

# ACIS Verification Summary Report

36-01515.082  
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**Specification:** AXAF Observatory to Science Instrument ICD (IF 1-20)

**Requirement Number/Title:** 3.9.1.6.4 Total Dose (VRSD 3.9.1.6.4)

**Requirement Statement:** ACIS shall meet operational requirements during and after exposure to the total integrated radiation dose, as defined in EV1-8 (SE-29)

**Verification Method:** Analysis and test

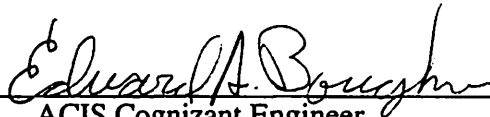
**Procedure Number:** N/A

**Configuration:** N/A

**Cycle Time:** N/A

## Verification Discussion/Results:

See attachment for discussion and results

 5-23-97  
ACIS Cognizant Engineer Date

## VERIFICATION DISCUSSION/RESULTS

The ACIS operational requirements for exposure to the AXAF radiation environment as defined in EV-8 (SE-29) are covered under the total dose and single event effects requirements of SE-29. The Total Integrated Radiation Dose and Single Event Effects requirements include the Solar Protons environment, Trapped Electron environment, Trapped Proton environment, Cosmic Ray environment and Solar Flare environment.

Total dose testing was performed at Space Electronics Inc. (SEI) to acquire radiation tolerance data on 23 semiconductor devices used in the ACIS instrument, and the data reported in the MIT Combined Radiation Reports SEI Job Number 2476-025, additional total dose testing on the DAC 8800 D to A converter was performed by GSFC and reported on by Kusam Sahu in a memo dated October 30, 1996 titled Rad Report on DAC 8800. This data was used to establish maximum allowable total dose levels for the components tested and as input to a total dose analysis performed by Jim Howard of MSFC and a worse case analysis performed by Mary Ann Dooley of TRW.

An analysis of total dose effects on the ACIS instrument was performed by Jim Howard to ensure that all the electronics components in the ACIS instrument meet the required design margins of the AXAF mission. A Report on the results of this analysis was submitted to the AXAF Project Office on April 18 1996 and updated on June 5, 1996 (This updated report is an attachment to this VSR). This report suggested that additional shielding be added to the outside of the ACIS Detector Electronics Assembly (DEA) to reduce the total dose radiation levels at some of the more sensitive components and satisfy the radiation requirements of SE-29 with adequate margin. The recommended amount (in some cases a larger amount) of additional shielding specified in Jim's report was added to the electronics boxes and is identified in the attached MIT ECO #752.

In addition to the added box level shielding, local part shielding of several of the more sensitive part types was also recommended by Jim in his report. To comply with Jim's recommendation tantalum shielding was added to four types of components (see Dwg # 36-02340 attached) to increase their radiation tolerance and provide the necessity margin to comply with the requirements of SE-29.

In addition to Jim Howard's report Mary Ann Dooley of TRW prepared a worse case analysis of the ACIS electronic parts (included as an attachment) for review by the ACIS program design engineers. Tony Lavoie of the AXAF Chief Engineers Office requested that the ACIS program respond to the concerns raised in Mary Ann's worst case analysis (see NASA memo EJ32 (96-108) included as an attachment). The ACIS response to Tony's request was submitted to MSFC in the form of a memo by Ed Boughan (see Ed Boughan's memo of March 18, 1997 included as an attachment).

Jim Howard performed a review of ACIS for Single Event Effects (SEE) and submitted two memos to the ACIS project office (ACIS work to do May 4, 1996 and CA5012 issues and recommendations October 11, 1996) that identified two part types that required additional testing to evaluate their susceptibility to latchup and single event effects. The two part types tested were the DAC-8800 D to A converter and the CS-5012 A to D converter. This testing was performed at both NRL (see Mary Ann Dooley's report of July 10, 1996 Laser testing of ACIS A/D converter) and the Brookhaven National Labs (see Single Event Effects Test Report from GSFC test date June 12-15, 1996). Additional testing of the CS5012 under latched conditions in a vacuum was conducted at MIT, the results being reported on in attachment "c" Response to NASA memo EJ32(96-108) March 18, 1997.

### Enclosures:

- a) Jim Howard's ACIS Radiation Ray Trace Update Report June 5, 1996
- b) Mary Ann Dooley's Final Report on ACIS Radiation AXAF.96.220.090A

- c) Ed Boughan's Response to NASA memo EJ32(96-108) March 18, 1997
- d) NASA Request for Response to ACIS Radiation Study Results EJ32 (96-108)
- e) Radiation Shielding and Marking MIT Dwg # 36-02340
- f) Single Event Effects Test Report from GSFC test date June 12-15, 1996
- g) MIT ECO#752
- h) Mary Ann Dooley's report of July 10, 1996 Laser testing of ACIS A/D converter)
- j) Jim Howard's memo ACIS work to do May 4 ,1996
- k) Jim Howard's memo CA5012 issues and recommendations October 11, 1996
- l) Kusam Sahu's memo dated October 30, 1996 titled Rad Report on DAC 8800
- m) MIT Combined Radiation Reports SEI Job Number 2476-025