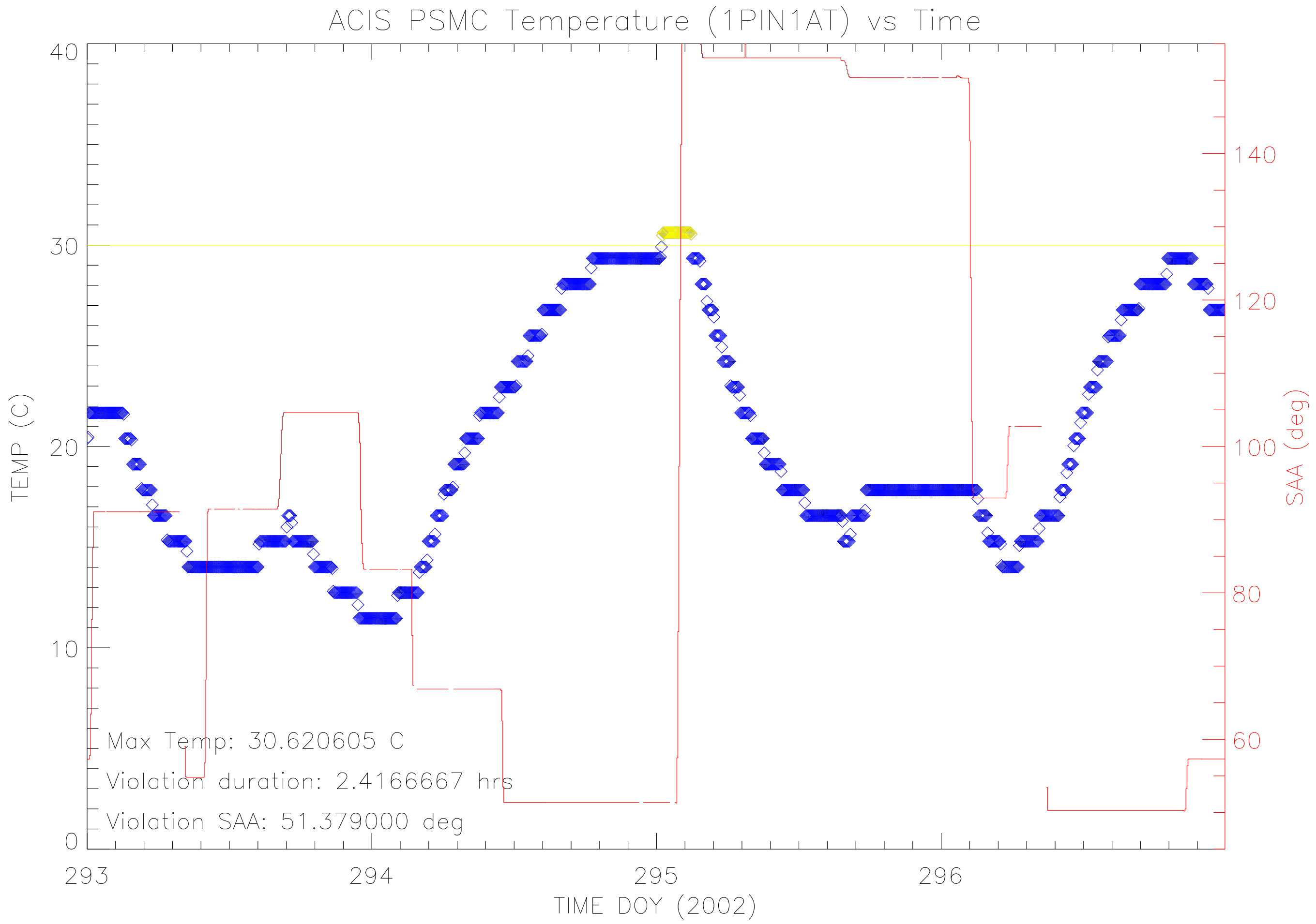

Figure A.3: Plot of temperature versus time for 1PIN1AT yellow high limit trip on day 295 of 2002. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time spent above the yellow limit regardless of temperature fluctuations above this level.

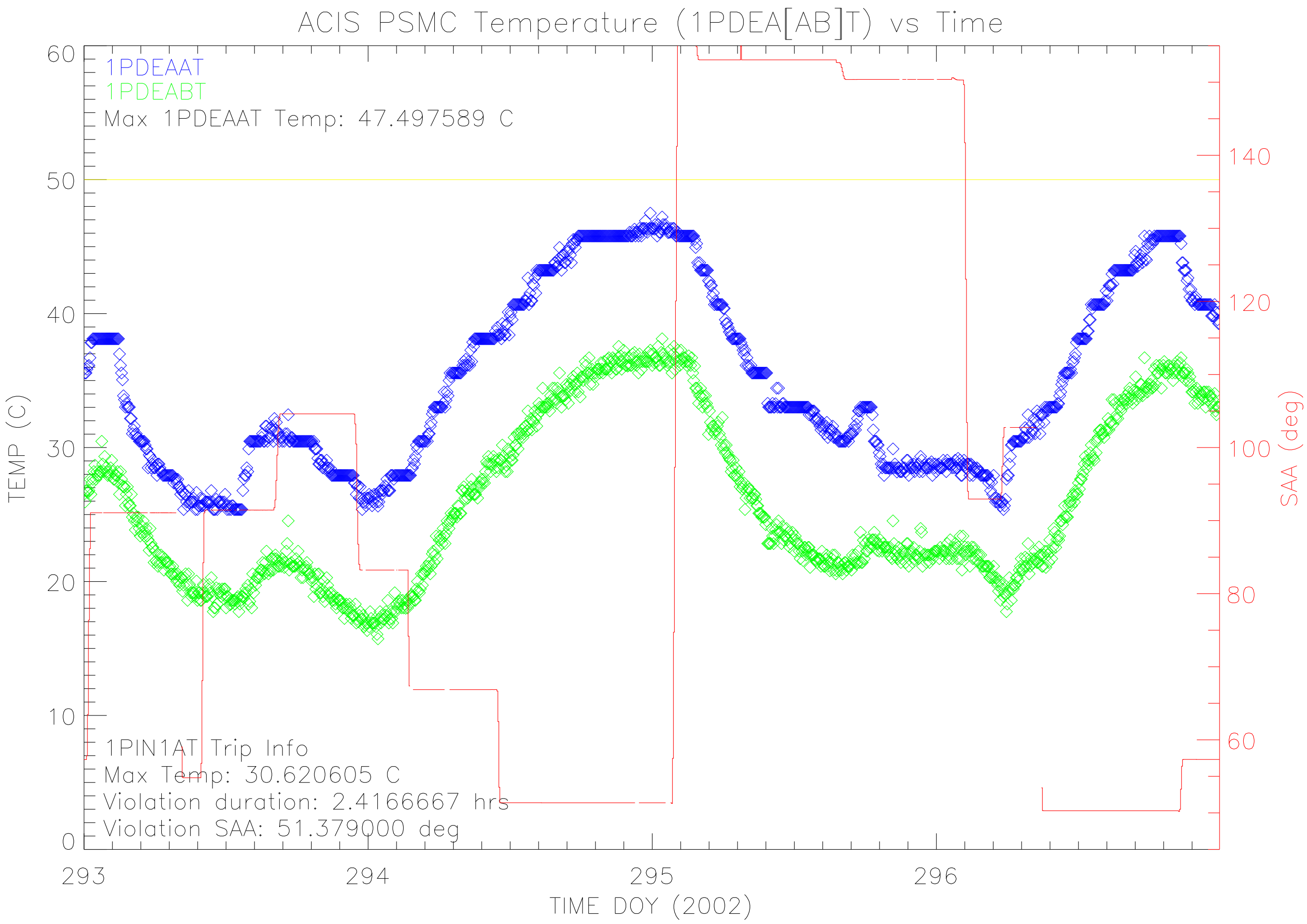

Figure A.4: Plot of temperature versus time for 1PDEA[AB]T during the 1PIN1AT yellow high limit trip on day 295 of 2002. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time that 1PIN1AT spent above the yellow limit regardless of temperature fluctuations above this level.

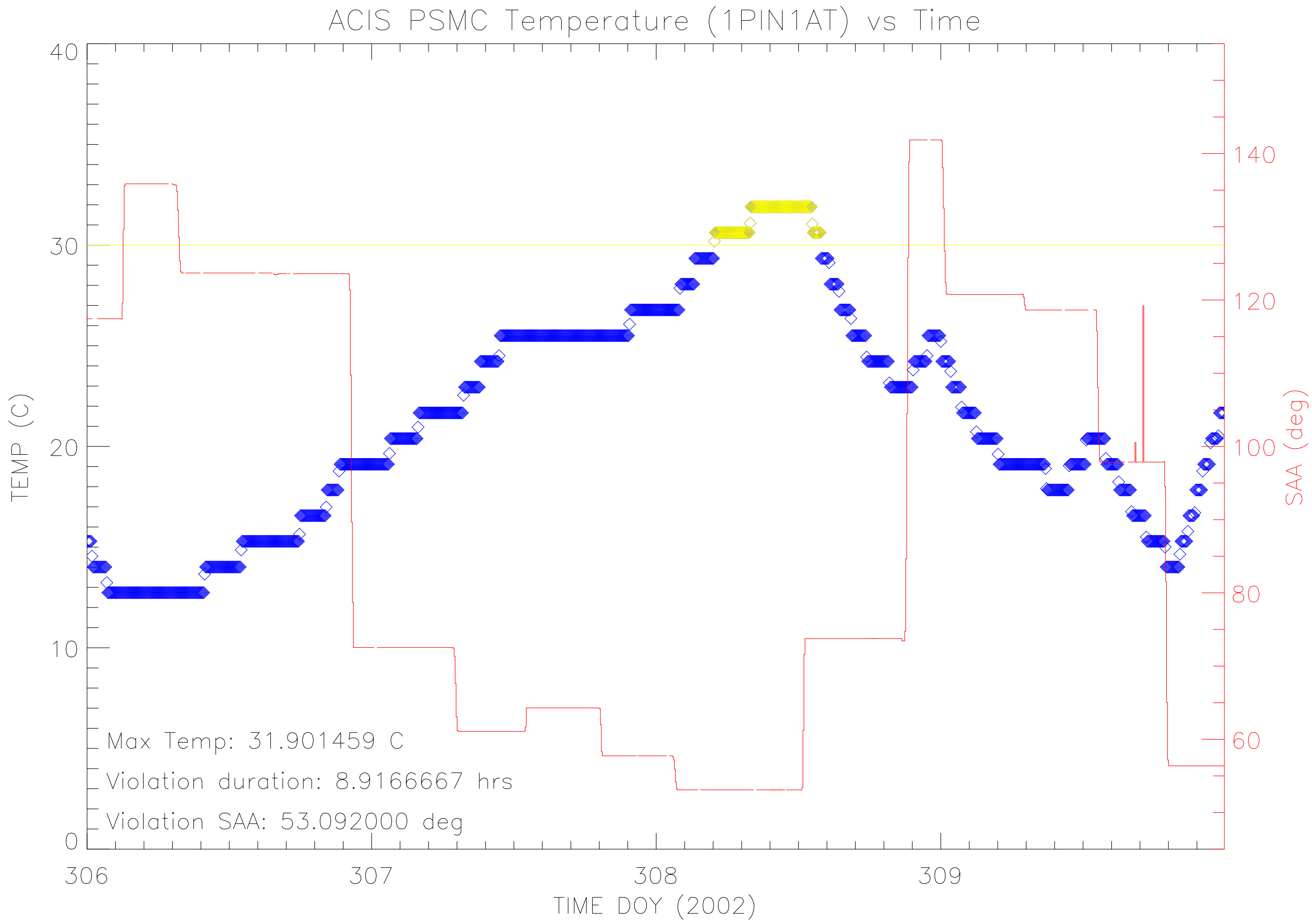

Figure A.5: Plot of temperature versus time for 1PIN1AT yellow high limit trip on day 308 of 2002. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time spent above the yellow limit regardless of temperature fluctuations above this level.

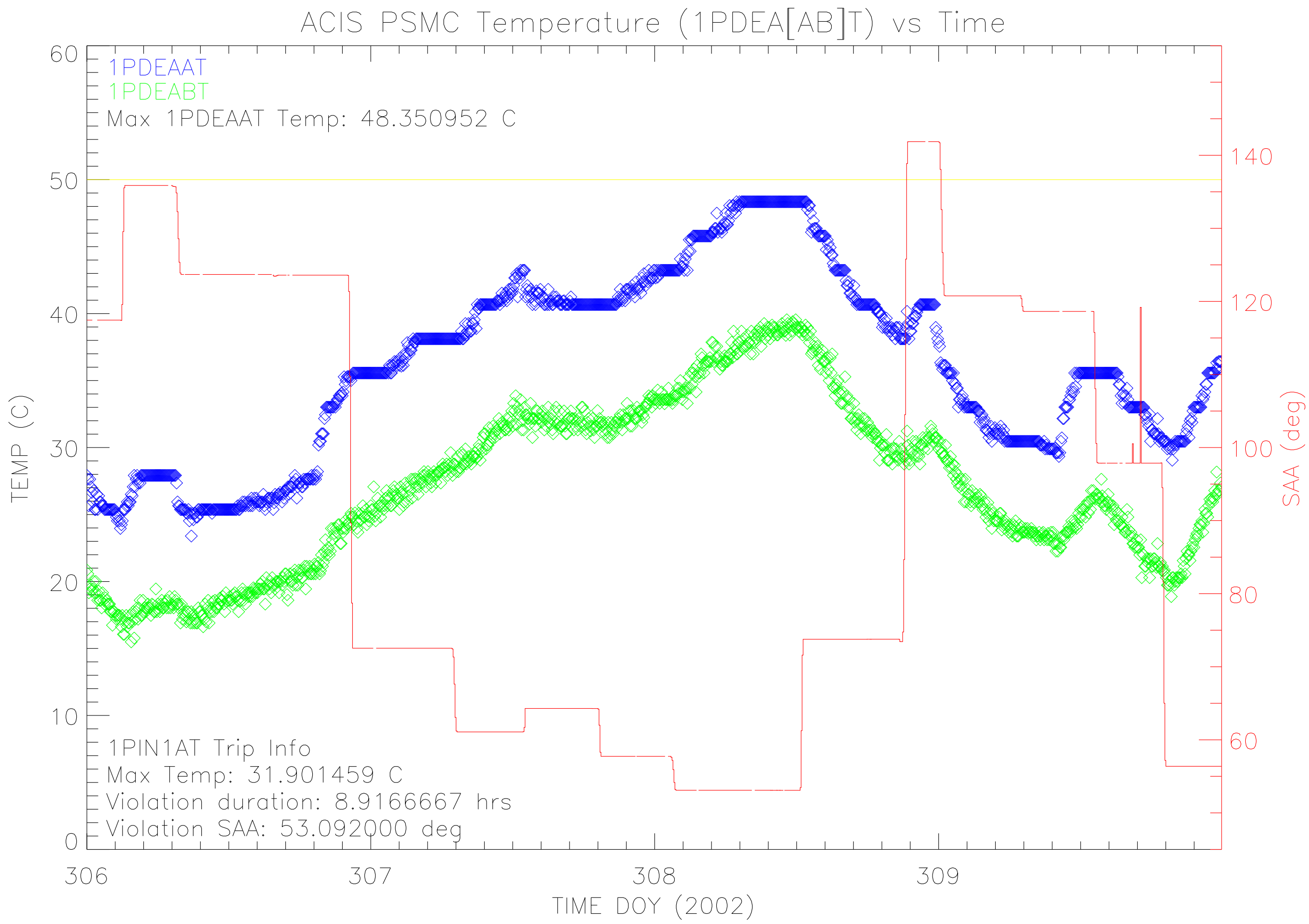

Figure A.6: Plot of temperature versus time for 1PDEA[AB]T during the 1PIN1AT yellow high limit trip on day 308 of 2002. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time that 1PIN1AT spent above the yellow limit regardless of temperature fluctuations above this level.

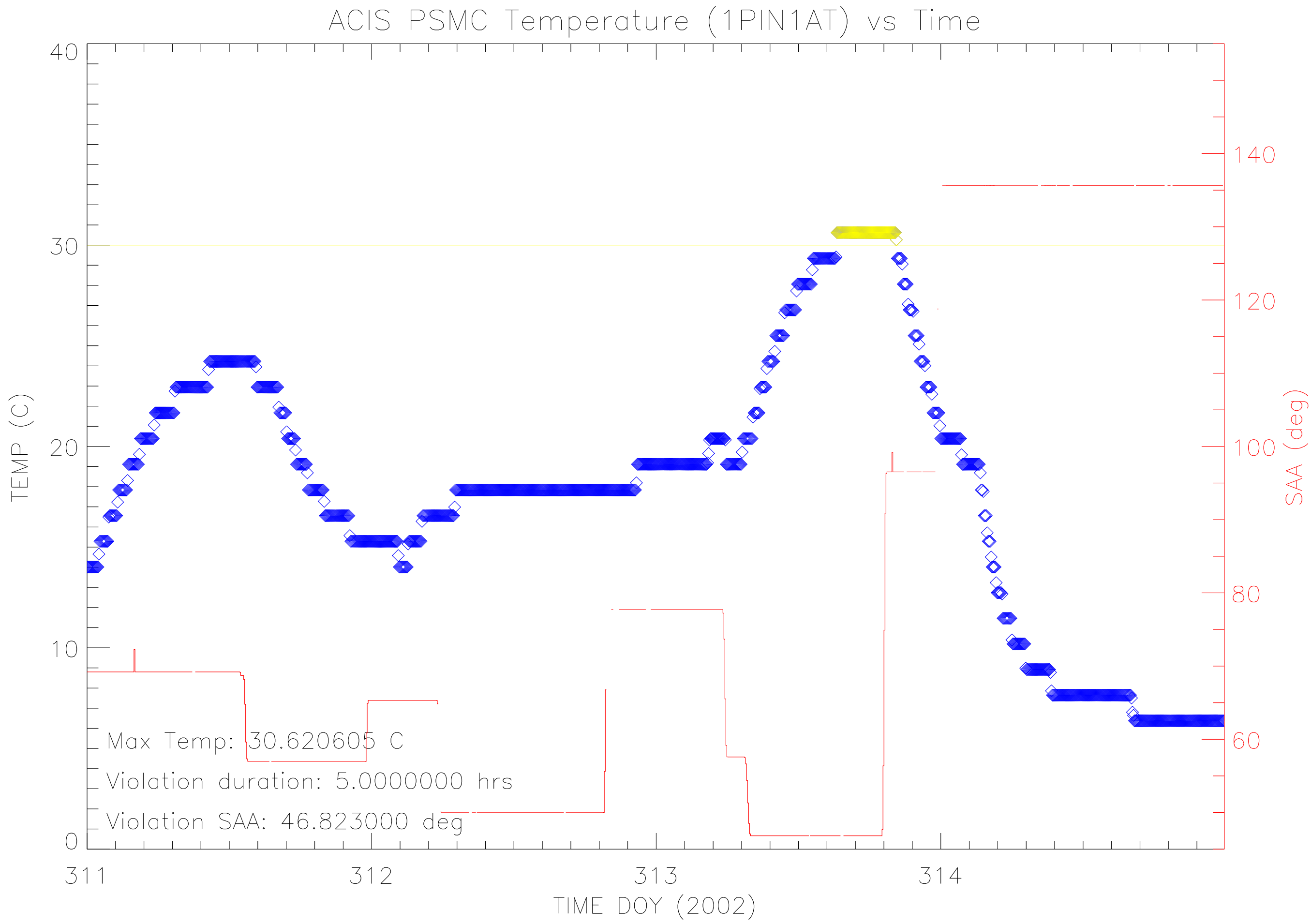

Figure A.7: Plot of temperature versus time for 1PIN1AT yellow high limit trip on day 313 of 2002. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time spent above the yellow limit regardless of temperature fluctuations above this level.

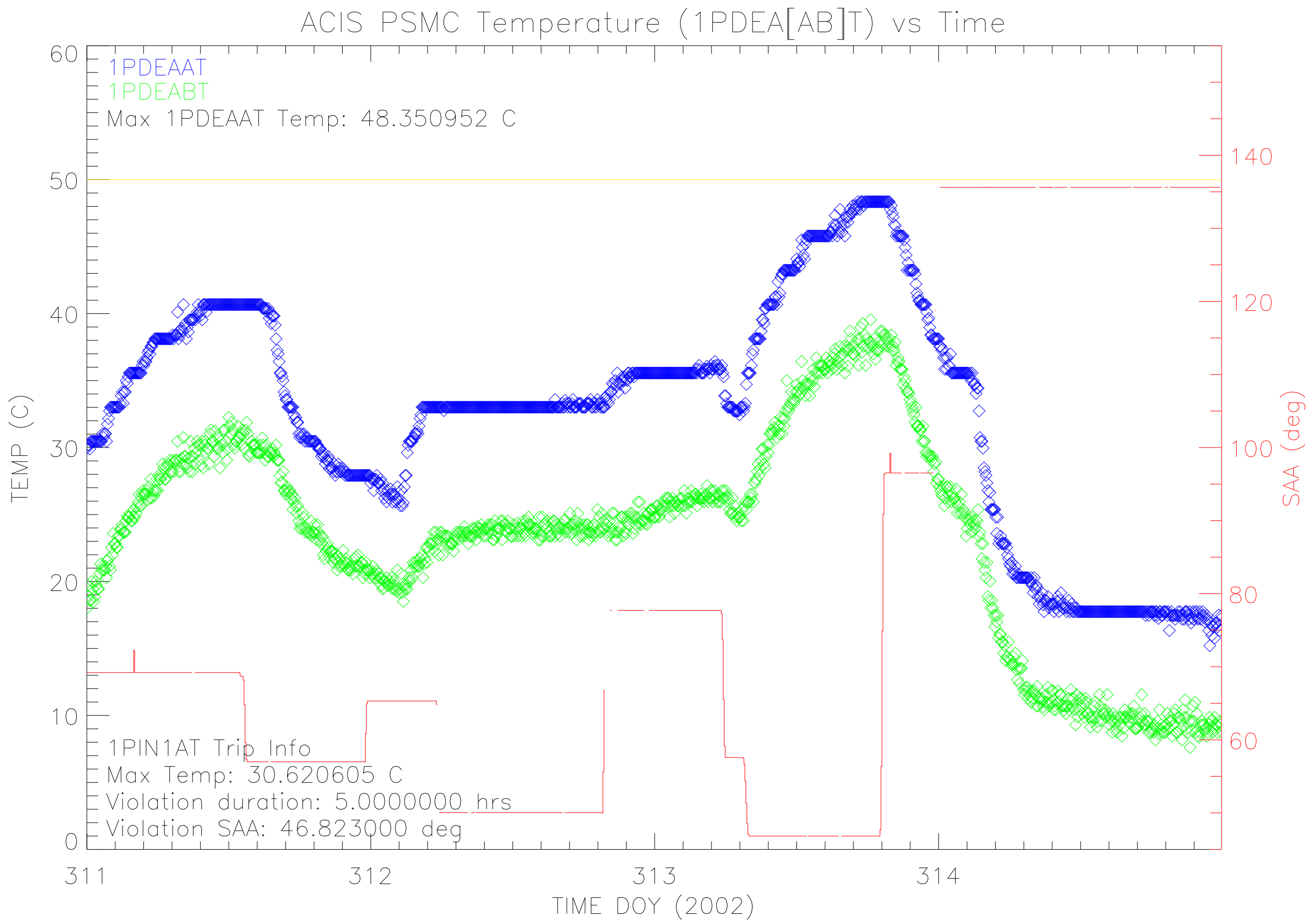

Figure A.8: Plot of temperature versus time for 1PDEA[AB]T during the 1PIN1AT yellow high limit trip on day 313 of 2002. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time that 1PIN1AT spent above the yellow limit regardless of temperature fluctuations above this level.

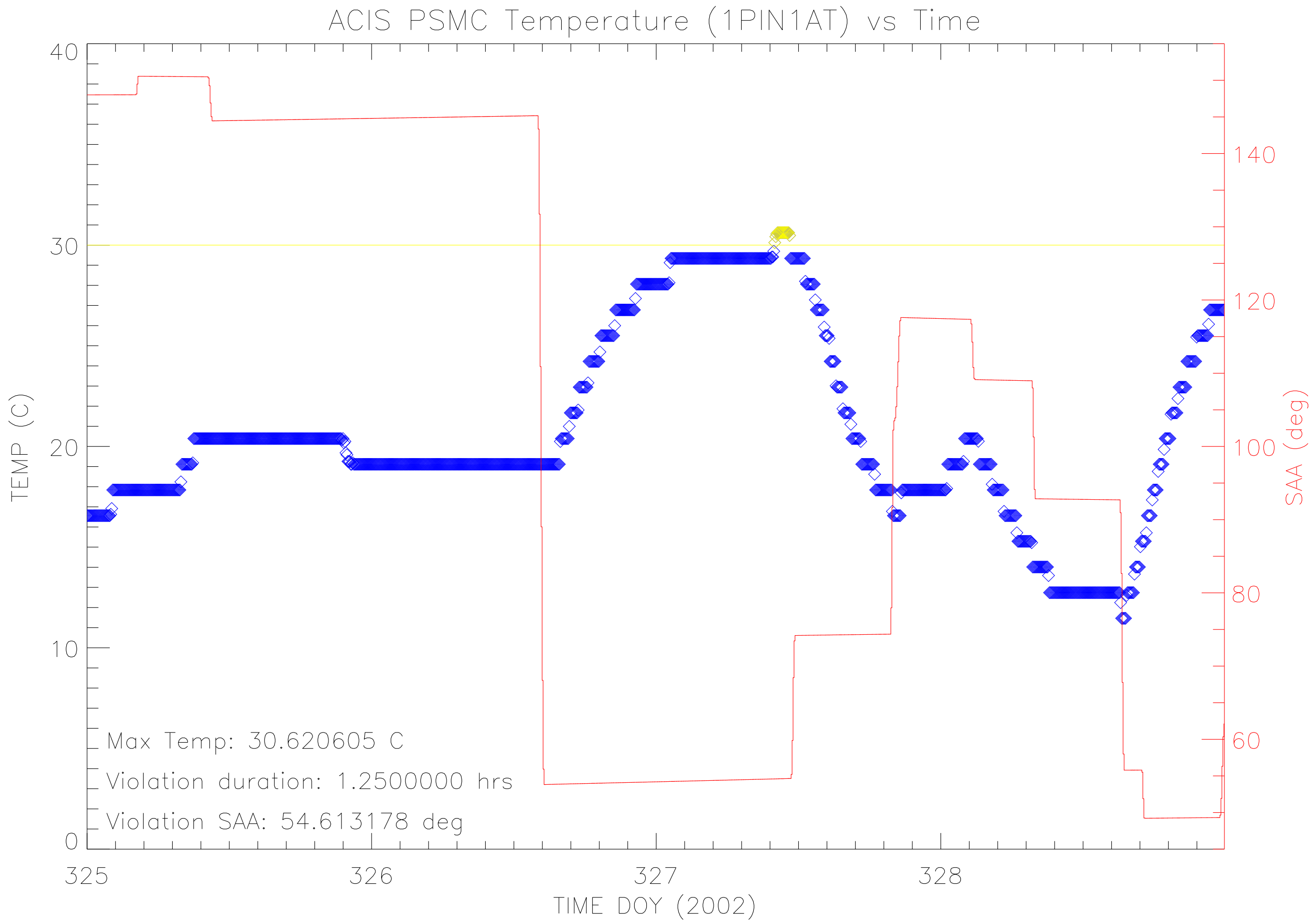

Figure A.9: Plot of temperature versus time for 1PIN1AT yellow high limit trip on day 327 of 2002. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time spent above the yellow limit regardless of temperature fluctuations above this level.

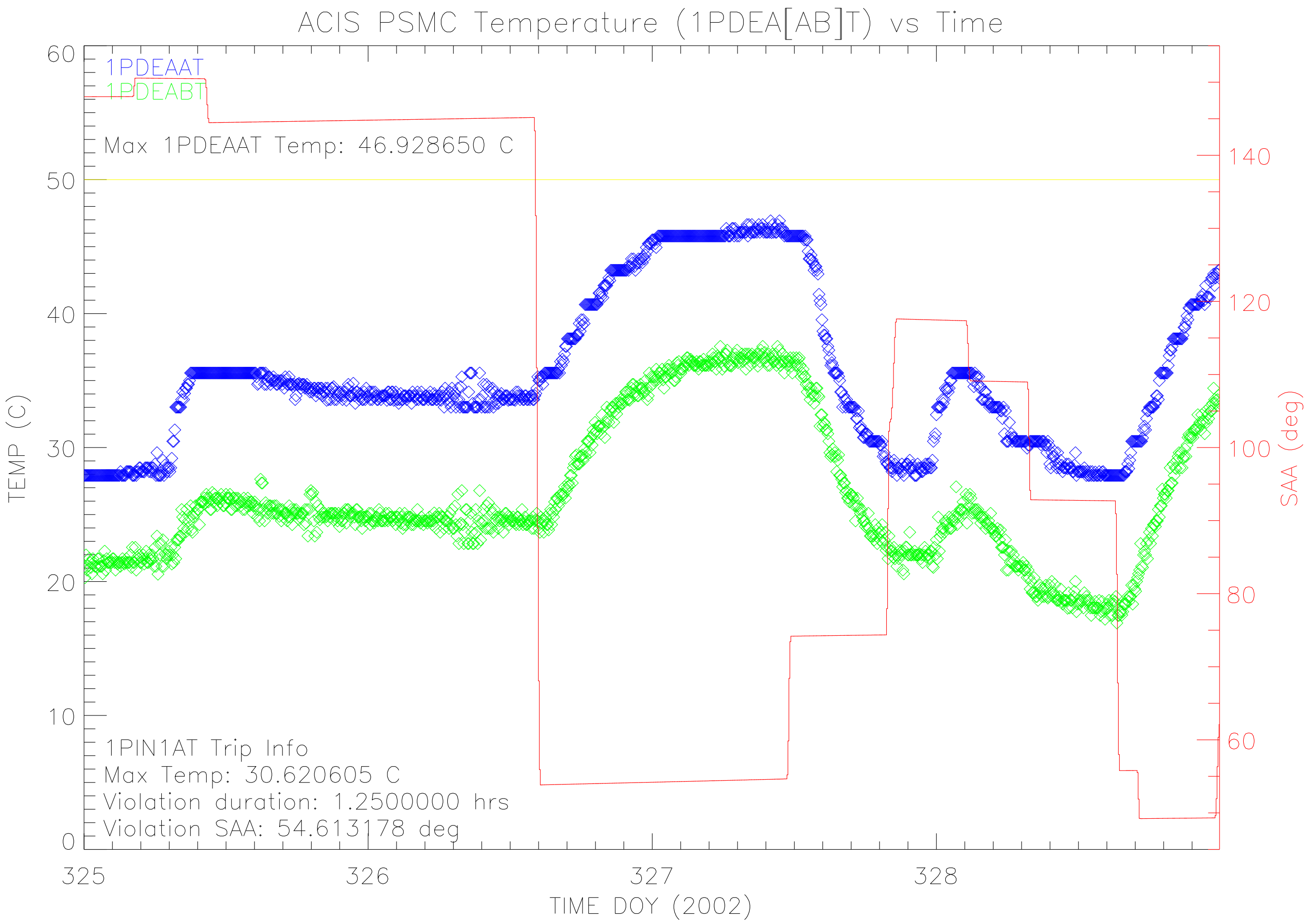

Figure A.10: Plot of temperature versus time for 1PDEA[AB]T during the 1PIN1AT yellow high limit trip on day 327 of 2002. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time that 1PIN1AT spent above the yellow limit regardless of temperature fluctuations above this level.

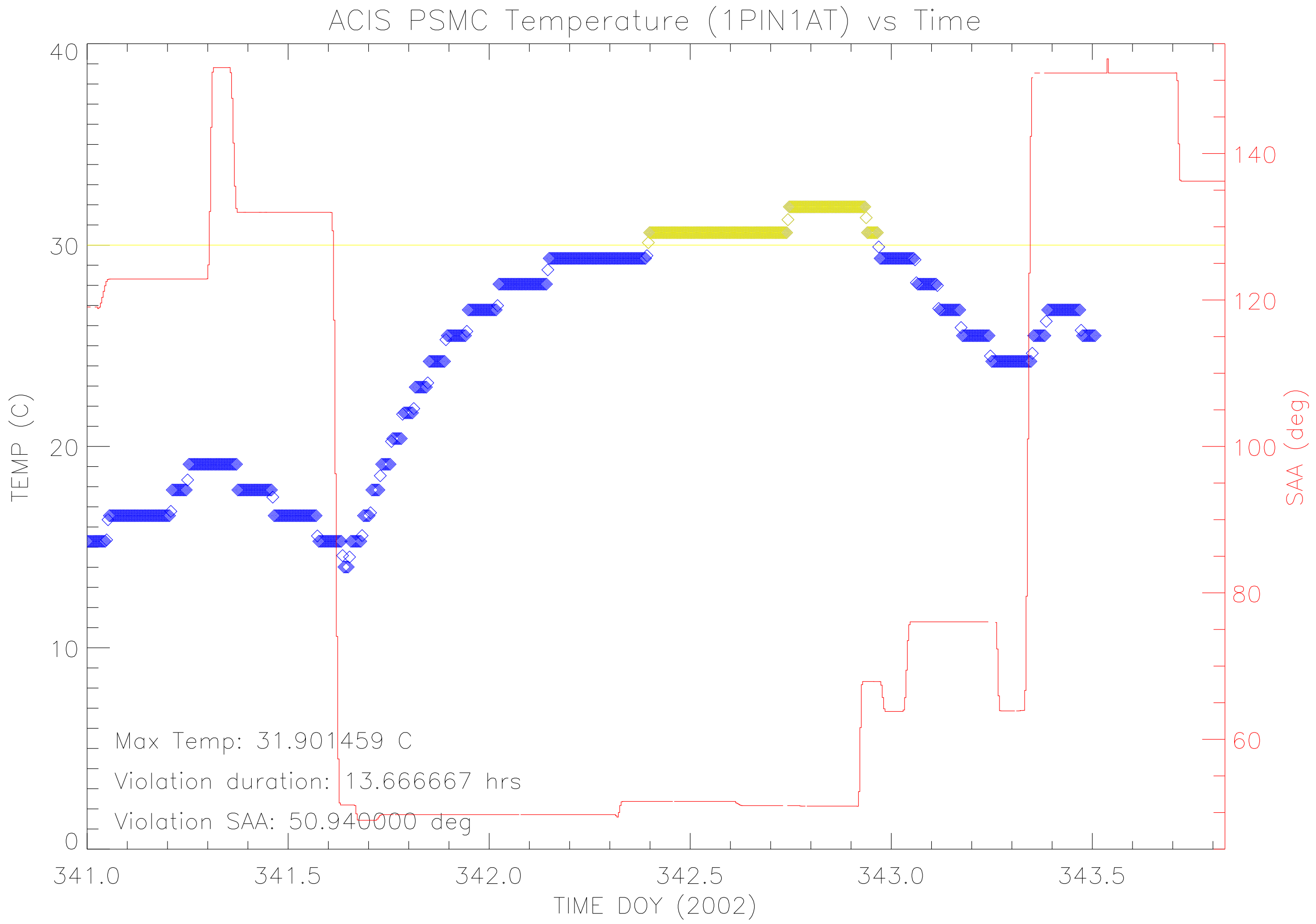

Figure A.11: Plot of temperature versus time for 1PIN1AT yellow high limit trip on day 342 of 2002. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time spent above the yellow limit regardless of temperature fluctuations above this level.

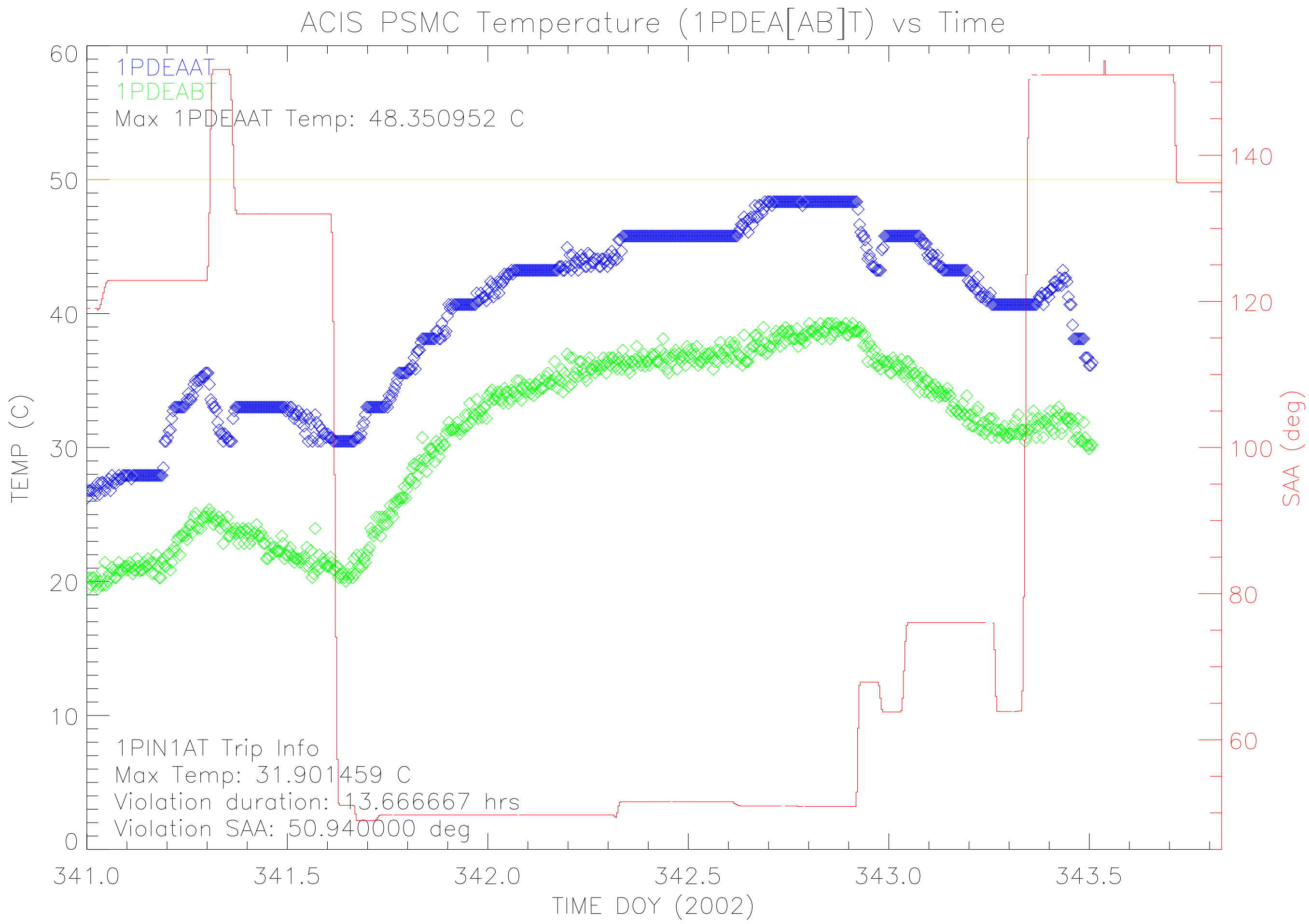

Figure A.12: Plot of temperature versus time for 1PDEA[AB]T during the 1PIN1AT yellow high limit trip on day 342 of 2002. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time that 1PIN1AT spent above the yellow limit regardless of temperature fluctuations above this level.

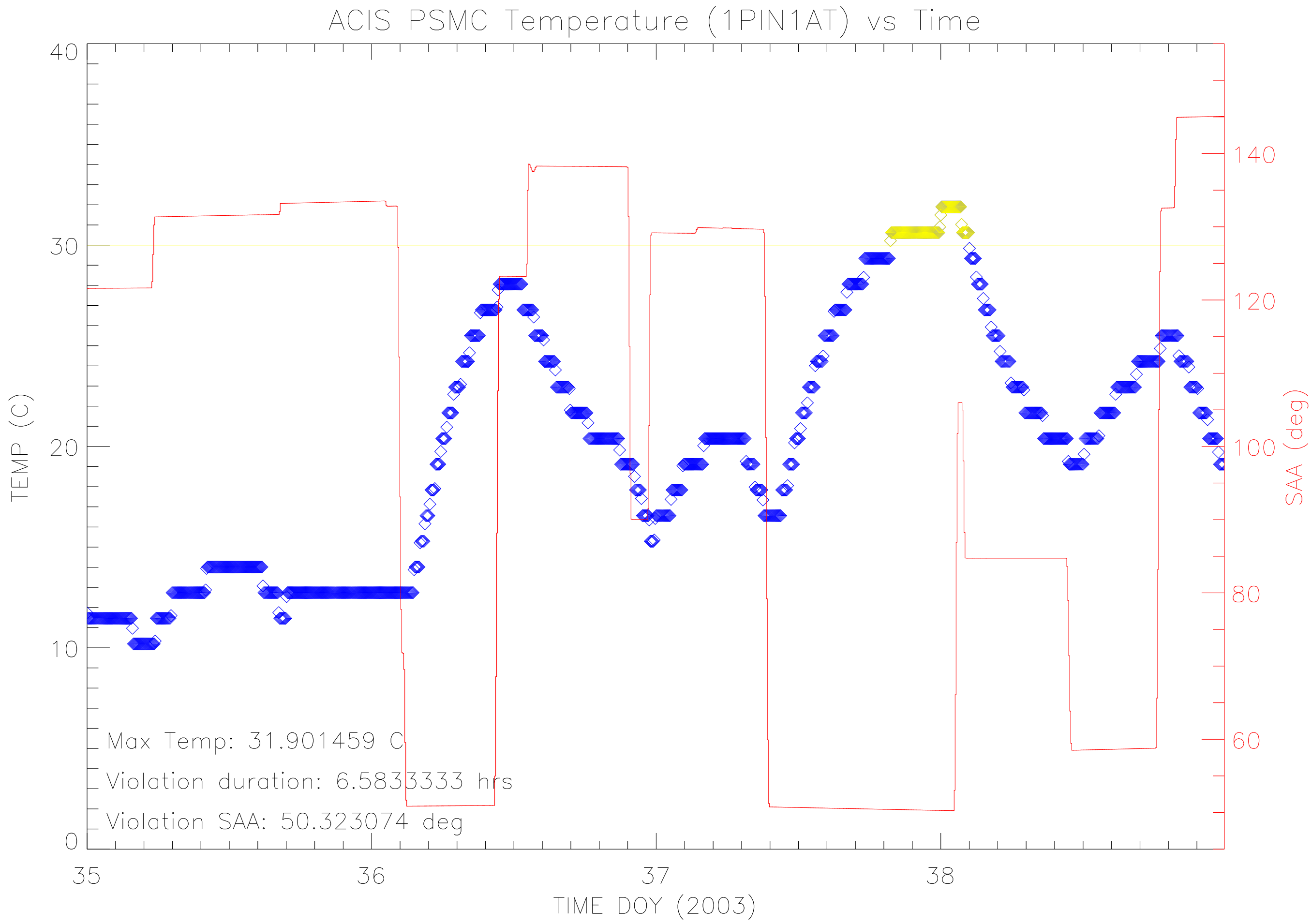

Figure A.13: Plot of temperature versus time for 1PIN1AT yellow high limit trip on day 37 of 2003. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time spent above the yellow limit regardless of temperature fluctuations above this level.

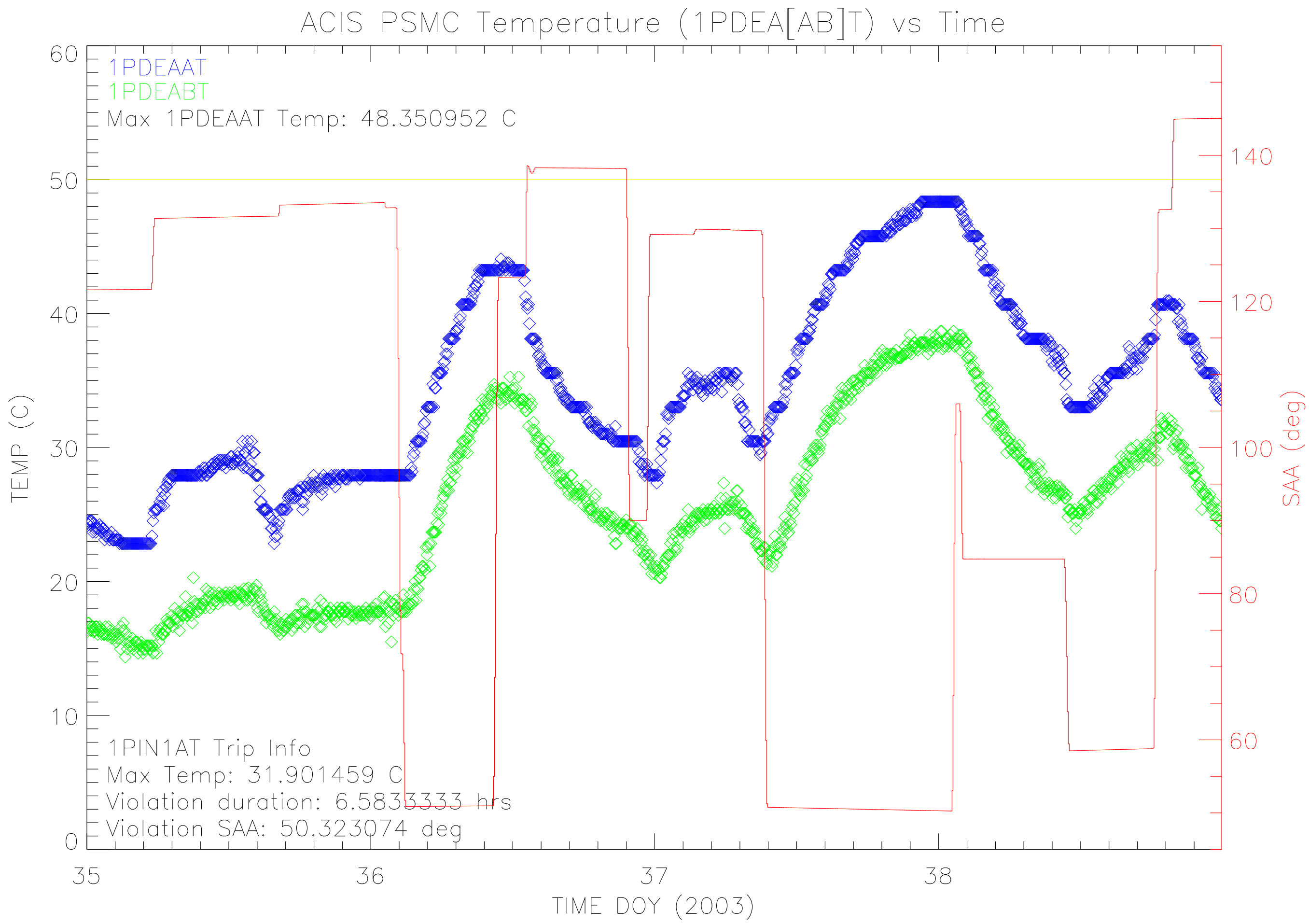

Figure A.14: Plot of temperature versus time for 1PDEA[AB]T during the 1PIN1AT yellow high limit trip on day 37 of 2003. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time that 1PIN1AT spent above the yellow limit regardless of temperature fluctuations above this level.

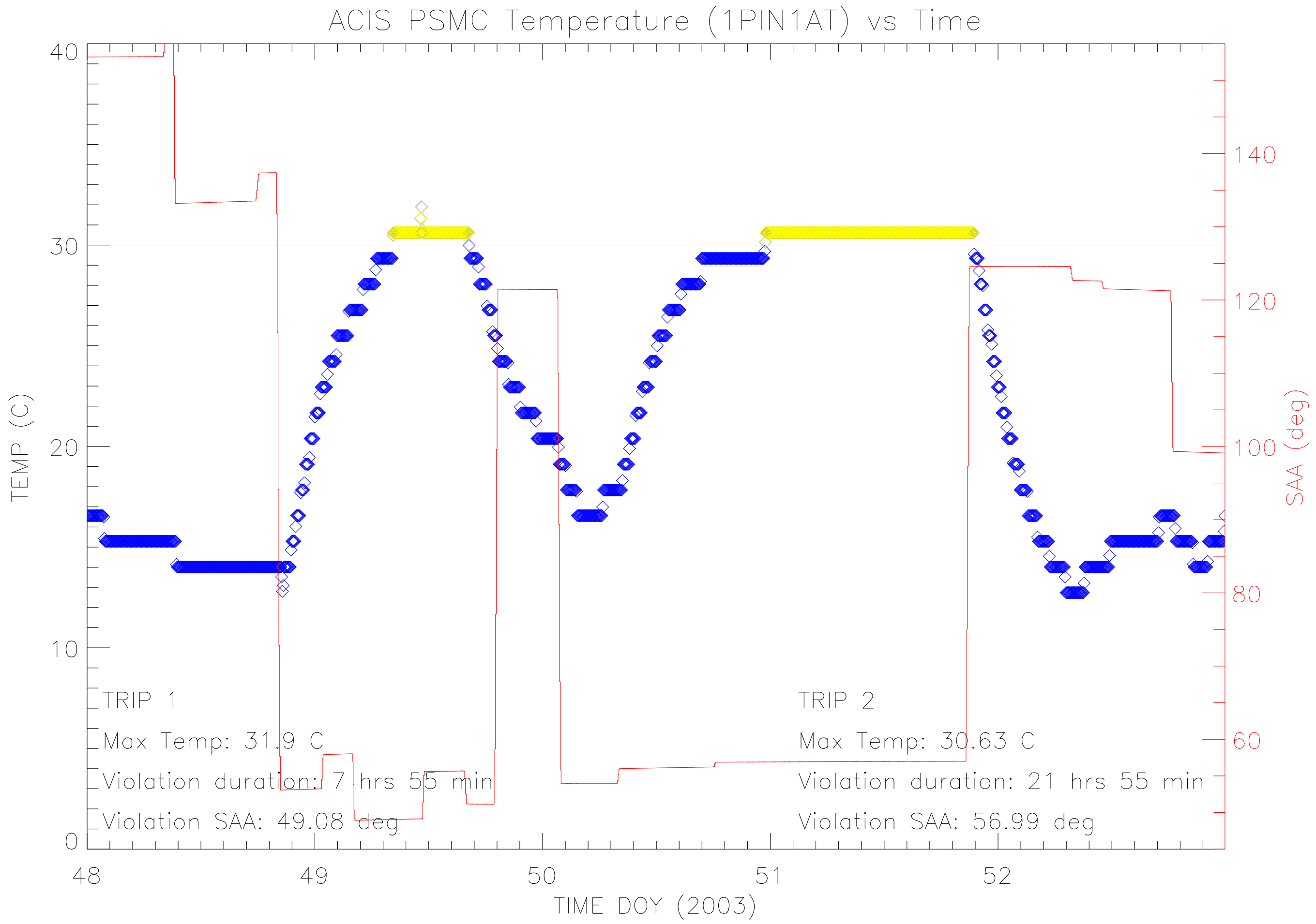

Figure A.15: Plot of temperature versus time for 1PIN1AT yellow high limit trip on day 49 of 2003. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time spent above the yellow limit regardless of temperature fluctuations above this level.

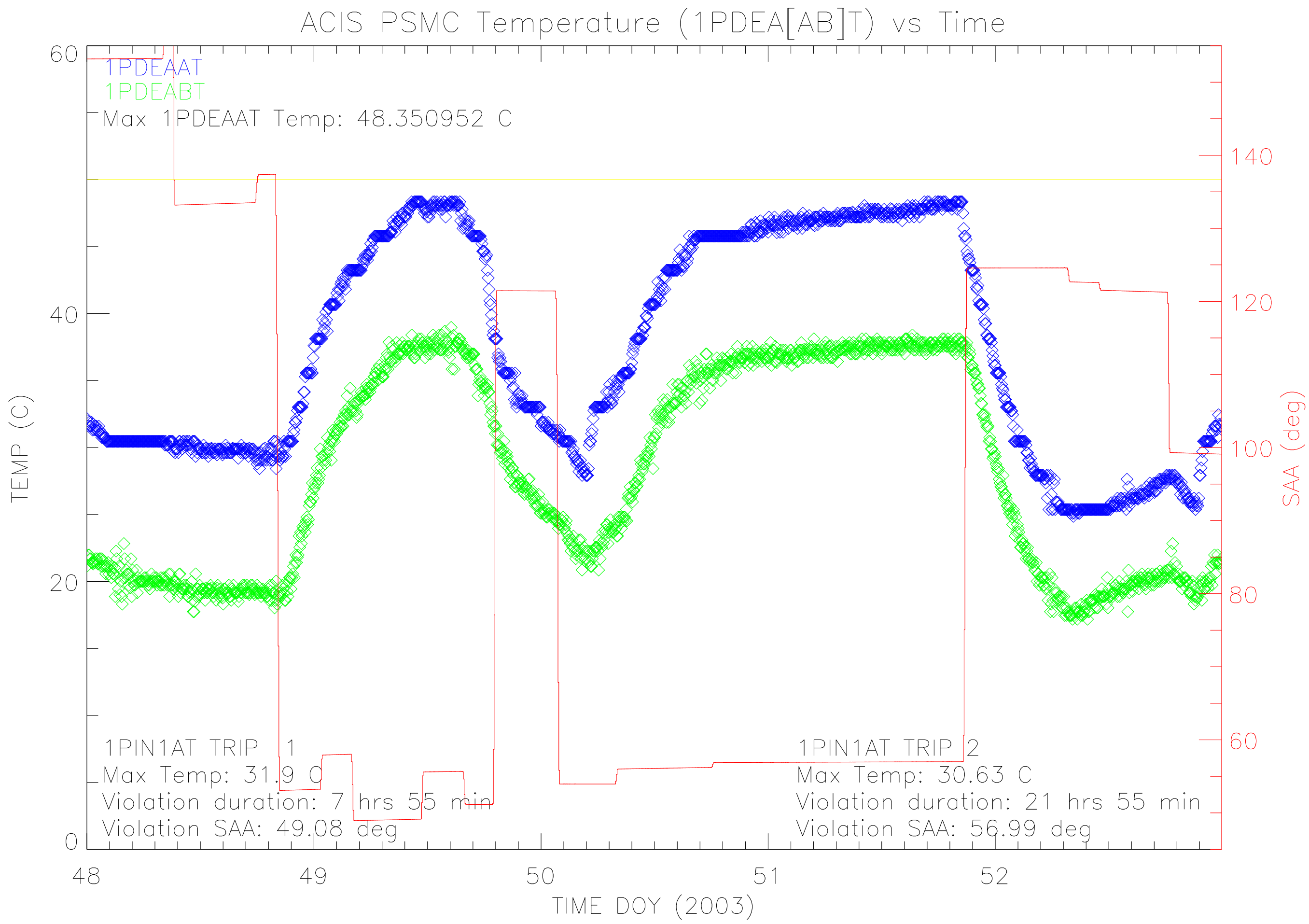

Figure A.16: Plot of temperature versus time for 1PDEA[AB]T during the 1PIN1AT yellow high limit trip on day 49 of 2003. Included in red on this plot is the SAA for the duration of the trip. The duration listed on the plot is the total time that 1PIN1AT spent above the yellow limit regardless of temperature fluctuations above this level.