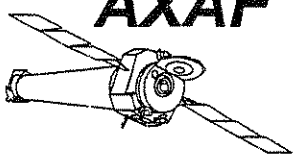
IF1-20C
16 July 1998
NAS8-37710
DPD692 CM07a
Type 1 Document

JHC

TRW

AXAF



Advanced X-ray Astrophysics Facility

Observatory to Science Instrument ICD

MSFC BASELINE

AX2-00-0268, 6 July 1998

PCN AX000625

Submitted to:
George C. Marshall Space Flight Center
National Aeronautics and Space Administration
Marshall Space Flight Center, AL 35812

Submitted by:
TRW Space & Electronics Group
One Space Park
Redondo Beach, CA 90278

TRW Space &
Electronics Group

One Space Park
Redondo Beach, CA 90278

TRW

DPD692 CM07a
NASA-37710
Type 1 Document

CAGE CODE NO. 11982

TITLE

ADVANCED X-RAY ASTROPHYSICS FACILITY - IMAGING

Observatory to Science Instrument ICD

DOCUMENT DATE 16 July 1998

NO. IF1-20
REV. C

Superseding : B
2 May 1997

PREPARED BY: *Kevin H Soranno* 14-DEC-95
K. A. Soranno DATE
Systems Engineer

APPROVAL SIGNATURES:

Rick [signature] for 12/18/95
J.A. Zboril, Manager DATE
Product Assurance

John F Donaghy
J. F. Donaghy DATE
Science Instrument Accommodation

J. E. Korka 12/15/95
J.E. Korka, Manager DATE
Telescope Systems

J G Payne 12/15/95
J. G. Payne, Manager DATE
Spacecraft and Observatory

R S Watson 12/15/95
R.S. Watson, Manager DATE
Operations

Ralph Iwens 12/15/95
R.P. Iwens, Manager DATE
Systems Engineering and Integration

ORIGINAL CADM RELEASE: *[signature]* 97-01-23

TRW Space &
Electronics Group

One Space Park
Redondo Beach, CA 90278

TRW

Revision/Change Record

For Document No IF1-20 C

SYMBOL	DATE	AUTHORIZATION	REVISION/CHANGE DESCRIPTION	PAGES AFFECTED
--	01/11/96	Original CADM Rel 22 Aug 97 01/23	Initial Release • Incorporated the following pre-approved PIRNs: CM7A-001C CM7A-041 • Incorporated the following pending PIRNs with the related changes considered TBR until the PIRNs are approved by MSFC: CM7A-012A - Verification Matrix CM7A-019A - ICD Corrections CM7A-027 - General Revisions CM7A-035 - ACIS ICD Dwg CM7A-036 - HRC ICD Dwg Additional changes: • Table 3.4-4 WAS Table 3.4-1 in 15-Mar-95 version of CM07a. (Change not described in 22-Sep-95 version) NASA/MSFC approved as baseline per CCBD AX2-00-0121 and contract letter GP54B-96-071 dated May 29, 1996.	----

(File directly after cover sheet)

TRW Space &
Electronics Group

One Space Park
Redondo Beach, CA 90278

TRW

Revision/Change Record

For Document No IF1-20 C

SYMBOL	DATE	AUTHORIZATION	REVISION/CHANGE DESCRIPTION	PAGES AFFECTED
A	1/31/97	John F Donaghy J. F. Donaghy SI Instr. Accomm. Ralph Iwens R. I. Iwens Sys. Eng & Int. J. G. Payne Spacecraft & Observ. J. A. Zboril Product Assurance R. S. Watson Operations S. J. Loer Telescope Systems K. A. Soranno K. A. Soranno ICD Book Mgr. 1-30-97 M. Otomo Configuration Mgr. D. Vargas CADM/PDMO 97-1-30	• Incorporated the following PIRNs which were approved as part of the baseline document on 13-May-96: CM7A-009B CM7A-013 CM7A-018A CM7A-019A CM7A-021A CM7A-027 CM7A-029C CM7A-031 CM7A-038 CM7A-040 CM7A-043 CM7A-047 CM7A-048A CM7A-050A CM7A-054 • Deleted changes related to PIRN CM7A-012A, which was incorporated into the baseline document but has since been withdrawn. • Incorporated IRNs which have been MSFC/CCB approved after baseline: IRN No. (PIRN No.): 001 (20-0001A) 002 (20-0016) 003 (20-0010) Note: IRN 003 incorporated into drawings 301475 and 301477 in Appendix. G 004 (20-0005) 005 (20-0006) 006 (20-0007) 007 (20-0018) 008 (CM7A-028A) 009 (20-0004) 010 (20-0008) 011 (20-0012) 012 (CM7A-037B) 013 (20-0022) 014 (CM7A-061A) 015 (20-0009A)	

(File directly after cover sheet)

TRW Space & Electronics Group
One Space Park
Redondo Beach, CA 90278

TRW

Revision/Change Record

For Document No IF1-20 C

SYMBOL	DATE	AUTHORIZATION	REVISION/CHANGE DESCRIPTION	PAGES AFFECTED
B	5/02/97	J. F. Donaghy SI Instr. Accomm. R. I. Iwens Sys. Eng & Int. J. G. Payne Spacecraft & Observ. J. A. Zboril Product Assurance R. S. Watson Operations S. J. Loer Telescope Systems K. A. Soranno ICD Book Mgr. M. Otomo Configuration Mgr. 970502 CADM/PDMO	• Incorporated the following IRNs which were MSFC/CCB approved since the last release (Rev. A): IRN No. (PIRN No.): 016 (20-0002B) 017 (20-0014) 018 (20-0030) 019 (20-0011) 020 (20-0019A) 021 (20-0037A) 022 (20-0028B) 023 (20-0024) 024 (20-0029) 025 (20-0041) 026 (20-0043) 027 (20-0017A) 028 (20-0021B) 029 (20-0042) 030 (20-0013B) 031 (20-0020A) 032 (20-0036) 033 (20-0046) 034 (20-0026A) 035 (20-0039) 036 (20-0048) 037 (20-0047) 038 (20-0031) 039 (20-0032) 040 (20-0049)	

(File directly after cover sheet)

TRW Space & Electronics Group

One Space Park
Redondo Beach, CA 90278

TRW

Revision/Change Record

For Document No IF1-20 C

SYMBOL	DATE	AUTHORIZATION	REVISION/CHANGE DESCRIPTION	PAGES AFFECTED
C1	1/30/98	K. A. Soranno ICD Book Manager J. F. Donaghy SI Instr. Accomm. R. I. Iwens Sys. Eng & Int. J. G. Payne Spacecraft & Observ. J. A. Zboril Product Assurance R. S. Watson Operations S. C. Texter Telescope Systems 98/02/26 PDMO	• Incorporated the following IRNs which were MSFC/CCB approved since the last release (Rev. A): IRN No. (PIRN No.): 041 (20-0035) 042 (20-0025B) 043 (20-0050A) 044 (20-0023A) 045 (20-0038A, Superseded by IRN 050) 046 (20-0053) 047 (20-0054) 048 (20-0003B) 049 (20-0055) 050 (20-0059) 051 (20-0060A) 052 (20-0061) 053 (20-0062A) 054 (20-0058A) 055 (20-0057A) 056 (20-0051)	

(File directly after cover sheet)

TRW Space & Electronics Group

One Space Park
Redondo Beach, CA 90278

TRW

Revision/Change Record

For Document No IF1-20 C

SYMBOL	DATE	AUTHORIZATION	REVISION/CHANGE DESCRIPTION	PAGES AFFECTED
C	7/16/98	John F Donaghy J. F. Donaghy SI Instr. Accomm.	• Incorporated the following IRNs which were MSFC/CCB approved since the last release (Rev. B):	
			IRN No. (PIRN No.):	
		Ralph Iwens R. I. Iwens Sys. Eng & Int.	041 (20-0035)	90,92, C4, C5
			042 (20-0025B)	54
			043 (20-0050A)	75,76, G3
		D. H. Brady Spacecraft & Observ.	044 (20-0023A)	G7-G12
			045 (20-0038A) [Superseded by IRN 050]	—
		J. A. Zbofil Product Assurance	046 (20-0053)	112
			047 (20-0054) [Includes resultant clerical change]	30,31
		R. S. Watson Operations	048 (20-0003B)	3,4,113-115
			049 (20-0055)	31
			050 (20-0059)	18,19,22,23, 29-31
		S. C. Texter Telescope Systems	051 (20-0060A)	116
			052 (20-0061)	77,A12,A13
		K. A. Soranno ICD Book Mgr.	053 (20-0062A) [Partially superseded by IRN 057]	A12
		N. Vargas PDMO 98-7-29	054 (20-0058A)	G16, G17
			055 (20-0057A)	G20, G21
			056 (20-0051)	G20
			057 (20-0065)	A12
			058 (20-0066)	A-9, A11
			059 (20-0069)	108
			060 (20-0067)	3,4
			061 (20-0063A)	61, 69
			062 (20-0064A)	3, 18, 24, 26, 38, 60, 63, 69, 73, 77, 79, 84, 85, 94, 104, 110, 112, 113, 117, 118, B1-B14, D11, D15
			063 (20-0068B) [Includes clarification change per MSFC]	C4, D5
			064 (20-0070)	A4
			Incorporates IRNs041-064 per	AX2-00-026B.

(File directly after cover sheet)

Table of Contents

1.0: SCOPE **1**
1.1: DEFINITION 1
1.2: SI COMPLEMENT 1
2.0: GENERAL **2**
2.1: APPLICABLE DOCUMENTS 2
2.1.1: Specifications 2
2.1.2: Standards 2
2.1.3: Other Publications 3
2.1.4: Drawings 5
2.2: ACRONYM LIST 6
2.3: COORDINATE SYSTEMS 8
2.3.1: Orbiter Coordinate System 8
2.3.2: Payload Coordinate System 8
2.3.3: AXAF-I Coordinate System 11
2.3.4: Telescope Coordinate System 11
2.3.5: ISIM Coordinate System 11
3.0: INTERFACE REQUIREMENTS **12**
3.1: OPTICAL INTERFACES 12
3.1.1: X-Ray Imaging Interface Description 12
3.1.1.1: High Resolution Mirror Assembly (HRMA) Characteristics 12
3.1.1.2: Aspect Determination System 12
3.1.1.3: Other Error Sources 12
3.1.1.4: X-ray Background Attenuation 12
3.1.2: Light Leaks 13
3.1.2.1: ACIS Aperture Stray Light 13
3.1.2.2: HRC Aperture Stray Light 13
3.2: MECHANICAL INTERFACES 15
3.2.1: Focal Plane Science Instrument Interfaces 15
3.2.1.1: Focal Plane Science Instrument Descriptions 15
3.2.1.1.1: AXAF CCD Imaging Spectrometer 15
3.2.1.1.2: High Resolution Camera 15
3.2.1.2: FPSI Mounting 15
3.2.1.2.1: Mechanical Interface Mounting Details 15
3.2.1.2.2: Harness Mounting 15
3.2.1.2.3:GSE Access 18
3.2.1.2.4: FPSI Installation Torques 18
3.2.1.3: Aim Point Selection and Focus Adjustment 18
3.2.1.3.1 Aim Point Selection 18
3.2.1.3.2: Focus Adjustment 18
3.2.1.4: FPSI-to-Observatory Alignment 18
3.2.1.4.1: Static Alignment 18

3.2.1.4.1.1: Observatory Static Alignment and Orientation 18
3.2.1.4.1.2: FPSI Static Alignment and Orientation 20
3.2.1.4.2: On-Orbit Alignment Stability 20
3.2.1.4.2.1: Observatory Alignment Stability 20
3.2.1.4.2.2: FPSI Alignment Stability 21
3.2.1.4.3: FPSI Alignment Provisions 21
3.2.1.4.4: SIM Drill Templates 21
3.2.1.5: Fiducial Light System 22
3.2.1.5.1: Location of Fiducial Lights 22
3.2.1.5.2: Fiducial Light Characteristics 22
3.2.2: Grating Mechanical Interfaces and Locations 24
3.2.2.1 Envelope 24
3.2.2.2 Mounting 24
3.2.2.2.1 Grating Orientation and Coordinates 24
3.2.2.2.2 LETG and HETG Mounting 24
3.2.2.3: Grating Alignment 26
3.2.2.4: X-Ray Beam Geometry 26
3.2.2.5: OTG Command and Fail-Safe Modes 26
3.2.2.6: Grating Simulators 28
3.2.2.6.1: Mechanical Features 28
3.2.2.6.2: Alignment Features 28
3.2.2.6.3: Finish Requirements 28
3.2.2.6.4: Cleanliness Requirements 28
3.2.2.6.5: Protection and Handling 28
3.2.2.6.6: Product Assurance 29
3.2.3: Mass Properties 29
3.2.3.1: Weight 29
3.3: THERMAL INTERFACES 32
3.3.1: On-Orbit Thermal Environment 32
3.3.1.1: FPSI Thermal Environment 32
3.3.1.1.1: FPSI Thermal Interfaces 32
3.3.1.1.1.1: ACIS Detector Assembly Thermal Interfaces 32
3.3.1.1.1.2: ACIS Support Structure/DPA/DEA Thermal Interfaces 33
3.3.1.1.1.3: ACIS Radiator Thermal Interfaces 37
3.3.1.1.1.4: ACIS Telescope Shade and Sun Shade Thermal Interfaces for On-orbit Operation. 37
3.3.1.1.1.5: ACIS PSMC Thermal Interfaces 38
3.3.1.1.1.6: HRC Instrument Thermal Interfaces 38
3.3.1.1.1.7: (Deleted) 49
3.3.1.1.2: Thermal Characteristics and Models 49
3.3.1.1.3: FPSI Thermal Power Modes 50
3.3.1.1.3.1: ACIS Thermal Power Modes 50
3.3.1.1.3.2: HRC Thermal Power Modes 50
3.3.1.1.3.3: (Deleted) 50
3.3.1.2: Grating Thermal Interface 54

3.3.1.2.1: Grating Thermal Environment 54
3.3.1.2.2: (Deleted) 54
3.3.2: Science Instrument Thermal Control 56
3.3.2.1: Science Instrument Temperature Range 56
3.3.2.2: FPSI Survival and Operational (Trim) Heater Requirements 56
3.3.3: Other Thermal Environments 56
3.3.3.1: Preflight 56
3.3.3.1.1: X-Ray Calibration 56
3.3.3.1.2: Prelaunch and Ground Testing 56
3.3.3.1.3: Transportation and Storage 60
3.3.3.2: Flight 60
3.3.3.2.1: ACIS Orientation During Shuttle Open Cargo Bay and Transfer Orbit Phases. 60
3.4: STRUCTURAL LOADS AND DYNAMICS 61
3.4.1: Structural Loads and Dynamics Description 61
3.4.1.1: Structural and Dynamic Math Models 61
3.4.1.2: Launch and Landing Loads 61
3.4.1.2.1: Natural Frequency Requirements 61
3.4.1.2.2: Random Vibrations 62
3.4.1.2.2.1: Science Instrument Random Vibrations 62
3.4.1.2.2.2: Fiducial Light Random Vibrations 62
3.4.1.2.3: Acoustics 62
3.4.1.2.4: Pressure 63
3.4.1.2.5: (Deleted) 63
3.4.1.2.6: Shock loads 63
3.4.1.2.7: SIM Translation Table Stiffness Coefficients 63
3.4.1.2.8: HRC Mount Interface Loads 69
3.4.1.2.9: ACIS Mount Interface Loads 69
3.4.1.2.10: FPSI Dynamic Envelope 69
3.4.1.3: Handling and Transportation 69
3.4.1.4: Orientation 69
3.4.2: Vibration Compatibility 71
3.4.2.1: FPSI Induced Disturbances 71
3.4.2.1.1 HRC Door Constraints 71
3.4.2.2: FPSI Vibration Sensitivity 71
3.5: ELECTRICAL INTERFACES 72
3.5.1: Electrical Power Interface 72
3.5.1.1: Input Voltage 72
3.5.1.2: Bus Characteristics 72
3.5.1.3: Power Control 72
3.5.1.4: Circuit Protection 72
3.5.1.5: FPSI Power Requirements 72
3.5.1.6: Power Redundancy 72
3.5.2: Connectors and Harnesses 73
3.5.2.1: Interface Connectors 73

3.5.2.1.1: Connector Locations and Types 73
3.5.2.1.2: (Deleted) 73
3.5.2.2: Harnesses 73
3.5.2.3: Shielding 73
3.5.2.3.1: HRC Fiducial Light Conductor Shielding 73
3.5.2.3.2: (Deleted) 73
3.5.2.4: Interface Signals 74
3.5.3: Electromagnetic Compatibility 74
3.5.3.1: EMI and RFI 74
3.5.3.2: Electrical Grounding 74
3.5.3.2.1: SI Electronic Equipment Grounding 74
3.5.3.2.2: ACIS Sunshade Assembly Grounding 74
3.5.4: Magnetics 77
3.5.4.1: Magnetic Field Intensity 77
3.5.4.2: On-orbit AC Magnetic Field Emission Limit 77
3.5.5: SI Protection 77
3.5.5.1: Bright Object Protection 77
3.5.5.2: Radiation Detector Signal 77
3.6: COMMAND AND DATA HANDLING INTERFACES 78
3.6.1: Commands 78
3.6.1.1: SI Commanding 78
3.6.1.1.1: ACIS - OBC Software - Ground Software 78
3.6.1.1.1.1: Buffer Size 78
3.6.1.1.1.2: Command Formats 78
3.6.1.1.1.3: ACIS Operations 78
3.6.1.2: ACIS Processor Loads 79
3.6.2: SI Telemetry 79
3.6.2.1: SI Science Data 79
3.6.2.2: SI Engineering Data 84
3.6.2.3: (Deleted) 84
3.6.2.4: Telemetry Synchronization 84
3.6.2.5: Telemetry Format Changes 84
3.6.3: Central Timing 84
3.6.4: RCTU Characteristics 85
3.6.5: CCDM/SI Interface Requirements 86
3.6.5.1: SI Command Interface Requirements 86
3.6.5.1.1: Serial Digital Commands 86
3.6.5.1.1.1: Serial Digital Command Characteristics 86
3.6.5.1.1.2: Serial Digital Command Timing 88
3.6.5.1.2 High Level Pulse Commands 90
3.6.5.1.2.1 High Level Pulse Command Characteristics 91
3.6.5.1.2.2 High Level Pulse Command Timing 91
3.6.5.2: SI Telemetry Interface Requirements 92
3.6.5.2.1 Serial Digital Telemetry 92
3.6.5.2.1.1 Serial Digital Telemetry Characteristics 92

3.6.5.2.1.2 Serial Digital Telemetry Timing 94
3.6.5.2.2 Active Analog Telemetry 97
3.6.5.2.2.1 Active Analog Telemetry Characteristics 97
3.6.5.2.3 Passive Analog Telemetry 99
3.6.5.2.3.1 Passive Analog Telemetry Characteristics 101
3.6.5.2.4 Bilevel Telemetry 101
3.6.5.2.4.2 Bilevel Telemetry Characteristics 103
3.6.5.3 Synchronization Signals 104
3.7: POINTING AND CONTROL 107
3.8: (DELETED) 107
3.9: OTHER REQUIREMENTS 107
3.9.1: Natural And Induced Environments 107
3.9.1.1: Natural and Induced Environment Definition 107
3.9.1.1.1: Meteoroid and Orbital Debris Protection 107
3.9.1.2: (Deleted) 107
3.9.1.3: (Deleted) 107
3.9.1.4: (Deleted) 107
3.9.1.5: Corona Suppression 107
3.9.1.6: Radiation Environment 107
3.9.1.6.1: Solar Flare Protons 108
3.9.1.6.2: Trapped Electrons 108
3.9.1.6.3: Trapped Protons 108
3.9.1.6.4: Total Dose 108
3.9.1.6.5: Cosmic Ray and Solar Flare Environments 108
3.9.1.6.6: Spacecraft Charging Effects 108
3.9.1.6.7: Radioactive Sources for Flight Contamination Monitor 109
3.9.2: Contamination Control 110
3.9.2.1: SI External Environment 110
3.9.2.1.1: Orbiter Cargo Bay Environment 110
3.9.2.1.2: (Deleted) 110
3.9.2.2: SI Cleanliness 110
3.9.2.2.1: Internal 110
3.9.2.2.2: External 110
3.9.2.2.3: Materials Selection 110
3.9.2.3: Venting 111
3.9.2.3.1: Ascent and Reentry Venting 111
3.9.2.4: Handling and Transportation Contamination 111
3.9.3: Ground Support Equipment And Facilities 112
3.9.3.1: SI Test and Integration Description 112
3.9.3.1.1: Interface Testing at SI Facility 112
3.9.3.1.2: X-Ray Testing and Calibration 112
3.9.3.1.3: SI Integration Activities 112
3.9.3.1.3.1: Pre-Integration Functional Test 112
3.9.3.1.3.2: Post-Integration Functional Tests 113
3.9.3.2: Transportation and Storage Monitoring 113

3.9.3.3: SI Prelaunch Activities 113
3.9.3.3.1: SI Tests 113
3.9.3.3.2: Maintenance of FPSI Internal Atmosphere 113
3.9.3.3.2.1: Gas/Vacuum GSE Access to FPSIs 114
3.9.3.3.2.2: GSE Responsibility 114
3.9.3.3.2.3: Time Constraints on GSE Access 114
3.9.4: System Safety 115
3.9.4.1: Flight Safety 115
3.9.4.2: Launch Site Safety 115
3.9.4.3: Nuclear Sources 115
3.9.5: Access 116
3.9.5.1: SI Access 116
3.9.6: Crew Systems 116
3.9.6.1: Crew Systems Requirements 116
3.9.7: Quality Assurance 116
3.9.7.1: Quality Assurance Requirements 116
3.10: CONTRACTOR FURNISHED EQUIPMENT 117
3.11: (DELETED) 117

4.0: VERIFICATION 118

4.1: GENERAL 118
4.1.1: Responsibility for Verification 118
4.1.2: Verification Method Selection 118
4.1.2.1: Assessment 119
4.1.2.1.1: Similarity Assessment 119
4.1.2.1.2: Analysis Assessment 119
4.1.2.1.3: Inspection Assessment 119
4.1.2.1.4: Demonstration Assessment 119
4.1.2.1.5: Validation of Records Assessment 120
4.1.3: Tests 120
4.1.3.1 Performance Tests 120
4.1.3.2 Functional Tests 120
4.1.3.3 Environmental Tests 120
4.1.3.4 Special Tests 121
4.1.3.5 Interface Tests 121
4.1.3.6 Structural Tests 121
4.2: PHASED VERIFICATION REQUIREMENTS 122
4.2.1:Development Phase 122
4.2.2: Qualification / Acceptance 122
4.2.3: Acceptance 123
4.2.4: Prelaunch Phase 123
4.2.5: Launch Phase 123
4.2.6: Flight/Orbital Verification Phase 123
4.2.7: X-ray Calibration 123
4.3: VERIFICATION MATRIX 124

4.4: HARDWARE AND SOFTWARE FAILURES 126
4.5: VERIFICATION FACILITIES AND EQUIPMENT 126
4.6: VERIFICATION DOCUMENTATION 126

APPENDIX A: SI/SI INTERFACES A1-A16

APPENDIX B: VERIFICATION RESPONSIBILITY MATRIX **B1-B14**

APPENDIX C: OBSERVATORY TO ACIS ELECTRICAL INTERFACES C1-C28

APPENDIX D: OBSERVATORY TO HRC ELECTRICAL INTERFACES D1-D18

APPENDIX E: (RESERVED) E1-E2

APPENDIX F: (RESERVED) F1-F2

APPENDIX G: INTERFACE CONTROL DRAWINGS G1-G31

List of Figures

FIGURE 2.3-1: ORBITER COORDINATE SYSTEM........9
FIGURE 2.3-2: AXAF-I COORDINATE SYSTEM........10
FIGURE 2.3-3: ISIM COORDINATE SYSTEM........10
FIGURE 3.2-1: ACIS INSTRUMENT........16
FIGURE 3.2-2: HRC INSTRUMENT........17
FIGURE 3.2-3: OTG COORDINATE SYSTEM........25
FIGURE 3.2-4: X-RAY NOMINAL BEAM CONE ANGLES........27
FIGURE 3.3-1: ISIM HOT AND COLD OPERATIONAL CASE BOUNDARY TEMPERATURES AND IR EMITTANCES FOR ACIS DETECTOR CABLES AND SUPPORT STRUCTURE/DPA/DEA THERMAL ANALYSIS........34
FIGURE 3.3-1A: ISIM COLD SURVIVAL, NON-OPERATING BOUNDARY TEMPERATURES AND IR EMITTANCES FOR ACIS DETECTOR CABLES AND SUPPORT STRUCTURE/DPA/DEA THERMAL ANALYSIS........35
FIGURE 3.3-1B: ISIM ACIS COLD STANDBY MODE 3A BOUNDARY TEMPERATURES AND IR EMITTANCES FOR ACIS DETECTOR CABLES AND SUPPORT STRUCTURE/DPA/DEA THERMAL ANALYSIS........36
FIGURE 3.3-2: ISIM HOT AND COLD OPERATIONAL CASE BOUNDARY TEMPERATURES AND IR EMITTANCES FOR ACIS PSMC THERMAL ANALYSIS........39
FIGURE 3.3-2A: ISIM COLD SURVIVAL, NON-OPERATING BOUNDARY TEMPERATURES AND IR EMITTANCES FOR ACIS PSMC THERMAL ANALYSIS........40
FIGURE 3.3-2B: ISIM ACIS COLD STANDBY MODE 3A, BOUNDARY TEMPERATURES AND IR EMITTANCES FOR ACIS PSMC THERMAL ANALYSIS........41
FIGURE 3.3-2C: ISIM ACIS BAKEOUT MODE BOUNDARY TEMPERATURES AND IR EMITTANCES FOR ACIS PSMC THERMAL ANALYSIS........42
FIGURE 3.3-3: ISIM HOT AND COLD OPERATIONAL CASE BOUNDARY TEMPERATURES AND IR EMITTANCES FOR HRC THERMAL ANALYSIS, HRC VIEWING........44
FIGURE 3.3-3A: ISIM COLD SURVIVAL, NON-OPERATING BOUNDARY TEMPERATURES AND IR EMITTANCES FOR HRC THERMAL ANALYSIS........45
FIGURE 3.3-3B: ISIM HOT AND COLD OPERATIONAL CASE BOUNDARY TEMPERATURES AND IR EMITTANCES FOR HRC THERMAL ANALYSIS, ACIS VIEWING........46
FIGURE 3.3-3C: ISIM COLD STANDBY MODE 3A BOUNDARY TEMPERATURES AND IR EMITTANCES FOR HRC THERMAL ANALYSIS........47
FIGURE 3.3-4: HRC INSTRUMENT AND ELECTRONICS BOXES IR EMITTANCES........48
FIGURE 3.3-5: OTG THERMAL ENVIRONMENT........55
FIGURE 3.4-1: FIDUCIAL LIGHT RANDOM VIBRATION ENVIRONMENT........62
FIGURE 3.4-2: PRESSURE AT SI APERTURE VERSUS TIME AFTER LAUNCH........63
FIGURE 3.4-3: ACIS AND HRC MOUNT INTERFACE LOCATIONS........68

FIGURE 3.5-2: POWER GROUNDING - AXAF 75
FIGURE 3.5-3: ESD GROUNDING - AXAF 76
FIGURE 3.6-1: AXAF-I TELEMETRY MINOR FRAME FORMAT 81
FIGURE 3.6-2A: SCIENCE AND ENGINEERING TELEMETRY MAJOR FRAME FORMAT 1 82
FIGURE 3.6-2B: SCIENCE AND ENGINEERING TELEMETRY MAJOR FRAME FORMAT 2 82
FIGURE 3.6-3: EARTH CENTERED INERTIAL COORDINATES 83
FIGURE 3.6.5-1: SERIAL DIGITAL COMMAND INTERFACE CIRCUITRY 87
FIGURE 3.6.5-2: SERIAL DIGITAL COMMAND TIMING (AT SI INTERFACE) 89
FIGURE 3.6.5-3: HIGH-LEVEL PULSED DRIVER DIAGRAM 90
FIGURE 3.6.5-4: HIGH-LEVEL PULSE COMMAND TIMING 91
FIGURE 3.6.5-5: SERIAL DIGITAL TELEMETRY CIRCUIT 93
FIGURE 3.6.5-6: SERIAL DIGITAL TELEMETRY TIMING (AT SI INTERFACE) 96
FIGURE 3.6.5-7: ACTIVE ANALOG TELEMETRY CIRCUIT 98
FIGURE 3.6.5-8: PASSIVE ANALOG TELEMETRY CIRCUIT 100
FIGURE 3.6.5-9: BILEVEL TELEMETRY CIRCUIT 102
FIGURE 3.6.5-10: DIFFERENTIAL SYNC PULSE INTERFACE DIAGRAM 104
FIGURE 3.6.5-11: SINGLE ENDED SYNC SIGNAL INTERFACE DIAGRAM 105
FIGURE 3.9-1: TRANSIENT PULSE SHAPE 109

Figure 3.5-1: ISIM Grounding Diagram G3
Figure 3.5-1A: ACIS Active Analog Circuits G4
Figure 3.5-1B: SIM DPA/PSMC/RCTU Grounding Interface G5
Drawing 301330: Interface Control Drawing - Fiducial Light, HRC G6
Drawing 301331: ICD - Objective Transmission Grating (OTG), AXAF-I G7-G12
Drawing 301438: Interface Control Drawing - Fid Light and Detector G13-G15
Drawing 301475: Interface Control Drawing - ACIS G16-G19
Drawing 301476: Interface Control Drawing - HRC G20-G21
Drawing 301477: Interface Control Drawing - Translation Table to FPSIs G22-G25
Drawing 533571: Template Assy, Drill - HRC G26-G27
Drawing 533572: Template Assy, Drill - ACIS G28-G30
Drawing 822022: Interface Control Drawing - Fiducial Light - ACIS G31

List of Tables

TABLE 3.1-1: ACIS FIDUCIAL LIGHT COMBINATIONS FOR PARAGRAPH 3.1.1.2C 14
TABLE 3.1-2: FPSI UV AND XUV STRAY LIGHT FROM SOLAR SOURCES 14
TABLE 3.1-3: FPSI UV AND XUV STRAY LIGHT FROM TERRESTRIAL SOURCES 14
TABLE 3.2-1: FPSI INSTALLATION TORQUES 19
TABLE 3.2-2: ACIS FIDUCIAL LIGHT BEAM ANGULAR SIZE 23
AND ORIENTATION 23
TABLE 3.2-3: HRC FIDUCIAL LIGHT BEAM ANGULAR SIZE 23
AND ORIENTATION 23
TABLE 3.2-4: ACIS EQUIPMENT CONTROL WEIGHTS AND MOMENTS 30
TABLE 3.2-5: HRC EQUIPMENT CONTROL WEIGHTS AND MOMENTS 31
TABLE 3.3-1: ACIS THERMAL POWER MODES 51
TABLE 3.3-2: HRC THERMAL POWER MODES 53
TABLE 3.3-3: SCIENCE INSTRUMENT TEMPERATURE RANGES 57
TABLE 3.3-4: SURVIVAL AND OPERATIONAL (TRIM) HEATER AREA AND POWERS 58
TABLE 3.4-1: TRANSLATION TABLE STIFFNESS MATRIX AT HRC LOCATION 64
TABLE 3.4-2: TRANSLATION TABLE STIFFNESS MATRIX AT SUPPORT STRUCTURE LOCATION 66
TABLE 3.4-3: TRANSLATION TABLE STIFFNESS MATRIX AT ACIS DETECTOR ASSEMBLY LOCATION 67
TABLE 3.4-4: SI AND AXAF-I ORIENTATIONS 70
TABLE 3.6-1: ACIS DATA PACKET FORMAT 80
TABLE 3.6-2: (DELETED) 80
TABLE 3.6.5-1: SERIAL DIGITAL COMMAND CHARACTERISTICS 88
TABLE 3.6.5-2: HIGH-LEVEL PULSE COMMAND CHARACTERISTICS 91
TABLE 3.6.5-3: SERIAL DIGITAL TELEMETRY CHARACTERISTICS 95
TABLE 3.6.5-4: ACTIVE ANALOG SIGNAL CHARACTERISTICS 99
TABLE 3.6.5-5: PASSIVE ANALOG SIGNAL CHARACTERISTICS 101
TABLE 3.6.5-6: BILEVEL TELEMETRY CHARACTERISTICS 103
TABLE 3.6.5-7: DIFFERENTIAL SYNC SIGNAL CHARACTERISTICS 104
TABLE 3.6.5-8: 1 MHZ CLOCK SIGNAL CHARACTERISTICS 105
TABLE 3.6.5-9: SINGLE ENDED SYNC SIGNAL CHARACTERISTICS 106
TABLE 4.3. VERIFICATION REQUIREMENTS MATRIX (VRM) CODING KEY 125

1.0: SCOPE

1.1: DEFINITION

This document describes and defines the interfaces between the AXAF-I Observatory and the AXAF-I Science Instruments. The body of the document, with reference to Appendices and to other documents, deals with Observatory to SI interfaces. Appendix 'A' defines SI to SI interfaces.

1.2: SI COMPLEMENT

The AXAF-I Science Instrument (SI) complement consists of two Focal Plane Science Instruments (FPSI) and two objective transmission gratings (OTG). The focal plane instruments are the AXAF-I CCD Imaging Spectrometer (ACIS) and the High Resolution Camera (HRC). The two Objective Transmission Gratings are the Low Energy Transmission Grating (LETG) and the High Energy Transmission Grating (HETG). OTG spectroscopy observations are normally performed with the HETG paired with the ACIS or with the LETG paired with the HRC, although either OTG may be used with either imaging instrument.

2.0: GENERAL

2.1: APPLICABLE DOCUMENTS

The following documents form a part of this requirement to the extent specified herein. In the event of conflict between documents referenced below and other detailed content of this ICD, the requirements specified herein shall govern.

2.1.1: Specifications

Specification	Title	Paragraph(s) Where Referral Appears
MSFC-SPEC-1238	Thermal Vacuum Bakeout Specification for Contamination Sensitive Hardware	3.9.2.2.1; 3.9.2.2.3
MIL-B-5087B(3)	Electrical Bonding and Lightning Protection for Aerospace Systems	3.5.3.2.1
MSFC-SPEC-1443	Outgassing Test for Non-metallic Materials Associated with Sensitive Optical Surfaces	3.9.2.2.3
MIL-E-6051D(1)	Systems Electromagnetic Compatibility Requirements, September 7,1967	3.5.3.1
MSFC-SPEC-1837	MSFC AXAF-I X-Ray Test Calibration Facility Requirements Document	3.9.3.1.2; 4.2.7
IRN 060 (PIRN 20-0067 — TRW SY 24-2 (DPD692, CM02) Latest Issue	AXAF-I Observatory Contract End Item Specification	4.1; 3.1.1.1; 3.1.1.2; 3.7

2.1.2: Standards

IRN 062 (PIRN 20-0064A

Standard	Title	Paragraph(s) Where Referral Appears
MIL-STD-461B Part 1 and Part 3	Requirements for Electromagnetic Interference Characteristics	3.5.3.1
MIL-STD-1246B	Product Cleanliness Levels and Contamination Control Program	3.9.2.2.1; 3.9.2.2.2; 3.9.2.2.3
MSFC-STD-531	High Voltage Design Criteria	3.9.1.5
MSFC-CR-5320.9	Payload and Experiment Failure Mode and Effects Analysis and Critical Items List Groundrules	4.2

2.1.3: Other Publications

Publication	Title	Paragraph(s) Where Referral Appears	
DPD692 OP05, 23 Oct 96	AXAF Operations Constraints, Restrictions and Limitations	3.6.1.1	
DPD692 SE11i (TRW D22088) Rev. E as defined by MSFC memo EJ32 (97-051), which is TRW ECR H099	Dynamic Loads and Criteria	3.4.1.2	IRN 060 (PIRN 20-0067)
DPD692 SE11w , 11 Jan 96	System and Subsystem Technical Analysis and Models	3.2.2.3	
DPD692 SE17, (TRW D23684) Latest Issue	Instrument Program and Command List	3.6.1.1; 3.6.2.1	
DPD692 SE19, 11 Jan 96, Rev. C (TRW D17389) plus Rev. D1, 08 Oct 96	Electromagnetic Compatibility Control Plan	3.5.1.2; 3.5.2.3; 3.5.3.1; 3.5.3.2.1	
DPD692 SE28, 11 Jan 96 (TRW D17393A)	Contamination Control and Implementation Plan	3.9.3.3.2.4	IRN 048 (PIRN 20-0003B)
EV1-8 (SE29) Rev.A, 11 Jan 96 Plus SCNs B1, 28 Jun 96 and B2, 20 Dec 96	AXAF-I Environment Document	3.4.1.2.2.1; 3.4.1.2.3; 3.4.1.2.4; 3.4.1.2.6; 3.9.1.1.1; 3.9.1.6; 3.9.1.6.5	IRN 060 (PIRN 20-0067)
DPD692 SE31, 09 Sep 96	AXAF-I Systems Error Budgets and Analysis	3.1.1.2	
DPD692 SA03, (TRW D17396) 09 Oct 92	AXAF-I Safety Plan	3.9.4.3	
GP-1098E	KSC Ground Safety Plan, Launch Complex and KSC Industrial Amco, Volumes 1 and 2	3.9.4.2	
ICD-B-81217 Latest Issue	AXAF/IUS Interface Control Document	3.3.3.2.1	IRN 062 (PIRN 20-0064A)
IF1-0016, Rev. A, 03 Oct 96	Integrated Science Instrument Module to Telescope System and Spacecraft Interface Control Document	3.1.1.4	
IF1-29 13 Sep 96	AXAF-I Spacecraft to Telescope Interface Control Document	3.1.1.4; 3.9.1.6.7	
JSC 20001	Orbital Debris Environment for Space Station	3.9.1.1	
JSC-SP-R-0022A	Vacuum Stability Requirements of Polymeric Materials for Spacecraft Application General Specification	3.9.2.2.1; 3.9.2.2.3	

	Publication	Title	Paragraph(s) Where Referral Appears
IRN 048 (PIRN 20-0003B)	KHB 1700.7B	Shuttle Transportation System Payload Ground Safety Handbook	3.9.4.2, 3.9.3.3.2.4
	KMI 1710.1C	KSC Safety Program	3.9.4.2
	MMI 1860.4B	Reporting Requirements for Minor Radioactive Sources	3.9.4.3
IRN 051 (PIRN 20-0060A)	MSFC Letter, 11 Feb. 97 EJ33(97-012) to Distribution	Informal Interface Control Document (ICD) & Technical Description of OTG Inspection Roles and Responsibilities	3.9.5.1
	MSFC-RQMT-2601 28 Oct. 96	AXAF Flight Contamination Monitors, Development	3.9.1.6.7
	NHB 1700.1 (VI-A)	Basic Safety Manual	3.9.4.1
	NHB 5300.4 (1D-2)	Safety, Reliability, Maintainability and Quality Provisions for the Space Shuttle Program	3.9.7.1
	NASA TM-86481	Natural Environment Design Criteria (AXAF-I)	3.9.1.1
	NSTS-1700.7B	Safety Policy and Requirements for Payload Using the National Space Transportation System	3.9.4.1
IRN 062 (PIRN 20-0064A)	NSTS 21330	AXAF Payload Integration Plan	3.3.3.2.1
	NSTS-07700, Volume XIV, Revision J Attachment 1	Space Shuttle System, Payload Accommodations	2.3.1; 3.9.1.1; 3.9.2.1.1; 3.9.6.1
	NSTS-13830B	Implementation Procedure for STS Payload System Safety Requirements	3.9.4.1; 3.9.4.3
	NSTS-18798A	Interpretation of STS Payload Safety Requirements	3.9.4.1
	SAO-HRC-DR-93-022, Rev. A February 1994	HRC Electromagnetic Compatibility Control Plan	3.5.2.3; 3.5.3.1; 3.5.3.2.1
	MIT 36-01205 SHF07 Revision -02	ACIS Electromagnetic Compatibility Control Plan	3.5.2.3; 3.5.3.1; 3.5.3.2.1
	SSP 30425	Space Station Program Natural Environment Definition for Design	3.9.1.1
IRN 062 (PIRN 20-0064A)	TRW D17387, 17 Jan 96, Rev. D	AXAF-I RCTU User Interface Requirements	3.6.4
	TRW SR4-26	VRSD Compliance Document	4.6

2.1.4: Drawings

Drawings	Title	Paragraph(s) Where Referral Appears
TRW 301475	Interface Control Drawing, ACIS	3.2.1.2; 3.3.3.2; 3.4.1.2.10
TRW 301476	Interface Control Drawing, HRC	3.2.1.2; 3.3.3.2; 3.4.1.2.10
TRW 301477	Interface Control Drawing, SIM Translation Table to FPSIs	
TRW 301330	Interface Control Drawing, Fiducial Light, HRC - AXAF-I	3.2.1.5
TRW 301331	Interface Control Drawing, Objective Transmission Grating	3.2.2.1; 3.2.2.2; 3.2.2.3
TRW 301438	Interface Control Drawing - Fid Light and Detector, AXAF-I	3.2.1.5.1
BASD 533571 Revision B	Template Assy, Drill - HRC	3.2.1.4.4
BASD 533572 Revision D	Template Assy, Drill - ACIS	3.2.1.4.4
TRW 822022	Interface Control Drawing, Fiducial Light, ACIS - AXAF-I	3.2.1.5

2.2: ACRONYM LIST

ACC	Aft Containment Cover
ACIS	AXAF-I CCD Imaging Spectrometer
AXAF-I	Advanced X-Ray Astrophysics Facility-Imaging
ASC	AXAF Science Center (SAO)
BASD	Ball Aerospace Systems Division
CCD	Charge Coupled Device
CCDM	Communications, Command and Data Management
CDM	Command and Data Management
CDR	Critical Design Review
CEI	Contract End Item
CFE	Contractor Furnished Equipment
CM	Center of Mass
CTU	Command and Telemetry Unit
DEA	Detector Electronics Assembly (for ACIS)
DPA	Detector Processor Assembly (for ACIS)
DSN	Deep Space Network
EGSE	Electronic Ground Support Equipment
EKC	Eastman-Kodak Corporation
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EPS	Electrical Power Subsystem
ESD	Electrostatic Discharge
FPSI	Focal Plane Science Instrument
GESS	Grating Element Support Structure
GFE	Government Furnished Equipment
GSE	Ground Support Equipment
HESS	High Energy Support Structure
HETG	High Energy Transmission Grating
HRC	High Resolution Camera
HRMA	High Resolution Mirror Assembly
ICD	Interface Control Document
IPI	Instrument Principal Investigator
IR	Infra-red

ISIM	Integrated Science Instrument Module
JSC	Johnson Space Center
kbps	kilobits per second
KSC	Kennedy Space Center
LETG	Low Energy Transmission Grating
LOS	Line of Sight
MLI	Multi-layer Insulation
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
OB	Optical Bench
OBA	Optical Bench Assembly
OBC	On-Board computer
OFLS	Off-Line Systems (software)
OGM	Objective Grating Mechanism
OTG	Objective Transmission Grating
PCAD	Pointing Control and Aspect Determination
PRD	Program Requirements Document
PSMC	Power Supply and Mechanisms Controller (for ACIS)
RCTU	Remote Command and Telemetry Unit
RFI	Radio Frequency Interference
rms	Root Mean Square
SI	Science Instrument
SIM	Science Instrument Module
SSA	Support Structure Assembly
STS	Space Transportation System
TBD	To Be Determined
TBR	To Be Revised
TBS	To Be Supplied
TFTE	Telescope Forward Thermal Enclosure
TS	Telescope System
TSC	Translating Science Compartment
VRSD	Verification Requirements and Specifications Document
XRCF	X-Ray Calibration Facility

2.3: COORDINATE SYSTEMS

2.3.1: Orbiter Coordinate System

The Orbiter coordinate system is taken from NSTS 07700, Volume XIV, Revision J. The subscript 'O' shall be used in conjunction with the Orbiter coordinate systems. Figure 2.3-1 shows the Orbiter coordinate system.

Origin: As shown in Figure 2.3-1

Orientation: The X-axis is parallel to the centerline of the cargo bay, negative in the direction of launch.

The Z-axis is positive upward in landing attitude.

The Y-axis completes the right-handed system.

2.3.2: Payload Coordinate System

The payload coordinate system is shown in Figure 2.3-2. The subscript 'P' (for payload) shall be used for this coordinate system.

Origin: As shown in Figure 2.3-2

Orientation: The X_P axis is parallel to the TS centerline and to the Orbiter X axis with the positive direction toward the AXAF-I viewing end.

The Y_P axis is perpendicular to the vertical plane of symmetry of the TS, positive direction pointing left when viewing in the +X direction.

The Z_P axis completes the right-handed orthogonal system.

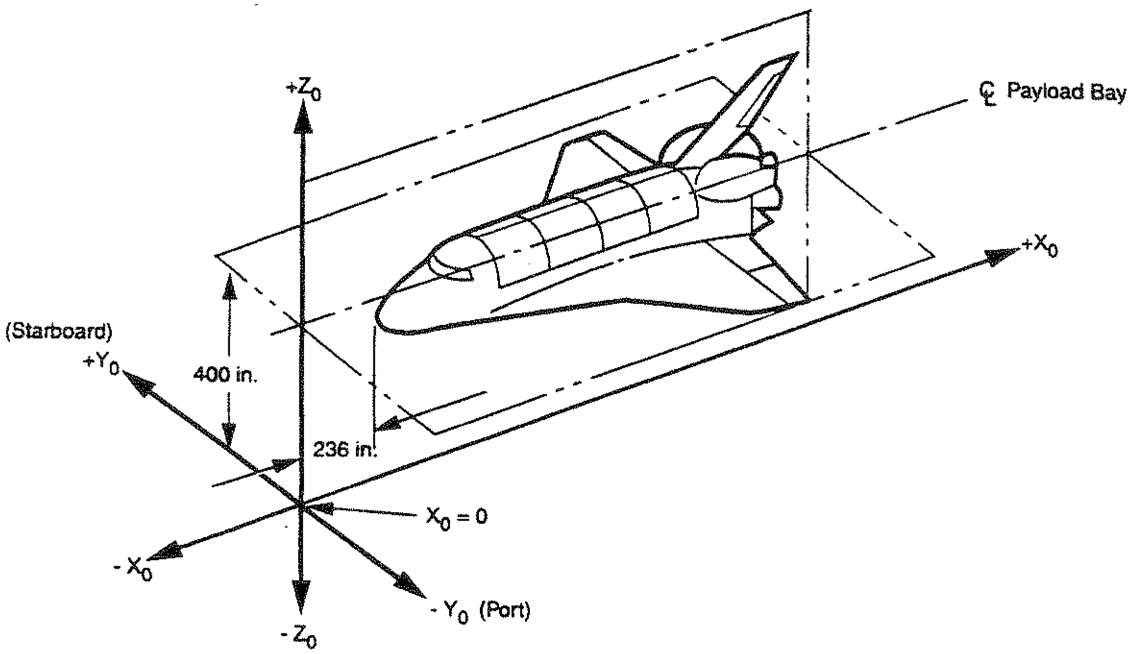


Figure 2.3-1: Orbiter Coordinate System

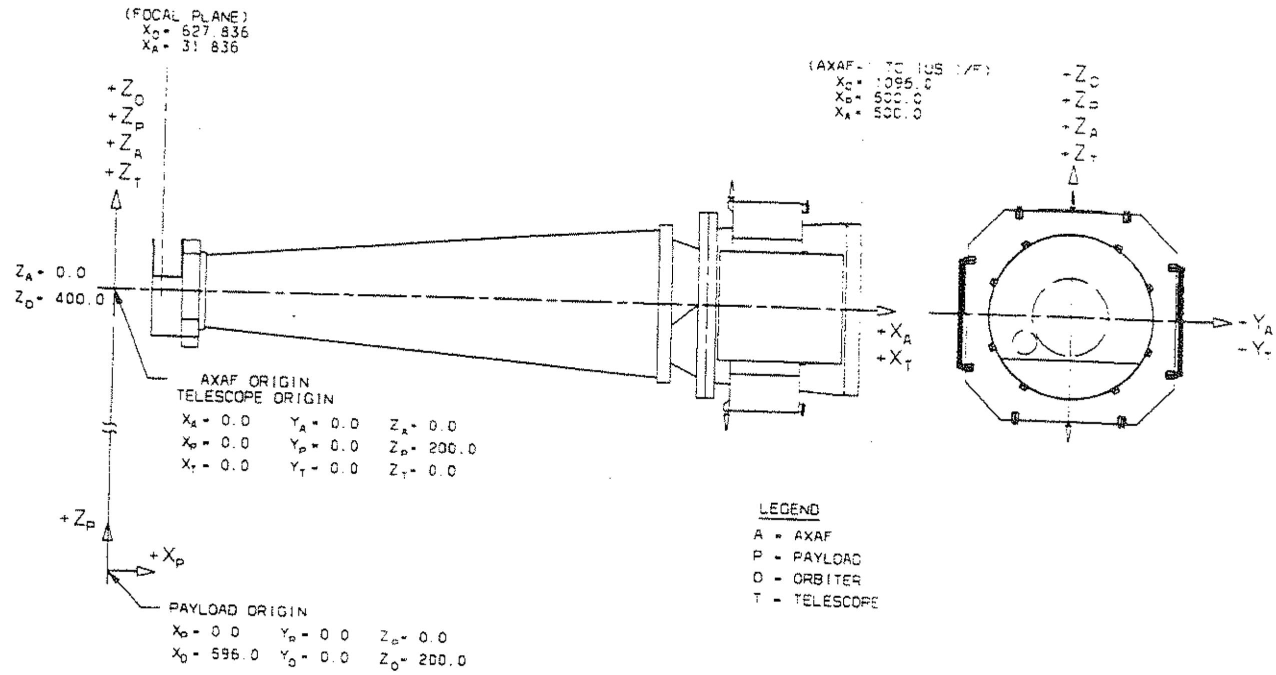


Figure 2.3-2: AXAF-I Coordinate System

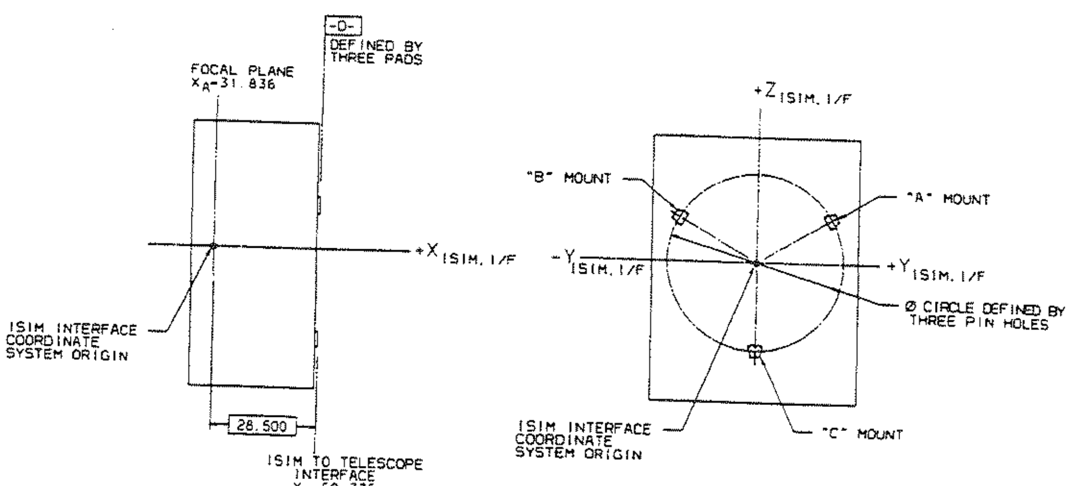


Figure 2.3-3: ISIM Coordinate System

2.3.3: AXAF-I Coordinate System

The AXAF-I coordinate system is also shown in Figure 2.3-2. The subscript 'A' (for AXAF-I), shall be used for this coordinate system.

Origin: As shown in Figure 2.3-2

Orientation: The X_A axis shall coincide with the centerline of the TS with the positive direction towards the viewing end.

The Y_A axis shall be parallel with the Y_P axis, positive direction pointing left when viewing in the +X direction.

The Z_A axis completes the right-handed orthogonal system.

2.3.4: Telescope Coordinate System

The Telescope System coordinates are co-incident with the AXAF-I coordinate system as described in Section 2.3.3 and as illustrated in Figure 2.3-2. The subscript "T" (for Telescope System) shall be used when referencing this coordinate system.

2.3.5: ISIM Coordinate System

The ISIM coordinate system is shown in Figure 2.3-3. The subscript 'ISIM' shall be used for this coordinate system.

Origin: The origin lies on the intersection of the TS centerline and the focal plane such that its coordinates are X_A=31.836, Y_A= 0, Z_A= 0 inches with respect to the AXAF-I coordinate system.

Orientation: The X_{ISIM} axis shall coincide with the centerline of the TS with the positive direction towards the viewing end.

The Y_{ISIM} axis shall be parallel with the Y_A axis, positive direction pointing left when viewing in the +X direction.

The Z_{ISIM} axis completes the right-handed orthogonal system.

3.0: INTERFACE REQUIREMENTS

3.1: OPTICAL INTERFACES

3.1.1: X-Ray Imaging Interface Description

3.1.1.1: High Resolution Mirror Assembly (HRMA) Characteristics

HRMA performance characteristics are specified in the AXAF-I CEI Specification, SY 24-2.

3.1.1.2: Aspect Determination System

Aspect Determination System performance characteristics are specified in the AXAF CEI Specification SY 24-2, Section 3.2.1.8.2

For each FPSI, the axial separation of the fiducial light mounting plane from the SI focal plane, and the θ_Y,θ_Z tilt stability, shall be such that the "axial location induced error" (as defined in Section 4.3.2.2 of DPD692 SE31) does not exceed 0.038 arcseconds over any consecutive 48 hour period of an observation. For information only: This requirement will be satisfied, for either FPSI, if the axial location of the fid light mounting plane is as specified in Interface Control Drawing 301438 (Appendix G), and the angular (θ_Y,θ_Z) alignment stability is as specified in Section 3.2.1.4.2.2.

The FPSI shall, by choice of mounting structure materials and/or temperature control or other means, ensure that the angular motion of the centroid of any set of selected (operating) fiducial lights, in response to temperature variations across the SI, does not exceed 0.030 arcseconds (1-axis, rms) over any consecutive 48 hour period of an observation. (Ref.:Sec. 4.3.2.1 of DPD692 SE31.) This requirement shall not apply for ACIS during the ± 3 hour period around perigee. The fiducial light combinations for which this requirement applies are as follows:

a) HRC-Imaging Detector: Any combination of 3 of the 4 Imaging lights

b) HRC-Spectroscopy Detector: Any combination of 3 of the 4 Spectroscopy lights

c) ACIS: Seven (7) specific combinations of fid lights, as specified in Table 3.1-1.

3.1.1.3: Other Error Sources

Performance characteristics with respect to other error sources are specified in the AXAF CEI Specification SY 24-2, Section 3.2.1.8.3

3.1.1.4: X-ray Background Attenuation

The observatory provides a set of baffles to reduce the level of the unfocused X-ray background seen by the focal plane instruments.

Locations and dimensions of the baffles on the optical bench and on the SIM are defined in IF1-29, Appendix C, drawing 301160, Telescope ICD, sheets 16, 17, 18 and 19. Thickness of the SIM -mounted baffle is defined in Integrated Science Module to Telescope System and Spacecraft Interface control Document, IF1-0016, drawing C301166, sheet 6.

3.1.2: Light Leaks

Paragraphs 3.1.2.1 and 3.1.2.2 specify the Observatory requirements for the limitation of radiation incident upon the entrance aperture of any operating FPSI, from sources external to the SI but not including energy focused by the HRMA.

3.1.2.1: ACIS Aperture Stray Light

The irradiance incident upon any point in the entrance aperture of the ACIS, in the spectral band between 3000 angstroms and 11,000 angstroms, shall not exceed 2.0×10^9 photons/centimeters^2/second. Furthermore, this irradiance shall not exceed the requirements specified for the spectral bands as listed in Tables 3.1-2 and 3.1-3. The ACIS will be considered operating while in its normal science data gathering positions and in its calibration positions.

3.1.2.2: HRC Aperture Stray Light

The irradiance incident upon any point in the entrance aperture of the HRC shall not exceed the requirements specified for the spectral bands as listed in Tables 3.1-2 and 3.1-3. These requirements apply when the HRC is actively observing at the HRMA focal point. Radiation entering from the -X direction in the SIM TSC shall be occluded by means of a baffle mounted to the HRC. Baffle envelope is documented in Drawing 301476 in Appendix G.

TABLE 3.1-1: ACIS FIDUCIAL LIGHT COMBINATIONS FOR PARAGRAPH 3.1.1.2C

Config. No.	Use Of Configuration	ACIS Fid-Light #
1	Imaging - Primary Configuration	1, 2, 6
2	Imaging - Redundant Configuration; Use if 2 or 6 fails	1, 3, 5
3	Imaging - Redundant Configuration; Use if 1 fails	2, 3, 4
4	Spectroscopy - Primary Configuration #1	3, 4, 5
5	Spectroscopy - Redundant Configuration; Use if 3 fails	2, 4, 5
6	Spectroscopy - Primary Configuration #2; also a Redundant Configuration (Use if 4 fails)	1, 5, 6
7	Spectroscopy - Redundant Configuration; Use if 5 fails	2, 4, 6

TABLE 3.1-2: FPSI UV and XUV STRAY LIGHT from SOLAR SOURCES

Wavelength band (Angstroms, Å)	Log_{10} (PST* Requirement)
100-500 (XUV)	-12
500-1000 (UV)	-10
1000-3000 (UV)	-12

* PST = Point Source Transmission

TABLE 3.1-3: FPSI UV and XUV STRAY LIGHT from TERRESTRIAL SOURCES

Wavelength band (Angstroms, Å)	Log_{10} (BST** Requirement)
100-500 (XUV)	-7
500-3000 (UV)	-7

** BST = Broad Source Transmission

3.2: MECHANICAL INTERFACES

3.2.1: Focal Plane Science Instrument Interfaces

3.2.1.1: Focal Plane Science Instrument Descriptions

3.2.1.1.1: AXAF CCD Imaging Spectrometer

The ACIS is comprised of the equipment shown in Table 3.2-4. Figure 3.2-1 shows the configuration of the ACIS detector (radiators not shown). The ACIS warm radiator supports the cold radiator and interfaces with the SIM. IRN 050 (PIRN 20-0059)

3.2.1.1.2: High Resolution Camera

The HRC is provided as a single assembly containing imaging and spectroscopy microchannel plate detectors; associated electronics and power supplies; a shutter assembly; and anti-coincidence shield. The HRC mounts to the SIM kinematically via three bipods which are part of the instrument. Figure 3.2-2 shows the HRC assembly.

3.2.1.2: FPSI Mounting

The observatory Science Instrument Module (SIM) shall provide mounting structure for the HRC and for the various components of ACIS. Any shims necessary to properly align the FPSI with the observatory shall be provided by the SI contractor. Mounting hardware shall be supplied by the SIM contractor.

3.2.1.2.1: Mechanical Interface Mounting Details

ACIS static envelope and mechanical interface details are defined in Drawing 301475,Appendix G. HRC static envelope and mechanical interface details are defined in Drawing 301476,Appendix G.

3.2.1.2.2: Harness Mounting

The Observatory's SIM shall provide all interface harnesses and associated harness and cable clamps for SI to Observatory electrical interfaces.

The Observatory's SIM shall also provide harness clamps for harnesses (provided as part of the SI) between SI assemblies.

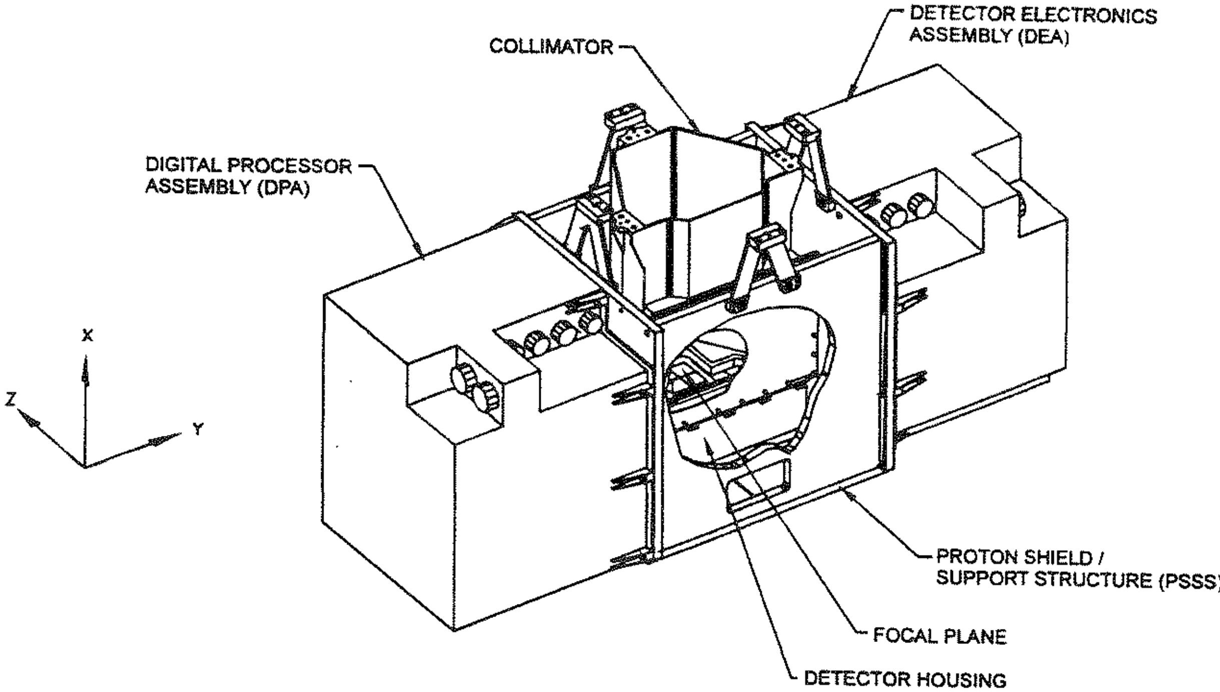


**Figure 3.2-1: ACIS Instrument
(Radiators not shown)**

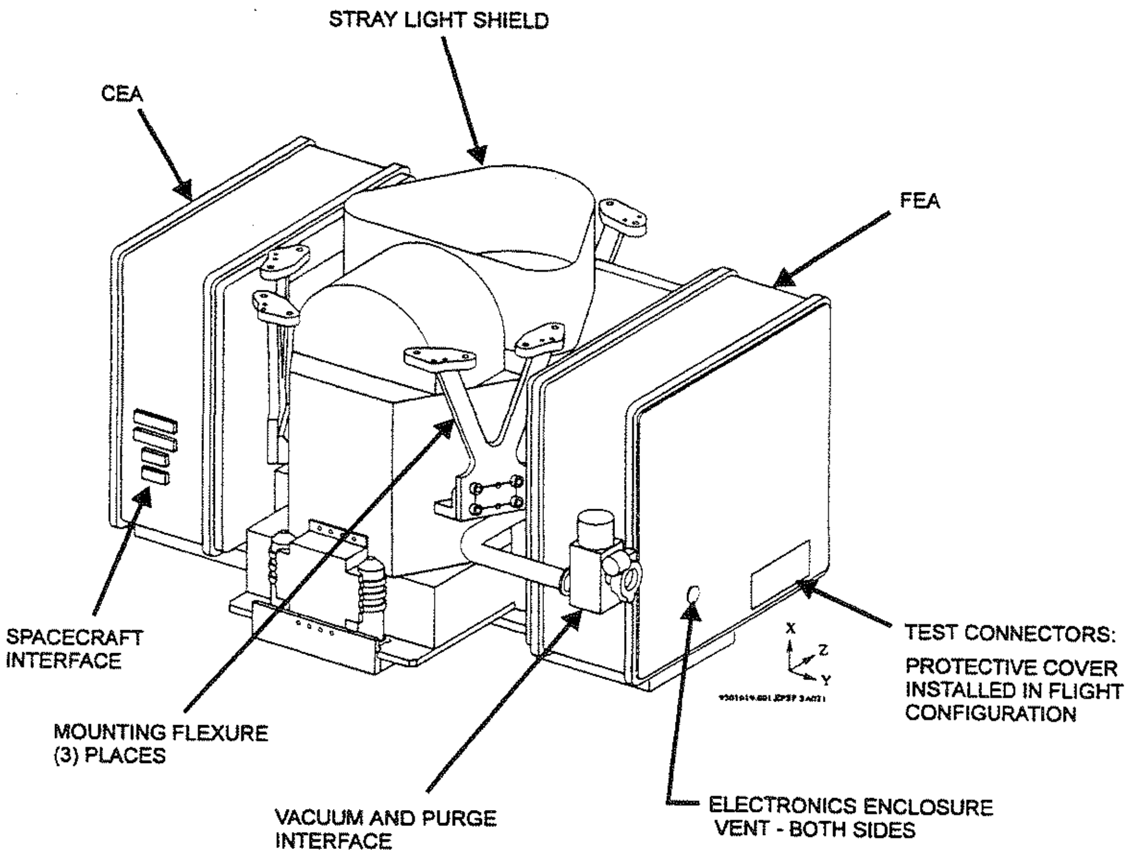


Figure 3.2-2: HRC Instrument

3.2.1.2.3:GSE Access

IRN 062 (PIRN 20-0064A)

The design of the observatory will provide access for connecting FPSI team supplied electrical and mechanical GSE to the instruments. Details of GSE access requirements are covered in paragraph 3.9.3.3.2.1.

3.2.1.2.4: FPSI Installation Torques

IRN 050 (PIRN 20-0059)

The fastener torques used when installing the FPSIs onto the SIM Translation Table shall be as shown in Table 3.2-1.

3.2.1.3: Aim Point Selection and Focus Adjustment

IRN 062 (PIRN 20-0064A)

3.2.1.3.1 Aim Point Selection

The Observatory shall provide a translation mechanism for aim point selection which permits travel along the observatory Z-axis.

The translation mechanism shall have a total range capability to translate from the extreme edge of the ACIS detector to the extreme edge of the HRC detector.

The translation mechanism shall have the capability of being positioned at any aimpoint over the active region of the detectors to within the alignment tolerances specified in paragraph 3.2.1.4.1.

3.2.1.3.2: Focus Adjustment

The design of the Observatory shall include provisions to locate the SI aim point at the desired location along the X direction to within the alignment tolerance specified in paragraph 3.2.1.4.1.

3.2.1.4: FPSI-to-Observatory Alignment

3.2.1.4.1: Static Alignment

3.2.1.4.1.1: Observatory Static Alignment and Orientation

The observatory shall provide the following static alignment of the FPSI preferred axis, as defined by the FPSI external alignment reference, to the HRMA optical axis:

Focus (displacement along X)	± 0.0005 inches
Lateral displacement along Y	± 0.040 inches
Lateral positioning along Z	± 0.005 inches
Angular alignment about X	± 50 arcmin
Angular alignment about Y	± 101.3 arcsec
Angular alignment about Z	± 101.3 arcsec

TABLE 3.2-1: FPSI INSTALLATION TORQUES

Location/Component (Item Installed)	Washer Part No. (or equivalent)	Fastener Part No. (or equivalent)	Nom. Dia. (in.)	Torque (1) [in-lbs.] (3)	Running Torque [in-lbs] (3)
ACIS ASSEMBLY					
Support Structure	NAS620C416	NAS1351N4H20 (5)	.250	91-99	3.5-30
Detector Assembly	NAS620C416	NAS1351N4H20 (4) (11)	.250	91-99 (11)	3.5-30
External Calibration Source	NAS620C4L	NAS1352N04-10	.112	82-132 in-oz.	10-48 in-oz.
Venting Subsystem:					
Vent Actuator Mech.Brkt	NAS620C10	NAS1351N3-16	.190	33-48	2-13
Vent/Light Shade Bracket	NAS620C10	NAS1351N3-12	.190	33-48	2-13
Electrical Bracket	NAS620C10	NAS1351N3-12	.190	33-48	2-13
PSMC	NAS620C416	NAS1351N4-12	.250	91-99	3.5-30
PSMC Thermal Strap	NAS620C6L	NAS1352N06-6	.138	145-246 in-oz.	16-96 in-oz.
TCS:					
Radiator Assembly	NAS620C6	NAS1352N06-8	.138	9-11 (2)	16-96 in-oz.
Sun Shade (Middle-5)	NAS620C10L	NAS1351N3-12	.190	35-40 (2)	2-13
Sun Shade (End-2)	NAS620C10L	NAS1351N3-12	.190	14-18 (2)	2-13
Telescope Shade	NAS620C10L	NAS1351N3-12	.190	35-40 (2)	2-13
Support Posts @ Tele.Shd.	NAS620C10L	NAS1351N3-20	.190	25-30 (2)	2-13
Support Posts @ Sun Shd.	NAS620C10L	NAS1351N3-12	.190	25-30 (2)	2-13
DPA Grounding Lugs	NAS620C10L	NAS1351N3-8	.190	20-25 (7)	0-3 (7)
PSMC Grounding Lugs	NAS620C10L	NAS1291C3M (nut)	.190	25-28 (8)	2-18
HRC INSTRUMENT	NAS1149E0663R	NAS1351N6H20 (6)	.375	331-360	9.5-80
HRC Grounding Lugs (10)	(10)	(10)	.250	54-60 (9)	Approx. 0

IRN 050 (PIRN 20-0059) ENTIRE PAGE

Notes:

1. Net torque, above running torque (lubricated with MSFC-SPEC-1238 compatible materials and processes)
2. Specified per ACIS/LMA Drawing 849AC500003 (lubricated, above any running torque). Deviates from standard BASD SIM torque specifications.
3. Unless otherwise specified
4. Per BASD Dwg. 530904-001, length = 1.110-1.140 in.
5. Per BASD Dwg. 530904-005
6. Per BASD Dwg. 530904-006
7. Per F. Kasperian/MIT at BASD TIM 05-Aug-97
8. Per N. Tice/LMA, e-mail, 07-Aug-97
9. Per J. Polizotti/SAO, e-mail, 27-Aug-97
10. Remove and reinstall existing HRC nut and restake

BASD MDR C05200 replaced two bolts at +Z side with P/N MDR C05200-403, torque 64-66 in-lb.

3.2.1.4.1.2: FPSI Static Alignment and Orientation

The FPSIs shall provide the following static alignment and orientation of the detector focal plane and aim points to the HRMA optical axis (assuming a perfect Observatory):

	ACIS	HRC
Focus (displacement along X)*	± 0.003 inches	± 0.0005 inches
Lateral displacement along Y	± 0.009 inches	± 0.009 inches
Lateral positioning along Z	± 0.009 inches	± 0.009 inches
Angular alignment about X	± 10 arcmin	± 10 arcmin
Angular alignment about Y	± 83.2 arcsec	± 56 arcsec
Angular alignment about Z	± 83.2 arcsec	± 56 arcsec

* Nominal axial location behind the -X surface of the SIM Translation Table is -14.000 inches.

3.2.1.4.2: On-Orbit Alignment Stability

3.2.1.4.2.1: Observatory Alignment Stability

The observatory, except for occultation, shall provide the following stability for a 48 hour period:

	Low Frequency (1)	High Frequency (2)
Lateral displacement along Y	± 0.010 inches	± 0.00010 inches
Lateral positioning along Z	± 0.010 inches	± 0.00010 inches
Angular alignment about X	± 9.833 arcmin	± 10 arcsec
Focus (displacement along X)	± 0.003 inches (3)	
Angular alignment about Y	± 18.7 arcsec (3)	
Angular alignment about Z	± 18.7 arcsec (3)	

Notes:
(1) Low Frequency applies to frequencies less than 0.05 Hz
(2) High Frequency Applies to frequencies greater than 0.05 Hz
(3) Requirement applies to all frequencies

This performance shall be maintained during operational phases for the above mentioned time period, accounting for the thermal environment including worst case slews, and/or changes in

FPSI power configuration. Stability requirements need not be met while the observatory is slewing from one target to another .

3.2.1.4.2.2: FPSI Alignment Stability

The FPSIs, except for occultation, shall provide the following stability of the detector focal plane and aim points (assuming a perfect Observatory), at frequencies less than 0.05 Hz, for a 48 hour period. The FPSI's shall meet their alignment stability requirements whenever the thermal interface environment provided by the SIM is as specified in Section 3.3.:

	ACIS	HRC
Focus (displacement along X)	± 0.001 inches	± 0.0005 inches
Lateral displacement along Y	± 0.002 inches	± 0.002 inches
Lateral positioning along Z	± 0.002 inches	± 0.002 inches
Angular alignment about X	± 2.5 arcmin	± 2.5 arcmin
Angular alignment about Y*	± 15.0 arcsec	± 11.4 arcsec
Angular alignment about Z*	± 15.0 arcsec	± 11.4 arcsec

*Requirement also applies at the FPSI fid-light mounting plane

This performance shall be maintained during operational phases for the above mentioned time period, accounting for the thermal environment including worst case slews and/or changes in FPSI power configuration.

3.2.1.4.3: FPSI Alignment Provisions

The design of the FPSI detectors shall incorporate a means of knowing the location of the detector focal surface with respect to an external datum on the detector such that when aligned in the observatory, the preferred axis or principal aim point of the FPSI shall be aligned within the tolerances specified in section 3.2.1.4.1.2. The locations of the FPSI alignment mirrors are shown in drawing 301475 for ACIS and in drawing 301476 for HRC (see Appendix G).

3.2.1.4.4: SIM Drill Templates

The SIM contractor shall supply a drill template to each of the FPSI teams for use in match drilling and aligning the instruments. The drill templates are defined in Ball Drawing 533571 and 533572 in Appendix G.

3.2.1.5: Fiducial Light System

The Observatory shall provide fiducial lights and an optical system which can project the image of the fiducial lights mounted near the SI's focal plane onto the aspect sensor. Fiducial light configurations and interface characteristics are as shown in Interface Control Drawings 301330 and 822022 located in Appendix G.

3.2.1.5.1: Location of Fiducial Lights

The locations of the fiducial lights on ACIS and HRC shall be as shown in Interface Control Drawing 301438 located in Appendix G.

Each FPSI shall maintain the mounting interface plane for each fiducial light perpendicular to the HRMA optical axis (assuming a perfect Observatory) to within ± 7.0 arcminutes. This tolerance is an on-orbit, 'not to exceed' number, and encompasses both static and dynamic effects. This requirement shall apply to the final FPSI assembly.

IRN 050 (PIRN 20-0059) The tilt angle and beam angular size are shown for each ACIS and HRC fiducial light in Tables 3.2-2 and 3.2-3, respectively. The tolerances are as indicated in the footnotes to these tables.

The fid light clocking angle (pointing direction in the Y-Z plane) is shown for each fid light on Interface Control Drawing 301438 (Appendix G). The tolerance on the clocking angle is ±5° for HRC (±2° for the instrument and ±3° for the fid light) and ±4.5° for ACIS (±1.5° for the instrument and ±3° for the fid light). For both HRC and ACIS, the clocking error due to clearance between the #2-56 mounting screws and the fid light clearance holes is considered part of the ±3° fid light tolerance.

The SI shall provide a clear field of view of the fiducial lights for the fiducial transfer optics located at the HRMA nodal point

3.2.1.5.2: Fiducial Light Characteristics

The fiducial lights are CFE by the AXAF-I contractor to the SI developer. The fiducial lights shall be compatible with the SI vacuum and contamination requirements.

For information purposes, the output radiant intensity of each fiducial light as a function of angle is specified in the Spacecraft to Telescope ICD (IF1-29). The spectral distribution peak is a function of temperature. At 20°C, the peak is at 635 ± 20 nm. At -60°C, the peak is at 626 ± 20 nm. The half-power points will be within 40 nm of the peak position.

The maximum power dissipation of each fiducial light is specified in section 3.10 of this document.

The fiducial lights shall be capable of operating within the temperature ranges of their respective support structures, (i.e.: Camera Housing for ACIS fiducial lights and the Detector Assembly for the HRC fiducial lights), as specified in paragraph 3.3.2 of this document.

The fiducial lights shall be capable of operating to performance requirements following exposure to the random vibrations as specified in paragraph 3.4.1.2.2.2 of this document.

TABLE 3.2-2: ACIS FIDUCIAL LIGHT BEAM ANGULAR SIZE AND ORIENTATION

IRN 050 (PIRN 20-0059)

FL#	θ_{tilt} (deg)	θ_{zero} (deg)
ACIS-1	0.45	1.2
ACIS-2	0.45	1.2
ACIS-3	0.45	1.2
ACIS-4	0.60	1.2
ACIS-5	0.55	1.2
ACIS-6	0.40	1.2

TABLE 3.2-3: HRC FIDUCIAL LIGHT BEAM ANGULAR SIZE AND ORIENTATION

IRN 050 (PIRN 20-0059)

FL#	θ_{tilt} (deg)	θ_{zero} (deg)
HRC-I-1	0.45	1.5
HRC-I-2	0.45	1.5
HRC-I-3	0.45	1.5
HRC-I-4	0.45	1.5
HRC-S-1	0.4	1.3
HRC-S-2	0.4	1.3
HRC-S-3	0.4	1.3
HRC-S-4	0.4	1.3

Notes:

1. The tilt angle (θ_{tilt}) is the angle measured between the center line of the fiducial beam, and the normal to the mounting surface at the fiducial light mounting location. Tolerance on θ_{tilt} is the responsibility of the FLA developer, and is included in θ_{zero} (see Note 2).

2. θ_{zero} is the angular size of the fiducial beam (half cone angle), measured from the beam center line to the "perimeter" of the beam. (θ_{zero} , which is defined in the Spacecraft-to-Telescope ICD, IF1-29 Paragraphs 3.2.2.7.2.4 and 3.2.2.7.2.5, is the angular radius outside of which the radiant intensity from the fiducial light does not exceed 10% of the average intensity over the central region of the beam.) The values for θ_{zero} in Tables 3.2-2 and 3.2-3 do <u>not</u> include the Observatory and FPSI contributions to the angular alignment tolerance for the fid light mounting plane. IRN 050 (PIRN 20-0059)

   <u>For information only</u>: The total angular alignment tolerance for the fid light mounting plane is 9 arcminutes: 7 arcminutes for the FPSI (specified in Paragraph 3.2.1.5.1, 2nd subparagraph), plus 2 arcminutes for the Observatory (specified in Paragraphs 3.2.1.4.1.1 and 3.2.1.4.2.1). All values are "±".

3.2.2: Grating Mechanical Interfaces and Locations

There are two Objective Transmission Grating SIs included in the AXAF-I instrument complement. They are the High Energy Transmission Grating (HETG) and the Low Energy Transmission Grating (LETG). The gratings and are moved by means of their respective Objective Grating Mechanisms (OGMs).

3.2.2.1 Envelope

The envelope for both the High Energy Transmission Grating (HETG) and the Low Energy Transmission Grating (LETG) shall be as shown in OTG/AXAF-I Interface Control Drawing 301331 (Appendix G). When the grating are in the active position, the front of this envelope shall be normal to the HRMA optical axis, to the precision of the tolerances specified in paragraph 3.2.2.3 The grating central region (excepting non-flight alignment mirrors, etc.) shall not contain any obstructions to the transmission of the fiducial light beams from the focal plane instruments within 9.70 inches radius except at ARM mounting pads where the minimum radius shall be 9.25 inches.

3.2.2.2 Mounting

3.2.2.2.1 Grating Orientation and Coordinates

The grating coordinate system is designated using the subscript "G" as shown in Figure 3.2-3. The grating optical axis is Xg, the grating dispersion axis is Yg. Zg completes the right-handed coordinate system. The origin of the OTG coordinates is the Telescope optical axis (X-axis) intersection with the OTG reference plane (defined as the surface on the OTG which is normal to the optical axis and closest to the focal plane instruments). In the HETG, the dispersion axis of the high energy gratings is rotated 5°±30 arcminutes CCW from the Ya axis when viewing from the AXAF coordinate origin along the +X axis. The dispersion axis of the medium energy grating is rotated 5°±30 arcminutes CW with respect to the Ya axis when viewing from the same perspective.

IRN 062 (PIRN 20-0064A)

For either grating, in the observing position the grating X axis is coincident with the HRMA optical (X) axis; the grating Z and Y (dispersion) axes are parallel to the AXAF Z and Y axes as shown. The normal to the LETG hinge line (shown tangent to the grating) is rotated 30° from the +Yz axis toward the +Za axis. The normal to the HETG hinge line is rotated 30° from the Yz axis toward the +Za axis.

3.2.2.2.2 LETG and HETG Mounting

The Observatory's Telescope shall support the LETG and HETG by a yoke assembly attached to the HRMA. The Telescope shall accommodate the LETG and HETG as shown in the OTG/AXAF-I interface control drawing 310331. The yoke assembly shall contain a means of ensuring that there is only one clocking position about the X axis in which the grating can be installed (e.g., keying or non-symmetrical mounts).

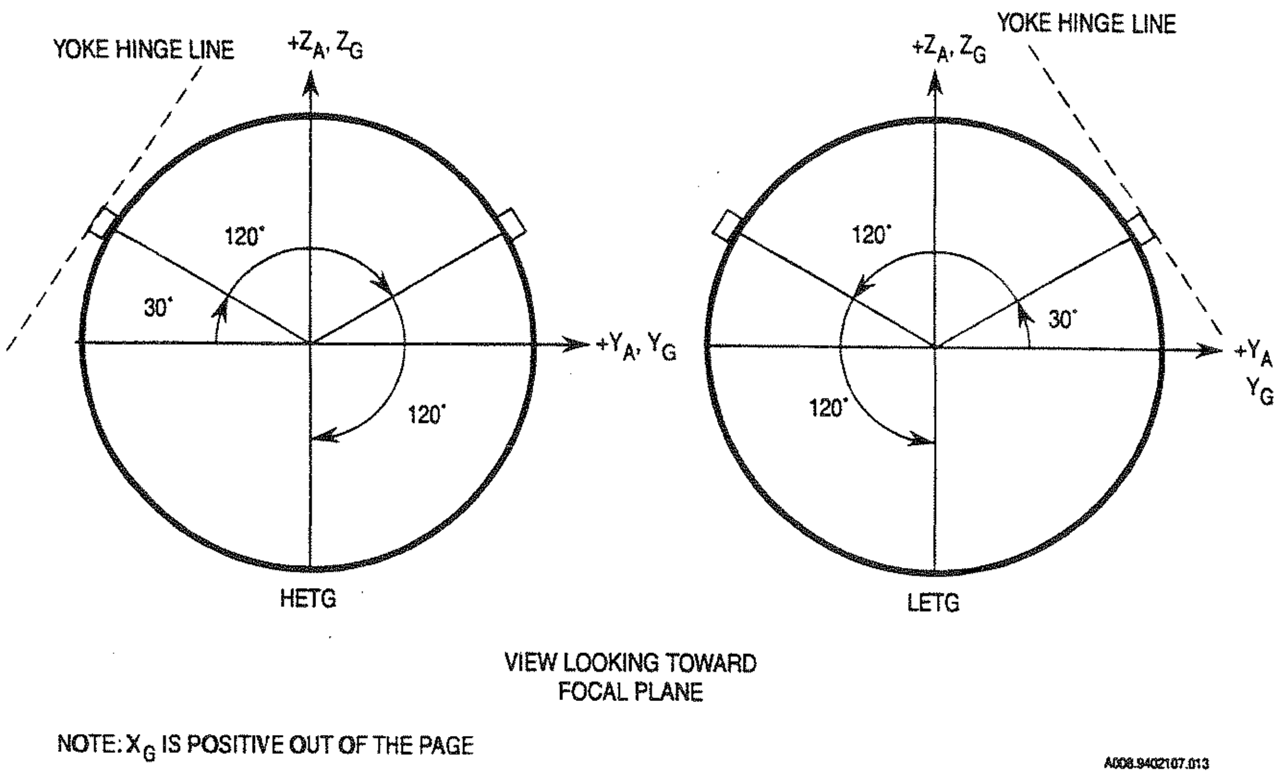


Figure 3.2-3: OTG Coordinate System

3.2.2.3: Grating Alignment

The observatory shall provide the following alignment repeatability and stability of the gratings to the HRMA when the gratings are in the active position:

	Static	Repeatability	Stability*
Focus (X):	± 0.0394 inches	± 0.0118 inches	± 0.0158 inches
Decenter (radial):	± 0.0174 inches	± 0.0052 inches	± 0.0064 inches
Clocking (about X):	± 3.75 arcmin	± 1.125 arcmin	± 1.791 arcmin
Tip/Tilt (radial):	± 3.54 arcmin	± 1.06 arcmin	± 1.894 arcmin

Note: Stability includes both long-term thermal effects and high frequency jitter. For an allocation of these requirements, see IOC AXAF.94.700.106 in SE11w.

The design of the gratings shall include provisions for a removable alignment reference mirror as specified in TRW drawing 301331 and shall include three gauging surfaces on the side of the grating mounting plate facing the HRMA.

The design of the HRMA shall include three gauging surfaces on a surface facing the gratings.

3.2.2.4: X-Ray Beam Geometry

Table 1 of Figure 3.2-4 shows the nominal cone angles of the four annular x-ray beams. Effects of focal plane uncertainty and off axis sources are shown in Table 2 . The HRMA focal point is at F. The front edge of the HRMA hyperboloids is at C, and the rear edge is at D. The beam is contained between angles θ_C and θ_D.

3.2.2.5: OTG Command and Fail-Safe Modes

IRN 062 (PIRN 20-0064A)

a) The OTGs shall be commandable in and out of the x-ray beam and are moved by means of their respective Objective Grating Mechanisms (OGM).
b) The OGMs shall also have a fail-safe mode that insures that, following two failures, the gratings will be retracted from the x-ray beam, leaving it free and clear, so as not to interfere with the FPSI science operations and observations..

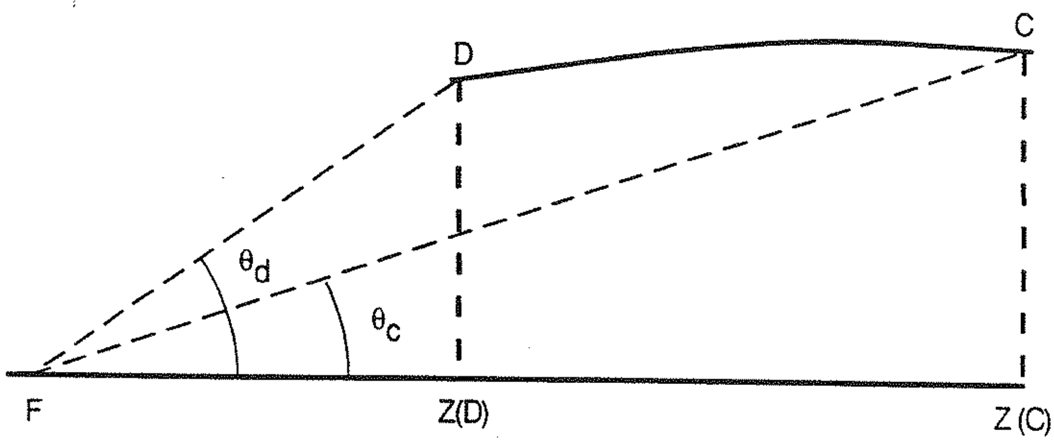


Table 1: On Axis Source

Element No.	Radial Location of ray bundle **(1)** (mm)	Thickness of ray bundle (mm)	Angle θC (deg)	Angle θd (deg)
H-1	521.618	10.816	3.421	3.493
H-3	419.859	8.729	2.755	2.813
H-4	370.616	7.702	2.432	2.483
H-6	275.415	5.749	1.808	1.846

Table 2: Off Axis (3 arcminutes) Source

Element No.	Radial Location of ray bundle **(1)** (mm)	Thickness of ray bundle (mm)	Angle θC (deg)	Angle θd (deg)
H-1	521.279	12.554	3.416	3.497
H-3	419.520	10.467	2.747	2.816
H-4	370.277	9.440	2.42	2.487
H-6	275.076	7.487	1.800	1.849

Notes: (1) At the nominal location of the gratings

Figure 3.2-4: X-ray Nominal Beam Cone Angles

3.2.2.6: Grating Simulators

The grating manufacturers shall provide simulators for the LETG and the HETG. The simulators will be mechanically identical with the flight units except that the grating modules will be replaced by a few dummy modules. They will be subjected to acceptance level flight loads and vibration but not to acoustics, thermal or vacuum environments. The following paragraphs describe the simulator requirements.

3.2.2.6.1: Mechanical Features

The simulator's mass, CG location, maximum envelope, and mechanical/thermal stability shall be within the tolerances of the flight unit. Stiffness shall be within +/- 10% of the flight unit. The first mode natural frequency shall be within +/- 5% of the flight unit. The dimensions and tolerances shall be as shown on drawing 301331, ICD- Objective Transmission Grating, Appendix G. The units shall be capable of withstanding acceptance level vibration and quasi static loads and transportation loads. The number and location of dummy modules is at the discretion of the manufacturer.

3.2.2.6.2: Alignment Features

The simulators shall include alignment features equivalent to the flight unit as shown on drawing 301331 and including the ARM which shall be aligned with the three mounting pads to simulate the flight unit alignment.

3.2.2.6.3: Finish Requirements

Flight type finish is not required except for the mounting pads which are to be finished identically with the flight unit for purposes of duplicating surface friction. Stray light requirements do not apply.

3.2.2.6.4: Cleanliness Requirements

The simulators shall be cleanable to level 350 class A which requires the aluminum surfaces to be coated. An irridite or anodize coating is acceptable. The dummy modules shall be removable and replaceable if required for purposes of cleaning following delivery.

3.2.2.6.5: Protection and Handling

One set of handling equipment consisting of 1) rigging for a single point lift and 2) rigging for a three point lift shall be provided. A set of Flight Protective covers (or equivalent), one set for the HETG and one set for the LETG respectively shall be provided by the OTG manufacturers.

3.2.2.6.6: Product Assurance

As built dimensions, weight, CG, and alignment measurements shall be made with formally calibrated instruments, verified by Product Assurance, and the data provided with delivery of the simulator.

3.2.3: Mass Properties

3.2.3.1: Weight

The maximum control weight of the HETG shall be 32 pounds. The maximum control weight of the LETG shall be 38 pounds. This control weight does not include prime contractor- furnished equipment, interfacing structures or components. There is no NASA reserve for the OTGs.

The maximum control weights, center of mass, and moments of inertia for the HRC and Contractor Furnished Equipment (CFE) attached to it shall be as shown in Table 3.2-5.

IRN 050 (PIRN 20-0059)

The maximum control weight, center of mass, and moments of inertia for the ACIS components shall be as shown in Table 3.2-4.

IRN 050 (PIRN 20-0059)

TABLE 3.2-4: ACIS EQUIPMENT CONTROL WEIGHTS AND MOMENTS

Component Name	Maximum Control Wt. (1,2) (lbs)		Center of Mass (in.) (3)			Moments of Inertia ($lb \cdot sec^2 \cdot in$) (3)		
			Xcg	Ycg	Zcg	Ixx	Iyy	Izz
Detector Assembly ACIS Total	37.7		3.84	0.57	0.21			
CFE Fiducial Light System	1.00							
CFE Trim & Survival Heater Sys.	0.90							
CFE Mounting Hardware	0.50							
Detector Assembly Total		**40.10**						
Vent Valve less Vent Tube	5.10		12.73	13.64	-0.07			
CFE Mounting Hardware	0.30							
Vent Valve less Vent Tube Total		**5.40**						
Vent Mechanical Interface	2.20		12.73	19.98	3.50			
CFE Mounting Hardware	0.10							
Vent Mechanical Interface Total		**2.30**						
Vent Electrical I/F	0.50		12.85	20.18	-3.94			
CFE Mounting Hardware	0.10							
Vent Electrical I/F Total		**0.60**						
Support Assy ACIS Total	123.80		3.44	0.55	0.26	64.80	15.90	68.90
CFE Trim & Survival Heater Sys	4.20							
CFE Mounting Hardware	1.00							
Support Assy Total		**139.00**						
Radiators (5)	13.50		3.23	-0.02	8.83	2.49	0.74	3.20
CFE Mounting Hardware	0.12							
Radiators Total		**13.62**						
Sun Shade	8.50		-5.34	-0.52	19.64			
CFE Mounting Hardware	0.10							
Sun Shade Total		**8.60**						
Telescope Shade & Posts	7.60		13.67	-0.63	20.39			
CFE Mounting Hardware	0.50							
Telescope Shade & Posts Total		**8.10**						
PSMC	32.90		6.00	12.00	-32.50			
CFE Mounting Hardware	1.10							
CFE Trim & Survival Heater Sys	1.00							
PSMC Total		**35.00**						
PSMC Cable Less Ends	6.10		—	—	—			
CFE Cable Clamps & Hardware	1.00							
PSMC Cable Total		**7.10**						
SIM Mounted Calibration Source	4.20		20.75	0.00	16.88			
CFE O-Ring and Hardware	0.20							
SIM Mounted Cal. Source Total		**4.40**						

IRN 047 (PIRN 20-0054)

ACIS Control Weight (1)	242.20
CFE Subtotal	12.12
Total Control Weight (2)	**254.32**

See next page for Table Notes

IRN 050 (PIRN 20-0059)

NOTES FOR TABLE 3.2-4:

1. Maximum Control Weights include contingency and are specified by component for SIM interface design purposes. Actual weights of the components may be less. The maximum control weight of the ACIS instrument assembly is 243 lbs.

Clerical change resultant from IRN 047 (PIRN 20-0054)

2. Weights do not include RCTU Cables and cable clamps, Fiducial Light Controller Assembly, cables and connectors, or Light Seal..

3. Coordinate system for the Center of Mass is the ISIM system with ACIS in the launch locked position. Moments of Inertia are with respect to the unit Center of Mass.

4. Tolerance for CM is ± 1 inch along the X axis and ± 0.5 inch along the Y and Z axes.

5. Includes ~ 0.9 lbs distributed weight for +Z Panel MLI blanket.

TABLE 3.2-5: HRC EQUIPMENT CONTROL WEIGHTS AND MOMENTS

IRN 050 (PIRN 20-0059)

Component Name	Maximum Control Wt. (1)	Center of Mass (2,3) (in)			Moments of Inertia ($lbs \cdot sec^2 \cdot in$)		
	(lbs)	Xcg	Ycg	Zcg	Ixx	Iyy	Izz
Total HRC Control Weight	**248.0**	**5.78**	**0.2**	**-4.87**	**103.4**	**52.46**	**97.18**

IRN 049 (PIRN 20-0055)

Notes:

1. Maximum Control Weights contain zero contingency and are specified by component for SIM interface design purposes.
2. Center of Mass coordinates are given in HRC coordinate system. Moments of Inertia are with respect to the HRC origin.
3. Tolerance for CM is +/-1 inch along the X axis and +/- 0.5 along the Y and Z axes.

3.3: THERMAL INTERFACES

3.3.1: On-Orbit Thermal Environment

The observatory shall provide a controlled thermal environment for the two grating SIs and for the various components of the HRC and of the ACIS, so as to maintain instrument component temperatures within the ranges (operating or survival depending on observatory status) specified in Table 3.3.-3.

3.3.1.1: FPSI Thermal Environment

3.3.1.1.1: FPSI Thermal Interfaces

3.3.1.1.1.1: ACIS Detector Assembly Thermal Interfaces

3.3.1.1.1.1.1 Heat flow between the ACIS detector and the SIM will be primarily by radiation to/from the SIM translation table, and radiation to/from the Telescope entrance aperture or the focused structure depending on whether ACIS or HRC is in the viewing position.

a) The ACIS shall be equipped with a radiator for detector temperature control.

b) The ACIS shall provide radiator mounts, telescope shade, sun shade and thermal blankets as required.

3.3.1.1.1.1.2 (Deleted)

3.3.1.1.1.1.3 For detector thermal analysis, the total thermal conductance between the detector and translation table shall be assumed to be ≤0.05 Watts/°C as provided by the detector collimator tube.

3.3.1.1.1.1.4 For detector thermal analysis, the ACIS translation table aperture at the SIM interface shall be represented as a black body radiator with an operational temperature range of +8 to +12°C when the ACIS is in the viewing position.

3.3.1.1.1.1.5 For detector thermal analysis, the entrance aperture of the ACIS at the SIM interface, i.e. the calibration source, shall be assumed to be a black body radiator at 16°C for the hot case and at -38°C for the cold case when the HRC is in the viewing position.

3.3.1.1.1.1.6 For detector hot case conditions with the ACIS operating in the viewing position, the SIM translation table interface temperature shall be maintained to ≤ 0°C.

3.3.1.1.1.1.7 For detector cold case analysis with the ACIS operating in the viewing position, the SIM translation table interface temperature shall be assumed to be ≥-38°C.

3.3.1.1.1.1.8 For detector cold case analysis with the HRC in the viewing position, the SIM translation table interface temperature shall be assumed to be ≥ -53 °C.

3.3.1.1.1.1.9 For detector performance analysis, it shall be assumed that:

a) The maximum steady state gradient that the ACIS collimator attach fittings will see is -1.4°C/inch in the Z direction, (i.e. the +Z fittings are colder) and -0.4°C/inch in the Y direction.

b) The average temperature of the translation table at the collimator attach fittings changes a maximum of +12°C during the first 64 hours after ACIS is translated into viewing position.

3.3.1.1.1.1.10 For ACIS hot case and cold case analyses of the detector cables, the boundary temperatures and surface IR emittances of the ISIM as shown in Figure 3.3-1 shall be used.

3.3.1.1.1.1.11 (Deleted)

3.3.1.1.1.2: ACIS Support Structure/DPA/DEA Thermal Interfaces

Primary heat flow from the ACIS Support Structure/DPA/DEA to the SIM shall be through radiation to the internal surfaces of the SIM enclosure.

3.3.1.1.1.2.1 (Deleted)

3.3.1.1.1.2.2 Support Structure to Translation Table Thermal Conductance

a) For ACIS thermal analysis, the thermal conductance of the four (4) flexure supports mounting the Support Structure to the Translation Table shall be assumed to be ≤ 0.025 W/°C each.

b) For ACIS thermal analysis, the thermal conductance of the ACIS wiring from the Support Structure/DPA/DEA to the Translation Table shall be assumed to be ≤ 0.05 Watts/°C.

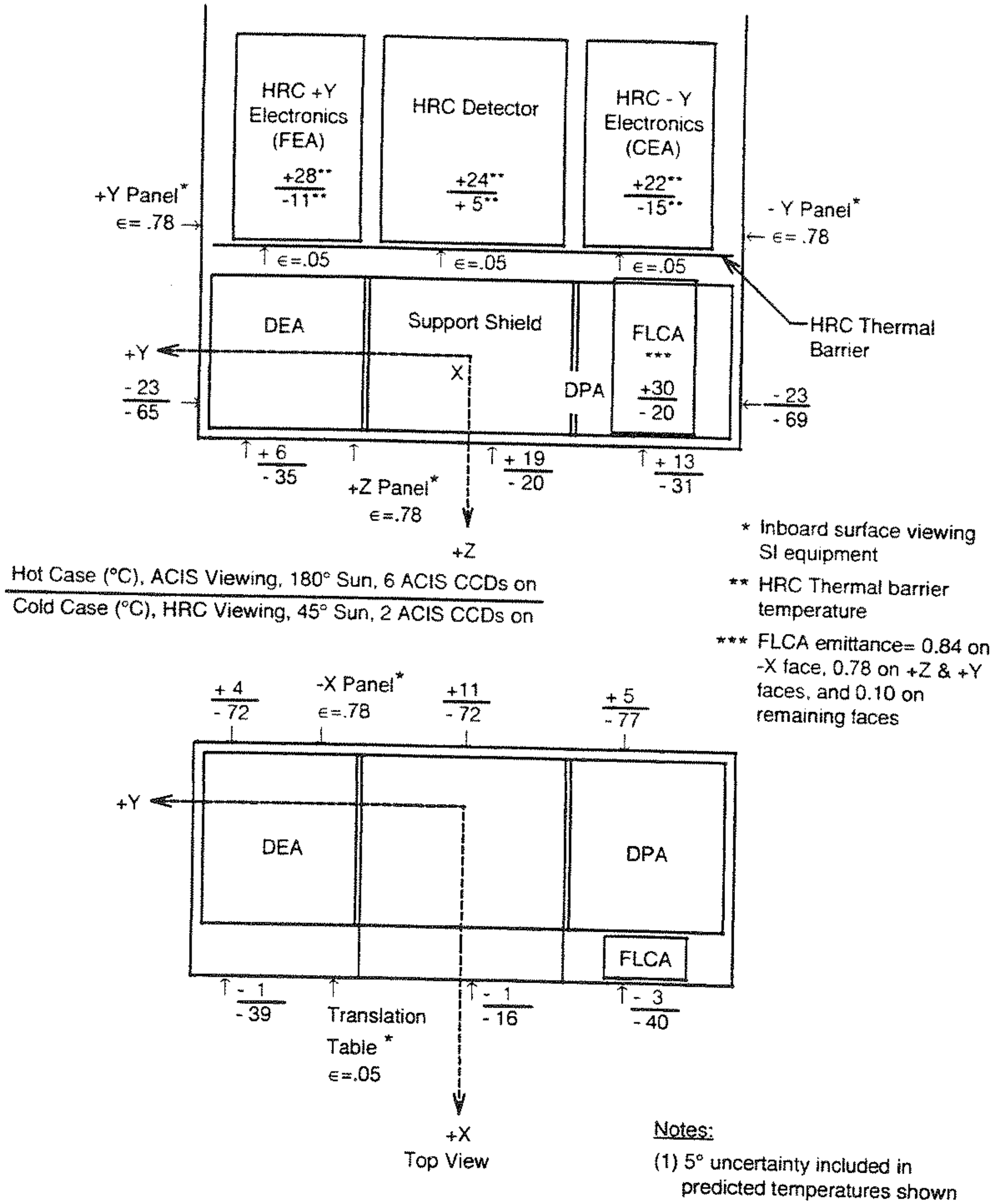


Figure 3.3-1: ISIM Hot and Cold Operational Case Boundary Temperatures and IR Emittances for ACIS Detector Cables and Support Structure/DPA/DEA Thermal Analysis

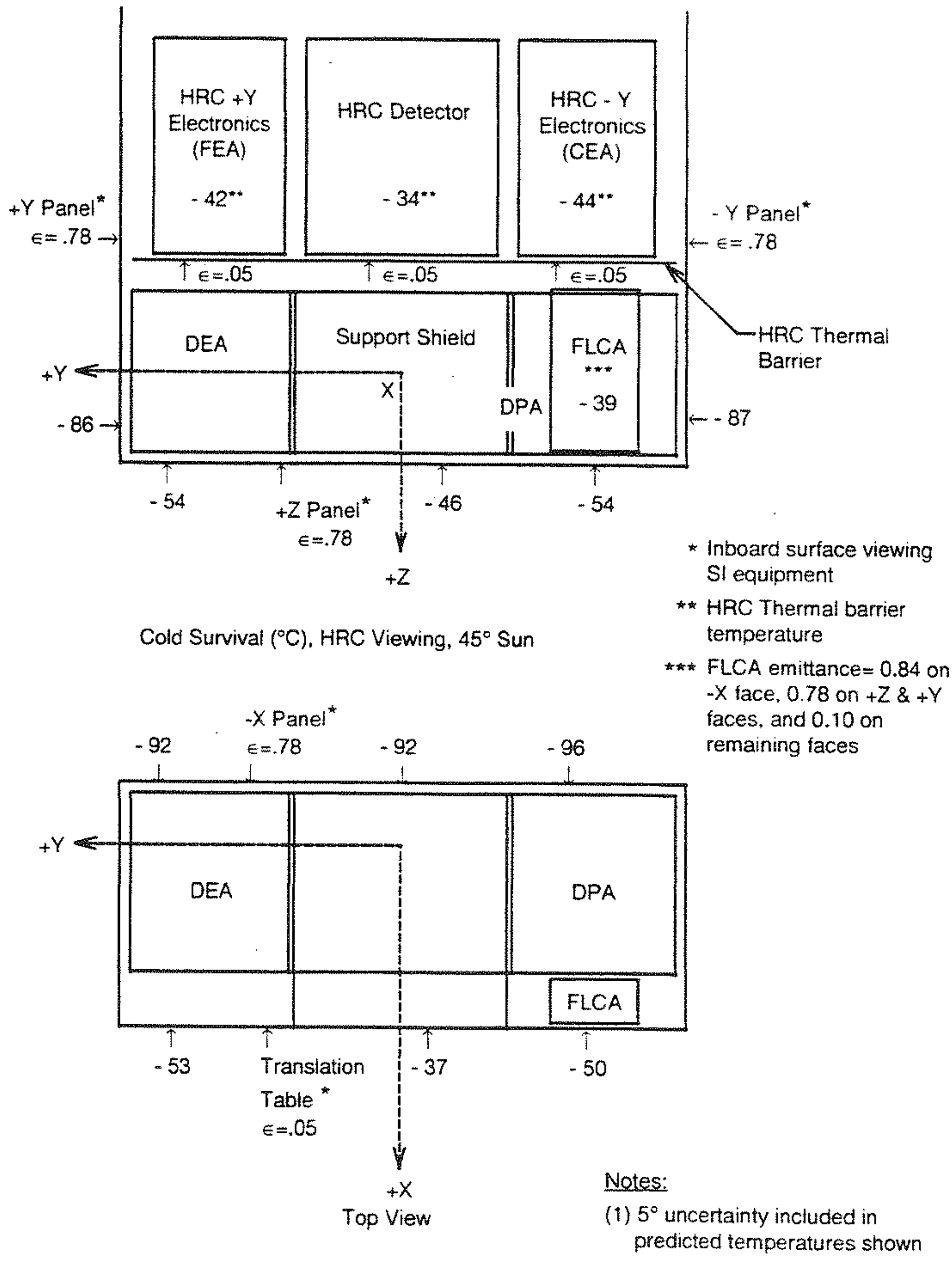


Figure 3.3-1a: ISIM Cold Survival, Non-operating Boundary Temperatures and IR Emittances for ACIS Detector Cables and Support Structure/DPA/DEA Thermal Analysis

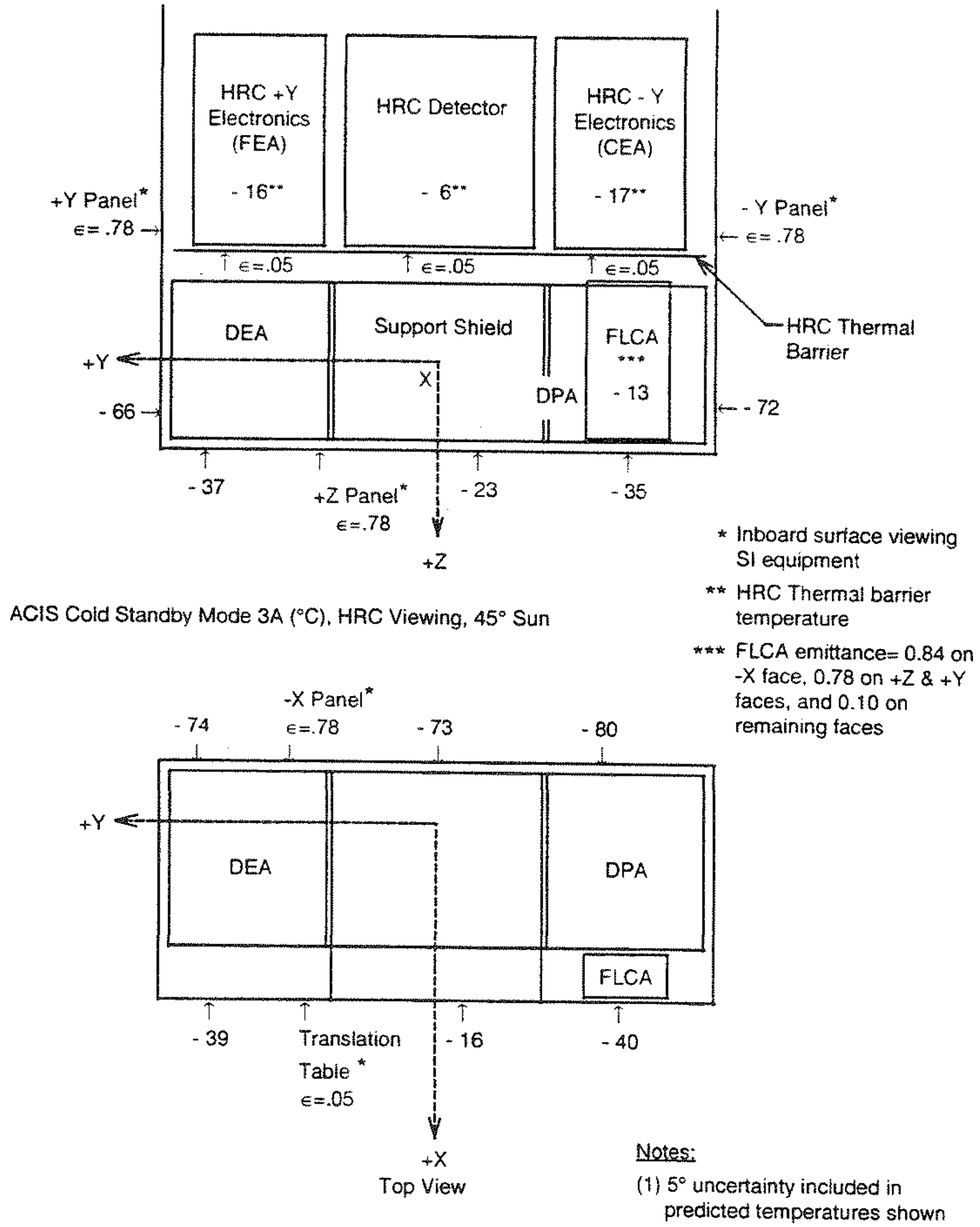


Figure 3.3-1b: ISIM ACIS Cold Standby Mode 3A Boundary Temperatures and IR Emittances for ACIS Detector Cables and Support Structure/DPA/DEA Thermal Analysis

3.3.1.1.1.2.3 For Support Structure/DPA/DEA hot case and cold case analyses, the boundary temperatures and surface IR emittances of the ISIM as shown in Figure 3.3-1 shall be used.

3.3.1.1.1.2.4 (Deleted)

3.3.1.1.1.2.5 Heat flow conducted from the Support Structure to the SIM translation table shall be less than 3.0 Watts total through all four flexures for any operating mode.

3.3.1.1.1.2.6 The Support Structure shall have an external emittance ≥ 0.8 on all sides.

3.3.1.1.1.2.7 The DEA and DPA boxes shall have an emittance ≥ 0.8 on all sides except the +X sides facing the translation table; these sides shall have an emittance ≤ 0.10.

3.3.1.1.1.3: ACIS Radiator Thermal Interfaces

3.3.1.1.1.3.1 The Observatory shall provide the ACIS radiators with a direct view to space on the +Z side of the SIM.

3.3.1.1.1.3.2 Heat flow from the ACIS radiators to or from the SIM +Z panel will be by conduction through the ACIS provided thermal standoffs and by radiation between surfaces. For ACIS thermal analysis the thermal standoffs shall be assumed to have a conductance of .00064 ±.0002 W/°C for each of the eight (8) standoffs.

3.3.1.1.1.3.3 An MLI blanket with an e* ≤ 0.025 and ≥ 0.005 shall be provided by ACIS between the warm radiator and the SIM +Z panel. Mounting provisions are controlled by Drawing 301475 in Appendix G.

3.3.1.1.1.3.4 For ACIS radiator thermal analysis, the SIM +Z panel temperature shall be assumed to be ≤ 18°C for on-orbit operating hot case conditions and ≥ -25°C for on-orbit operating cold case conditions, with ACIS in the viewing position.

3.3.1.1.1.4: ACIS Telescope Shade and Sun Shade Thermal Interfaces for On-orbit Operation.

Heat flow from the ACIS telescope shade and sun shade to the SIM will be through conduction and radiation.

3.3.1.1.1.4.1 The ACIS Telescope Shade and ACIS Sun Shade have 9 and 11 SIM-designed bolted interfaces, respectively, with the SIM. For the shades thermal analysis, the bolted interface conductance for each of the 20 bolt interfaces with the SIM shall be assumed to be ≤ 1.5 Watts/°C

3.3.1.1.1.4.2 An MLI blanket with an e* ≤ 0.030 and ≥ 0.005 shall be provided by the SIM for the -X side of the Sun shade. Mounting details are controlled by Drawing 301475 in Appendix G.

3.3.1.1.1.4.3 (Deleted)

3.3.1.1.1.4.4 For the shades thermal analysis, the SIM translation table at the Telescope shade interface shall be assumed to be ≤ 16°C for on-orbit operating hot case conditions and ≥ -80°C for on-orbit operating cold case conditions.

3.3.1.1.1.4.5 An MLI blanket with an e* ≤ 0.030 and ≥ 0.005 shall be provided by BASD on the exposed +X side of the Telescope shade. Mounting details are controlled by Drawing 301475 in Appendix G

IRN 062 (PIRN 20-0064A) 3.3.1.1.1.4.6 (Deleted)

3.3.1.1.1.5: ACIS PSMC Thermal Interfaces

3.3.1.1.1.5.1 Heat flow from the ACIS PSMC will be primarily by radiation from the external surfaces of the box which shall have an emittance ≥ 0.84 on all sides including the +X side facing the translation table.

3.3.1.1.1.5.2 The SIM shall provide thermal standoffs which provide a total effective conductance to the translation table of ≤ 2.0 Watts/°C, including the single standoff adjacent to the HRC bipods which shall have a conductance ≤.0.09 W/ °C.

3.3.1.1.1.5.3 For PSMC hot case and cold case analyses, the boundary temperatures and surface IR emittances of the ISIM as shown in Figure 3.3-2 shall be used.

3.3.1.1.1.5.4 The SIM shall provide a thermal strap between the PSMC and the SIM Translation Table. The total effective thermal conductance of the strap and the conduction interface on the translation table, as defined by the translation table boundary temperatures in Figures 3.3-2 and 3.3-2a, shall be 0.13 ± 0.05 Watts/°C

3.3.1.1.1.6: HRC Instrument Thermal Interfaces

Heat flow from the HRC instrument to the SIM will be primarily by radiation to the interior of the SIM. There will be some conduction to/from the SIM translation table, and radiation to/from the Telescope entrance aperture or the focused structure depending on whether ACIS or HRC is in the viewing position.

3.3.1.1.1.6.1 (Deleted)

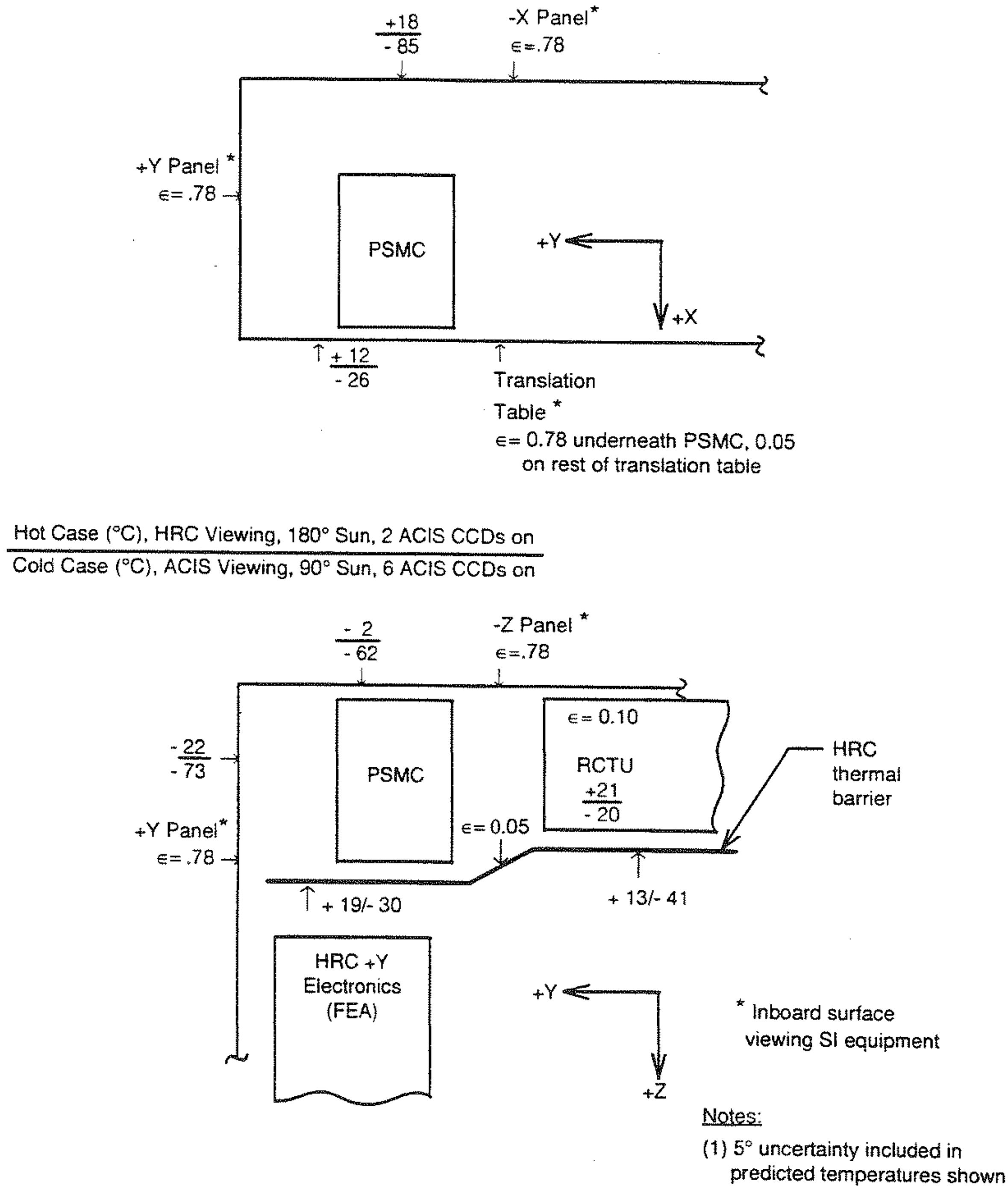


Figure 3.3-2: ISIM Hot and Cold Operational Case Boundary Temperatures and IR Emittances for ACIS PSMC Thermal Analysis

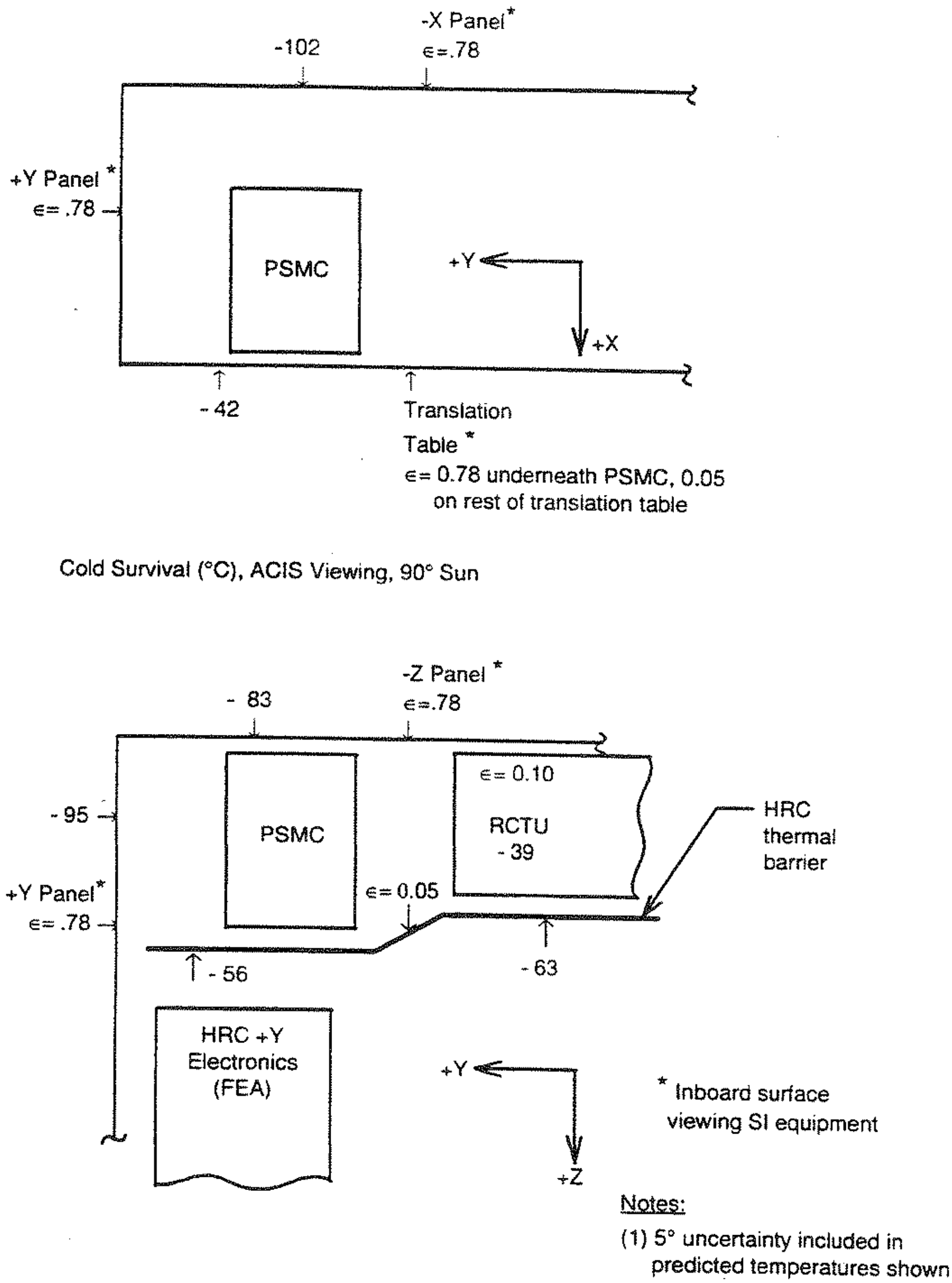
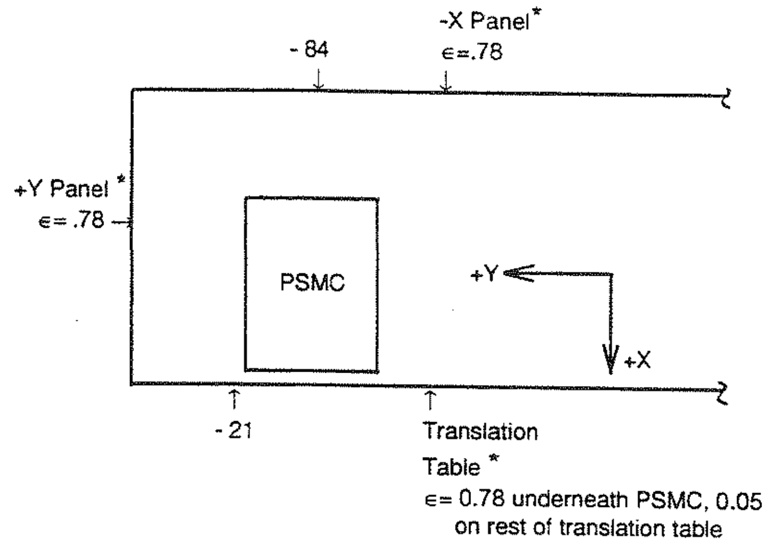


Figure 3.3-2a: ISIM Cold Survival, Non-operating Boundary Temperatures and IR Emittances for ACIS PSMC Thermal Analysis



ACIS Cold Standby Mode 3A (°C), HRC Viewing, 90° Sun

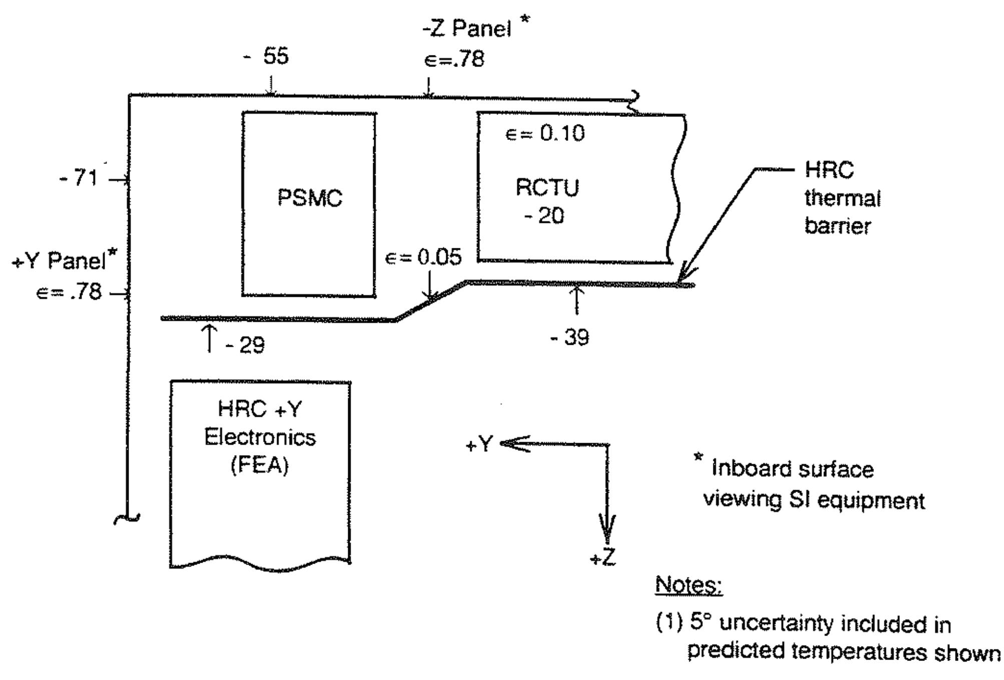
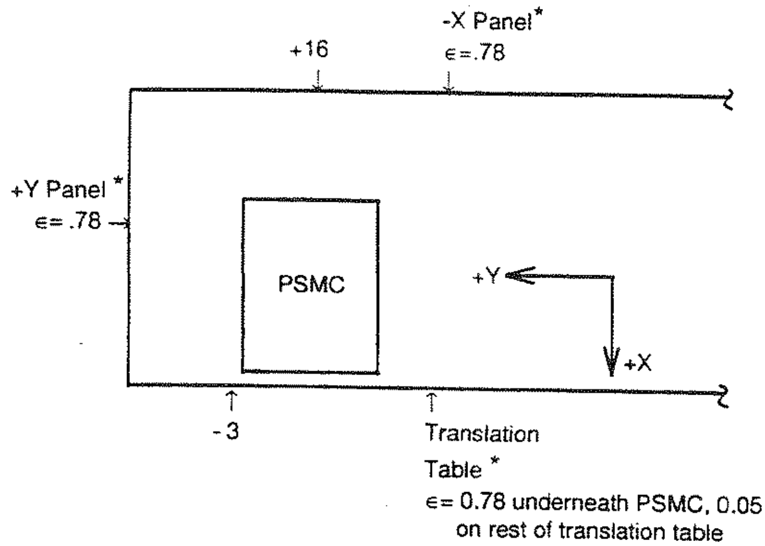


Figure 3.3-2b: ISIM ACIS Cold Standby Mode 3A, Boundary Temperatures and IR Emittances for ACIS PSMC Thermal Analysis



ACIS Bakeout Mode Hot Case (°C), ACIS Viewing, 180° Sun

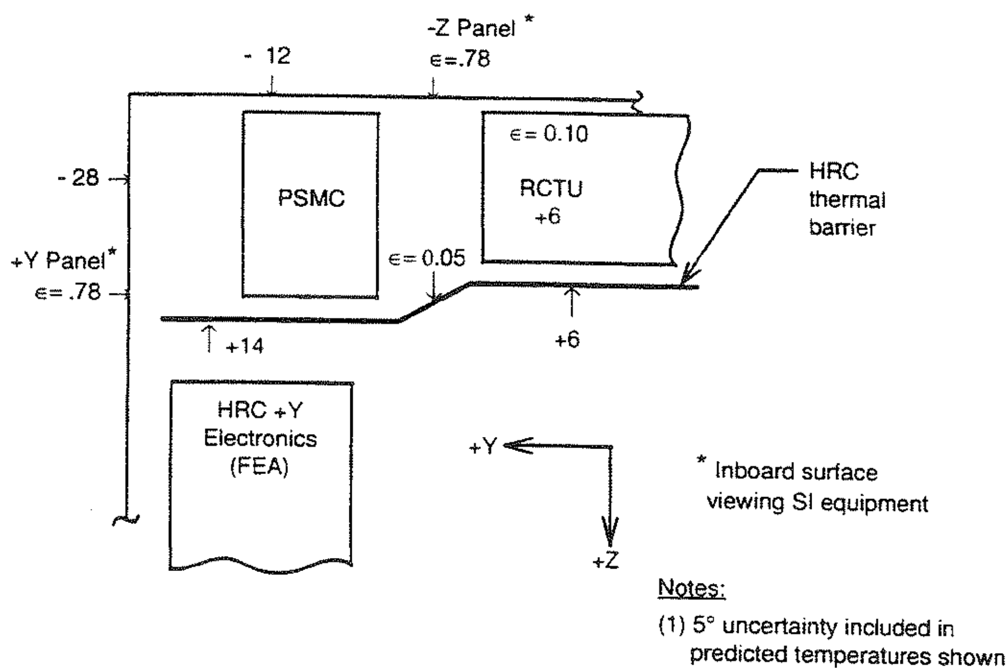


Figure 3.3-2c: ISIM ACIS Bakeout Mode Boundary Temperatures and IR Emittances for ACIS PSMC Thermal Analysis

3.3.1.1.1.6.2 For HRC thermal analysis, thermal conductance of the six (6) flexure supports mounting the detector to the SIM Translation Table shall be assumed to be less than 0.01 W/°C each.

3.3.1.1.1.6.3 For HRC thermal analysis, the HRC translation table aperture at the SIM interface shall be represented as a black body with an operational temperature range of +8 to +12°C when the HRC is in the viewing position.

3.3.1.1.1.6.4 HRC Entrance Aperture Thermal Interfaces

a) The entrance aperture of the HRC at the SIM interface when ACIS is viewing, i.e., the SIM focus structure, shall have an emittance of ≥ .75

b) For HRC thermal analysis, the entrance aperture of the HRC at the SIM interface when ACIS is viewing, i.e. the SIM focus structure, shall be assumed to have a temperature of 0° C for the hot case and -23°C for the cold case.

3.3.1.1.1.6.5 (Deleted)

3.3.1.1.1.6.6 (Deleted)

3.3.1.1.1.6.7 For HRC hot case and cold case analyses, the boundary temperatures and surface IR emittances of the ISIM (excluding HRC surfaces) as shown in Figure 3.3-3 shall be used.

3.3.1.1.1.6.8 (Deleted)

3.3.1.1.1.6.9 For HRC performance analysis, it shall be assumed that:

a) The worst case steady state gradients in the HRC attach fittings occur with the -Z/+Y fittings at 17°C, the -Z/-Y fittings at 13°C, and the +Z fittings at 0° C.

b) The average temperature of the HRC detector support interfaces with the SIM Translation Table changes a maximum of +13°C during the first 64 hours after HRC is translated into viewing position.

c) The temperature gradient across the translation table , between any pair of HRC mounting legs, does not change by more than 14°C over any 48 hour observation period.

3.3.1.1.1.6.10 For the FPSIs and ISIM thermal analyses, the HRC instrument shall be assumed to have external emittances as shown in Figure 3.3-4.

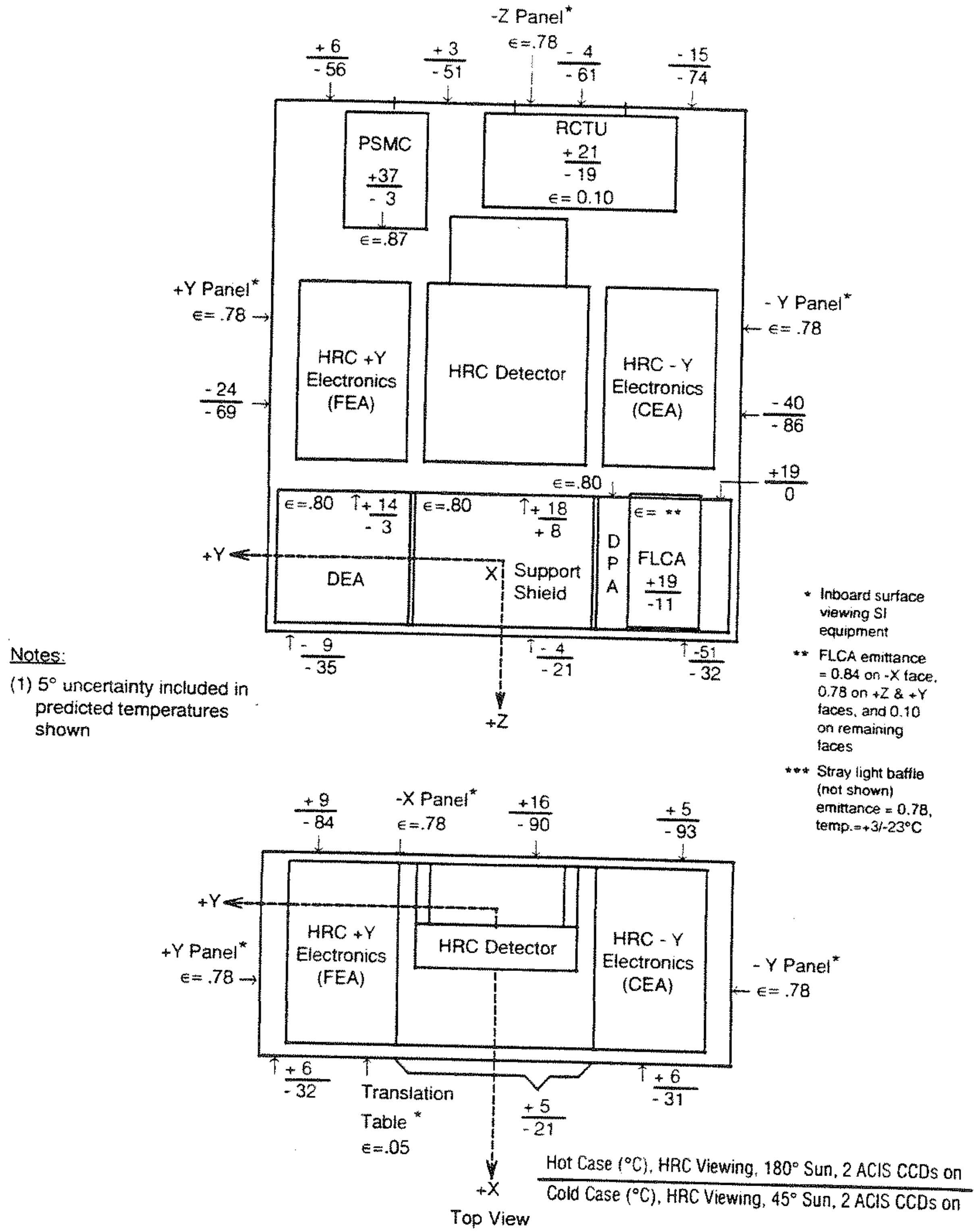


Figure 3.3-3: ISIM Hot and Cold Operational Case Boundary Temperatures and IR Emittances for HRC Thermal Analysis, HRC Viewing

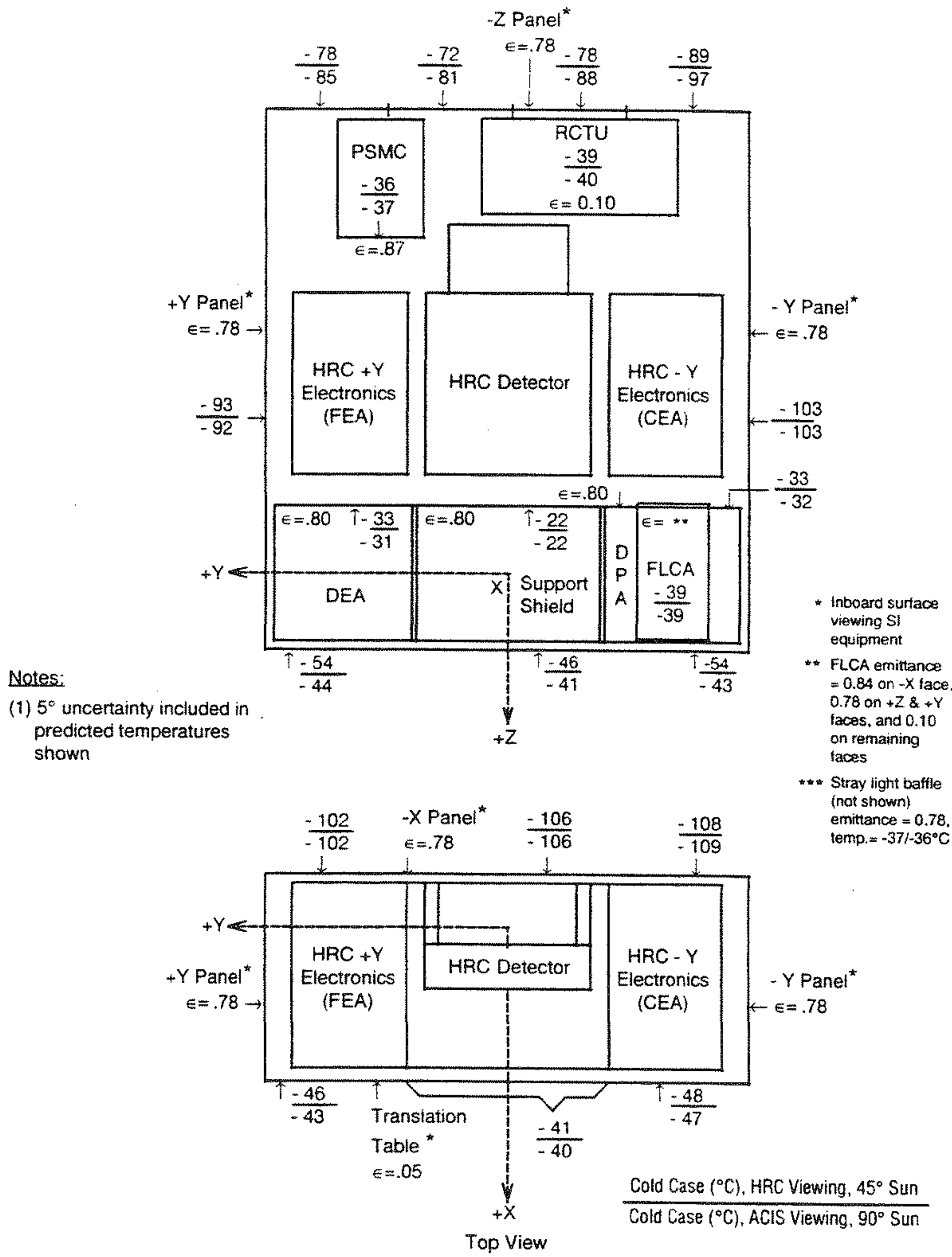


Figure 3.3-3a: ISIM Cold Survival, Non-operating Boundary Temperatures and IR Emittances for HRC Thermal Analysis

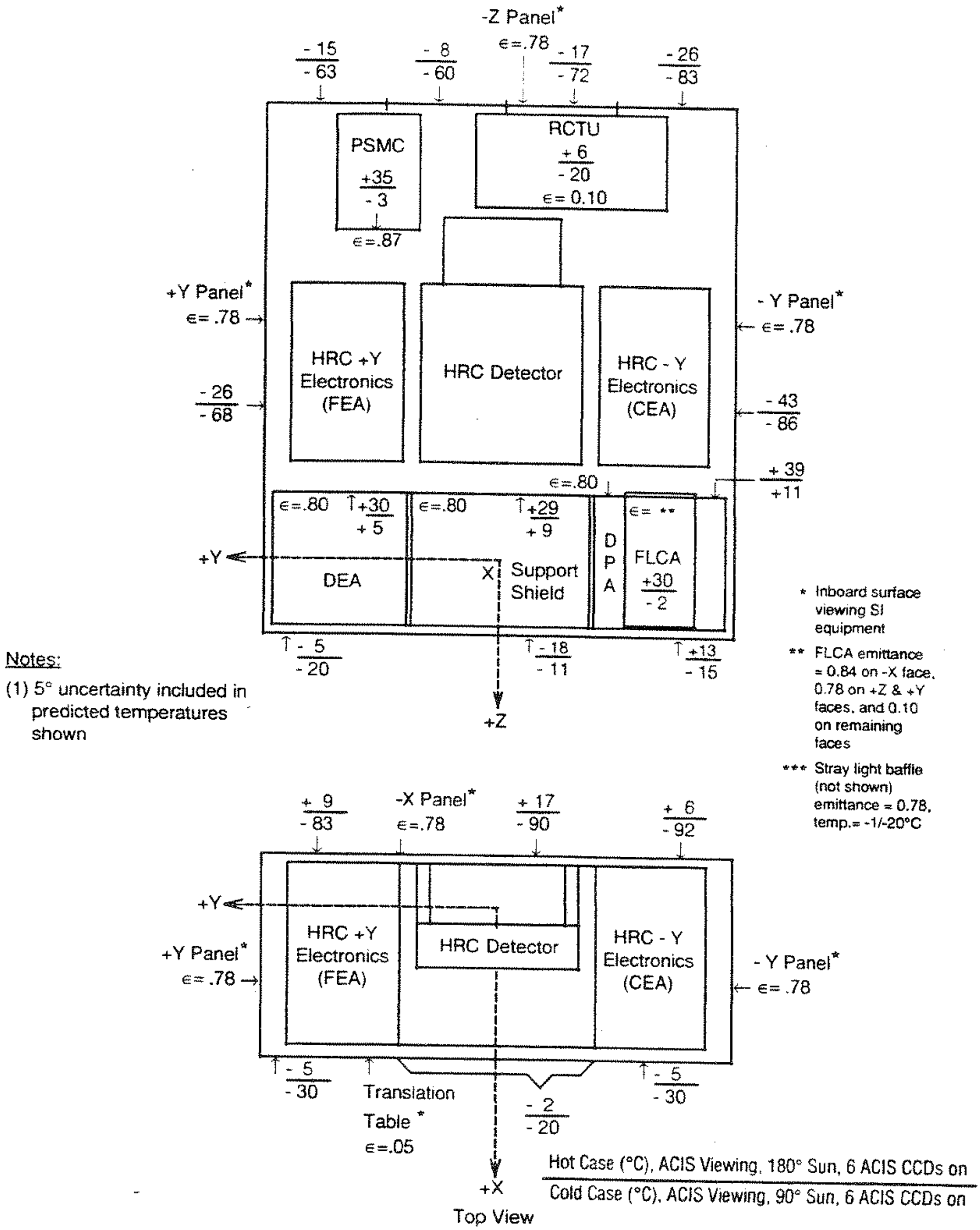


Figure 3.3-3b: ISIM Hot and Cold Operational Case Boundary Temperatures and IR Emittances for HRC Thermal Analysis, ACIS Viewing

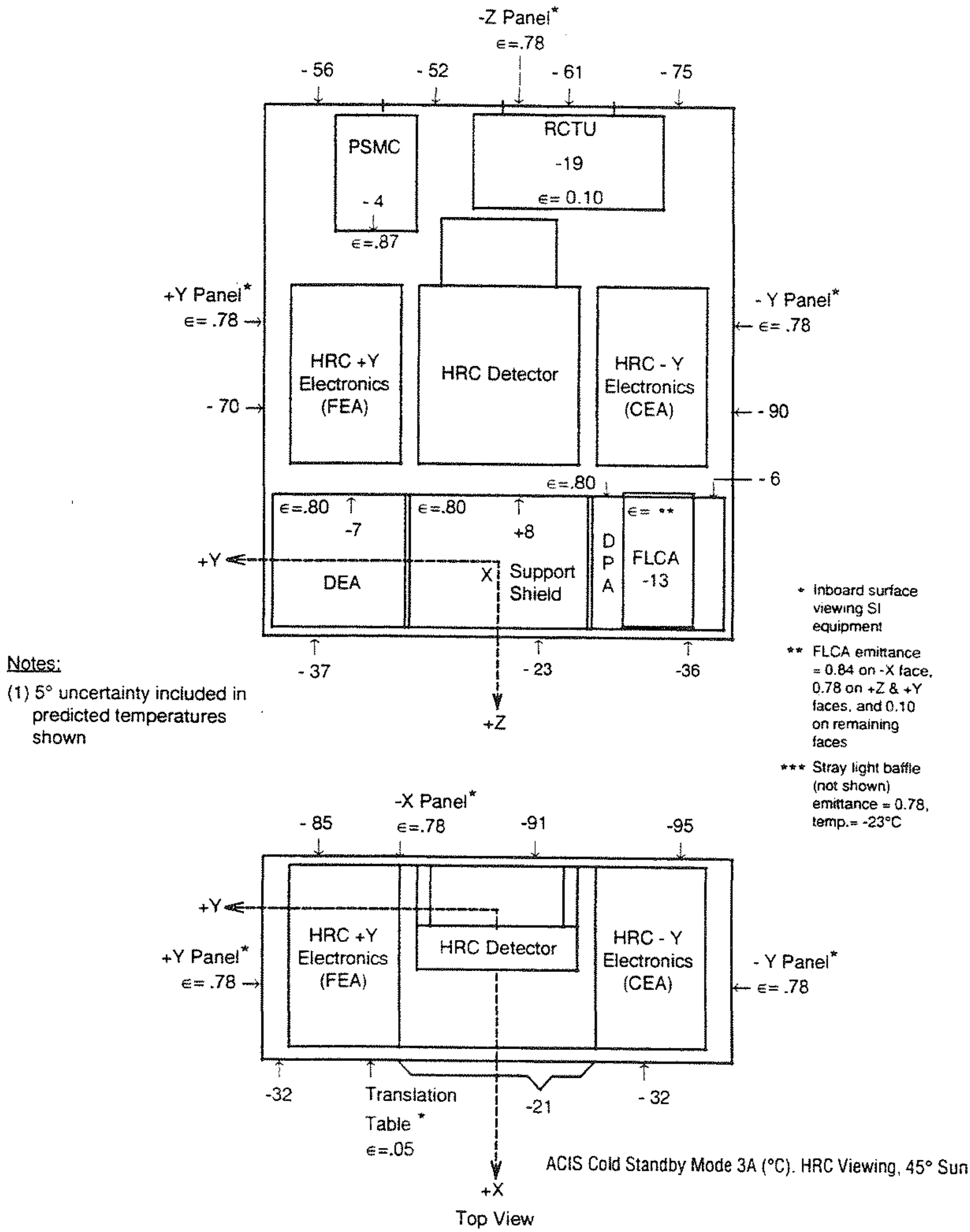
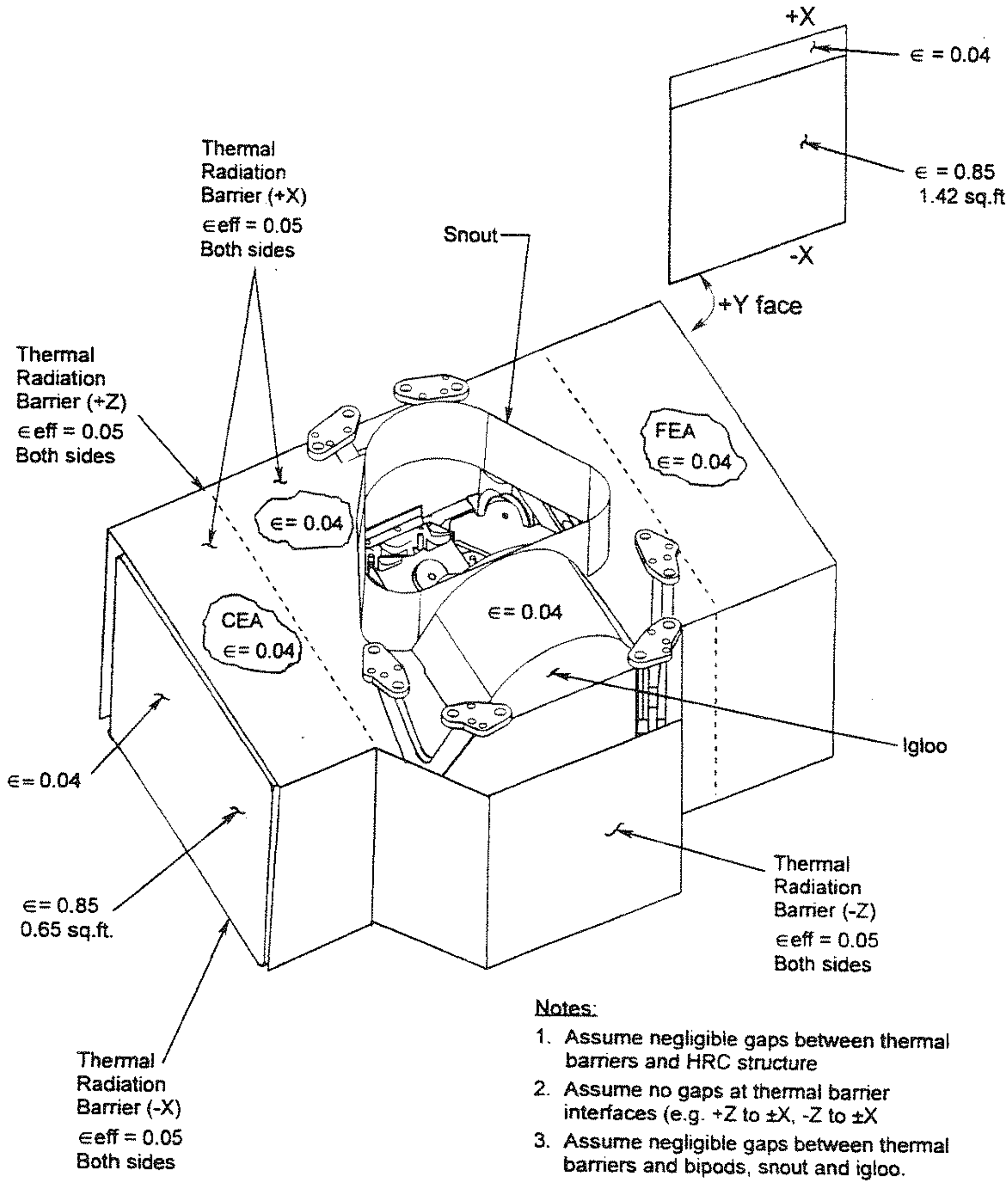


Figure 3.3-3c: ISIM Cold Standby Mode 3A Boundary Temperatures and IR Emittances for HRC Thermal Analysis



Notes:

1. Assume negligible gaps between thermal barriers and HRC structure
2. Assume no gaps at thermal barrier interfaces (e.g. +Z to ±X, -Z to ±X
3. Assume negligible gaps between thermal barriers and bipods, snout and igloo.

Figure 3.3-4: HRC Instrument and Electronics Boxes IR Emittances

3.3.1.1.1.7: (Deleted)

3.3.1.1.1.7.1 (Deleted).

3.3.1.1.1.7.2 (Deleted)

3.3.1.1.1.7.3 (Deleted)

3.3.1.1.1.7.4 (Deleted)

3.3.1.1.1.7.5 (Deleted)

3.3.1.1.1.7.6 (Deleted)

3.3.1.1.2: Thermal Characteristics and Models

a) The AXAF contractor shall provide to the SI team a detailed description of the SIM, for use in determining temperature of thermally critical components (e.g. the ACIS detector).

b) The ACIS team shall provide a thermal model of the ACIS detector [including radiator, heat conductors (straps), thermal isolation mounts and thermal blankets], the electronics and the interconnecting harness. This model shall be in SINDA format and shall have on the order of 40 nodes.

c) The HRC team shall provide a thermal model of the HRC detector assembly in SINDA format with approximately 10 nodes.

d) Each SI team shall provide thermal models of each of the other components of the SI. These models will have up to six nodes.

3.3.1.1.3: FPSI Thermal Power Modes

One instrument will be at the telescope focal plane. The other instrument will be in a mode which assures systems integrity and provides the capability for the instrument to be brought on line in a matter of seconds.

The FPSI general power conditions during AXAF-I on orbit operation are:

<u>Operating:</u> Both instruments are turned on and instrument temperatures are within operating limits.

<u>Off/Survival:</u> Instrument power is off. SI component temperatures are maintained above their low temperature survival limit, using observatory supplied heaters. Note that this mode may be of short duration during an eclipse or for an extended period following a spacecraft anomaly with the observatory in a safe hold mode.

Following an eclipse or recovery from an anomaly, instrument power is turned on and instruments use self-heating and trim heater power to raise from minimum survival temperature to their minimum operating value.

3.3.1.1.3.1: ACIS Thermal Power Modes

a) The ACIS will have six on-orbit power modes: OFF/SURVIVAL, OPERATING, CALIBRATION (out of focal plane), STANDBY, BAKEOUT, and MEMORY SAVE. The power dissipations for each mode to be assumed for ISIM thermal design shall be as shown in Table 3.3-1.

b) The BAKEOUT shall be performed only while ACIS is in the viewing position.

c) The MEMORY SAVE mode may be used during eclipse, pending Spacecraft power and thermal constraints, within the 844 watt-hours per hour two-battery capacity.

3.3.1.1.3.2: HRC Thermal Power Modes

The HRC will have three power modes during operation on orbit: OFF during eclipse, OPERATING, and SURVIVAL. The power dissipations for each mode to be assumed for ISIM thermal design shall be as shown in Table 3.3-2.

3.3.1.1.3.3: (Deleted)

TABLE 3.3-1: ACIS THERMAL POWER MODES

Operating Mode	Min Power (Watts)	Max Power (5) (Watts)	Operating Mode	Min Power (Watts)	Max Power (Watts)
Operating [Mode 1A] 6 CCD Clk: (6)			Bakeout [Mode 4A] Full: (10)		
DEA	28	35	DEA	9	14
DPA	49	61	DPA	7	10
PSMC	53	62	PSMC	48	63
Focal Plane Htr (2)	2	3	Focal Plane Htr	23	33
Det. Housing Htr	0	9	Det. Housing Htr	0	53
Mode 1A Total:	132	170	Mode 4A Total:	87	173
Calibration [Mode 2 C] 2 CCD Clk: (7)			Off / Survival (1) [Mode 5A] Energized SC Pwr.Bus:		
DEA	10	13	DEA	0	0
DPA	22	28	DPA	0	0
PSMC	46	53	PSMC	3	6
Focal Plane Htr (2)	2	3	Focal Plane Htr	0	0
Det. Housing Htr	0	9	Det. Housing Htr (3)(4)	0	0
Mode 2C Total:	80	106	Mode 5A Total:	3	6
Standby [Mode 3A] Full: (8)			Memory Save [Mode 3B] (1)		
DEA	2	4	DEA	0	0
DPA	7	10	DPA	5	7
PSMC	43	49	PSMC	12	19
Focal Plane Htr	2	4	Focal Plane Htr	0	0
Det. Housing Htr	0	9	Det. Housing Htr	0	0
Mode 3A Total:	54	76	Mode 3B Total:	17	26

NOTES FOR TABLE 3.3-1:

1. Current baseline is that the FPSIs are turned off during eclipses and during Survival Mode (5A). However, during eclipse, ACIS may be allocated power, as available, to enter MEMORY SAVE mode, depending upon the power and thermal constraints of the Spacecraft.
2. Assumes No CCD dissipation
3. Current Survival heater requirements to maintain focal plane and housing above the minimum survival temperature limits specified herein. The physical location of the survival heaters are found on the appropriate mechanical drawings. The physical size of the heater is 1 x 6 inches.
4. Survival heater values are shown in Table 3.3-4.
5. Based on clocking only 2 CCDs at a time.
6. When ACIS is in the focal plane, 6 CCDs are operating. The SIM thermal subsystem shall be designed to accommodate operation of two CCDs when ACIS is out of the focal plane.
7. ACIS is out of the focal plane for calibration.
8. ACIS trim heaters are on for Standby Modes 3A and operational temperatures do have to be maintained. ACIS is out of the focal plane during standby mode.
9. (Deleted)
10. ACIS is in the focal plane for bakeout.

TABLE 3.3-2: HRC THERMAL POWER MODES

Operating Mode	Min Power (Watts)	Max Power (Watts)
Off (During Eclipse): (1)		
Detector	0	0
Electronics +Y (2)	0	0
Electronics -Y (2)	0	0
Heaters	0	3.6 avg.
Operating: (HRC Viewing)	BOL (5)	EOL (5)
Detector (not including operational heaters)	1	2
Electronics +Y (FEA)	24	30
Electronics -Y (CEA)	16	19
Operating Total:	41	51
Standby (ACIS Viewing):	BOL (5)	EOL (5)
Detector (not including operational heaters)	1	1
Electronics +Y	24	30
Electronics -Y	14	15
Standby Total:	39	46

Notes:

1. Current baseline is that HRC is turned off during eclipse and survival modes. All HRC heaters are tied to the survival bus and therefore could be active when the instrument is off.
2. See Table 3.3-4
3. (Deleted)
4. (Deleted)
5. BOL = Beginning of Life, cold case; EOL = End of Life, hot case

3.3.1.2: Grating Thermal Interface

3.3.1.2.1: Grating Thermal Environment

This section provides the operational temperature predictions for the OTGs which are in thermal equilibrium with the HRMA, OBA, TFTE, and SSA. Unless otherwise specified, the following temperatures are valid only during normal mission operation.

A grating in the stowed position sees the telescope wall (i.e.: the interior conical surface of the optical bench) on one side. On the other side it sees the telescope walls, SSA equipment, including the open aft contamination cover (ACC), aft HRMA structure, and the other grating. In the observing position, the grating will see the aft HRMA on one side; on the other side it sees the telescope walls, the open ACC, SSA mechanisms and struts, and the other grating. Figure 3.3-5 illustrates the gratings and surrounding telescope surfaces.

The OBA and TFTE walls shall be controlled at 10°C±1.4°C.

IRN 042 (PIRN 20-0025B) ENTIRE PAGE

The spatial average temperature of the OB shall be within 1.4°C of the set point. The TFTE spatial average temperature shall be within 1.4°C of the OB set point. The spacecraft struts that are part of the OBA will range from -20°C to 30°C. The HRMA struts will range from 8.6°C to 22.5°C. Electrical box temperatures (which are part of the SSA equipment) will range from 8.6°C to 47.8°C.

The aft HRMA structure temperature ranges between the aft heater set point and the OB and TFTE average set point. The current predicted aft heater set point is 21.7°C. This set point will maintain the HRMA H-mirror cavity at 21.1°C ±1.4°C. HRMA aft baffle plate #6 is predicted to be within 2.8°C of the OBA, SSA, and TFTE spatial average temperature.

The grating structures (GESS/HESS, yoke, hinge mechanism) average temperature will also be determined by the OBA, SSA, and TFTE spatial average temperature. The steady state average temperature is predicted to be 10.5°C for cold telescope orientation. The maximum predicted change between the hot and cold cases is less than 1.0°C. The maximum predicted change for a fixed telescope orientation (with respect to the sun) is 0.3°C.

During Sunlight Safe Contingency Hold mode, the telescope receives full electrical power. The optical bench and HRMA will be maintained within operational thermal control limits.

During eclipse the OTG grating environment will be determined by the HRMA, OBA, SSA and TFTE spatial average temperature. The HRMA is assumed to be maintained at operational temperatures during eclipse. The OBA, SSA and TFTE temperatures will remain above OTG survival limits during both lunar and Earth eclipses. The spatial average OBA, SSA and TFTE temperature is predicted to be ≥ -10°C during eclipse.

3.3.1.2.2: (Deleted)

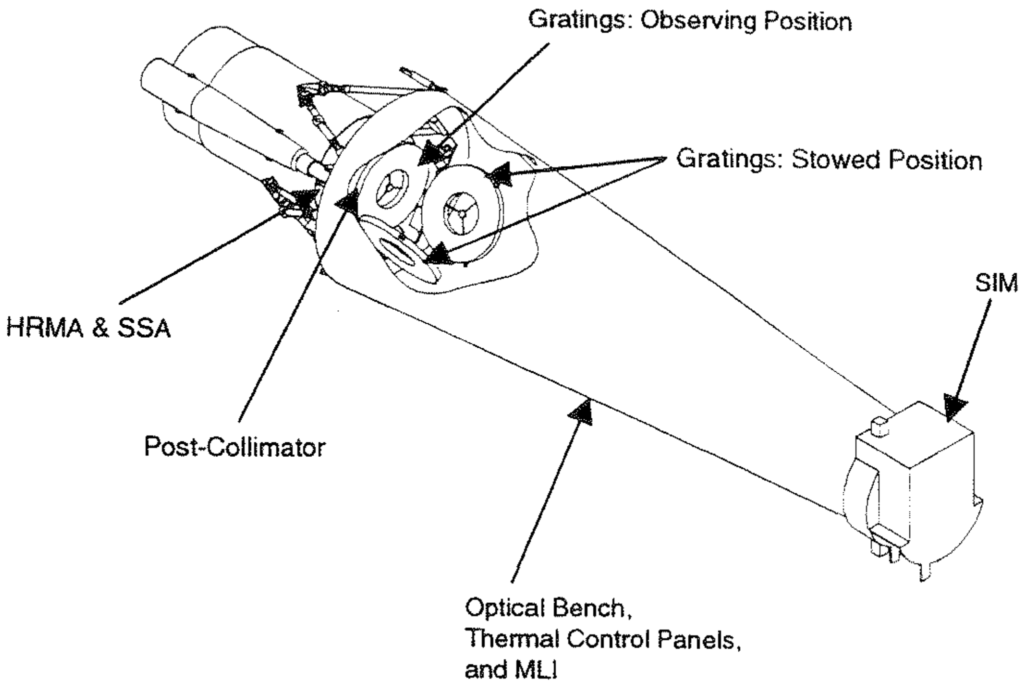


Figure 3.3-5: OTG Thermal Environment

3.3.2: Science Instrument Thermal Control

3.3.2.1: Science Instrument Temperature Range

Survival and operational temperature ranges for the SIs are as specified in Table 3.3-3.

3.3.2.2: FPSI Survival and Operational (Trim) Heater Requirements

The design of the ACIS shall include provisions for controlling the specified temperatures (including minimum survival temperature) of the focal plane and of the detector housing.

The design of the HRC shall include provisions for controlling the specified temperatures (including minimum survival temperature) of the detector housing.

The survival and operational (trim) heaters for the FPSI electronic boxes shall have the physical area, power and setpoints as shown in Table 3.3-4.

3.3.3: Other Thermal Environments

Other thermal environments to which the SIs will be exposed include preflight and flight environments as described below.

3.3.3.1: Preflight

The SI preflight environments include x-ray calibration at the XRCF, prelaunch, ground testing, transportation, and storage.

3.3.3.1.1: X-Ray Calibration

During X-Ray calibration the SIs shall be maintained within their operating/survival limits as specified in paragraph 3.3.2.

3.3.3.1.2: Prelaunch and Ground Testing

During prelaunch operations and ground testing, the SI electronics shall be maintained within their operating/survival temperature limits as specified in paragraph 3.3.2.

TABLE 3.3-3: SCIENCE INSTRUMENT TEMPERATURE RANGES

(All temperatures in Celsius)

Instrument	Survival Temperatures Minimum	Survival Temperatures Maximum	On-Orbit Operating Temp.(4) Minimum	On-Orbit Operating Temp.(4) Maximum
ACIS				
PSMC	-40	+40	-25	+35
DPA	-40	+43	-20	+43
DEA	-40	+43	-20	+38
Detector Housing	-76 (3)	+40 (2)	-61	-59
Focal Plane	-136	+40 (2)	-121	-119
HRC				
Electronics	-40	+40	-20	+40
Detector	-15	+40	-15	+40
HETG (1)	-18	+40	8.6	11.4
LETG (1)	-18	+40	8.6	11.4

Notes:

1. Temperatures shown are for HETG and LETG predicted environment rather than the instrument temperatures themselves.
2. +50°C for ground bakeout
3. Controlled by survival heaters to -76°C. Survival heaters sized to 1.25 times calculated requirement at 22 volts.
4. For electronics, refers to housing temperature.
5. For non-thermal ground testing, the maximum allowable ground test temperatures are +30°C for LETG, HETG, HRC, and ACIS.
6. Per the AXAF-I Environment Document, SE29, 5°C margin should be applied when protoflight or acceptance thermal testing of these components for on-orbit operation.

TABLE 3.3-4: SURVIVAL AND OPERATIONAL (TRIM) HEATER AREA AND POWERS

Heater Location and Type of Heater	Heater Minimum Area (in^2)	Power Dissipation (watts) at 22 volts (4)	Heater Setpoints On/Off (°C) (11)	
			Primary	Redundant
ACIS Detector Housing, Survival (12)	6.0	12.7	-71.1/-69.8	-73.6/-72.5
ACIS Support Structure, Trim & Survival (12)	54 (1)	100.2 (2)	+11.7/+13.1 -19/-16.3	+8.7/+10 -21.8/-19.6
ACIS DPA (5)	0	0	NA	NA
ACIS DEA (5)	0	0	NA	NA
ACIS PSMC, Trim & Survival (12)	17.0 (8.5 ea. of 2 htrs)	30.3 (Total for 2 htrs)	-1.9/+0.2 -24.7/-22.8	-4.8/-2.7 -28/-25.7
ACIS Focal Plane, Trim and Bakeout (13)	Trim: 0.96 (8) Bakeout: 1.28	Trim: 3.2 to 4.8 (7) Bakeout: 30.9 to 37.9 (7)	-120 ± 1 for Trim Adjustable to +30 for bakeout	
ACIS Detector Housing, Trim and Bakeout (13)	8.5	Trim: 9.0 Maximum (7); Bakeout: 53 Maximum (7)	-60 ± 1 for Trim +26 ±2 for bakeout	
HRC Detector, Survival	10.7 (6)	20.2 (6)	-10/-5	-10/-5
HRC +Y (FEA) Electronics, Survival	7.6 (9)	10.0 (9)	-36/-28	
HRC -Y (CEA) Electronics, Survival	3.8 (10)	5.0 (10)	-36/-28	
HRC Detector, Trim/Survival	7.6 (3)	10.0 (3)	-5/+5	

NOTES FOR TABLE 3.3-4

1. 3 heater circuits, 18 in^2 each.
2. 3 heater circuits, 33.4 watts each.
3. Two heaters wired in parallel, each 5.0 watts, 96 ohms, and 0.38x10 inches in size.
4. Heater power includes 25% margin at 22V (except for HRC heaters).
   Indicated powers are for each of the prime and redundant heater circuits.
5. Heaters for DPA and DEA are mounted on the Support Structure.
6. Two heaters wired in parallel, each 10.1 watts, 48 ohms and 0.38 x 14.0 inches in size.
7. This heater is not a function of bus voltage
8. Two heaters, each 0.66 x 0.73 inch
9. Two heaters wired in parallel, each 5.0 watts, 96 ohms, and 0.38 x 10 inches in size.
10. One heater, ~96 ohms, 0.38 x 10.0 inches in size.
11. If two sets of On/Off values are listed, the first is trim, the second is survival.
12. Tolerances on heater setpoints for heaters controlled by SSTSs is ± 1°C.
13. Heaters internally powered and controlled by ACIS. (Data is for information only)

3.3.3.1.3: Transportation and Storage

During transportation and storage the SI temperature shall be controlled as specified for flight equipment in DPD SE29.

3.3.3.2: Flight

Non-operational flight environments are defined as launch, ascent, deployment, orbital injection, eclipse, and Orbiter re-entry for contingency return to earth.

In these environments, instrument power will be off. Instrument temperatures shall be maintained within survival temperature limits by the observatory.

3.3.3.2.1: ACIS Orientation During Shuttle Open Cargo Bay and Transfer Orbit Phases.

IRN 062 (PIRN 20-0064A)

For the purposes of evaluating ACIS thermal response during the AXAF-I residence in the Shuttle Orbiter open cargo bay and transfer orbit phases, ACIS orientation information is provided in the AXAF Payload Integration Plan (NSTS 21330, section 4.2.3.1.1) and the AXAF/IUS ICD (ICD-B-81217, sections 3.4.2 and 3.4.1.8).

3.4: STRUCTURAL LOADS AND DYNAMICS

3.4.1: Structural Loads and Dynamics Description

3.4.1.1: Structural and Dynamic Math Models

The SI structural models provided by SI contractors to the AXAF-I contractor for the purpose of dynamic coupled loads analysis shall be simplified NASTRAN representations of the detailed models used by SI contractors. The models shall represent the SI dynamic characteristics up to 70 Hz. IRN 061 (PIRN 20-0063A)

The ACIS and HRC models provided by the SI contractors to the AXAF-I contractor for the purposes of structural analysis shall be either the full or simplified NASTRAN representations of the detailed models used by the SI contractors. The models shall adequately represent the stiffness of the SI at the translation table interface in all six degrees of freedom.

The interface points for the above models shall be representative of the SI interfaces points as defined in drawing 301475 (ACIS), 301476 (HRC) and 301330 (HETG) in Appendix G. IRN 061 (PIRN 20-0063A)

After delivery of the structural models, no changes shall be made to the models without the concurrence of the AXAF-I contractor. The currently controlled structural models are:

HRC: hrc0897a.dat
ACIS Detector: det0697.dat
ACIS Support Structure: pss9803a.dat
ACIS Shades: shd0695a.dat

3.4.1.2: Launch and Landing Loads

The design limit loads for the FPSIs and the OTGs in the stowed position are specified in SE11i, Tables 4.0-8 and 4.0-9 , respectively, which were derived from a coupled loads analysis and represent the transient flight events for an STS launch and landing. Emergency landing accelerations are specified in SE11i, Table 4.0-3. Random vibration loads are not included in the loads specified in this paragraph , but are defined in paragraph 3.4.1.2.2.

3.4.1.2.1: Natural Frequency Requirements

a) Components, assemblies and modules of the focal plane SIs shall be designed such that their lowest natural frequency is greater than 50 Hz, when mounted on a rigid structure.

b) The grating assembly minimum natural frequency shall be greater than 25 Hz, in the stowed position, when mounted in the Telescope System.

3.4.1.2.2: Random Vibrations

3.4.1.2.2.1: Science Instrument Random Vibrations

The SIs shall be designed to operate properly following exposure to the random vibrations as described in SE29, paragraph 3.1.3.1.2.

3.4.1.2.2.2: Fiducial Light Random Vibrations

The TRW supplied fiducial lights shall be capable of operating to performance requirements following exposure to the random vibrations as shown in Figure 3.4-1.

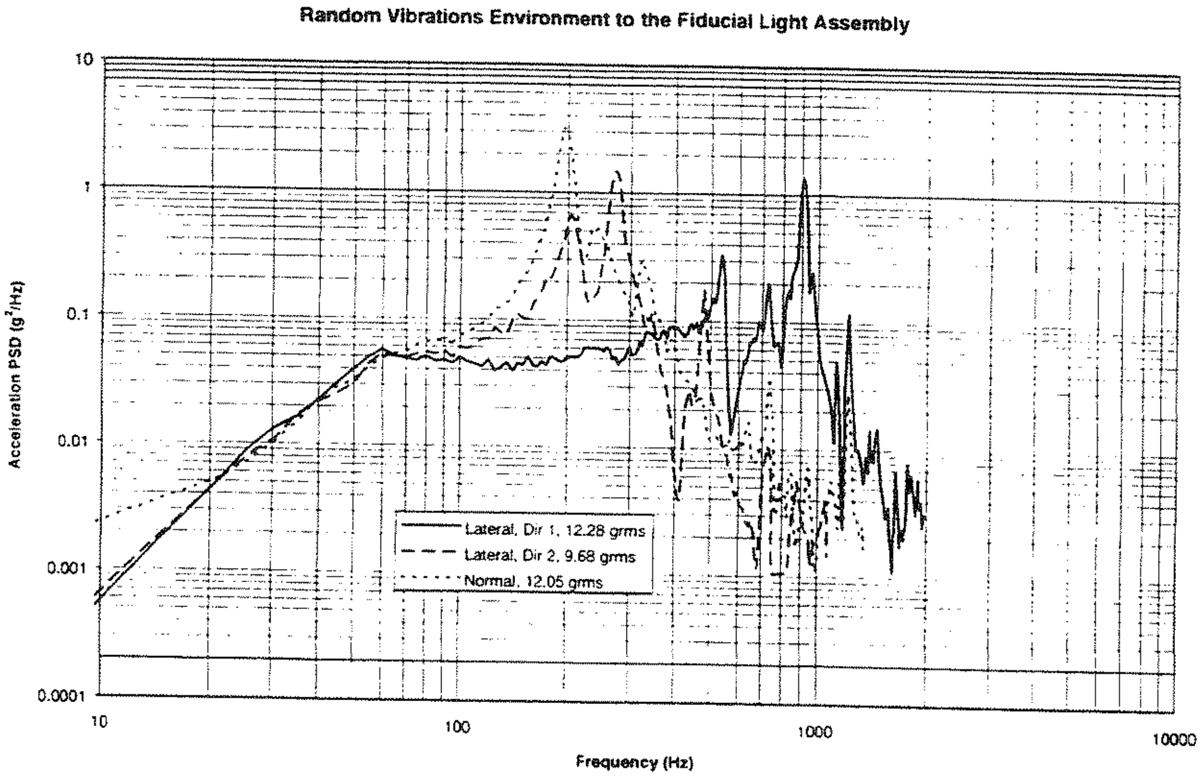


Figure 3.4-1: Fiducial Light Random Vibration Environment

3.4.1.2.3: Acoustics

The design of the SIs shall be compatible with the maximum expected launch and transonic sound pressure levels as described in SE29, paragraph 3.1.3.1.1.

3.4.1.2.4: Pressure

The SI components shall be designed to withstand the pressure changes as described in SE29, paragraph 3.1.3.3.. The pressure at the SI aperture as a function of time after launch shall be less than the pressure profile of Figure 3.4-2.

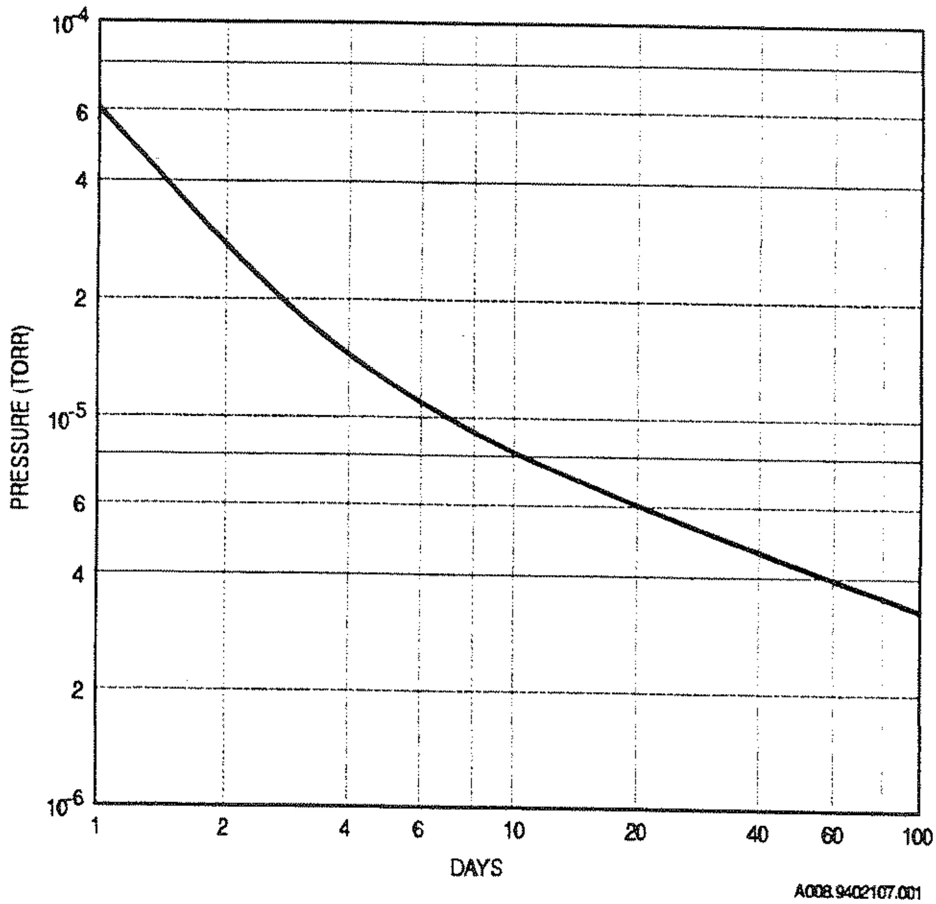


Figure 3.4-2: Pressure at SI Aperture Versus Time After Launch

3.4.1.2.5: (Deleted) IRN 062 (PIRN 20-0064A)

3.4.1.2.6: Shock loads

The FPSIs and OTGs shall be designed to withstand the shock load environment as described in SE29, paragraph 3.1.3.1.3.

3.4.1.2.7: SIM Translation Table Stiffness Coefficients

The SIM Translating Table stiffness coefficients based on the current design of the SIM Translating Table and the SI mounting configurations are listed in Tables 3.4-1, 3.4-2 and 3.4-3. Relative stiffness coefficients between various components can be calculated using these tables.

TABLE 3.4-1: TRANSLATION TABLE STIFFNESS MATRIX AT HRC LOCATION

HRC1

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
1.53E+06	4.52E+03	1.05E+05	-8.76E+04	8.29E+05	-1.65E+06
4.52E+03	3.49E+06	1.59E+05	7.22E+05	1.29E+05	2.52E+06
1.05E+05	1.59E+05	3.92E+06	4.99E+06	-2.40E+06	-2.57E+05
-8.76E+04	7.22E+05	4.99E+06	4.11E+07	-2.28E+06	-8.42E+05
8.29E+05	1.29E+05	-2.40E+06	-2.28E+06	1.44E+07	-2.88E+06
-1.65E+06	2.52E+06	-2.57E+05	-8.42E+05	-2.88E+06	2.21E+07

HRC2

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
1.46E+06	-2.74E+04	-1.48E+04	4.51E+03	-2.17E+06	-9.83E+04
-2.74E+04	2.72E+06	2.27E+05	3.08E+06	3.15E+04	1.75E+06
-1.48E+04	2.27E+05	3.92E+06	7.32E+05	-2.05E+06	9.35E+04
4.51E+03	3.08E+06	7.32E+05	1.98E+07	-3.84E+05	1.68E+06
-2.17E+06	3.15E+04	-2.05E+06	-3.84E+05	1.58E+07	-6.81E+03
-9.83E+04	1.75E+06	9.35E+04	1.68E+06	-6.81E+03	9.09E+06

HRC3

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
2.95E+06	4.41E+04	1.30E+04	-1.73E+04	-4.73E+05	5.64E+06
4.41E+04	7.35E+06	-1.83E+04	9.37E+04	-2.89E+05	3.38E+06
1.30E+04	-1.83E+04	5.06E+06	-8.20E+06	-1.56E+06	-9.05E+03
-1.73E+04	9.37E+04	-8.20E+06	5.93E+07	-2.41E+04	-2.27E+04
-4.73E+05	-2.89E+05	-1.56E+06	-2.41E+04	1.60E+07	-2.55E+05
5.64E+06	3.38E+06	-9.05E+03	-2.27E+04	-2.55E+05	3.47E+07

TABLE 3.4-1: TRANSLATION TABLE STIFFNESS MATRIX AT HRC LOCATION (CONT.)

HRC4

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
2.91E+06	-7.01E+04	3.24E+04	-3.54E+03	-3.71E+05	-5.56E+06
-7.01E+04	7.38E+06	7.40E+03	1.77E+04	1.66E+05	3.51E+06
3.24E+04	7.40E+03	5.17E+06	7.36E+06	-1.61E+06	6.76E+04
-3.54E+03	1.77E+04	7.36E+06	6.01E+07	3.53E+05	-1.45E+05
-3.71E+05	1.66E+05	-1.61E+06	3.53E+05	1.63E+07	2.59E+05
-5.56E+06	3.51E+06	6.76E+04	-1.45E+05	2.59E+05	3.56E+07

HRC5

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
1.65E+06	-6.32E+04	-6.64E+04	-9.27E+04	-2.55E+06	1.97E+05
-6.32E+04	3.04E+06	-2.01E+05	3.56E+06	5.91E+04	2.46E+06
-6.64E+04	-2.01E+05	4.25E+06	-1.08E+06	-2.15E+06	-2.22E+05
-9.27E+04	3.56E+06	-1.08E+06	2.97E+07	8.08E+05	2.83E+06
-2.55E+06	5.91E+04	-2.15E+06	8.08E+05	1.82E+07	-2.08E+05
1.97E+05	2.46E+06	-2.22E+05	2.83E+06	-2.08E+05	1.50E+07

HRC6

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
1.67E+06	-7.56E+04	1.08E+05	1.41E+05	7.63E+05	1.71E+06
-7.56E+04	3.62E+06	-1.62E+05	6.87E+05	-1.90E+05	2.31E+06
1.08E+05	-1.62E+05	4.09E+06	-4.58E+06	-2.47E+06	2.21E+05
1.41E+05	6.87E+05	-4.58E+06	3.82E+07	1.99E+06	-6.41E+05
7.63E+05	-1.90E+05	-2.47E+06	1.99E+06	1.46E+07	2.22E+06
1.71E+06	2.31E+06	2.21E+05	-6.41E+05	2.22E+06	2.10E+07

TABLE 3.4-2: TRANSLATION TABLE STIFFNESS MATRIX AT SUPPORT STRUCTURE LOCATION

SA1

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
8.31E+05	5.22E+03	4.16E+04	4.49E+03	3.37E+05	5.33E+03
5.22E+03	2.33E+06	1.71E+04	3.46E+05	-1.95E+04	7.26E+05
4.16E+04	1.71E+04	2.09E+06	-1.46E+04	-1.00E+06	6.98E+03
4.49E+03	3.46E+05	-1.46E+04	2.49E+07	-1.29E+04	3.18E+05
3.37E+05	-1.95E+04	-1.00E+06	-1.29E+04	7.39E+06	2.88E+04
5.33E+03	7.26E+05	6.98E+03	3.18E+05	2.88E+04	8.53E+06

SA2

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
1.08E+06	-9.71E+04	-3.60E+04	-1.07E+04	2.41E+05	-2.40E+05
-9.71E+04	3.01E+06	2.32E+05	5.25E+05	-4.41E+04	2.15E+06
-3.60E+04	2.32E+05	2.45E+06	-1.23E+06	-1.22E+06	3.03E+05
-1.07E+04	5.25E+05	-1.23E+06	3.14E+07	8.32E+05	-1.67E+04
2.41E+05	-4.41E+04	-1.22E+06	8.32E+05	1.63E+07	-2.65E+05
-2.40E+05	2.15E+06	3.03E+05	-1.67E+04	-2.65E+05	1.43E+07

SA3

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
1.08E+06	7.91E+04	-1.83E+04	-4.80E+02	3.91E+04	1.72E+06
7.91E+04	3.05E+06	-8.74E+04	9.25E+05	-5.72E+04	2.62E+06
-1.83E+04	-8.74E+04	2.24E+06	-1.55E+06	-1.09E+06	-1.94E+05
-4.80E+02	9.25E+05	-1.55E+06	4.06E+07	5.36E+05	3.97E+05
3.91E+04	-5.72E+04	-1.09E+06	5.36E+05	1.62E+07	4.47E+05
1.72E+06	2.62E+06	-1.94E+05	3.97E+05	4.47E+05	2.00E+07

SA4

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
1.29E+06	-5.93E+04	-7.73E+04	1.11E+03	-1.32E+06	4.48E+05
-5.93E+04	2.85E+06	7.41E+04	1.43E+06	-4.78E+04	1.73E+06
-7.73E+04	7.41E+04	2.98E+06	-5.53E+05	-1.45E+06	9.74E+03
1.11E+03	1.43E+06	-5.53E+05	2.52E+07	2.81E+05	5.56E+05
-1.32E+06	-4.78E+04	-1.45E+06	2.81E+05	9.70E+06	-3.86E+05
4.48E+05	1.73E+06	9.74E+03	5.56E+05	-3.86E+05	2.07E+07

TABLE 3.4-3: TRANSLATION TABLE STIFFNESS MATRIX AT ACIS DETECTOR ASSEMBLY LOCATION

DET1

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
6.19E+05	4.15E+04	2.37E+04	-9.75E+04	6.24E+05	2.10E+05
4.15E+04	2.21E+06	-3.35E+05	-1.46E+06	2.41E+05	6.36E+05
2.37E+04	-3.35E+05	1.27E+06	3.36E+05	-4.23E+05	-1.35E+05
-9.75E+04	-1.46E+06	3.36E+05	2.31E+07	-1.35E+06	-2.41E+05
6.24E+05	2.41E+05	-4.23E+05	-1.35E+06	1.10E+07	6.39E+05
2.10E+05	6.36E+05	-1.35E+05	-2.41E+05	6.39E+05	4.54E+06

DET2

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
9.16E+05	-3.86E+04	1.17E+05	5.71E+04	-3.04E+05	2.28E+05
-3.86E+04	2.13E+06	1.22E+05	-9.93E+05	-3.35E+04	9.33E+05
1.17E+05	1.22E+05	2.38E+06	-2.03E+05	-7.33E+05	4.79E+04
5.71E+04	-9.93E+05	-2.03E+05	1.51E+07	-1.59E+04	-1.19E+06
-3.04E+05	-3.35E+04	-7.33E+05	-1.59E+04	3.36E+06	-3.23E+05
2.28E+05	9.33E+05	4.79E+04	-1.19E+06	-3.23E+05	1.02E+07

DET3

X lbs/in	Y lbs/in	Z lbs/in	RX in-lbs/rad	RY in-lbs/rad	RZ in-lbs/rad
5.57E+05	-6.08E+04	-1.49E+04	1.51E+05	8.14E+05	-3.39E+05
-6.08E+04	2.32E+06	4.66E+05	-1.69E+06	-3.48E+05	7.63E+05
-1.49E+04	4.66E+05	1.52E+06	-6.21E+05	-5.44E+05	1.99E+05
1.51E+05	-1.69E+06	-6.21E+05	2.46E+07	1.58E+06	-4.14E+05
8.14E+05	-3.48E+05	-5.44E+05	1.58E+06	1.14E+07	-9.04E+05
-3.39E+05	7.63E+05	1.99E+05	-4.14E+05	-9.04E+05	5.71E+06

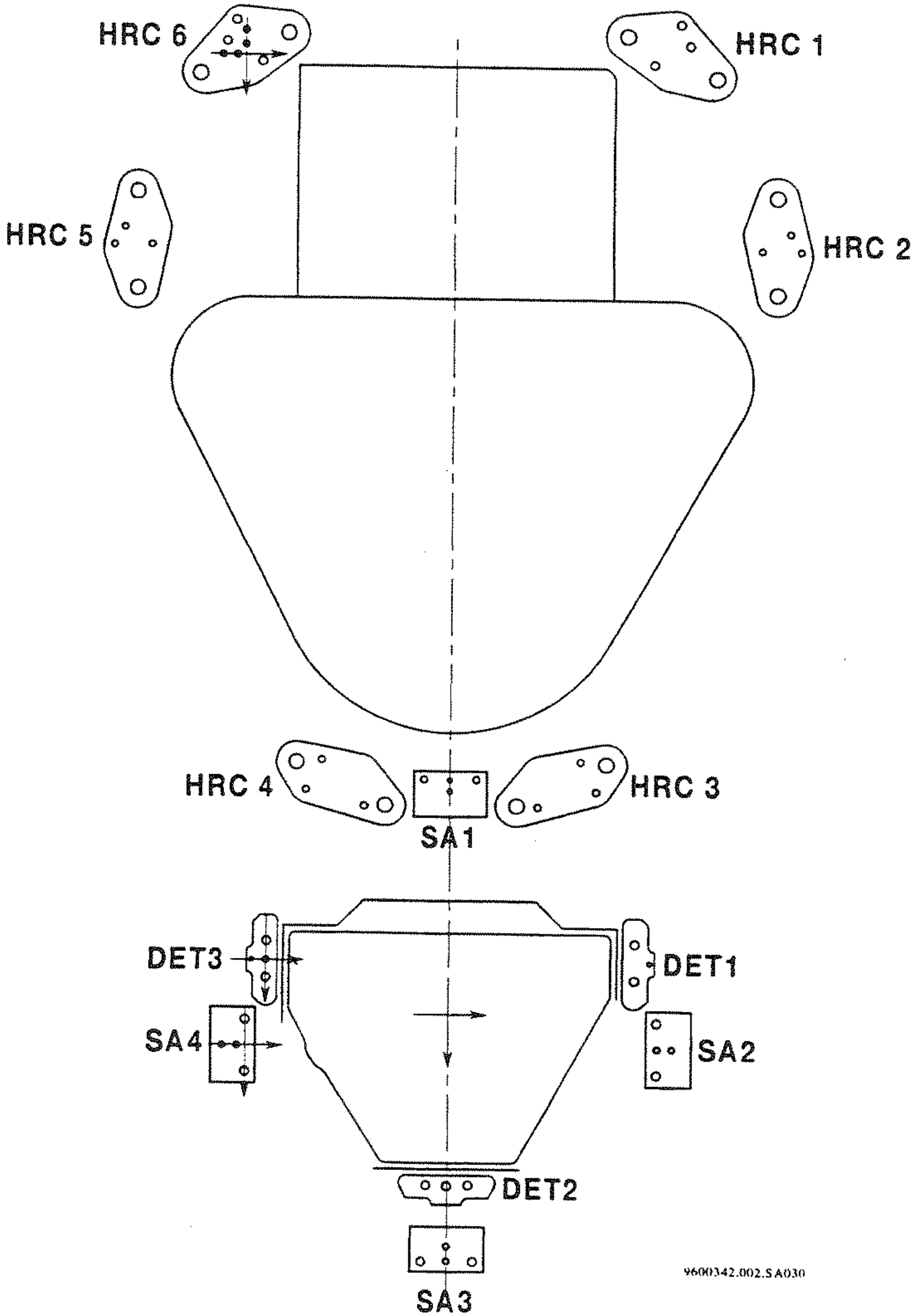


Figure 3.4-3: ACIS and HRC Mount Interface Locations

3.4.1.2.8: HRC Mount Interface Loads

Interface forces imparted into the SIM translation table mounting pads by the HRC shall be determined through the use of the model supplied in 3.4.1.1 coupled to either the SIM detailed model, or the stiffness coefficients provided in Table 3.4-1 which represents the translation table stiffnesses. IRN 061 (PIRN 20-0063A)

3.4.1.2.9: ACIS Mount Interface Loads

Interface forces imparted into the SIM translation table mounting pads by the ACIS Support structure, shades and detector shall be determined through the use of the models supplied in paragraph 3.4.1.1 coupled to either the SIM detailed model, or the stiffness coefficients provided in Table 3.4-2 and 3.4-3 respectively. IRN 061 (PIRN 20-0063A)

3.4.1.2.10: FPSI Dynamic Envelope

The dynamic envelopes of each of the FPSIs shall not, in general, extend more than 0.5 inches in any direction beyond the static envelopes defined in Drawings 301475 for ACIS and 301476 for HRC (see Appendix G). These drawings define smaller dynamic envelopes in certain locations.

3.4.1.3: Handling and Transportation

The loads experienced by AXAF-I or its components during handling and transportation shall be controlled by GSE design and operational constraints to preclude exceeding 80 percent of flight design levels of the design limit loads.

3.4.1.4: Orientation

Table 3.4-4 shows the orientation of the observatory and of the SIs at various stages of assembly, integration and test. ACIS and HRC shall include provisions to be lifted from their shipping containers and installed in the SIM with +X axis down. Orientation of the OTGs during installation is +X axis down. IRN 062 (PIRN 20-0064A)

TABLE 3.4-4: SI AND AXAF-I ORIENTATIONS

Activity	Orientation
SI installation in SIM	Vertical, +X down
Grating installation in telescope	Vertical, +X down
ISIM shipping	Vertical, +X down
SI calibration	Horizontal, +Z up
ISIM/AXAF-I integration, test*	Vertical, +X down
AXAF handling	Vertical, +X down
AXAF test (ambient functional)*	Vertical, +X down
AXAF test (TV)*	Vertical, +X down
AXAF test (acoustic)	Vertical, +X down
AXAF shipping	Horizontal, +Z up
AXAF payload processing at KSC*	Vertical, +X down
AXAF on launch pad	Vertical, +X down
Launch	Vertical, +X down

*The SIs will be operating intermittently during these activities

3.4.2: Vibration Compatibility

3.4.2.1: FPSI Induced Disturbances

The disturbances to the observatory which result from moving parts of the FPSIs shall be at sufficiently low levels such that scientific observations are not degraded. The allowable disturbances are specified as follows.

While either FPSI is taking measurements in the viewing position, the net disturbance reaction torque magnitude about the specified reference point resulting from FPSI part motion shall not exceed:

Net reaction torque about AXAF X-axis: 2.2×10^{-6} ft-lb

Net reaction torque about AXAF Y-axis: 5.5×10^{-5} ft-lb

Net reaction torque about AXAF Z-axis: 7.0×10^{-5} ft-lb

The net reaction force magnitude through the specified reference point resulting from FPSI part motion shall not exceed:

Net reaction force in AXAF X direction: 4.2×10^{-5} lb

Net reaction force in AXAF Y direction: 1.7×10^{-6} lb

Net reaction force in AXAF Z direction: 2.0×10^{-6} lb

The reference point for the above requirements is x = 14.0, y = 0.0, z = 0.0 inches as specified in the respective FPSI coordinate frames.

3.4.2.1.1 HRC Door Constraints

Observatory operational constraints will be established to prevent operation of the HRC door while ACIS is taking measurements.

3.4.2.2: FPSI Vibration Sensitivity

The FPSIs shall be able to operate without degradation while subjected to peak sinusoidal accelerations (applied simultaneously) as given in the following table in the frequency range most critical to the FPSIs. Accelerations are applied at the Detector Assembly center of mass for ACIS and the instrument center of mass for HRC:

	X (g)	Y (g)	Z (g)	RX (rad/sec^2)	RY (rad/sec^2)	RZ (rad/sec^2)
Peak Accelerations	± 0.002	± 0.002	± 0.002	± 0.02	± 0.02	± 0.02

3.5: ELECTRICAL INTERFACES

3.5.1: Electrical Power Interface

3.5.1.1: Input Voltage

The AXAF-I supplies at each SI power interface and heater connector a voltage of between +22 and +35 Vdc. The SI shall be designed to operate over this voltage range.

3.5.1.2: Bus Characteristics

The SIs shall be designed to operate properly from the electrical power bus with transient and ripple characteristics as specified in TRW D17389, Electromagnetic Compatibility Control Plan.

3.5.1.3: Power Control

The AXAF-I controls the main power control switching for the SIs.

3.5.1.4: Circuit Protection

Each SI power bus is fused in the observatory to protect the AXAF-I from shorts occurring in the SI. The fuse size ensures that steady state current, surge current, and in-rush currents have no deleterious effects on fuse operation.

3.5.1.5: FPSI Power Requirements

This section specifies capabilities of the electrical power service. Tables 3.3-1 and 3.3-2 of Section 3.3 in this ICD specifies the average power dissipations, in various FPSI power modes, to satisfy thermal interface requirements.

The maximum peak power required by the two FPSIs operating simultaneously shall not exceed 260 watts. This controlled power includes SI contingencies and an MSFC reserve.

The maximum peak power for ACIS shall be 175 watts.

The maximum peak power for HRC shall be 85 watts.

The observatory power system shall be capable of supplying these powers at the bus voltages specified in 3.5.1.1.

3.5.1.6: Power Redundancy

Two independently controlled power services, one prime and one redundant, shall be provided to each FPSI. Both services will be on concurrently for ACIS. Only one service will be on at any time for HRC.

3.5.2: Connectors and Harnesses

3.5.2.1: Interface Connectors

3.5.2.1.1: Connector Locations and Types

SI/Observatory interface connectors locations are defined on Drawings 301475 and 301476 (Appendix G). Connector types are specified in Appendix C for ACIS and Appendix D for HRC.

3.5.2.1.2: (Deleted) IRN 062 (PIRN 20-0064)

3.5.2.2: Harnesses

Redundant power and signal lines shall be carried on separate connectors.

3.5.2.3: Shielding

All internal instrument electrical wiring not contained within an electrically conductive enclosure shall be shielded in accordance with DPD 692 SE19, or equivalent FPSI EMC Control Plan (SAO-HRC-DR-93-022 or MIT 36-01205-SHF07)

3.5.2.3.1: HRC Fiducial Light Conductor Shielding

Fiducial light mounting and wiring shall be electrically shielded from the HRC grids, channel plates, and wiring harnesses within the detector. Shields shall be terminated at the detector body.

3.5.2.3.2: (Deleted)

3.5.2.4: Interface Signals

Interface signals between the observatory and ACIS, and between the observatory and HRC are specified in Appendices C and D, respectively.

3.5.3: Electromagnetic Compatibility

3.5.3.1: EMI and RFI

The SIs shall be electromagnetically compatible with the AXAF-I as specified in AXAF-I EMC Control Plan SE19, or equivalent FPSI EMC Control Plan (SAO-HRC-DR-93-022 or MIT 36-01205 SHF07) and meet the requirements specified in MIL-E-6051. Electronic equipment shall meet the requirements of MIL-STD-461, Parts 1 and 3, which shall be modified as necessary to assure compliance with system-level requirements of MIL-E-6051 and the EMC Control Plan.

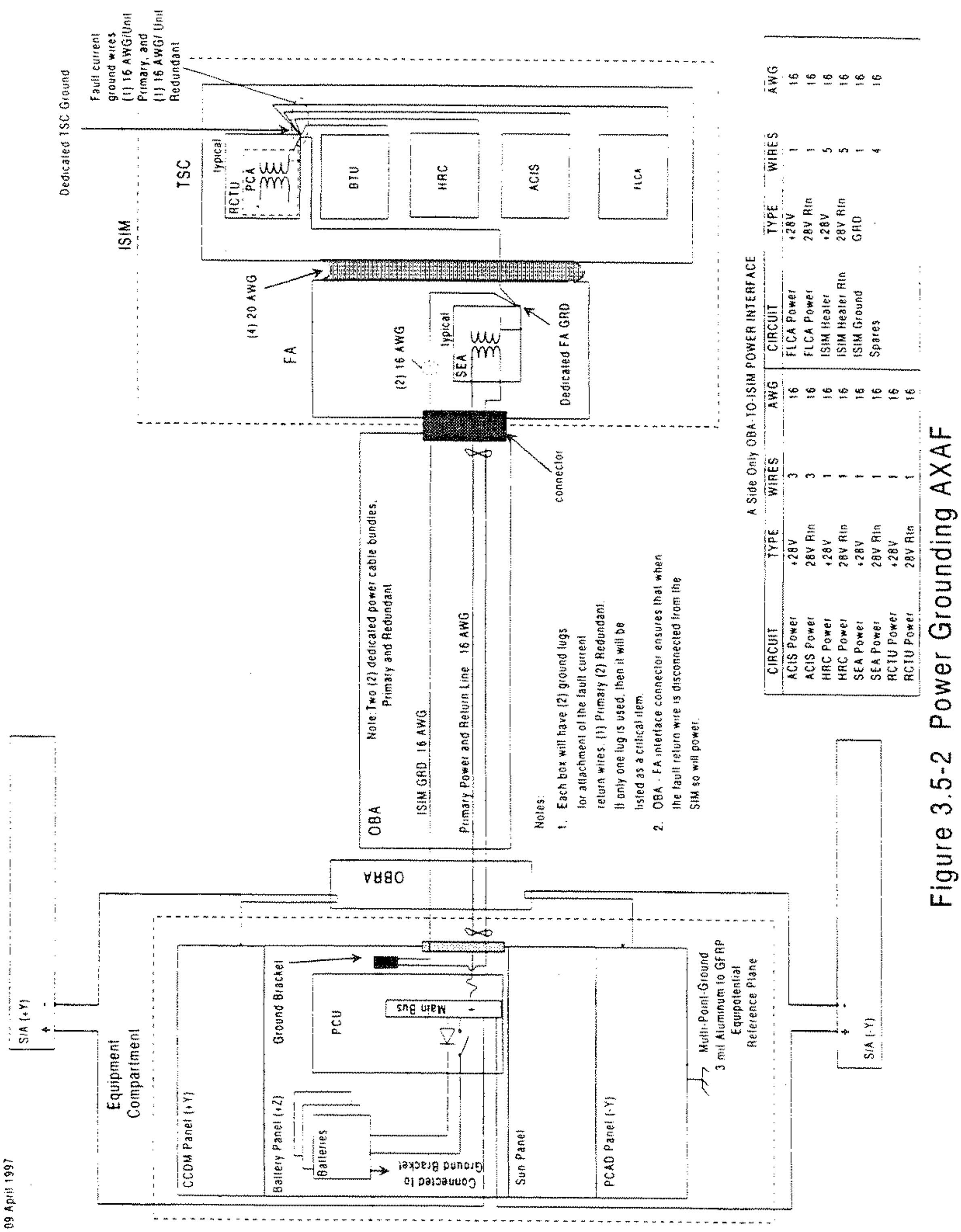
3.5.3.2: Electrical Grounding

3.5.3.2.1: SI Electronic Equipment Grounding

a) SI structure and equipment mounting shall be electrically bonded in accordance with MIL-B-5087 and with DPD 692 SE19 or equivalent FPSI EMC Control Plan as specified in paragraph 3.5.3.1.
b) SIM grounding shall be in accordance with Figures 3.5-1, 3.5-1B (Appendix G), 3.5-2 and 3.5-3. Figure 3.5-1B illustrates the grounding configuration between the RCTU, PSMC and DPA for clarity.
c) FPSI grounding details shall be in accordance with Figures 3.5-1, 3.5-1A, 3.5-1B (Appendix G), 3.5-2 and 3.5-3 for their respective components.
d) Each FPSI unit shall provide two ground lugs; one for primary and one for redundant fault current return. If only one lug is used for both primary and redundant, it will be listed as a critical item.

3.5.3.2.2: ACIS Sunshade Assembly Grounding

The ACIS Sunshade Assembly shall be grounded via surface conductance through the feying (contacting) surfaces of the Sunshade Assembly and the two metallic fittings in the SIM Translation Table to which the Sunshade Support Posts are mounted. The SIM shall be responsible for grounding the fittings in the translation table. The ACIS shall be responsible for grounding the Sunshade Assembly to the surfaces on their Telescope Shade which contact the Translation Table fittings. The mount fasteners shall not be considered for grounding purposes.



IRN 043
(PIRN
20-0050A)
ENTIRE
PAGE

Figure 3.5-2: Power Grounding - AXAF

IRN 043
(PIRN
20-0050A)
ENTIRE
PAGE

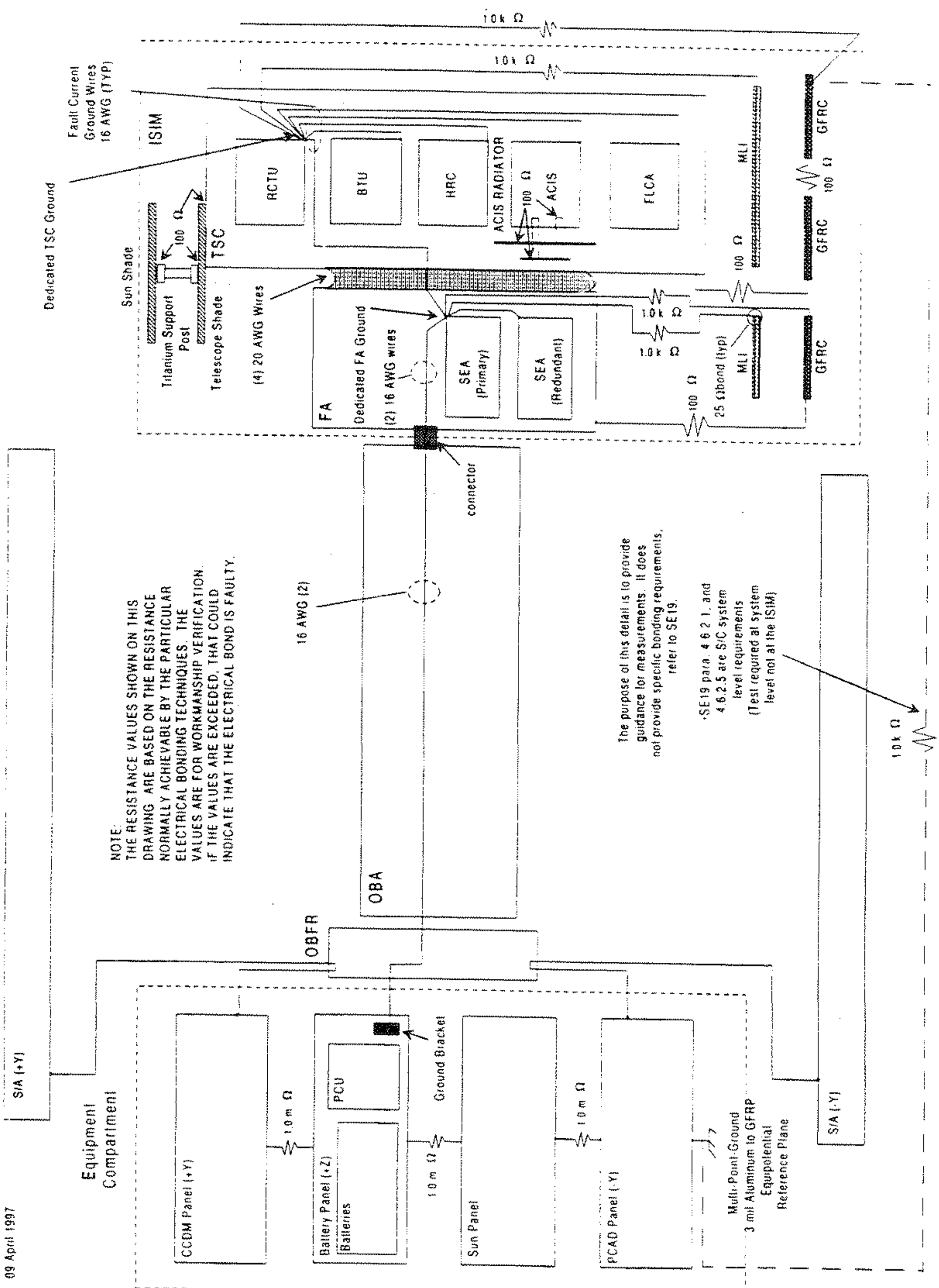


Figure 3.5-3: ESD Grounding - AXAF

3.5.4: Magnetics

3.5.4.1: Magnetic Field Intensity

The magnetic field generated by the observatory equipment shall not exceed 0.8 gauss within the volume allocated to FPSIs. The magnetic field from any SI shall not exceed 170 dBpT (3 Gauss) at the edge of the SI envelope.

3.5.4.2: On-orbit AC Magnetic Field Emission Limit

The on-orbit AC magnetic field generated by ISIM equipment shall not exceed the limit as specified in paragraph 5.2.3 of DPD692 SE19.

3.5.5: SI Protection

Sensors are provided by the observatory to generate signals to warn of the presence of bright object and charged particle radiation. IRN 062 (PIRN 20-0064A)

3.5.5.1: Bright Object Protection

The observatory shall provide protection for the SIs in the event of the observatory inadvertently pointing to within 45° of the sun. This protection consists of positioning the SIM translation table such that the HRMA focal point is midway between the two FPSIs and retracting an OTG if necessary. IRN 062 (PIRN 20-0064A)

3.5.5.2: Radiation Detector Signal

The observatory shall provide a signal via the CCDM RCTU, having multiple threshold settings, for direct distribution to each focal plane SI, indicating the presence of high energy particles. Threshold levels are defined in Appendix C for ACIS and Appendix D for HRC.

The signal to ACIS is defined as a serial command to the ACIS digital Processor Assembly HW command port. The bit description is defined in Appendix C. A second signal (bit pattern shown in Appendix C, para. 4.0) shall be sent when the charged particle count has dropped below a second settable threshold. IRN 052 (PIRN 20-0061)

The signal to HRC shall consist of a series of commands, specified in Appendix D, Section 3.0, which will reduce the detector high voltage when the radiation threshold is exceeded, and restore the high voltage when the radiation returns below threshold..

3.6: COMMAND AND DATA HANDLING INTERFACES

3.6.1: Commands

3.6.1.1: SI Commanding

SI commanding shall be principally accomplished through updatable command memory loads which are preplanned and stored in the onboard computer for later execution. The stored commands for the entire SI complement over a 72 hour period shall not exceed 5400 commands. All SI Commands and Command Constraints shall be defined in DPD 692 SE17, the AXAF-I Instrument Program and Command List and in DPD692 OP05, the AXAF Operations Constraints, Restrictions and Limitations Document. SE17 obtains its information from DPDs 727/726 DR SSE10, the ACIS and HRC Instrument Program and Command List inputs.

3.6.1.1.1: ACIS - OBC Software - Ground Software

3.6.1.1.1.1: Buffer Size

ACIS commands stored in OBC memory shall require no more than 10K Bytes

3.6.1.1.1.2: Command Formats

1. ACIS commands received by OBC S/W shall consist of:
   a) Table loads in the format and with the contents described in Table 3.6-1, and
   b) Software commands
2. An ACIS table load shall not exceed 512 bytes
3. A software command shall initiate the transmission of a specific ACIS table.
4. The OBC shall issue the ACIS table load as regular 16 bit commands to the RCTU address assigned to ACIS.

3.6.1.1.1.3: ACIS Operations

3.6.1.1.1.3.1: Normal and Standby Operations

ACIS shall be commanded identically in standby mode and in normal observation modes.

3.6.1.1.1.3.2: Memory Uplink Mode

When large amounts of ACIS memory need to be transferred, ACIS and the OBC shall be configured to pass the 512 byte ACIS packet directly to ACIS after storing it in a temporary buffer. A continuous stream of buffers can be sent mixed in with other OBC uplinks.

Note: This configuration is not a special mode for the OBC. A stored, or real time command can be sent to ACIS to configure it for a memory uplink (or any other activity requiring many data transfers). The OBC will receive a buffer and a command to send that buffer immediately to ACIS, and this completes the memory uplink mode.

3.6.1.2: ACIS Processor Loads

The design of the observatory shall provide a capability of loading data into the ACIS processor memory. Memory loads will be on an infrequent basis. The memory load size is on the order of 32K 24 bit words.

3.6.2: SI Telemetry

3.6.2.1: SI Science Data

a) Data is transmitted from AXAF-I to the ground in major data frames as shown in Figure 3.6-1, Figure 3.6-2A, and Figure 3.6-2B. A major data frame shall provide an average science data rate of 24 kbps, including headers. Aspect data shall not be included in this data allocation. All SI data is collected in serial 8 bit words by the RCTU.

b) The science data header as specified in Figure 3.6-2A shall be a part of the engineering telemetry.

c) The Earth Centered Inertial coordinate system used for position and attitude information, provided in the OBC contribution to telemetry, is defined in Figure 3.6-3. The X axis coincides with the vernal equinox (epoch 2000); the Z axis coincides with the earth's rotational axis, and the Y axis completes the right-handed system. IRN 062 (PIRN 20-0064A

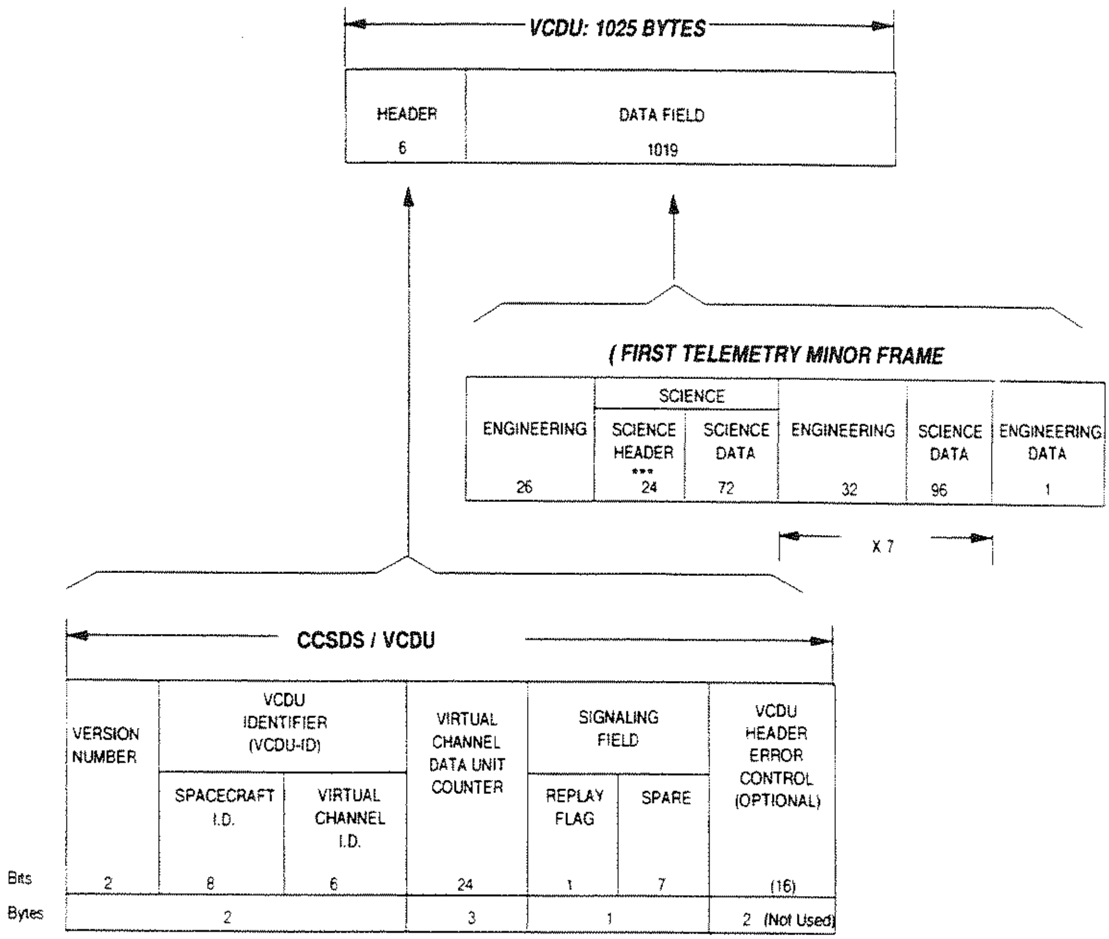
d) In Telemetry Format 1, 24 kbps of science data shall be collected from HRC ; 512 bps of data shall be collected from ACIS,. In Telemetry Format 2, ACIS shall provide 24 kbps of science data while HRC provides 512 bps of science data. There shall be no data loss caused by transition between Telemetry Formats 1 and 2.

e) All SI telemetry shall be defined in DPD692 DRSE17, the AXAF-I Instrument Program and Command List which obtains its information from DPDs 727/726 DR SE10, the ACIS and HRC Instrument Program and Command List inputs.

TABLE 3.6-1: ACIS DATA PACKET FORMAT

Field Name	Size (Bits)	Source	Description / Comment
Packet Word Length	16	ACIS / ASC	The number of 16 bit words (commands) in the command packet.
Packet Identifier	16	ASC / OFLS	
Data	[Packet Word Length - 2] * 16	ACIS / ASC	See ACIS Science Instrument Software Detailed Design Specification, 36-01105 Rev. 00 NAS8-37716 DR SDM03

TABLE 3.6-2: (DELETED)



(***) SCIENCE HEADER IS IN FIRST MINOR FRAME OF EACH GROUP OF (8) MINOR FRAMES. (THIS APPLIES ONLY TO HRC, FORMAT 1.)

Figure 3.6-1: AXAF-I Telemetry Minor Frame Format

x7 (Engineering 32 / Science 96 columns)

x 16

Minor Frame No.	CCSDS Header 6	Engineering 26	Header 24	Science Data 72	Engineering 32	Science 96	Eng. 1
0							
1	CCSDS	Engineering 26	Science Data 96		Engineering 32	Science Data 96	Eng. 1
2	CCSDS	Engineering 26	Science Data 96		Engineering 32	Science Data 96	Eng. 1
3	CCSDS	Engineering 26	Science Data 96		Engineering 32	Science Data 96	Eng. 1
4	CCSDS	Engineering 26	Science Data 96		Engineering 32	Science Data 96	Eng. 1
5	CCSDS	Engineering 26	Science Data 96		Engineering 32	Science Data 96	Eng. 1
6	CCSDS	Engineering 26	Science Data 96		Engineering 32	Science Data 96	Eng. 1
7	CCSDS	Engineering 26	Science Data 96		Engineering 32	Science Data 96	Eng. 1

Format 1 - HRC Telemetry

Figure 3.6-2A: Science and Engineering Telemetry Major Frame Format 1

x7 (Engineering 32 / Science 96 columns)

x 16

Minor Frame No.	CCSDS Header 6	Engineering 26	Science Data 96	Engineering 32	Science 96	Eng. 1
0						
1	CCSDS	Engineering 26	Science Data 96	Engineering 32	Science Data 96	Eng. 1
2	CCSDS	Engineering 26	Science Data 96	Engineering 32	Science Data 96	Eng. 1
3	CCSDS	Engineering 26	Science Data 96	Engineering 32	Science Data 96	Eng. 1
4	CCSDS	Engineering 26	Science Data 96	Engineering 32	Science Data 96	Eng. 1
5	CCSDS	Engineering 26	Science Data 96	Engineering 32	Science Data 96	Eng. 1
6	CCSDS	Engineering 26	Science Data 96	Engineering 32	Science Data 96	Eng. 1
7	CCSDS	Engineering 26	Science Data 96	Engineering 32	Science Data 96	Eng. 1

Format 2 - ACIS Telemetry

Figure 3.6-2B: Science and Engineering Telemetry Major Frame Format 2

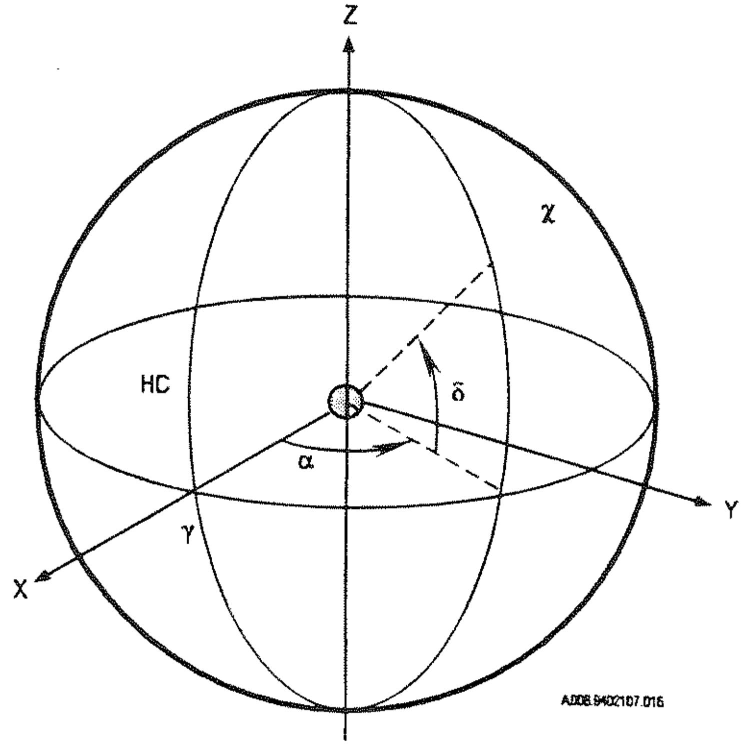


Figure 3.6-3: Earth Centered Inertial Coordinates

3.6.2.2: SI Engineering Data

The observatory shall provide the capability to acquire basic state of health engineering data from each SI in the Operational mode at a rate determined by the telemetry measurements listed in DPD692 SE17. The SI shall provide the data for collection on the AXAF-I data bus via the SI RCTU.

3.6.2.3: (Deleted)

3.6.2.4: Telemetry Synchronization

IRN 062 (PIRN 20-0064A) (See Section 3.6.3 for synchronization signal requirements)

3.6.2.5: Telemetry Format Changes

a) All command sequences changing the telemetry format shall be preceded by a serial digital command to the HRC specifying that HRC will be:
   1) provided with 24 kpbs downlink for science data
   2) provided with 512 bps downlink for science data
   3) provided no downlink for science data.

b) When the sequence is a stored command sequence, HRC notification shall occur within half a second prior to commanded telemetry format change.

Note: Since telemetry format changes occur at major frame synchs, there could be up to 32.5 seconds of delay between HRC notification and the actual telemetry mode change.

3.6.3: Central Timing

The AXAF-I central clock shall be relatable to Universal Time Coordinated (UTC) to within 0.1 milliseconds by routine ground processing. The AXAF-I clock shall have a resolution of 1.0 microsecond, and a stability of better than one part in 10^9 per 24 hour day.

The CCDM system shall provide prime and redundant major frame pulses to the FPSIs at the beginning of a telemetry major frame.

The CCDM system shall provide prime and redundant science header pulses to the FPSIs at the beginning of each telemetry major frame and every 2.05 seconds thereafter. The leading edge of the science header pulse shall be correlated to Universal Time on the ground.

The CCDM system shall provide prime and redundant 1.024 MHz clocks to the FPSIs for use by the "microsecond counter" in the instruments. The instrument will timetag X-Ray events with the count from the microsecond counter indicating the elapsed time since the science header pulse. The resolution of the microsecond counter will be as specified in the instrument CEI specification.

3.6.4: RCTU Characteristics

Electrical interface information on command, telemetry, and timing signals is provided in TRW Document D17387, AXAF-I RCTU User Interface Requirements. IRN 062 (PIRN 20-0064A)

3.6.5: CCDM/SI Interface Requirements

3.6.5.1: SI Command Interface Requirements

There are two types of commands available to the SI, which are as follows:

- Serial Digital Commands
- High-level Pulse Commands

3.6.5.1.1: Serial Digital Commands

Serial digital commands provide a set of signals to the SI circuitry (enable, clock and data) which are used to clock command data into the SI electronics. The serial digital command interface is shown in Figure 3.6.5-1 (as reference only). A serial digital word is defined as a concatenation of 16 bits formed into a digital word with the MSB transmitted first.

3.6.5.1.1.1: Serial Digital Command Characteristics

SIs shall meet the interface requirements at the SI's connector interface.

The electrical characteristics of serial digital commands, from a SI's viewpoint, are summarized in Table 3.6.5-1. Each serial digital command channel consists of three signals from the CDM equipment, which are: a clock, an enable, and a data line. At the SI connector interface all these signals are active low (negative logic). Command signal returns shall be brought back through the shields of the coaxial cable used to transfer the command signals to the SI, except in the case where the SI's secondary ground is isolated from its case. In the case where the secondary ground is isolated from SI's case ground the SIs secondary ground shall be brought back to the CDM equipment by a separate ground wire.

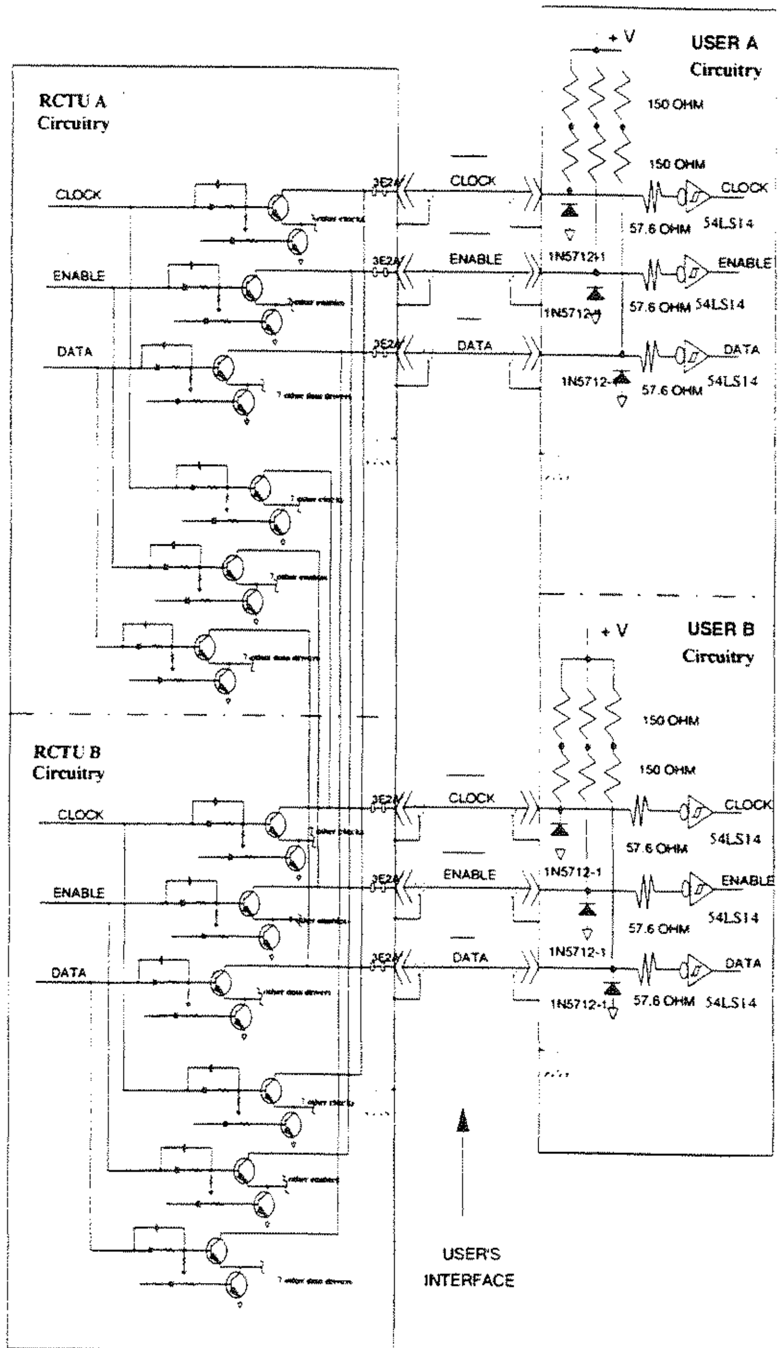


Figure 3.6.5-1: Serial Digital Command Interface Circuitry
(For Reference Only)

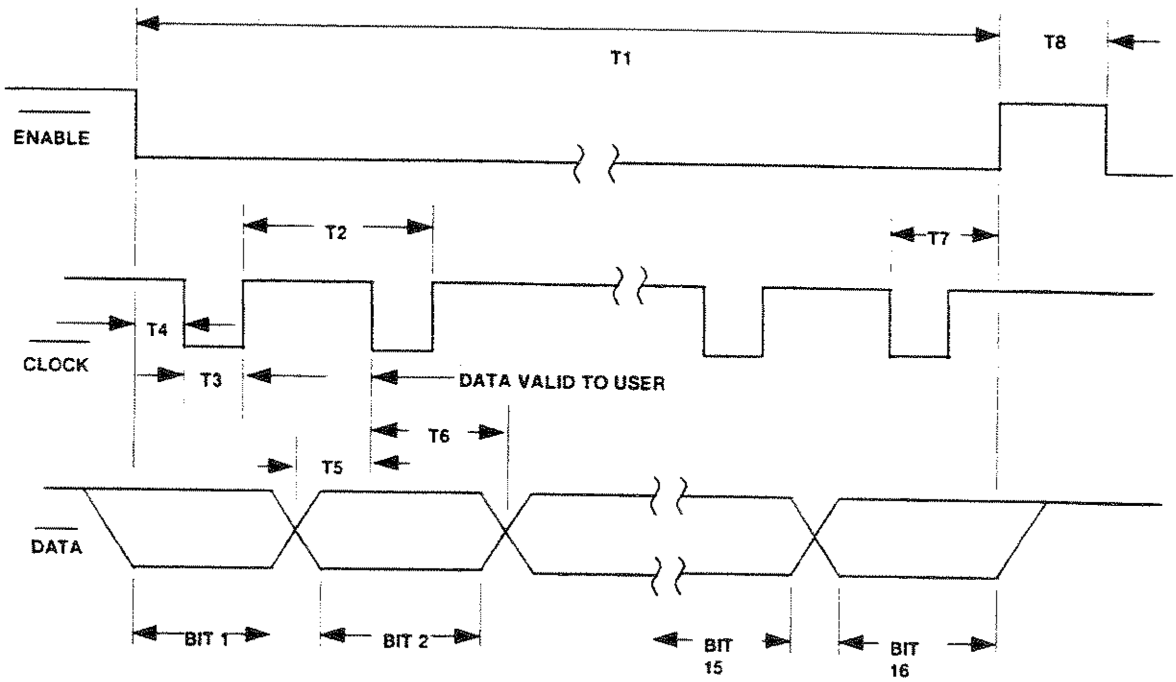
3.6.5.1.1.2: Serial Digital Command Timing

A timing diagram for serial digital commands, as seen from the SI's interface, is shown in Figure 3.6.5-2:

- The 16 bit command word period is 125 μsec. (128 KBPS).
- The "enable" signal goes low (active) less than 1 μsec after the serial digital output circuit is activated.

TABLE 3.6.5-1: SERIAL DIGITAL COMMAND CHARACTERISTICS

Function	Characteristic(s)
Waveform Characteristics:	
Clock	128 Khz, 25/75% duty cycle Negative Logic (active low)
Enable	125 ± 2.0 μsec Pulse Negative Logic (active low)
Command data	128 Kbps Data Rate 16-bit serial digital word Negative Logic (active low)
Rise time to 1.9 V (monotonically increasing)	≤ 900 ηsec
Fall time to 0.5 V (monotonically decreasing)	≤ 400 ηsec
SI's Receiver Characteristics:	
Pull-up Resistor	The SI's receiver shall have two pull-up resistors in series that will source a signal current from a min of 14.5 mA to a max of 19.0 mA.
Low-level input (V_{il}) SI sources ≤ 19.0 mA	≤ 0.4 V.
High-level input (I_h) SI circuit sinks ≤ 100 μA	2.1≤ V ≤ 5.5 Volts
SI-tolerated fault (V_f) Voltage from CDME interface. No damage	0 V ≤ V_f ≤ 5.5 V



T1 = 125 $\pm$ 2.0 USEC

T2 = 7.81 $\pm$ 0.1 USEC

T3 = 1.95 + 0.9, - 0.1 USEC

T4 = 3.91 $\pm$0.3 USEC (Enable to Clock Low Time)

T5 = 3.054 USEC MIN (Data Set-up Time) Note: $T5 + T6 \leq T2$

T6 = 3.544 USEC MIN (Data Hold Time) Note: $T5 + T6 \leq T2$

T7 = 3.544 USEC MIN (Clock to Enable Low Time)

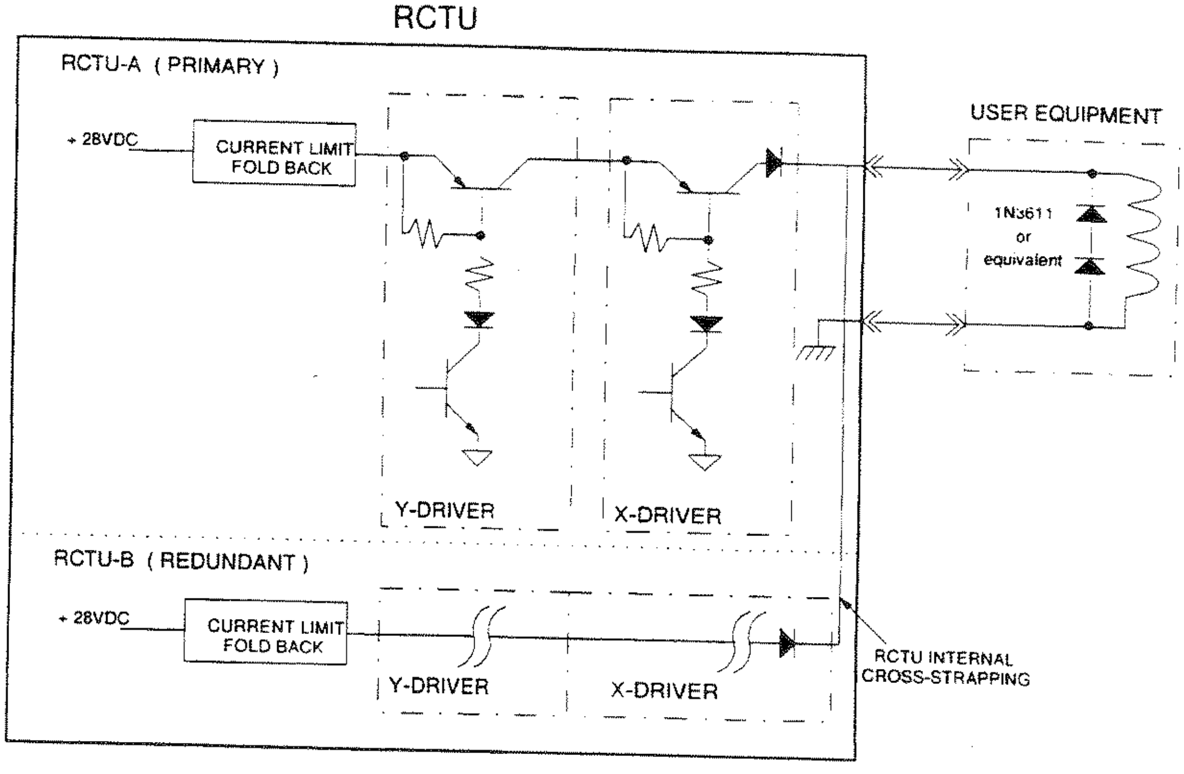
T8 $\geq$ 224 USEC (Period between CMDs)

Figure 3.6.5-2: Serial Digital Command Timing (at SI Interface)

3.6.5.1.2 High Level Pulse Commands

High-level pulse commands provide a current-limited +28V pulse to the SI. The high-level drivers use a single ended interface with a high level pulse command return wire, refer to Figure 3.6.5-3. The ground return at the SI's equipment shall be isolated from other returns and SI's chassis ground by at least 1 MΩ.

IRN 041 (PIRN 20-0035) ACIS uses opto-isolators instead of relays as the user interface for the high level pulse signals. The ACIS HLP interfaces are defined in Section 3.1 and Figure 3.1-1 of Appendix C.



Note: The circuit grounds are tied to chassis ground in the RCTU.

Figure 3.6.5-3: High-Level Pulsed Driver Diagram
(For Reference Only)

3.6.5.1.2.1 High Level Pulse Command Characteristics

The electrical characteristics of high level pulse commands are summarized in Table 3.6.5-2. SI relays shall activate by high level pulse commands with the following characteristics:

TABLE 3.6.5-2: HIGH-LEVEL PULSE COMMAND CHARACTERISTICS

Function	Characteristic(s)
Amplitude current-limited to 280 mA MAX	+20 V_{dc} minimum, +28 V_{dc} maximum,
Pulse duration	33.5 to 40 msec
Rise/Fall times, t	0.5 msec $\le t \le$ 1.5 msec
Load impedance, z	150 Ω $\le z \le$ 2500 Ω, resistive
Maximum Output Leakage Current	$\le$ 25 μA

3.6.5.1.2.2 High Level Pulse Command Timing

The high level pulse command duration is from 33.5 msec to 40 msec, refer to Figure 3.6.5-4.

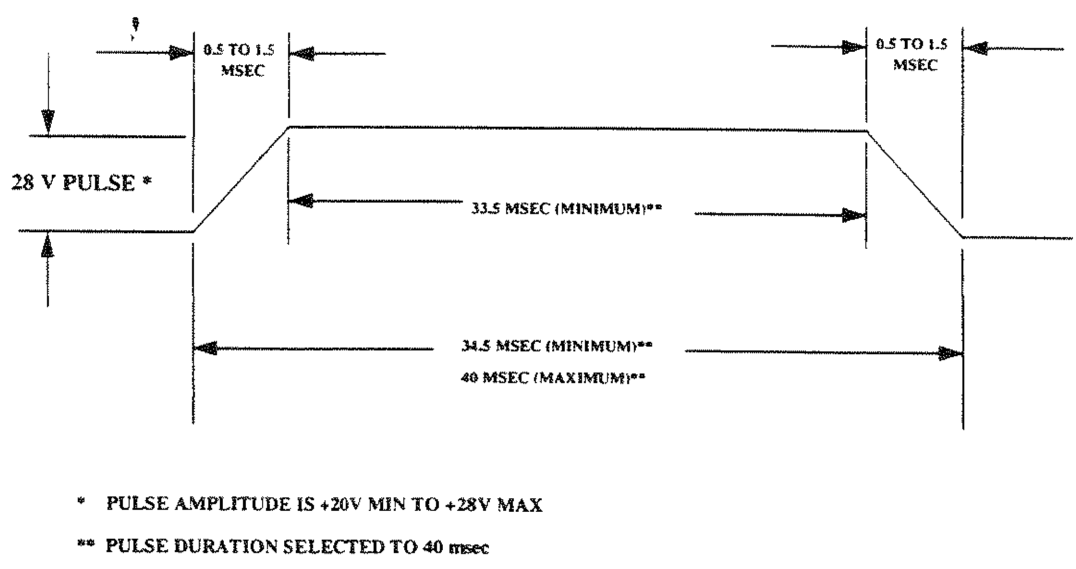


Figure 3.6.5-4: High-Level Pulse Command Timing

3.6.5.2: SI Telemetry Interface Requirements

There are four types of telemetry available to the SI, which are as follows:

- Serial Digital (SD) telemetry
- Active Analog (AA) telemetry
- Passive Analog (PA) telemetry
- Bilevel (BL) telemetry

3.6.5.2.1 Serial Digital Telemetry

IRN 041 (PIRN 20-0035)

Serial digital telemetry provide a set of signals to the SI circuitry from the CDM equipment (Clock & Enable) and the SI provides one signal to the CDM equipment (Data). The two signals from the CDM equipment, the Clock and Enable, are used to clock SI generated and formatted telemetry data from the SI's equipment to the CDM's telemetry processor. The serial digital telemetry interface is shown in Figure 3.6.5-5 (as reference only). The ACIS PSMC uses opto-isolators to couple signals to and from the RCTU. The PSMC serial digital telemetry interface circuit is defined in Section 3.2 and Figure 3.2-1 of Appendix C. A serial digital word is defined as a concatenation of 8 bits formed into a single digital word with the most significant bit transmitted first.

3.6.5.2.1.1 Serial Digital Telemetry Characteristics

The electrical characteristics of serial digital telemetry, from the SI's viewpoint, are summarized in Table 3.6.5-3. SIs shall meet the interface requirements at the SI's connector interface.

Each serial digital telemetry channel consists of three signals, two originating from the CDM equipment and one originating for the SI's equipment. At the SI connector interface the two signals from CDM equipment are active low (negative logic) and the signal from the SI equipment is active high (positive logic). The telemetry signal returns shall be brought back through the shields of the coaxial cable used to transfer the telemetry signals, except in the case where the SI's secondary ground is isolated from its case. In the case where the secondary ground is isolated from SI's case ground, the SI's secondary ground shall be brought back to the CDM equipment by a separate ground wire.

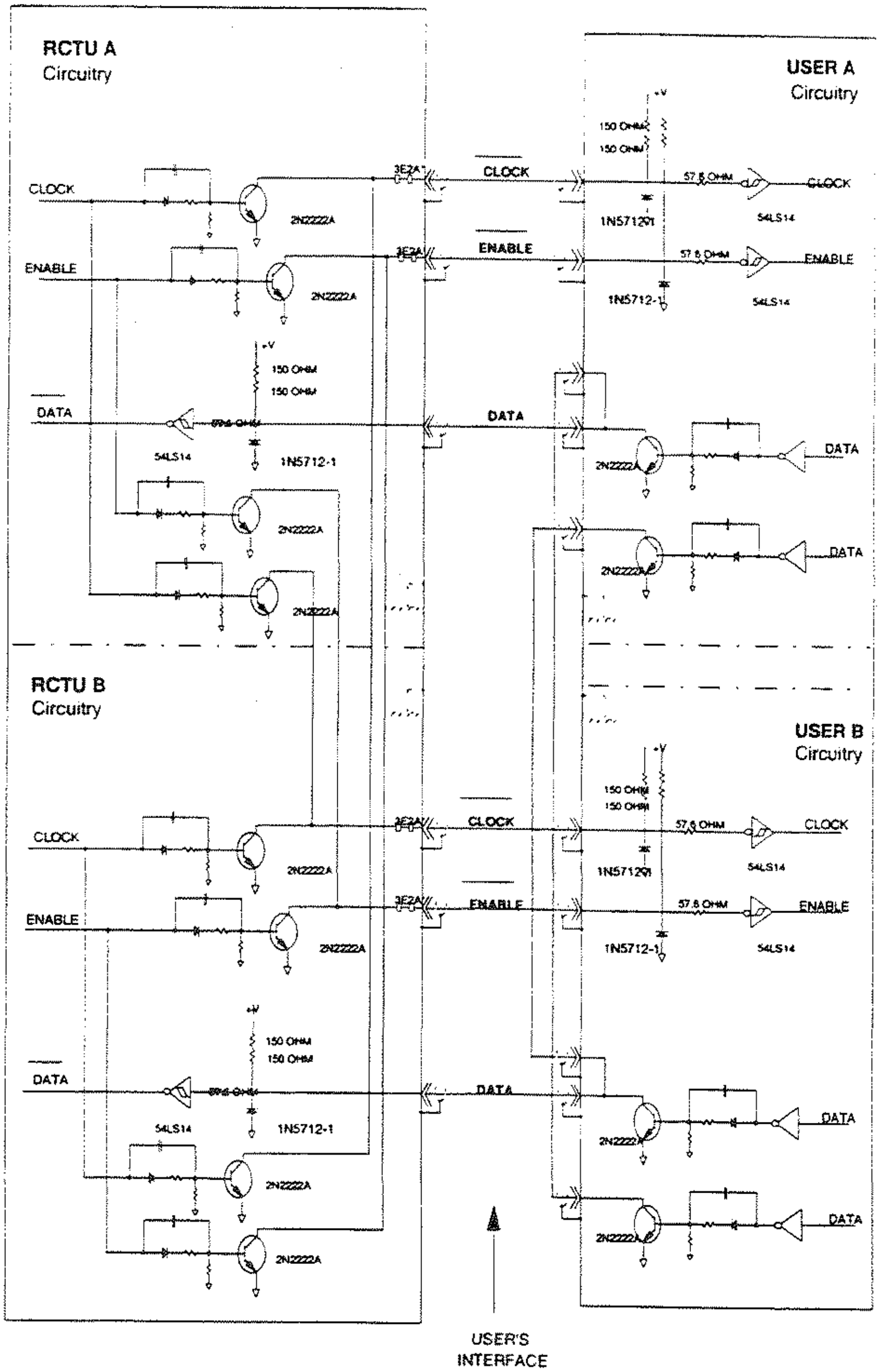


Figure 3.6.5-5: Serial Digital Telemetry Circuit
(For Reference Only)

IRN 062 (PIRN 20-0064A)

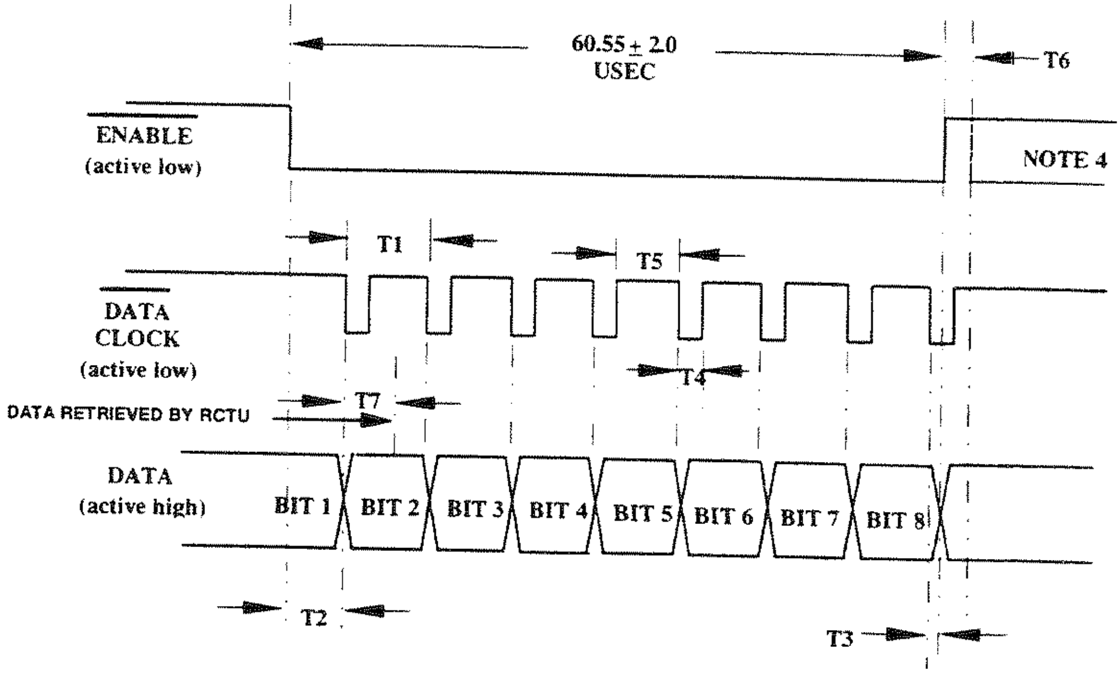
3.6.5.2.1.2 Serial Digital Telemetry Timing

A timing diagram for serial digital telemetry, as seen from the SI's interface (at the SI's connector) is shown in Figure 3.6.5-6:

- The 8-bit telemetry word period is 62.5 μsec (128 KBPS).
- The "enable" signal goes low (active) less than 1 μsec after the serial digital output circuit is activated.

TABLE 3.6.5-3: SERIAL DIGITAL TELEMETRY CHARACTERISTICS

Function	Characteristic(s)
Waveform Characteristics:	
Clock	128 Khz. 25/75 % duty cycle Negative Logic (active low)
Enable	60.55 ± 2.0 µsec Pulse Negative Logic (active low)
Telemetry data (at interface)	128 Kbps Data Rate 8-bit serial digital word Positive active (active high) MSB transmitted first
SI's Receiver Characteristics	
Pull-up Resistor	The SI's receiver shall have two pull-up resistors in series that will source a signal current from a min of 14.5 mA to a max of 19.0 mA. The pull-up resistor shall consist of two resistors in series to eliminate the possibility of a single resistor shorting and damaging the CDM equipment.
Low-level input (V_{il}) SI source ≥ 19.0 mA	≤ 0.4 V
High-level input (I_{ih}) SI circuit sinks ≤ 100 µA	2.1 ≤ V ≤ 5.5 Volts
SI-tolerated fault (V_f) voltage from CDME interface. No damage	0 V ≤ V_f ≤ 5.5 V
Risetime to 1.9 V (monotonically increasing)	≤ 900 ηsec
Falltime to 0.5 V (monotonically decreasing)	≤ 400 ηsec
SI's Driver Characteristics (TLM data)	
Low-level output (V_{ol}) SI sinking approx. ≤ 19.0 mA	≤ 0.4 V
High-level output (I_{oh}) RCTU circuit sinks ≤ 100 µA	2.1 ≤ V ≤ 5.5 Volts
SI-tolerated fault (V_f) voltage from CDME interface, No damage	0 V ≤ V_f ≤ 5.5 V
Risetime to 1.9 V (monotonically increasing)	≤ 760 ηsec
Falltime to 0.5 V (monotonically decreasing)	≤ 270 ηsec



NOTES:

1. CLOCK HAS A 25% DUTY CYCLE
2. USER UPDATES DATA ON FALLING EDGE OF THE CLOCK
3. CLOCK, ENABLE AND DATA SIGNALS ARE AT USER INTERFACE
4. ENABLE GOES LOW, AS SHOWN, IF CONTIGUOUS ACCESS OCCURS.

TIMING:

T1 - 7.81 ± 0.1 USEC
T2 - 3.91 ± 0.3 USEC
T3 - 1.95 + 1.2, -0.4 USEC
T4 - 1.95 +0.9, -0.1 USEC
T5 - 5.81 +0.2, -0.9 USEC
T6 - 1.95 USEC MIN
T7 - 4.17 USEC MAX (Data Settling Time)

Figure 3.6.5-6: Serial Digital Telemetry Timing (at SI Interface)

3.6.5.2.2 Active Analog Telemetry

The SI active analog telemetry measurement is transferred out of the SI equipment to the CDM equipment, which will convert the analog measurement into a 8-bit digital telemetry word. Active analog telemetry from the SI shall be greater than or equal to 0 volts and less than or equal to 5.1 volts.

The active analog telemetry processing circuitry is shown in Figure 3.6.5-7

3.6.5.2.2.1 Active Analog Telemetry Characteristics

The characteristics of active analog telemetry outputs from the SI are summarized in Table 3.6.5-4. SI interface circuitry shall be compatible with these characteristics.

The accuracy of the A/D conversion shall be from ±0.9 bit at beginning-of-life (BOL) to ±1.20 bits at end-of-life (EOL). SI circuitry required measurement accuracy shall require no greater than ± 1 count per required unit of accuracy.

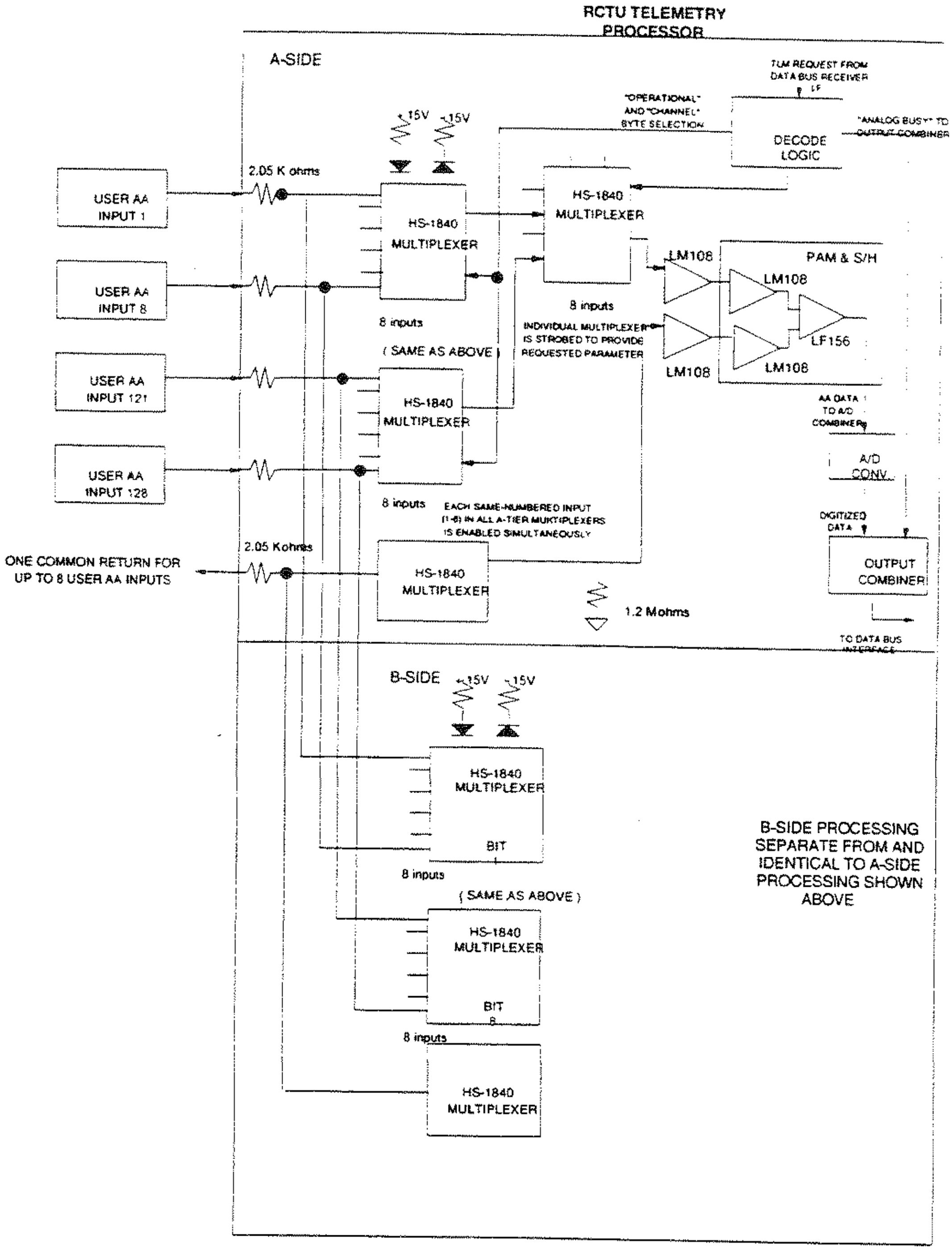


Figure 3.6.5-7: Active Analog Telemetry Circuit (For Reference Only)

TABLE 3.6.5-4: ACTIVE ANALOG SIGNAL CHARACTERISTICS

Function	Characteristic(s)
Output voltage from SI (full scale range)	0.0 V_{dc} to 5.1 V_{dc} (0 - 255 counts for 8 bit words)
Output impedance to CDM equipment secondary ground	During sampling: 10 MΩ (min) Not sampling: 50 MΩ (min) Off: 50 MΩ (min)
Source impedance (from signal to return) at SI interface	≤ 5.1 KΩ, shunted by ≤ 1000 pF including cable
Common Mode Rejection Capability Signal return with respect to CDM chassis ground. 1.2 MΩ isolation between signal return and chassis ground	- 0.5 volts to + 6.11 volts
Output short tolerance	The SI equipment shall not be damaged by shorting any output signal to ground: no damage shall result to any telemetry circuitry or propagate to any other telemetry circuitry from shorting any output signal line to ground
Over/undervoltage output limits (SI fault voltage, V_f)	$-15\ V_{dc} \le V_f \le +20\ V_{dc}$

3.6.5.2.3 Passive Analog Telemetry

The SI passive analog telemetry measurement is transferred out of the SI equipment to the CDM equipment, which will convert the analog measurement into a 8 bit digital telemetry word. The passive analog SI circuitry shall receive a 1 ±0.02 mA signal from the CDM equipment to generate a voltage across the measurement resistance. This passive analog telemetry shall be greater than 0 volts and less than or equal to 5.1 volts, which requires the effective measurement resistance to be in the range between 0 and 5.1KΩ.

The passive analog telemetry processing circuitry is shown in Figure 3.6.5-8.

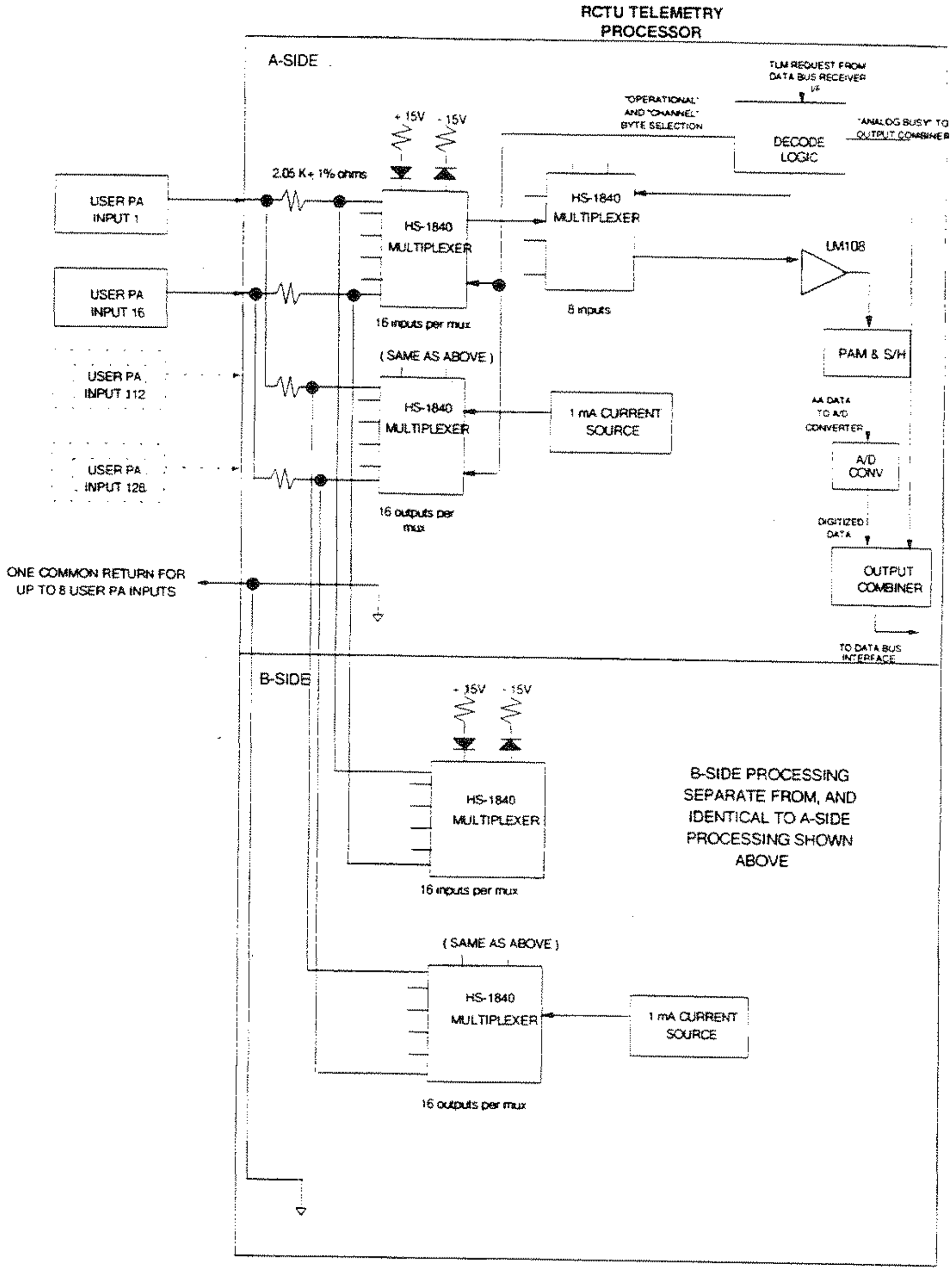


Figure 3.6.5-8: Passive Analog Telemetry Circuit (For Reference Only)

3.6.5.2.3.1 Passive Analog Telemetry Characteristics

The characteristics of passive analog telemetry outputs from the SI are summarized in Table 3.6.5-5. SI interface circuitry shall be compatible with these characteristics.

The accuracy of the A/D conversion shall be from ±0.9 bit at beginning-of-life (BOL) to ±1.20 bits at end-of-life (EOL). SI circuitry required measurement accuracy shall require no greater than ± 1 count per required unit of accuracy.

TABLE 3.6.5-5: PASSIVE ANALOG SIGNAL CHARACTERISTICS

Function	Characteristic(s)
Output voltage from SI (full scale range)	0.0 V_{dc} to 5.1 V_{dc} (0 - 255 counts for 8 bit words) The SI equipment shall not supply any current to the effective measurement resistance.
Input impedance CDM equipment to ground	During sampling: 10 M Ω (min) Off: 50 M Ω (min)
Source impedance (from signal to return) at SI interface	≤ 5.1 KΩ, shunted by ≤ 1000 pF
1 mA current source	1 mA ±2% EOL, Pulse width is 62.5 μsec ±1%

3.6.5.2.4 Bilevel Telemetry

The telemetry processor in the CDM equipment samples the SI's bilevel circuitry through the SI interface. The measurement is changed into a single bit of a 8-bit digital telemetry word. The SI output shall be either an active voltage greater than 0 volts and less than or equal to 5.1 volts, or a contact closure that is either open or closed to SI secondary ground.

The bilevel telemetry processing circuitry is shown in Figure 3.6.5-9.

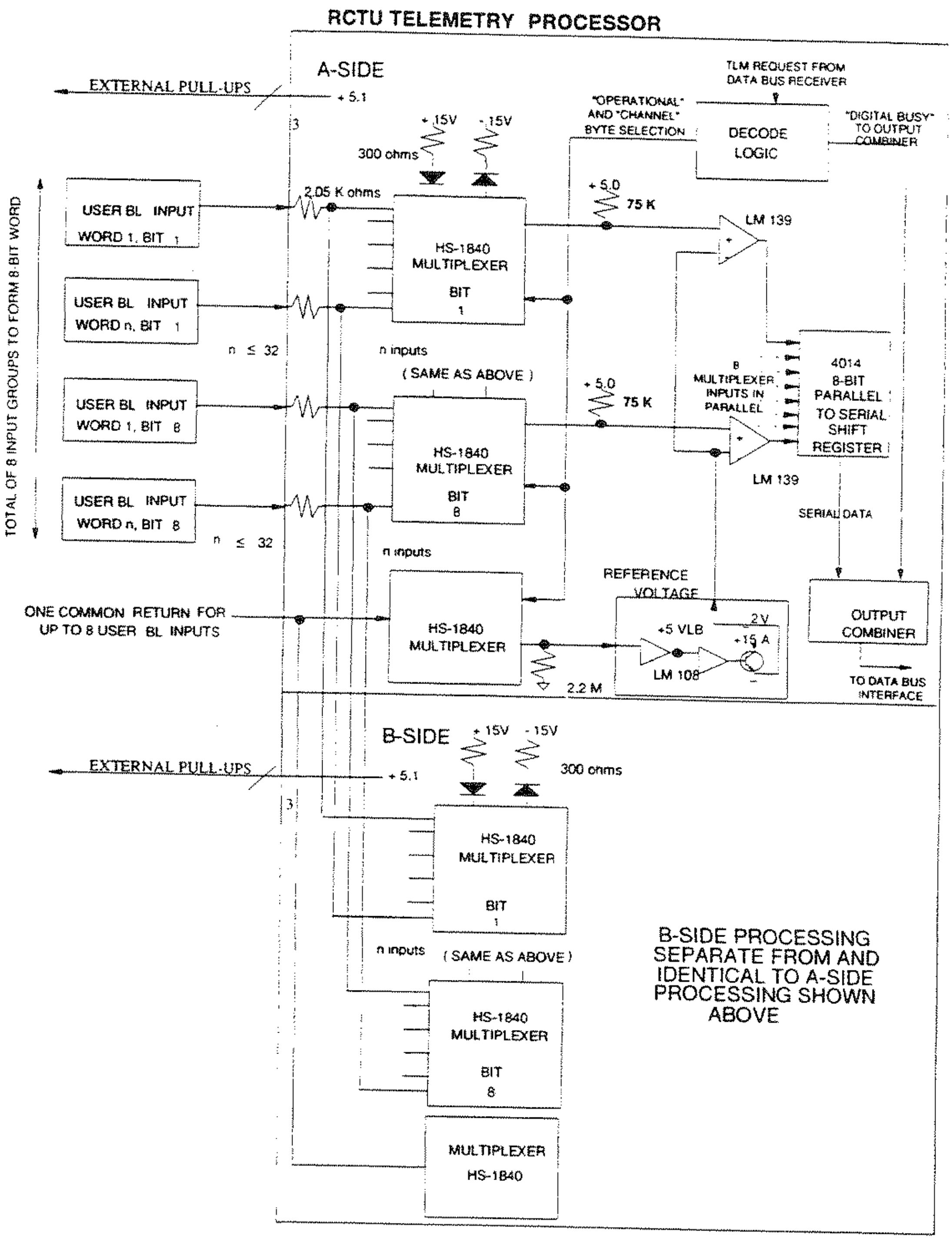


Figure 3.6.5-9: Bilevel Telemetry Circuit
(For Reference Only)

3.6.5.2.4.2 Bilevel Telemetry Characteristics

The characteristics of the bilevel telemetry inputs are summarized in Table 3.6.5-6. SI interface circuitry shall be compatible with the following characteristics.

TABLE 3.6.5-6: BILEVEL TELEMETRY CHARACTERISTICS

Function	Characteristic(s)
Signal range	
SI's Voltage source	0 V_{dc} to 5.1 V_{dc}
SI's Relay - Impedance to SI secondary ground	Zero or Open Circuit
Logic "1" threshold (note 1)	
SI's Voltage source	+2.1 V_{dc} to 5.1 V_{dc}
SI's Relay - Impedance to SI secondary ground	> 100K Ω
Logic "0" threshold (note 1)	
SI's Voltage Source	0 V_{dc} to +1.8 V_{dc}
SI's Relay - Impedance to SI secondary ground	< 5K Ω
Input impedance	During sampling: 73 KΩ (min) Off: 50 MΩ (min)
Output short tolerance	The SI equipment shall not be damaged by shorting any output signal to ground; no damage will result to any telemetry circuitry or propagate to any other telemetry circuitry from shorting any output signal line to ground
Over/undervoltage output limits (SI fault voltage, V_f)	$-15\ V_{dc} \leq V_f \leq +20\ V_{dc}$

Note 1: An output to the CDM equipment in the range of +1.8 to +2.1 V_{dc} is ambiguous and might be converted as either "1" or "0"; SI circuitry shall be designed to avoid this voltage range.

IRN 062 (PIRN 20-0064A)

3.6.5.3 Synchronization Signals

Synchronization pulses and 1.024 MHz CDM Clock signals, from the CDM equipment to the science instrument SIs are transferred via dedicated differential hardlines, refer to Figure 3.6.5-10 and single ended hardlines, refer to Figure 3.6.5-11. The characteristics of the synchronization signal are summarized in Tables 3.6.5-7 & 3.6.5-9. The characteristics of the 1 Mhz Clock is summarized in Table 3.6.5-8.

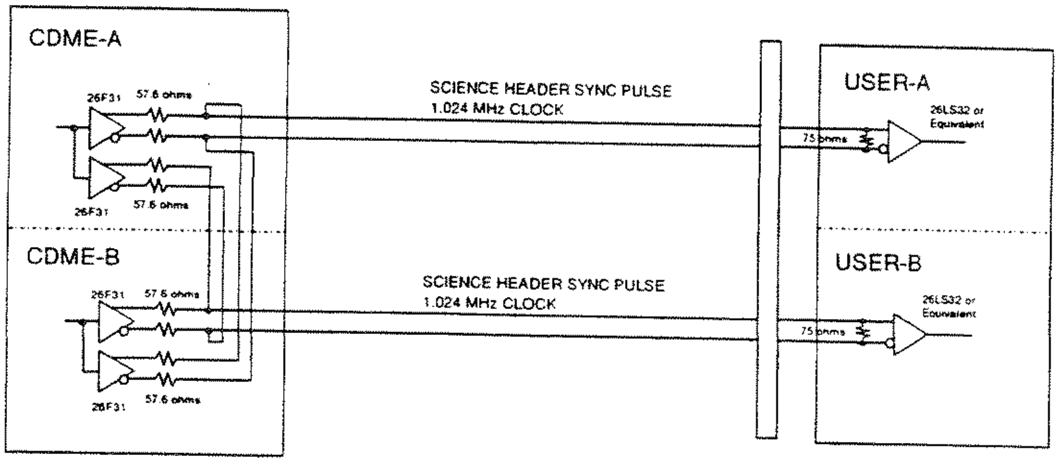


Figure 3.6.5-10: Differential Sync Pulse Interface Diagram (For Reference Only)

TABLE 3.6.5-7: DIFFERENTIAL SYNC SIGNAL CHARACTERISTICS

Function	Characteristic(s)
Science Header Sync	
Logic convention	Negative logic: falling edge indicates start of frame
Signal Level	> 1.5 V p-p
Signal duration	62.5 +10, -0 μsec (sync signal only)
Risetime to 1.9 volts	≤ 100 nanosec
Falltime to 0.5 volts	≤ 100 nanosec
Receiver Characteristic Input Impedance	75 Ω ± 5%
Science Header Sync pulse duty cycle	When CTU is in 32 Kbps telemetry mode, science header sync occurs once every 2.05 sec;

TABLE 3.6.5-8: 1 MHZ CLOCK SIGNAL CHARACTERISTICS

Function	Characteristic(s)
1 Mhz Clock	
Logic convention	Negative logic: falling edge indicates start of frame
Signal Level	> 1.52 V p-p
Cycle Duration	0.9766 ± 0.0001μsec
Duty Cycle	45 to 55 Percent
Risetime to 1.9 volts	≤ 100 nanosec
Falltime to 0.5 volts	≤ 100 nanosec

Minor Cycle synchronization pulse signal, from the interface unit to SIs is transferred via dedicated single ended hardlines, refer to Figure 3.6.5-11. The characteristics of the Minor Cycle synchronization signal is summarized in Table 3.6.5-9.

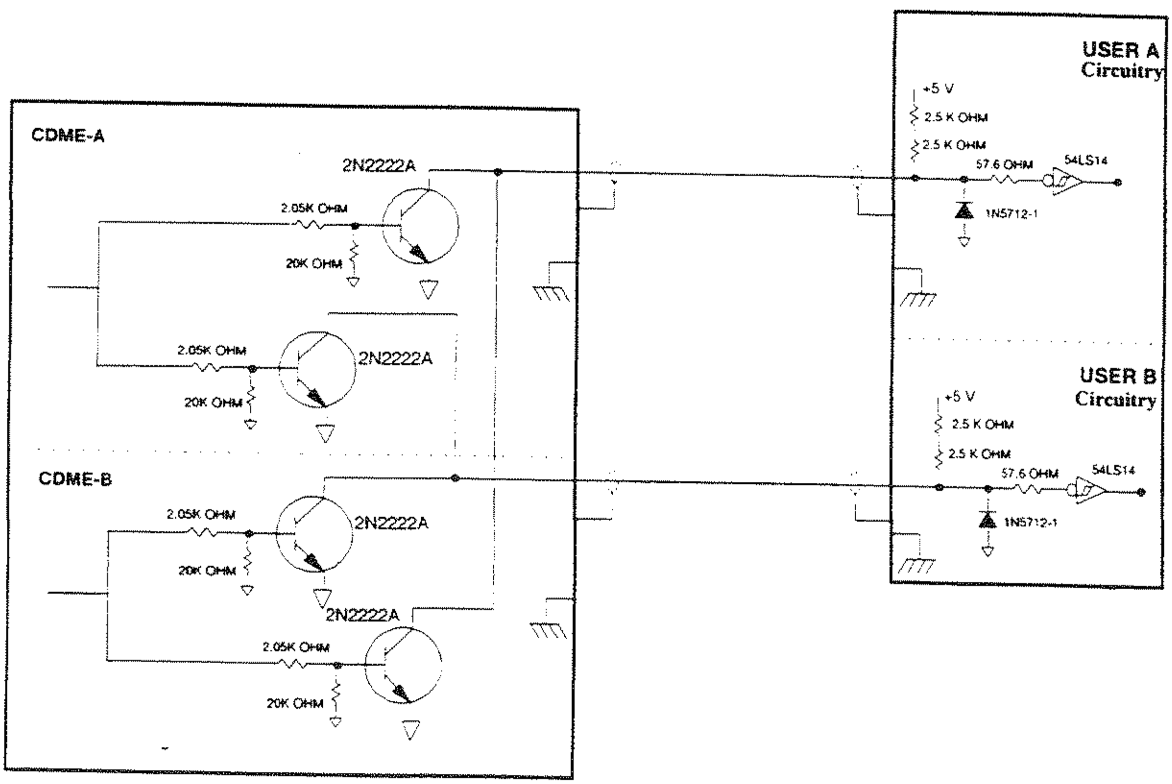


Figure 3.6.5-11: Single Ended Sync Signal Interface Diagram (For Reference Only)

TABLE 3.6.5-9: SINGLE ENDED SYNC SIGNAL CHARACTERISTICS

Function	Characteristic(s)
Major Frame, Minor Frame and Science Header & Minor Cycle pulse	
Logic convention	Negative logic: falling edge indicates start of sync pulse
Logic high SI pullup ≥ 4.5 V, ≤ 5.5	≤ 100 µA (transistor leakage current)
Logic low RCTU sinking approx. 1 mA	≤ 0.4 V
Signal duration	62.5 µsec +20, 0 µsec
Risetime to 1.9 volts	≤ 11.0 µsec
Falltime to 0.5 volts	≤ 1.5 µsec
Pull-up Resistor	The SI's receiver shall have two pull-up resistors in series that will source a signal current from a min of 0.89 mA to a max of 1.13 mA.
Minor Cycle Sync pulse duty cycle	The minor cycle sync occurs once every 64.0625 msec.
Major Frame Sync pulse duty cycle	When CTU is in 32 Kbps telemetry mode, major frame sync occurs once every 32.80 sec;
Minor Frame Sync pulse duty cycle	When CTU is in 32 Kbps telemetry mode, minor frame sync pulse occurs once every 256.25 msec;
Science Header Sync pulse duty cycle	When CTU is in 32 Kbps telemetry mode, Science Header sync pulse occurs once every 2.05 sec;

3.7: POINTING AND CONTROL

For pointing and control details, see Sections 3.2.1.6 and 3.7.1.5 of SY 24-2, AXAF-I Observatory CEI Specification

3.8: (DELETED)

3.9: OTHER REQUIREMENTS

3.9.1: Natural And Induced Environments

3.9.1.1: Natural and Induced Environment Definition

The SIs shall be designed to withstand the natural environment as specified in SSP 30425, "Space Station Program Natural Environment Definition for Design", and JSC 20001, "Orbital Debris Environment for Space Station", in accordance with the criteria of NASA TM- 86481, "Natural Environment Design Criteria (AXAF-I)". As a minimum, the SIs shall also be designed to accommodate the environment to which they will be exposed when integrated with the Observatory. They shall be capable of surviving any induced environment or combination of environments as specified in NSTS-07700, Volume XIV, Attachment 1, Section 4.

3.9.1.1.1: Meteoroid and Orbital Debris Protection

The AXAF-I shall provide the SIs protection against loss of functional capability when subjected to the meteoroid and debris environment model as defined in DPD SE29. The probability of meteoroid induced failure shall be as specified in DPD692 SE29.

3.9.1.2: (Deleted)

3.9.1.3: (Deleted)

3.9.1.4: (Deleted)

3.9.1.5: Corona Suppression

SI electrical and electronic subsystems and components shall be designed in accordance with MSFC-STD-531, "High Voltage Design Criteria" such that their proper performance shall not be impaired by corona discharge in normal operating environments and shall not be a source of interference which adversely affects the operation of other equipment or SIs.

3.9.1.6: Radiation Environment

The SIs shall be designed to meet their operational requirements during and after exposures to the radiation environment as described in section 3.1.4.2 of DPD SE29.

3.9.1.6.1: Solar Flare Protons

The SIs shall be designed to meet their operational requirements during and after exposures to solar flare protons as described in paragraph 3.1.4.2.1 of DPD SE29

3.9.1.6.2: Trapped Electrons

The SIs shall be designed to meet their operational requirements during and after exposures to trapped electrons as described in section 3.1.4.2.2 of DPD SE29.

3.9.1.6.3: Trapped Protons

The SIs shall be designed to meet their operational requirements during and after exposures to trapped protons as described in section 3.1.4.2.3 of DPD SE29.

3.9.1.6.4: Total Dose

The SIs shall be designed to meet their operational requirements during and after exposures to the total integrated radiation dose as described in section 3.1.4.2.4 of DPD SE29..

3.9.1.6.5: Cosmic Ray and Solar Flare Environments

IRN 059 (PIRN 20-0069) The SIs shall be designed to meet their operational requirements during the cosmic ray environment through the mission and after exposures to solar flare environments as described in section 3.1.4.2.5 of DPD SE29. The SIs are not expected to meet their operational requirements through a solar flare event.

3.9.1.6.6: Spacecraft Charging Effects

Arcing will occur due to spacecraft charging during the times the AXAF-I is in the 5-15 Earth Radii portion of the orbit. Discharge transients listed below are coupled onto the spacecraft harnesses. The transient waveform for the discharges is given in Figure 3.9-1.

Peak voltages (V_{PEAK}) are as follows:

HRC primary power:	51.1 V
ACIS primary power:	51.1 V
RCTU Interfaces:	
High level pulse:	0.7 V
Low level pulse:	0.7 V
Serial Digital Command:	0.7 V
Serial Digital Telemetry:	0.7 V

The SIs shall operate properly in the presence of these transients.

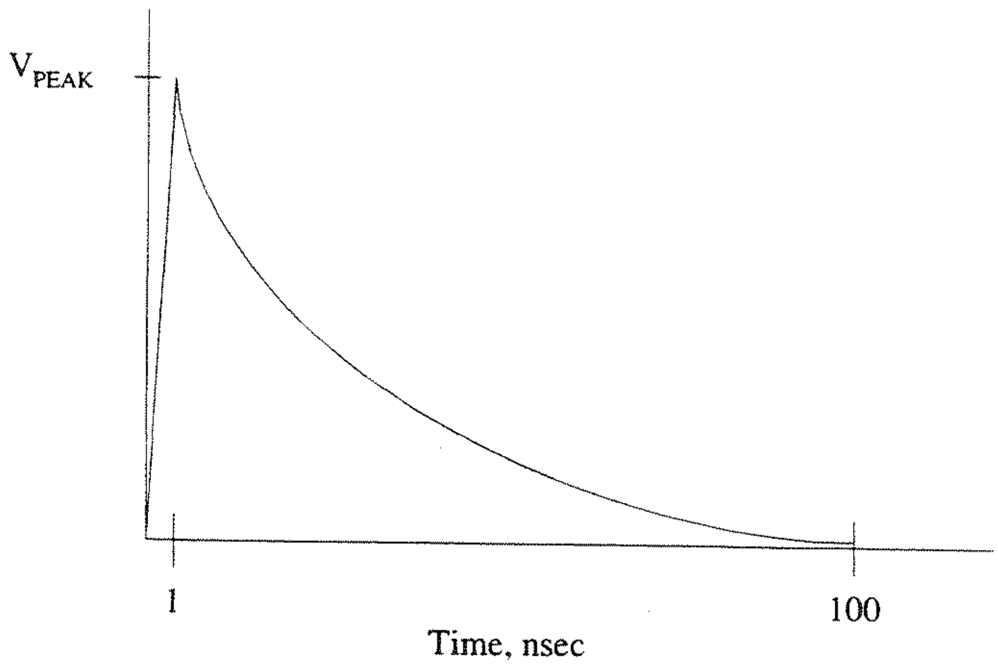


Figure 3.9-1: Transient Pulse Shape

3.9.1.6.7: Radioactive Sources for Flight Contamination Monitor

There are 16 radioactive sources (GFE) mounted on the HRMA Forward Contamination Cover. These sources are used with ACIS to measure contamination occurring between the end of X-ray calibration and insertion of the AXAF into orbit.
Source characteristics are defined in Flight Contamination Monitors: Development Requirements document, MSFC-RQMT 2601. The locations of the sources on the Forward Contamination Cover are defined in AXAF-I Spacecraft to Telescope Interface Control Document, IF1-29, Appendix C, drawing 301427, ICD-HRMA Forward Contamination Cover

3.9.2: Contamination Control

3.9.2.1: SI External Environment

3.9.2.1.1: Orbiter Cargo Bay Environment

AXAF-I shall be designed to be compatible with the contamination and pressure environments specified in Section 10.6 of NSTS 07700, Volume XIV, Attachment 1. The SIs shall provide protective devices in the event the contamination environment specified herein is unacceptable.

IRN 062 (PIRN 20-0064A)

3.9.2.1.2: (Deleted)

3.9.2.2: SI Cleanliness

3.9.2.2.1: Internal

The SI, and non-hermetically sealed components thereof, that have been determined to vent into the telescope shall be thermal-vacuum baked in accordance with MSFC-SPEC-1238. Acceptance criteria shall be in accordance with MSFC-SPEC-1238. Subsequent to thermal-vacuum baking the SI (or components) shall be handled and bagged per MSFC-SPEC-1238.

Non-sealed components containing interior materials which cannot be cleaned to level 350A of MIL-STD-1246 shall be designed with filtered vents (20 micron pore size) meeting the requirements of paragraph 3.9.2.3 below.

IRN 062 (PIRN 20-0064A)

SI wiring harness materials shall be selected to be low outgassing as defined in JSC-SP-R-0022.

If thermal bakeout occurs more than one month earlier than integration into the SI, the harness shall be bagged in a clean and dry atmosphere to minimize accumulation of contamination. All wiring harnesses (including connectors) shall be certified to MSFC-SPEC-1238.

3.9.2.2.2: External

External surfaces of the Science Instruments shall be cleaned to level 350A per MIL-STD-1246. Objective transmission gratings shall be maintained clean to level 350A of MIL-STD-1246.

3.9.2.2.3: Materials Selection

To prevent the molecular cleanliness requirement of Level A per MIL-STD-1246 from being exceeded, all polymeric materials used in SI components, including organic based lubricants and polymeric seals, and wire coatings, as a minimum shall meet the vacuum stability requirements of JSC-SP-R-0022. Any polymeric materials based upon location or quantity or venting direction, which have the potential to contaminate the AXAF-I optics or the SI detector focal surface shall be tested and accepted per MSFC-SPEC-1443. The SIs shall be verified clean per MSFC-SPEC-1238.

3.9.2.3: Venting

3.9.2.3.1: Ascent and Reentry Venting

The AXAF-I design shall provide ascent and reentry venting between the AXAF-I internal volume and the Orbiter cargo bay. Orbital venting shall be provided to reduce the internal volume pressure to required levels prior to activating pressure sensitive equipment. Figure 3.4-2 shows expected SI internal pressure versus time after launch.

3.9.2.3.2: SI Venting

The TS venting design shall allow achievement of a vacuum level of < 1x105 torr at the SI aperture within 10 days after on-orbit deployment (See Figure 3.4-2).

3.9.2.4: Handling and Transportation Contamination

The SI shall provide protective covers and transportation containers as required to maintain the instrument cleanliness as specified in paragraph 3.9.2.2.

3.9.3: Ground Support Equipment And Facilities

3.9.3.1: SI Test and Integration Description

3.9.3.1.1: Interface Testing at SI Facility

IRN 062 (PIRN 20-0064A)

SI to AXAF-I electrical, and data and command interfaces will be tested at the SI (or SI contractor) facility. The AXAF-I contractor will supply to each SI team a Data Bus/CTU Emulator which will emulate the AXAF-I data bus. This unit will be used to send commands to, and receive data from, the SI via a non-flight RCTU, also CFE.

IRN 046 (PIRN 20-0053)

3.9.3.1.2: X-Ray Testing and Calibration

IRN 062 (PIRN 20-0064A)

X-ray calibration of the HRMA and the SIs will be performed at the MSFC test facility prior to integration. MSFC X-Ray Calibration Facility (XRCF) requirements are described in MSFC-SPEC-1837, MSFC AXAF-I X-Ray Test Calibration Facility Requirements.

3.9.3.1.3: SI Integration Activities

IRN 062 (PIRN 20-0064A)

The SI contractor will provide both personnel and SI unique mechanical and electrical GSE to support SI integration into the AXAF-I and final system test activities. The AXAF-I contractor will install the SIs in AXAF-I using special fixtures provided with the SI.

3.9.3.1.3.1: Pre-Integration Functional Test

IRN 062 (PIRN 20-0064A)

The SIs will undergo pre-integration tests at the AXAF-I SIM contractor facility before installation into the AXAF-I SIM. The pre-integration tests are functional electrical and data interface tests. A plan for these tests will be prepared by the SI teams and concurrence obtained from the AXAF-I contractor. The tests will be conducted by the SI support personnel and witnessed by AXAF-I contractor and MSFC personnel at the AXAF-I SIM contractor facility.

3.9.3.1.3.2: Post-Integration Functional Tests

Post-integration tests will verify the functional integrity of the mechanical, electrical, and data and command interfaces of the SI with AXAF-I. The plan for the post-integration SI tests will be prepared by the AXAF-I contractor and concurrence obtained from the IPI or his representative. These tests will be directed by the AXAF test conductor and supported by AXAF-I personnel and SI representatives. Procedures for testing the SIs will be prepared by the SI teams. SI EGSE will be operated by SI personnel. IRN 062 (PIRN 20-0064A)

3.9.3.2: Transportation and Storage Monitoring

The CFE-supplied AXAF-I transportation equipment shall accommodate monitoring and maintenance of critical SI parameters such as nitrogen purge system performance and specialized SI venting requirements. Monitoring and maintenance equipment shall be provided by the SI contractors and shall be integrated into the AXAF-I transportation system by the prime contractor.

3.9.3.3: SI Prelaunch Activities

Prelaunch activities include all activities from arrival at the Eastern Test Range to launch of the Orbiter. SI specific prelaunch activities and requirements are described in the following paragraphs.

3.9.3.3.1: SI Tests

Abbreviated health and status tests will be performed on each of the focal plane science instruments. These tests will consist, at a minimum, of sending commands to the SIs and monitoring of SI responses via telemetry/hardline. These tests will be performed approximately nine weeks prior to scheduled launch. These tests will be conducted by AXAF-I prime contractor and witnessed by the SI representative. IRN 062 (PIRN 20-0064A)

3.9.3.3.2: Maintenance of FPSI Internal Atmosphere

The ACIS detector requires maintenance of an internal vacuum during ground operations at the instrument developer's facility, at BASD, at XRCF, at TRW and at KSC as described below. The HRC detector requires maintenance of an internal nitrogen atmosphere at all times when not in a vacuum. During those times when the HRC may be exposed to variations in ambient pressure (i.e. during shipment or severe storms), the HRC should remain connected to the HRC GSE nitrogen supply. Operation of the HRC detector requires the detector housing to be evacuated using the HRC GSE vacuum cart when not in a vacuum chamber. IRN 048 (PIRN 20-0003B)

3.9.3.3.2.1: Gas/Vacuum GSE Access to FPSIs

Access to the side of the HRC shall be provided through the +Y panel of the SIM for connection of nitrogen back fill lines as shown in drawing 301476 . The hoses which connect the HRC GSE cart to the instrument shall be capable of allowing a separation distance between the GSE and the SIM +Y panel of at least 12 feet. .

Access to the side of the ACIS shall be provided through the +Y panel of the SIM for connection of vacuum lines and control lines as shown in drawing 301475 . The hoses which connect the ACIS GSE vacuum equipment shall be capable of allowing a separation distance between the GSE and the SIM +Y panel of at least 12 feet. . The ACIS vacuum equipment contains a Remote Valve Assembly which must be removed from the instrument as part of removal of the GSE.

3.9.3.3.2.2: GSE Responsibility

The instrument teams shall perform detector internal environment operations, using GSE provided by the instrument developers.

IRN 048 (PIRN 20-0003B) ENTIRE PAGE

3.9.3.3.2.3: Time Constraints on GSE Access

There are three sets of conditions which apply to the use of FPSI gas/vacuum GSE after delivery to the government:

- Ground operations at BASD, at the XRCF, at TRW and at KSC which govern the intervals between accesses to the instruments and the allowed access time.
- Maximum elapsed time between disconnect of the GSE from the instrument and the launch of AXAF-I.
- Maximum elapsed time between disconnect of the GSE from the instrument and reconnect in the event of a launch scrub.

During operations at BASD and TRW, when not in the vacuum chamber, and at KSC, when possible, access shall be provided to each of the instruments for at least two hours every eight days for maintenance of detector internal environments. When it is not possible to provide access every eight days, the HRC GSE nitrogen supply shall remain connected to the HRC, and access shall be provided every two weeks for maintenance. As a goal, the ACIS will be continuously evacuated by the GSE, on a non-interference basis with other operations.

The instruments shall be designed to operate properly in orbit after removal of their respective nitrogen/vacuum equipment as much as 184 hours prior to launch.

For information purposes, the maximum elapsed time between disconnect of GSE and reconnect in the event of a launch scrub will be approximately 224 hours.

3.9.3.3.2.4: FPSI Gas/Vacuum GSE Requirements

Size , weight and power requirements for the FPSI gas/vacuum GSE is shown below:

	ACIS	HRC
Size - maximum (inches)	30 W x 42 D x54 H (with shipping covers) 36 D without covers	60L x 28W x 43H
Weight (pounds)	< 250	< 320
Power Requirements	One 120 Volt, 60 Hertz , 20 Amp service	One 120 Volt, 60 Hertz, 20 Amp service

IRN 048 (PIRN 20-0003B)

Hoses and other GSE that can come in contact with the SIM or other flight hardware shall be clean per DPD692 SE28 and their weight shall be externally supported.

The FPSI GSE shall meet the applicable requirements of KHB 1700.7B, and shall be explosion-proofed or hazard-proofed per KHB 1700.7B requirements if the GSE is to be operated during propellant loading or similar operation.

3.9.4: System Safety

The science instruments shall be designed to be in compliance with the following MSFC and NASA safety requirements.

3.9.4.1: Flight Safety

The science instrument shall be designed to comply with the following safety documents: NHB-1700.1 (VI-A), NSTS-1700.7, NSTS-13830 and NSTS-18798.

3.9.4.2: Launch Site Safety

The science instruments shall be designed to comply with the following launch site safety documents; KHB-1700.7, KMI-1710.1, and GP-1098.

3.9.4.3: Nuclear Sources

Any materials, components or subsystems containing natural or man-made services of nuclear radiation shall be avoided without prior approval from NASA, and if approved, shall be in compliance with the following requirements: NSTS 1700.7B .

Handling and control of instrument and spacecraft equipment containing radioactive sources shall be in accordance with the AXAF-I Safety Plan DPD-692 SA03. ACIS contains radioactive sources as defined in Appendix A, paragraph 4.4. HRC contains radioactive sources as defined in Appendix A, paragraph 3.4.

3.9.5: Access

3.9.5.1: SI Access

a) The observatory's SIM design shall accommodate ground removal, servicing and replacement of all FPSI components with minimum disassembly of the SIM itself. The design shall include appropriate tools and access as required. The SIM shall also provide access for connecting FPSI team supplied electrical and mechanical GSE to the instruments.

IRN 051 (PIRN 20-0060A)

b) The observatory's Telescope design shall accommodate ground removal, servicing and replacement of the LETG and HETG. The design shall include appropriate tools and access as required. Grating removal, if necessary, will require removal of the HRMA from the optical bench.

c) The design of the observatory's Telescope shall accommodate visual inspection of the LETG and HETG (using, for instance, a periscope or other optical aids) at any time prior to leaving the Vertical Processing Facility at KSC.

d) Inspection equipment shall be provided as part of the grating GSE. Interfaces between the inspection equipment and contractor are defined in MSFC letter EJ33 (97-012), 11 February 1997.

3.9.6: Crew Systems

3.9.6.1: Crew Systems Requirements

The AXAF-I shall be compatible with NSTS payload accommodations as defined in NSTS 07700, Vol. XIV, including Appendix 7, for extravehicular activities.

3.9.7: Quality Assurance

3.9.7.1: Quality Assurance Requirements

The SIM contractor will provide Quality Assurance functions in accordance with NHB-5300.4(1D2) and the contractors Quality Assurance Plan, for the SIs after delivery as GFE to the SIM contractor, with AXAF-I prime contractor oversight.

AXAF-I prime contractor will perform Quality Assurance functions for the SIs, in accordance with NHB-5300.4(1D2) and the AXAF Quality Assurance Plan, at the XRCF, at the prime contractor site and at the launch site.

These functions will include problem reporting, receiving inspections and surveillance inspection during all processing, i.e., packaging, handling, shipping, interface management and all testing. Interface Quality Assurance agreements with contractors and customers will be preplanned and formally documented to provide continuity and smooth transition of Quality Operations.

3.10: CONTRACTOR FURNISHED EQUIPMENT

The equipment listed below will be provided as Contractor Furnished Equipment to the SI development teams. IRN 062 (PIRN 20-0064A)

Flight Hardware

Item	Qty	Size (inches)	Weight (lbs)	Power (watts)
Fiducial Lights:		See Appendix G	See Appendix G	
ACIS	6	Dwg. 822022	Dwg. 822022	≤ 0.05
HRC	8	Dwg. 301330	Dwg. 301330	≤ 0.05

Note: Mounting hardware (bolts, nuts, etc.) is to be supplied by the SIM developer

Non-flight Hardware

Item	Size (inches)	Weight (lbs)	Power (watts)
Data Bus/CTU Emulator		52.5	540
— Computer	17W x 17L X 5H		max
— Monitor	15W X 15L X 16H		115V
— Keyboard	19W X 8L X 2H		60 Hz
Remote Command and Telemetry Unit	8.5W X 16.6L X 4.7H	17.5	21.1
— RCTU Power Supply	4 3/8H X 4W X 10L	7	30
ACIS Drill & Alignment Template	Drawing No. 533572 (See Appendix G)		N/A
HRC Drill & Alignment Template	Drawing No. 533571 (See Appendix G)		

3.11: (DELETED) IRN 062 (PIRN 20-0064A)

IRN 062 (PIRN 20-0064A)

4.0: VERIFICATION

4.1: GENERAL

Verification of the observatory to science instruments interface shall assure that the hardware and software meet the stated requirements of this ICD. Verification of ICD requirements shall occur at the following levels of assembly:

a. At the SI and observatory levels prior to integration

b. During SI/observatory integration (in-process verification)

c. At the AXAF-I level (following SI/observatory integration)

4.1.1: Responsibility for Verification

Commensurate with the levels of assembly (defined in paragraph 4.1) at which ICD requirements shall be verified, responsibility and control of associated verification activities shall be as follows:

a. Prior to SI delivery to TRW, verification of the SI side of the interface shall be to sole responsibility of the SI developer; all associated verification activities shall be controlled by the applicable SI CEI Specification. Verification of the observatory side of the interface shall be the sole responsibility of TRW; all associated verification activities shall be controlled by this ICD.

IRN 062 (PIRN 20-0064A)

b. After SI delivery to TRW, in-process interface verification, as well as verification activities following SI/observatory integration, shall be the responsibility of TRW; these verification activities shall be controlled by this ICD, per the verification matrix (Appendix B). Support shall be provided by the SI developers, as appropriate.

4.1.2: Verification Method Selection

Verification methods shall include tests and assessments, as appropriate. Verification methods are listed in Table 4.3-1. Testing shall be the prime method of requirements verification when any of the following conditions exist:

a. Assessment (non-test) techniques do not produce adequate results.

b. Failure modes exist which could compromise personnel safety, adversely affect launch System or payload operations, or result in a significant loss of mission objectives.

c. NASA or other government requirements specify testing is required for a specific application.

d. All components/materials (lots) used in structural criticality categories 1 and 1R applications, as defined per MSFC-CR-5320.9, will be independently (test) verified to prove material specifications compliance or certification tests will be witnessed for acceptability by the contractor.

4.1.2.1: Assessment

Verification by assessment includes similarity, analysis, inspection, demonstration, and verification of records.

4.1.2.1.1: Similarity Assessment

Verification by similarity is the process of assessing by review of prior test data or hardware configuration and applications that the article is similar or identical in design and manufacturing process to another article that has previously been qualified to equivalent or more stringent specifications.

4.1.2.1.2: Analysis Assessment

Verification by analysis is a process used in lieu of or in addition to testing to verify compliance to specification requirements. The selected techniques may include systems engineering analysis, statistics and qualitative analysis, computer and hardware simulations, and analog modeling. Analytical techniques may be used in lieu of tests for such things as reliability assessment, life, storage, failure analysis, safety, interchangeability, and some other performance requirements which cannot be tested.

4.1.2.1.3: Inspection Assessment

Verification by inspection is a process which may be used in lieu of or in conjunction with testing to verify design features. Inspection is used to verify construction features, workmanship, dimension and physical condition, such as configuration cleanliness, surface finish, surface emissivity, and locking hardware.

4.1.2.1.4: Demonstration Assessment

Validation by demonstration is the process where demonstration techniques are used to verify requirements such as access, transportability, and human engineering features.

4.1.2.1.5: Validation of Records Assessment

Verification by validation of records is the process where manufacturing records are used at end-item acceptance to verify the hardware (as-built) has been fabricated in accordance with approved and released documentation (as-designed). This verification method compliments the prior design review process which verifies compliance of "as-designed" hardware with overall program design and construction requirements.

4.1.3: Tests

4.1.3.1 Performance Tests

A performance test consists of an individual test or series of electrical and/or mechanical tests conducted on flight or flight-configured hardware and software at conditions equal to or less than design specifications. Its purpose is to verify compliance of the test article with the stated applicable specification requirements which are verifiable by test. Typically, a full performance test is conducted at ambient conditions at the beginning and end of a test sequence, during which the test article is subjected to applicable environmental conditions (e.g. vacuum, high/low temperature extremes, acoustic/random mechanical excitation).

4.1.3.2 Functional Tests

A functional test is a suitably chosen subset of a performance test. Typically, functional tests are conducted at ambient conditions between environmental exposures during the qualification or acceptance test sequence. The objective is to verify, prior to application of the next environment that exposure to the environment has not adversely affected performance. When appropriate, functional tests (or a portion thereof) are conducted while the test article is in a particular thermal vacuum. Functional tests (or, a portion thereof) may also be conducted to assess the state of health of the hardware after major operations, such as transportation of flight hardware from one location to another.

4.1.3.3 Environmental Tests

Environmental testing is an individual test or series of tests conducted on flight or flight-configured hardware to assure that flight hardware will perform satisfactorily after it is subjected to the induced launch environments, as well as its flight environment. Examples are vibration, acoustic, temperature cycling, thermal vacuum and EMI/EMC. Depending upon the severity of the chosen environmental conditions, the purpose of the environmental exposure is to sufficiently stress the hardware, so as to verify the adequacy of the design (qualification levels and durations) or workmanship during fabrication (acceptance levels and durations)

4.1.3.4 Special Tests

Special tests are individual tests or a series of tests conducted on flight or flight-configured hardware to assure satisfactory performance of a particular critical element of the system(e.g. optical alignment). The special test verification category includes structural, mechanism and communication tests. Special tests may or may not be performed in conjunction with environmental exposure

4.1.3.5 Interface Tests

A set of mechanical, electrical, and/or data interface tests that verify the compatibility between units and elements, integrated into a higher level of assembly such as a module, subsystem, element or a system.

4.1.3.6 Structural Tests

Structural strength qualification tests shall be in accordance with MSFC-HDBK-505, Rev. A.

4.2: PHASED VERIFICATION REQUIREMENTS

Verification phases are specific, event related sequences of activities which allow the verification process to be effectively segmented. The AXAF-I verification phases include the following:

a. Development
b. Qualification
c. Acceptance
d. Prelaunch
e. Launch
f. Flight/Mission
g. X-ray Calibration

Refer to the verification matrix for specific requirements to be verified in each of the above phases.

4.2.1:Development Phase

This phase includes (a) test(s) intended to assess/validate new design approach(es), and (b) analyses in support of design activities, or to provide confidence in the ability of flight hardware/software to pass qualification tests. Engineering models and breadboards are common development test articles. Development testing does not constitute formal verification of hardware/software performance, nor is it subject to formal controls. However, if protoflight hardware is development tested, it shall have formal controls, plans, specifications, procedures, and reports.

4.2.2: Qualification / Acceptance

Prototype qualification (qualification/acceptance) shall be performed to verify that selected AXAF-I elements meet design and performance requirements under anticipated operational regimes and environments. Prototype qualification shall be limited to those elements for which heritage and performance history at previous environmental levels in similar applications is inadequate. These elements may be refurbished and, after testing per 4.2.3, may be used for flight. Prototype qualification of the selected AXAF-I elements shall be completed prior to the start of AXAF-I system verification.

Protoflight qualification testing preserves the flight-worthiness of the hardware under test by suitable adjustment of the levels and durations of environmental exposure (stressing). Protoflight qualification testing shall be applied when heritage and performance history of the test hardware results in low risk and cost. Typically, protoflight hardware is subjected to environments at qualification levels and acceptance durations. (This does not apply to thermal testing) The total life capability remaining after protoflight testing shall be sufficient to complete checkouts and flight mission requirements.

All environments of prototype qualification tests shall be below design safety factor level and time exposure based on use cycle/type of flight item. Either prototype, or protoflight qualification tests include, but are not limited to performance, functional, random vibration, thermal vacuum, acoustic, and EMI/EMC.

4.2.3: Acceptance

Acceptance verification shall be performed on all previously qualified flight hardware to verify workmanship and compliance with all stated design and performance requirements. Tests performed during this phase include, but are not limited to, performance, functional, random vibration, thermal cycling/thermal vacuum, as appropriate, and acoustic.

4.2.4: Prelaunch Phase

This phase begins when AXAF-I arrives at KSC and ends with final payload bay door closure. Prelaunch verification shall be performed to verify that the observatory and the AXAF-I systems are in readiness for the science mission. All planned flight equipment activities shall be minimized, shall be at the AXAF-I level, and shall be oriented toward verifying the continued integrity of the flight hardware/software and the end-to-end data system.

4.2.5: Launch Phase

This phase starts with final payload bay door closure and ends after insertion of AXAF-I into its final orbit.

4.2.6: Flight/Orbital Verification Phase

This phase begins after AXAF-I is inserted into its final orbit and includes the activation and on-orbit checkout operations. The initial testing in this phase shall verify proper activation and operation of AXAF-I and its compatibility with the AXAF-I ground system and the DSN.

4.2.7: X-ray Calibration

X-ray calibration of the HRMA and the HRMA/SI system shall be performed in the MSFC X-ray Calibration Facility (XRCF). The HRMA scientific calibration requirements are given in MSFC-SPEC-1838, and the SI calibration requirements are given in MSFC-SPEC-1839. The XRCF detailed definition is provided in MSFC-SPEC-1837.

4.3: VERIFICATION MATRIX

Per paragraph 4.1.1, the verification matrix, Appendix B, summarizes the verification activities performed by TRW only; verification activities by the SI developer are annotated in the verification matrix of the applicable SI CEI Specification.

The verification matrix addresses all interface requirements of section 3.0. Table 4.3-1 provides the coding used in Appendix B.

The verification plan (TRW DR VR01) defines, to the appropriate level of detail, the specific activities called for in the verification matrix.

TABLE 4.3. VERIFICATION REQUIREMENTS MATRIX (VRM) CODING KEY

Code	Verification Method
D	Title, Description, Definition
TF	Functional Test
TE	Environmental Test
TN	Vibration Test
TA	Acoustic Test
TC	Thermal Cycle Test
TV	Thermal Vacuum Test
TM	EMI/EMC Test
TS	Special Test
TL	Structural Test
TH	Mechanism Test
TG	MDI Test
TP	PCAD Test
TO	Communication Test
TD	CCDM Test
TQ	EPS Test
TR	Propulsion Test
TU	Software Test
TZ	GSE Test
TW	EDI Test
TI	Interface Test
AS	Verification by Similarity
AA	Verification by Analysis
AI	Verification by Inspection
AV	Validation of Records
AD	Demonstration

Code		Verification Assembly Level
C		Component Level Verification
	CT	TRW Component
	CE	EKC Component
	CB	BALL Component
	CI	SI Component
M		Module Level Verification
	MT	TRW Module
	ME	EKC Module
	MB	BALL Module
	MI	SI Module
U		Subsystem Level Verification
	UT	TRW Subsystem
	UE	EKC Subsystem
	UB	BALL Subsystem
	UI	SI Subsystem
T		Telescope
SI		Science Instruments
SM		SI Module (SIM)
S		Spacecraft
O		Observatory
F		AXAF-I Facility
G		Ground Segment
P		Support Equipment
A		AXAF-I System
	-	Not Applicable

Code	Verification Phase
A	Development
B	Qualification
C	Acceptance
D	Prelaunch
E	Launch
F	Flight / Mission
G	X-Ray Calibration

Examples:

VRM Code	Verification
AA/O	Verification by Analysis / Observatory Level
TH/CB	Mechanism Test / BALL Component Level

4.4: HARDWARE AND SOFTWARE FAILURES

The management of failures/discrepancies in the course of interface testing by TRW shall be governed by the Verification Plan (TRW DR VR01).

The management of failures/discrepancies in the course of SI interface testing by the SI developer shall be governed by the appropriate SI Verification Plan, or the equivalent.

4.5: VERIFICATION FACILITIES AND EQUIPMENT

a. Facilities and equipment existing at TRW and its subcontractors shall be used to the maximum practical extent.

b. Test facilities, and equipment, used at more than one location, during TRW interface testing shall be integrated to assure uniformity of test results.

c. All TRW and subcontractor facilities employed in interface testing shall be verified prior to use.

d. All TRW and subcontractor GSE employed in interface testing shall be qualified or certified to ensure that no damage or degradation will be introduced into the hardware being tested.

Verification of SI developer's facilities and equipment shall be governed by the pertinent SI developer's contractual documentation.

4.6: VERIFICATION DOCUMENTATION

All documentation pertinent to the TRW verification of ICD requirements (as defined in Appendix B) shall be available to inspection, test and assessment personnel. Applicable verification drawings, specifications and procedures shall be physically located at the verification site at the time of the verification event. When each verification event is complete, the compliance information shall be entered into the VRSD compliance data base for completion of the matrices in the VRSD Compliance Document, TRW Document SR4-26 in response to TRW DR SE08.

All documentation pertinent to interface verification by the SI developer shall be governed by the pertinent SI developer's contractual requirements.

APPENDIX A: SI/SI INTERFACES

(This page intentionally left blank)

TABLE OF CONTENTS - APPENDIX A

1.0: SCOPE 5

2.0: APPLICABLE DOCUMENTS 5

3.0: HIGH RESOLUTION CAMERA 5

3.1: HIGH RESOLUTION CAMERA DESCRIPTION 5
3.2: FOCAL PLANE 6
3.2.1: Focal Plane Geometry 6
3.2.2: HRC-I Detector Active Area 6
3.2.3: HRC-I Detector Location 6
3.2.4: HRC-I Detector Alignment 6
3.2.5: HRC-S Detector Active Area 6
3.2.6: HRC-S Detector Location 6
3.2.7: HRC-S Detector Alignment 6
3.3: PERFORMANCE CHARACTERISTICS 10
3.3.1: Quantum Efficiency 10
3.3.2: Spatial Resolution 10
3.3.3: Energy Resolution 10
3.3.4: Temporal Resolution 10
3.3.5: Sensitivity 10
3.4: RADIOACTIVE SOURCES 10
3.5: UV/ION SHIELD CHARACTERISTICS 10
3.5.1: HRC-I (Deleted) 10
3.5.2: HRC-S (Deleted) 10

4.0: AXAF CCD IMAGING SPECTROMETER 11

4.1: AXAF CCD IMAGING SPECTROMETER DESCRIPTION 11
4.2: FOCAL PLANE 11
4.2.1: Focal Plane Geometry 11
4.2.2: ACIS-I Detector Active Area 11
4.2.3: ACIS-I Detector Location 11
4.2.4: ACIS-I Detector Alignment 13
4.2.5: ACIS-S Detector Active Area 13
4.2.6: ACIS-S Detector Location 13
4.2.7: ACIS-S Detector Alignment 13
4.2.8: (Reserved) 13
4.3: PERFORMANCE CHARACTERISTICS 13
4.3.1: Quantum Efficiency 13
4.3.2: Spatial Resolution 13
4.3.3: Energy Resolution 13
4.3.4: Temporal Resolution 14
4.3.5: Sensitivity 14

4.4: RADIOACTIVE SOURCES 14
4.5: OPTICAL BLOCKING FILTER 14

5.0: LOW ENERGY TRANSMISSION GRATING 15

5.1: LETG DESCRIPTION 15
5.2: ROWLAND CIRCLE GEOMETRY 15
5.2.1: Rowland Circle Diameter 15
5.2.2: Location 15

6.0: HIGH ENERGY TRANSMISSION GRATING 15

6.1: DESCRIPTION 15
6.2: ROWLAND CIRCLE GEOMETRY 15
6.2.1: Rowland Circle Diameter 15
6.2.2: Location 15

1.0: SCOPE

This appendix describes and defines interfaces between the various AXAF-I science instruments.

2.0: APPLICABLE DOCUMENTS

Document	Title
SAO-HRC -DR-92-011	Specification, High Resolution Camera Contract End Item
MIT 36-01101-01 7 May 1993	Specification, AXAF-I CCD Imaging Spectrometer Contract End Item
MIT 96-91700-A 7 May 1993	Specification, HETG Contract End Item
SCM02 1 February 1993	Specification, Low Energy Transmission Grating Contract End Item

3.0: HIGH RESOLUTION CAMERA

3.1: HIGH RESOLUTION CAMERA DESCRIPTION

The HRC consists of two photon counting imaging detectors, one for direct imaging (HRC-I) and the other for reading out a transmission grating spectrum (HRC-S). For each detector, the active x-ray detecting element consists of a coated microchannel plate (MCP) and a second MCP for additional electron gain. In front of each detector is a thin film UV/Ion shield which blocks unwanted UV light, low energy electrons, and ions. For each detector, a readout device records the magnitude of the charge cloud emerging from the cascaded MCPs, time of occurrence of the event, and information on the spatial distribution of the charge cloud. The latter is used to determine, by ground data processing, the event position. Both detectors are mounted within a single vacuum housing with a protective door. This assembly along with an anti-coincidence high energy particle shield and a shutter assembly is mounted within the Science Instrument Module (SIM) of AXAF-I. The electronics that provide power, operation, and command and event processing are housed in several additional assemblies.

Additional information may be found in the instrument CEI specification.

3.2: FOCAL PLANE

3.2.1: Focal Plane Geometry

The HRC focal plane geometry is shown in Figures 3-1 and 3-3. The HRC-I detector is a square, flat detector normal to the optical axis. The HRC-S detector is a linear detector composed of three segments, with the two outer segments tilted to approximate the grating Rowland Circle. Tilt of the outer segments shall be as shown in Figure 3-3.

3.2.2: HRC-I Detector Active Area

The HRC-I shall have an active area per the HRC CEI Specification, paragraph 3.2.1.1. (Ref: Figure 3-1).

3.2.3: HRC-I Detector Location

IRN 064 (PIRN 20-0070)

The center of HRC-I is located on the optical axis as shown in Figure 3-1. The HRC-I displacement from the HRMA focal point along the X (optical) axis is +.006 inch [0.15 mm].

3.2.4: HRC-I Detector Alignment

HRC alignment requirements are specified in paragraph 3.2.1.4.2 of the main body of the document.

3.2.5: HRC-S Detector Active Area

The HRC-S shall have an active area per the HRC CEI Specification, paragraph 3.2.1.1. (Ref: Figure 3-1).

3.2.6: HRC-S Detector Location

IRN 064 (PIRN 20-0070)

The HRC-S displacement from the HRMA focal point along the X axis is -0.020 inch [0.51 mm]. The HRC-S is displaced in the minus Y direction as shown in Figure 3-3. Figure 3-3 also shows the intersections of the LETG Rowland Circle with the HRC-S.

3.2.7: HRC-S Detector Alignment

HRC alignment requirements are specified in paragraph 3.2.1.4.2 of the main body of the document.

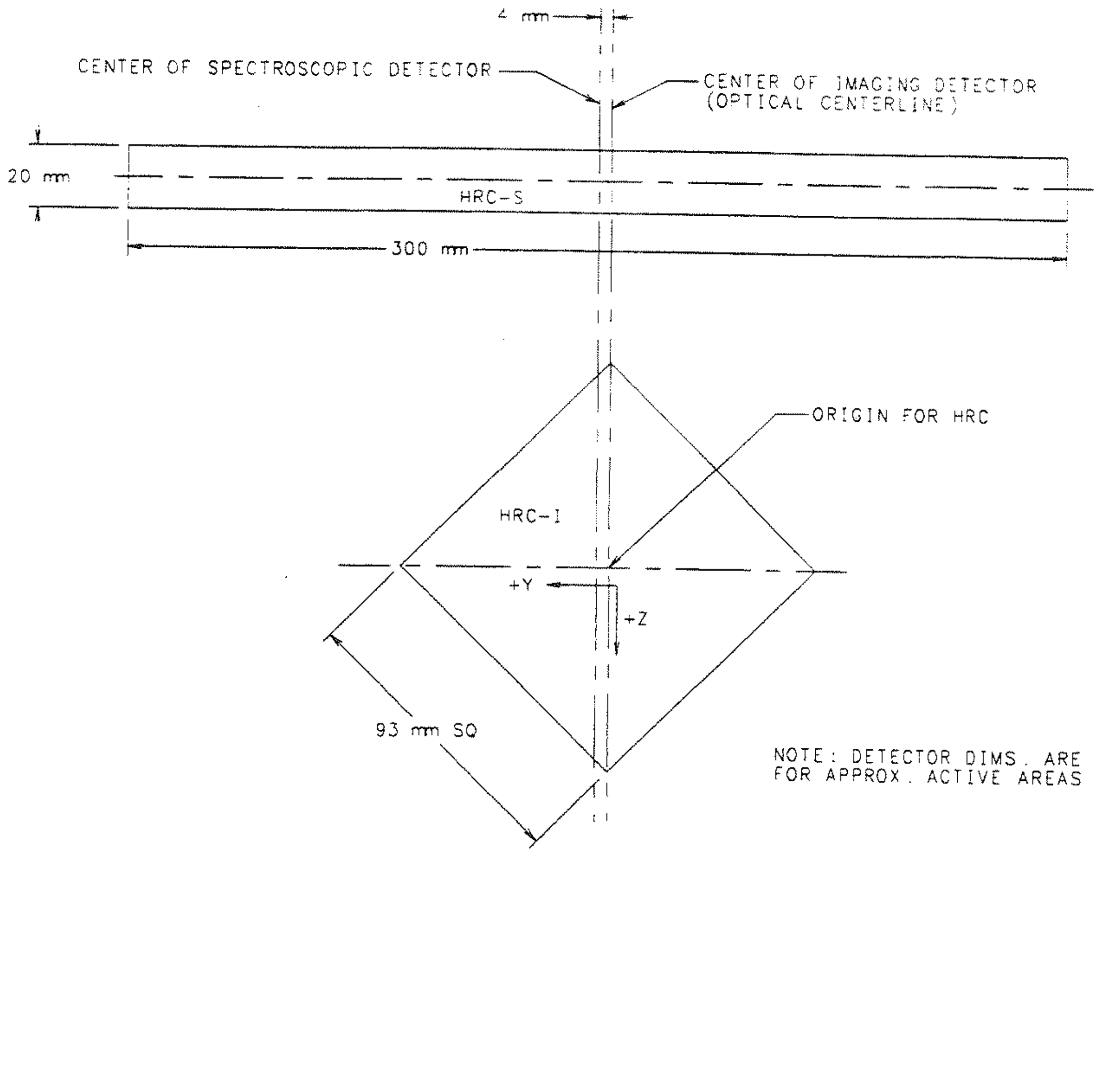


Figure 3-1. HRC Detector Configuration

(THIS FIGURE HAS BEEN DELETED)

Figure 3-2. HRC-S Configuration

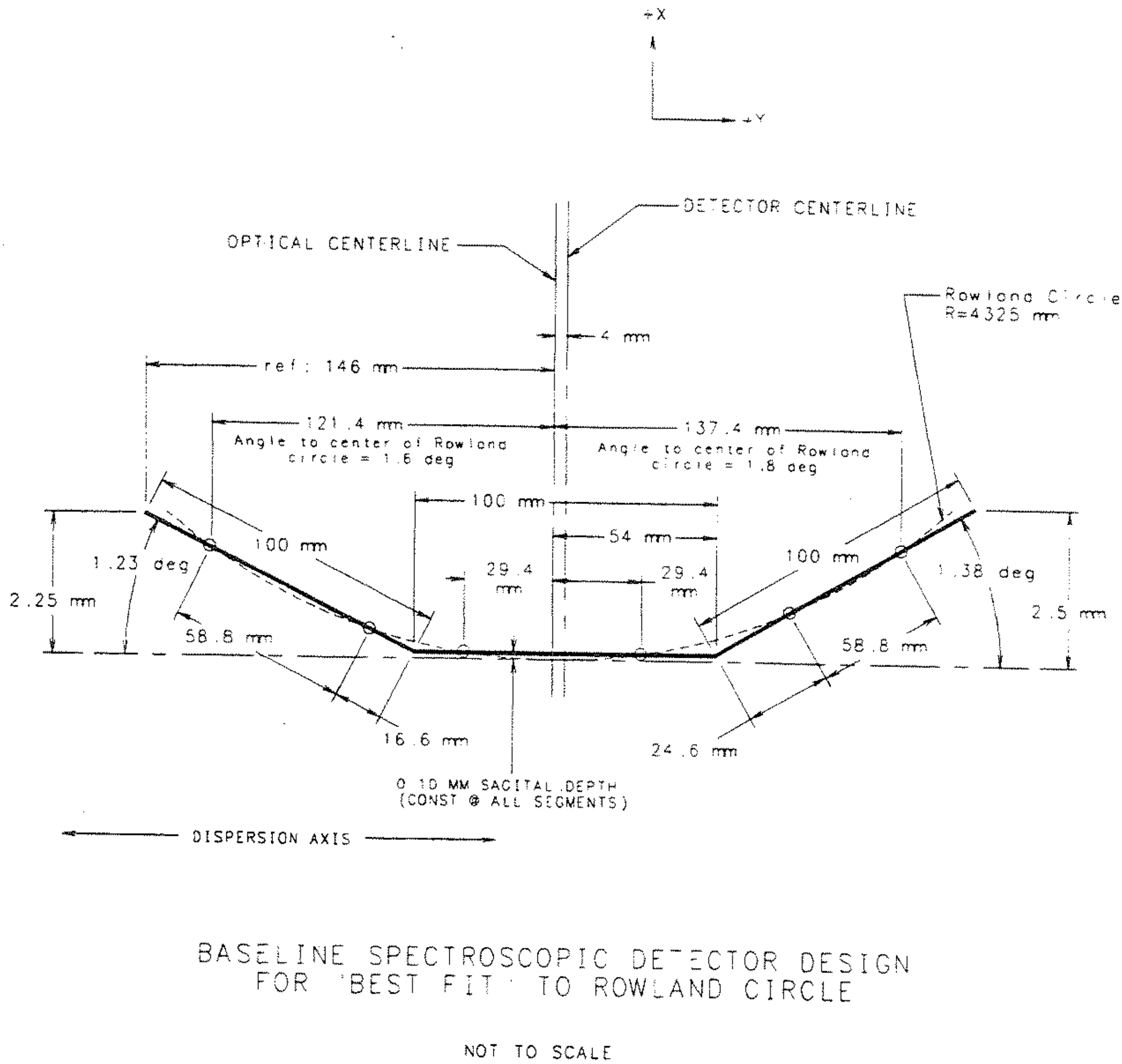


Figure 3-3. Intersections of HRC-S Surface with Rowland Circle

3.3: PERFORMANCE CHARACTERISTICS

3.3.1: Quantum Efficiency

HRC quantum efficiency is defined in the HRC CEI specification, paragraph 3.2.1.5.

3.3.2: Spatial Resolution

HRC spatial resolution is defined in the HRC CEI specification, paragraph 3.2.1.2.

3.3.3: Energy Resolution

HRC energy resolution is defined in the HRC CEI specification, paragraph 3.2.1.3.

3.3.4: Temporal Resolution

HRC temporal resolution is defined in the HRC CEI specification, paragraph 3.2.1.4.

3.3.5: Sensitivity

HRC sensitivity is defined in the HRC CEI specification, paragraph 3.2.1.6.

3.4: RADIOACTIVE SOURCES

Radioactive sources mounted on the HRC are located in the HRC door assembly. There are three sources, each with one millicurie of Cm244. The three X-ray lines emitted are Ti, C and Al.

3.5: UV/ION SHIELD CHARACTERISTICS

UV/ION shield characteristics are per the HRC CEI Specification, paragraph 3.2.2.3.

3.5.1: HRC-I (Deleted)

3.5.2: HRC-S (Deleted)

4.0: AXAF CCD IMAGING SPECTROMETER

4.1: AXAF CCD IMAGING SPECTROMETER DESCRIPTION

The AXAF-I CCD Imaging Spectrometer (ACIS) is a focal plane Science Instrument on the Advanced X-ray Astrophysics Facility - Imaging (AXAF-I). ACIS has two Charge-Coupled Device (CCD) arrays: one for imaging and one for spectroscopy. ACIS detects faint X-ray sources over the range of 0.2 to 10keV. The pixel size shall be no greater than 24 microns.

Primary assemblies comprising ACIS are as follows. The Detector Assembly houses the CCD arrays, fiducial lights and an X-ray calibration source. Signals from the CCD's are amplified and digitized in the Detector electronics Assembly. The Digital Processing Assembly controls instrument operation, extracts valid X-ray events, and processes the data for downlink. The Remote Command and Telemetry Unit provides the interface between ACIS and the Observatory data management system. The Power Supply supplies conditioned power to all assemblies. The Thermal Control system provides thermal control for the DA allowing operation of the focal plane at a nominal temperature of -120°C. Heaters provided by the Science Instrument Module will maintain minimum temperature levels on ACIS electronic assemblies.

Additional information may be found in the instrument CEI specification.

4.2: FOCAL PLANE

4.2.1: Focal Plane Geometry

The ACIS focal plane geometry is shown in Figure 4-1. The ACIS-I is a square array of four CCD detectors. The four imaging CCD chips are tilted to approximate the HRMA focal surface. The ACIS-S is composed of a linear array of six CCD chips tilted to approximate the grating Rowland Circle.

4.2.2: ACIS-I Detector Active Area

The ACIS-I shall have an active area as shown in Figure 4-1.

4.2.3: ACIS-I Detector Location

The HRMA focal point is 0.0019 inch below the ACIS-I detector surface. (Stating differently, ACIS-I is 0.0019 inch in the x-direction from the HRMA focal point). The displacement along the -Y axis shall be as shown in Figure 4-1. IRN 058 (PIRN 20-0066)

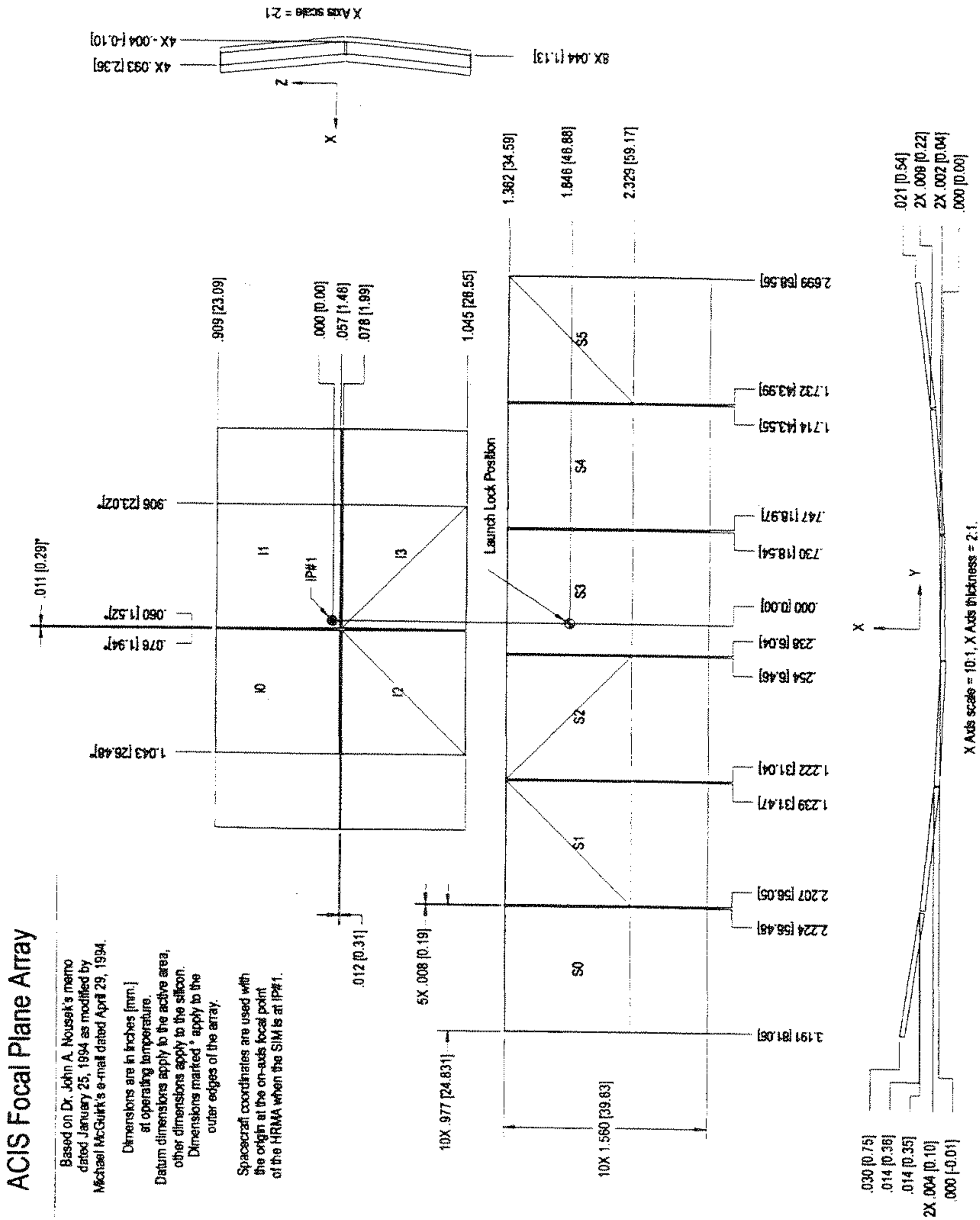


Figure 4-1. ACIS Detector Geometry

4.2.4: ACIS-I Detector Alignment

Alignment requirements are specified in paragraph 3.2.1.4.2 of the main body of the document.

4.2.5: ACIS-S Detector Active Area

The ACIS shall have an active area as shown in Figure 4-1.

4.2.6: ACIS-S Detector Location

The HRMA focal point is 0.0008 inch below the ACIS-S detector surface. (Stating differently, ACIS-S is 0.0008 inch in the x-direction from the HRMA focal point). The displacement along the -Y axis shall be as shown in Figure 4-1. IRN 058 (PIRN 20-0066)

4.2.7: ACIS-S Detector Alignment

Alignment requirements are specified in paragraph 3.2.1.4.2 of the main body of the document.

4.2.8: (Reserved)

4.3: PERFORMANCE CHARACTERISTICS

4.3.1: Quantum Efficiency

ACIS quantum efficiency is defined in the ACIS CEI specification, paragraph 3.2.1.d.

4.3.2: Spatial Resolution

ACIS spatial resolution is defined in the ACIS CEI specification, paragraph 3.2.1.b.

4.3.3: Energy Resolution

ACIS energy resolution is defined in the ACIS CEI specification, paragraph 3.2.1.e.

4.3.4: Temporal Resolution

IRN 052 (PIRN 20-0061)

ACIS temporal resolution is defined in the ACIS CEI Specification, paragraph 3.1.3.2 (a).

4.3.5: Sensitivity

IRN 052 (PIRN 20-0061)

ACIS sensitivity is defined in the ACIS CEI Specification, paragraph 3.2.1 (d).

4.4: RADIOACTIVE SOURCES

IRN 053 (PIRN 20-0062A & IRN 057 (PIRN 20-0065)

The ACIS contains radioactive sources which are mounted on the SIM focused structure and on the detector housing door. The external source consists of not more than 107.084 Millicuries of Iron(55); the internal source consists of a maximum of 10 microcuries of Iron(55). The external source illuminates 2 different targets; Aluminum and Titanium, which then emit to the ACIS Focal Plane in addition to the Iron 55 lines.

4.5: OPTICAL BLOCKING FILTER

IRN 052 (PIRN 20-0061)

The ACIS optical blocking filter characteristics are defined in the ACIS CEI Specification, paragraph 3.2.1 (g).

5.0: LOW ENERGY TRANSMISSION GRATING

5.1: LETG DESCRIPTION

The LETG consists of a toroidal shaped grating elements support structure (GESS) which carries several hundreds of grating elements. The nominal line density of the gratings is 1008 lines per millimeter. The LETG is positioned at the Rowland torus, aft the HRMA. This ensures optimum spectral resolution. The toroidal shape of the GESS and the detector surface on the Rowland circle provide a coma free astigmatic line image.

Additional information may be found in the instrument CEI specification.

5.2: ROWLAND CIRCLE GEOMETRY

5.2.1: Rowland Circle Diameter

The Rowland Circle Diameter for the LETG is defined in the LETG CEI Specifications, paragraph 3.2.1.4. IRN 052 (PIRN 20-0061)

5.2.2: Location

The location of the LETG grating shall be as specified in TRW Interface Control Drawing 301331.

6.0: HIGH ENERGY TRANSMISSION GRATING

6.1: DESCRIPTION

6.2: ROWLAND CIRCLE GEOMETRY

6.2.1: Rowland Circle Diameter

The Rowland Circle Diameter for the HETG is defined in the HETG CEI Specifications, paragraph 3.2.1.2.2. IRN 052 (PIRN 20-0061)

6.2.2: Location

The location of the HETG grating shall be as specified in TRW Interface Control Drawing 301331.

(This page intentionally left blank)

IRN 062
(PIRN
20-0064A)
ENTIRE
APPENDIX

APPENDIX B: VERIFICATION RESPONSIBILITY MATRIX

(This page intentionally left blank)

IRN 062 (PIRN 20-0064A) ENTIRE APPENDIX

APPENDIX B
IF1-20 VERIFICATION RESPONSIBILITY MATRIX

This matrix identifies the verification responsibilities for the requirements in the ICD. It also defines the type of verification activity for TRW and EKC but does not define the type of verification activities required by BASD and the Science Instrument teams. Instead, the matrix refers the reader to the appropriate CEI Specification or other verification reference. The verification matrix in each CEI specification contains the specific verification activities satisfying the ICD requirements.

Paragraph Number	Title	Resp. *	Mthd	Level	Phase	Comments
3.0	INTERFACE REQMTS.	—	—	—	—	Title
3.1	OPTICAL INTERFACES	—	—	—	—	Title
3.1.1	X-Ray Imaging Interface Description	—	—	—	—	Title
3.1.1.1	High Resolution Mirror Assembly (HRMA) Characteristics	—	—	—	—	Descriptive
3.1.1.2	Aspect Determination System	FP	—	—	—	See FPSI Verification
3.1.1.3	Other Error Sources	—	—	—	—	Descriptive
3.1.1.4	X-ray Background Attenuation	—	—	—	—	Descriptive
3.1.2	Light Leaks	—	—	—	—	Descriptive
3.1.2.1	ACIS Aperture Stray Light	TR	AA	O	C	
3.1.2.2	HRC Aperture Stray Light	TR	AA	O	C	
3.2	MECHANICAL INTERFACES	—	—	—		Title
3.2.1	Focal Plane Science Instrument Interfaces	—	—	—	—	Title
3.2.1.1	Focal Plane Science Instrument Descriptions	—	—	—	—	Title
3.2.1.1.1	AXAF CCD Imaging Spectrometer	—	—	—	—	Descriptive
3.2.1.1.2	High Resolution Camera	—	—	—	—	Descriptive
3.2.1.2	FPSI Mounting	BA	—	—	—	See SIM CEI Spec. 3.6.1.2
3.2.1.2	FPSI Mounting	FP	—	—	—	See FPSI Verification
3.2.1.2.1	Mechanical Interface Mounting Details	—	—	—	—	Descriptive
3.2.1.2.2	Harness Mounting	BA	—	—	—	See SIM CEI Spec. 3.6.1.1
3.2.1.2.3	GSE Access	—	—	—	—	Descriptive
3.2.1.2.4	FPSI Installation Torques	BA	AV	SM	C	
3.2.1.3	Aim Point Selection and Focus Adjustment	—	—	—	—	Title
3.2.1.3.1	Aim Point Selection	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.1.1 & 3.2.1.2.1.1.2

Paragraph Number	Title	Resp. *	Mthd	Level	Phase	Comments
3.2.1.3.2	Focus Adjustment	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.1.3
3.2.1.4	FPSI-to-Observatory Alignment	—	—	—	—	Title
3.2.1.4.1	Static Alignment	—	—	—	—	Title
3.2.1.4.1.1	Observatory Static Alignment and Orientation	TR	AA	O	C	See SE32, Systems Performance Prediction Analysis
3.2.1.4.1.2	FPSI Static Alignment and Orientation	FP	—	—	—	See FPSI Verification
3.2.1.4.2	On-Orbit Alignment Stability	—	—	—	—	Title
3.2.1.4.2.1	Observatory Alignment Stability	TR	AA	O	C	See SE32
3.2.1.4.2.2	FPSI Alignment Stability	FP	—	—	—	See FPSI Verification
3.2.1.4.3	FPSI Alignment Provisions	FP	—	—	—	See FPSI Verification
3.2.1.5	Fiducial Light System	TR	AD	O	C	
3.2.1.5.1	Location of Fiducial Lights	FP	—	—	—	See FPSI Verification
3.2.1.5.2	Fiducial Light Characteristics	TR	TS	CT	C	
3.2.2	Grating Mechanical Interfaces and Locations	—	—	—	—	Descriptive
3.2.2.1	Envelope	GR	—	—	—	See Grating Verification
3.2.2.2	Mounting	—	—	—	—	Title
3.2.2.2.1	Grating Orientation and Coordinates	GR	—	—	—	See Grating Verification
3.2.2.2.2	LETG and HETG Mounting	EK	AA	CE	C	See E-K Compliance Review Document (CRD) 6009
3.2.2.3	Grating Alignment	EK	AA	T	C	See E-K CRD 6002
3.2.2.3	Grating Alignment	GR	—	—	—	See Grating Verification
3.2.2.4	X-Ray Beam Geometry	EK	AA	T	C	See E-K CRD 6003
3.2.2.5.a	OTG Command and Fail-Safe Modes	EK	—	—	—	See Telescope CEI Spec 3.2.1.7
3.2.2.5.b	OTG Command and Fail-Safe Modes	EK	—	—	—	See Telescope CEI Spec 3.7.3.2 & sub-paragraphs
3.2.2.6	Grating Simulators	GR	—	—	—	See Grating Verification
3.2.2.6.1	Mechanical Features	GR	—	—	—	See Grating Verification
3.2.2.6.2	Alignment Features	GR	—	—	—	See Grating Verification
3.2.2.6.3	Finish Requirements	GR	—	—	—	See Grating Verification
3.2.2.6.4	Cleanliness Requirements	GR	—	—	—	See Grating Verification
3.2.2.6.5	Protection and Handling	GR	—	—	—	See Grating Verification
3.2.2.6.6	Product Assurance	GR	—	—	—	See Grating Verification
3.2.3	Mass Properties	—	—	—	—	Title
3.2.3.1	Weight	FP	—	—	—	See FPSI Verification
3.3	THERMAL INTERFACES	—	—	—	—	Title
3.3.1	On-Orbit Thermal Environment	TR	AA	O	C	

Paragraph Number	Title	Resp. *	Mthd	Level	Phase	Comments
3.3.1	On-Orbit Thermal Environment	TR	TV	O	B	
3.3.1	On-Orbit Thermal Environment	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4 & 3.2.1.2.4.2.1
3.3.1	On-Orbit Thermal Environment	EK	—	—	—	See Tele. CEI Spec 3.6.2.3.3
3.3.1.1	FPSI Thermal Environment	—	—	—	—	Title
3.3.1.1.1	FPSI Thermal Interfaces	—	—	—	—	Title
3.3.1.1.1.1	ACIS Detector Assembly Thermal Interfaces	—	—	—	—	Title
3.3.1.1.1.1.1	(No title)	—	—	—	—	Descriptive
3.3.1.1.1.1.2	(No title)	—	—	—	—	Descriptive
3.3.1.1.1.1.3	(No title)	—	—	—	—	Descriptive
3.3.1.1.1.1.4	(No title)	—	—	—	—	Descriptive
3.3.1.1.1.1.5	(No title)	—	—	—	—	Descriptive
3.3.1.1.1.1.6	(No title)	BA	—	—	—	See SIM CEI SPEC 3.6.1.4
3.3.1.1.1.1.7	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.1.8	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.1.9.a	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.1.9.b	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.1.10	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.1.11	(Deleted)	—	—	—	—	
3.3.1.1.1.2	ACIS Support Structure/ DPA/DEA Thermal Interfaces	AC	—	—	—	See ACIS Verification
3.3.1.1.1.2.1	(Deleted)	—	—	—	—	
3.3.1.1.1.2.2.a	(No title)	—	—	—	—	Descriptive
3.3.1.1.1.2.2.b	(No title)	—	—	—	—	Descriptive
3.3.1.1.1.2.3	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.2.4	(Deleted)	—	—	—	—	
3.3.1.1.1.2.5	(No title)	AC	—	—	—	See ACIS Verification
3.3.1.1.1.2.6	(No title)	AC	—	—	—	See ACIS Verification
3.3.1.1.1.3	ACIS Radiator Thermal Interfaces	—	—	—	—	Title
3.3.1.1.1.3.1	(No title)	TR	AV	O	C	
3.3.1.1.1.3.3	(No title)	AC	—	—	—	See ACIS Verification
3.3.1.1.1.3.4	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.4	ACIS Telescope Shade and Sun Shade Thermal Interfaces for On-orbit Operation.	—	—	—	—	Descriptive
3.3.1.1.1.4.1	(No title)	—	—	—	—	Descriptive
3.3.1.1.1.4.2	(No title)	BA	—	—	—	See SIM CEI SPEC 3.6.1.5
3.3.1.1.1.4.3	(Deleted)	—	—	—	—	
3.3.1.1.1.4.4	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.4.5	(No title)	BA	—	—	—	See SIM CEI SPEC 3.6.1.6

Paragraph Number	Title	Resp. *	Mthd	Level	Phase	Comments
3.3.1.1.1.4.6	(Deleted)	—	—	—	—	(Ref. MSFC GP54B-97-097)
3.3.1.1.1.5	ACIS PSMC Thermal Interfaces	—	—	—	—	Title
3.3.1.1.1.5.1	(No title)	AC	—	—	—	See ACIS Verification
3.3.1.1.1.5.2	(No title)	BA	—	—	—	See SIM CEI SPEC 3.6.1.8
3.3.1.1.1.5.3	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.5.4	(No title)	BA	—	—	—	SIM SPEC 3.6.1.12
3.3.1.1.1.6	HRC Instrument Thermal I/Fs	—	—	—	—	Descriptive
3.3.1.1.1.6.1	(Deleted)	—	—	—	—	
3.3.1.1.1.6.2	(No title)	—	—	—	—	Descriptive
3.3.1.1.1.6.3	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.6.4.a	(No title)	BA	—	—	—	See SIM CEI SPEC 3.6.1.13
3.3.1.1.1.6.4.b	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.6.5	(Deleted)	—	—	—	—	
3.3.1.1.1.6.6	(Deleted)	—	—	—	—	
3.3.1.1.1.6.7	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.6.8	(Deleted)	—	—	—	—	
3.3.1.1.1.6.9.a	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.6.9.b	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.6.9.c	(No title)	BA	—	—	—	See SIM CEI SPEC 3.2.1.2.4
3.3.1.1.1.6.10	(No title)	—	—	—	—	Descriptive
3.3.1.1.1.7	(Deleted)	—	—	—	—	
3.3.1.1.1.7.1	(Deleted)	—	—	—	—	
3.3.1.1.1.7.2	(Deleted)	—	—	—	—	
3.3.1.1.1.7.3	(Deleted)	—	—	—	—	
3.3.1.1.1.7.4	(Deleted)	—	—	—	—	
3.3.1.1.1.7.5	(Deleted)	—	—	—	—	
3.3.1.1.1.7.6	(Deleted)	—	—	—	—	
3.3.1.1.2.a	Thermal Characteristics and Models	TR	AV	SIM	C	
3.3.1.1.2.b	Thermal Characteristics and Models	AC	—	—	—	See ACIS Verification
3.3.1.1.2.c	Thermal Characteristics and Models	HR	—	—	—	See HRC Verification
3.3.1.1.2.d	Thermal Characteristics and Models	FP	—	—	—	See FPSI Verification
3.3.1.1.3	FPSI Thermal Power Modes	—	—	—	—	Descriptive
3.3.1.1.3.1	ACIS Thermal Power Modes	—	—	—	—	Descriptive
3.3.1.1.3.2	HRC Thermal Power Modes	—	—	—	—	Descriptive
3.3.1.1.3.3	(Deleted)	—	—	—	—	
3.3.1.2	Grating Thermal Interface	—	—	—	—	Title
3.3.1.2.1	Grating Thermal Environment	EK	—	—	—	See Tele. CEI Spec 3.6.2.3.3

Paragraph Number	Title	Resp. *	Mthd	Level	Phase	Comments
3.3.1.2.2	(Deleted)	—	—	—	—	
3.3.2	Science Instrument Thermal Control	—	—	—	—	Title
3.3.2.1	Science Instrument Temp. Range	—	—	—	—	Descriptive
3.3.2.2	FPSI Survival and Operational (Trim) Heater Requirements	AC	—	—	—	See ACIS Verification
3.3.2.2	FPSI Survival and Operational (Trim) Heater Rqmts (con.t)	HR	—	—	—	See HRC Verification
		FP	—	—	—	See FPSI Verification
3.3.3	Other Thermal Environments	—	—	—	—	Descriptive
3.3.3.1	Preflight	—	—	—	—	Descriptive
3.3.3.1.1	X-Ray Calibration	TR	AV	SIM	G	
3.3.3.1.2	Prelaunch and Ground Testing	TR	AV	O	D	
3.3.3.1.3	Transportation and Storage	BA	—	—	—	See SIM CEI Spec. 3.6.1.9
		TR	AV	UTF	C	
3.3.3.2	Flight	—	—	—	—	Descriptive
3.3.3.2.1	ACIS Orientation During Shuttle Open Cargo Bay and Transfer Orbit Phases.	—	—	—	—	Descriptive
3.4	STRUCTURAL LOADS AND DYNAMICS	—	—	—	—	Title
3.4.1	Structural Loads and Dynamics Description	—	—	—	—	Title
3.4.1.1	Structural and Dynamic Math Models	SI	—	—	—	See FPSI and Grating Verification
3.4.1.2	Launch and Landing Loads	—	—	—	—	Descriptive
3.4.1.2.1.a	Natural Frequency Requirements	FP	—	—	—	See FPSI Verification
3.4.1.2.1.b	Natural Frequency Requirements	EK	AA	T	C	See E-K CRD 6005
3.4.1.2.2	Random Vibrations	—	—	—	—	Title
3.4.1.2.2.1	Science Instrument Random Vibrations	SI	—	—	—	See FPSI and Grating Verification
3.4.1.2.2.2	Fiducial Light Random Vibrations	TR	TS	CT	C	
3.4.1.2.3	Acoustics	SI	—	—	—	See FPSI and Grating Verification
3.4.1.2.4	Pressure	SI	—	—	—	See FPSI and Grating Verification
3.4.1.2.5	(Deleted)	—	—	—	—	
3.4.1.2.6	Shock loads	SI	—	—	—	See FPSI and Grating Verification

Paragraph Number	Title	Resp. *	Mthd	Level	Phase	Comments
3.4.1.2.7	SIM Translation Table Stiffness Coefficients	BA	AA	SM	C	
3.4.1.2.8	HRC Mount Interface Loads	HR	—	—	—	See HRC Verification
3.4.1.2.9	ACIS Mount Interface Loads	AC	—	—	—	See ACIS Verification
3.4.1.2.10	FPSI Dynamic Envelope	FP	—	—	—	See FPSI Verification
3.4.1.3	Handling and Transportation	TR	AV	O	C	
3.4.1.4	Orientation	FP	—	—	—	See FPSI Verification
3.4.2	Vibration Compatibility	—	—	—	—	Title
3.4.2.1	FPSI Induced Disturbances	FP	—	—	—	See FPSI Verification
3.4.2.1.1	HRC Door Constraints	TR	AV	O	C	
3.5	ELECTRICAL INTERFACES	—	—	—	—	Title
3.5.1	Electrical Power Interface	—	—	—	—	Title
3.5.1.1	Input Voltage	FP	—	—	—	See FPSI Verification
3.5.1.2	Bus Characteristics	FP	—	—	—	See FPSI Verification
3.5.1.3	Power Control	—	—	—	—	Descriptive
3.5.1.4	Circuit Protection	—	—	—	—	Descriptive
3.5.1.5	FPSI Power Requirements	FP	—	—	—	See FPSI Verification
3.5.1.5	FPSI Power Requirements	TR	—	—	—	See Obs. CEI Spec. 3.7.1.3.4.3
3.5.1.6	Power Redundancy	TR	—	—	—	See Obs. CEI Spec. 3.7.1.3.4.3
3.5.2	Connectors and Harnesses	—	—	—	—	Title
3.5.2.1	Interface Connectors	—	—	—	—	Title
3.5.2.1.1	Connector Locations and Types	—	—	—	—	Descriptive
3.5.2.1.2	(Deleted)	—	—	—	—	
3.5.2.2	Harnesses	TR	AV	O	C	
		FP	—	—	—	See FPSI Verification
3.5.2.3	Shielding	FP	—	—	—	See FPSI Verification
3.5.2.3.1	HRC Fiducial Light Conductor Shielding	FP	—	—	—	See FPSI Verification
3.5.2.4	Interface Signals	—	—	—	—	Descriptive
3.5.3	Electromagnetic Compatibility	—	—	—	—	Title
3.5.3.1	EMI and RFI	FP	—	—	—	See FPSI Verification
3.5.3.2	Electrical Grounding	—	—	—	—	Title
3.5.3.2.1.a	SI Elect. Equipment Grounding	FP	—	—	—	See FPSI Verification
3.5.3.2.1.b		BA	—	—	—	See SIM CEI SPEC 3.6.1.10
3.5.3.2.1.c		FP	—	—	—	See FPSI Verification
3.5.3.2.1.d		FP	—	—	—	See FPSI Verification
3.5.3.2.2	ACIS Sunshade Assy Grounding	BA	—	—	—	See SIM CEI SPEC 3.6.1.11
		AC	—	—	—	See ACIS Verification
3.5.4	Magnetics	—	—	—	—	Title

Paragraph Number	Title	Resp. *	Mthd	Level	Phase	Comments
3.5.4.1	Magnetic Field Intensity	TR	AA	O	C	
		FP	—	—	—	See FPSI Verification
3.5.4.2	On-orbit AC Magnetic Field Emission Limit	TR	TM	CT	B	
		BA	—	—	—	See SIM CEI Spec. 3.3.3
		FP	—	—	—	See FPSI Verification
3.5.5	SI Protection					Descriptive
3.5.5.1	Bright Object Protection	TR	TF	O	B	
3.5.5.2	Radiation Detector Signal	TR	TF	O	B	
3.6	COMMAND AND DATA HANDLING INTERFACES	—	—	—	—	Title
3.6.1	Commands	—	—	—	—	Title
3.6.1.1	SI Commanding	TR	TD	O	C	
		FP	—	—	—	See FPSI Verification
3.6.1.1.1	ACIS - OBC Software - Ground Software	—	—	—	—	Title
3.6.1.1.1.1	Buffer Size	TR	AV	CT	C	
3.6.1.1.1.2-1	Command Formats	AC	—	—	—	See ACIS Verification
3.6.1.1.1.2-2		AC	—	—	—	See ACIS Verification
3.6.1.1.1.2-3		TR	TD	O	B	
3.6.1.1.1.2-4		TR	TD	O	B	
3.6.1.1.1.3	ACIS Operations	—	—	—	—	Title
3.6.1.1.1.3.1	Normal and Standby Operations	AC	—	—	—	See ACIS Verification
3.6.1.1.1.3.2	Memory Uplink Mode	TR	TD	O	B	
		AC	—	—	—	See ACIS Verification
3.6.1.2	ACIS Processor Loads	TR	AV	UT	C	
3.6.2	SI Telemetry	—	—	—	—	Title
3.6.2.1.a	SI Science Data	TR	AV	UT	B	
3.6.2.1.b		TR	TD	O	B	
3.6.2.1.c		—	—	—	—	Descriptive
3.6.2.1.d		TR	TD	O	B	
3.6.2.1.e		TR	AV	UT	C	
3.6.2.2	SI Engineering Data	TR	AV	O	C	
3.6.2.2	SI Engineering Data	FP	—	—	—	See FPSI Verification
3.6.2.3	(Deleted)	—	—	—	—	
3.6.2.4	Telemetry Synchronization	—	—	—	—	Descriptive (ref. to 3.6.3)
3.6.2.5.a & b	Telemetry Format Changes	TR	TD	O	B	
3.6.3	Central Timing	TR	—	—	—	See Obs. CEI Spec. 3.7.4.1.6 & sub-paragraphs
		TR	TD	UT	B	
		FP	—	—	—	See FPSI Verification

Paragraph Number	Title	Resp. *	Mthd	Level	Phase	Comments
3.6.4	RCTU Characteristics	—	—	—	—	Descriptive (Ref. to D17387)
3.6.5	CCDM/SI Interface Reqmts.	FP	—	—	—	See FPSI Verification
3.6.5.1	SI Command Interface Reqmts.	FP	—	—	—	See FPSI Verification
3.6.5.1.1	Serial Digital Commands	FP	—	—	—	See FPSI Verification
3.6.5.1.1.1	Serial Digital Command Characteristics	FP	—	—	—	See FPSI Verification
		TR	—	—	—	See S/C CEI Spec. 3.7.4.2.6.8
3.6.5.1.1.2	Serial Digital Command Timing	FP	—	—	—	See FPSI Verification
		TR	—	—	—	See S/C CEI Spec. 3.7.4.2.6.8
3.6.5.1.2	High Level Pulse Commands	FP	—	—	—	See FPSI Verification
3.6.5.1.2.1	High Level Pulse Command Characteristics	FP	—	—	—	See FPSI Verification
3.6.5.1.2.1	High Level Pulse Command Characteristics (cont.)	TR	—	—	—	See S/C CEI Spec. 3.7.4.2.6.8
3.6.5.1.2.2	High Level Pulse Command Timing	TR	—	—	—	See S/C CEI Spec. 3.7.4.2.6.8
3.6.5.2	SI Telemetry Interface Reqmts.	FP	—	—	—	See FPSI Verification
3.6.5.2.1	Serial Digital Telemetry	FP	—	—	—	See FPSI Verification
3.6.5.2.1.1	Serial Digital Telemetry Characteristics	FP	—	—	—	See FPSI Verification
		TR	—	—	—	See S/C CEI Spec. 3.7.4.2.6.8
3.6.5.2.1.2	Telemetry Timing	FP	—	—	—	See FPSI Verification
		TR	—	—	—	See S/C CEI Spec. 3.7.4.2.6.8
3.6.5.2.2	Active Analog Telemetry	FP	—	—	—	See FPSI Verification
3.6.5.2.2.1	Active Analog Telemetry Characteristics	FP	—	—	—	See FPSI Verification
		TR	—	—	—	See S/C CEI Spec. 3.7.4.2.6.8
3.6.5.2.3	Passive Analog Telemetry	FP	—	—	—	See FPSI Verification
3.6.5.2.3.1	Passive Analog Telemetry Characteristics	FP	—	—	—	See FPSI Verification
		TR	—	—	—	See S/C CEI Spec. 3.7.4.2.6.8
3.6.5.2.4	Bilevel Telemetry	FP	—	—	—	See FPSI Verification
3.6.5.2.4.1	(Deleted)	—	—	—	—	
3.6.5.2.4.2	Bilevel Telemetry Characteristics	FP	—	—	—	See FPSI Verification
		TR	—	—	—	See S/C CEI Spec. 3.7.4.2.6.8
3.6.5.3	Synchronization Signals	FP	—	—	—	See FPSI Verification
		TR	—	—	—	See S/C CEI Spec.3.7.4.2.6.10
3.7	POINTING AND CONTROL	—	—	—	—	Descriptive (Ref. to SY 24-2)
3.8	(DELETED)	—	—	—	—	
3.9	OTHER REQUIREMENTS	—	—	—	—	Title

Paragraph Number	Title	Resp. *	Mthd	Level	Phase	Comments
3.9.1	Natural And Induced Environments	—	—	—	—	Title
3.9.1.1	Natural and Induced Environment Definition	FP	—	—	—	See FPSI Verification
3.9.1.1.1	Meteoroid and Orbital Debris Protection	TR	AA	F	C	
3.9.1.2	(Deleted)	—	—	—	—	
3.9.1.3	(Deleted)	—	—	—	—	
3.9.1.4	(Deleted)	—	—	—	—	
3.9.1.5	Corona Suppression	FP	—	—	—	See FPSI Verification
3.9.1.6	Radiation Environment	FP	—	—	—	See FPSI Verification
3.9.1.6.1	Solar Flare Protons	FP	—	—	—	See FPSI Verification
3.9.1.6.2	Trapped Electrons	FP	—	—	—	See FPSI Verification
3.9.1.6.3	Trapped Protons	FP	—	—	—	See FPSI Verification
3.9.1.6.4	Total Dose	FP	—	—	—	See FPSI Verification
3.9.1.6.5	Cosmic Ray and Solar Flare Environments	FP	—	—	—	See FPSI Verification
3.9.1.6.6	Spacecraft Charging Effects	FP	—	—	—	See FPSI Verification
		TR	AA	F	C	
3.9.1.6.7	Radioactive Sources for Flight Contamination Monitor	—	—	—	—	Descriptive
3.9.2	Contamination Control	—	—	—	—	Title
3.9.2.1	SI External Environment	—	—	—	—	Title
3.9.2.1.1	Orbiter Cargo Bay Environment	TR	—	—	—	See Obs. CEI Spec 3.2.7.3, 3.2.7.3.1 & 3.3.9.3
		FP	—	—	—	See FPSI Verification
3.9.2.1.2	(Deleted)	—	—	—	—	
3.9.2.2	SI Cleanliness	—	—	—	—	Title
3.9.2.2.1	Internal	FP	—	—	—	See FPSI Verification
3.9.2.2.2	External	FP	—	—	—	See FPSI Verification
3.9.2.2.3	Materials Selection	FP	—	—	—	See FPSI Verification
3.9.2.3	Venting	—	—	—	—	Title
3.9.2.3.1	Ascent and Reentry Venting	TR	—	—	—	See SIM CEI Spec. 3.2.1.2.3 & sub-paragraphs See Telescope CEI Spec. 3.2.7.1.4 & sub-paragraphs
3.9.2.3.2	SI Venting	TR	—	—	—	See SIM CEI Spec. 3.2.1.2.3 & sub-paragraphs See Telescope CEI Spec. 3.2.7.1.4 & sub-paragraphs
3.9.2.4	Handling and Transportation Contamination	SI	—	—	—	See FPSI & Grating Verification

Paragraph Number	Title	Resp. *	Mthd	Level	Phase	Comments
3.9.3	Ground Support Equipment And Facilities	—	—	—	—	Title
3.9.3.1	SI Test and Integration Description	—	—	—	—	Title
3.9.3.1.1	Interface Testing at SI Facility	—	—	—	—	Descriptive
3.9.3.1.2	X-Ray Testing and Calibration	—	—	—	—	Descriptive
3.9.3.1.3	SI Integration Activities	—	—	—	—	Descriptive
3.9.3.1.3.1	Pre-Integration Functional Test	—	—	—	—	Descriptive
3.9.3.1.3.2	Post-Integration Functional Tests	—	—	—	—	Descriptive
3.9.3.2	Transportation and Storage Monitoring	TR	AV	O	C	
3.9.3.3	SI Prelaunch Activities	—	—	—	—	Descriptive
3.9.3.3.1	SI Tests	—	—	—	—	Descriptive
3.9.3.3.2	Maintenance of FPSI Internal Atmosphere	—	—	—	—	Descriptive
3.9.3.3.2.1	Gas/Vacuum GSE Access to FPSIs	BA	—	—	—	See SIM CEI Spec. 3.2.8
3.9.3.3.2.1	Gas/Vacuum GSE Access to FPSIs	FP	—	—	—	See FPSI Verification
3.9.3.3.2.2	GSE Responsibility	FP	—	—	—	See FPSI Verification
3.9.3.3.2.3	Time Constraints on GSE Access	TR	AV	O	C	
3.9.3.3.2.3	Time Constraints on GSE Access	BA	—	—	—	See SIM CEI Spec. 3.6.1.14
3.9.4	System Safety	—	—	—	—	Descriptive
3.9.4.1	Flight Safety	SI	—	—	—	See FPSI & Grating Verification
3.9.4.2	Launch Site Safety	SI	—	—	—	See FPSI & Grating Verification
3.9.4.3	Nuclear Sources	FP	—	—	—	See FPSI Verification
3.9.5	Access	—	—	—	—	Title
3.9.5.1.a	SI Access	BA	—	—	—	See SIM CEI Spec. 3.2.8, 3.2.8.3
3.9.5.1.b	SI Access	EK	AA	UE	C	See E-K CRD 6006
3.9.5.1.c	SI Access	EK	AD	T	C	See E-K CRD 6007 and MIT SVR04N, Post-acoustic Grating Inspection Report
3.9.5.1.d	SI Access	GR	—	—	—	See Grating Verification
3.9.6	Crew Systems	—	—	—	—	Title
3.9.6.1	Crew Systems Requirements	TR	—	—	—	See Obs. CEI Spec 3.6.1.1.1
		AC	—	—	—	See ACIS Verification
3.9.7	Quality Assurance	—	—	—	—	Title
3.9.7.1	Quality Assurance Requirements	—	—	—	—	Descriptive

Paragraph Number	Title	Resp. *	Mthd	Level	Phase	Comments
3.10	CONTRACTOR FURNISHED EQUIPMENT	—	—	—	—	Descriptive
3.11	(Deleted)	—	—	—	—	

*Legend for Responsibility Column:

AC= ACIS
BA= BASD
EK= EKC
FP= FPSIs
GR= Gratings
HR= HRC
SI= All SIs
TR= TRW

(This page intentionally left blank)

APPENDIX C: OBSERVATORY TO ACIS ELECTRICAL INTERFACES

(This page intentionally left blank)

APPENDIX C
OBSERVATORY TO ACIS ELECTRICAL INTERFACES

1.0 CONNECTOR TYPES

Connector types are defined in the wire lists included in this appendix. All connectors on the instrument interfacing with the observatory shall be male.

2.0 OBSERVATORY/ACIS ELECTRICAL INTERFACES

Electrical signals are specified in the following interface signal lists. Interface signal categories and quantities are as follows:

Signal Category / Code	Quantity
Primary Power	2
Command channels:	
High level pulse (HLP)	68
Serial digital (SD)	2
Telemetry channels:	
Active analog (AA)	42
Passive analog (PA)	21
Bilevel (BL)	20
Serial digital (SD)	3
Timing signals:	
Major frame sync (RCTU)	2
Science header sync	1
1.024 Mhz clock	1
Fiducial light signals	6

3.0: ACIS UNIQUE INTERFACE CIRCUITS

3.1: High Level Pulse Commands

IRN 041 (PIRN 20-0035) The ACIS interface circuit for high level pulse commands is defined in Figure 3.1-1. These circuits use opto-isolators instead of relays.. These circuits are used in lieu of the User Equipment Circuit shown in Figure 3.6.5-3 in the main body of this document.

3.2: PSMC Serial Digital Telemetry Interface Circuits

IRN 041 (PIRN 20-0035) The PSMC serial digital telemetry interface circuit is defined in Figure 3.2-1. The PSMC uses opto-isolators to couple signals to and from the RCTU. This circuit is used in lieu of that shown in Figure 3.6.5-5 in the main body of this document.

4.0 ACIS RADIATION DETECTOR COMMANDS

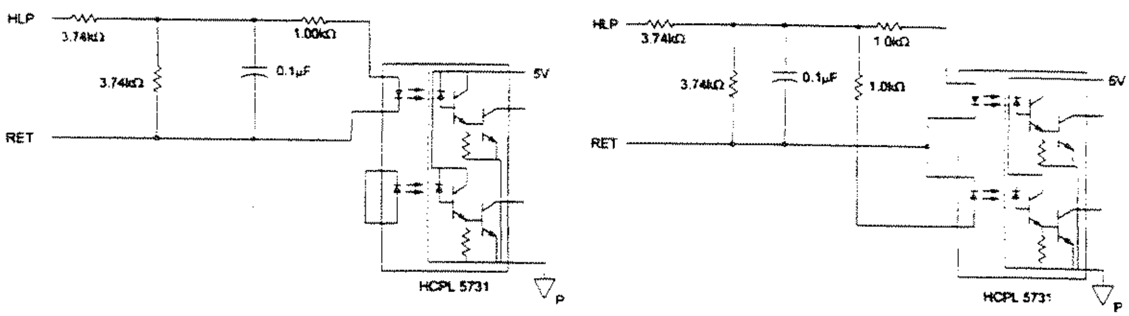
When the background radiation level exceeds or drops below a commandable threshold over a commandable time period, the OBC shall send a command via the ISIM RCTU to the ACIS Hardware Serial Command Port. For both the high and low radiation thresholds, the EPHIN channel PG41GM will be used. The channel is independent of EPHIN Geometric Factor. The high radiation threshold will have a value of 100 counts per 65.6 second integration period. The data from EPHIN (in counts/period) will not be averaged by the OBC (Averaging Parameter is 1). When the EPHIN value (in counts/period) exceeds the 100 threshold for 3 consecutive periods, the high radiation flag will be set and the high radiation command sent to ACIS. The software implementation is such that this command will be sent each 65.6 second period that the criterion met.

IRN 063 (PIRN 20-0068A)

The low radiation threshold will have a value of 30 counts per 65.6 second integration period. The data from the EPHIN (in counts/period) will not be averaged by the OBC (Averaging Parameter is 1). When the EPHIN value (in counts/period) drops below the 30 threshold value for 3 consecutive periods, the low radiation flag will be set and the low radiation command sent to the ACIS. The software implementation is such that this command will be sent each 65.6 second period that the criterion is met .

The commands to be sent are as follows:

Radiation above the high threshold	Command 0x0701 hex
Radiation below the low threshold	Command 0x0700 hex



IRN 041 (PIRN 20-0035)

Figure 3.1-1: ACIS High Level Pulse Driver Interface

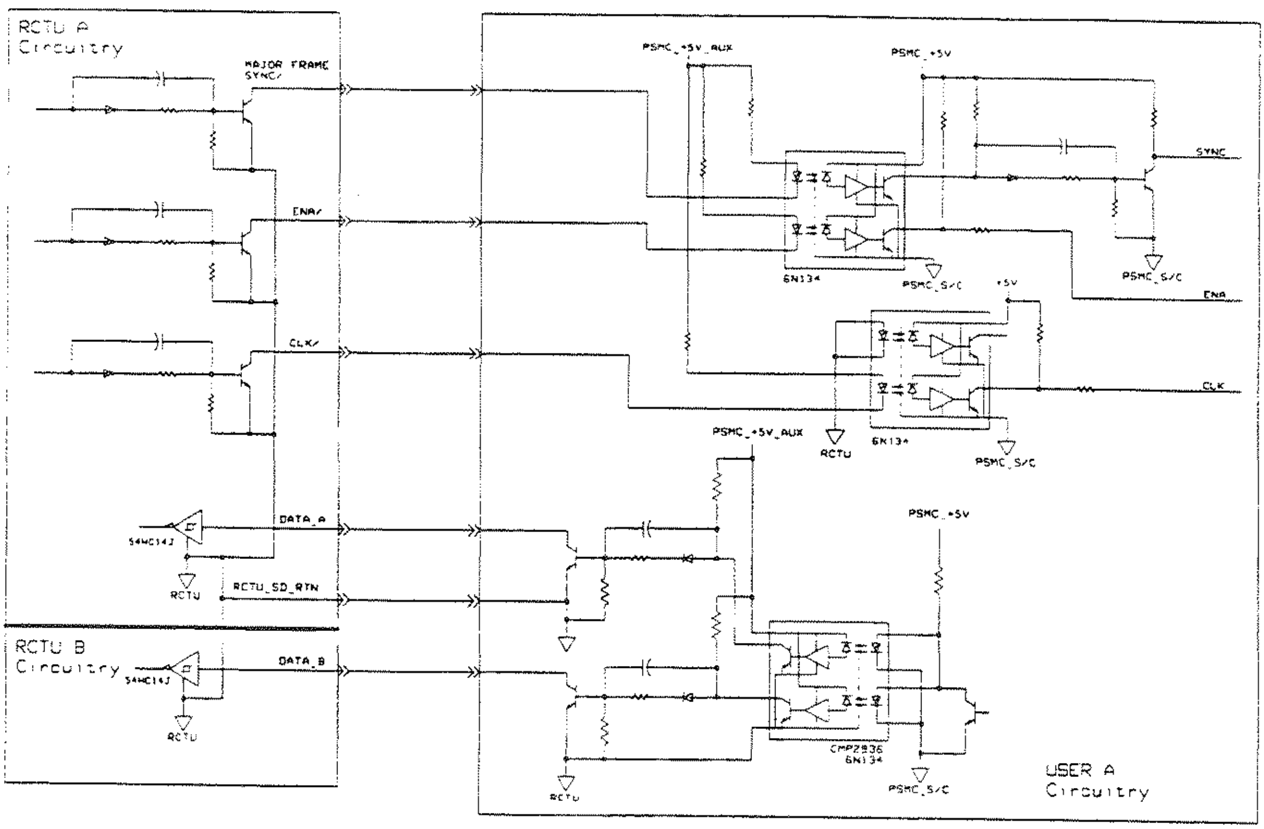


Figure 3.2-1: ACIS Serial Digital Telemetry Interface Circuitry (PSMC Only)

5.0 ACIS UNIQUE INTERFACE HARNESS CHARACTERISTICS

5.1 Fiducial Light Harness (FLCA to DA)

Clerical change. Moved from page C-5

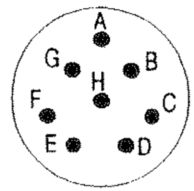
The Fiducial Light Harness shall utilize wires with conductor size not greater than 24 AWG. Harness shielding, if terminated at the DA interface connector shall be of low thermal conductance material such as stainless steel.

5.2 Detector Assembly Survival Heater Harness (BTU to DA)

The DA Survival Heater Harness shall utilize wires with conductor size not greater than 24 AWG. Harness shielding, if terminated at the DA interface connector shall be of low thermal conductance material such as stainless steel.

Signal List: ACIS/SIM

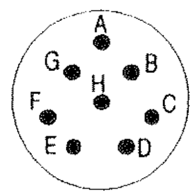
FROM UNIT: IFB				TO UNIT: PSMC MS27505E17F8PA					
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
7103	P101	15		PSMC	A1J1	A	16	PSMC Primary Power 1 "A"	P-PWR 1 "A"
7103	P101	16							
7103	P101	32		PSMC	A1J1	B	16	PSMC Primary Power 1 "A" Return	P-PWR 1 "A" Rtn.
7103	P101	33							
7103	P101	13		PSMC	A1J1	D	16	PSMC Primary Power 2 "A"	P-PWR 2 "A"
7103	P101	14							
7103	P101	30		PSMC	A1J1	E	16	PSMC Primary Power 2 "A" Return	P-PWR 2 "A" Rtn.
7103	P101	31							
7103	P101	17		PSMC	A1J1	G	16	PSMC Primary Power 3 "A"	P-PWR 3 "A"
7103	P101	18							
7103	P101	50		PSMC	A1J1	H	16	PSMC Primary Power 3 "A" Return	P-PWR 3 "A" Rtn.
7103	P101	35							
				PSMC	A1J1	C	16	N/C	
				PSMC	A1J1	F	16	N/C	



Clerical change. Added "A" side signal list in place of duplicate "B" side list inadvertently incorporated in previous revision

Signal List: ACIS/SIM

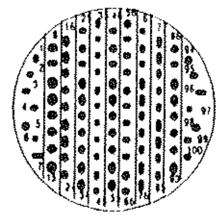
FROM UNIT: IFB — TO UNIT: PSMC (MS27505E17F8PB)



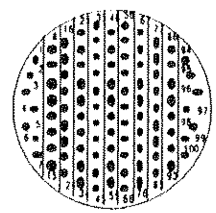
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
7103	P201	15		PSMC	A1J2	A	16	PSMC Primary Power 1 "B"	P-PWR 1 "B"
7103	P201	16							
7103	P201	32		PSMC	A1J2	B	16	PSMC Primary Power 1 "B" Return	P-PWR 1 "B" Rtn.
7103	P201	33							
7103	P201	13		PSMC	A1J2	D	16	PSMC Primary Power 2 "B"	P-PWR 2 "B"
7103	P201	14							
7103	P201	30		PSMC	A1J2	E	16	PSMC Primary Power 2 "B" Return	P-PWR 2 "B" Rtn.
7103	P201	31							
7103	P201	17		PSMC	A1J2	G	16	PSMC Primary Power 3 "B"	P-PWR 3 "B"
7103	P201	18							
7103	P201	50		PSMC	A1J2	H	16	PSMC Primary Power 3 "B" Return	P-PWR 3 "B" Rtn.
7103	P201	35							
				PSMC	A1J2	C	16	N/C	
				PSMC	A1J2	F	16	N/C	

Signal List: ACIS/SIM

FROM UNIT: RCTU — TO UNIT: PSMC, MS27505E23F35PA

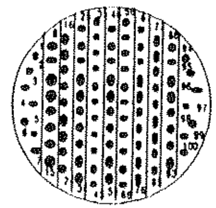


REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
RCTU	J31	76		PSMC	A1J7	1		DEA Power Supply Enable "A"	HLP
RCTU	J31	37		PSMC	A1J7	2		DEA Power Supply OFF "A"	HLP
RCTU	J31	73		PSMC	A1J7	3		DEA Power Supply Disable "A"	HLP
RCTU	J31	34		PSMC	A1J7	4		DEA Power Supply ON "A"	HLP
RCTU	J31	18		PSMC	A1J7	5		DPA Power Supply Enable "A"	HLP
RCTU	J31	15		PSMC	A1J7	6		DPA Power Supply Disable "A"	HLP
RCTU	J31	54		PSMC	A1J7	7		DPA Power Supply ON "A"	HLP
				PSMC	A1J7	8		N/C	
RCTU	J31	57		PSMC	A1J7	9		DPA Power Supply OFF "A"	HLP
RCTU	J31	78		PSMC	A1J7	10		DPA Power Supply Command Return "A"	HLP RTN
RCTU	J31	36		PSMC	A1J7	11		Mechanism Command Enable "A"	HLP
RCTU	J31	75		PSMC	A1J7	12		Mechanism Command Disable "A"	HLP
RCTU	J31	39		PSMC	A1J7	13		Command 1 Return "A"	HLP RTN
RCTU	J31	35		PSMC	A1J7	14		Vent Valve Command Enable "A"	HLP
RCTU	J31	74		PSMC	A1J7	15		Little Valve Command Enable "A"	HLP
RCTU	J31	55		PSMC	A1J7	16		Mechanism Open Door ON Command "A"	HLP
RCTU	J31	16		PSMC	A1J7	17		Mechanism Close Door ON Command "A"	HLP
RCTU	J31	56		PSMC	A1J7	18		Mechanism Open Door OFF Command "A"	HLP
RCTU	J31	17		PSMC	A1J7	19		Mechanism Close Door OFF Command "A"	HLP
RCTU	J31	72		PSMC	A1J7	20		Vent Valve Command Disable "A"	HLP
RCTU	J31	33		PSMC	A1J7	21		Vent Valve Command Open ON "A"	HLP
RCTU	J31	29		PSMC	A1J7	22		Vent Valve Command Close ON "A"	HLP
RCTU	J31	69		PSMC	A1J7	23		Vent Valve Command Open OFF "A"	HLP
RCTU	J31	50		PSMC	A1J7	24		Vent Valve Command Close OFF "A"	HLP
RCTU	J31	38		PSMC	A1J7	25		Command 2 Return "A"	HLP RTN

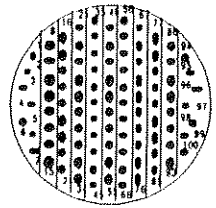
Signal List: ACIS/SIM									
FROM UNIT: RCTU				TO UNIT: PSMC					
				MS27505E23F35PA					
									
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
RCTU	J31	10	22	PSMC	A1J7	26	22	Little Valve Command Disable "A"	1LVCADS
RCTU	J31	14	22	PSMC	A1J7	27	22	Little Valve Command Open ON "A"	1LVCOAON
RCTU	J31	53	22	PSMC	A1J7	28	22	Little Valve Command Close ON "A"	1LVCCAON
				PSMC	A1J7	29	22	N/C	
RCTU	J31	32	22	PSMC	A1J7	30	22	Housing Heater Disable "A"	1HHTRADS
RCTU	J31	71	22	PSMC	A1J7	31	22	Housing Heater OFF "A"	1HHTRAOF
RCTU	J31	51	22	PSMC	A1J7	32	22	Housing Heater ON "A"	1HHTRAON
RCTU	J31	11	22	PSMC	A1J7	33	22	Housing Heater Enable "A"	1HHTRAEN
RCTU	J31	19	22	PSMC	A1J7	34	22	Command 4 Return "A"	
RCTU	J18	54	22	PSMC	A1J7	35	22	DEA + 5 V Analog "A1"	1DEP0AVO
RCTU	J18	16	22	PSMC	A1J7	36	22	DEA - 5 V Analog "A1"	1DEN0AVO
RCTU	J18	53	22	PSMC	A1J7	37	22	DEA + 15 V Analog "A1"	1DEP1AVO
RCTU	J18	15	22	PSMC	A1J7	38	22	DEA - 15 V Analog "A1"	1DEN1AVO
RCTU	J18	52	22	PSMC	A1J7	39	22	DEA + 24 V Analog "A1"	1DEP2AVO
RCTU	J18	14	22	PSMC	A1J7	40	22	DEA + 28 V Analog "A1"	1DEP3AVO
RCTU	J18	73	22	PSMC	A1J7	41	22	DEA + 28 V Input "A2"	1DE28AVO
RCTU	J18	11	22	PSMC	A1J7	42	22	DEA Input Current "A3"	1DEICACU
				PSMC	A1J7	43	22	N/C	
RCTU	J18	51	22	PSMC	A1J7	44	22	DPA + 5 V Analog "A1"	1DPP0AVO
RCTU	J18	35	22	PSMC	A1J7	45	22	DPA + 28 V Input "A2"	1DP28AVO
RCTU	J18	72	22	PSMC	A1J7	46	22	DPA Input Current "A2"	1DPICACU
RCTU	J18	41	22	PSMC	A1J7	47	22	Telemetry "A2" Return (Primary)	RTN
				PSMC	A1J7	48	22	N/C	
RCTU	J18	34	22	PSMC	A1J7	49	22	DA Heater Voltage "A2"	1DAHAVO
RCTU	J18	71	22	PSMC	A1J7	50	22	DA Heater Current "A2"	1DAHACU

Signal List: ACIS/SIM

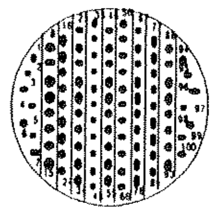
FROM UNIT: RCTU — TO UNIT: PSMC, MS27505E23F35PA



REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
RCTU	J18	12	22	PSMC	A1J7	51	22	Mechanism Actuator HTR Open "A3"	1MAHOATM
RCTU	J18	49	22	PSMC	A1J7	52	22	Mechanism Actuator HTR Close "A3"	1MAHCATM
				PSMC	A1J7	53	22	N/C	
RCTU	J31	77	22	PSMC	A1J7	54	22	Command "A3" Return	HLP RTN
				PSMC	A1J7	55	22	N/C	
RCTU	J18	48	22	PSMC	A1J7	56	22	Vent Valve Actuator HTR Open "A3"	1VAHOATM
RCTU	J18	10	22	PSMC	A1J7	57	22	Vent Valve Actuator HTR Close "A3"	1VAHCATM
RCTU	J18	47	22	PSMC	A1J7	58	22	Housing Pressure "A3"	1HOPRAPR
RCTU	J18	33	22	PSMC	A1J7	59	22	DA Housing Temperature A Offset "A2"	1DAHATM
				PSMC	A1J7	60	22	N/C	
				PSMC	A1J7	61	22	N/C	
RCTU	J31	70	22	PSMC	A1J7	62	22	Housing B.O. Enable "A"	1HBOAEN
RCTU	J31	12	22	PSMC	A1J7	63	22	Housing B.O. Disable "A"	1HBOADS
RCTU	J31	52	22	PSMC	A1J7	64	22	Housing B.O. ON "A"	1HBOAON
RCTU	J31	13	22	PSMC	A1J7	65	22	Housing B.O. OFF "A"	1HBOAOF
				PSMC	A1J7	66	22	N/C	
				PSMC	A1J7	67	22	N/C	
RCTU	J18	4	22	PSMC	A1J7	68	22	Telemetry "A1" Return (Secondary)	RTN
				PSMC	A1J7	69	22	N/C	
				PSMC	A1J7	70	22	N/C	
RCTU	J18	22	22	PSMC	A1J7	71	22	Telemetry "A3" Return (Primary)	RTN
				PSMC	A1J7	72	22	N/C	
				PSMC	A1J7	73	22	N/C	
				PSMC	A1J7	74	22	N/C	
				PSMC	A1J7	75	22	N/C	

Signal List: ACIS/SIM									
FROM UNIT: RCTU				TO UNIT: PSMC					
				MS27505E23F35PA					
									
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
				PSMC	A1J7	76	22	N/C	
RCTU	J31	28	22	PSMC	A1J7	77	22	Pressure Command Enable "A"	1PRESAEN
RCTU	J31	68	22	PSMC	A1J7	78	22	Pressure Command Disable "A"	1PRESADS
RCTU	J20	31	22	PSMC	A1J7	79	22	PSMC A Major Sync.	NA
RCTU	J20	6	22	PSMC	A1J7	80	22	PSMC A Serial Digital Data Return	
RCTU	J14	63	22	PSMC	A1J7	81	22	Warm Radiator Temperature A	1WRATM
RCTU	J14	44	22	PSMC	A1J7	82	22	Warm Radiator Temperature A Rtn.	
RCTU	J14	22	22	PSMC	A1J7	83	22	Camera Body Temp A	1CBATM
RCTU	J14	3	22	PSMC	A1J7	84	22	Camera Body Temp A Rtn	
RCTU	J14	23	22	PSMC	A1J7	85	22	Cold Radiator Temperature A	1CRATM
RCTU	J14	4	22	PSMC	A1J7	86	22	Cold Radiator Temperature A Rtn.	
RCTU	J14	24	22	PSMC	A1J7	87	22	Open Actuator Housing Temperature A	1OAHATM
RCTU	J14	5	22	PSMC	A1J7	88	22	Open Actuator Housing Temperature A Rtn.	
RCTU	J14	62	22	PSMC	A1J7	89	22	Detector Assembly Collimator-top Temp A	1DACTATM
RCTU	J14	43	22	PSMC	A1J7	90	22	Detector Assembly Collimator-top Temp A Rth	
RCTU	J14	64	22	PSMC	A1J7	91	22	PSMC DEA PS A Temp	1PDEAATM
RCTU	J14	41	22	PSMC	A1J7	92	22	PSMC DEA PS A Temp Return	
				PSMC	A1J7	93	22	N/C	
RCTU	J18	70	22	PSMC	A1J7	94	22	DA Housing Heater +28V Input "A2"	1DAHHAVO
				PSMC	A1J7	95	22	N/C	
				PSMC	A1J7	96	22	N/C	
				PSMC	A1J7	97	22	N/C	
RCTU	J12	22	22	PSMC	A1J7	98	22	PSMC A Serial Clock	NA
RCTU	J12	14	22	PSMC	A1J7	99	22	PSMC A Serial Digital Data A	NA
RCTU	J12	16	22	PSMC	A1J7	100	22	PSMC B Serial Digital Data A	NA

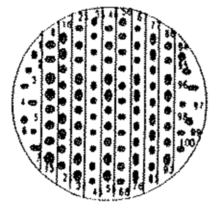
Signal List: ACIS/SIM



FROM UNIT: RCTU				TO UNIT: PSMC MS27505E23F35PB					
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
RCTU	J32	43		PSMC	A1J8	1		DEA Power Supply Enable "B"	HLP
RCTU	J32	15		PSMC	A1J8	2		DEA Power Supply OFF "B"	HLP
RCTU	J32	46		PSMC	A1J8	3		DEA Power Supply Disable "B"	HLP
RCTU	J32	6		PSMC	A1J8	4		DEA Power Supply ON "B"	HLP
RCTU	J32	22		PSMC	A1J8	5		DPA Power Supply Enable "B"	HLP
RCTU	J32	25		PSMC	A1J8	6		DPA Power Supply Disable "B"	HLP
RCTU	J32	65		PSMC	A1J8	7		DPA Power Supply ON "B"	HLP
				PSMC	A1J8	8		N/C	
RCTU	J32	62		PSMC	A1J8	9		DPA Power Supply OFF "B"	HLP
RCTU	J32	59		PSMC	A1J8	10		Command 5 Return "B"	HLP RTN
RCTU	J32	4		PSMC	A1J8	11		Mechanism Command Enable "B"	HLP
RCTU	J32	44		PSMC	A1J8	12		Mechanism Command Disable "B"	HLP
RCTU	J32	42		PSMC	A1J8	13		Command 1 Return "B"	HLP RTN
RCTU	J32	5		PSMC	A1J8	14		Vent Valve Command Enable "B"	HLP
RCTU	J32	45		PSMC	A1J8	15		Little Valve Command Enable "B"	HLP
RCTU	J32	64		PSMC	A1J8	16		Mechanism Open Door ON Command "B"	HLP
RCTU	J32	24		PSMC	A1J8	17		Mechanism Close Door ON Command "B"	HLP
RCTU	J32	63		PSMC	A1J8	18		Mechanism Open Door OFF Command "B"	HLP
RCTU	J32	23		PSMC	A1J8	19		Mechanism Close Door OFF Command "B"	HLP
RCTU	J32	47		PSMC	A1J8	20		Vent Valve Command Disable "B"	HLP
RCTU	J32	7		PSMC	A1J8	21		Vent Valve Command Open ON "B"	HLP
RCTU	J32	50		PSMC	A1J8	22		Vent Valve Command Close ON "B"	HLP
RCTU	J32	10		PSMC	A1J8	23		Vent Valve Command Open OFF "B"	HLP
RCTU	J32	29		PSMC	A1J8	24		Vent Valve Command Close OFF "B"	HLP
RCTU	J32	41		PSMC	A1J8	25		Command 2 Return "B"	HLP RTN

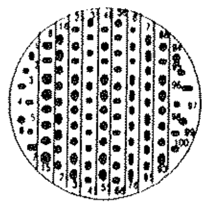
Signal List: ACIS/SIM

FROM UNIT: RCTU — TO UNIT: PSMC (MS27505E23F35PB)



REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
RCTU	J32	69	22	PSMC	A1J8	26	22	Little Valve Command Disable "B"	1LVCBDS
RCTU	J32	26	22	PSMC	A1J8	27	22	Little Valve Command Open ON "B"	1LVCOBON
RCTU	J32	66	22	PSMC	A1J8	28	22	Little Valve Command Close ON "B"	1LVCCBON
				PSMC	A1J8	29	22	N/C	
RCTU	J32	8	22	PSMC	A1J8	30	22	Housing Heater Disable "B"	1HHTRBDS
RCTU	J32	48	22	PSMC	A1J8	31	22	Housing Heater OFF "B"	1HHTRBOF
RCTU	J32	9	22	PSMC	A1J8	32	22	Housing Heater ON "B"	1HHTRBON
RCTU	J32	49	22	PSMC	A1J8	33	22	Housing Heater Enable "B"	1HHTRBEN
RCTU	J32	61	22	PSMC	A1J8	34	22	Command 4 Return "B"	
RCTU	J17	52	22	PSMC	A1J8	35	22	DEA + 5 V Analog "B"	1DEP0BVO
RCTU	J17	12	22	PSMC	A1J8	36	22	DEA - 5 V Analog "B1"	1DEN0BVO
RCTU	J17	51	22	PSMC	A1J8	37	22	DEA + 15 V Analog "B1"	1DEP1BVO
RCTU	J17	11	22	PSMC	A1J8	38	22	DEA - 15 V Analog "B1"	1DEN1BVO
RCTU	J17	50	22	PSMC	A1J8	39	22	DEA + 24 V Analog "B1"	1DEP2BVO
RCTU	J17	10	22	PSMC	A1J8	40	22	DEA + 28 V Analog "B1"	1DEP3BVO
RCTU	J17	72	22	PSMC	A1J8	41	22	DEA + 28 V Input "B2"	1DE28BVO
RCTU	J17	7	22	PSMC	A1J8	42	22	DEA Input Current "B3"	1DEICBCU
				PSMC	A1J8	43	22	N/C	
RCTU	J17	49	22	PSMC	A1J8	44	22	DPA + 5 V Analog "B1"	1DPP0BVO
RCTU	J17	32	22	PSMC	A1J8	45	22	DPA + 28 V Input "B2"	1DP28BVO
RCTU	J17	71	22	PSMC	A1J8	46	22	DPA Input Current "B2"	1DPICBCU
RCTU	J17	38	22	PSMC	A1J8	47	22	Telemetry "B2" Return (Primary)	RTN
				PSMC	A1J8	48	22	N/C	
RCTU	J17	31	22	PSMC	A1J8	49	22	DA Heater Voltage "B2"	1DAHBVO
RCTU	J17	70	22	PSMC	A1J8	50	22	DA Heater Current "B2"	1DAHBCU

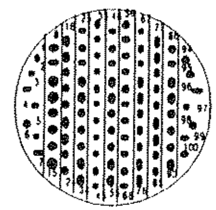
Signal List: ACIS/SIM



FROM UNIT: RCTU				TO UNIT: PSMC MS27505E23F35PB					
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
RCTU	J17	8	22	PSMC	A1J8	51	22	Mechanism Actuator HTR Open "B3"	1MAHOBTM
RCTU	J17	47	22	PSMC	A1J8	52	22	Mechanism Actuator HTR Close "B3"	1MAHCBTM
				PSMC	A1J8	53	22		
RCTU	J32	78	22	PSMC	A1J8	54	22	Command "B3" Return	HLP RTN
				PSMC	A1J8	55	22	N/C	
RCTU	J17	46	22	PSMC	A1J8	56	22	Vent Valve Actuator HTR Open "B3"	1VAHOBTM
RCTU	J17	6	22	PSMC	A1J8	57	22	Vent Valve Actuator HTR Close "B3"	1VAHCBTM
RCTU	J17	45	22	PSMC	A1J8	58	22	Housing Pressure "B3"	1HOPRBPR
RCTU	J17	30	22	PSMC	A1J8	59	22	DA Housing Temperature B Offset "B2"	1DAHBTM
				PSMC	A1J8	60	22	N/C	
				PSMC	A1J8	61	22	N/C	
RCTU	J32	68	22	PSMC	A1J8	62	22	Housing B.O. Enable "B"	1HBOBEN
RCTU	J32	28	22	PSMC	A1J8	63	22	Housing B.O. Disable "B"	1HBOBDS
RCTU	J32	67	22	PSMC	A1J8	64	22	Housing B.O. ON "B"	1HBOBON
RCTU	J32	27	22	PSMC	A1J8	65	22	Housing B.O. OFF "B"	1HBOBOF
				PSMC	A1J8	66	22	N/C	
				PSMC	A1J8	67	22	N/C	
RCTU	J17	58	22	PSMC	A1J8	68	22	Telemetry "B1" Return (Secondary)	RTN
				PSMC	A1J8	69	22	N/C	
				PSMC	A1J8	70	22	N/C	
RCTU	J17	18	22	PSMC	A1J8	71	22	Telemetry "B3" Return (Primary)	RTN
				PSMC	A1J8	72	22	N/C	
				PSMC	A1J8	73	22	N/C	
				PSMC	A1J8	74	22	N/C	
				PSMC	A1J8	75	22	N/C	

Signal List: ACIS/SIM

FROM UNIT: RCTU — TO UNIT: PSMC (MS27505E23F35PB)



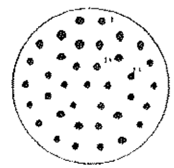
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
				PSMC	A1J8	76	22	N/C	
RCTU	J32	51	22	PSMC	A1J8	77	22	Pressure Command Enable "B"	1PRESBEN
RCTU	J32	11	22	PSMC	A1J8	78	22	Pressure Command Disable "B"	1PRESBDS
RCTU	J19	31	22	PSMC	A1J8	79	22	PSMC B Major Sync.	NA
RCTU	J19	6	22	PSMC	A1J8	80	22	PSMC B Serial Digital Data Return	
RCTU	J16	24	22	PSMC	A1J8	81	22	Warm Radiator Temperature B	1WRBTM
RCTU	J16	5	22	PSMC	A1J8	82	22	Warm Radiator Temperature B Rtn.	
RCTU	J16	62	22	PSMC	A1J8	83	22	Camera Body Temp B	1CBBTM
RCTU	J16	43	22	PSMC	A1J8	84	22	Camera Body Temp B Rtn	
RCTU	J16	63	22	PSMC	A1J8	85	22	Cold Radiator Temperature B	1CRBTM
RCTU	J16	44	22	PSMC	A1J8	86	22	Cold Radiator Temperature B Rtn.	
RCTU	J16	64	22	PSMC	A1J8	87	22	Open Actuator Housing Temperature B	1OAHBTM
RCTU	J16	41	22	PSMC	A1J8	88	22	Open Actuator Housing Temperature B Rtn.	
RCTU	J16	23	22	PSMC	A1J8	89	22	Detector Assembly Collimator-top Temp B	1DACTBTM
RCTU	J16	4	22	PSMC	A1J8	90	22	Detector Assembly Collimator-top Temp B Rtn	
RCTU	J16	25	22	PSMC	A1J8	91	22	PSMC DEA PS B Temp	1PDEABTM
RCTU	J16	6	22	PSMC	A1J8	92	22	PSMC DEA PS B Temp Return	
				PSMC	A1J8	93	22	N/C	
RCTU	J17	69	22	PSMC	A1J8	94	22	DA Housing Heater +28V Input "B2"	1DAHHBVO
				PSMC	A1J8	95	22	N/C	
				PSMC	A1J8	96	22	N/C	
				PSMC	A1J8	97	22	N/C	
RCTU	J11	22	22	PSMC	A1J8	98	22	PSMC B Serial Clock	NA
RCTU	J11	16	22	PSMC	A1J8	99	22	PSMC A Serial Digital Data B	NA
RCTU	J11	14	22	PSMC	A1J8	100	22	PSMC B Serial Digital Data B	NA

Signal List: SIM (BTU & RCTU)/ACIS									
FROM UNIT: PSMC				TO UNIT: BTU/RCTU					
311P409-1P-B-12									
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
PSMC	A1J11	1	20	BTU	7964P02	1	22	PSMC Survival Temp In 2A	
PSMC	A1J11	2	20	BTU	7964P02	40	22	PSMC Trim Temp In 2A	
PSMC	A1J11	3	20	RCTU	J14	12	22	PSMC Temp In 1A (FM53)	1PIN1ATM
PSMC	A1J11	4	20					N/C	
PSMC	A1J11	5	20	BTU	7964P01	1	20	PSMC Heater Power +28V 4A	
PSMC	A1J11	6	20	BTU	7964P02	21	22	PSMC Survival Temp Rtn 2A	
PSMC	A1J11	7	20	BTU	7964P02	60	22	PSMC Trim Temp Rtn 2A	
PSMC	A1J11	8	20	RCTU	J14	31	22	PSMC Temp Rtn 1A (FM53)	
PSMC	A1J11	9	20	BTU	7964P01	18	20	PSMC Heater +28V Rtn 4A	

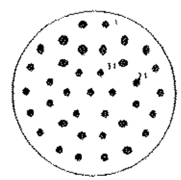
Signal List: SIM (BTU & RCTU)/ACIS									
FROM UNIT: PSMC				TO UNIT: BTU/RCTU					
311P409-1P-B-12									
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
PSMC	A1J12	1	20	BTU	7964P04	1	22	PSMC Survival Temp In 2B	
PSMC	A1J12	2	20	BTU	7964P04	40	22	PSMC Trim Temp In 2B	
PSMC	A1J12	3	20					N/C	
PSMC	A1J12	4	20					N/C	
PSMC	A1J12	5	20	BTU	7964P03	1	20	PSMC Heater Power +28V 4B	
PSMC	A1J12	6	20	BTU	7964P04	21	22	PSMC Survival Temp Rtn 2B	
PSMC	A1J12	7	20	BTU	7964P04	60	22	PSMC Trim Temp Rtn 2B	
PSMC	A1J12	8	20					N/C	
PSMC	A1J12	9	20	BTU	7964P03	18	20	PSMC Heater +28V Rtn 4B	

Signal List: SIM (RCTU)/ACIS

FROM UNIT: RCTU — TO UNIT: DPA (MS27656E15F35SA)

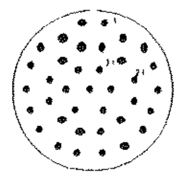


REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
RCTU	J33	35	22	DPA	A5J6	1	22	Software Command Clock _A	SWCMDCK_A
				DPA	A5J6	2	22	Software Command Return	NOT USED FLT CABLE
RCTU	J33	5	22	DPA	A5J6	3	22	Software Command Enable_A	SWCMDEN_A
RCTU	J33	20	22	DPA	A5J6	4	22	Software Command Data_A	SWCMDDAT_A
RCTU	J33	22	22	DPA	A5J6	5	22	Hardware Command Clock_A	HWCMDCK_A
				DPA	A5J6	6	22	Hardware Command Return	NOT USED FLT CABLE
RCTU	J33	37	22	DPA	A5J6	7	22	Hardware Command Enable_A	HWCMDEN_A
RCTU	J33	6	22	DPA	A5J6	8	22	Hardware Command Data_A	HWCMDDAT_A
RCTU	J10	24	22	DPA	A5J6	9	22	Telemetry Clock_A	TLMCK_A/SD
RCTU	J10	6	22	DPA	A5J6	10	22	Telemetry Return	TLMRTN_A/SD
RCTU	J10	15	22	DPA	A5J6	11	22	Telemetry Enable_A	TLMEN_A/SD
RCTU	J10	16	22	DPA	A5J6	12	22	Telemetry Data_A	TLMDAT_A/SD
7103	P103	49		DPA	A5J6	13	22	Science Header Sync Positive_A	SHSNCP_A
7103	P103	33		DPA	A5J6	14	22	Science Header Sync Negative_A	SHSNCN_A
7103	P103	48		DPA	A5J6	15	22	1.0 Megahertz Clock Positive_A	1MCKP_A
7103	P103	32		DPA	A5J6	16	22	1.0 Megahertz Clock Negative_A	1MCKN_A
RCTU	JO6	21	22	DPA	A5J6	17	22	SW Bilevel Telemetry Bit 0	1STAT0ST
RCTU	JO6	25	22	DPA	A5J6	18	22	SW Bilevel Telemetry Bit 1	1STAT1ST
RCTU	JO6	29	22	DPA	A5J6	19	22	SW Bilevel Telemetry Bit 2	1STAT2ST
RCTU	JO6	33	22	DPA	A5J6	20	22	SW Bilevel Telemetry Bit 3	1STAT3ST
RCTU	J05	24	22	DPA	A5J6	21	22	SW Bilevel Telemetry Bit 4	1STAT4ST
RCTU	J05	28	22	DPA	A5J6	22	22	SW Bilevel Telemetry Bit 5	1STAT5ST
RCTU	J05	32	22	DPA	A5J6	23	22	SW Bilevel Telemetry Bit 6	1STAT6ST
RCTU	J05	36	22	DPA	A5J6	24	22	SW Bilevel Telemetry Bit 7	1STAT7ST
RCTU	J05	2	22	DPA	A5J6	25	22	Bilevel Return	BX RTN

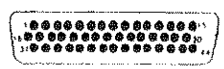


Signal List: SIM (RCTU)/ACIS									
FROM UNIT: RCTU				TO UNIT: DPA					
				MS27656E15F35SA					
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
RCTU	J14	10		DPA	A5J6	26		Support Structure +Y Panel Temp	PA
RCTU	J14	61		DPA	A5J6	27		Support Structure -Y Panel Temp	PA
RCTU	J14	48		DPA	A5J6	28		DEA -Z Panel Temp	PA
RCTU	J14	68		DPA	A5J6	29		RCTU Temp Return	PA
RCTU	J14	25		DPA	A5J6	30		DPA -Z Panel Temp	PA
RCTU	J14	50		DPA	A5J6	31		DPA -Y Panel Temp	PA
					A5J6	32		Program Enable_A	NOT USED FLT CABLE
					A5J6	33		N/C	
					A5J6	34		N/C	
					A5J6	35		N/C	
					A5J6	36		N/C	
					A5J6	37		N/C	

Signal List: SIM (RCTU)/ACIS



FROM UNIT: RCTU				TO UNIT: DPA MS27656E15F35SB					
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
RCTU	J34	35	22	DPA	A5J7	1	22	Software Command Clock _B	SWCMDCK_B
				DPA	A5J7	2	22	Software Command Return	NOT USED FLT CABLE
RCTU	J34	5	22	DPA	A5J7	3	22	Software Command Enable_B	SWCMDEN_B
RCTU	J34	20	22	DPA	A5J7	4	22	Software Command Data_B	SWCMDDAT_B
RCTU	J34	22	22	DPA	A5J7	5	22	Hardware Command Clock_B	HWCMDCK_B
				DPA	A5J7	6	22	Hardware Command Return	NOT USED FLT CABLE
RCTU	J34	37	22	DPA	A5J7	7	22	Hardware Command Enable_B	HWCMDEN_B
RCTU	J34	6	22	DPA	A5J7	8	22	Hardware Command Data_B	HWCMDDAT_B
RCTU	J09	22	22	DPA	A5J7	9	22	Telemetry Clock_B	TLMCK_B
RCTU	J09	4	22	DPA	A5J7	10	22	Telemetry Return	TLMRTN_B/SD
RCTU	J09	13	22	DPA	A5J7	11	22	Telemetry Enable_B	TLMEN_B/SD
RCTU	J09	14	22	DPA	A5J7	12	22	Telemetry Data_B	TLMDAT_B/SD
7103	P203	49		DPA	A5J7	13	22	Science Header Sync Positive_B	SHSNCP_B
7103	P203	33		DPA	A5J7	14	22	Science Header Sync Negative_B	SHSNCN_B
7103	P203	48		DPA	A5J7	15	22	1.0 Megahertz Clock Positive_B	1MCKP_B
7103	P203	32		DPA	A5J7	16	22	1.0 Megahertz Clock Negative_B	1MCKN_B
				DPA	A5J7	17	22	N/C	
				DPA	A5J7	18	22	N/C	
				DPA	A5J7	19	22	N/C	
				DPA	A5J7	20	22	N/C	
				DPA	A5J7	21	22	N/C	
				DPA	A5J7	22	22	N/C	
				DPA	A5J7	23	22	N/C	
				DPA	A5J7	24	22	N/C	

Signal List: SIM (FLCA)/ACIS (DA)									
FROM UNIT: FLCA				TO UNIT: DA					
311P407-3P-B-12				DAMA15PNMB-K52					
									
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
				DA	A2J5	1		N/C	
FLCA	J02	11		DA	A2J5	2		Fiducial Light #1 Anode	
FLCA	J02	9		DA	A2J5	3		Fiducial Light #1 Cathode	
FLCA	J02	13		DA	A2J5	4		Fiducial Light #2 Anode	
FLCA	J02	15		DA	A2J5	5		Fiducial Light #2 Cathode	
FLCA	J02	35		DA	A2J5	6		Fiducial Light #3 Anode	
FLCA	J02	33		DA	A2J5	7		Fiducial Light #3 Cathode	
				DA	A2J5	8		N/C	
FLCA	J02	37		DA	A2J5	9		Fiducial Light #4 Anode	
FLCA	J02	7		DA	A2J5	10		Fiducial Light #4 Cathode	
FLCA	J02	1		DA	A2J5	11		Fiducial Light #5 Anode	
FLCA	J02	31		DA	A2J5	12		Fiducial Light #5 Cathode	
FLCA	J02	5		DA	A2J5	13		Fiducial Light #6 Anode	
FLCA	J02	3		DA	A2J5	14		Fiducial Light #6 Cathode	
				DA	A2J5	15		N/C	

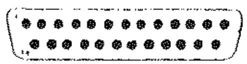
Signal List: ACIS (DA)/BTU

FROM UNIT: DA				TO UNIT: BTU					
311P409-1P-B-12									
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
DA	A2J18	1	20	BTU	7964P02	4	22	ACIS Det Housing Survival Tmp In 1A	RT1-1
DA	A2J18	2	20					N/C	
DA	A2J18	3	20					N/C	
DA	A2J18	4	20					N/C	
DA	A2J18	5	20	BTU	7964P01	5	20	ACIS Det Htr +28V 2A	HR1-1
DA	A2J18	6	20	BTU	7964P02	24	22	ACIS Det Housing Survival Tmp Rtn 1A	RT1-2
DA	A2J18	7	20					N/C	
DA	A2J18	8	20					N/C	
DA	A2J18	9	20	BTU	7964P01	22	20	ACIS Det Htr +28V Rtn 2A	HR1-2

Signal List: ACIS (DA)/BTU									
FROM UNIT: DA				TO UNIT: BTU					
311P409-1P-B-12									
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
DA	A2J19	1	20	BTU	7964P04	4	22	ACIS Det Housing Survival Tmp In 1B	RT2-1
DA	A2J19	2	20					N/C	
DA	A2J19	3	20					N/C	
DA	A2J19	4	20					N/C	
DA	A2J19	5	20	BTU	7964P03	5	20	ACIS Det Htr +28V 2B	HR1-3
DA	A2J19	6	20	BTU	7964P04	24	22	ACIS Det Housing Survival Tmp Rtn 1B	RT2-1
DA	A2J19	7	20					N/C	
DA	A2J19	8	20					N/C	
DA	A2J19	9	20	BTU	7964P03	22	20	ACIS Det Htr +28V Rtn 2B	HR1-4

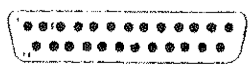
Signal List: Support Structure/BTU

FROM UNIT: Support Structure				TO UNIT: BTU					
311P409-3P-B-12									
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
SS	J2	1	20	BTU	7964P02	5	22	ACIS Support Structure Survival Temp In 1A	RT900
SS	J2	2	20	BTU	7964P02	44	22	ACIS Support Structure Trim Temp In 1A	RT901
SS	J2	3	20	BTU	7964P02	6	22	ACIS Support Structure Survival Temp In 2A	RT904
SS	J2	4	20	BTU	7964P02	45	22	ACIS Support Structure Trim Temp In 2A	RT905
SS	J2	5	20	BTU	7964P02	7	22	ACIS Support Structure Survival Temp In 3A	RT908
SS	J2	6	20	BTU	7964P02	46	22	ACIS Support Structure Trim Temp In 3A	RT909
SS	J2	7	20					N/C	
SS	J2	8	20					N/C	
SS	J2	9	20					N/C	
SS	J2	10	20					N/C	
SS	J2	11	20	BTU	7964P01	38	20	ACIS Support Structure Htr +28V 3A	HR902 (A)
SS	J2	12	20	BTU	7964P01	36	20	ACIS Support Structure Htr +28V 2A	HR901 (A)
SS	J2	13	20	BTU	7964P01	34	20	ACIS Support Structure Htr +28V 1A	HR900 (A)
SS	J2	14	20	BTU	7964P02	25	22	ACIS Support Structure Survival Temp Rtn 1A	RT900 RTN
SS	J2	15	20	BTU	7964P02	64	22	ACIS Support Structure Trim Temp Rtn 1A	RT901 RTN
SS	J2	16	20	BTU	7964P02	26	22	ACIS Support Structure Survival Temp Rtn 2A	RT904 RTN
SS	J2	17	20	BTU	7964P02	65	22	ACIS Support Structure Trim Temp Rtn 2A	RT905 RTN
SS	J2	18	20	BTU	7964P02	27	22	ACIS Support Structure Survival Temp Rtn 3A	RT908 RTN
SS	J2	19	20	BTU	7964P02	66	22	ACIS Support Structure Trim Temp Rtn 3A	RT909 RTN
SS	J2	20	20					N/C	
SS	J2	21	20					N/C	
SS	J2	22	20					N/C	
SS	J2	23	20	BTU	7964P01	39	20	ACIS Support Structure Htr +28V Rtn 3A	HR902 (A) RTN
SS	J2	24	20	BTU	7964P01	37	20	ACIS Support Structure Htr +28V Rtn 2A	HR901 (A) RTN
SS	J2	25	20	BTU	7964P01	35	20	ACIS Support Structure Htr +28V Rtn 1A	HR900 (A) RTN



Signal List: Support Structure/BTU

FROM UNIT: Support Structure				TO UNIT: BTU					
311P409-3P-B-12									
REF	CONNECTOR	PIN	PIN SIZE	REF	CONNECTOR	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
SS	J3	1	20	BTU	7964P04	5	22	ACIS Support Structure Survival Temp In 1B	RT902
SS	J3	2	20	BTU	7964P04	44	22	ACIS Support Structure Trim Temp In 1B	RT903
SS	J3	3	20	BTU	7964P04	6	22	ACIS Support Structure Survival Temp In 2B	RT906
SS	J3	4	20	BTU	7964P04	45	22	ACIS Support Structure Trim Temp In 2B	RT907
SS	J3	5	20	BTU	7964P04	7	22	ACIS Support Structure Survival Temp In 3B	RT910
SS	J3	6	20	BTU	7964P04	46	22	ACIS Support Structure Trim Temp In 3B	RT911
SS	J3	7	20					N/C	
SS	J3	8	20					N/C	
SS	J3	9	20					N/C	
SS	J3	10	20					N/C	
SS	J3	11	20	BTU	7964P03	38	20	ACIS Support Structure Htr +28V 3B	HR902 (B)
SS	J3	12	20	BTU	7964P03	36	20	ACIS Support Structure Htr +28V 2B	HR901 (B)
SS	J3	13	20	BTU	7964P03	34	20	ACIS Support Structure Htr +28V 1B	HR900 (B)
SS	J3	14	20	BTU	7964P04	25	22	ACIS Support Structure Survival Temp Rtn 1B	RT902 RTN
SS	J3	15	20	BTU	7964P04	64	22	ACIS Support Structure Trim Temp Rtn 1B	RT903 RTN
SS	J3	16	20	BTU	7964P04	26	22	ACIS Support Structure Survival Temp Rtn 2B	RT906 RTN
SS	J3	17	20	BTU	7964P04	65	22	ACIS Support Structure Trim Temp Rtn 2B	RT907 RTN
SS	J3	18	20	BTU	7964P04	27	22	ACIS Support Structure Survival Temp Rtn 3B	RT910 RTN
SS	J3	19	20	BTU	7964P04	66	22	ACIS Support Structure Trim Temp Rtn 3B	RT911 RTN
SS	J3	20	20					N/C	
SS	J3	21	20					N/C	
SS	J3	22	20					N/C	
SS	J3	23	20	BTU	7964P03	39	20	ACIS Support Structure Htr +28V Rtn 3B	HR902 (B) RTN
SS	J3	24	20	BTU	7964P03	37	20	ACIS Support Structure Htr +28V Rtn 2B	HR901 (B) RTN
SS	J3	25	20	BTU	7964P03	35	20	ACIS Support Structure Htr +28V Rtn 1B	HR900 (B) RTN



Signal List: ACIS Ground Lug Connections									
FROM UNIT: ACIS				TO UNIT: RCTU					
REF	LUG	PIN	PIN SIZE	REF	LUG	PIN	PIN SIZE	CIRCUIT NAME	SIGNAL TYPE
PSMC	A1E1			RCTU	E1			ISIM Ground A	
PSMC	A1E2			RCTU	E2			ISIM Ground B	
DA	A2E2							N/C	
DA	A2E3							N/C	
DEA	A4E1							N/C	
DEA	A4E2							N/C	
DPA	A5E1			RCTU	E9			ISIM Ground A	
DPA	A5E2			RCTU	E10			ISIM Ground B	

(This page intentionally left blank)

APPENDIX D: OBSERVATORY TO HRC ELECTRICAL INTERFACES

(This page intentionally left blank)

APPENDIX D
OBSERVATORY TO HRC ELECTRICAL INTERFACES

1.0 CONNECTOR TYPES

Connector types are as follows:

Reference Designator	Connector Type	Part Number
CEA J166, J167 (2)	Rectangular D.Miniature, 15-pin	M24308/8-336
CEA J168, J169 (2)	Rectangular D.Miniature, 78-pin	M24308/8-349
Detector fiducial lights: DHJ143, DHJ144 (4)	Hermetic Feed-through MIL-C-83513 compliant 15- socket	PCT (5) P/N: 92739-15
Instrument survival/trim heaters: CEA J172, J173 (2)	Rectangular D.Miniature 25-pin	M24308/8-337

Notes:

1. Connector types shown are on the HRC side of the interface.
2. J166, J167, J168, J169, J172 and J173 are male on the HRC side of the interface.
3. Fiducial light connectors are female on the HRC side of the interface. (The feed-through vacuum connectors are only available in female.)
4. PCT = Pacific Coast Technologies

2.0 OBSERVATORY/HRC ELECTRICAL INTERFACES

Electrical signals are specified in the following interface signal lists. Interface signal categories and quantities are as follows:

Signal Category / Code	Quantity
Primary Power	2
Heater Power	2
Command channels:	
High level pulse (HLP)	36
Serial digital (SD)	1
Telemetry channels:	
Active analog (AA)	24
Passive analog (PA)	10
Bilevel (BL)	24
Serial digital (SD)	1
Timing signals:	
Major frame sync (RCTU)	1
Science header sync (RCTU)	1
Science header sync (IU)	1
1.024 Mhz clock (IU)	1
Fiducial light signals	8

3.0 HRC RADIATION DETECTOR COMMANDS

When the OBC recognizes the transition from the "normal" (low integrated background rate) state to the "abnormal" (high background) state, the commands listed below will be sent to the HRC to disable the high voltage in the HRC. HRC will be reset from the ground when the low threshold is reached after a high radiation event. (Later in the mission, the ASC HRC ground team may elect to automatically restore part or total capability after the thresholds have dropped back down to acceptable levels, but the condition at launch will be that this is performed by ground commanding.)

Threshold levels are to be specified so that when the background radiation level exceeds a commandable threshold over a commandable time period, the OBC shall send a command sequence via the ISIM RCTU to the HRC Serial command Port.

For HRC, the high radiation trigger will use the INT channel from EPHIN and will have a value of 570 counts per 65.6 second integration period. When the EPHIN Geometric Factor is set to "small", a Scale Factor of 19 will be applied to the data. The data from EPHIN (in counts/period) will not be averaged by the OBC (Averaging Parameter is 1). When the EPHIN INT data value exceeds the 570 threshold value for 3 consecutive periods, the high radiation flag will be set and the commands listed below sent to HRC. The software implementation is such that these commands will be sent each 65.6 second period that the criterion is met.

The command sequence is as follows:

Mnemonic (Variable = value)	SDD Code	Remarks
2SPHVOF	0100 hex	HRC-S HVPS OFF
2IMHVOF	0900 hex	HRC-I HVPS OFF
2S1HVOF	0500 hex	Shield PMT#1 HVPS OFF
2S2HVOF	0d00 hex	Shield PMT#2 HVPS OFF
2SPTTHV (2SPTTHV2=0)	0200 hex	Set HRC-S to Top MCP HV Step to 0
2SPTBHV (2SPTBHV2=0)	0300 hex	Set HRC-S to Bottom MCP HV Step to 0
2IMTTHV (2IMTTHV2 = 0)	0a00 hex	Set HRC-I to Top MCP HV Step to 0
2IMTBHV (2IMTBHV2 = 0)	0b00 hex	Set HRC-I to Bottom MCP HV Step to 0
2S1STHV (2S1STHV2=0)	0600 hex	Shield PMT#1 HV Step to 0
2S2STHV (2S2STHV2=0)	0e00 hex	Shield PMT#2 HV Step to 0
CODISASX (CODISASI=92)		Disable SCS#92/HRC-I MCP HV ON
CODISASX (CODISASI=93)		Disable SCS#93/HRC-I MCP HV ON

There should be a one second delay between the execution of commands on this list except for the last two, which have a shorter delay.

IRN 063 (PIRN 20-0068B) ENTIRE PAGE

Clarification change to IRN 063 Per MSFC

Signal List: HRC / OBA-ISIM IFB

	FROM UNIT:			TO UNIT:				
	7103 REF DESIG	CONNECTOR	PIN	7943 REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	SIGNAL CODE
1	7103	P101	10	CEA	J166	13	+28V Prime Power 1 "A"	PPH1AHRC A001
2	7103	P101	11	¦	¦	12	+28V Prime Power 2 "A"	PPH1AHRC A002
3	7103	P101	27	¦	¦	5	Prime Power Return 1 "A"	PPL1AHRC A001
4	7103	P101	28	¦	¦	4	Prime Power Return 2 "A"	PPL1AHRC A002
5	7103	TBD		¦	¦	15	HRC Secondary Ground 1 "A"	
6	7103	TBD		¦	¦	14	HRC Secondary Ground 2 "A"	
7	7103	P103	13	¦	¦	1	IU 1.024 MHz Clock High "A"	SCAA+IU1 A
8	7103	P103	29	¦	¦	2	IU 1.024 MHz Clock Low "A"	SHAA+IU1 A
9	7103	P103	14	¦	¦	7	IU Science Header Pulse High "A"	SCAA+IU1 A
10	7103	P103	30	¦	¦	8	IU Science Header Pulse Low "A"	SHAA+IU1 A
11				¦	¦	6	Spare Pin	
12				¦	¦	3	¦	
13				¦	¦	9	¦	
14				¦	¦	10	¦	
15				CEA	J166	11	Spare Pin	
16								
17								
18								
19								
20								

Signal List: HRC / OBA-ISIM IFB

	FROM UNIT:			TO UNIT:				
	7103 REF DESIG	CONNECTOR	PIN	REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	SIGNAL CODE
1	7103	P201	10	CEA	J167	13	+28V Prime Power 1 "B"	PRH1BHRC A001
2	7103	P201	11	¦	¦	12	+28V Prime Power 2 "B"	PRH1BHRC A002
3	7103	P201	27	¦	¦	5	Prime Power Return 1 "B"	PRL1BHRC A001
4	7103	P201	28	¦	¦	4	Prime Power Return 2 "B"	PRL1BHRC A002
5	7103	TBD		¦	¦	15	HRC Secondary Ground 1 "B"	
6	7103	TBD		¦	¦	14	HRC Secondary Ground 2 "B"	
7	7103	P203	13	¦	¦	1	IU 1.024 MHz Clock High "B"	SCAB+IU1 A
8	7103	P203	29	¦	¦	2	IU 1.024 MHz Clock Low "B"	SCAB-IU1 A
9	7103	P203	14	¦	¦	7	IU Science Header Pulse High "B"	SHAB+IU1 A
10	7103	P203	30	¦	¦	8	IU Science Header Pulse Low "B"	SHAB-IU1 A
11				¦	¦	6	Spare Pin	
12				¦	¦	3	¦	
13				¦	¦	9	¦	
14				¦	¦	10	¦	
15				CEA	J167	11	Spare Pin	
16								
17								
18								
19								
20								

Signal List: HRC / FLCA

	FROM UNIT:			TO UNIT:				
	7209 REF DESIG	CONNECTOR	PIN	7941 REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	SIGNAL CODE
1	FLCA	P03	7	DET	DH143	1	Fiducial Light HRC-I-1 Anode	HRC7HI_A
2	¦	¦	5	¦	¦	9	Fiducial Light HRC-I-1 Cathode	HRC7LO_A
3	¦	¦	15	¦	¦	3	Fiducial Light HRC-I-2 Anode	HRC8HI_A
4	¦	¦	44	¦	¦	11	Fiducial Light HRC-I-2 Cathode	HRC8LO_A
5	¦	¦	13	¦	¦	5	Fiducial Light HRC-I-3 Anode	HRC9HI_A
6	¦	¦	42	¦	¦	13	Fiducial Light HRC-I-3 Cathode	HRC9LO_A
7	¦	¦	40	¦	¦	7	Fiducial Light HRC-I-4 Anode	HRC10HI_A
8	¦	¦	38	¦	DH143	15	Fiducial Light HRC-I-4 Cathode	HRC10LO_A
9	¦	¦	36	¦	DH144	1	Fiducial Light HRC-S-1 Anode	HRC11HI_A
10	¦	¦	34	¦	¦	9	Fiducial Light HRC-S-1 Cathode	HRC11LO_A
11	¦	¦	1	¦	¦	3	Fiducial Light HRC-S-2 Anode	HRC13HI_A
12	¦	¦	31	¦	¦	11	Fiducial Light HRC-S-2 Cathode	HRC13LO_A
13	¦	¦	3	¦	¦	5	Fiducial Light HRC-S-3 Anode	HRC12HI_A
14	¦	¦	32	¦	¦	13	Fiducial Light HRC-S-3 Cathode	HRC12LO_A
15	¦	¦	11	¦	¦	7	Fiducial Light HRC-S-4 Anode	HRC14HI_A
16	FLCA	P03	9	DET	DH144	15	Fiducial Light HRC-S-4 Cathode	HRC14LO_A
17								
18								
19								
20								

Signal List: HRC / RCTU

	FROM UNIT:			TO UNIT:				
	7501 REF DESIG	CONNECTOR	PIN	7943 REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	RCTU SIGNAL CODE
1	RCTU	P33	17	CEA	J168	4	Serial Command Clock "A"	C0A
2	¦	¦	1	¦	¦	23	Serial Command Data "A"	D0A
3	¦	¦	32	¦	¦	41	Serial Command Enable "A"	E0A
4	¦	P33	2	¦	¦	61	Serial Command Return "A"	GND0A
5	¦	P10	26	¦	¦	2	Serial TLM Clock "A"	C3A
6	¦	¦	18	¦	¦	21	Serial TLM Data "A"	D3A
7	¦	¦	17	¦	¦	60	Serial TLM Enable "A"	E3A
8	¦	P10	8	¦	¦	40	Serial TLM Return "A"	GND3A
9	¦	P06	36	¦	¦	59	Bus Select, CEA A LVPS	BILEVEL D16-4
10	¦	¦	32	¦	¦	58	Bus Select, Imaging HVPS	¦ D16-3
11	¦	¦	28	¦	¦	57	Bus Select, Shield A HVPS	¦ D16-2
12	¦	P06	24	¦	¦	56	Detector Select Preamp "A"	¦ D16-1
13	¦	P05	27	¦	¦	55	Shield PMT Select, Preamp "A"	¦ D16-5
14	¦	¦	31	¦	¦	54	+5V LVPS A On/Off	¦ D16-6
15	¦	¦	35	¦	¦	78	Door Open	¦ D16-7
16	¦	P05	39	¦	¦	77	Door Closed	¦ D16-8
17	¦	P06	76	¦	¦	76	+Y Shutter Home	¦ D15-4
18	¦	P06	72	¦	¦	75	+Y Shutter Max	¦ D15-3
19	¦	P05	4	¦	¦	73	Bilevel TLM Return "1A"	¦ D16-RTN
20	¦	¦	23	¦	¦	53	Bilevel TLM Return "2A"	¦ D15-RTN
21	¦	¦	65	¦	¦	7	Failsafe Master Relay ON/OFF	¦ D15-5
22	RCTU	P05	69	CEA	J168	26	Failsafe Cal Src Relay ON/OFF	BILEVEL D15-6

Signal List: HRC / RCTU

	FROM UNIT:			TO UNIT:				
	7501 REF DESIG	CONNECTOR	PIN	7943 REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	SIGNAL CODE
1	RCTU	P18	46	CEA	J168	52	Primary Bus Voltage "A"	AA A48
2	|	|	8	|	|	71	Primary Bus Current "A"	| A49
3	|	|	45	|	|	51	Secondary +5 Bus Voltage "A"	| A50
4	|	|	7	|	|	70	Secondary +15 Bus Voltage "A"	| A51
5	|	|	44	|	|	50	Secondary -15 Bus Voltage "A"	| A52
6	|	|	6	|	|	69	Secondary +24 Bus Voltage "A"	| A53
7	|	|	43	|	|	49	Detector Event Rate "A"	| A54
8	|	|	5	|	|	68	Shield Rate "A"	| A55
9	|	|	NC	|	|	48	SPARE Active Analog	| ---
10	|	|	NC	|	|	67	SPARE Active Analog	| ---
11	|	|	NC	|	|	47	SPARE Active Analog	| ---
12	|	|	NC	|	|	66	SPARE Active Analog	| ---
13	|	P18	21	|	|	46	Active Analog Return "A"	| AR6
14	|	—	NC	|	|	65	SPARE Active Analog TLM Return	AA ---
15	|	P14	45	|	|	10	PMT 1 Temperature	PA PA0
16	|	|	9	|	|	29	PMT 2 Temperature	| PA5
17	|	|	46	|	|	9	Detector Housing Temperature 1	| PA2
18	|	|	8	|	|	28	Detector Housing Temperature 2	| PA3
19	|	|	47	|	|	8	FE Box Temperature	| PA4
20	RCTU	P14	28	CEA	J168	27	Passive Analog Return "A"	PA PA5RTN
21								
22								

IRN 062 (PIRN 20-0064A)

Signal List: HRC / RCTU

	FROM UNIT:			TO UNIT:					
	7501 REF DESIG	CONNECTOR	PIN	7943 REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	SIGNAL CODE	
1	RCTU	P31	41	CEA	J168	20	Bus A Select, CEA A LVPS	HLP	HC50
2	¦	¦	61	¦	¦	39	Bus B Select, CEA A LVPS	¦	HC51
3	¦	¦	42	¦	¦	19	Bus A Select, Imaging HVPS	¦	HC52
4	¦	¦	45	¦	¦	38	Bus B Select, Imaging HVPS	¦	HC54
5	¦	¦	5	¦	¦	18	Bus A Select, Shield HVPS "A"	¦	HC55
6	¦	¦	63	¦	¦	37	Bus B Select, Shield HVPS "A"	¦	HC56
7	¦	¦	23	¦	¦	17	Spectr Detector Select, Preamp A	¦	HC57
8	¦	¦	62	¦	¦	36	Imaging Detector Select, Preamp A	¦	HC58
9	¦	¦	22	¦	¦	16	Shield PMT A Select, Preamp A	¦	HC59
10	¦	¦	43	¦	¦	35	Shield PMT B Select, Preamp A	¦	HC61
11	¦	¦	4	¦	¦	15	+5V Power Supply A On	¦	HC62
12	¦	¦	44	¦	¦	34	+5V Power Supply A Off	¦	HC63
13	¦	¦	—	¦	¦	74	HLP Spare	¦	--
14	¦	¦	—	¦	¦	72	HLP Spare	¦	--
15	¦	¦	25	¦	¦	32	Failsafe Master Relay Enable	¦	HC34
16	¦	¦	46	¦	¦	12	Failsafe Master Relay Disable	¦	HC36
17	¦	¦	6	¦	¦	31	Failsafe Cal Src Enable	¦	HC37
18	¦	¦	67	¦	¦	11	Failsafe Cal Src Disable	¦	HC40
19	¦	¦	59	¦	¦	14	HLP Return 1A	¦	HRTN
20	RCTU	P31	58	CEA	J168	33	HLP Return 2A	HLP	HRTN
21									
22									

Signal List: HRC / RCTU

	FROM UNIT:			TO UNIT:				
	7501 REF DESIG	CONNECTOR	PIN	7943 REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	SIGNAL CODE
1	RCTU		—	CEA	J168	13	Spare HLP Return	—
2	¦	P20	30	¦	¦	44	RCTU Major Frame Sync "A"	MJFR_2A
3	¦	P20	25	¦	¦	25	RCTU Science Header Sync "A"	SH_1A
4	RCTU	P20	12	¦	¦	64	RCTU Sync Return	SYNC_RTN
5				¦	¦	30	Spare Pin	
6				¦	¦	45	Spare Pin	
7				¦	¦	—		
8				¦	¦	—		
9				¦	¦	6	Spare Pin	
10				¦	¦	5	¦	
11				¦	¦	24	¦	
12				¦	¦	3	¦	
13				¦	¦	22	¦	
14				¦	¦	1	¦	
15				¦	¦	63	¦	
16				¦	¦	62	¦	
17				¦	¦	42	¦	
18				CEA	J168	43	Spare Pin	
19								
20								
21								
22								

Signal List: HRC / RCTU

FROM UNIT:			TO UNIT:				
7501 REF DESIG	CONNECTOR	PIN	7944 REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	RCTU SIGNAL CODE
RCTU	P34	17	CEA	J169	4	Serial Command Clock "B"	C0B
¦	¦	1	¦	¦	23	Serial Command Data "B"	D0B
¦	¦	32	¦	¦	41	Serial Command Enable "B"	E0B
¦	P34	2	¦	¦	61	Serial Command Return "B"	GND0B
¦	P09	20	¦	¦	2	Serial TLM Clock "B"	C3B
¦	¦	12	¦	¦	21	Serial TLM Data "B"	D3B
¦	¦	11	¦	¦	60	Serial TLM Enable "B"	E3B
¦	P09	2	¦	¦	40	Serial TLM Return "B"	GND3B
¦	P08	36	¦	¦	59	Bus Select, CEA B LVPS	BILEVEL D32-4
¦	¦	32	¦	¦	58	Bus Select, Spectroscopy HVPS	¦ D32-3
¦	¦	28	¦	¦	57	Bus Select, Shield B HVPS	¦ D32-2
¦	P08	24	¦	¦	56	Detector Select Preamp "B"	¦ D32-1
¦	P07	27	¦	¦	55	Shield PMT Select, Preamp "B"	¦ D32-5
¦	¦	31	¦	¦	54	+5V LVPS B On/Off	¦ D32-6
¦	¦	35	¦	¦	78	-Y Shutter Home	¦ D32-7
¦	P07	39	¦	¦	77	-Y Shutter Max	¦ D32-8
¦	P08	76	¦	¦	76	CAL Home	¦ D31-4
¦	P08	72	¦	¦	75	CAL Max	¦ D31-3
¦	P07	4	¦	¦	73	Bilevel TLM Return "1B"	¦ D32RTN
¦	¦	23	¦	¦	53	Bilevel TLM Return "2B"	BILEVEL D31RTN
¦	¦	65	¦	¦	7	Failsafe +Y Shutter ON/OFF	¦ D31-5
RCTU	P07	69	CEA	J169	26	Failsafe -Y Shutter ON/OFF	¦ D31-6

Signal List: HRC / RCTU

	FROM UNIT:			TO UNIT:					
	7501 REF DESIG	CONNECTOR	PIN	7944 REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	SIGNAL CODE	
1	RCTU	P17	44	CEA	J169	52	Primary Bus Voltage "B"	AA	A112
2	¦	¦	4	¦	¦	71	Primary Bus Current "B"	¦	A113
3	¦	¦	43	¦	¦	51	Secondary +5 Bus Voltage "B"	¦	A114
4	¦	¦	3	¦	¦	70	Secondary +15 Bus Voltage "B"	¦	A115
5	¦	¦	42	¦	¦	50	Secondary -15 Bus Voltage "B"	¦	A116
6	¦	¦	2	¦	¦	69	Secondary +24 Bus Voltage "B"	¦	A117
7	¦	¦	41	¦	¦	49	Detector Event Rate "B"	¦	A118
8	¦	¦	1	¦	¦	68	Shield Rate "B"	¦	A119
9	¦	¦	NC	¦	¦	48	SPARE Active Analog	¦	---
10	¦	¦	NC	¦	¦	67	SPARE Active Analog	¦	---
11	¦	¦	NC	¦	¦	47	SPARE Active Analog	¦	---
12	¦	¦	NC	¦	¦	66	SPARE Active Analog	¦	---
13	¦	P17	37	¦	¦	46	Active Analog Return "B"	¦	AR14
14	¦	—	NC	¦	¦	65	SPARE Active Analog TLM Return	AA	---
15	¦	P16	9	¦	¦	10	CE Box Temperature	PA	PA69
16	¦	¦	48	¦	¦	29	UV Lightshld Temperature, Top-next to snout	¦	PA70
17	¦	¦	47	¦	¦	9	Conduit -X Face Temperature	¦	PA68
18	¦	¦	8	¦	¦	28	FEA Radiator Temperature at Approx. Center	¦	PA67
19	¦	¦	46	¦	¦	8	CEA Radiator Temperature at Approx. Center	¦	PA66
20	RCTU	P16	28	CEA	J169	27	Passive Analog Return "B"	PA	PA69RTN
21									
22									

IRN 062
(PIRN
20-0064A)

Signal List: HRC / RCTU

	FROM UNIT:			TO UNIT:					
	7501 REF DESIG	CONNECTOR	PIN	7944 REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	SIGNAL CODE	
1	RCTU	P32	77	CEA	J169	20	Bus A Select, CEA B LVPS	HLP	HC116
2	¦	¦	38	¦	¦	39	Bus B Select, CEA B LVPS	¦	HC117
3	¦	¦	74	¦	¦	19	Bus A Select, Spectroscopy HVPS	¦	HC118
4	¦	¦	35	¦	¦	38	Bus B Select, Spectroscopy HVPS	¦	HC119
5	¦	¦	56	¦	¦	18	Bus A Select, Shield HVPS "B"	¦	HC120
6	¦	¦	17	¦	¦	37	Bus B Select, Shield HVPS "B"	¦	HC121
7	¦	¦	57	¦	¦	17	Spectr Detector Select, Preamp B	¦	HC122
8	¦	¦	18	¦	¦	36	Imaging Detector Select, Preamp B	¦	HC123
9	¦	¦	37	¦	¦	16	Shield PMT A Select, Preamp B	¦	HC124
10	¦	¦	76	¦	¦	35	Shield PMT B Select, Preamp B	¦	HC125
11	¦	¦	36	¦	¦	15	+5V Power Supply B On	¦	HC126
12	¦	¦	75	¦	¦	34	+5V Power Supply B Off	¦	HC127
13	¦	¦	—	¦	¦	74	HLP Spare	¦	—
14	¦	¦	—	¦	¦	72	HLP Spare	¦	—
15	¦	¦	34	¦	¦	32	Failsafe +Y Shutter Enable	¦	HC101
16	¦	¦	30	¦	¦	12	Failsafe +Y Shutter Disable	¦	HC102
17	¦	¦	13	¦	¦	31	Failsafe -Y Shutter Enable	¦	HC105
18	¦	¦	53	¦	¦	11	Failsafe -Y Shutter Disable	¦	HC106
19	¦	¦	2	¦	¦	14	HLP Return 1B	¦	HRTN
20	RCTU	P32	20	CEA	J169	33	HLP Return 2B	HLP	HRTN
21									
22									

Signal List: HRC / RCTU

	FROM UNIT:			TO UNIT:				
	7501 REF DESIG	CONNECTOR	PIN	7944 REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	SIGNAL CODE
1	RCTU		—	CEA	J169	13	Spare HLP Return	—
2	¦	P19	30	¦	¦	44	RCTU Major Frame Sync "B"	MJFR_2B
3	¦	P19	25	¦	¦	25	RCTU Science Header Sync "B"	SH_1B
4	RCTU	P19	12	¦	¦	64	RCTU Sync Return	SYNC_RTN
5				¦	¦	30	Spare Pin	
6				¦	¦	45	Spare Pin	
7				¦	¦	—		
8				¦	¦	—		
9				¦	¦	6	Spare Pin	
10				¦	¦	5	¦	
11				¦	¦	24	¦	
12				¦	¦	3	¦	
13				¦	¦	22	¦	
14				¦	¦	1	¦	
15				¦	¦	63	¦	
16				¦	¦	62	¦	
17				¦	¦	42	¦	
18				CEA	J169	43	Spare Pin	
19								
20								
21								
22								

Signal List: HRC SURVIVAL HEATERS

	FROM UNIT:				TO UNIT:					
	NOTE	REF DESIG	CONNECTOR	PIN	NOTE	7943 REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	SIGNAL CODE
1		7964	J01	4	(1)	CEA	J172	1	HRC Heater +28 5A	
2		7964	J01	21		CEA	J172	2	HRC Heater +28 Return 5A	
3		---	---	NC		CEA	J172	3	NC	
4		---	---	NC		CEA	J172	4	NC	
5		---	---	NC		CEA	J172	5	NC	
6		---	---	NC		CEA	J172	6	NC	
7		---	---	NC		CEA	J172	7	NC	
8		---	---	NC		CEA	J172	8	Test Point, Detector Survival Heaters A, T-Stat 1	
9		---	---	NC		CEA	J172	9	Test Point, Detector Survival+J47 Heaters A, T-Stat 2	
10		---	---	NC		CEA	J172	10	Test Point, Detector Survival Heaters A, T-Stat 1	
11		---	---	NC		CEA	J172	11	Test Point, Detector Survival Heaters A, T-Stat 2	
12		---	---	NC		CEA	J172	12	NC	
13		---	---	NC		CEA	J172	13	NC	
14		---	---	NC		CEA	J172	14	NC	
15		---	---	NC		CEA	J172	15	NC	
16		---	---	NC		CEA	J172	16	NC	
17		---	---	NC		CEA	J172	17	NC	
18		---	---	NC		CEA	J172	18	NC	
19		---	---	NC		CEA	J172	19	NC	
20		---	---	NC		CEA	J172	20	NC	
21		---	---	NC		CEA	J172	21	NC	
22		---	---	NC		CEA	J172	22	Test Point, FEA Survival Heater A, T-Stat 1	
23		---	---	NC		CEA	J172	23	Test Point, FEA Survival Heater A, T-Stat 2	
24		---	---	NC		CEA	J172	24	Test Point, CEA Survival Heater A, T-Stat 1	
25		---	---	NC		CEA	J172	25	Test Point, CEA Survival Heater A, T-Stat 2	

Notes: (1) Nominal maximum load 40 watts at 22 volts

Signal List: HRC SURVIVAL HEATERS

	FROM UNIT:				TO UNIT:					
	NOTE	REF DESIG	CONNECTOR	PIN	NOTE	7943 REF DESIG	CONNECTOR	PIN	CIRCUIT NAME	SIGNAL CODE
1		7964	J03	4	(1)	CEA	J173	1	HRC Heater +28 5B	
2		7964	J03	21		CEA	J173	2	HRC Heater +28 Return 5B	
3		---	---	NC		CEA	J173	3	NC	
4		---	---	NC		CEA	J173	4	NC	
5		---	---	NC		CEA	J173	5	NC	
6		---	---	NC		CEA	J173	6	NC	
7		---	---	NC		CEA	J173	7	NC	
8		---	---	NC		CEA	J173	8	Test Point, Detector Survival Heaters B, T-Stat 1	
9		---	---	NC		CEA	J173	9	Test Point, Detector Survival Heaters B, T-Stat 2	
10		---	---	NC		CEA	J173	10	Test Point, Detector Survival Heaters B, T-Stat 1	
11		---	---	NC		CEA	J173	11	Test Point, Detector Survival HeaterS B, T-Stat 2	
12		---	---	NC		CEA	J173	12	NC	
13		---	---	NC		CEA	J173	13	NC	
14		---	---	NC		CEA	J173	14	NC	
15		---	---	NC		CEA	J173	15	NC	
16		---	---	NC		CEA	J173	16	NC	
17		---	---	NC		CEA	J173	17	NC	
18		---	---	NC		CEA	J173	18	NC	
19		---	---	NC		CEA	J173	19	NC	
20		---	---	NC		CEA	J173	20	NC	
21		---	---	NC		CEA	J173	21	NC	
22		---	---	NC		CEA	J173	22	Test Point, FEA Survival Heater B, T-Stat 1	
23		---	---	NC		CEA	J173	23	Test Point, FEA Survival Heater B, T-Stat 2	
24		---	---	NC		CEA	J173	24	Test Point, CEA Survival Heater B, T-Stat 1	
25		---	---	NC		CEA	J173	25	Test Point, CEA Survival Heater B, T-Stat 2	

NOTES:(1) Nominal maximum load 40 watts at 22 volts

APPENDIX E: (RESERVED)

(This page intentionally left blank)

APPENDIX F: (RESERVED)

(This page intentionally left blank)

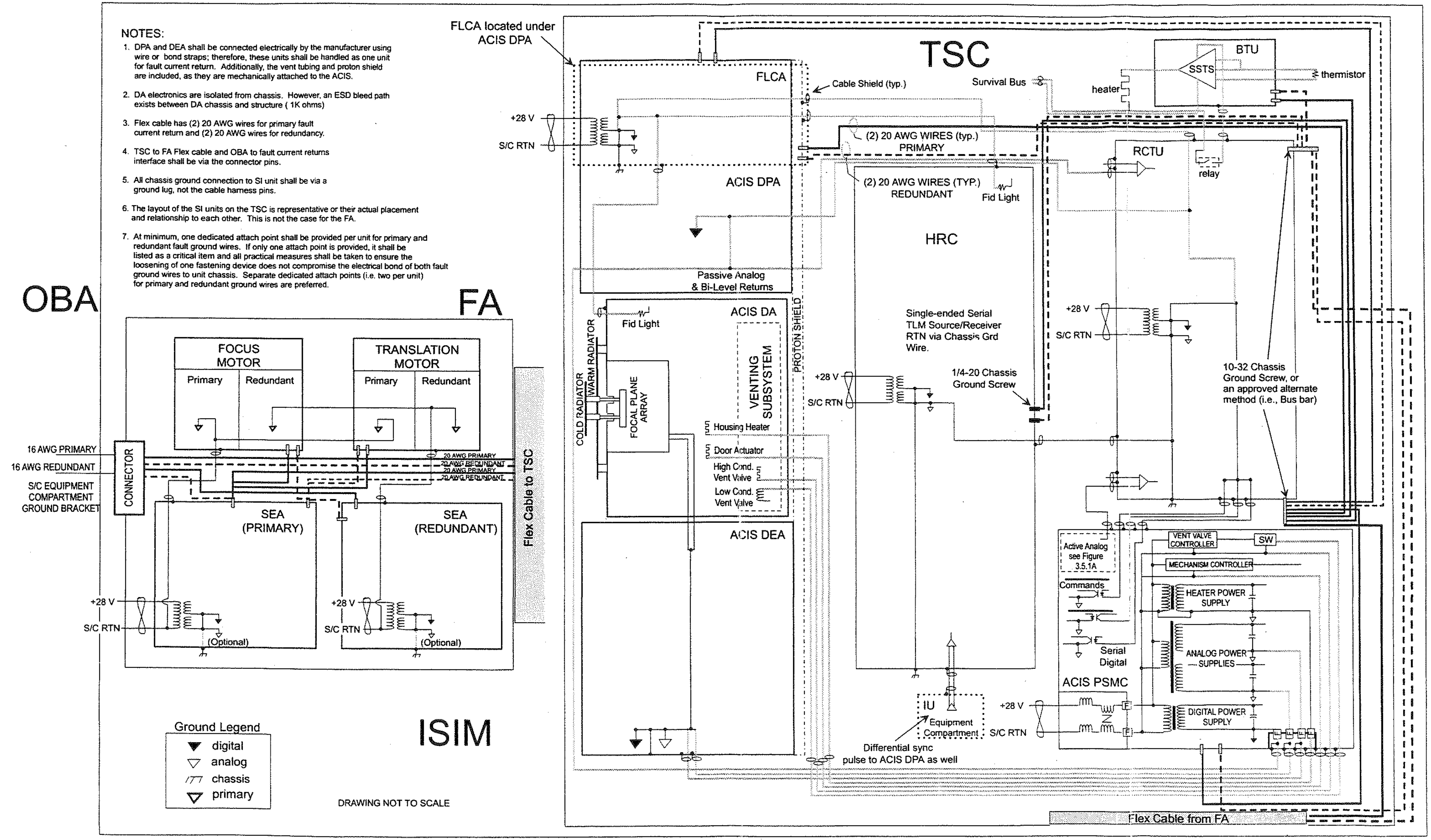
APPENDIX G: INTERFACE CONTROL DRAWINGS

(This page intentionally left blank)

09 April 1997

NOTES:

1. DPA and DEA shall be connected electrically by the manufacturer using wire or bond straps; therefore, these units shall be handled as one unit for fault current return. Additionally, the vent tubing and proton shield are included, as they are mechanically attached to the ACIS.
2. DA electronics are isolated from chassis. However, an ESD bleed path exists between DA chassis and structure (1K ohms)
3. Flex cable has (2) 20 AWG wires for primary fault current return and (2) 20 AWG wires for redundancy.
4. TSC to FA Flex cable and OBA to fault current returns interface shall be via the connector pins.
5. All chassis ground connection to SI unit shall be via a ground lug, not the cable harness pins.
6. The layout of the SI units on the TSC is representative or their actual placement and relationship to each other. This is not the case for the FA.
7. At minimum, one dedicated attach point shall be provided per unit for primary and redundant fault ground wires. If only one attach point is provided, it shall be listed as a critical item and all practical measures shall be taken to ensure the loosening of one fastening device does not compromise the electrical bond of both fault ground wires to unit chassis. Separate dedicated attach points (i.e. two per unit) for primary and redundant ground wires are preferred.



IRN 043 (PIRN 20-0050A) ENTIRE PAGE

Figure 3.5-1 ISIM Grounding Detail

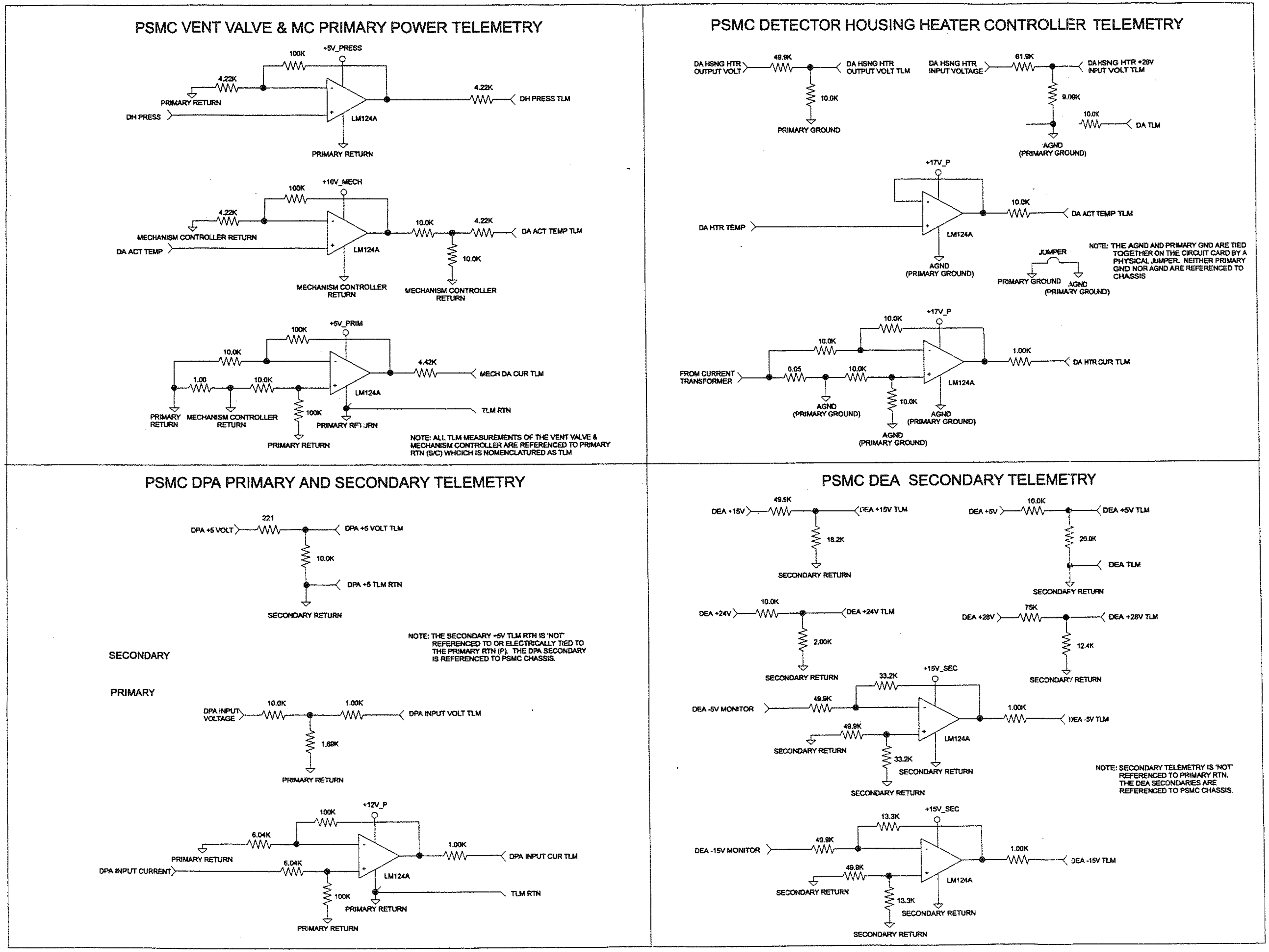


Figure 3.5-1A: ACIS Active Analog Circuits

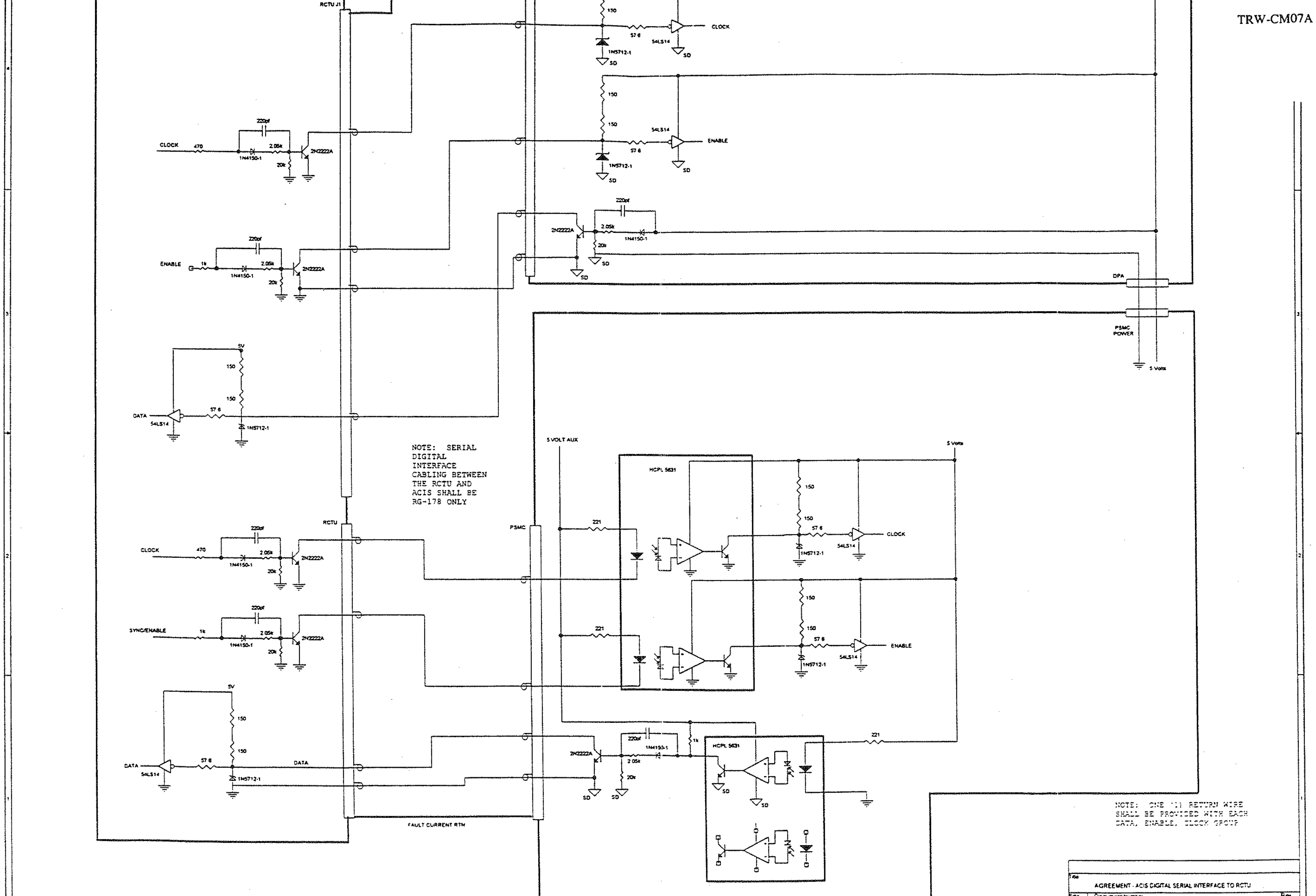
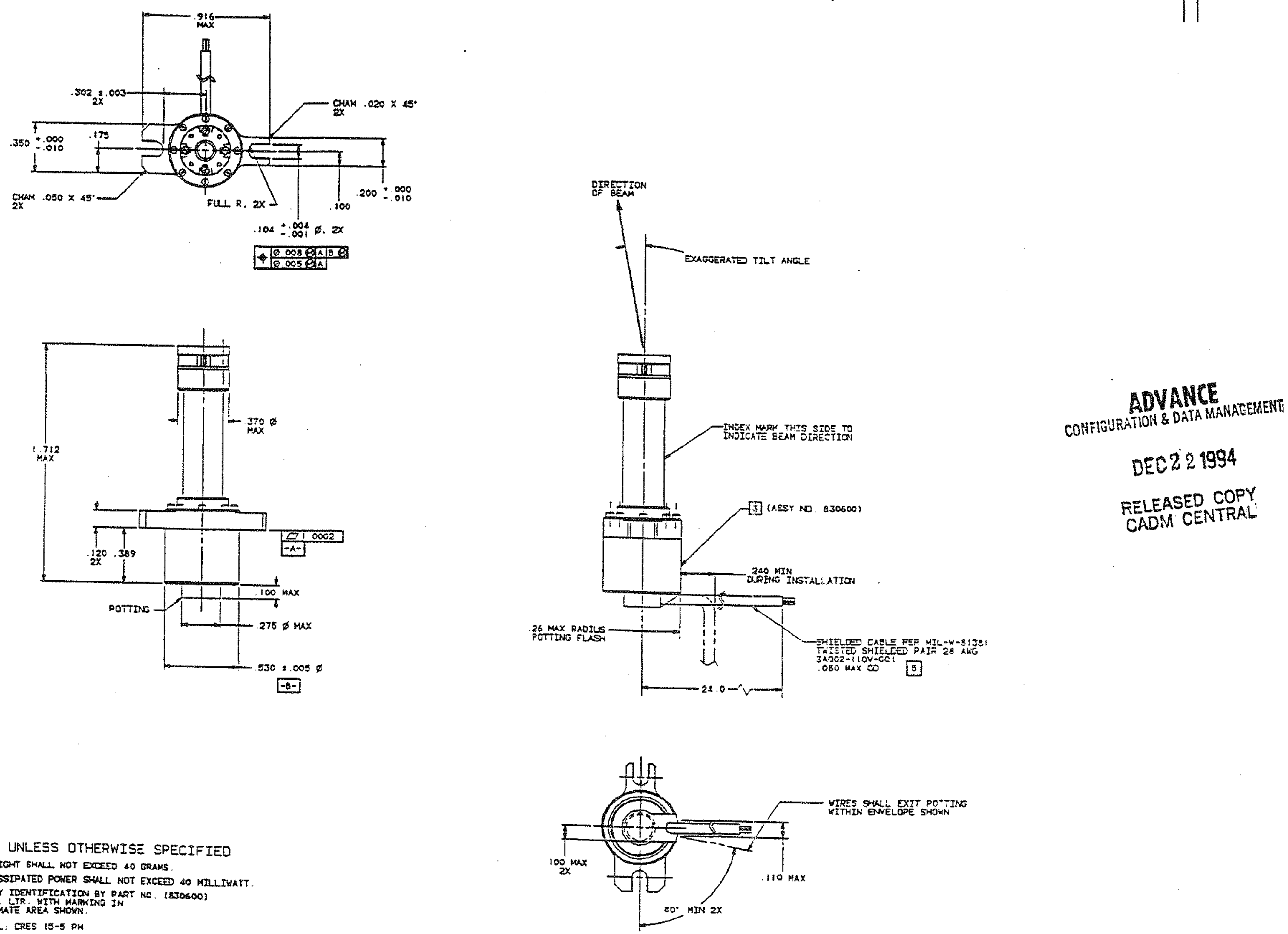


Figure 3.5-1B SIM DPA/PSMC/RCTU GROUNDING INTERFACE

GROUP=REL SUBGRP=CHECK SCALE= 0.0000 DRAWID=301330 INC01 LAST FILE=94356 10:40
DATE=12/22/94 TIME=10.51 ACCESS=NONE FMT=E SIZE 1
PLOT TOO LARGE - SCALE OF 0.000 WAS FACTORED BY 3.110



ADVANCE
CONFIGURATION & DATA MANAGEMENT
DEC 22 1994
RELEASED COPY
CADM CENTRAL

NOTES: UNLESS OTHERWISE SPECIFIED
1. UNIT WEIGHT SHALL NOT EXCEED 40 GRAMS.
2. UNIT DISSIPATED POWER SHALL NOT EXCEED 40 MILLIWATT.
3. ASSEMBLY IDENTIFICATION BY PART NO. (830600) AND REV. LTR. WITH MARKING IN APPROXIMATE AREA SHOWN.
4. MATERIAL: CRES 15-5 PH.
5. WIRE CODING: BLACK = CATHODE
6. EXTERIOR SURFACE FINISH PER MIL-P-18317, BLACK NICKEL.

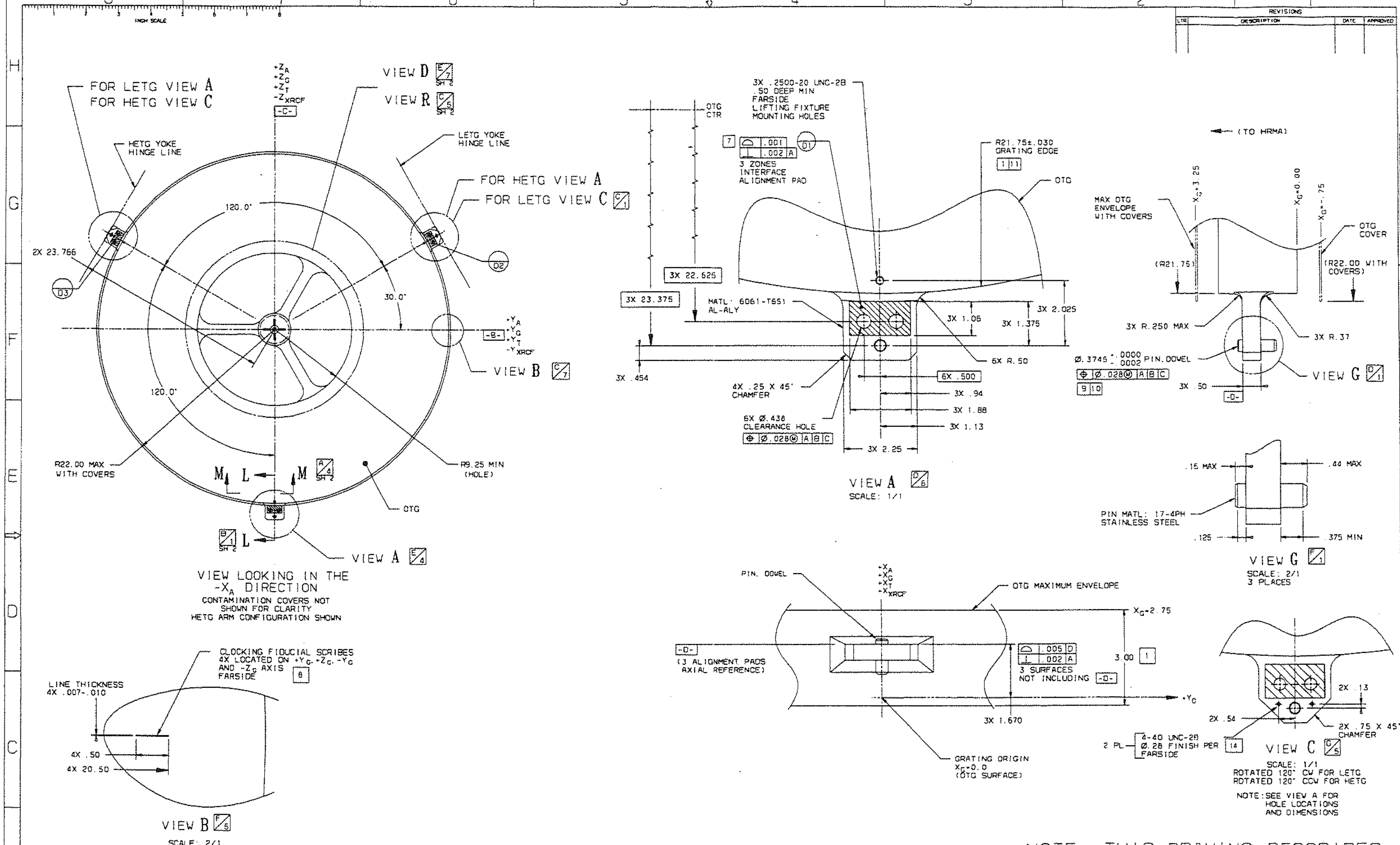
NAS 8-37710
A P SALZ
J STARKUS
J DONAGHY
S WALLACE
C LINDERMAN

TRW

INTERFACE CONTROL DRAWING-
FIDUCIAL LIGHT, HRC

E 11982 301330

301330



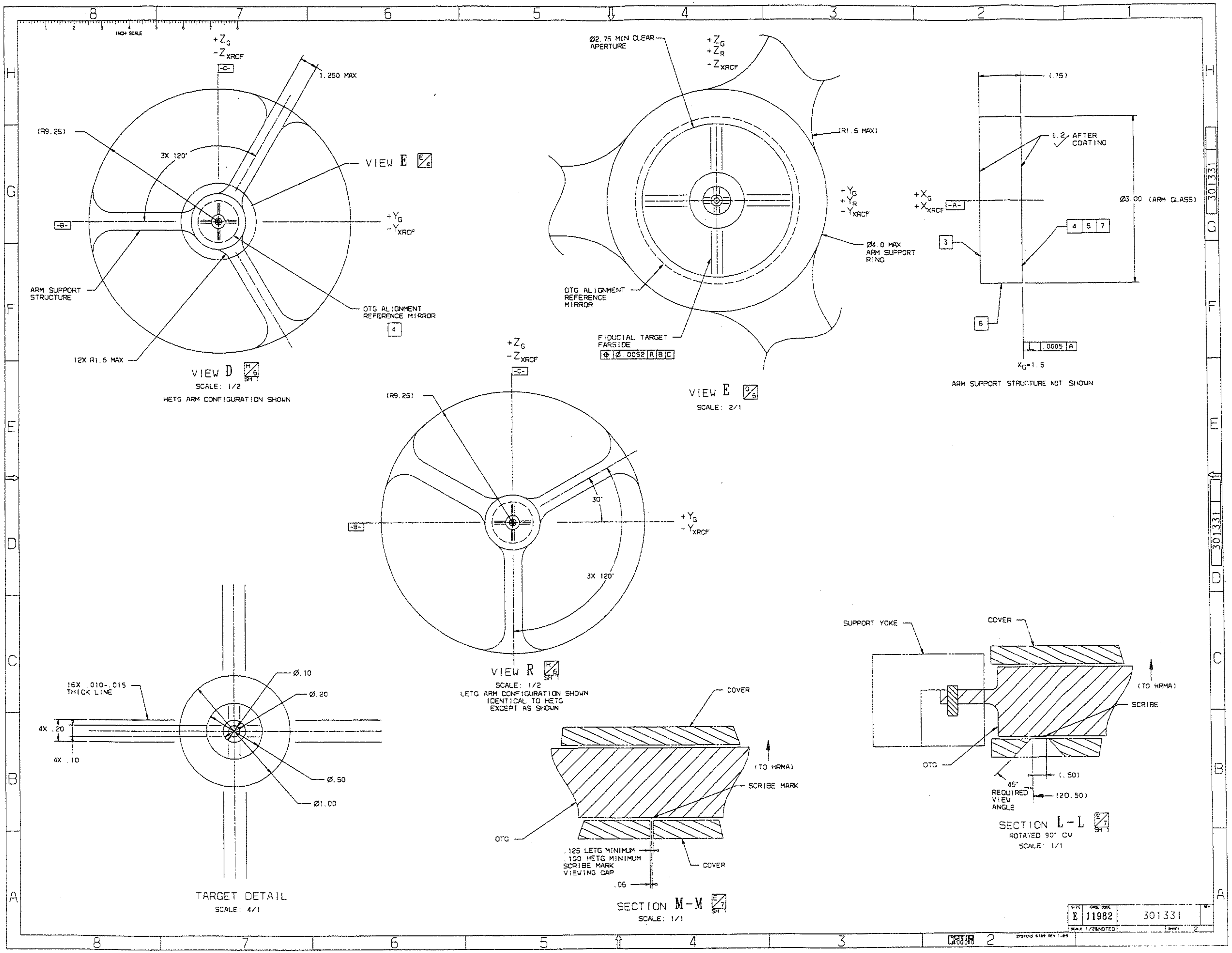
NOTE: THIS DRAWING DESCRIBES FLIGHT, XRCF, AND MASS SIMULATOR INTERFACES.

NOTES: UNLESS OTHERWISE SPECIFIED

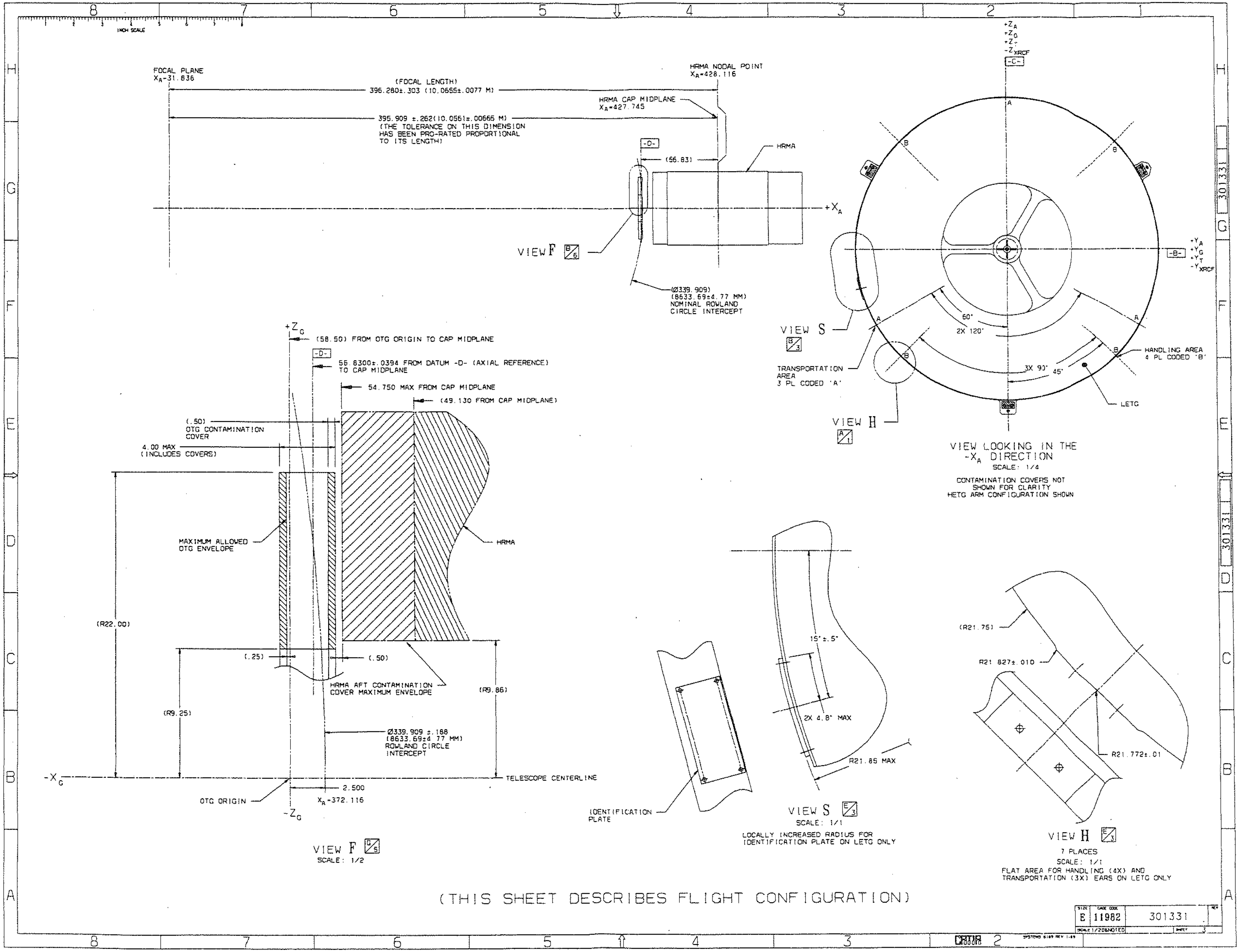
1. MAXIMUM STATIC ENVELOPE EXCEPT AT MOUNT PROTRUSIONS.
2. SUBSCRIPT AND ACRONYM LEGEND.
   A=AXAF-I (ADVANCED X-RAY ASTROPHYSICS FACILITY-IMAGING)
   G=GRATING COORDINATE SYSTEM
   HETG=HIGH ENERGY TRANSMISSION GRATING
   HRMA=HIGH RESOLUTION MIRROR ASSEMBLY
   LETG=LOW ENERGY TRANSMISSION GRATING
   MDS=MOTION DETECTION SYSTEM
   OTG=OBJECTIVE TRANSMISSION GRATING
   R=REFERENCE MIRROR COORDINATE
   T=TELESCOPE COORDINATE SYSTEM
3. SIDE SHALL BE ANTI-REFLECTION COATED BETWEEN 400 AND 700 NANOMETERS. THE AVERAGE REFLECTIVITY SHALL BE LESS THAN 1.0%.
4. AVERAGE MIRROR REFLECTIVITY SHALL BE GREATER THAN 90% WHEN VIEWED FROM EITHER SIDE AT BETWEEN 400 AND 700 NANOMETERS.
5. REFLECTIVITY OF REFERENCE TARGET LINE TO BE LESS THAN 5% WHEN VIEWED FROM EITHER SIDE.
6. THE ANGULAR DEVIATION OF A RAY IN TRANSMISSION SHALL BE LESS THAN 10 ARCSECONDS.
7. DIMENSION TO X_G=0 TO BE DOCUMENTED WITHIN .005.
8. THE ENTIRE 0.50 LENGTH OF THE FIDUCIAL SCRIBE LINE SHALL BE VISIBLE THROUGH THE OTG AT AN ANGLE OF ±45° FROM THE X_G AXIS IN A RADIAL PLANE.
9. PRESS FIT REQUIRED. MUST BE ABLE TO WITHSTAND A 100 LB AXIAL LOAD WITHOUT SLIPPING.
10. MUST BE ABLE TO WITHSTAND THE ENTIRE SHEAR LOAD DUE TO LAUNCH WITHOUT PERMANENT DEFLECTION WITH A MINIMUM SURFACE HARDNESS OF 35 RC.
11. GRATING EDGES ARE NOMINAL. LETG DEVIATIONS FROM NOMINAL ARE CAPTURED IN VIEW H (SH 3).
12. MASS SIMULATOR: THREE MOUNTING PADS SHALL BE FINISHED TO FLIGHT TOLERANCES WITH FLIGHT FINISHES.
13. MASS SIMULATOR SHALL BE CLEANABLE TO CLASS 350A PER MIL-STD-1246.
14. CHEM FILM SPECIFIED AREAS PER MIL-C-5541, CLASS 3.
15. GROUND LUG FINISH SHALL BE NICKEL PLATED PER QQ-N-290 (SULFAMATE TYPE), 100-200 MICROINCH AND GOLD PLATED PER MIL-G-45204, TYPE 1 OR 2, GRADE C, 50 MICROINCH MINIMUM.

ICD - OBJECTIVE TRANSMISSION GRATING (OTG), AXAF-I
CONTRACT NO. NAS8-37710
DRAWN D. LINDEMANN
SIZE E CAGE CODE 11982 DWG NO. 301331
SCALE 1/AS NOTED SHEET 1 OF 5

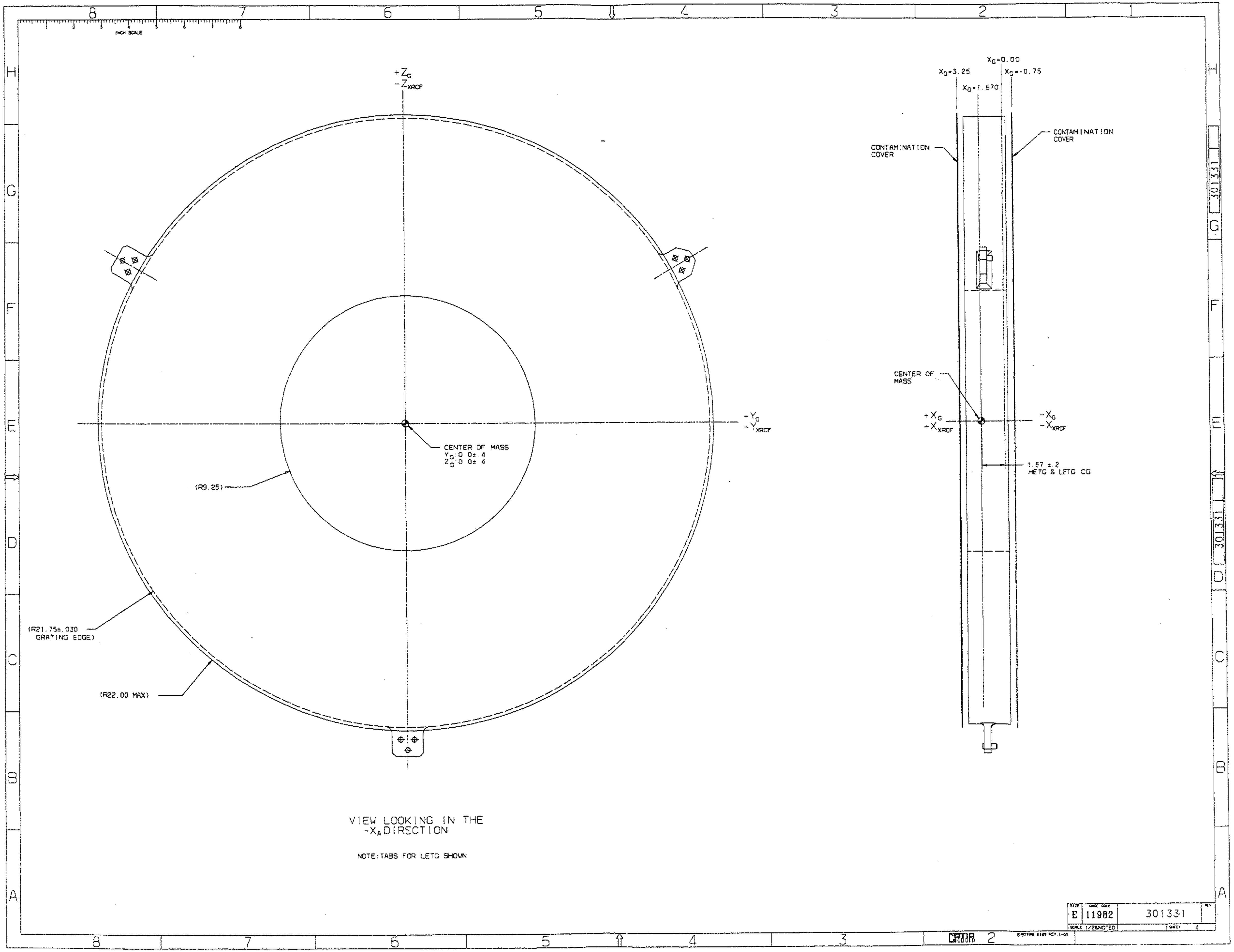
IRN 044 (PIRN 20-0023A) ENTIRE PAGE



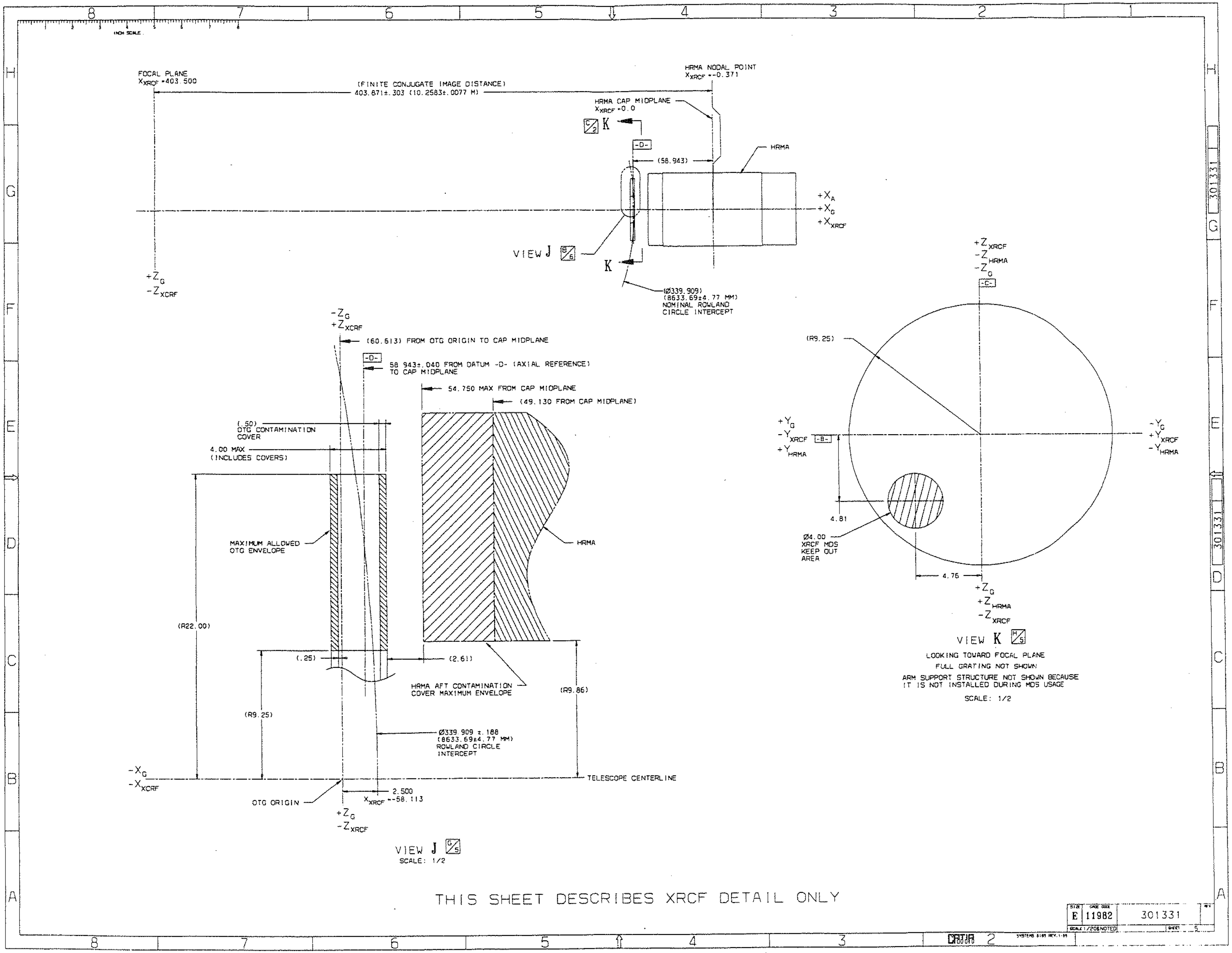
IRN 044
(PIRN
20-0023A)
ENTIRE
PAGE



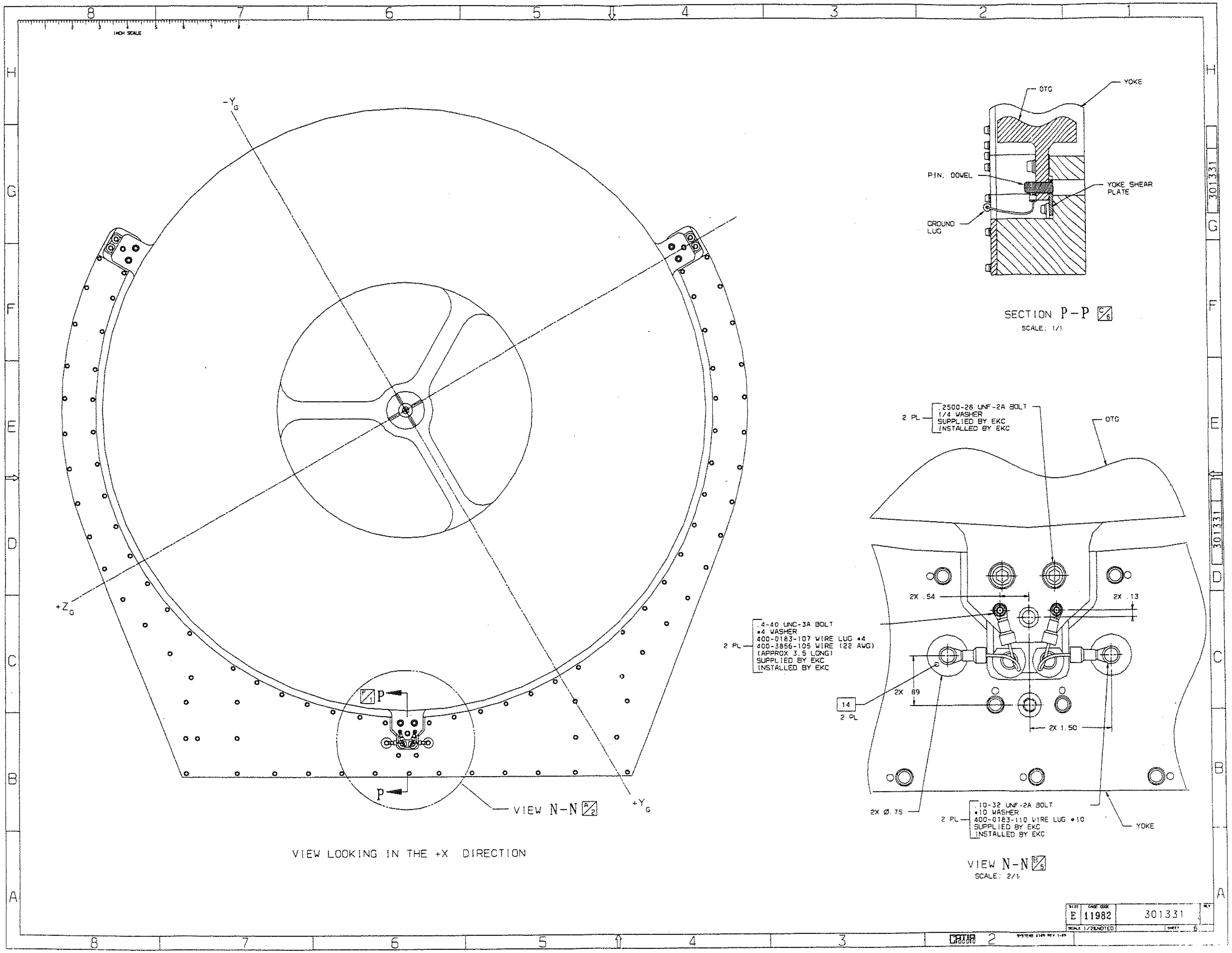
IRN 044
(PIRN
20-0023A)
ENTIRE
PAGE



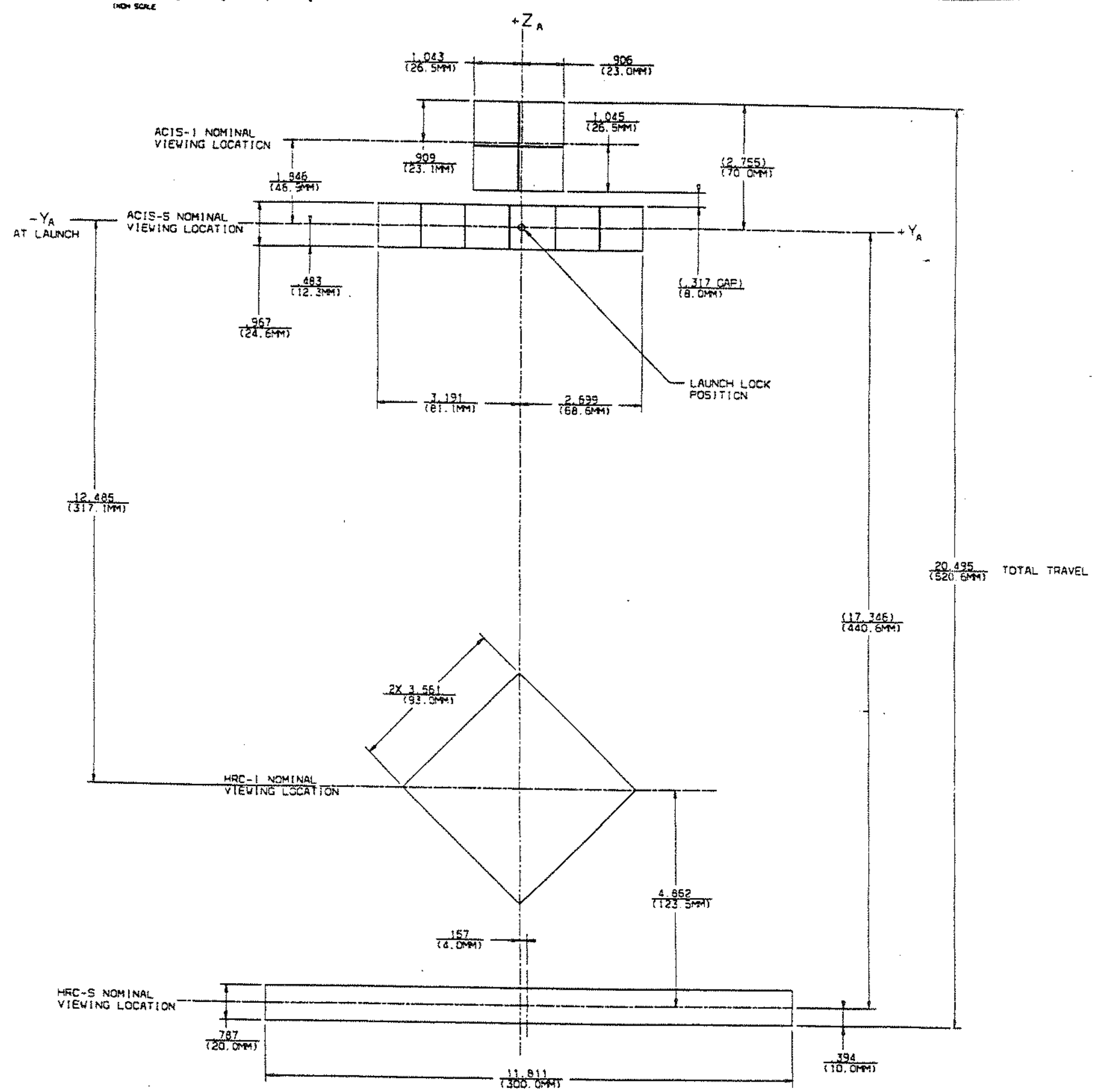
IRN 044
(PIRN
20-0023A)
ENTIRE
PAGE



IRN 044
(PIRN
20-0023A)
ENTIRE
PAGE



IRN 044
(PIRN
20-0023A)
ENTIRE
PAGE



SI AIMPOINT DETAIL

NOMINAL DIMENSION FOR REFERENCE ONLY
VIEW LOOKING IN THE $-X_A$ DIRECTION
(FROM HRMA TOWARDS FOCAL PLANE)

TABULATION BLOCK

FID LIGHT NO.	PART NO.	TILT ANGLE (DEGREE) FOR REF ONLY
ACIS-1	822040-2	0.45
ACIS-2	822040-2	0.45
ACIS-3	822040-2	0.45
ACIS-4	822040-1	0.6
ACIS-5	822040-4	0.55
ACIS-6	822040-3	0.4
HRC-I-1	830600-2	0.45
HRC-I-2	830600-2	0.45
HRC-I-3	830600-2	0.45
HRC-I-4	830600-2	0.45
HRC-S-1	830600-1	0.4
HRC-S-2	830600-1	0.4
HRC-S-3	830600-1	0.4
HRC-S-4	830600-1	0.4

NOTES: UNLESS OTHERWISE SPECIFIED

1. SUBSCRIFT AND ACRONYM LEGEND:
   A=AXAF-I (ADVANCED X-RAY ASTROPHYSICS FACILITY-IMAGING)
   ACIS=AXAF-I CCD IMAGING SPECTROMETER
   FID=FIDUCIAL
   HRC=HIGH RESOLUTION CAMERA
   I=IMAGING
   S=SPECTROSCOPY
   SI=SCIENCE INSTRUMENT
2. DELETED
3. LOCATION OF THE MOUNTING PLANE OF THE FIDUCIAL LIGHT ALONG THE X_A AXIS SHALL BE 1.400±.010 INCHES FORWARD OF THE HRC CROSS GRID CHARGE DETECTOR (CGCD) PLANE
4. LOCATION OF THE MOUNTING PLANE OF THE FIDUCIAL LIGHT ALONG THE X_A AXIS SHALL BE 1.000±.010 INCHES FORWARD OF THE ACIS FOCAL PLANE.
5. MAXIMUM STORAGE TEMPERATURE SHALL BE -50°C.
6. THE FOLLOWING INFORMATION PROVIDED FOR REFERENCE ONLY:
   A) MOUNT FID LIGHTS USING #2-56 UNC-2B SCREWS
   B) TORQUE SCREWS TO 2.8-3.5 IN-LB
   C) USE 20 mA WHEN OPERATING FID LIGHTS
   D) PROCEDURE FOR DETERMINING ANODE/CATHODE:
      IF FOR SOME REASON THE IDENTIFICATION MARKS FOR THE FID LIGHT'S ANODE AND CATHODE LEADS ARE MISSING OR ARE IN QUESTION, THE LEADS CAN BE REIDENTIFIED USING THE DVM IN OHMMETER MODE WITH THE RESISTANCE RANGE ON 20MEGAΩ. ATTACH THE DVM LEADS ACROSS THE FID LIGHT LEADS. IF THE DVM READS 11 TO 12 MEGAΩ, THEN THE DVM "V-Ω" HI LEAD IS ATTACHED TO THE ANODE. IF THE DVM READS > 20 MEGAΩ, (THE DVM DISPLAY FLASHING A OVERANGE CONDITION) THEN THE DVM "V-Ω" HI LEAD IS ATTACHED TO THE CATHODE.
   E) SEE SHEET X FOR A SCHEMATIC OF TEST SET (TO TURN ON/OFF AT 20 mA.)

DIMENSIONS IN INCH / (MM)

REVISIONS

CONTRACT NO. NAS8-37710

D. LINDEMAN
B. NGUYEN
D. LINDEMAN
J. VREN
L. HARPER
J. LOVE
J. TJIA

TRW

INTERFACE CONTROL DRAWING - FID LIGHT AND DETECTOR, AXAF

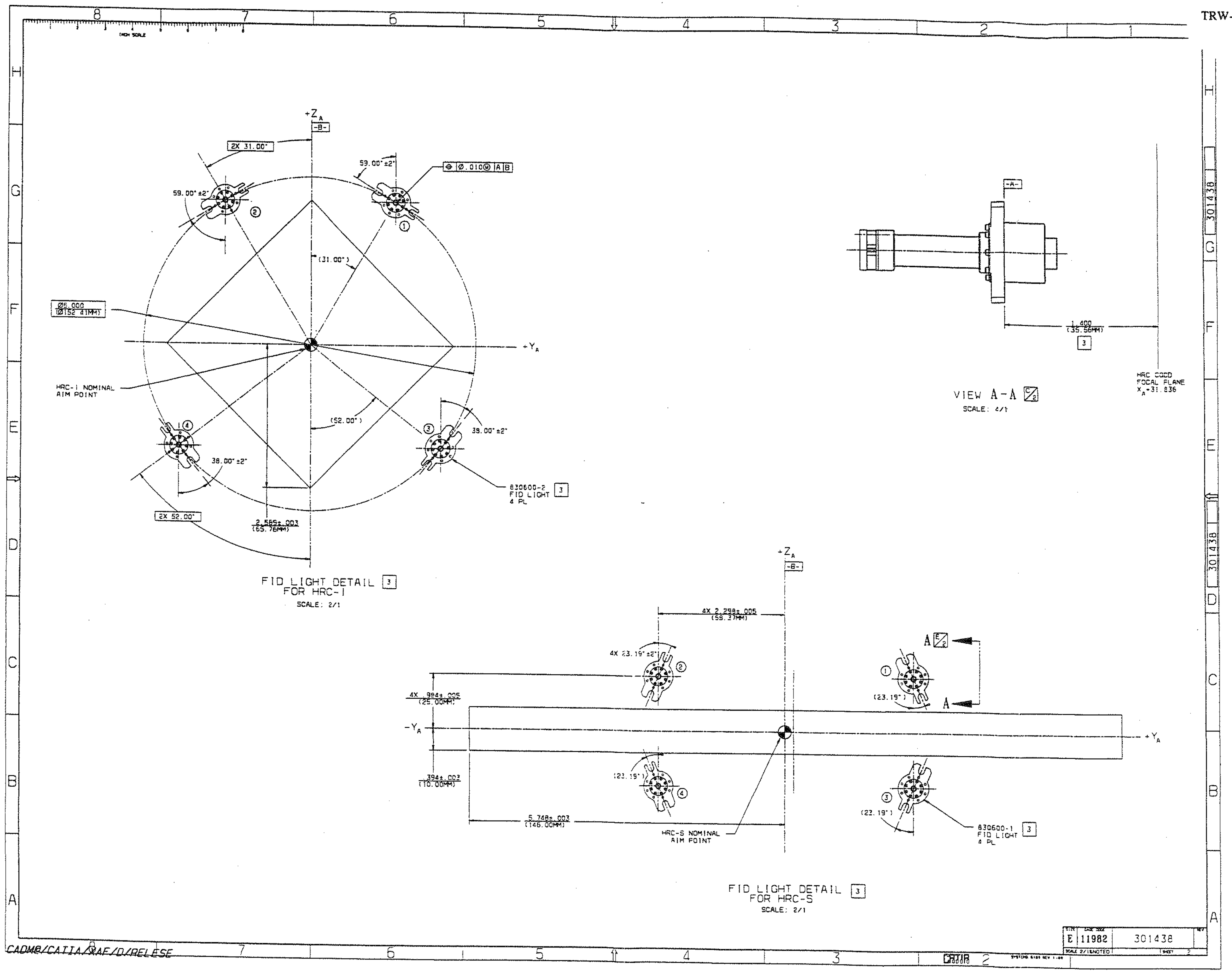
E | 11982 | 301438

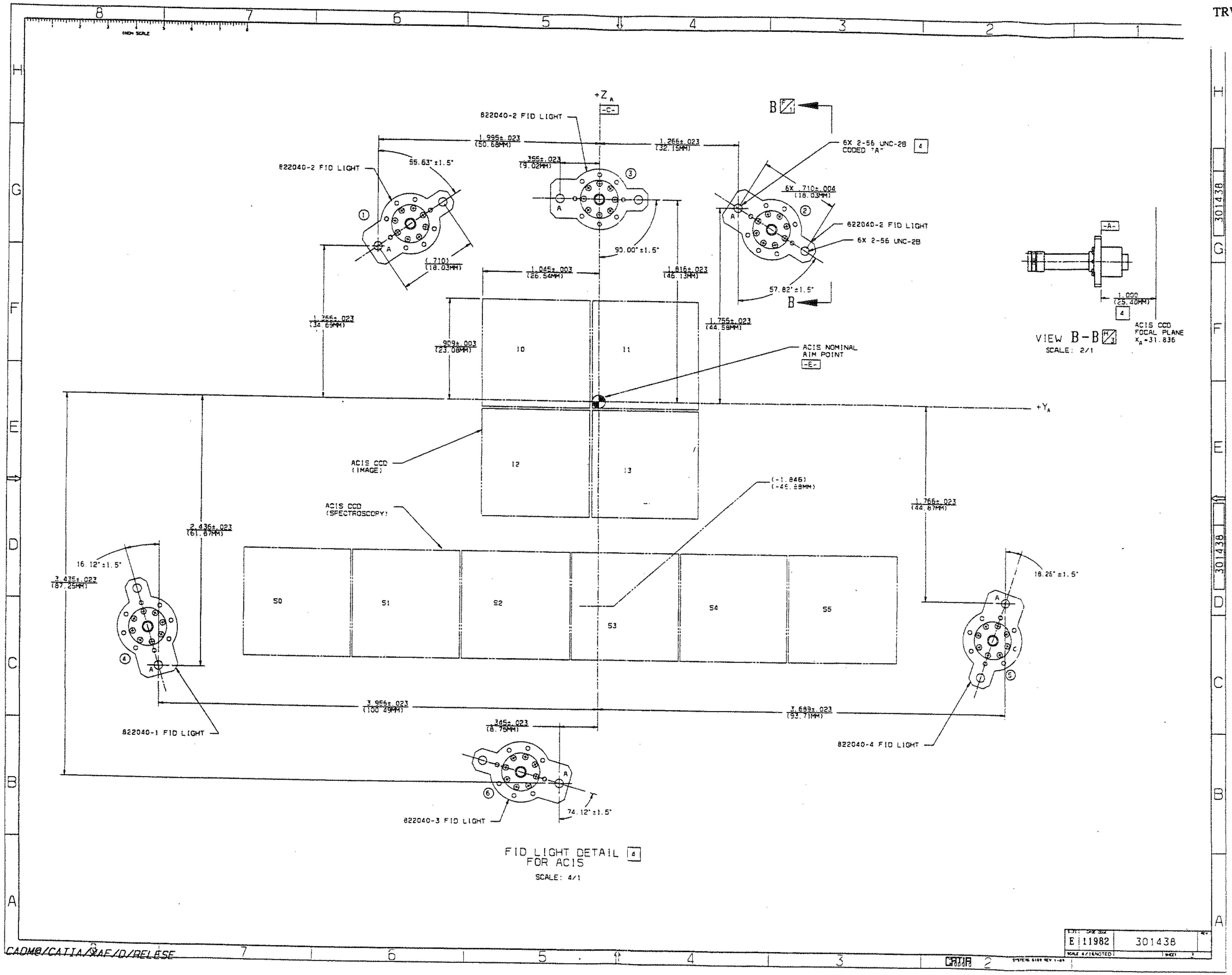
SCALE 1/1 (NOTED) | SHEET 1 OF 3

AXAF | L73101P1

301438

CADMB/CATIA/AXAF/D/RELESE


FID LIGHT DETAIL 3
FOR HRC-I
SCALE: 2/1
2X 31.00°
59.00° ±2°
Ø 0.010Ⓜ A B
Ø5.000
(Ø152.41MM)
HRC-I NOMINAL
AIM POINT
(31.00°)
(52.00°)
39.00° ±2°
38.00° ±2°
830600-2
FID LIGHT
4 PL
2X 52.00°
2.589±.003
(65.76MM)
VIEW A-A
SCALE: 4/1
1.400
(35.56MM)
HRC CCDD
FOCAL PLANE
X_A=31.836
FID LIGHT DETAIL 3
FOR HRC-S
SCALE: 2/1
4X 2.298±.005
(59.27MM)
4X 23.19° ±2°
4X .984±.005
(25.00MM)
.394±.002
(10.00MM)
(23.19°)
5.748±.003
(146.00MM)
HRC-S NOMINAL
AIM POINT
830600-1
FID LIGHT
4 PL
E 11982 301438
CADMB/CATIA/RAE/D/RELESE

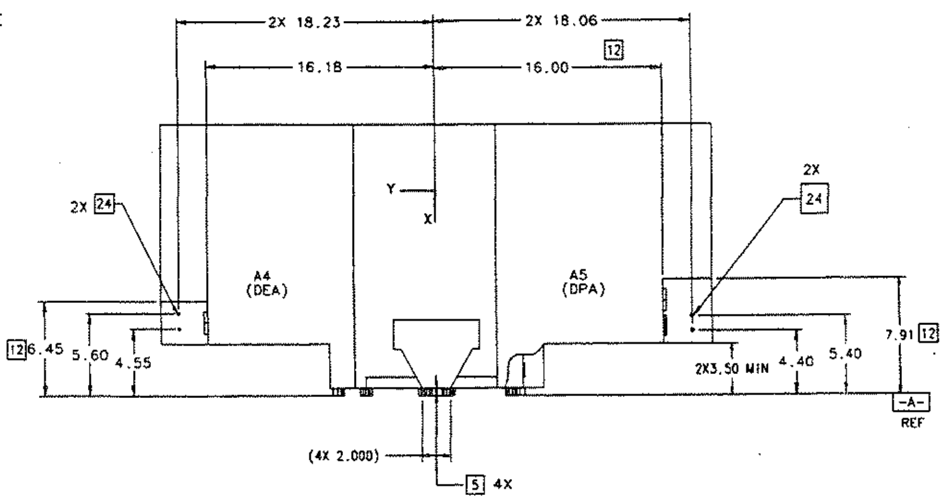

822040-2 FID LIGHT
+Z_A
-C-
1.995±.023 (50.68MM)
1.266±.023 (32.15MM)
.355±.023 (9.02MM)
55.63°±1.5°
6X 2-56 UNC-2B CODED "A"
6X .710±.004 (18.03MM)
6X 2-56 UNC-2B
(.710) (18.03MM)
90.00°±1.5°
1.045±.003 (26.54MM)
1.816±.023 (46.13MM)
57.82°±1.5°
1.766±.023 (34.69MM)
1.755±.023 (44.59MM)
.909±.003 (23.08MM)
ACIS NOMINAL AIM POINT
-E-
+Y_A
ACIS CCD (IMAGE)
ACIS CCD (SPECTROSCOPY)
(-1.846) (-46.89MM)
1.766±.023 (44.87MM)
2.436±.023 (61.87MM)
16.12°±1.5°
3.435±.023 (87.25MM)
18.26°±1.5°
I0
I1
I2
I3
S0
S1
S2
S3
S4
S5
3.956±.023 (100.49MM)
3.689±.023 (93.71MM)
.345±.023 (8.75MM)
822040-1 FID LIGHT
822040-4 FID LIGHT
822040-3 FID LIGHT
74.12°±1.5°
FID LIGHT DETAIL 4
FOR ACIS
SCALE: 4/1
-A-
1.000 (25.40MM)
VIEW B-B
SCALE: 2/1
ACIS CCD FOCAL PLANE X_A=31.836
E 11982
301438
CADMB/CATIA/SAE/D/RELEASE

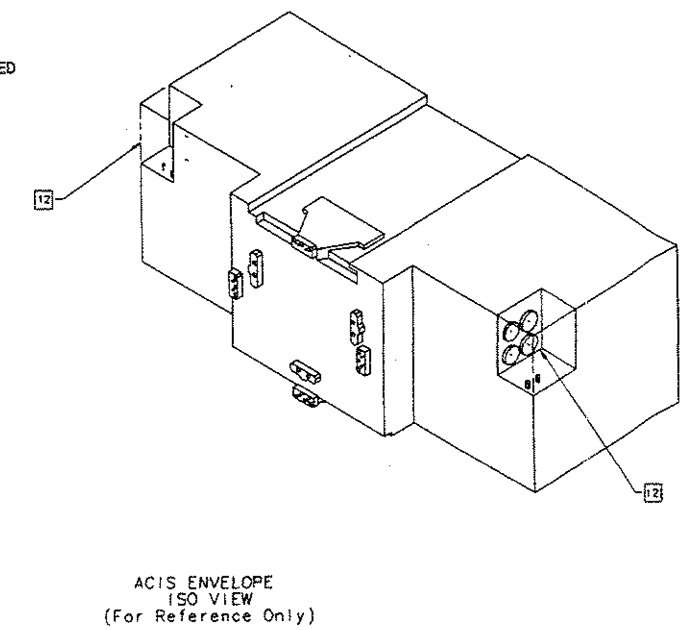
IRN 054
(PIRN 20-0058A)

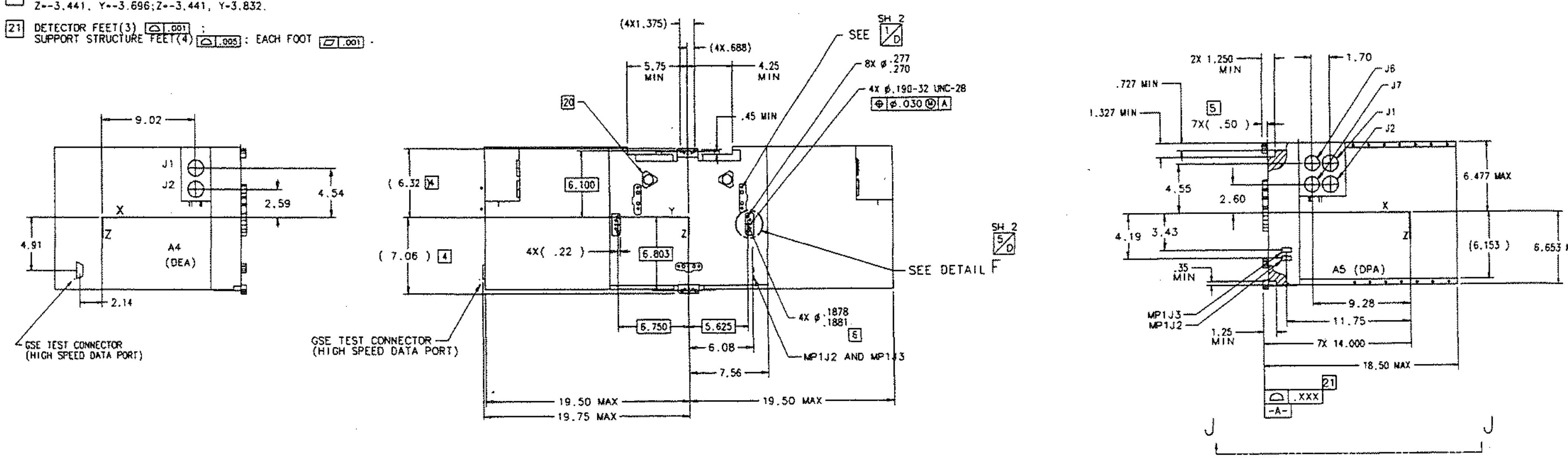
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
-	INITIAL RELEASE; REVISED AND REDRAWN FROM BALL DRAWING 530898 INCORPORATES PIRN CM7A-035B, PIRN 20-0005 (IRN 004), PIRN 20-0010 (IRN 003), PIRN 20-0019A (IRN 020), PIRN 20-0026A (IRN 034), PIRN 20-0041 (IRN 025) WHICH SUPERSEDES PART OF PIRN 20-0026A, AND PIRN 20-0031 (IRN 038)	97-03-07	
A	INCORPORATED IRN 054 (PIRN 20-0058A)	98-01-30	

NOTES, UNLESS OTHERWISE SPECIFIED

1. THIS DRAWING DEFINES THE PERMISSIBLE STATIC ENVELOPES FOR THE ACIS SCIENCE INSTRUMENT. THE UNION OF ALL OF THE ENVELOPES DEFINES THE MAXIMUM PERMISSIBLE VOLUME. THESE ENVELOPES INCLUDE ALL CONNECTORS AND THEIR ASSOCIATED BACKSHELLS. ALL DIMENSIONS ARE AT ASSEMBLY ROOM TEMPERATURES.
2. THE XYZ COORDINATE SYSTEM SHOWN IS THE SIM COORDINATE SYSTEM WHICH IS LOCATED AT THE AXAF LAUNCH POSITION AT ASSEMBLY ROOM TEMPERATURES.
3. DATUM -A- IS THE TRANSLATION TABLE MOUNTING INTERFACE.
4. DIMENSION APPLIES TO MOUNTING INTERFACES.
5. SUPPORT STRUCTURE MOUNTING FOOT PAD THICKNESS SHALL BE 0.490 - 0.510 FOR FASTENER LENGTH DETERMINATION PURPOSES. ACCESS TO MOUNTING FOOT FASTENERS IS FROM THE -X DIRECTION.
6. NOTED HOLE TO BE LOCATED BY SIM DRILL TEMPLATE, BASD P/N 533572-500 (FOR D.A. ONLY) OR BASD 533572-501 (FOR S.S. ONLY).
7. SUPPORT STRUCTURE STATIC ENVELOPE DOES NOT INCLUDE VACUUM MANIFOLD ASSEMBLY-TO-SIM INTERFACE FOOTPRINT NOR COLLIMATOR-TO-SIM INTERFACE FOOTPRINT, THESE ARE IDENTIFIED AND SHOWN SEPARATELY.
8. NOTED AREA FOR OVERLAP OF ACIS INTERFACE COVER (BASD PART 530943-005) OF UP TO .31" THICKNESS.
9. SIM +Z COVER PANEL SHOWN.
10. MOUNTING FOOT PAD THICKNESS IS SHOWN FOR FASTENER LENGTH DETERMINATION PURPOSES. ACCESS TO MOUNTING FOOT FASTENERS IS FROM THE -X DIRECTION.
11. MATERIAL AT INTERFACE TO BE TITANIUM 6AL-4V OR MATERIAL OF EQUIVALENT OR SMALLER COEFFICIENT OF THERMAL EXPANSION.
12. PERMISSIBLE FLIGHT CONNECTOR LOCATION ENVELOPE.
13. MAXIMUM FOOTPRINT AT SIM INTERFACE.
14. PSMC CONNECTOR AND BACKSHELL ENVELOPE.
15. MLI FASTENERS TO BE PROVIDED BY BASD.
16. MAXIMUM ENVELOPE FOR RADIATION SOURCES TO VIEW DETECTOR. (MINIMUM SIM INTERFACE FLANGE THRU HOLE DIAMETER.)
17. DELETED
18. GSE HIGH SPEED DATA PORT ACCESS ENVELOPE.
19. O-RING LIGHT SEAL; GROOVE OD= 2.754+.000/-.020;GROOVE WIDTH=.083-.088; GROOVE DEPTH = .050-.054;MAX FILLET R.=.015; -O-RING:MIL-R-83248, TYPE 1, CLASS 1, V747-75, SIZE 2-038 PROVIDED BY BASD.
20. REFERENCE MIRRORS LOCATED APPROXIMATELY AS SHOWN AT Z=-3.441, Y=-3.696;Z=-3.441, Y=3.832.
21. DETECTOR FEET(3) [⌓ .001] ; SUPPORT STRUCTURE FEET(4) [⌓ .005] ; EACH FOOT [▱ .001] .
22. MLI ATTTACHMENT POST ASSEMBLIES (BASD DRAWING 530950) BONDED PER LOCKHEED MARTIN SPECIFICATION STMM 555. LOCATIONS APPROXIMATELY AS SHOWN AND DETERMINED BY BALL TEMPLATE T128070 (SUNSHADE) AND T128072 (TELESCOPE SHADE). BONDLINE TO BE .020".
23. MLI ATTACHMENT POST ASSEMBLIES (BASD DRAWING 530950) BONDED IN PLACE PER BASD SPECIFICATION BPS 21.02, TYPE IV, CLASS 2, TEMPERATURE 1 BONDLINE THICKNESS .020.
24. DPA AND DEA GROUND WIRE ATTACHMENT POINTS: ø.190 -32 UNF; .50" MAXIMUM FASTENER ENGAGEMENT.
25. PSMC GROUNDING ATTACHMENT POINTS: ø.190-32 UNF POST : .50" HIGH.
26. MLI GROUNDING STRAP ATTACHMENT POINTS.
27. VENT SUBSYSTEM LIGHT BAFFLE. INSTALL FOR FLIGHT.
28. VENT SUBSYSTEM LIGHT BAFFLE DUST COVER. REMOVE FOR FLIGHT.
29. CABLE TIE MOUNTS (PANDUIT P/N TM3S8-C76) LOCATED SIX PLACES.
30. FOOTPRINT FOR BASD TURTLE SHELL CONN. BRKT. (DRWG 530923).
31. HIGH CONDUCTANCE VACUUM LINE PROTUBERANCE IS ENCOMPASSED BY LIGHT SHADE ENVELOPE WHEN LIGHT SHADE IS INSTALLED







PARTS LIST

UNLESS OTHERWISE SPECIFIED

CONTRACT NO. NAS8-37710

DRAWN BOB LEYNER

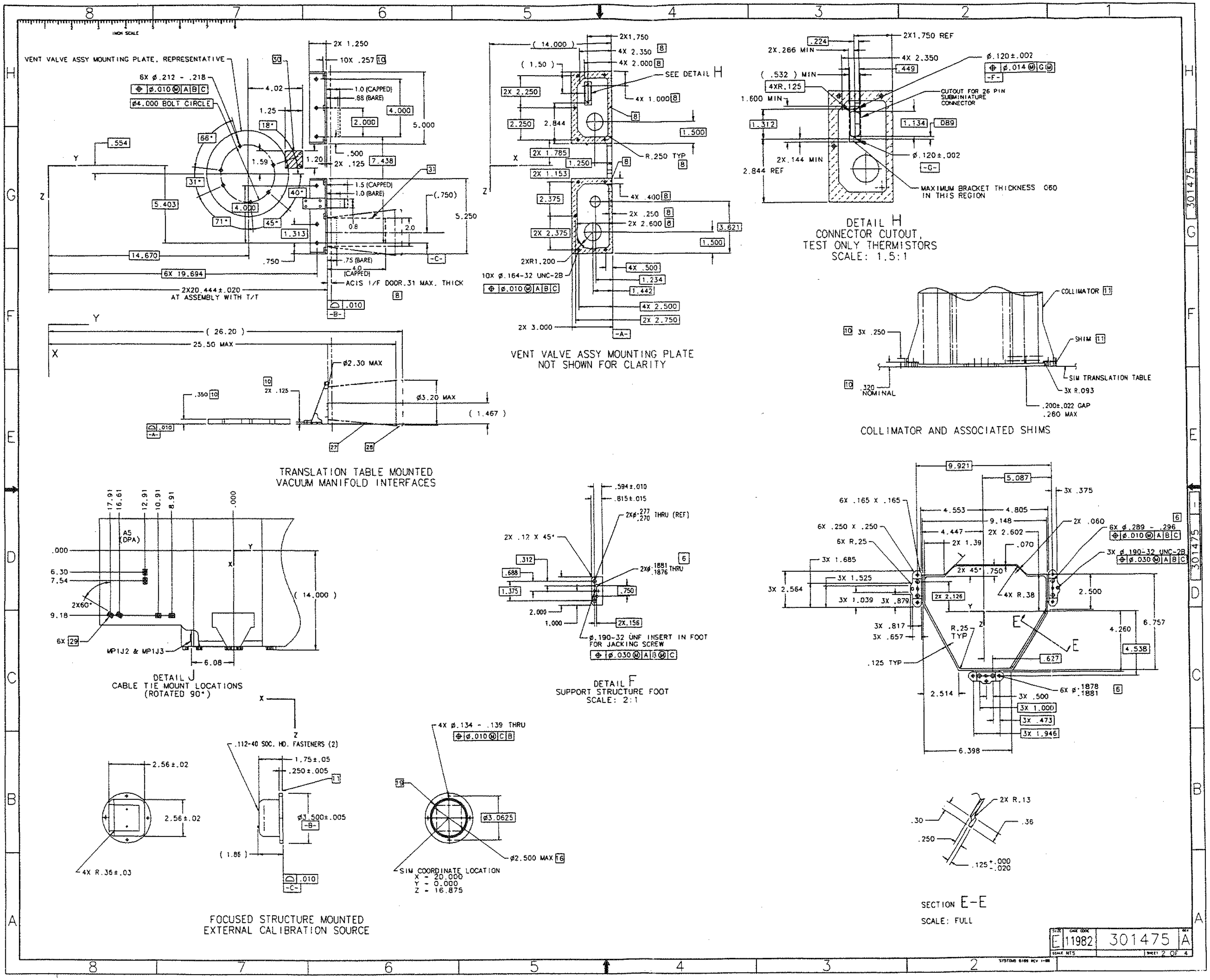
INTERFACE CONTROL DRAWING-ACIS

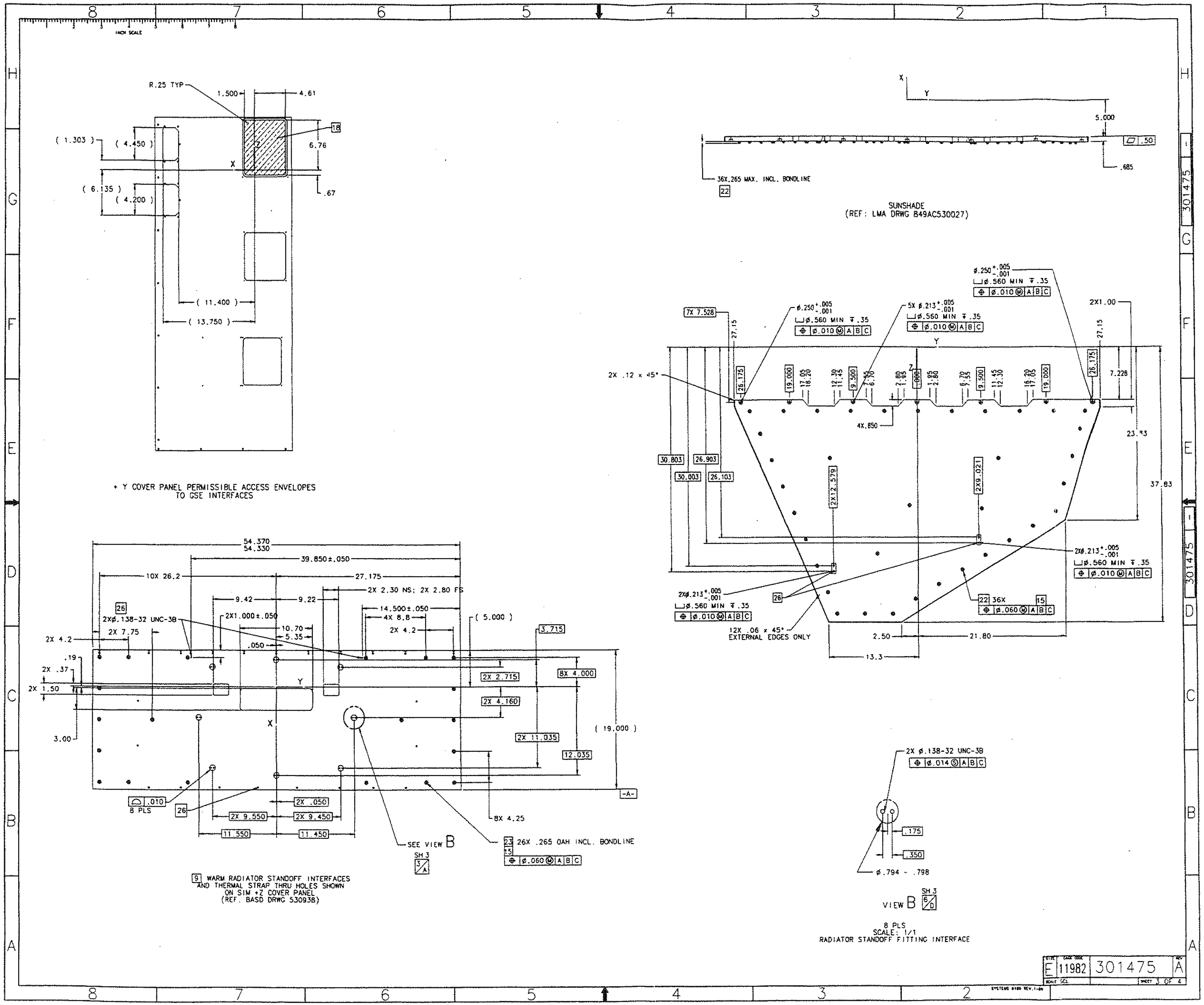
SIZE	CAGE CODE	DWG NO.	REV
E	11982	301475	A

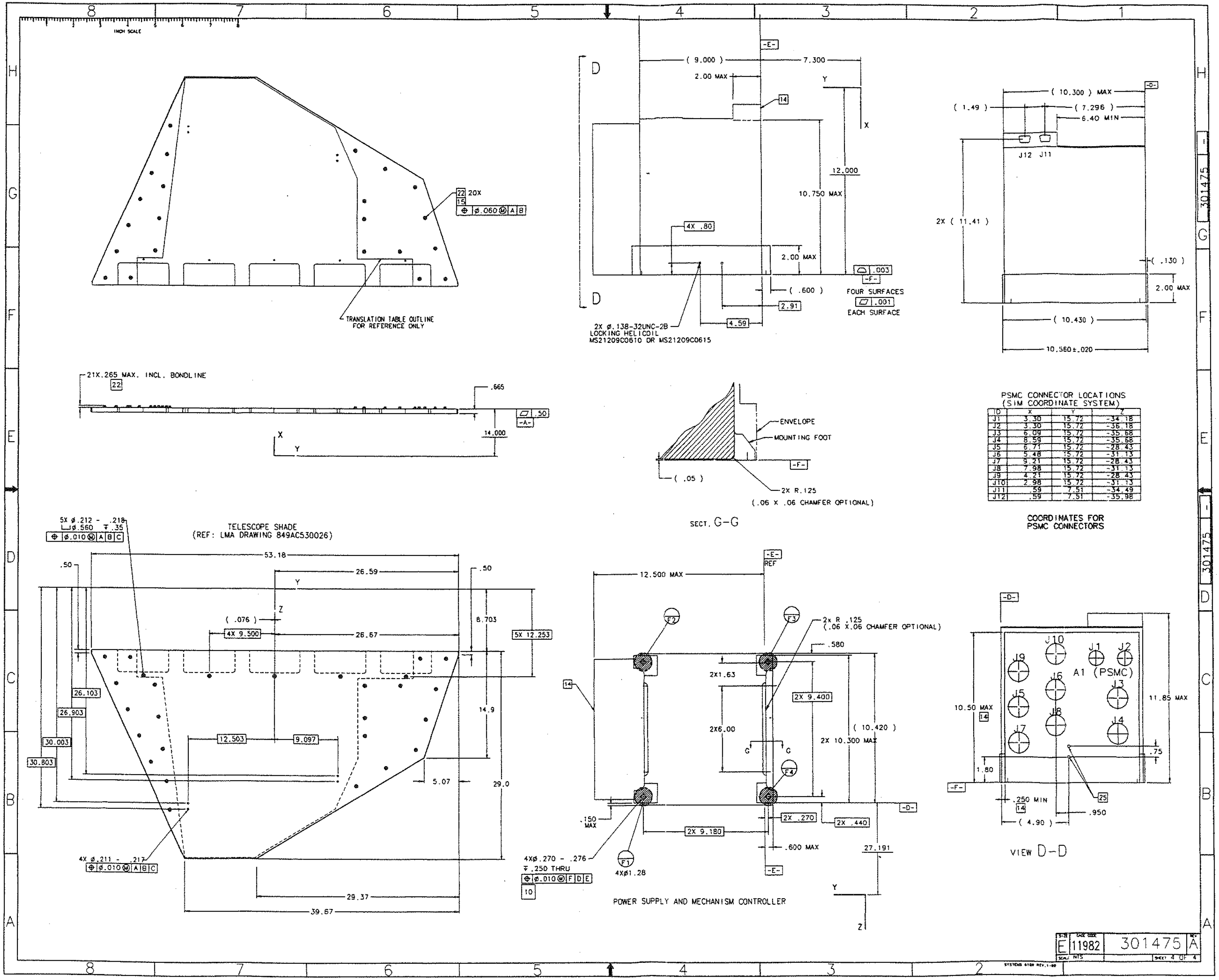
SCALE NTS SHEET 1 OF 4

ACIS ENVELOPE_2:530898:1

IRN 054
(PIRN 20-0058A)




+ Y COVER PANEL PERMISSIBLE ACCESS ENVELOPES
TO GSE INTERFACES
SUNSHADE
(REF: LMA DRWG 849AC530027)
36X.265 MAX. INCL. BONDLINE
WARM RADIATOR STANDOFF INTERFACES
AND THERMAL STRAP THRU HOLES SHOWN
ON SIM +Z COVER PANEL
(REF. BASD DRWG 530938)
SEE VIEW B
26X .265 OAH INCL. BONDLINE
12X .06 x 45°
EXTERNAL EDGES ONLY
VIEW B
8 PLS
SCALE: 1/1
RADIATOR STANDOFF FITTING INTERFACE
E 11982 301475 A
SHEET 3 OF 4



PSMC CONNECTOR LOCATIONS
(SIM COORDINATE SYSTEM)

ID	X	Y	Z
J1	3.30	15.72	-34.18
J2	3.30	15.72	-36.18
J3	6.09	15.72	-35.68
J4	8.59	15.72	-35.68
J5	6.71	15.72	-28.43
J6	5.48	15.72	-31.13
J7	9.21	15.72	-28.43
J8	7.98	15.72	-31.13
J9	4.21	15.72	-28.43
J10	2.98	15.72	-31.13
J11	.59	7.51	-34.49
J12	.59	7.51	-35.98

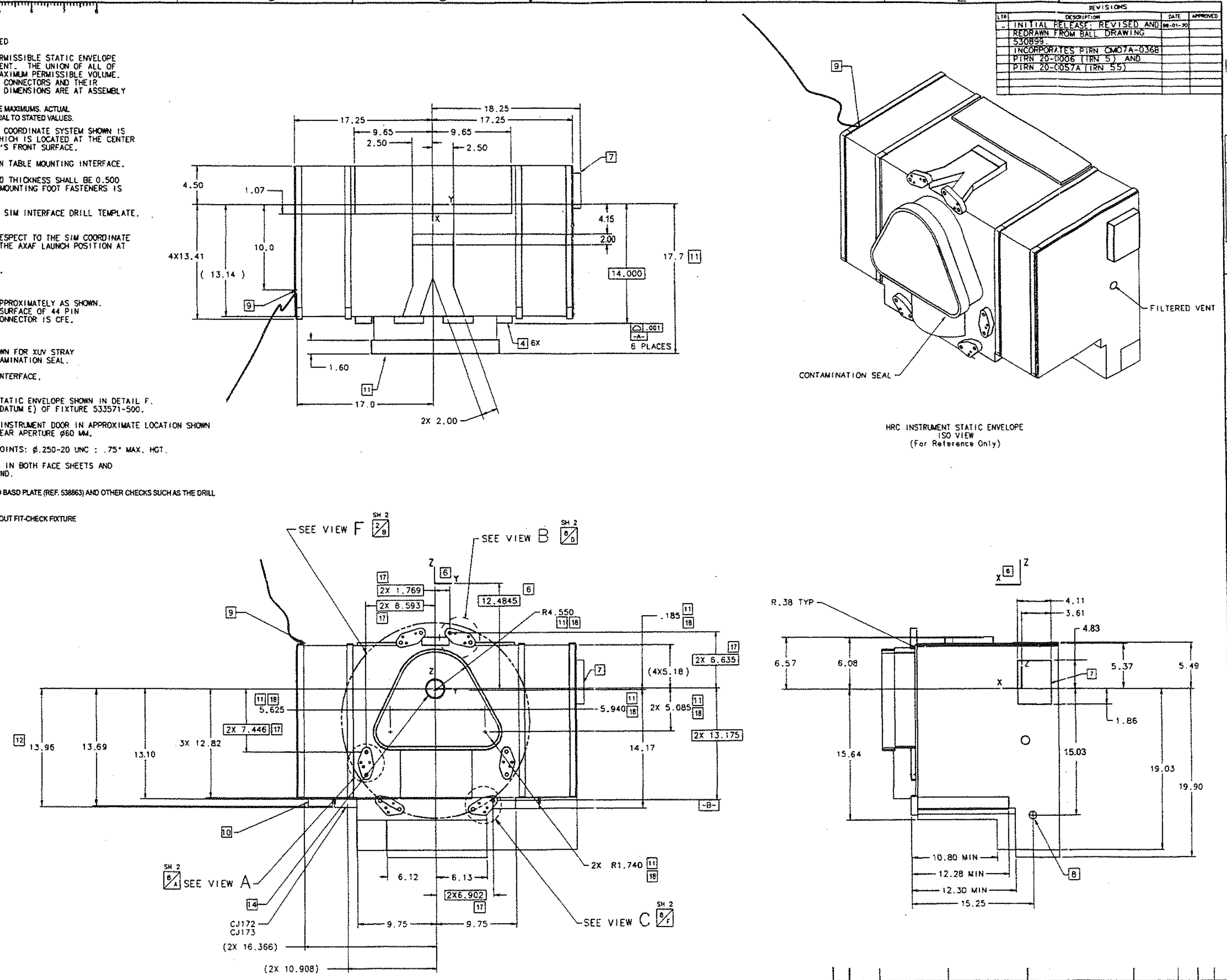
COORDINATES FOR PSMC CONNECTORS

IRN 056
(PIRN
20-0051)

IRN 055
(PIRN
20-0057A)
ENTIRE
PAGE

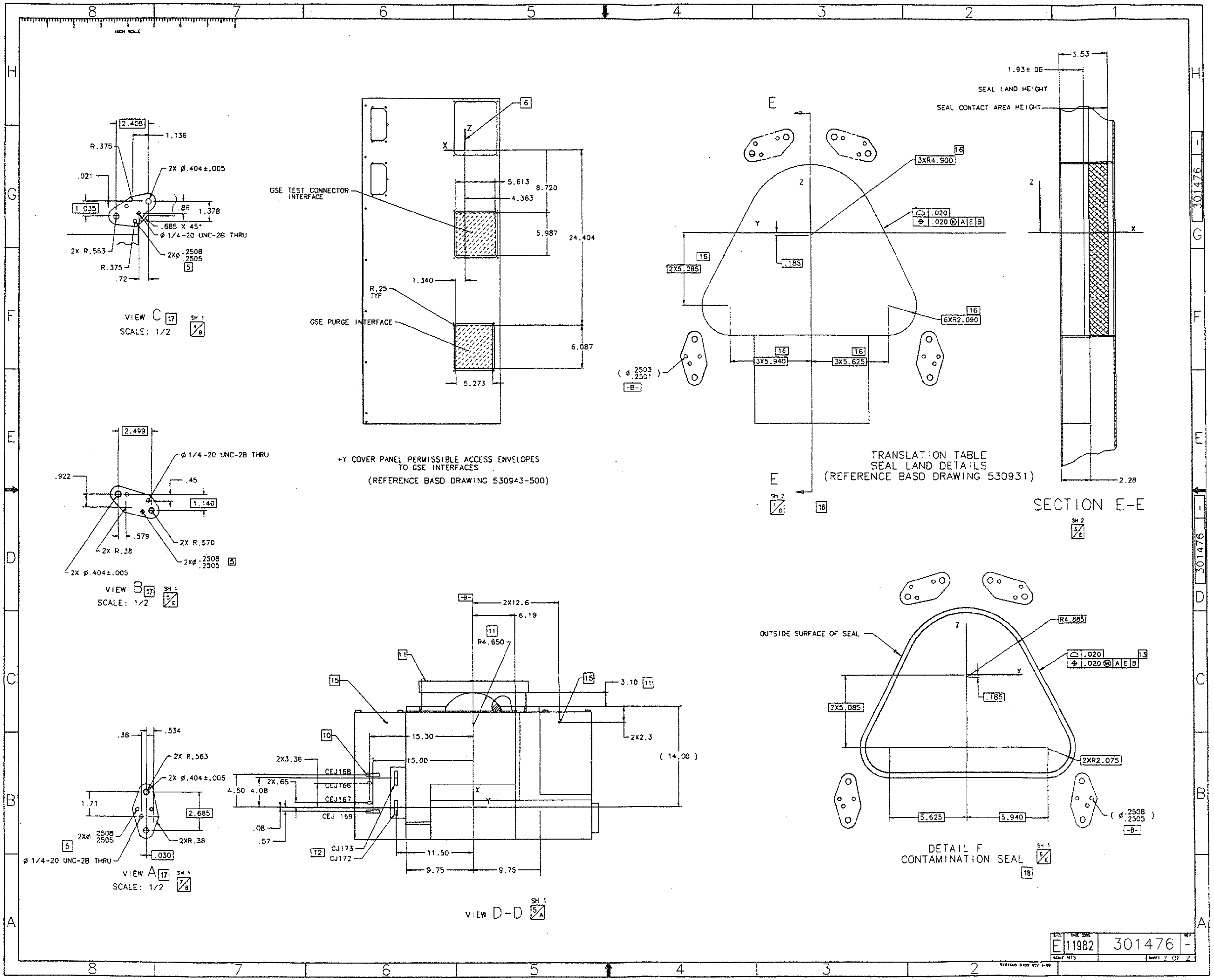
NOTES, UNLESS OTHERWISE SPECIFIED

1. THIS DRAWING DEFINES THE PERMISSIBLE STATIC ENVELOPE FOR THE HRC SCIENCE INSTRUMENT. THE UNION OF ALL OF THE ENVELOPES DEFINES THE MAXIMUM PERMISSIBLE VOLUME. THESE ENVELOPES INCLUDE ALL CONNECTORS AND THEIR ASSOCIATED BACKSHELLS. ALL DIMENSIONS ARE AT ASSEMBLY ROOM TEMPERATURE.
EXCEPT AS NOTED, ALL DIMENSIONS ARE MAXIMUMS. ACTUAL DIMENSIONS MAY BE LESS THAN OR EQUAL TO STATED VALUES.
2. UNLESS OTHERWISE NOTED, THE COORDINATE SYSTEM SHOWN IS THE HRC COORDINATE SYSTEM WHICH IS LOCATED AT THE CENTER OF THE HRC IMAGING DETECTOR'S FRONT SURFACE.
3. DATUM -A- IS THE TRANSLATION TABLE MOUNTING INTERFACE.
4. INSTRUMENT MOUNTING FOOT PAD THICKNESS SHALL BE 0.500 TYP ALL FOOTPADS. ACCESS TO MOUNTING FOOT FASTENERS IS FROM THE -X DIRECTION.
5. NOTED HOLE TO BE LOCATED BY SIM INTERFACE DRILL TEMPLATE, BASD P/N 533571-500.
6. NOTED DIMENSIONS ARE WITH RESPECT TO THE SIM COORDINATE SYSTEM WHICH IS LOCATED AT THE AXAF LAUNCH POSITION AT ASSEMBLY ROOM TEMPERATURE.
7. GSE TEST CONNECTOR ENVELOPE.
8. VAC HOSE PORT LOCATION.
9. FLCA CABLE EXIT LOCATION, APPROXIMATELY AS SHOWN. LENGTH 13.0± .25 TO MATING SURFACE OF 44 PIN SUBMINIATURE D CONNECTOR. CONNECTOR IS CFE.
10. FLIGHT CONNECTOR LOCATION.
11. MAXIMUM STATIC ENVELOPE SHOWN FOR XUV STRAY LIGHT SHIELD EXCLUDING CONTAMINATION SEAL.
12. SURVIVAL HEATER CONNECTOR INTERFACE.
13. CONTAMINATION SEAL MAXIMUM STATIC ENVELOPE SHOWN IN DETAIL F. DATUM E IS THE CENTER HOLE (DATUM E) OF FIXTURE 533571-500.
14. REFERENCE MIRROR MOUNTED ON INSTRUMENT DOOR IN APPROXIMATE LOCATION SHOWN (Z=0.00, Y=0.00). MIRROR CLEAR APERTURE ⌀60 MM.
15. HRC GROUND WIRE ATTACHMENT POINTS: ⌀.250-20 UNC ; .75" MAX. HGT.
16. DIMENSIONS APPLY TO OPENINGS IN BOTH FACE SHEETS AND INSIDE SURFACE OF SEALING LAND.
17. DIMENSION IS VERIFIED VIA FIT-CHECK TO BASD PLATE (REF. 538863) AND OTHER CHECKS SUCH AS THE DRILL TEMPLATE, ETC.
18. DIMENSIONS WILL BE VERIFIED USING SNOUT FIT-CHECK FIXTURE



REVISIONS
- INITIAL RELEASE; REVISED AND REDRAWN FROM BALL DRAWING 530899. INCORPORATES PIRN CM07A-036B PIRN 20-0006 (IRN 5) AND PIRN 20-0057A (IRN 55)

INTERFACE CONTROL DRAWING - HRC
CONTRACT NO. NS8-37710
DRAWN BOB LEYNER
SIZE E CAGE CODE 11982 DWG NO. 301476 REV -
SCALE NTS SHEET 1 OF 2
HRC_Envelope_2_0068.dwg

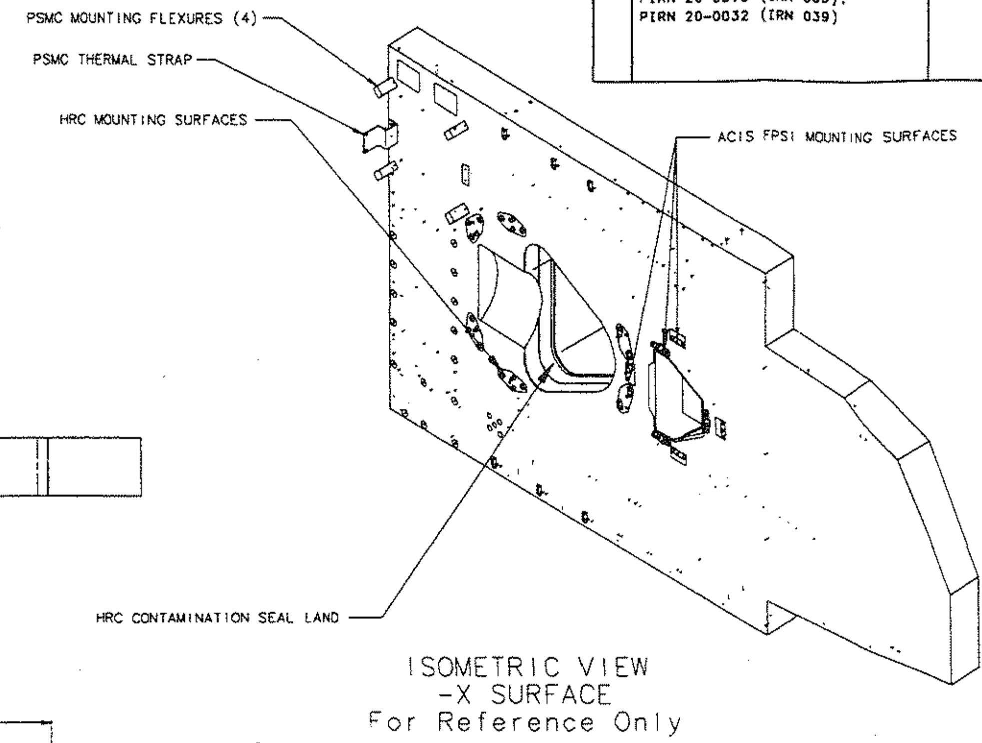


IRN 055
(PIRN
20-0057A)
ENTIRE
PAGE

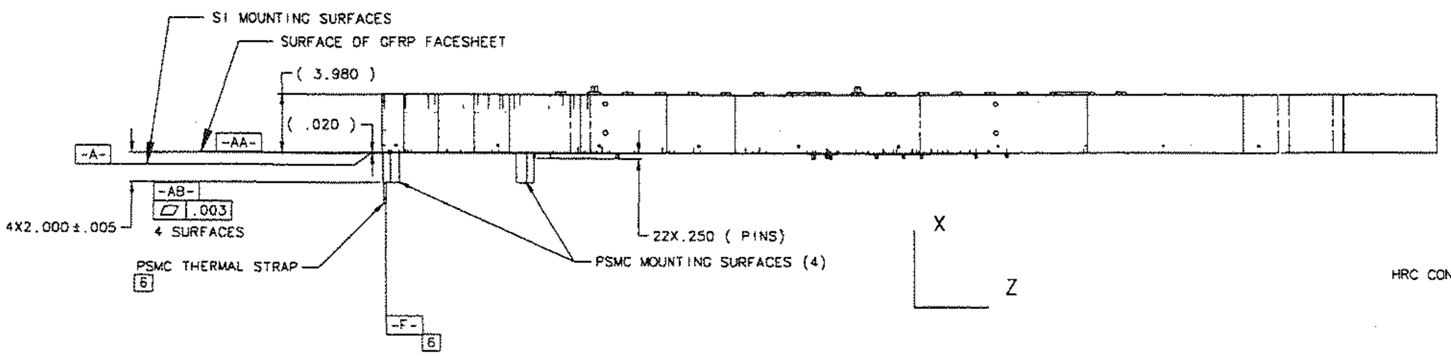
REV	DESCRIPTION	DATE	APPROVED
-	INITIAL RELEASE: INCORP. PIRN 20-0007 (IRN 006). PIRN 20-0010 (IRN 003). PIRN 20-0032 (IRN 039)	97-03-07	

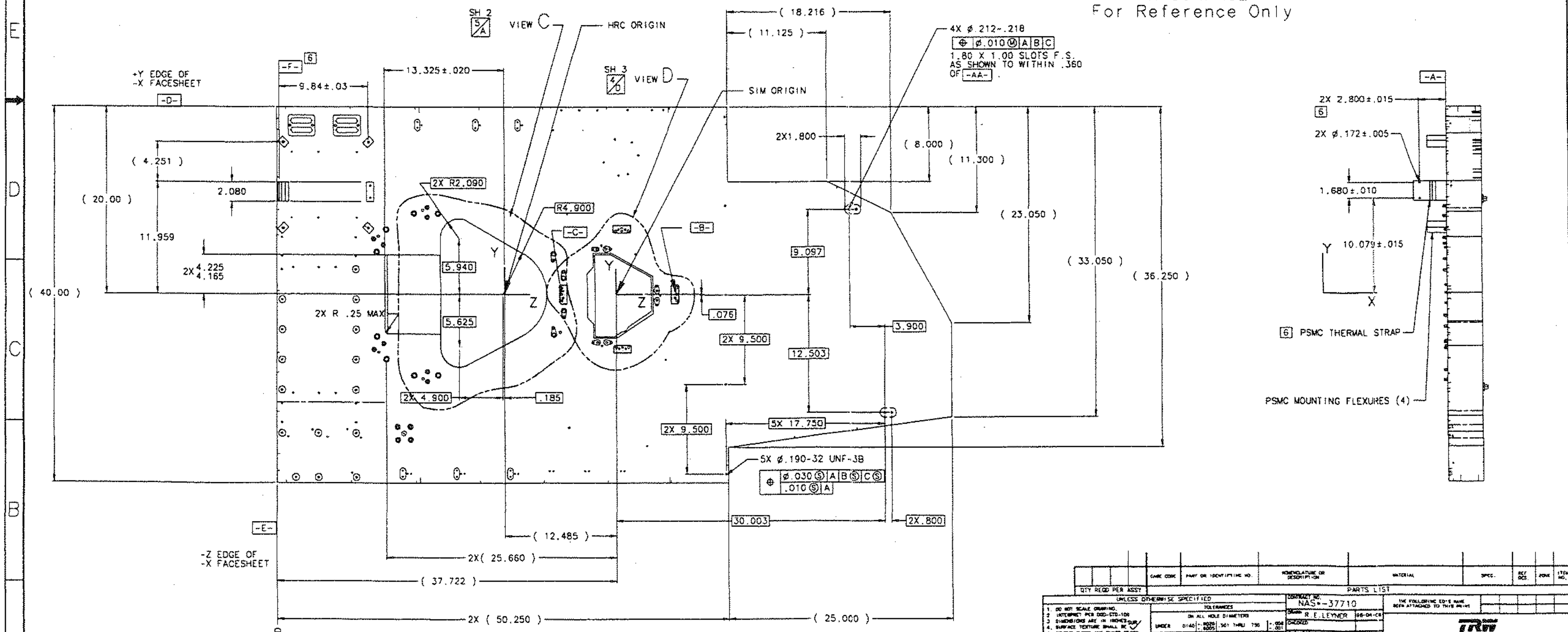
NOTES: UNLESS OTHERWISE SPECIFIED

1 DATUM A REPRESENTS THE MOUNTING PLANE FOR THE SCIENCE INSTRUMENTS. EACH INSERT SURFACE IS .020" ABOVE THE DATUM AA WHICH REPRESENTS THE TOP SURFACE OF THE TABLE COMPOSITE STRUCTURE.
2 ACIS FOCAL PLANE SCIENCE INSTRUMENT MOUNTING: ⌀.250-28UNF-3B LOCKING INSERTS PER MS21209-F4-15.
3 HRC MOUNTING: ⌀.375-24UNF-3B, LOCKING INSERT PER MS 21209-F6-15.
4 TRANSITION TABLE OPENING PROFILE APPLIES TO BOTH FACE SHEETS AND SEALING LAND.
5 BASD TRANSLATION TABLE DRAWING 530931 USED AS PRIMARY SOURCE FOR DIMENSIONS.
6 PSMC THERMAL STRAP INTERFACE TO THE PSMC BASEPLATE. THERMAL STRAP IS 2.080±.015 WIDE BY .100±.010 THICK COPPER PER BASD DRAWING 530969.
7 DIMENSIONS SHOWN ARE FOR THE PSMC THERMAL STRAP TO TRANSLATION TABLE FASTENERS AND ARE FOR REFERENCE ONLY.
8 LOCATIONS OF THREADED INSERTS AND ALIGNMENT PINS IN THE TRANSLATION TABLE ARE CONTROLLED BY THE COI MASTER TEMPLATE (COI DRAWING # 01J250).
9 ALIGNMENT PINS AT LOCATIONS MARKED 'A' ARE MS 16555 PINS WITH FLATS AS DESCRIBED IN DETAILS H,G,K, AND L.



ISOMETRIC VIEW
-X SURFACE
For Reference Only





PARTS LIST

UNLESS OTHERWISE SPECIFIED

CONTRACT NO. NAS8-37710

DRAWN R.E.LEYNER

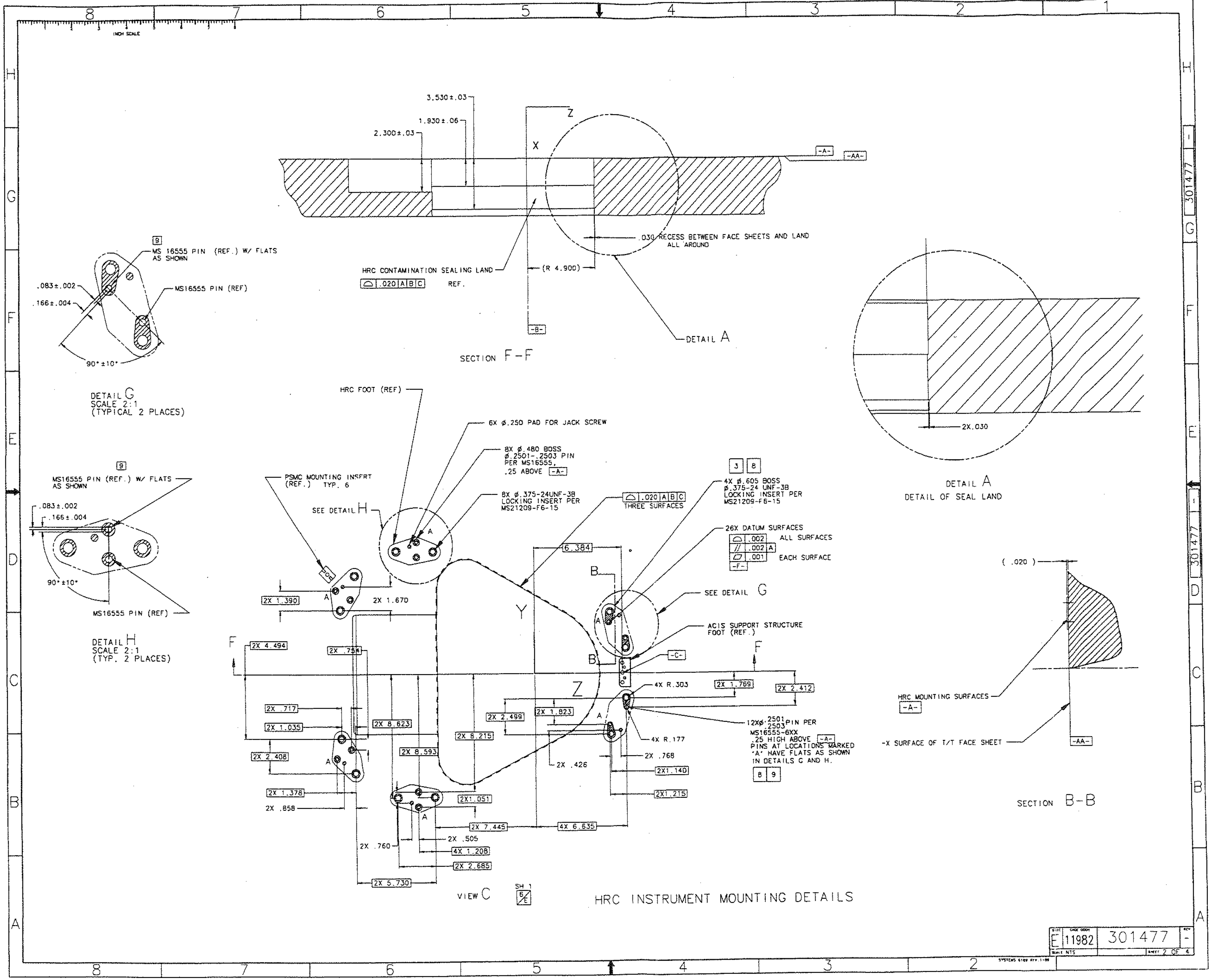
TRW

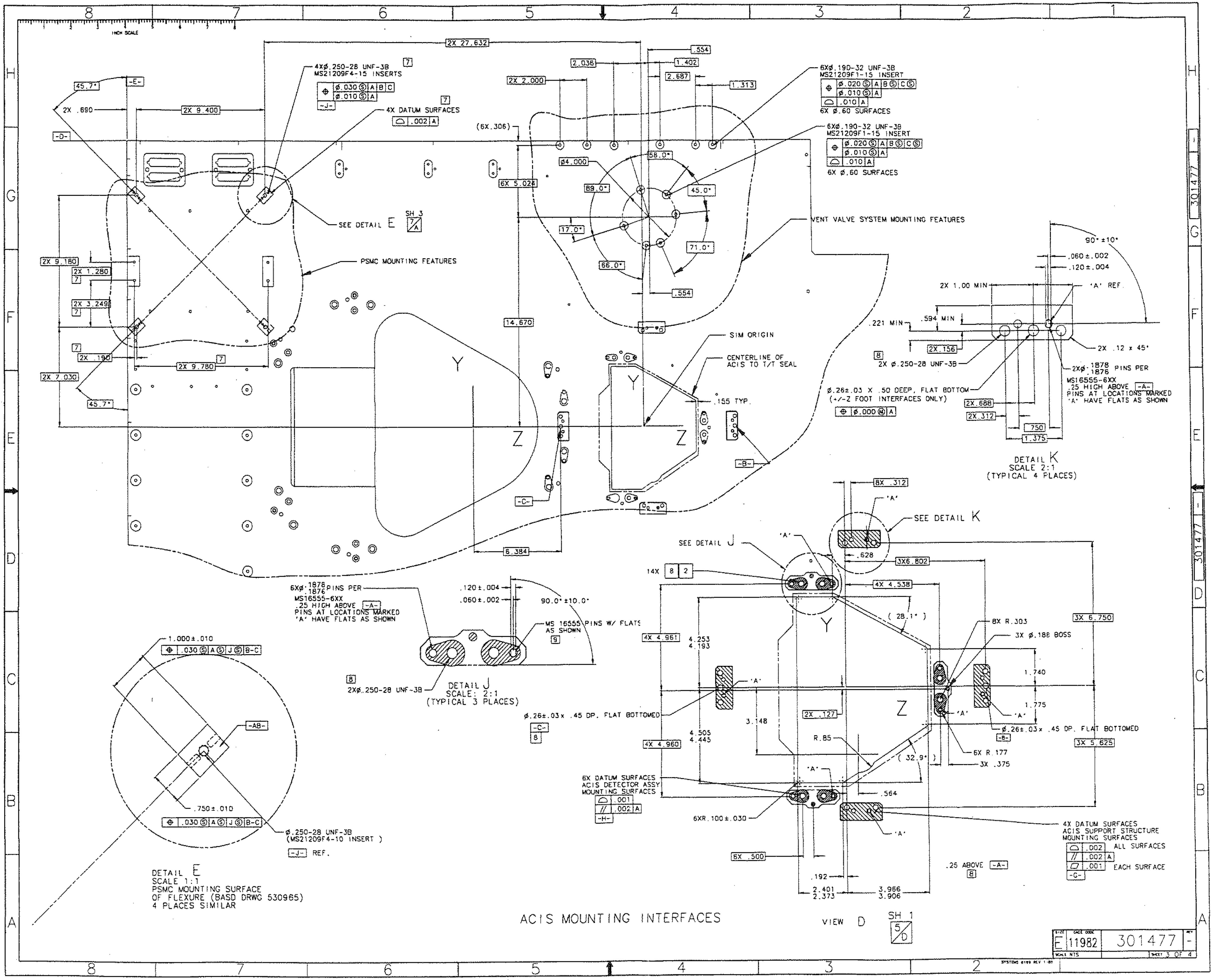
INTERFACE CONTROL DRAWING-TRANSLATION TABLE TO FPSI'S

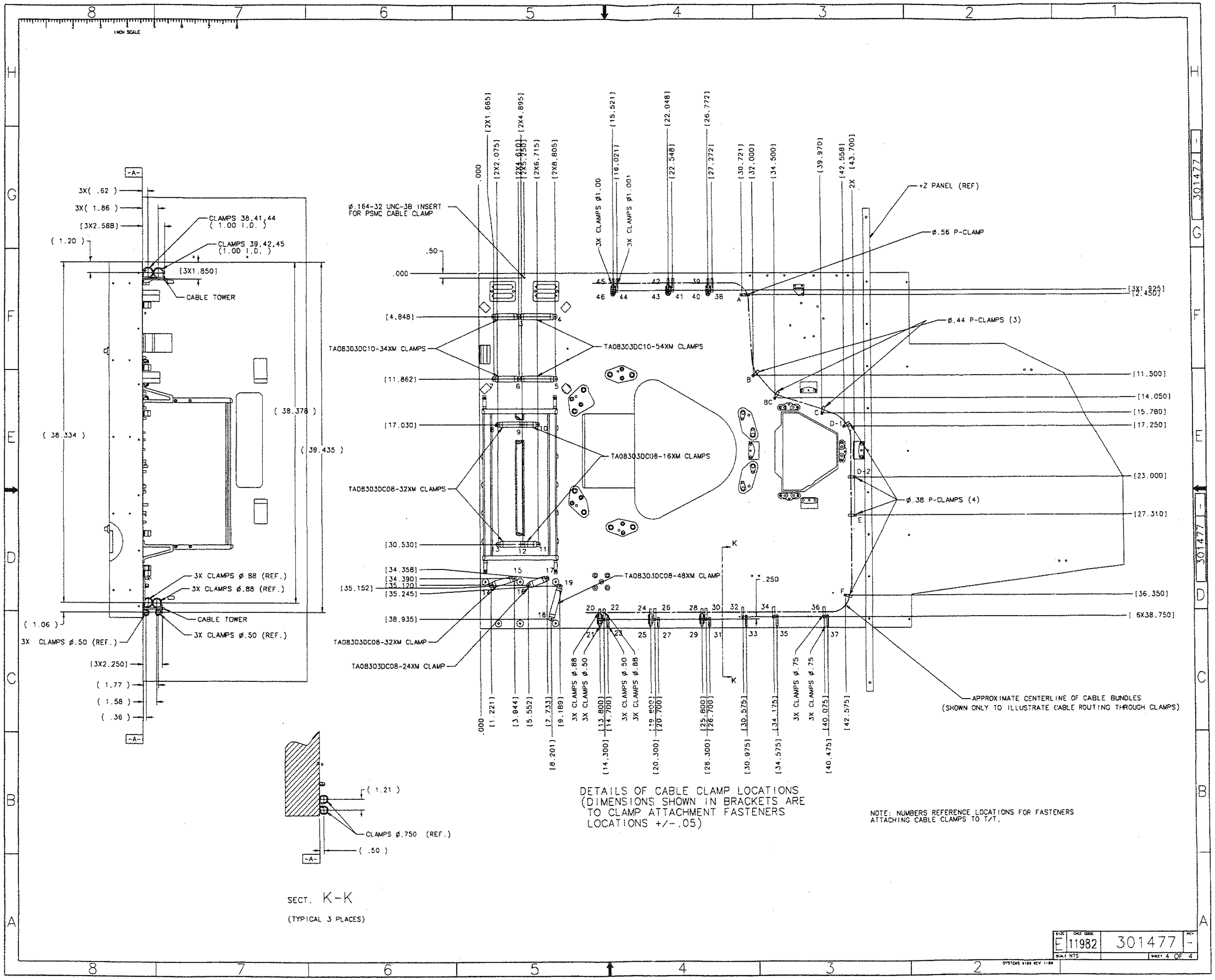
SIZE E CAGE CODE 11982 DWG NO. 301477 REV -

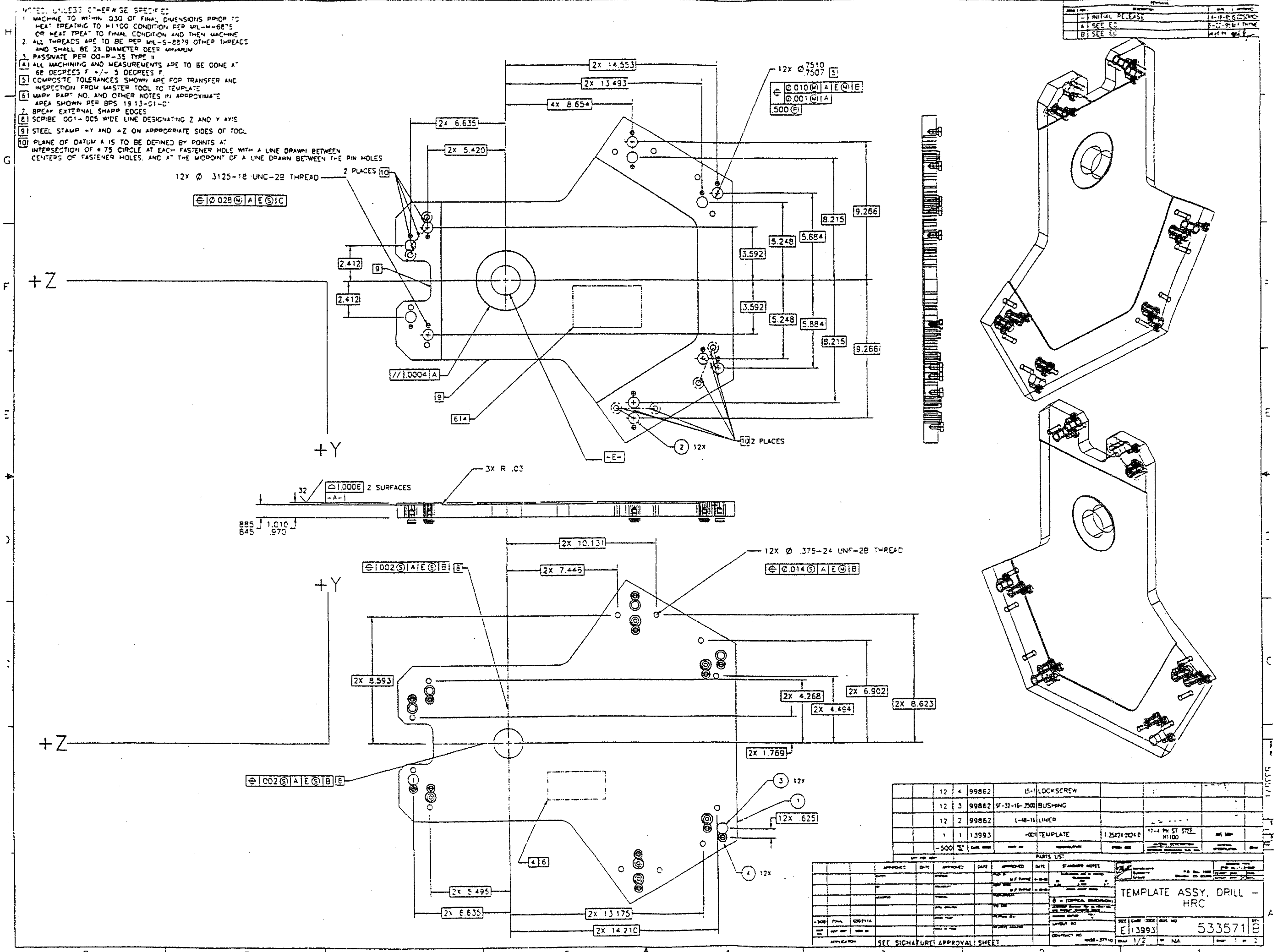
SCALE NTS SHEET 1 OF 4

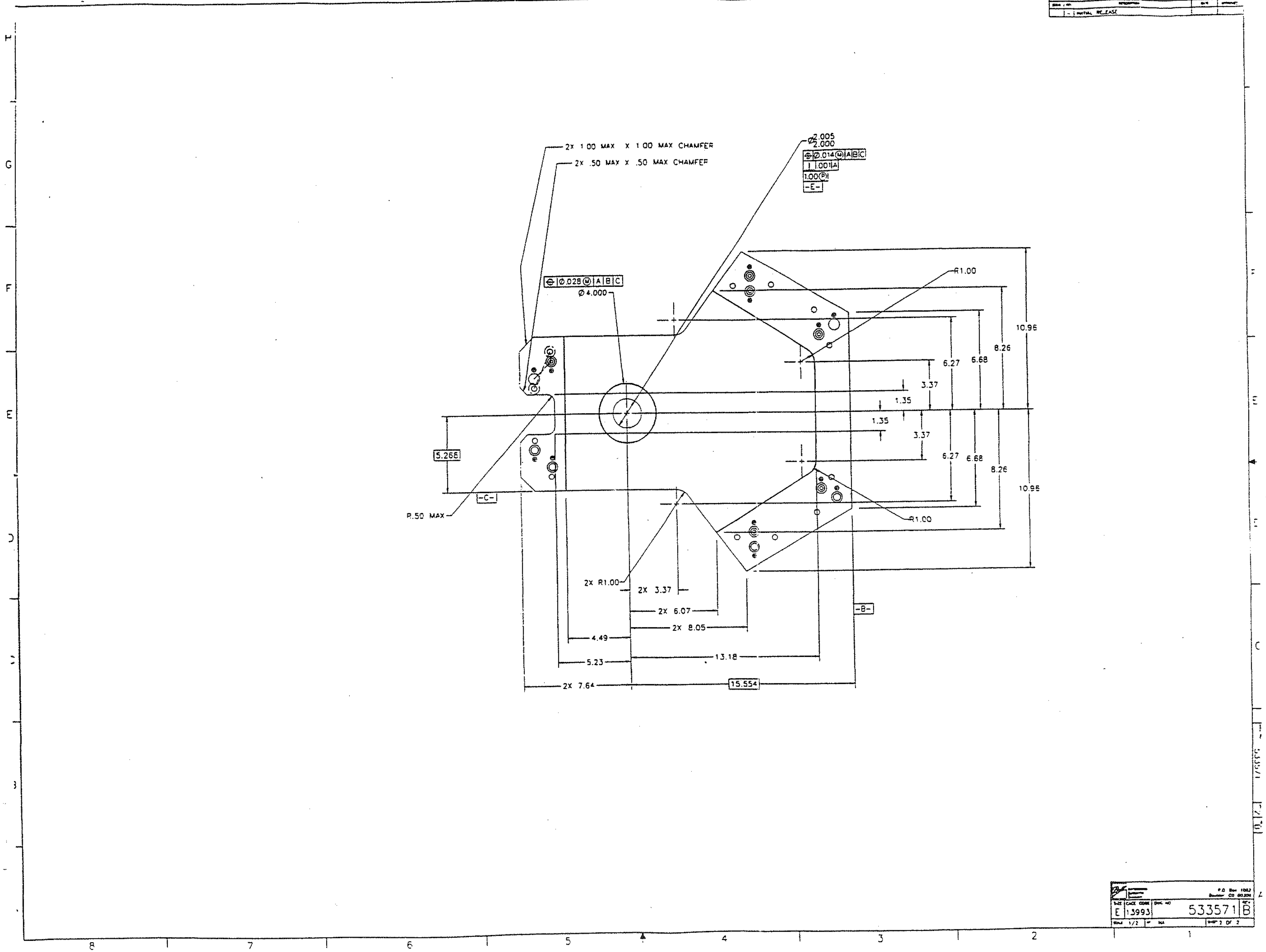
TRW-TRANSLATION_TABLE_0033.DWG

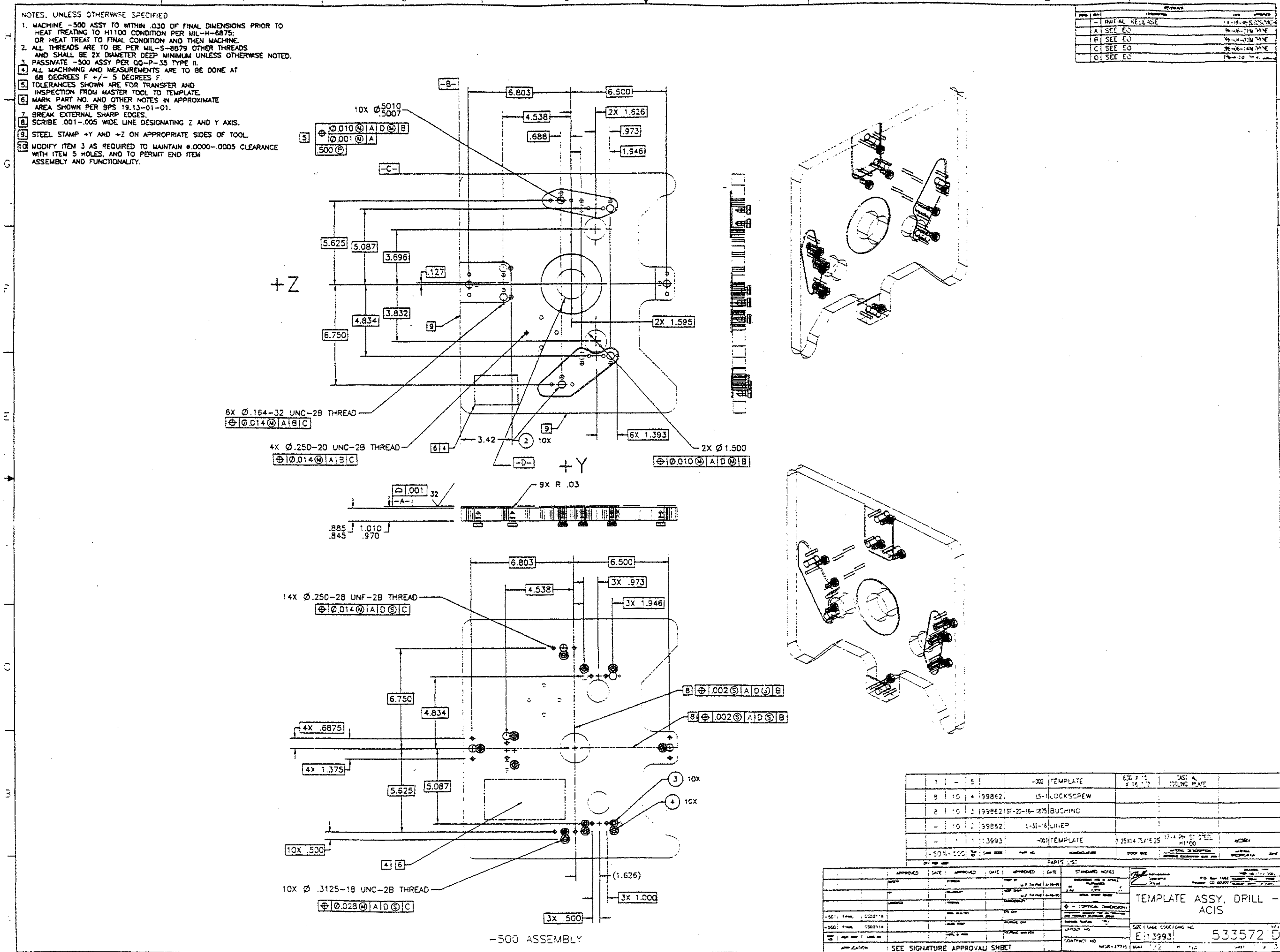

3.530±.03
1.930±.06
2.300±.03
Z
X
-A-
-AA-
.030 RECESS BETWEEN FACE SHEETS AND LAND ALL AROUND
HRC CONTAMINATION SEALING LAND
.020 A B C REF.
(R 4.900)
-B-
DETAIL A
SECTION F-F
9
MS 16555 PIN (REF.) W/ FLATS AS SHOWN
MS16555 PIN (REF)
.083±.002
.166±.004
90°±10°
DETAIL G
SCALE 2:1
(TYPICAL 2 PLACES)
2X.030
DETAIL A
DETAIL OF SEAL LAND
HRC FOOT (REF)
6X ⌀.250 PAD FOR JACK SCREW
8X ⌀.480 BOSS
⌀.2501-.2503 PIN
PER MS16555,
.25 ABOVE -A-
8X ⌀.375-24UNF-3B
LOCKING INSERT PER
MS21209-F6-15
PSMC MOUNTING INSERT (REF.) TYP. 6
SEE DETAIL H
.020 A B C THREE SURFACES
3 8
4X ⌀.605 BOSS
⌀.375-24 UNF-3B
LOCKING INSERT PER
MS21209-F6-15
26X DATUM SURFACES
.002 ALL SURFACES
.002 A
.001 EACH SURFACE
-F-
SEE DETAIL G
ACIS SUPPORT STRUCTURE FOOT (REF.)
-C-
9
MS16555 PIN (REF.) W/ FLATS AS SHOWN
.083±.002
.166±.004
90°±10°
MS16555 PIN (REF)
DETAIL H
SCALE 2:1
(TYP. 2 PLACES)
6.384
B
Y
2X 1.390
2X 1.670
F
2X 4.494
2X .754
4X R.303
2X 1.769
2X 2.412
Z
2X .717
2X 1.035
2X 8.623
2X 2.499
2X 1.823
2X 8.215
2X 8.593
2X 2.408
2X 1.378
2X .858
4X R.177
2X .768
2X .426
2X1.140
2X1.215
2X1.051
2X 7.445
4X 6.635
2X .505
2X .760
4X 1.208
2X 2.685
2X 5.730
12X⌀.2501/.2503 PIN PER
MS16555-6XX
.25 HIGH ABOVE -A-
PINS AT LOCATIONS MARKED
"A" HAVE FLATS AS SHOWN
IN DETAILS G AND H.
8 9
(.020)
HRC MOUNTING SURFACES
-A-
-X SURFACE OF T/T FACE SHEET
-AA-
SECTION B-B
VIEW C
SH 1 6/E
HRC INSTRUMENT MOUNTING DETAILS
E 11982 301477 -
SCALE NTS SHEET 2 OF 4

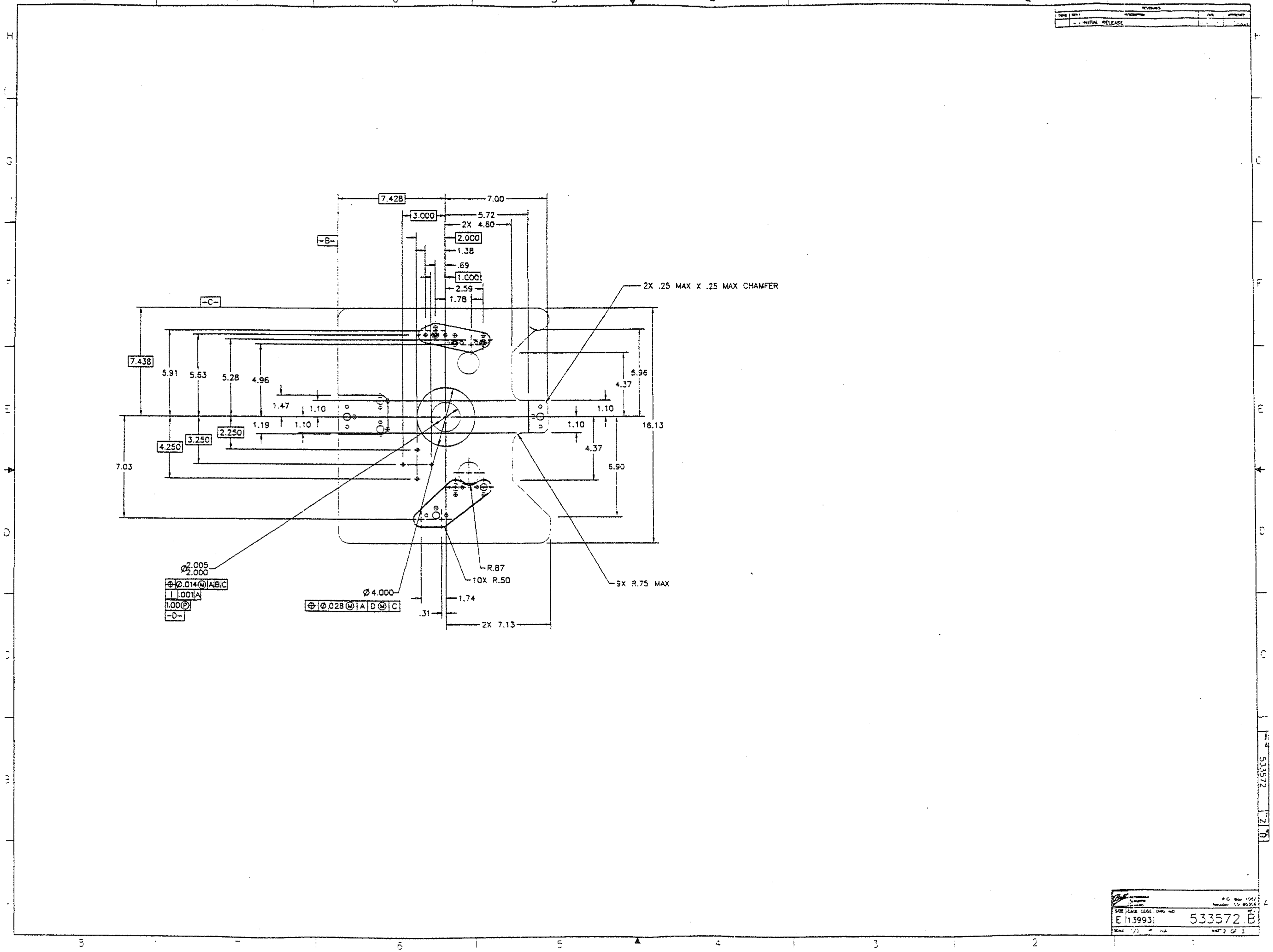

ACIS MOUNTING INTERFACES
PSMC MOUNTING FEATURES
VENT VALVE SYSTEM MOUNTING FEATURES
SEE DETAIL E
SIM ORIGIN
CENTERLINE OF ACIS TO T/T SEAL
DETAIL E
SCALE 1:1
PSMC MOUNTING SURFACE OF FLEXURE (BASD DRWG 530965)
4 PLACES SIMILAR
DETAIL J
SCALE: 2:1
(TYPICAL 3 PLACES)
DETAIL K
SCALE 2:1
(TYPICAL 4 PLACES)
SEE DETAIL J
SEE DETAIL K
VIEW D
6X DATUM SURFACES ACIS DETECTOR ASSY MOUNTING SURFACES
4X DATUM SURFACES ACIS SUPPORT STRUCTURE MOUNTING SURFACES
ALL SURFACES
EACH SURFACE
E 11982 301477 -
SHEET 3 OF 4

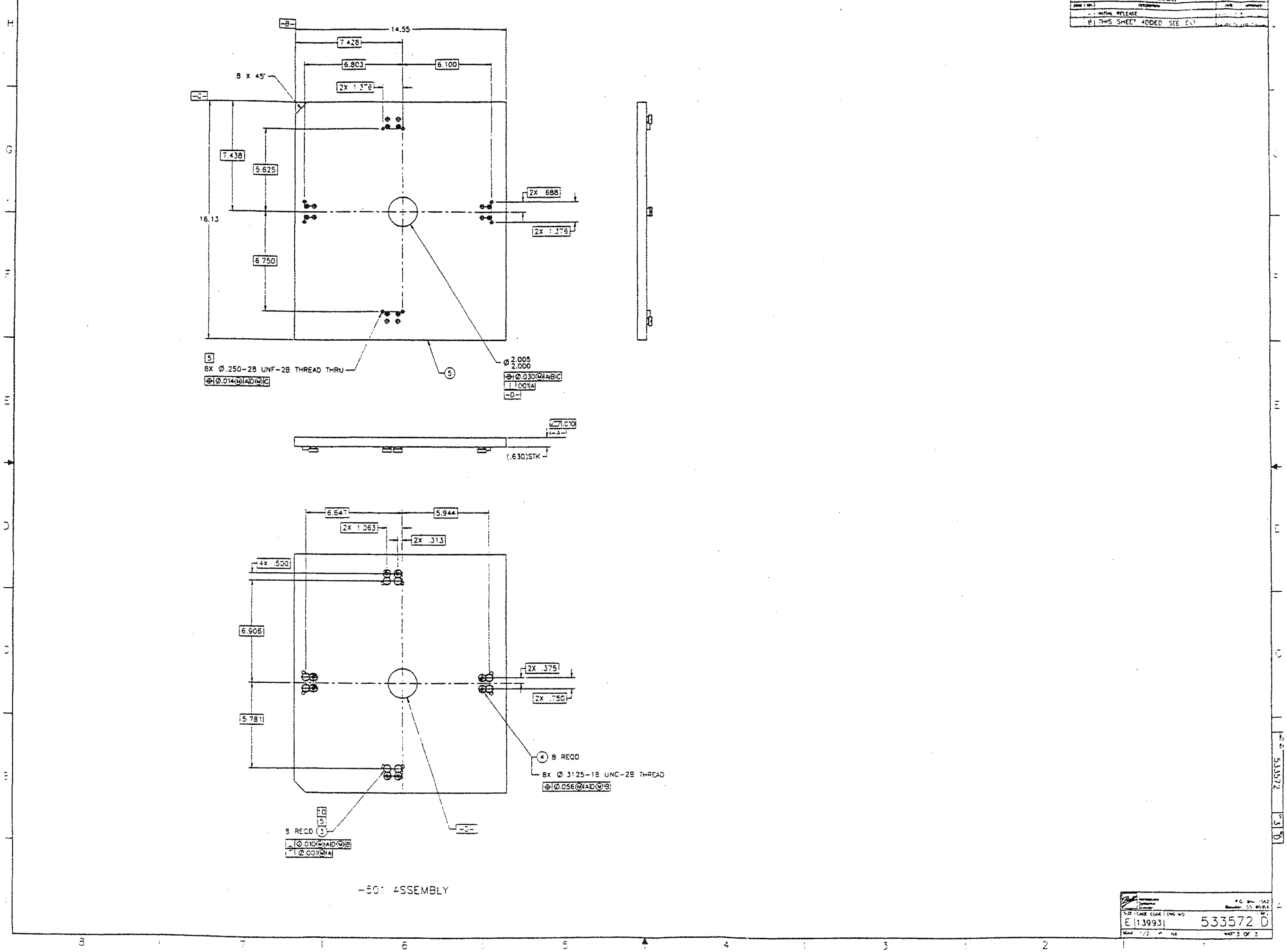

DETAILS OF CABLE CLAMP LOCATIONS
(DIMENSIONS SHOWN IN BRACKETS ARE TO CLAMP ATTACHMENT FASTENERS LOCATIONS +/-.05)
NOTE: NUMBERS REFERENCE LOCATIONS FOR FASTENERS ATTACHING CABLE CLAMPS TO T/T.
SECT. K-K
(TYPICAL 3 PLACES)
CLAMPS ø.750 (REF.)
CLAMPS 38,41,44 (1.00 I.D.)
CLAMPS 39,42,45 (1.00 I.D.)
CABLE TOWER
3X CLAMPS ø.88 (REF.)
3X CLAMPS ø.50 (REF.)
ø.164-32 UNC-3B INSERT FOR PSMC CABLE CLAMP
TA08303DC10-34XM CLAMPS
TA08303DC10-54XM CLAMPS
TA08303DC08-16XM CLAMPS
TA08303DC08-32XM CLAMPS
TA08303DC08-48XM CLAMP
TA08303DC08-32XM CLAMP
TA08303DC08-24XM CLAMP
+Z PANEL (REF)
ø.56 P-CLAMP
ø.44 P-CLAMPS (3)
ø.38 P-CLAMPS (4)
APPROXIMATE CENTERLINE OF CABLE BUNDLES (SHOWN ONLY TO ILLUSTRATE CABLE ROUTING THROUGH CLAMPS)
E 11982 301477 -
SHEET 4 OF 4

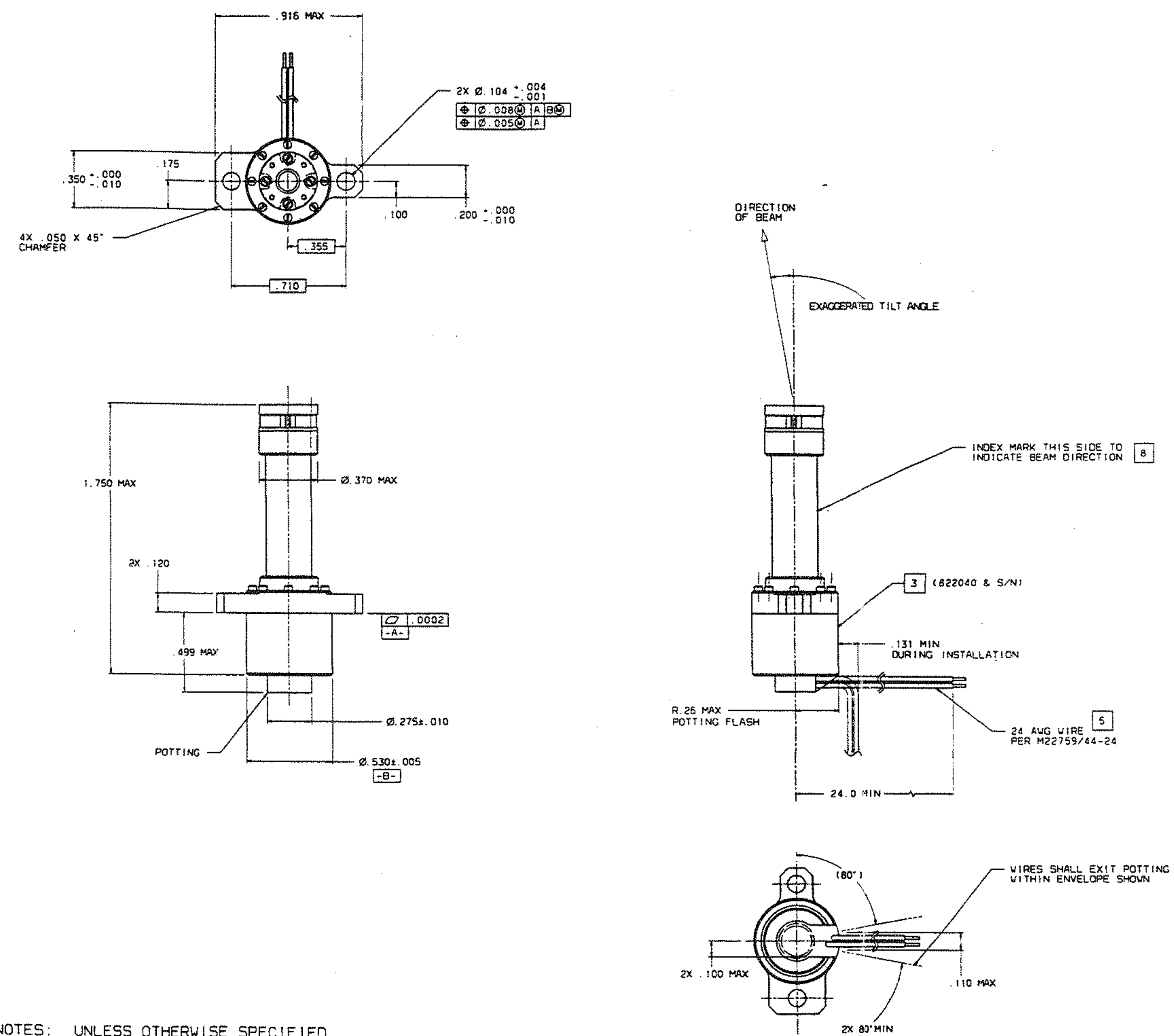

NOTES: UNLESS OTHERWISE SPECIFIED
1 MACHINE TO WITHIN .030 OF FINAL DIMENSIONS PRIOR TO HEAT TREATING TO H1100 CONDITION PER MIL-H-6875 OR HEAT TREAT TO FINAL CONDITION AND THEN MACHINE
2. ALL THREADS ARE TO BE PER MIL-S-8879 OTHER THREADS AND SHALL BE 2X DIAMETER DEEP MINIMUM
3. PASSIVATE PER QQ-P-35 TYPE II
4 ALL MACHINING AND MEASUREMENTS ARE TO BE DONE AT 68 DEGREES F +/- 5 DEGREES F.
5 COMPOSITE TOLERANCES SHOWN ARE FOR TRANSFER AND INSPECTION FROM MASTER TOOL TO TEMPLATE
6 MARK PART NO. AND OTHER NOTES IN APPROXIMATE AREA SHOWN PER BPS 19.13-01-01
7. BREAK EXTERNAL SHARP EDGES
8 SCRIBE .001-.005 WIDE LINE DESIGNATING Z AND Y AXIS
9 STEEL STAMP +Y AND +Z ON APPROPRIATE SIDES OF TOOL
10 PLANE OF DATUM A IS TO BE DEFINED BY POINTS AT INTERSECTION OF Ø.75 CIRCLE AT EACH FASTENER HOLE WITH A LINE DRAWN BETWEEN CENTERS OF FASTENER HOLES, AND AT THE MIDPOINT OF A LINE DRAWN BETWEEN THE PIN HOLES
12X Ø .3125-18 UNC-2B THREAD
2 PLACES
+Z
+Y
12X Ø.7510/.7507
2X 14.553
2X 13.493
4X 8.654
2X 6.635
2X 5.420
2.412
3.592
5.248
5.884
8.215
9.266
12 PLACES
12X
-E-
3X R .03
2 SURFACES
-A-
.885 .845
1.010 .970
12X Ø .375-24 UNF-2B THREAD
2X 10.131
2X 7.445
2X 8.593
2X 4.268
2X 4.494
2X 6.902
2X 8.623
2X 1.769
12X .625
2X 5.495
2X 13.175
2X 14.210
INITIAL RELEASE
SEE EC
12 | 4 | 99862 | 15-1 | LOCKSCREW
12 | 3 | 99862 | SF-32-16-2500 | BUSHING
12 | 2 | 99862 | L-48-16 | LINER
1 | 1 | 13993 | -001 | TEMPLATE | 17-4 PH ST STL H1100
PARTS LIST
TEMPLATE ASSY, DRILL - HRC
E 13993
533571 B
SEE SIGNATURE APPROVAL SHEET


2x 1.00 MAX X 1.00 MAX CHAMFER
2x .50 MAX X .50 MAX CHAMFER
Ø2.005 2.000
Ø.014 Ⓜ A B C
.001 A
1.00 Ⓟ
-E-
Ø.028 Ⓜ A B C
Ø4.000
R1.00
10.96
8.26
6.68
6.27
3.37
1.35
1.35
3.37
6.27
6.68
8.26
10.96
R1.00
5.266
-C-
R.50 MAX
2x R1.00
2x 3.37
2x 6.07
2x 8.05
-B-
4.49
5.23
13.18
2x 7.64
15.554
E
13993
533571
B


NOTES, UNLESS OTHERWISE SPECIFIED
1. MACHINE -500 ASSY TO WITHIN .030 OF FINAL DIMENSIONS PRIOR TO HEAT TREATING TO H1100 CONDITION PER MIL-H-6875; OR HEAT TREAT TO FINAL CONDITION AND THEN MACHINE.
2. ALL THREADS ARE TO BE PER MIL-S-8879 OTHER THREADS AND SHALL BE 2X DIAMETER DEEP MINIMUM UNLESS OTHERWISE NOTED.
3. PASSIVATE -500 ASSY PER QQ-P-35 TYPE II.
4 ALL MACHINING AND MEASUREMENTS ARE TO BE DONE AT 68 DEGREES F +/- 5 DEGREES F.
5 TOLERANCES SHOWN ARE FOR TRANSFER AND INSPECTION FROM MASTER TOOL TO TEMPLATE.
6 MARK PART NO. AND OTHER NOTES IN APPROXIMATE AREA SHOWN PER BPS 19.13-01-01.
7. BREAK EXTERNAL SHARP EDGES.
8 SCRIBE .001-.005 WIDE LINE DESIGNATING Z AND Y AXIS.
9 STEEL STAMP +Y AND +Z ON APPROPRIATE SIDES OF TOOL.
10 MODIFY ITEM 3 AS REQUIRED TO MAINTAIN ø.0000-.0005 CLEARANCE WITH ITEM 5 HOLES, AND TO PERMIT END ITEM ASSEMBLY AND FUNCTIONALITY.
+Z
+Y
10X Ø.5010 .5007
6X Ø.164-32 UNC-2B THREAD
4X Ø.250-20 UNC-2B THREAD
2X Ø1.500
9X R .03
14X Ø.250-28 UNF-2B THREAD
10X Ø .3125-18 UNC-2B THREAD
-500 ASSEMBLY
INITIAL RELEASE
SEE EO
TEMPLATE
LOCKSCREW
BUSHING
LINER
PARTS LIST
SEE SIGNATURE APPROVAL SHEET
TEMPLATE ASSY, DRILL - ACIS
533572 D


7.428
7.00
3.000
5.72
2X 4.60
2.000
1.38
.69
1.000
2.59
1.78
-B-
-C-
2X .25 MAX X .25 MAX CHAMFER
7.438
5.91
5.63
5.28
4.96
1.47
1.10
1.19
1.10
2.250
3.250
4.250
7.03
5.96
4.37
1.10
16.13
1.10
4.37
6.90
Ø2.005 2.000
Ø.014 Ⓜ A B C
.001 A
1.00 Ⓟ
-D-
Ø4.000
Ø.028 Ⓜ A D Ⓜ C
R.87
10X R.50
1.74
.31
2X 7.13
9X R.75 MAX
INITIAL RELEASE
E 13993
533572 B


14.55
7.428
6.803
6.100
8 X 45°
7.438
5.625
16.13
6.750
2X .688
8X Ø.250-28 UNF-2B THREAD THRU
Ø 2.005
2.000
(.630)STK
6.647
5.944
2X 1.063
2X .313
4X .500
6.906
5.781
2X .375
2X .750
8 REQD
8X Ø 3125-18 UNC-2B THREAD
-601 ASSEMBLY
INITIAL RELEASE
THIS SHEET ADDED SEE
E 13993
533572 D
SHEET 3 OF 3



NOTES: UNLESS OTHERWISE SPECIFIED

1. UNIT WEIGHT SHALL NOT EXCEED 30 GRAMS.
2. UNIT DISSIPATED POWER SHALL NOT EXCEED 40 MILLIWATT. WHEN OPERATING AT 20mA.
3. ASSEMBLY IDENTIFICATION BY PART NO. (822040) MARKING IN ACCORDANCE WITH MIL-STD-130. LOCATE APPROXIMATELY IN AREA INDICATED.
4. MATERIAL: ALUMINUM 6061-T6.
5. WIRE CODING: BLACK - CATHODE RED - ANODE
6. EXTERIOR SURFACE FINISH PER MIL-A-8625, TYPE III, EXCEPT SURFACE -A-, CHEM FILMED PER MIL-C-5541, CLASS 1A.
7. SINCE THIS FIDUCIAL LIGHT IS NOT INSTALLED BY A TRW DRAWING, THE FOLLOWING INFORMATION IS PROVIDED FOR REFERENCE: THE FIDUCIAL LIGHT WILL BE INSTALLED IN THE ACIS SCIENCE INSTRUMENT 36-10100(ACIS) AND LOCATED PER 301438(TRW) FID LIGHT ICD. THE ACIS IS INSTALLED BY BALL 530900(SIM) INTO THE INTEGRATED SCIENCE INSTRUMENT MODULE (ISIM). THE ISIM WILL BE INSTALLED ON THE TELESCOPE BY TRW DRAWING 301420.
8. INK STAMP A WHITE DOT .050±.030 ON BARREL OF FIDUCIAL LIGHT, IN ACCORDANCE WITH MIL-STD-130. LOCATE APPROXIMATELY IN AREA INDICATED.

CONTRACT NO. NAS8-37710

A. P. BALZ
K. KROENING
J. STARKUS
J. DONAHY
S. WALLACE
D. LINDEMAN
S. TJIA

TRW

INTERFACE CONTROL DRAWING-
FIDUCIAL LIGHT, ACIS

E 11982 822022

SCALE 4/1 SHEET 1 OF 1

AXAF