JPL Hardware Requirements Certification Review (HRCR)- Flight Spare (FS) Spectrometer Short Wavelength (SSW) Bolometer Detector Assembly (BDA)

10209800-5 S/N 016

SPIRE Element
Herschel Space Observatory Project

July 15, 2005

Change Log

Issue	Date	Section	Changes
1.0	15 July 05		Initial version (HRCR review)
1.1	30 Aug. 05	1	Attached scan of signed form
		3	Removed DQE issue, added RFW-022 reference
		5	Corrected ECR numbers, included ECR-003 and images of signed PDFs.
		6	Removed RFW-002v1
		6	Added RFW-022 and imagaes of signed rfw's.
		8	Added spectrometer filter replacement procedure
		8	Updated General Handling document
		14	Added 300mK Filter EIDP
		14	Added feedhorn data

CONTENTS

	SECTION
Hardware Requirements Certification Review (HRCR) Form	**1**
Difference List	
Final Inspection Report (IR)	**2**
Issues	**3**
M. Herman 15 May 2003 memo (fasteners for vibe. tests)	
Top Level Assembly Drawings	**4**
ECRs / NCRs	**5**
HR-SP-JPL-ECR-003 (300mK filter clamp fixing holes)	
HR-SP-JPL-ECR-007 (Spectrometer BDA envelope height)	
HR-SP-JPL-ECR-005v2 (Kapton Cable routing design error)	
HR-SP-JPL-NCR-007 (PMW and PSW focal position shift)	
Waivers	**6**
HR-SP-JPL-RFW-005v1 (Sine Vibe Omission)	
HR-SP-JPL-RFW-006 (Vibration Test Levels)	
HR-SP-JPL-RFW-022 (BDA Vibration Test Temperature)	
Open Problem / Failure Reports (PFR)	**7**
This Hardware: (None)	
Similar Hardware: (None)	
Handling Documents	**8**
General / Unpacking	
Filter Replacement Procedure	
Electronic	
Environmental Requirements Verification Matrix	**9**
Performance Data Matrix	**10**
Qualification Status	**11**
Connector Mate and Operation Logs	**12**
Mechanical & Electrical ICDs	**13**
Other Data	**14**
Material List (MIUL) Coverpage	
Detector Backshort / Frontshort Data	
Alignment Measurement Summary	
Feedhorn Data	
300mK Spectrometer Filter EIDP	

RAL EIDP Table Of Contents Vs. HRCR Contents

EIDP Section	EIDP	HRCR Box #	Comments/Notebook Section
1	Shipping Documents		Shipper and Final IR
2	Transportation, Packing, Handling & Integration Procedures	20	Section 8
3	Certificate of Conformance / Delivery Review Board MoM		HRCR form is the CofC
4	As Built Configuration Status List	1	
5	List of Waivers	16	Section 6
6	Copies of Waivers	16	Section 6
7	List of Non-Conformance Reports	17, 18	Section 5
8	Copies of Non-Conformance Reports	17, 18	
9	Cleanliness Statement	10	Final IR includes inspection for conformance with cleanliness requirement (particulates)
10	Operational Manual	20	
11	Top Level Drawings (inc. Family Tree)	14	Section 4
12	Interface Drawings	26	Section 13
13	Functional, Block & Mechanical Drawings	14	Section 4
14	Electrical Circuit Drawings		See Electrical Handling Doc.
15	Serialized Components List		In the build books – not shipped
16	Mass Properties/ Power Budget		Mass found in header of HRCR
17	Qualification Status List / Test Matrix	22	Qual. Report to be supplied later, Summary in Section 11
18	Test Reports		To be supplied later, Summaries in Sections 9 and 10
19	Open Work / Deferred Work / Open Tests	5	
20	Calibration Data		Section 10
21	Historical Record		Section 12
22	Manufacturing Logbook(s)	--	To be retained at JPL
23	Operating Time / Cycle Record	24	Section 12
24	Connector Mating Record	24	Section 12
25	Age Sensitive Items Record		NA for BDA
26	Pressure Vessels – History/Test Record		NA
27	Temporary Installation Record		Section 12
28	Reference List of EIDPs (Lower level)		300mK Filter EIDP - Section 14
29	Other Useful Information		Section 14

JPL Hardware Requirements Certification Review – SPIRE Element #D-32366

Assembly/Subsystem	PEM	Phone	Section	Date
SPIRE	Martin Herman	(818) 354-8541	385	15 July, 2005

Drawing/ Part No.	Dwg. Rev.	Nomenclature	Serial No.	Model	Type	Final IR No.	Mass (grams) As Meas. / Req.
10209800-5	B	Bolometer Detector Assembly	016	FS	SSW	926212	485 g / 510 g

Check applicable answer and give necessary explanation in remarks column	Yes	No	N/A	Remarks
1. Are all drawings and specifications complete, approved, released and frozen?	X			
2. Do the released drawings and specifications reflect all approved changes?	X			
3. Is hardware identical to other hardware delivered? If no, provide difference list.		X		Previous Hardware was PFM SSW BDA S/N009. See difference list attached
4 Does the hardware meet the requirement of its functional requirements, specifications, waivers and/or ICDs ? If no, provide difference list.	X			See Issues (section 3). See section 10 for detector performance matrix.
5. Have all IR discrepancies and MRBs been dispositioned and agreed to by Engineering/ QA ?	X			
6. Is complete as-built list information included in the build book?	X			
7. Have all required environmental tests & analyses been completed?	X			See section 9.
8. Is all required assembly and/or subsystem level functional testing complete?	X			
9. Have all piece parts, processes and materials been approved by JPL?	X			See MIUL coverpage in section 14.
10. Does this hardware meet all contamination control requirements?	X			
11. Are all required shipping containers, shipping procedures, and special handling procedures ready?	X			See section 8 for handling procedures.
12. Is additional work required to bring this hardware to flight readiness?		X		
13. Is this hardware acceptable for flight ?	X			

Data Attachments (Package Sec. #)	Signature Approval & Date
14. Latest Top Assembly Drawings ☒ Attached ☐ None (Sec. 4)	Cog E 7-15-05
15. List of open ECRs ☒ Attached ☐ None (Sec. 5)	PEM R. Vaquez (for M. Herman) 7/15/05
16. Waivers ☒ Attached ☐ None (Sec. 6)	QA Engineer 7-15-05
17. Open MRBs ☐ Attached ☒ None (N/A)	Environments/Reliability 7/15/05
18. Open P/FRs on this H/W ☐ Attached ☒ None (Sec. 7)	Mission Assurance Mgr. 7/15/05
19. Open P/FRs on similar H/W ☐ Attached ☒ None (Sec. 7)	Project 7/15/05
20. Handling Documents ☒ Attached ☐ None (Sec. 8)	PI 7/15/05
21. Shortage List ☐ Attached ☒ None (N/A)	
22. Requirements Verification Matrix ☒ Attached ☐ None (Sec. 9)	
23. Qualification Status ☒ Attached ☐ None (Sec. 11)	
24. Connector Mate / Demate Log ☒ Attached ☐ None (Sec. 12)	
25. Operation Log ☒ Attached ☐ None (Sec. 12)	
26. ICDs ☒ Attached ☐ None (Sec. 13)	

Difference List

Part	Previous hardware: 10209800-5 PFM SSW SN 009	Current hardware 10209800-5 FS SSW SN016	Notes:
10209860 suspension assy.	no side screws into invar spacers	side spacer screws were used	screws had been eliminated in error when the vespel safety spacer was eliminated from the design. Units after SN009 (PFM SSW) have screws installed.
10209890 middle ring assy (part of suspension)	suspension Ring-A is pinned to flexure mounting plate with both old pins and smaller new invar pins.	suspension Ring-A is pinned to flexure mounting plate only new invar pins.	Old pins were partially machined away after assembly in early suspension units (up to suspension SN006). Final design used only the new pins.

*** INSPECTION REPORT ***
Printed Copies are for Reference Only - Please check with PDMS for official version

IR Number 926212

Action BROWSE

Status "IR & IRDI Initiated" IR Instructions

REFERS TO:

Part Number	Dash Number	Revision	Latest Rev	Serial Number	Quantity
10209800-5	(with part number)	B	B	016	1

Nomenclature:	**BOLOMETER DETECTOR ARRAY**		
Prgm/Project:	**HSO-PLANCK**	Inspection Date:	**06-APR-2005**
COGE:	**WEILERT, MARK A.**	ECO/ECI:	
QAE:	**HUGHES, SCOTT P.**	Reference Designator:	**SPIRE**
JPL/Mfr:	**JPL**	Lot No.:	
Type of Inspection:	**Final-Ship**	Insp. Std / Spec No.:	
Type of Item:	**Flight**	AIDS No.:	
Location:	**JPL**	Work Order No.:	
Manufacturer:	**JPL**	CAGE Code:	
Supplier:	**JPL**	Receipt No.:	
Parts received by:		Property / ID:	
Received date:		PO/CT No.:	
Qty Accepted:		Line No.:	
Qty Rejected:	**0**	Rel / Mod No.:	
QA Alert?		CAN Required?	
IMTE Code:	**None**	IMTE Number:	
IMTE Code No. 2:	**None**	IMTE Number No. 2:	
IMTE Code No. 3:	**None**	IMTE Number No. 3:	
IMTE Code No. 4:	**None**	IMTE Number No. 4:	
Orig Nomenclature:			

DISCREPANT ITEMS:

Item	Discrep Code	Qty	Zone	S/N	Description	Re-Work	Files

This IR has No Discrepant Items

Item	Disposition	Root Cause Code	Dispo Code	Disp. Appr.	Stamp Date

This IR has No Discrepant Items

Inspection Report Notes:

HARDWARE LISTED ABOVE HAS BEEN COMPLETED INSPECTIONS AND TESTING AND ACCEPTABLE TO DELIVER TO NEXT INTERGRATION RUTHERFORD APPLETON LABORATORY SPACE & SCIENCE TECHNOLOGY DEPT.
CHILTON, DIDCOT OXFORD, ENGLAND UNITED KINGDOM OX11 OQX ATTN: ERIC SAWYER PH#1235 44 6385

	Initiated by	Signed by COGE	Signed by QAE	Closed by
Number of Files Attached 0	Date	Date	Date	Date

Reserved by	Reserved on	Reason

Issues
FS SSW BDA 10209800-5 S/N 016

Configuration:

- The maximum height of 300 mK stage exceeds ICD drawing 10209721 Rev B allowed range by 1.0 mm due to changes in the spectrometer 300 mK filter stack thickness. See attached ECR: HR-SP-JPL-ECR-007 in section 5. This change has been incorporated into Rev-C of the ICD drawing 10209721.

  Several other ECRs related to the BDA hardware have been incorporated into released drawings. These do not apply directly to the SSW BDA type, but they affect the same drawings. They are included for reference:

  - A focus position shift caused by an internal mechanical interference fix was incorporated into ICD drawing 10209721 Rev C per HR-SP-JPL-NCR-007 (attached in in section 5) This is applicable only to -2 (PMW) and -3 (PSW) BDAs.

  - A pixel map modification was incorporated into electrical schematic 10209725 Rev C per HR-SP-JPL-ECR-005v2 (attached in section 5). This is applicable only to -2 (PMW) and -3 (PSW) BDAs. This drawing revision also incorporated JPL ECR 1026751.

Environmental Test:

- Shake tests were performed with non-flight-like 8-32 mounting screws, instead of 6-32. See attached email regarding this issue: (M. Herman, 15 May 2003) -- *This same issue applied to all the previous BDAs.*

- Shake tests were performed in accordance with waivers HR-SP-JPL-RFW-005v1 (Sine Vibration Omission), HR-SP-JPL-RFW-006 (Vibration Test Levels) and HR-SP-JPL-RFW-022 (BDA Vibration Test Temperature). See Waiver List (section 6).

Date: Mon, 11 Aug 2003 16:34:04 -0700
From: Martin Herman <Martin.I.Herman@jpl.nasa.gov>
Subject: Waiver Request (vibration fastners)
X-Sender: miherman@pop.jpl.nasa.gov
To: Mark.A.Weilert@jpl.nasa.gov
Cc: Henry.Abakians@jpl.nasa.gov

Date: Thu, 15 May 2003 11:41:18 -0700
To: Matt Griffin <Matt.Griffin@astro.cf.ac.uk>, Eric Sawyer <e.c.sawyer@rl.ac.uk>, Chris Brockley-Blatt <cbb@mssl.ucl.ac.uk>, Berend Winter <bw@mssl.ucl.ac.uk>
From: Martin Herman <Martin.I.Herman@jpl.nasa.gov>
Subject: Waiver Request (vibration fastners)
Cc: Ben.A.Parvin@jpl.nasa.gov, Jamie Bock <jjb@astro.caltech.edu>, Gary Parks <Gary.S.Parks@jpl.nasa.gov>, kalyani@squid.jpl.nasa.gov
Bcc:
X-Attachments:

Dear Matt and SPIRE Team,

To refresh everyone's memory. We requested the following information:

What type of fasteners will be used in Europe to mount the BDA? In our ICD, 6-32 fasteners are called for. However, the current test hardware uses 8-32 fasteners. We are looking to be consistent with the flight implementation.

The answer (Thanks Chris) was 6-32. Our current test fixture uses 8-32 and we are getting ready for vibration testing of the CQM next week. Therefore, we had a mechanical engineer look into this issue. His (Paul MacNeal) response was:

> It will acceptable to use four #8-32 fasteners for the vibration tests at JPL. The reasons are....
>
> 1) The test fixture has already been built using #8-32 tapped holes,
> 2) The use of #6-32 fasteners torqued to full value should be able to resist over 200 G's of lateral force before allowing slippage, and therefore is not a critical component of the vibration test, and
> 3) The test is primarily performed to verify integrity of the flexures, braid, and other components, and not the interface fasteners.

Based on this information, we are requesting a waiver for the CQM PLW vibration and for future QM, CQM, PFM and FS tests. The change for future test is small, but the fiscal situation is extremely challenging and no technical risk to the program is evident with the existing approach.

Thanks,
Marty

REVISIONS

LTR	ZONE	DESCRIPTION	CODE B	DWN	CHK	STRUCT	MATL	THRM CONT			ENGR	DSGN SUPV	DATA MGT	RELEASE DATE
A		INITIAL RELEASE		SEE TITLE BLOCK									RGB	03/15/04
B		ADDED ITEM 51, ADDED VIEW SH4, MOVED VIEW FROM SH2 TO SH4	B											

14. ALTERNATE OR EQUIVALENT ITEMS MAY BE USED FOR THIS ITEM WITH PRIOR ENGINEERING APPROVAL.

13. SEAL SHIPPING CONTAINER USING ITEMS 28, LID, 30, SCREWS, 31, O-RING, AND ITEM 32, PLUG. TORQUE ITEM 30, SCREWS TO 1.9 N*M PLUS RUNNING TORQUE PER JPL SPEC ES517040. TORQUE ITEM 32, PLUG TO 7.3 N*M PLUS RUNNING TORQUE PER JPL SPEC ES517040.

12. SECURE FLEXURE RING OF ITEM 1 OR 2, TO ITEM 26, USING ITEM 29, NUTS. TIGHTEN NUTS HALF TURN PAST FINGER TIGHT.

11. INSTALL ITEMS 26, MOUNT, INTO ITEM 27, SHIPPING BASE. TORQUE TO 200 N*MM PLUS RUNNING TORQUE PER JPL SPEC ES517040.

10. FOR -7 CONFIGURATION, SECURE ITEM 39, UNION NUT, TO ITEM 35, MASS SIMULATOR USING ITEM 40, SET SCREW, AND ITEM 25 ADHESIVE. TORQUE TO 1.7-2.2 N*M PER JPL SPEC ES517040. SECURE ITEM 33, ACCELEROMETER, TO ITEM 39, UNION NUT AND TORQUE TO 1.7-2.2 N*M PER JPL SPEC ES517040.

9. FOR -6, -7 AND -9 CONFIGURATION, SECURE ITEM 10, OR 36, ACCELEROMETER MOUNT, OR ITEM 43, ACCELEROMETER SIMULATOR, TO ITEM 9 OR 35, MASS SIMULATOR USING ITEM 22, SCREW. TORQUE TO 200 N*MM PLUS RUNNING TORQUE PER JPL SPEC ES517040.

8. FOR -7 CONFIGURATION, SECURE ITEM 33, ACCELEROMETER, TO ITEM 36, ACCELEROMETER MOUNT. TORQUE ITEM 33, ACCELEROMETER, TO 1.7-2.2 N*M PER JPL SPEC ES517040. CONNECT ITEM 34, CABLE, TO ITEM 33, ACCELEROMETER.

7. FOR -6 CONFIGURATION, BOND ITEM 37, ACCELEROMETER, TO ITEM 10, ACCELEROMETER MOUNT, USING ITEM 25, EPOXY.

6. FOR ALL CONFIGURATIONS EXCEPT -6, -7, AND -9, INSTALL ITEM 17, SCREW, INTO ITEM 11 OR 49, CAN. TORQUE TO 425 N*MM PER JPL SPEC ES517040.

5. FOR ALL CONFIGURATIONS EXCEPT -6 AND -7, SECURE ITEM 11, 42, OR 49, CAN AND ITEM 45, LIGHT SEAL TO FLEXURE RING OF ITEM 1 OR 2, USING ITEM 24, SCREW, AND ITEM 21, SPRING WASHER. TORQUE TO 200 N*MM PER JPL SPEC ES517040.

4. FOR ALL CONFIGURATIONS EXCEPT -6, -7, -8, AND -9, SECURE ITEM 12, 13, 14, 15, OR 16, FILTER, TO ITEM 1 OR 2, USING ITEM 23 OR 48, SCREW, ITEM 19, NUT, AND ITEM 21, SPRING WASHER. TORQUE TO 200 N*MM PER JPL SPEC ES517040.

3. FOR ALL CONFIGURATIONS EXCEPT -6, -7, AND -9, BEND THERMAL STRAP ON ITEM 3, 4, 5, 6, 7, OR 8 AND FASTEN TO ITEM 1 OR 2. FOR -9 CONFIGURATION SECURE ITEM 44, THERMAL STRAP SIMULATOR IN PLACE OF THERMAL STRAP. USE ITEM 22, SCREW, AND ITEM 46, WASHER AND TORQUE TO 100 N*MM FOR TEMPORARY INSTALLATION ONLY.

2. SECURE ITEM 3, 4, 5, 6, 7, 8, 9, OR 35, TO ITEM 1 OR 2 USING ITEM 19, NUT. FOR ALL CONFIGURATIONS EXCEPT -6 AND -7, SECURE CONNECTOR BRACKET OF ITEM 3, 4, 5, 6, 7, 8, OR 41 TO FLEXURE RING OF ITEM 1 OR 2, USING ITEM 18, SCREW, AND ITEM 21, SPRING WASHER. TORQUE TO 200 N*MM PER JPL SPEC ES517040. SPOT BOND ITEM 19, NUT USING ITEM 25, EPOXY ON ALL CONFIGURATIONS EXCEPT -6 AND -7.

1. FOR CONFIGURATIONS -7 AND -9, SECURE ITEM 33, ACCELEROMETER, TO ITEM 35, MASS SIMULATOR, ROTATING CONNECTOR TO ALLOW CABLE TO EXIT TOWARD TOP OF MASS SIMULATOR. TORQUE ITEM 38, SET SCREW, AGAINST ITEM 33, ACCELEROMETER, TO 1.7-2.2 N*M PER JPL SPEC ES517040. CONNECT ITEM 34, CABLE, TO ITEM 33, ACCELEROMETER.

NOTES: UNLESS OTHERWISE SPECIFIED

16. FOR -2 AND -3 CONFIGURATIONS, SECURE CONNECTOR BRACKETS OF ITEM 5 OR 6, TO ITEM 49, CAN, USING ITEM 50, SCREW. TORQUE TO 180 N*MM PER JPL SPEC ES517040.

15. FOR CONFIGURATIONS EXCEPT -6, -7, AND -9, MARK AS SHOWN WITH ITEM 47, EPOXY INK, USE APPROPRIATE DASH NO., S/N, MODEL (CQM/PFM) AND TYPE (P/LW, S/LW, ETC.).

PARTS LIST

-9	-8	-7	-6	-5	-4	-3	-2	-1	ITEM NO	REF DES	CAGE NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL OR NOTE	ZONE
QTY REQD																
				1	1				51			10209903-1	RING, SPACER			
						4	4		50			NA0070-016004	SCREW, MACHINE FLUSH HEAD	NA0070	A-286 CRES	
						1	1		49			10209805-2	CAN, LIGHT			
				6	6				48			NA0068A016012	SCREW, MACHINE PAN HEAD	NA0068	A-286 CRES	
	AR			AR	AR	AR	AR	AR	47				EPOXY INK, BLACK			
	2			2	2	2	2	2	46			ST12259-020	WASHER, COUNTERSUNK, LUBRICATED	ST12259	A-286 CRES	
	1			1	1	1	1	1	45			10209807-1	SEAL, LIGHT			
1									44			10209847-1	SIMULATOR, THERMAL STRAP			
1									43			10209744-1	MASS SIMULATOR, ACCELEROMETER			
1									42			10217688-1	CAN, LIGHT, STM			
1									41			10217680-1	DUMMY BOLOMETER			
		1							40		OE328	92313A829	SET SCREW, 10-32 UNF X 1/2"		MCMASTER CARR 14	
		1							39		OE328	90977A021	UNION NUT, 10-32 UNF		MCMASTER CARR 14	
1		1							38		OE328	92313A824	SET SCREW, 10-32 UNF X 3/16"		MCMASTER CARR 14	
			1						37				ACCELEROMETER, THREE AXIS			
		1							36			10209746-2	MOUNT, ACCELEROMETER			
1		1							35			10209745-2	MASS SIMULATOR			
1		3							34			6011 A10	CABLE, ACCELEROMETER		DYTRAN	
1		3							33			3031 B5	ACCELEROMETER, SINGLE AXIS		DYTRAN	
1	1	1	1	1	1	1	1	1	32		SE027	2 P5ON	PLUG, O-RING		PARKER FLUID CONNECTORS 14	
1	1	1	1	1	1	1	1	1	31		OE328	9262K331	O-RING, 114.5mm ID X 3mm WIDTH		MCMASTER CARR 14	
8	8	8	8	8	8	8	8	8	30			MS5197-50	SCREW, #8-32 UNC X 1.25"	MS5197	14	
4	4	4	4	4	4	4	4	4	29			NA0034C040	NUT, SELF LOCKING, HEX EXTENDED WASHER, 1100 MPa	NA0034	A-286 CRES 14	
1	1	1	1	1	1	1	1	1	28			10209809-1	CONTAINER, SHIPPING, LID			
1	1	1	1	1	1	1	1	1	27			10209808-1	CONTAINER, SHIPPING, BASE			
4	4	4	4	4	4	4	4	4	26		OE328	9217K32	MOUNT, NATURAL RUBBER, SANDWICH, M4 X 0.7		MCMASTER CARR 14	
AR	AR	AR	AR	AR	AR	AR	AR	AR	25			EC 2216 A/B	EPOXY			
4				4	4	4	4	4	24			NA0069-016010	SCREW, CAP, SOCKET HEAD. FULL THREAD, 1100 MPa	NA0069	A-286 CRES	
						6	6	6	23			NA0068A016010	SCREW, MACHINE PAN HEAD	NA0068	A-286 CRES	
6	2	4	4	2	2	2	2	2	22			NA0069-020010	SCREW, CAP, SOCKET HEAD. FULL THREAD, 1100 MPa	NA0069	A-286 CRES	
20	20			20	20	20	20	20	21			B0187-010-S	BELLEVILLE SPRING WASHER			
									20							
4	4	4	4	6	6	6	6	6	19			934-A2 M1.6 X 0.35	NUT	DIN 934	A-286 CRES	
4	4			4	4	4	4	4	18			NA0069-016004	SCREW, CAP, SOCKET HEAD. FULL THREAD, 1100 MPa	NA0069	A-286 CRES	
	2			2	2	2	2	2	17			NA0069-040008	SCREW, CAP, SOCKET HEAD. FULL THREAD, 1100 MPa	NA0069	A-286 CRES	
				1					16			S/SW FILTER	S/SW FILTER			
					1				15			S/LW FILTER	S/LW FILTER			
						1			14			P/SW FILTER	P/SW FILTER			
							1		13			P/MW FILTER	P/MW FILTER			
								1	12			P/LW FILTER	P/LW FILTER			
	1			1	1			1	11			10209805-1	CAN, LIGHT			
			1						10			10209746-1	MOUNT, ACCELEROMETER			
			1						9			10209745-1	MASS SIMULATOR			
				1					8			10209850-1	DETECTOR ASSEMBLY, SPECTROMETER SHORT WAVE			
					1				7			10209840-1	DETECTOR ASSEMBLY, SPECTROMETER LONG WAVE			
						1			6			10209830-1	DETECTOR ASSEMBLY, PHOTOMETER SHORT WAVE			
							1		5			10209820-1	DETECTOR ASSEMBLY, PHOTOMETER MEDIUM WAVE			
	1								4			10209810-2	DETECTOR ASSEMBLY, PHOTOMETER LONG WAVE SIMULATOR			
								1	3			10209810-1	DETECTOR ASSEMBLY, PHOTOMETER LONG WAVE			
								1	2			10209860-2	SUSPENSION ASSEMBLY			
1	1	1	1	1	1	1	1		1			10209860-1	SUSPENSION ASSEMBLY			

MATERIAL

METRIC

THIRD ANGLE PROJECTION

SPIRE

NEXT ASSEMBLY | USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MILLIMETERS
LINEAR TOLERANCES:

0-6	± 0.1
OVER 6-30	± 0.2
OVER 30-120	± 0.3
OVER 120-315	± 0.5
OVER 315-1000	± 0.8
OVER 1000	± 1.2

ANGULAR TOLERANCES: ± 0.5°

MACHINE FINISH (MICROMETERS) 3.2

DO NOT SCALE DRAWING
INTERPRET DWG PER ASME Y14.100M

CONTRACT NO 1244858

APPD _____ DATE _____

DWN	D. CRUMB	03/11/04
CHK	R MCNABB	03/11/04
STRUCT	P MACNEAL	03/11/04
MATL	M KNOPP	03/15/04
THRM CONT		
ENGR	M WEILERT	03/11/04
DSGN SUPV		

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CA 91109
RELEASED THROUGH EDMG

BOLOMETER DETECTOR ASSEMBLY

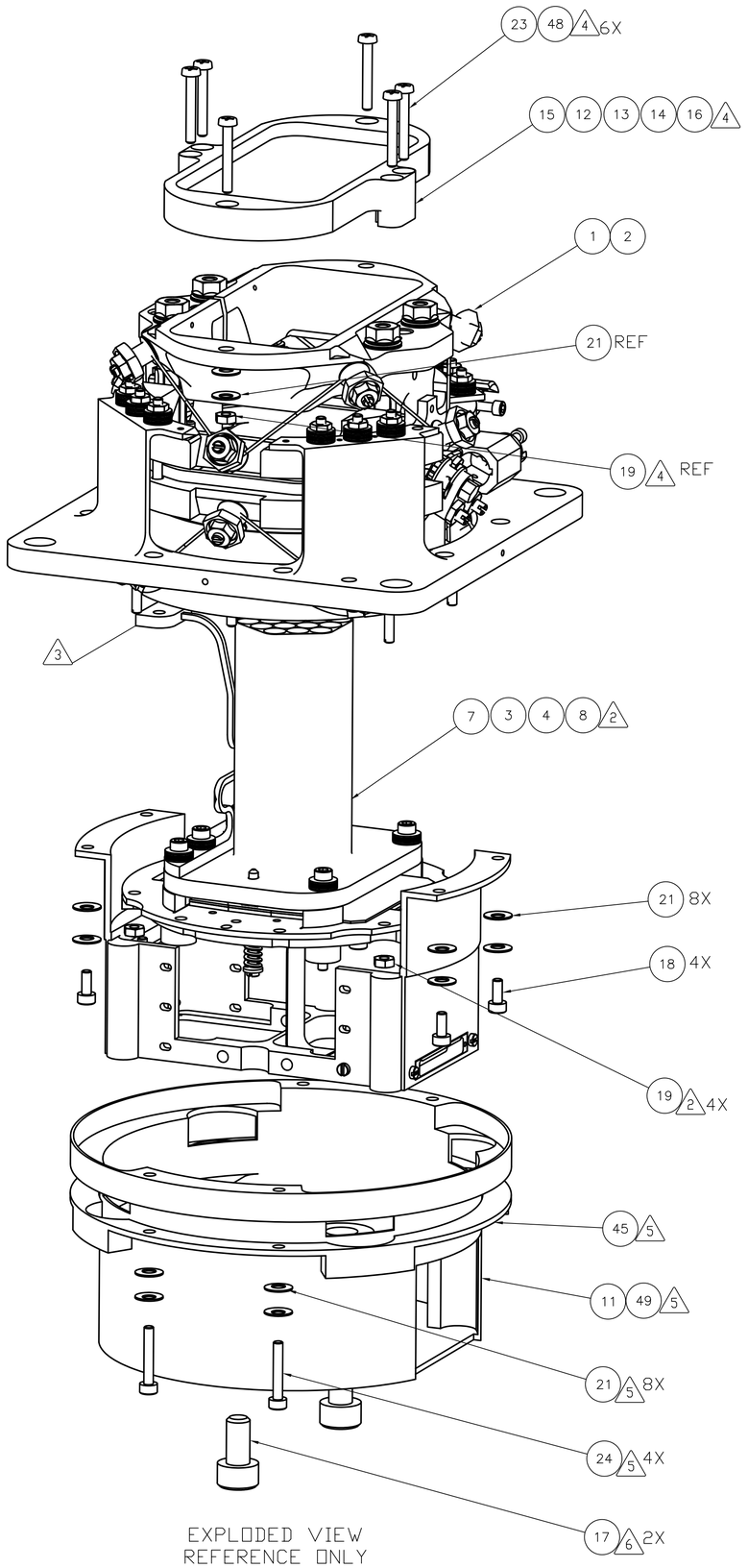
SIZE	CAGE NO		REV
A1	23835	10209800	B

SCALE NONE | UNCLASSIFIED | SHEET 1 OF 4

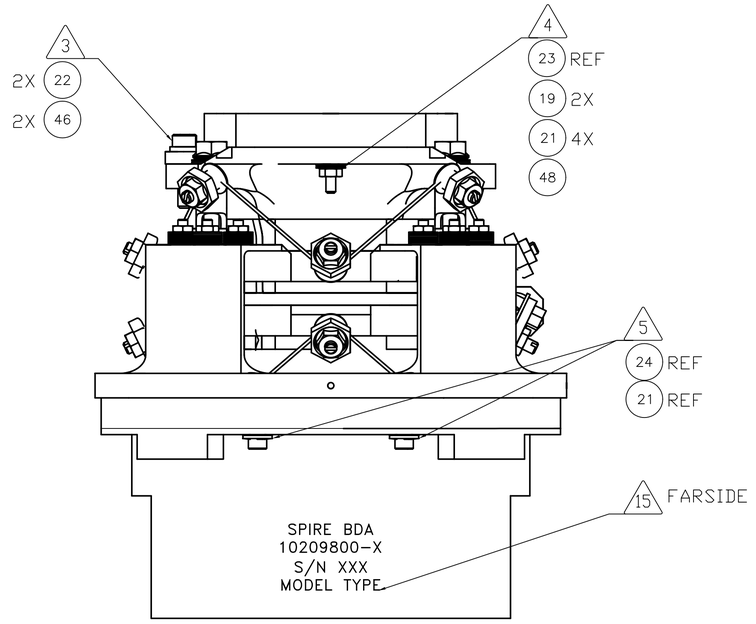
REV 2/00

AutoCAD GENERATED

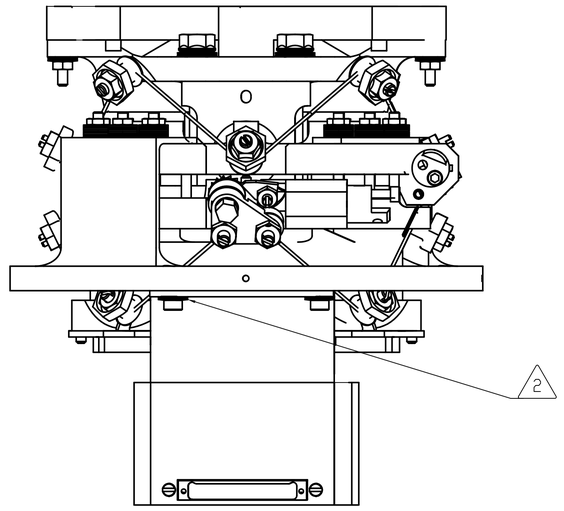
10209800 A1



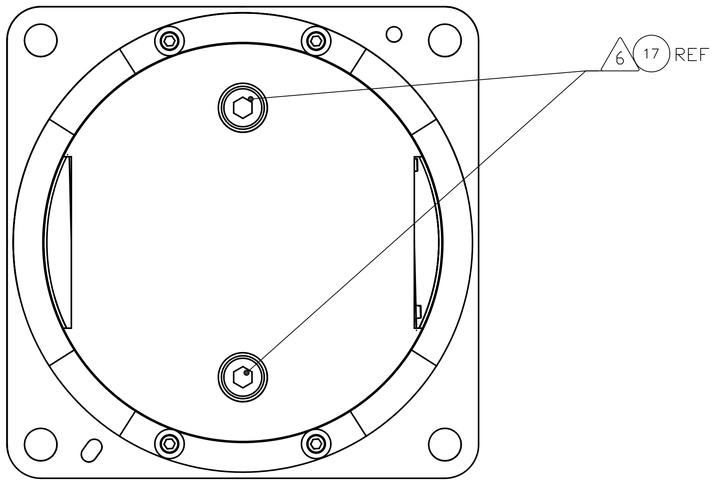
EXPLODED VIEW
REFERENCE ONLY
-4 CONFIGURATION SHOWN
-1, -5 CONFIGURATIONS ARE SIMILAR
-8 CONFIGURATION SIMILAR WITHOUT FILTER



-4 CONFIGURATION SHOWN
-1, -2, -3, -5 CONFIGURATIONS ARE SIMILAR
-8 CONFIGURATION SIMILAR WITHOUT FILTER



COMPONENTS REMOVED FOR CLARITY
-4 CONFIGURATION SHOWN
-1, -2, -3, -5 CONFIGURATIONS ARE SIMILAR
-8 CONFIGURATION SIMILAR WITHOUT FILTER



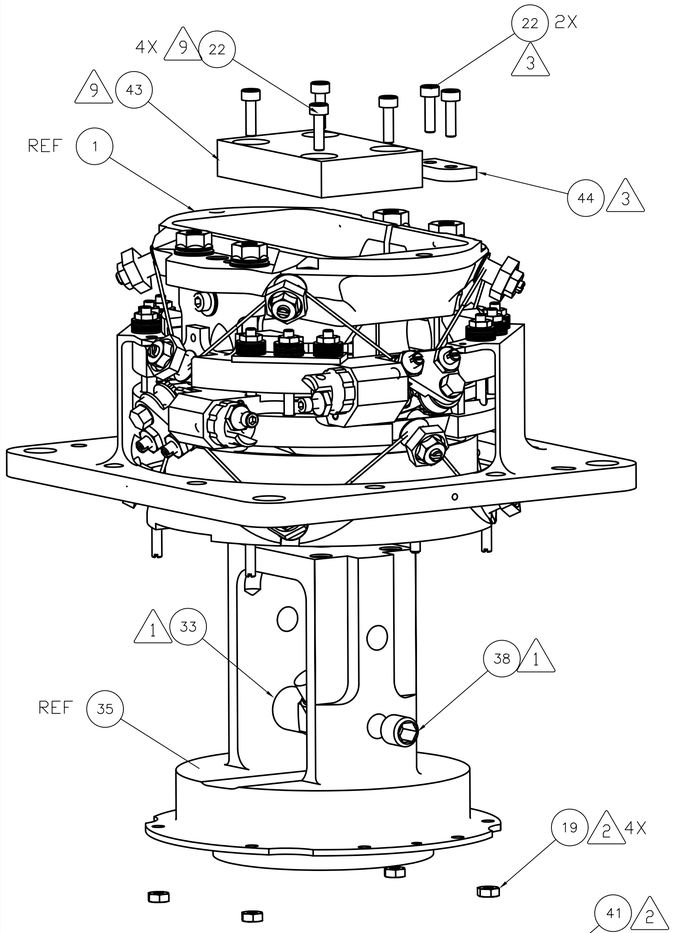
-4 CONFIGURATION SHOWN
-1 AND -5 CONFIGURATIONS ARE SIMILAR
-8 CONFIGURATION SIMILAR WITHOUT FILTER

SIZE	CAGE NO		REV
A1	23835	10209800	B
SCALE NONE	UNCLASSIFIED	SHEET 2 OF 4	

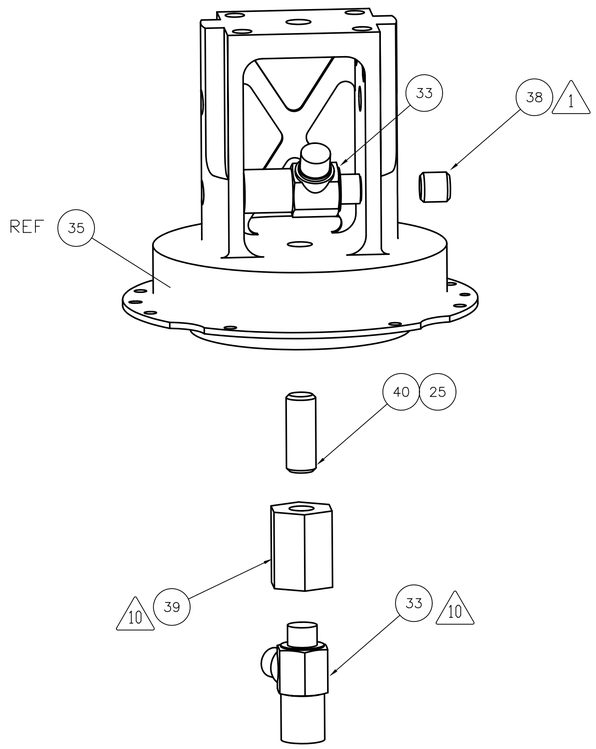
REV 2/00

AutoCAD GENERATED

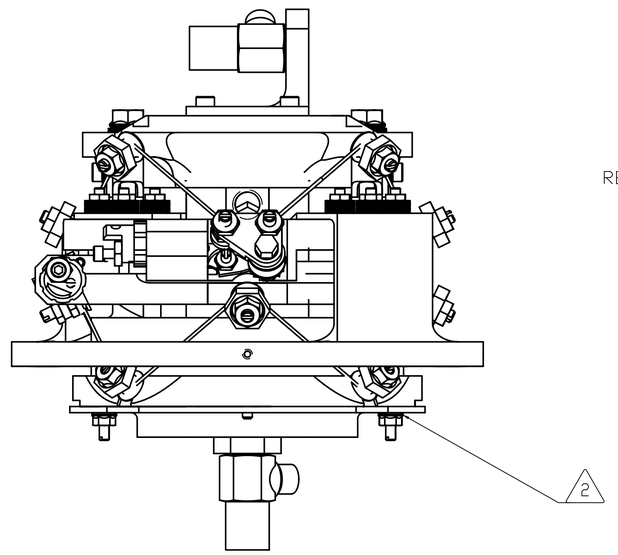
A1 10209800



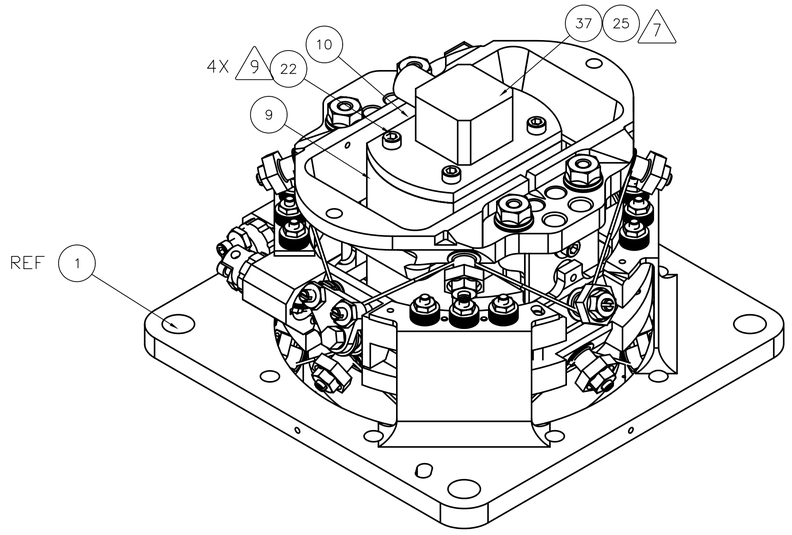
GENERAL VIEW
REFERENCE ONLY
SCALE: NONE
-9 CONFIGURATION,



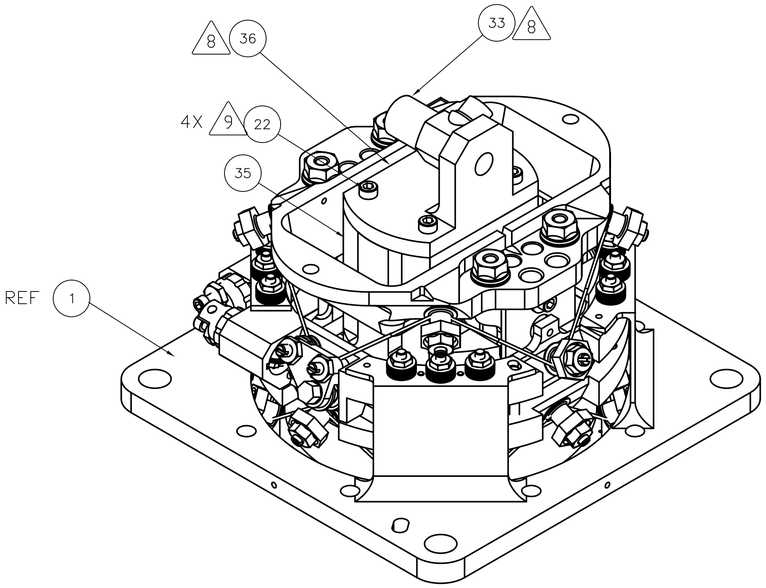
GENERAL VIEW
REFERENCE ONLY
SCALE: NONE
-7 CONFIGURATION,
ONLY ACCELEROMETERS AND
MASS SIMULATOR SHOWN



-7 CONFIGURATION



GENERAL VIEW
REFERENCE ONLY
SCALE: NONE
-6 CONFIGURATION

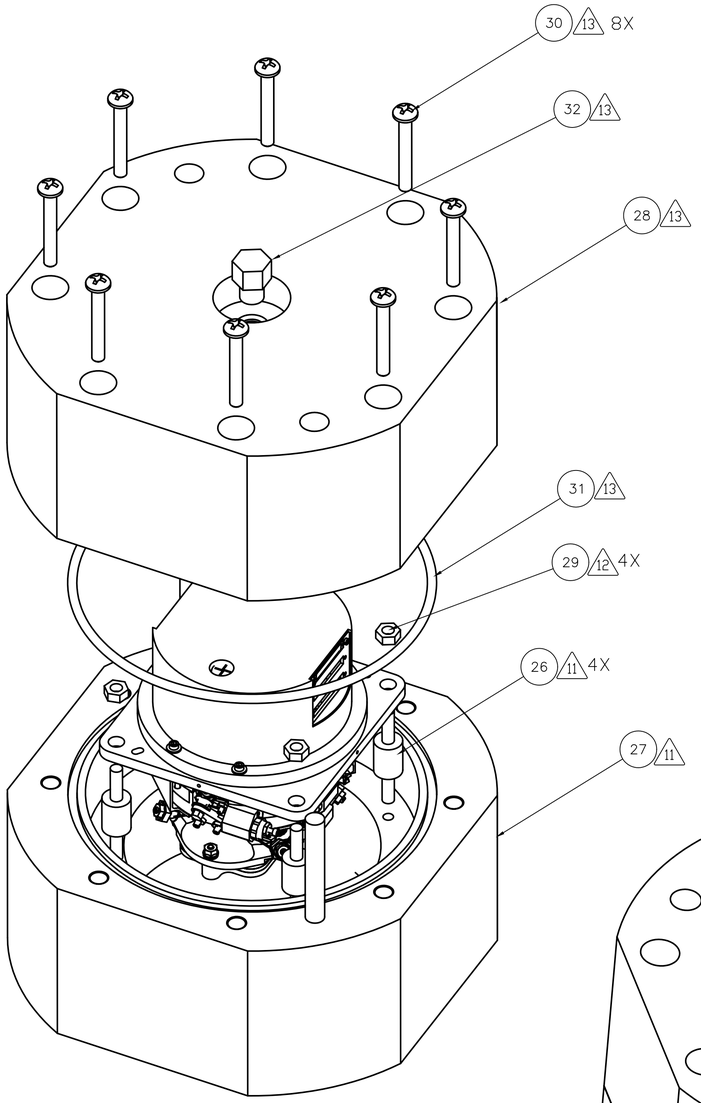


GENERAL VIEW
REFERENCE ONLY
SCALE: NONE
-7 CONFIGURATION

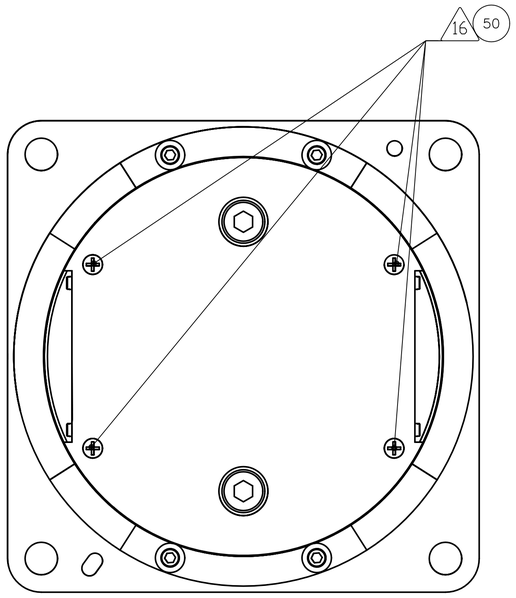
SIZE	CAGE NO		REV
A1	23835	10209800	B
SCALE NONE	UNCLASSIFIED	SHEET 3 OF 4	

REV 2/00

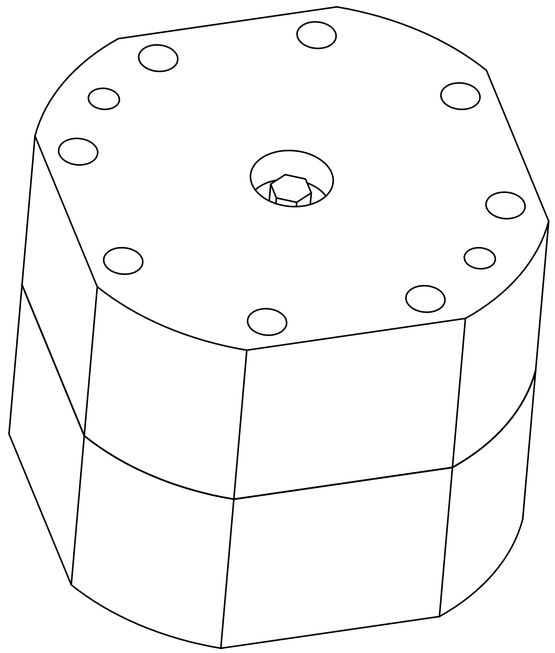
AutoCAD GENERATED A1 10209800



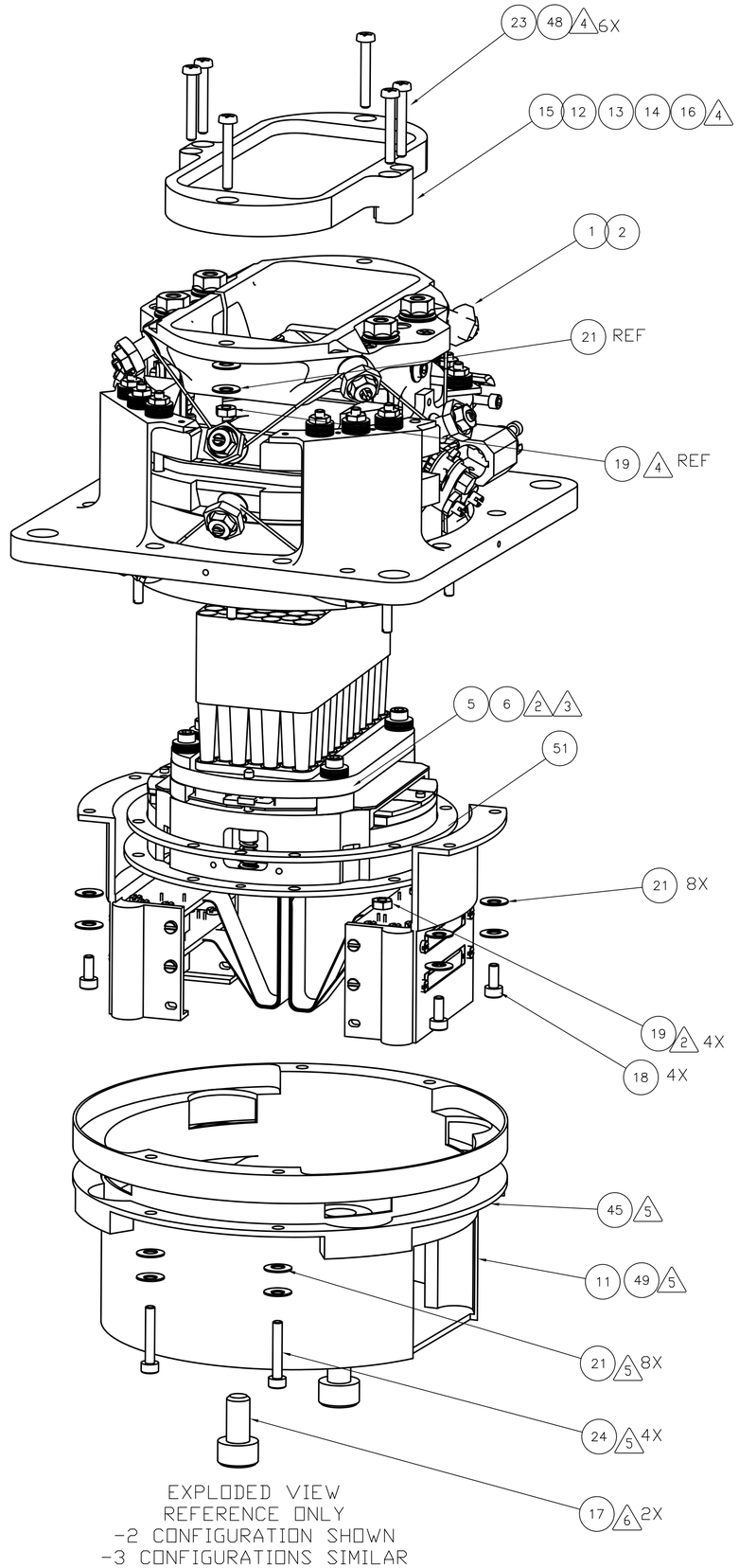
EXPLODED VIEW
REFERENCE ONLY
-5 CONFIGURATION
-1,-2,-3,-4, -8 AND -9 SIMILAR
-6 AND -7 SIMILAR WITH NO CAN



-2 CONFIGURATION SHOWN
-3 CONFIGURATION IS SIMILAR



GENERAL VIEW
REFERENCE ONLY
SCALE: NONE
ALL CONFIGURATIONS



EXPLODED VIEW
REFERENCE ONLY
-2 CONFIGURATION SHOWN
-3 CONFIGURATIONS SIMILAR

SIZE	CAGE NO		REV
A1	23835	10209800	B
SCALE NONE	UNCLASSIFIED	SHEET 4 OF 4	

REV 2/00

AutoCAD GENERATED

10209800

ECR/NCR List

FS SSW BDA 10209800-5 S/N 016

All of these have been incorporated into released drawings.

1. HR-SP-JPL-ECR-003 – Changes to the 300mK filter clamp fixing holes.

2. HR-SP-JPL-ECR-007 – Spectrometer BDA Envelope Height

3. HR-SP-JPL-ECR-005v2 – 300mK Stage Assembly – BDA Kapton cable routing design error. (NOTE: does not apply to the SSW BDA type, but affects the same drawings)

4. HR-SP-JPL-NCR-007 – PMW and PSW focal position shift. (NOTE: does not apply to the SSW BDA type, but affects the same drawings)

Rutherford Appleton Laboratory	Document / Engineering Change Request	PRODUCT ASSURANCE Space Science and Technology Department

DOCUMENT /ENGINEERING CHANGE REQUEST NO.: HR-SP-JPL-ECR-003

PROJECT:	**SPIRE**	**ORIGINATOR:**	**Martin Herman, JPL**
SYSTEM:	**FPU**	**SIGNATURE**	
SUB-SYSTEM:	**300mK Filter Stacks**	**DATE**	**22nd May 2003**

1) TITLE OF CHANGE: **Changes to the 300mK filter clamp fixing holes.**

2) AFFECTED ITEMS / WORK PACKAGES: **300mK Filters**

3) CLASSIFICATION OF CHANGE: (Highlight as required) **URGENT** | ROUTINE

4) DOCUMENTS AFFECTED (TITLE, NUMBER, ISSUE, PARAGRAPH):
Filters – Interface Control Document - SPIRE-UCF-PRJ-001151 issue 2.2
Figure 13 – "Filter assembly GA" – drawing number BDA.01.006
Figure 14 – "BDA upper filter ring" – drawing number BDA.01.003

5) DESCRIPTION OF CHANGE:

1. **The drawings BDA.01.006 and BDA.01.003 will be combined into one interface drawing. Title will be "300mK Filter ICD", drawing number will be "Filt-CQM/PFM-200"**
2. **Add missing dimension for length of projecting mounting legs – 2.75 ± 0.02mm in sector H8**
3. **Add box for total stack thickness and mass per channel in sector A8**
4. **Change existing callout in sector D4 from "*6 x 2.00mm thru*" to "*6 x 2.00mm thru. Counterbore 3.8mm dia., 1.00mm deep. Countersink 2.40mm dia., 45°*"**
5. **Modify existing parts in accordance with the new ICD - FILT-CQM/PFM-200**

(Figure 1. may be used for reference)

6) RELATED FACTORS: (Highlight as required)

SPACECRAFT	PERFORMANCE	POWER	OTHERS (SPECIFY)
GROUND SEGMENT	ELECT INTERFACES	WEIGHT	
LAUNCH VEHICLE	**MECH. INTERFACES**	**SCHEDULE**	
PAYLOAD	TEST/VERIFICATION	**COST**	

7) NEED / JUSTIFICATION FOR CHANGE:
Late specification of fixtures to be used by JPL

SPIRE-UCF-PRJ-001151 issue 3 Issued accordingly ECR Closed

ATTACHMENTS:	DISTRIBUTION:	CHANGE APPROVED SIGNATURE: DATE:	Digitally signed by Eric Clark Date: 2005.07.13 11:17:10 +01'00'
Draft version of new ICD – incomplete – for reference only *300MK_FILTER_ICD_170403_weilert.doc* **Shown as figure 1.**			

DOCUMENT /ENGINEERING CHANGE REQUEST NO.: HR-SP-JPL-ECR-003

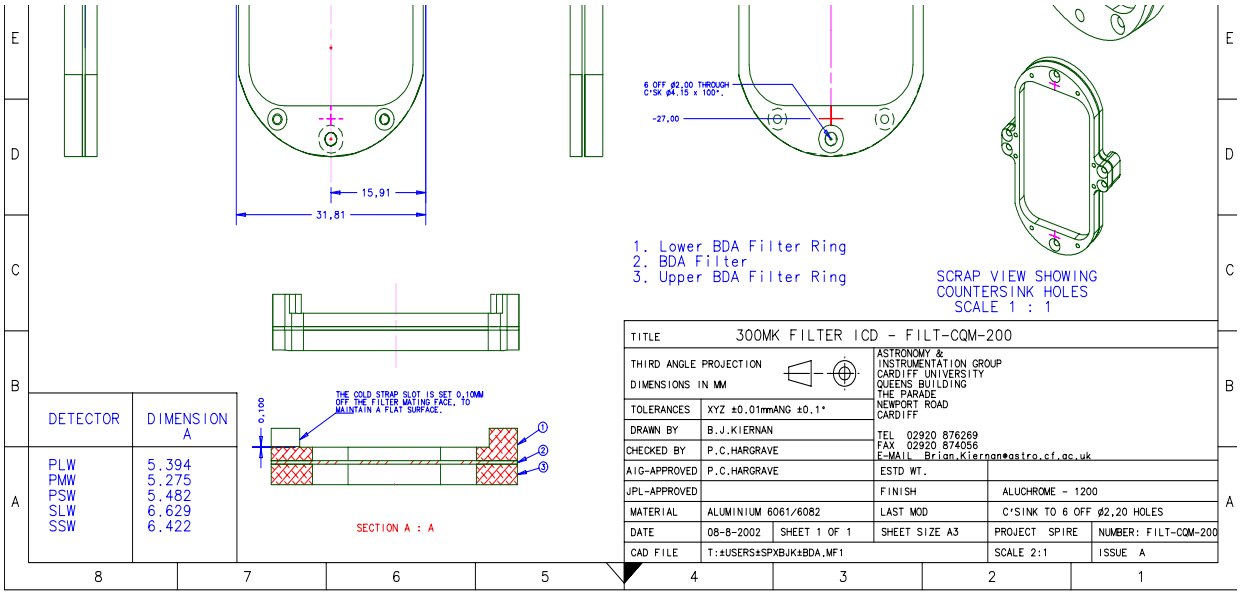


Figure 1 Preliminary draft of new ICD for reference only. Additional proposed changes to this drawing will be implemented by Cardiff, and sent to JPL for approval.

CCLRC Rutherford Appleton Laboratory

DOCUMENT / ENGINEERING CHANGE REQUEST (ECR)

PRODUCT ASSURANCE
Space Science and Technology Department

DCR / ECR Number:	HR-SP-JPL-ECR-007

Spacecraft / Project	**HERSCHEL**	**Originator's Name**	Martin Herman
System / Experiment / Model	**SPIRE /**	**Signature**	
Sub-System		**Date**	November 20,2003
Assembly		**Classification**	**Urgent** **Routine**
Sub-Assembly		**Ref. Doc. / Drwg No.**	JPL dwg 10209721
Item	Bolometer Detector Assembly (BDA)	**Reference**	

ECR/DCR Title	**Spectrometer BDA Envelope Height**

ECR Description

On the ICD Drawing 10209721 sheet 2, zone H4, the current maximum height dimension is 42.5 mm from the BDA mounting plate. This dimension needs to be changed to 43.6 to encompass the two spectrometer BDA types, SLW and SSW. Photometer BDA types do not require this change. The current dimension will be replaced with a note giving the two BDA type dependent values. The allowed 300mK stage shift given in note 9 will remain.

Need / Justification For Change

The Spectrometer BDA (types SLW and SSW) 300mK filter stacks were at some point increased in thickness due to the addition of a lens. This change was not flowed down into the BDA ICD. The SLW BDA S/N008 maximum height was measured at 44.04 mm from the mounting plate, which is 1.04 mm higher than the current allowed ICD range. The nominal 42.5 mm height plus the 0.5mm allowed displacement of the 300mK stage (see ICD note 9) gives the current 43.0 mm max height.

Affected Items / Work package (Title, Number, Issue, Para)

ICD drawing 10209721 rev B

Related Factors (Highlight as applicable)

Spacecraft	Performance	Power	Others (Specify)
Ground Segment	Elect. Interfaces	Weight	
Launch Vehicle	Mech. Interfaces	Schedule	
Payload	Test/Verification	Cost	

Attachments	Distribution

Change Approved Project	Digitally signed by Eric Sawyer Date: 2005.07.22 13:26:54 +01'00'	**Change Approved Customer**	N/A
Project Closure	Digitally signed by Eric Clark Date: 2005.07.22 14:19:40 +01'00'	**Customer Closure**	N/A

CCLRC Rutherford Appleton Laboratory

DOCUMENT / ENGINEERING CHANGE REQUEST (ECR)

PRODUCT ASSURANCE
Space Science and Technology Department

DCR / ECR Number:	HR-SP-JPL-ECR-005v2

Spacecraft / Project	**HERSCHEL**	**Originator's Name**	Anthony Turner	
System / Experiment / Model	**SPIRE /**	**Signature**		
Sub-System		**Date**	1/19/2004	
Assembly	10209800 -2 and -3	**Classification**	**Urgent**	**Routine**
Sub-Assembly	10209820 and 10209830	**Ref. Doc. / Drwg No.**	10209775	
Item	Kapton cables assemblies, 10217706 and 10209825	**Reference**		

ECR/DCR Title	**300-mK Stage Assembly-BDA Kapton cable routing design error**

ECR Description

Kapton cable right (10217705) was designed for a length of 73.93mm and Kapton cable left (10209824) was designed for a length of 68.87mm. This length designation forces the shorter cable to route into connector positions J01 and J02 on the 10209820 and 10209830 Detector Assembly-BDA builds while the longer cable will route into the J03 and J04 connector positions. This routing will cause a swap in the pixel maps for each connector denoted in wiring schematic 10209725-A under the 10209800-2 and 10209800-3 columns. Below is the correct switch in pixel maps for each column (only the first pixel of the original column is denoted for all connectors but the entire column should be switched accordingly):

10209800-2 P/MW: J01 – first pixel A7, J02 – first pixel E7, J03- first pixel A13, J04 – first pixel R1

10209800-3 P/SW: J01 – first pixel D6, J02 – first pixel F12, J03- first pixel R1, J04 – first pixel E1

In order to:
(1) maintain the existing pixel allocation, and
(2) ensure that the readout of the PTC Channels is carried out on DCU J22
the JFET-BDA harnesses need to be swapped and physically relabelled as follows:

JFP J37 → JFP J39
JFP J39 → JFP J37
JFP J40 → JFP J38
JFP J38 → JFP J40
JFP J29 → JFP J31
JFP J31 → JFP J29
JFP J30 → JFP J32
JFP J32 → JFP J30

The SPIRE Block Diagram (Issue 5.8) needs to be updated to reflect this change.

JPL drawing (10209725 Rev B) needs to be updated.

SPIRE Block Diagram (Issue 5.8) needs to be updated.

The re-labelling of the connectors (MDM 51S) will mean that the corresponding BDA-JFET harnesses will have a 180° twist in them between the FPU wall and the JFET rack.

Need / Justification For Change

The current flex cable assembly/routing will not correctly map to the pixel locations denoted in 10209725-A wiring schematic, SPIRE. The current schedule/budget will not allow for an acquisition of replacement cables which may have at least a 12-20 week lead from the manufacture. All sub-assembly builds (10209820 and 10209830) would have to be placed on hold until the new cables arrive. The schedule impact could be up to 6 months. The above pixel map designation change would have a minimal effect on the software side, save from rebuilding flex kapton cables and keep the project on its current schedule.

Affected Items / Work package (Title, Number, Issue, Para)

All 10209820 and 10209830 sub assemblies.
Drawing 10209775-A
SPIRE Block Diagram (Issue 5.8)

CCLRC Rutherford Appleton Laboratory	**DOCUMENT / ENGINEERING CHANGE REQUEST (ECR)**	**PRODUCT ASSURANCE Space Science and Technology Department**

DCR / ECR Number:	HR-SP-JPL-ECR-005v2

SPIRE Block Diagram (Issue 5.8)
JPL drawing (10209725 Rev B

Related Factors (Highlight as applicable)			
Spacecraft	Performance	Power	Others (Specify)
Ground Segment	Elect. Interfaces	Weight	
Launch Vehicle	Mech. Interfaces	Schedule	
Payload	Test/Verification	Cost	

Attachments	**Distribution**

Ref SPIRE-RAL-MoM-002462v1 NRB ECR Closed

Change Approved Project		**Change Approved Customer**	
Project Closure		**Customer Closure**	

CCLRC Rutherford Appleton Laboratory

NON-CONFORMANCE REPORT (NCR)

PRODUCT ASSURANCE
Space Science and Technology Department

NCR Number:	HR-SP-JPL-NCR-007

Spacecraft / Project	**Herschel**	**Originator's Name**	Martin Herman	
Experiment / Model	SPIRE / PFM+FS	**Signature**		
Sub-System		**Date**	July 1, 2004	
Assembly		**Level** (Highlight if applicable)	Major	Minor
Sub-Assembly				
Item	PMW and PSW BDA (10209800 -2 and -3)	**NRB Reference**		
Serial Number	11, 12, 14,15 (TBC)			

NCR Occurred During (Highlight if applicable)	Manufacture	Inspection	Test	Integration	Other

NCR Title	**PMW and PSW focal position shift**

NCR Description

An internal mechanical interference problem discovered during the manufacture of the PMW BDA has required a shift of the feedhorn and detector position with respect to the exterior envelope of the BDA. The exterior BDA envelope is unchanged. This NCR applies to PFM and FS models of the PMW and PSW BDAs.

This problem causes a non-conformance with the focus position specified in the ICD drawing 10209721 (see sheet 2, zone G3, and values tabulated on sheets 5-7). The PMW nominal focus position is changed by 1.0mm from 33.2mm to 32.2mm. The PSW focus position is changed by 1.2mm from 25mm to 23.8mm.

Front-short and back-short distances at the detectors are not affected by this change. The distance from the 300mK filter to the feedhorn entrance plane is increased by the shifts given above.

Other effects of this NCR are a small mass increase (approximately 4 grams) and a slight CG shift (estimated z-cg decrease of ~0.5mm). (Note that the PFM PMW, which is the only affected unit yet assembled, has a mass of 605g including the mass increase. This is still less than the 632g ICD limit.)

Cause of NCR

Disposition / Corrective Action

USE AS IS

Closed ref SPIRE-RAL-MoM-002462v1 NRB

Document or Drawing Affected (Title, Number & Issue)

Estimated COST OF NCR (cost of : correction, Materials, Resource, and delay to Project etc.)

NCR CLOSED (Signatures Required)	**PA Manager (Or Deputy)**	**Project Manager (Or Deputy)**	**Date**
	Digitally signed by Eric Clark Date: 2005.07.18 11:18:22 +01'00'	Closed ref SPIRE-RAL-MoM-002462v1 NRB	

Waiver List

1) **HR-SP-JPL-RFW-005v1 (Sine Vibration Omission)**

2) **HR-SP-JPL-RFW-006 (Vibration Test Levels)**

3) **HR-SP-JPL-RFW-022 (BDA Vibration Test Temperature)**

CCLRC Rutherford Appleton Laboratory	**REQUEST FOR WAIVER / DEVIATION (RFW/RFD)**	**PRODUCT ASSURANCE Space Science and Technology Department**

RFW/RFD Number:	HR-SP-JPL-RFW-005v1

Spacecraft / Project	Herschel	**Originator's Name**	Kalyani Sukhatme	
System / Experiment / Model	SPIRE	**Signature / Date**		
Sub-System	detectors	**Request Type** (Highlight applicable request)	Waiver (RFW)	Deviation (RFD)
Assembly		**Organisation**	Jet Propulsion Laboratory	
Sub-Assembly		**Ref. Doc. / Drwg No.**	SPIRE-JPL-PRJ-000456	
Item		**References**		
Serial No.				

RFW/RFD Title	**BDA and JFET module sine test deletion**

End Items(s) Affected (Hardware, Software)		
Name	**CI-Number**	**Model(s)**
Bolometric Detector Assemblies JFET Modules		CQM, PFM, FS CQM, PFM, FS

Requirement / Interface Documents Affected				
Specification/Drawing Title	**Number**	**Issue**	**Date**	**App. Paragraph**
BDA-SSSD (SPIRE-JPL-PRJ-000456)		3.2	Jan 7, 2003	BDA-DES-10, JFET-DES-07

Description of Deviation / Discrepancy / Non-Conformance

High Level Sine- Vibe Test is not performed on these units

Other Items or Requirements (Potentially) Affected

Need for RFW/RFD and Rationale for Acceptance

The hardware has to be qualified under a cold vibration test and is installed in the cold vibration facility for the purpose of the test. The high level sine vibration test configuration will put the hardware and the personnel at risk since the cold vibration facility is not structurally capable of withstanding the high levels. Obtaining additional resources (cost and schedule) for developing a new set-up is not feasible at this time.

Up issue RFW to 5v1 with this note added

There is no Requirement to do a high level sine test on previously Qualified units, Only Random Acceptance level test are required.

	Approved	**Rejected**	**Name**	**Date**
Engineering:	**REF SPIRE – RAL-MOM-002250**		Digitally signed by Eric Clark Date: 2004.12.22 08:57:49 Z	**20 December 04**
Product Assurance:				**20 December 04**
CCB-Chairman:				
Principle Investigator				
Product Assurance:				
Co-Investigator				
Prime Contractor				
ESA Project Office				

CCLRC Rutherford Appleton Laboratory	**REQUEST FOR WAIVER / DEVIATION (RFW/RFD)**	**PRODUCT ASSURANCE Space Science and Technology Department**

RFW/RFD Number:	HR-SP-JPL-RFW-006

Spacecraft / Project	**Herschel**	**Originator's Name**	Martin Herman	
System / Experiment / Model	**SPIRE/ All**	**Signature / Date**		
Sub-System	Detector	**Request Type** (Highlight applicable request)	Waiver (RFW)	Deviation (RFD)
Assembly	BDA	**Organisation**	Jet Propulsion Laboratory	
Sub-Assembly		**Ref. Doc. / Drwg No.**		
Item		**References**		
Serial No.				

RFW/RFD Title	**Random vibration test levels not the same.**

End Items(s) Affected (Hardware, Software)		
Name	**CI-Number**	**Model(s)**
BDA		QM, CQM, PFM, FS

Requirement / Interface Documents Affected				
Specification/Drawing Title	**Number**	**Issue**	**Date**	**App. Paragraph**
BDA-SSSD	BDA-DES-10	3.2	Jan 7, 03	

Description of Deviation / Discrepancy / Non-Conformance

1) **Random Vibration Test Levels are not the same as given in the BDA-SSSD (Issue 3.2), BDA-Des-10**
2) **There are five different flavours of the BDA. The qualification vibration test is done on only one QM unit which is of the PLW type.**

Other Items or Requirements (Potentially) Affected

Need for RFW/RFD and Rationale for Acceptance

1. **The random vibration test levels are as specified by Berend Winter (MSSL) in an email on May 2, 2003, which superseded the BDA-SSSD**
2. **The qualification test program in using the PLW flavour as the only Qual Model, is given in Interoffice Memorandum, Oct. 3, 2003, Henry Abakians, Subject: SPIRE BDA Random Vibration Test Program [IOM 5132-03-167]**

	Approved	**Rejected**	**Name**	**Date**
Engineering:	**REF SPIRE – RAL-MOM-002250**		Digitally signed by Eric Clark Date: 2004.12.21 09:09:53 Z	**20 December 04**
Product Assurance:				**20 December 04**
CCB-Chairman:				
Principle Investigator				
Product Assurance:				
Co-Investigator				
Prime Contractor				
ESA Project Office				

JPL

INTEROFFICE MEMORANDUM
5132-03-167
October 3, 2003
Project: Herschel/Planck

TO: Martin Herman

FROM: Henry Abakians ha

SUBJECT: SPIRE BDA random vibration test program

This IOM outlines the random vibration test program for Herschel/Planck project's SPIRE element. Due to schedule and cost constrains, our proposed test program does not strictly conform to JPL's standard random vibration program; however, it maintains a medium to low risk posture.
The recommendations will concentrate on the vibration environment since that is the source of highest stresses on the unit. The SPIRE qualification program also includes thermal cycling and accelerated aging, but it will not be addressed in this IOM.

The SPIRE element of the JPL Herschel/Planck project has several Bolometer Detector Assemblies (BDA). These BDAs are identical in their outer housing, and primarily vary in a thermally isolated suspension which contains the bolometer array and the feedhorn (the suspension is held on to the housing via two rows of braided Kevlar strings). There are five flavors to these suspensions: PSW, PMW, PLW, SSW, SLW (P: photometer, S: spectrometer, LW: long wave, MW: medium wave, SW: short wave). The suspensions also vary in their mass and center of gravity (PLW the heaviest, SSW the lightest).

In a traditional JPL Qual/FA test program, a Qual unit for each BDA flavor would be tested (3-axis, 2 min. per axis), and all subsequent flight units would be FA tested (3-axis test, FA levels, 1 min. per axis). In a traditional Protoflight program, all flight units would be protoflight tested (3-axis test, Qual levels, 1 min. per axis).

The SPIRE element has evolved into a Qual/FA/Protoflight test program. We have built and successfully tested a qual unit (CQM, PLW). It was random vibrated at Qual levels and durations (2 minutes) in three axes. This unit successfully passed the random vibration test, and remained within the specifications (performance or otherwise). Our proposed test program for all subsequent BDAs is as follows:

BDA type	test program	random vibe axis	duration
PSW	PF	x	2 min
PMW	PF	x	2 min
PLW	Qual/PF	3 axis Qual	2min/axis
		PF-x axis only	1 min
SSW	PF	x	2 min
SLW	PF	x	2 min

The test program deviates from a standard JPL program; however, we believe it maintains an acceptable risk posture for the following reasons:

1-The vibration in the z-direction is substantially more benign than x and y. Therefore, we can eliminate the random vibration test in the z-direction for all flight units (this is based on the CQM test results).

2-There is sufficient cross-talk between x and y (based on CQM test results). Therefore, we can eliminate the y direction shake and perform the test in the x-direction for an additional 1 minute (x is the more severe direction; moreover, since we are not concerned with low cycle fatigue failure – substantiated by the CQM test - we feel justified in extending the x-direction test duration to 2 minutes, thus indirectly testing for y-direction).
While it is clearly more desirable to test in y-direction directly, eliminating this test is primarily driven by cost and schedule constraints: all our test are performed at or below 100K, thus a one axis vibration will require a minimum of 3 work days; however, extending a 1 minute test to 2 minutes will not impact schedule, cost, or the safety of the hardware.

3-We have tested the heaviest assembly (PLW) for our qualification program. This ensures that our design is validated for the highest possible stresses in the Kevlar string.

4- Force transducers will be utilized in 3 directions. Their responses will be correlated with the CQM results providing additional assurance on hardware workmanship, reliability and robustness.

Concurrence: John Forgrave
John Forgrave,
Environmental requirements Engineering, Group Supervisor

Concurrence: Paul MacNeal
Paul MacNeal, Dynamics Engineer
Herschel/Planck

Concurrence: Tim Larson for
Tim Larson, Mission Assurance Manager
Herschel/Planck

Distribution:
Bill McAlpine
Margaret Frerking
Michael O'Connell
Gary Parks
Kalyani Sukhatme
Mark Weilert

CCLRC Rutherford Appleton Laboratory	**REQUEST FOR WAIVER / DEVIATION (RFW/RFD)**	**PRODUCT ASSURANCE Space Science and Technology Department**

RFW/RFD Number:	HR-SP-JPL-RFW-022

Spacecraft / Project	**Herschel**	**Originator's Name**	Mark Weilert	
System / Experiment / Model	**SPIRE / CQM, PFM, FS**	**Signature / Date**	22 July 2005	
Sub-System	**Detectors**	**Request Type** (Highlight applicable request)	Waiver (RFW)	Deviation (RFD)
Assembly		**Organisation**	Jet Propulsion Laboratory	
Sub-Assembly	**BDA**	**Ref. Doc. / Drwg No.**	SPIRE-JPL-PRJ-000456; Herschel-Planck ERD, JPL D-19155 Rev B.	
Item	10209800 -1 thru -5	**References**		
Serial No.	6,8,9 & 12 thru 19			

RFW/RFD Title	**BDA vibration test temperature.**

End Items(s) Affected (Hardware, Software)		
Name	**CI-Number**	**Model(s)**
Bolometric Detector Assemblies (all types)		CQM, PFM, FS

Requirement / Interface Documents Affected				
Specification/Drawing Title	**Number**	**Issue**	**Date**	**App. Paragraph**
BDA-SSSD (SPIRE-JPL-PRJ-000456)		3.2	Jan 7, 2003	BDA-DES-10

Description of Deviation / Discrepancy / Non-Conformance

BDA Cold vibration tests were performed with the BDA temperature at T < 100K instead of T < 90K as required in the SSSD sec. 3.4. Note that the Herschel-Planck Environmental Requirements Document (ERD), JPL D-19155 Rev B lists 100K for the required test temperature.

Other Items or Requirements (Potentially) Affected

Need for RFW/RFD and Rationale for Acceptance

The hardware is tested in the cold vibration facility which contains a liquid nitrogen cooled cold plate which typically reaches 81K minimum. The BDA temperature is measured on the Kevlar-isolated portion of the BDA, which cools down extremely slowly below about 120K. The 100K maximum test temperature used is the lowest that can be practically obtained without waiting an excessive amount of time during the test. The difference in vibration behaviour between 100K and 90K will be minimal, so this change does not affect the validity of the test results. Also note that the temperature of the mounting flange and other non-suspended parts of the BDA are likely less than 90K since they have much better thermal contact to the cold plate.

	Name	**Approved (Sign & Date)**	**Rejected (Sign & Date)**
Engineering:	**Eric Sawyer**	Digitally signed by Eric Sawyer Date: 2005.07.22 12:17:10 +01'00'	
Product Assurance:	**Eric Clark**	Digitally signed by Eric Clark Date: 2005.07.22 09:04:15 +01'00'	
CCB-Chairman:			
Principle Investigator			
Product Assurance:			
Co-Investigator			
Prime Contractor			
ESA Project Office			

Open Problem / Failure Report (PFR) List

Open PFR's on This Hardware (FS SSW BDA 10209800-5 S/N 016):

NONE

Open PFR's on Similar Hardware:

NONE

SPIRE
Bolometer Detector Assembly
Handling Document

Prepared by
Mark Weilert

20 August, 2003
revised 20 Nov. 03
revised 9 August, 05

WARNINGS

BDA is Contamination Sensitive: Open red shipping container only in an ISO 14644-1 class 7 (FED-STD-209 Class 10000) or cleaner cleanroom. Handle BDA with approved[1] nitrile or polyurethane ESD safe cleanroom gloves only. (See end of document for notes and JPL approved products).

BDA is ESD Sensitive: Handle with approved[2] wrist straps, ESD-safe gloves and ESD smocks at an approved ESD protected workstation[3]. All personnel within 1 meter of unprotected ESD sensitive hardware shall be certified for ESD awareness[4]. Note that no connector savers or other connector protection are shipped with the BDA, per the business agreement. Refer to attached electrical handling document for other important safety precautions. Follow all instructions for the use of wrist straps, ESD smocks, static protected work areas, ionizers, packing/unpacking and cable handling per JPL standard D-1348, rev. F (This document is available through the public domain by the following URL: http://standards.jpl.nasa.gov/contractor/docs/d1348f.html.)

ESD - Ionizer: Prior to mate or demate of any connector, turn on an ionizer approved[5] for ESD sensitive components in clean room environment at least 5 minutes in advance and place/hold both sides of the connections in front of the ionized air stream for a minimum of 10 seconds before mating/demating operation. Position the ionizer near the hardware within the required distance per manufacturer's manual. Different makes and models of ionizers have different positioning requirements. During the mating/demating operations, it is necessary to follow the requirements for handling ESD sensitive hardware.

ESD - Connection to GSE: It is essential to ensure that all signal and bias lines of the GSE are grounded prior to mating the BDA hardware to the GSE. A

safe-to-mate check *must* be performed prior to connecting the BDA to the GSE. No excessive voltages and currents on all signal and bias lines shall be observed while the hardware is connected.

QA Oversight: Quality Assurance personnel should witness all handling, electrical testing, operation and integration of BDA flight hardware. At a minimum, a "two person" rule should be invoked at all times, where oversight by an independent party is provided to ensure hardware safety during handling, test and integration operations.

BDA is Fragile: Do not drop or otherwise shock. Take care to avoid applying unnecessary force to the Kevlar suspended portion of the BDA. In particular, do not torque the thermal strap interface fasteners to greater than 320 N*mm. The BDA is preferably held/supported either by its square mounting flange, or by the light-seal can which holds the electrical connectors. Note that the red shipping container provides only minimal shock isolation, and should be treated as equally fragile while the BDA is inside. Because the Kevlar tension is higher at room temperature than cold, **DO NOT SHAKE TEST AT ANY TEMPERATURE ABOVE 100K** (except for low-level survey shakes, 0.25g typical). A full level shake at room temperature risks **catastrophic** failure. Avoid touching Kevlar braid with anything, it is sensitive to abrasion or cutting by seemingly smooth objects.

BDA is Humidity Sensitive: The Kevlar tension increases with moisture absorption. Keep in a dry environment when possible during storage or while not being handled. While being actively handled, hardware should be placed in a humidity-controlled cleanroom. Maintain humidity level at 35%-50% RH typical, for ESD safety.

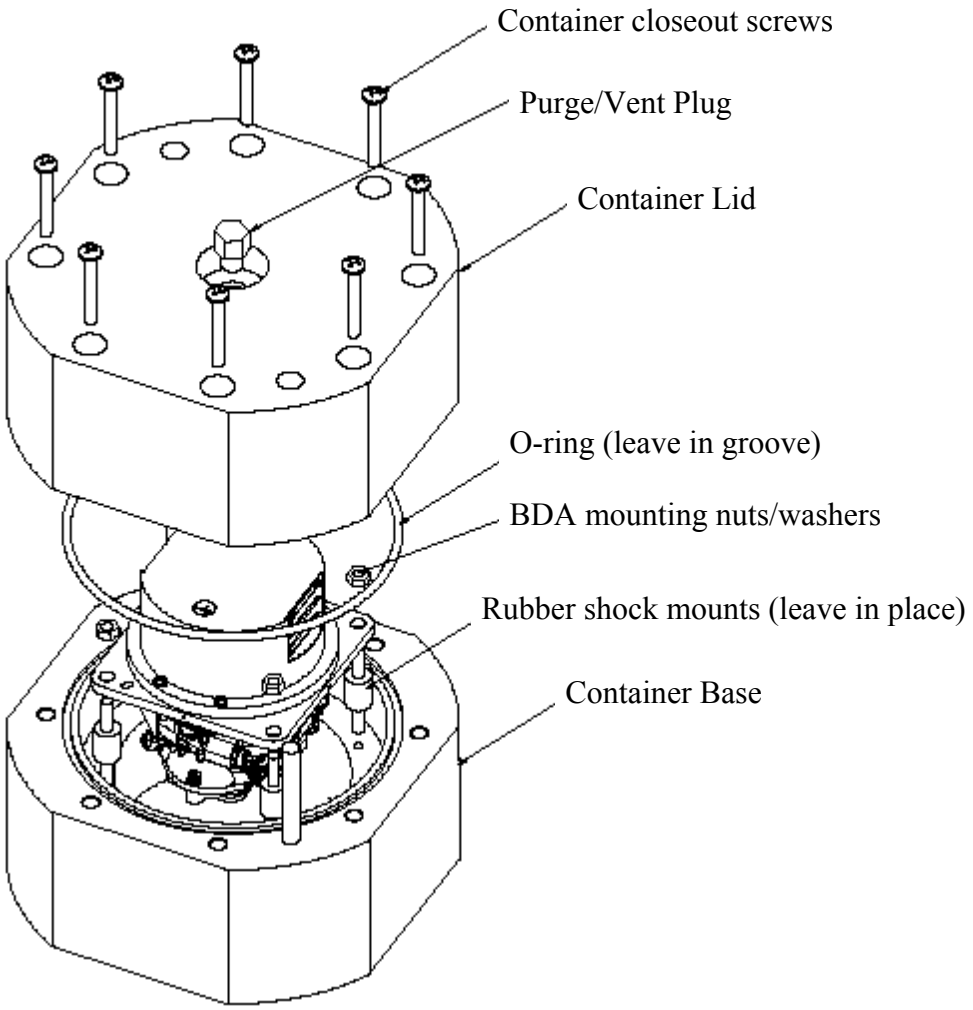
BDA is Temperature Sensitive: The Kevlar tension and creep increases at high temperatures, **DO NOT BAKE OUT AT ABOVE 80°C.**

Unpacking Procedure:

The BDA is shipped in a multi-layer container, a custom shipping container (red) inside a case inside a case. The case should be opened only in a reasonably clean area in order to protect the red shipping container, which should only be opened in a class 10000 or better clean room at an ESD-safe workstation. The red shipping container has three shock-monitors attached to the top, labeled 10g, 20g and 50g. The monitors have steel balls and springs which are contained between plastic rails if the unit has not seen the marked shock level. If the monitors have experienced their specified shock, some of the balls will be loose in the bottom. Please note the state of the three shock monitors and report the result to JPL. These monitors may need to be removed from the top of the red shipping container before it is opened, since they probably obstruct access to the vent plug. They are attached with a double-stick tape adhesive and may be pulled off by applying force to the white base. (Avoid just pulling on the clear case, as this will likely open up the monitor and spill the contents.) **NOTE: The cases holding the red shipping container must be returned to JPL for use in future shipments.**

Opening the Red Shipping Container:

An exploded view of the container is shown below. The top is the side with the vent plug in the center. Make sure the area around the plug is clean, then remove the plug to equalize the pressure. The 8 closeout screws are next loosened alternately (with a 1/8"



hex key) to relieve pressure on the o-ring seal, and then backed off completely to disengage the screws from the base. The container lid is then lifted straight up to open the container. Two guide pins prevent significant sideways motion of the lid until it is high enough to clear the BDA The BDA is removed from the shipping container base by removing the mounting nuts and washers from the rubber shock mounts and lifting the BDA straight up.

For re-installation of the BDA into the red container, note that the light can must be up, as shown, to prevent the container lid from hitting the BDA. Also, the epoxy terminations of the Kevlar braids should be oriented towards the cutouts in the container base.

NOTES:

[1] JPL approved ESD safe cleanroom gloves are:

Nitrile:	
Ansell-Edmont Nitrilite	http://www.ansellpro.com/ce/products3.asp?pid=87
Ansell-Edmont Nitrilite Silky	http://www.ansellpro.com/ce/products3.asp?pid=149
Ansell-Edmont Silky Ultra-Clean	http://www.ansellpro.com/ce/products3.asp?pid=150
Safeskin Critical (white)	http://www.safeskin.com/crit_nt_glv.asp
Polyurethane:	
Wilshire Technology DuraCLEAN	call in US, 323-259-6469 for ordering information

[2] JPL approved wrist straps are:
Speidel Twist-o-Flex ™ brand metal expansion bracelet wrist straps
3M model 4600 adjustable molded thermoplastic wrist straps

[3] All work areas shall be certified and operated in compliance with the requirements of the following subsections sections of JPL-STD D-1348 rev. F section 2.3: subsections: 6, 8-11, 14-19, 21, 23 – 27, 29 – 36, 38 – 43 and 45.

[4] All personnel shall be trained and certified to the requirements of section 2.3.3 of JPL STD_D-1348 rev. F.

[5] The ionizer performance shall be verified to comply with the requirements of JPL-STD-D-1348 rev. F, Table 1 for devices with human body model ESD sensitivity less than 50 volts. The ionizer shall discharge from ± 1000 volts to less than ± 20 volts in less than 20 seconds and have a float potential of less than ± 20 volts.

SPIRE

Subject: Spectrometer BDA Filter Replacement Procedure
Prepared by: Mark Weilert

Document No: D-31978

Issue: 1 **Date: 4-May-05**

Checked by: ……. Date:……

Approved by:…… Date:……

Distribution

RAL SPIRE: Doug Griffin, Bruce Swinyard, Eric Sawyer and Eric Clark

JPL SPIRE: Jamie Bock, Jim Newell, and Martin Herman

Change Record

Issue	**Date**
1 (initial issue)	4-May-05

Table of Contents

Introduction…..…….... page 5
Warnings…….. page 5
Filter Removal…….... page 5
Filter Installation……. page 6
Figure 1 (Filter Detail from Assy. Dwg)…….…….……page 8
Figure 2 (Pictures of Typical Staking)…….…….…… page 9

Attachments

10209800-B.pdf (BDA top-level assembly Drawing, as included in HRCR package)

1 Introduction

The removal and replacement of the BDA filter is in principle a simple procedure, consisting of removing the screws, removing the filter, replacing the filter, replacing the screws, torquing the screws, and staking the screws. This procedure applies to both SSW and SLW BDA's, part #'s 10209800-5 and 10209800-4, respectively.

The difficulty is due to the drive for the screws, which is an offset-cruciform drive ("Torq-set" drive, per NA0025). The driver we use is a commercially available part, but the filter screws use a very small size and we tried a couple of different drives before finding a good one.

Also, since the filter removal and re-installation applies significant force to the suspended portion of the BDA, if the unit were at JPL we would perform metrology measurements before and after the process to see if the suspended portion of the BDA had shifted. This worry can be reduced somewhat by trying to hold the BDA by the top ring (to which the filter attaches) during the screw removal and torquing.

Detailed procedures follow below. Item numbers refer to the parts list in drawing 10209800, which is included in the HRCR package and attached. See sheet 2 of the drawing for the filter installation detail, which is reproduced in figure 1 below.

2 Warnings

The BDA is shock, ESD, and contamination sensitive. Handle in accordance with the general handling requirements listed in the SPIRE BDA Handling Document, JPL D-26653, included in the HRCR package.

This procedure could cause a shift in the location of the suspended portion of the BDA. Checking the position of the suspended portion with respect to the mounting flange before and after is recommended.

All procedures should be performed with QA witness, and a calibrated torque wrench should be used.

3 Filter Removal

3.1 Remove the 6x item 48 screws, 2x item 19 nuts and 4x item 21 Belleville washers holding filter to the top ring of the BDA.

The two end screws are held into nuts which must be held to loosen the screws. The loosening torque can be applied to the screw or the nut as desired.

Note that the screws are staked with epoxy. This epoxy will break away when the screws are loosened. Take care to contain the epoxy bits so they do not fall into the BDA assembly.

3.2 Retain all screws, nuts, and washers for later re-installation.

3.3 Lift the filter off the top ring.

4 Filter Installation

4.1 Place new filter into position on the BDA top ring. Note that the filter will only go on in one orientation due to the clearance slot for the thermal strap.

4.2 Attach the filter using the 6x item 48 NA0068A016012 screws removed during disassembly. Use an item 19, nut, and two item 21 Belleville spring washers in series (<>) at each of the two thru-hole locations. Finger tighten screws in an alternating pattern, such as that suggested in figure 1 below.

Note that residual staking epoxy must be cleaned from the parts before re-use. This can easily be accomplished by heating the screws, washers or nuts slightly with a heat gun, which softens the epoxy enough for removal with a sharp tool. **Do not use a heat gun on the assembled unit.**

ALTERNATE OPTION:
If you have sufficient clearance above the top of the BDA in the next level of assembly, it is acceptable to use NA0069-016012 socket-head cap screws for the filter installation instead of the NA0068 screws which were originally installed. This will avoid the problems with the offset-cruciform drive, but will leave the heads of the screws extending above the top of the filter. Make sure that the screws are not longer than 12mm (measuring from under the head), because the clearance from the end of the screw to the bottom of the threaded holes is a bit tight. The location of the washers and nuts, as well as the torquing and staking in the following steps is unchanged.

4.3 Torque all item 48 screws to 200N*mm in the same pattern as above.

The end screws must have the nuts held with a small closed-ended wrench during torquing. Torque is applied to the screws in all cases.

4.4 Stake the six filter screws using item 25, 2216A/B epoxy.

The four central screws are staked at the heads, while the end screws are staked at the nut such that epoxy connects the screw to the nut. See figure 2 for pictures of typical staking.

4.5 Cure epoxy for 24 hours minimum at room temperature.

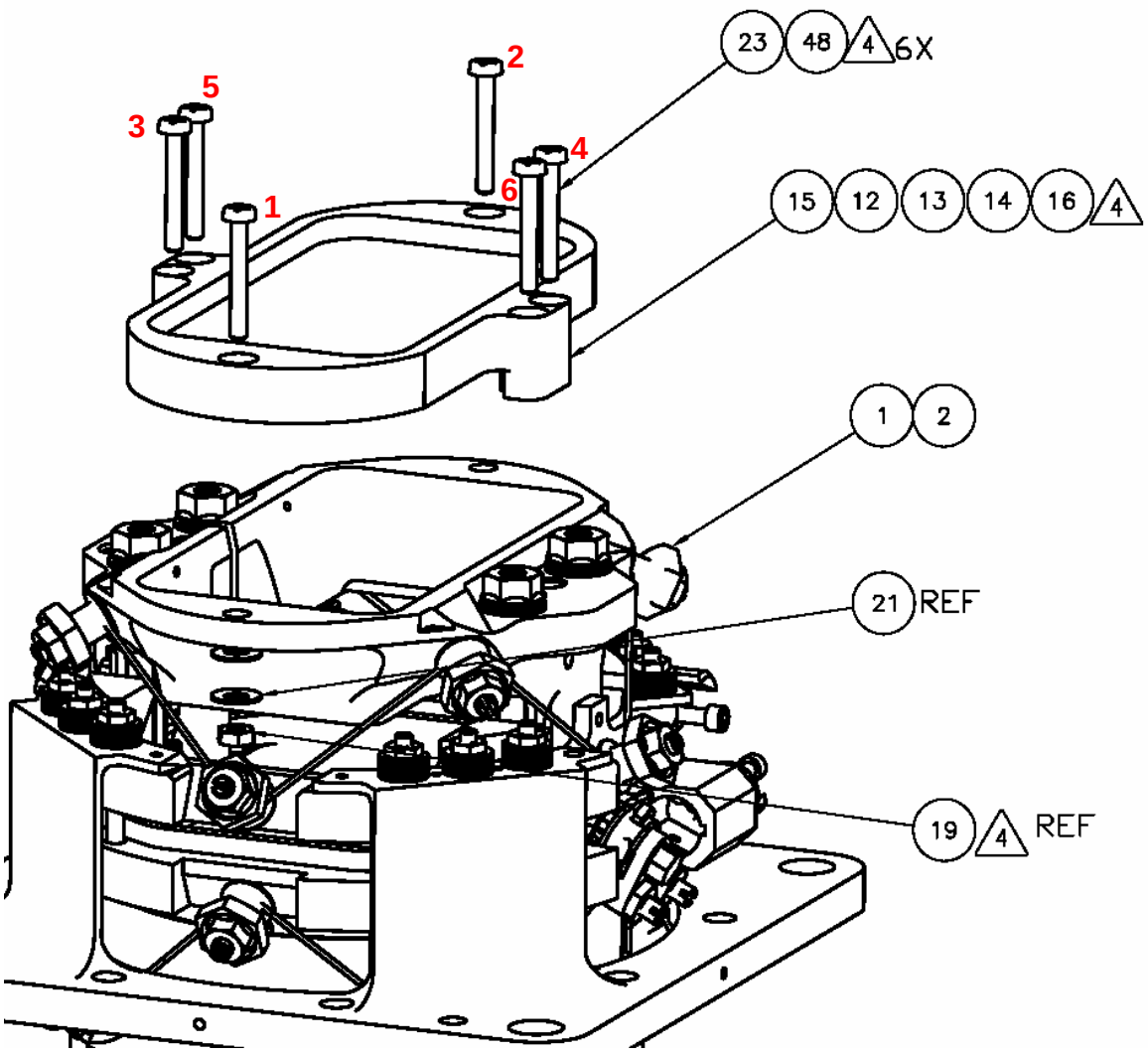
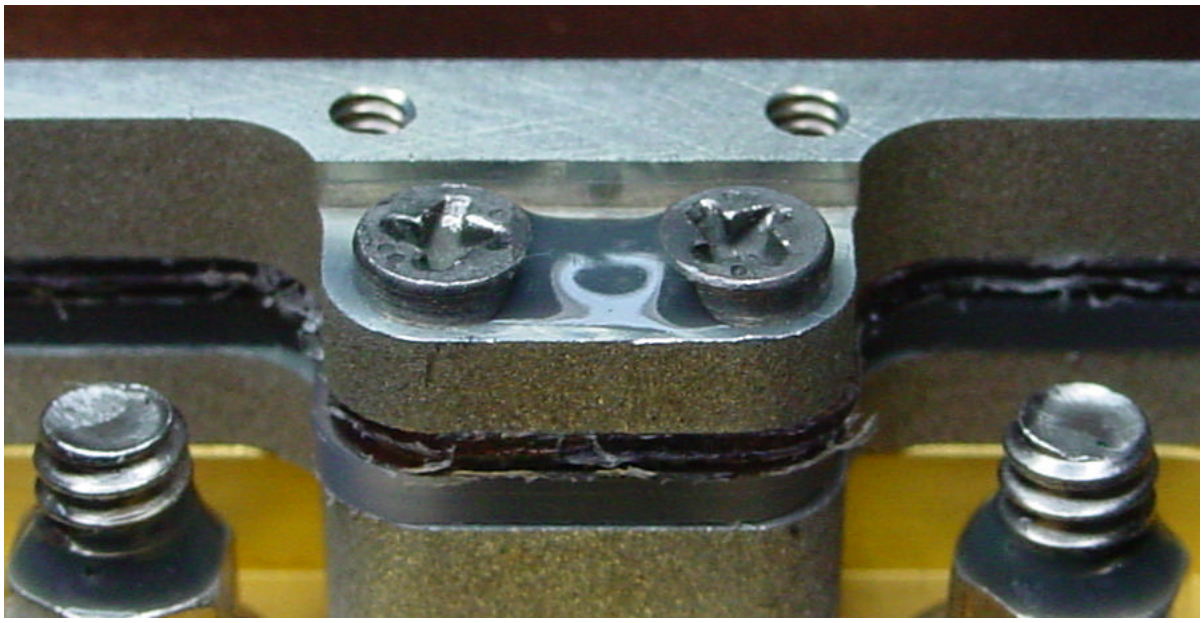


Figure 1

Filter Detail from Drawing 10209800 rev B, showing suggested screw tightening pattern in red. See attached full drawing for part number references.



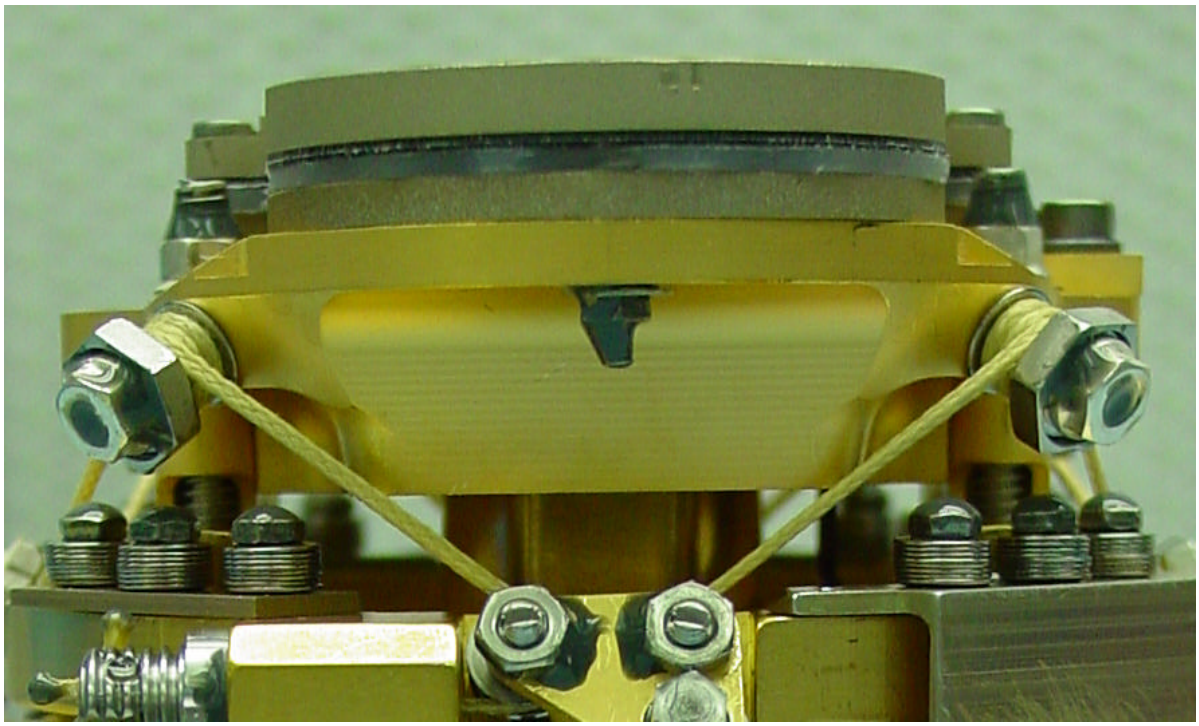


Figure 2

Typical Fastener Staking.

SPIRE

Subject: BDA Electronic Handling Procedure, SPIRE S/SW-FS, SN016

Prepared by: Anthony Turner

Document No:

Issue: Draft **Date: 7/12/2005**

Checked by: ……. Date:……

Approved by:…… Date:……

Distribution

Change Record

Issue	Date

Table of Contents

1. Introduction…..…… page 6
2. Handling……... page 6
3. Signal Requirements……... page 6
4. Device Isolation…… page 7
5. Room Temperature Detector Values Check……. page 7
6. Load Resistor-Detector Continuity Check…… page 10

Glossary

1. Introduction:

This document provides the Electronic Handling Procedure for the Flight Spare-Spectrometer Short Wavelength Bolometer Detector Array SN016.

2. Handling:

1. **BDA is Contamination Sensitive**: Handle BDA with Gloves only in a FED-STD-209 Class 10000 clean room (ISO 14644-1 class 7) or better.

2. **BDA is ESD Sensitive**: Electronic parts included in the S/SW-FS science instrument are subject to electro-static discharge failures. Please handle with appropriate ESD hardware handling procedures. Handle with grounding straps, ESD-safe gloves, ESD smocks at an ESD-safer workstation.

3. Signal Requirements:

The interface circuit for the BDA contains a series of resistive networks as depicted in figure 1. Two high resistive load resistors (~ 6-14 MΩ) are coupled to a NTD Ge thermistor (R_{bolo}) through a lithographed metalization circuit and provide the bias circuitry for the device. The maximum DC input voltage for the bias lines V+ and V- lines is +/- 1 V, and the maximum AC input voltage is 100mV rms.

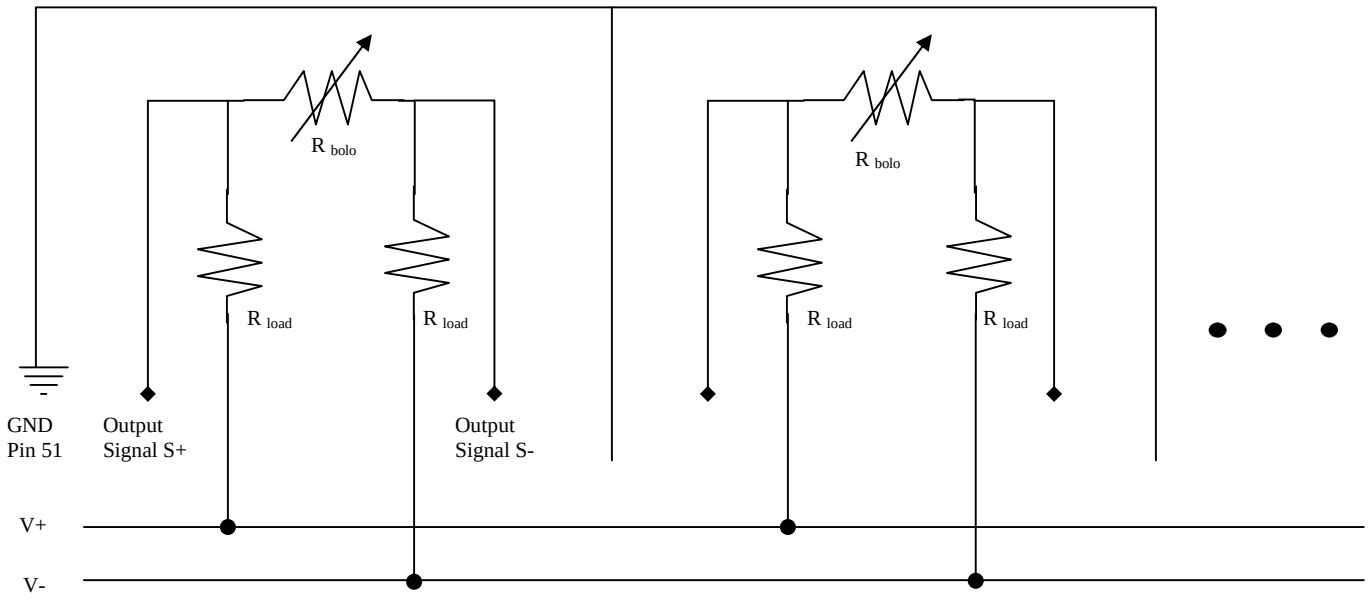


Figure 1: Interface circuit of the Bolometer Detector Array

DC Voltage-Current Limits for Room Temperature Detector Values Check:

Signal	Pin	Nominal Value	Max Value
V+	25	+50mV	+1 V
V-	50	-50mV	-1 V
I+,I-	25,50	10μA	25μA

DC Voltage-Current Limits for room temperature Load Resistor-Detector Continuity Check:

Signal	Pin	Nominal Value	Max Value
V+	25	+50mV	+1 V
V-	50	-50mV	-1 V
I+, I-	25,50	<0.5μA	1μA

4. Device Isolation Check:

The 300mK stage Kevlar suspended portion of the detector chassis is grounded directly to the electronic ground on pin 51 of the nanonics 51 pin connectors on each side. A resistance of less than 200Ω can be checked from the thermal strap of the 300mK stage to electrical ground pin 51. The 2K stage is electrically isolated from the electronic ground via the Kevlar supports. Measuring from pin 51 to any metal section of the 2K stage will yield an open circuit.

5. Room Temperature Detector Values Check

The final measured DC resistance value for each of the bolometer detector at room temperature is shown in the Table 1 and 2. The measurements bypass the load resistors in the circuit measuring directly through the output signal pins on the two nanonics 51 pin connectors. All measurements were performed with a Fluke 87 True RMS Multimeter set in the 4kΩ range. All measurements are in kΩ unless designated otherwise. Channels that are out of range are re-measured using the 40MΩ range to determine their value. The failure mode of any particular channel is also designated in table 1 and 2. The designation for the failure modes are open- Channel open at 300mK, short-channel shorted at 300mK, float- channel floating at 300mK, or caution- cautionary status which will be associated with a note following each table on that channel.

Table 1: S/SW-FS Room Temperature DC Detector Measurements J05 connector

Connector Label	Signal	Nanonics Pin From	Nanonics Pin To	Detector Label	Resistance (kohms)	Failure Mode
Z1/J05	1	1	26	R1	3.84M	
	2	2	27	A4	2.066	
	3	3	28	A3	2.016	
	4	4	29	A2	1.994	
	5	5	30	A1	1.949	
	6	6	31	DK1	1.916	
	7	7	32	B3	2.018	
	8	8	33	B2	1.984	
	9	9	34	B1	1.918	
	10	10	35	C3	1.948	
	11	11	36	C2	1.896	
	12	12	37	C1	1.836	
	13	13	38	D3	1.898	
	14	14	39	D2	1.883	
	15	15	40	D1	1.89	
	16	16	41	E3	1.988	
	17	17	42	E2	1.996	
	18	18	43	E1	1.968	
	19	19	44	F3	2.07	
	20	20	45	F2	2.061	
	21	21	46	F1	2.047	
	22	22	47	G1	2.072	
	23	23	48	T1	2.109	
	24	24	49	G2	2.176	
	V+ to V-	25	50		0.705M	
	V- to gnd	50	51		>40M	
	V+ to gnd	25	51		>40M	
	Chassis to gnd				62.7 ohms	

Table 2: S/SW-FS Room Temperature DC Detector Measurements J06 connector

Connector Label	Signal	Nanonics Pin From	Nanonics Pin To	Detector Label	Resistance (kohms)	Failure Mode
Z1/J06	1	1	26		1.182	
	2	2	27		1.164	
	3	3	28		1.246	
	4	4	29		1.131	
	5	5	30		1.117	
	6	6	31		1.101	
	7	7	32	G3	1.785	
	8	8	33	G4	1.764	caution
	9	9	34	DK2	1.701	
	10	10	35	F5	1.694	
	11	11	36	F4	1.703	
	12	12	37	E6	1.63	
	13	13	38	E5	1.713	
	14	14	39	E4	1.748	
	15	15	40	D7	1.688	
	16	16	41	D6	1.752	
	17	17	42	D5	1.798	
	18	18	43	D4	1.853	
	19	19	44	C6	1.768	
	20	20	45	C5	1.821	
	21	21	46	C4	1.877	
	22	22	47	B5	1.838	
	23	23	48	B4	1.867	
	24	24	49	T2	1.902	
	V+ to V-	25	50		0.702M	
	V- to gnd	50	51		>40M	
	V+ to gnd	25	51		>40M	
	Chassis to gnd				57.1 ohms	

Caution note: Channel G4 has a extra nitride path from center or pixel web to pixel frame that may effect the thermal time constant

6. Load Resistor-Detector Continuity Check

A DC continuity check of the load resistors in series with the bolometer detectors will complete the electrical checkout at room temperature. The test can be performed with a Fluke 87 True RMS multimeter set on the 40MΩ scale. The data set measures from V+ to output signal S+ and V- to output signal S- for each channel. The nominal value read for the live bolometer channels (room temp detector DC resistance ~ 1.5kΩ) should read approximately 3-6MΩ. Channels with open bolometer channels will give values 8MΩ or higher. The Data sets for the S/SW-FS for the final test through the entire circuit are shown in Table 3.

Table 3: S/SW-FS Load Resistor- Detector DC Continuity Check J05 connector

Connector Label	Signal	Detector Label	Bias V+ (pin 25) To S+ pin	Resistance V+ to S+ (Mohms)	Bias V- (pin 50) To S- pin	Resistance V- to S- (Mohms)
Z1/J05	1	R1	1	5.11	26	5.11
	2	A4	2	4.31	27	4.24
	3	A3	3	4.28	28	4.28
	4	A2	4	4.32	29	4.28
	5	A1	5	4.28	30	4.28
	6	DK1	6	4.32	31	4.28
	7	B3	7	4.32	32	4.32
	8	B2	8	4.28	33	4.32
	9	B1	9	4.28	34	4.28
	10	C3	10	4.32	35	4.28
	11	C2	11	4.32	36	4.32
	12	C1	12	4.36	37	4.36
	13	D3	13	4.32	38	4.32
	14	D2	14	4.32	39	4.32
	15	D1	15	4.36	40	4.36
	16	E3	16	4.4	41	4.4
	17	E2	17	4.4	42	4.34
	18	E1	18	4.33	43	4.32
	19	F3	19	4.36	44	4.36
	20	F2	20	4.4	45	4.36
	21	F1	21	4.4	46	4.36
	22	G1	22	4.4	47	4.36
	23	T1	23	4.42	48	4.38
	24	G2	24	4.4	49	4.38

Table 4: S/SW-FS Load Resistor- Detector DC Continuity Check J06 connector

Connector Label	Signal	Detector Label	Bias V+ (pin 25) To S+ pin	Resistance V+ to S+ (Mohms)	Bias V- (pin 50) To S- pin	Resistance V- to S- (Mohms)
Z2/J06	1		1	4.36	26	4.4
	2		2	4.36	27	4.44
	3		3	4.36	28	4.44
	4		4	4.36	29	4.4
	5		5	4.4	30	4.4
	6		6	4.44	31	4.36
	7	G3	7	4.42	32	4.36
	8	G4	8	4.4	33	4.4
	9	DK2	9	4.36	34	4.4
	10	F5	10	4.36	35	4.4
	11	F4	11	4.4	36	4.36
	12	E6	12	4.4	37	4.36
	13	E5	13	4.36	38	4.4
	14	E4	14	4.36	39	4.36
	15	D7	15	4.32	40	4.36
	16	D6	16	4.4	41	4.4
	17	D5	17	4.37	42	4.36
	18	D4	18	4.36	43	4.36
	19	C6	19	4.38	44	4.36
	20	C5	20	4.4	45	4.36
	21	C4	21	4.4	46	4.36
	22	B5	22	4.4	47	4.36
	23	B4	23	4.44	48	4.36
	24	T2	24	4.4	49	4.36

EIDP Coverpage For SSW BDA (SN016)

Unit Identfication							
Name	SSW BDA						
Part #	10209800-5						
S/N	#016						

Environmemtal Testing							
	Axes Tested	Temperature	Duration or Number of Cycles	Pass/Fail	Requirement	Source	Waiver #
Random Vibration Test	X	100 K	2 min per axis	P	X, Y, Z at 90 K 1 min per axis	SSSD Sec # 3.4	HR-SP-JPL-RFW-006
High Level Sine Vibe Test	None	NA	NA	NA	X, Y, Z at 90 K	SSSD Sec # 3.4	HR-SP-JPL-RFW-005
Bakeout	NA	NA	NA	NA	None (other than as part of the assembly procedure)	D-20549	
Thermal Cycles	NA	RoomT to ~ 6 K	2	P	1 thermal cycle roomT to 77 K (max 5)	D-20549	

Other Testing	Frequency [Hz]						
	Pre-full level	Post-full level			Minimum Performance	Source	Waiver #
Lowest Resonant Frequency	312 Hz	310 Hz			> 200 Hz (Goal: >250 Hz)	SSSD Sec # 3.1.3	NA
Metrology Measurements were performed before and after the Vibration Test and the Thermal Cycles							
	Motion in X/Y	Motion in Z		Meets Goal ?	Performance Goal	Source	Waiver #
Maximum motion due to Random Vibration Test	21 μm	43 μm		Y	125 μm in X/Y and 500 μm in Z	SSSD Sec # 3.1.1	NA
Maximum motion due to the 1st thermal cycle	12 μm	16 μm		Y	125 μm in X/Y and 500 μm in Z	SSSD Sec # 3.1.1	NA
Maximum motion due to the 2nd thermal cycle	6 μm	6 μm		Y	125 μm in X/Y and 500 μm in Z	SSSD Sec # 3.1.1	NA
Cumulative Maximum motion	38 μm	65 μm		Y	125 μm in X/Y and 500 μm in Z	SSSD Sec # 3.1.1	NA
Cold Continuity Measurements were made during each of the thermal cycles							
				Pass/Fail	Requirement	Source	Waiver #
Cold Continuity Test (1st Thermal Cycle)				P	None	NA	NA
Cold Continuity Test (2nd Thermal Cycle)				P	None	NA	NA

ENVIRONMENTAL TEST AUTHORIZATION AND SUMMARY (ETAS)

AUTHORIZATION SECTION

PROJECT	LOG NO.
Herschel	HS039

SYSTEM/ASSEMBLY TITLE	DATE ISSUED
SSW BDA SN016	03/14/2005

REFERENCE DESIGNATION NUMBER	PART NO. (IF MULTIPLE, ATTACH LIST)	REV.	SERIAL NO.
	10209800		016

HARDWARE TYPE
☐ EM QUAL ☒ FLIGHT ☐ FLIGHT SPARE ☐ OTHER

PRE-ENVIRONMENTAL INSPECTION REPORT NUMBER (ATTACH IR)

WIRING HARNESS	PART NO.	REV.	SERIAL NO.
☐ EM QUAL ☐ FLIGHT ☐ EM ☐ SE			

TEST DESCRIPTION (CHECK ALL APPLICABLE)
☐ SINE VIBRATION ☐ PYROSHOCK ☐ ACOUSTIC ☐ EMC ☐ OTHER _____
☒ RANDOM VIBRATION ☒ THERMAL VAC. ☐ THERMAL ATMOSPHERE

TYPE OF TEST
☐ QUALIFICATION ☐ FLIGHT ACCEPTANCE
☒ PROTO FLIGHT ☐ RETEST

WILL ALL TESTS/LEVES/DURATIONS REQUIRED BY THE PROJECT DOCUMENTS BE PERFORMED ON THIS UNIT?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) ENTER PROJ. DOC. NO. AND REV. ____

HAS THE UNIT PASSED ALL PRE-ENVIRONMENTAL FUNCTIONAL TESTS?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

HAVE ALL DESIGN ANALYSES BEEN COMPLETED AND REQUIRED CHANGES BEEN IMPLEMENTED?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

IS THE TEST ARTICLE IDENTICAL TO OTHER FLIGHT UNITS?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

ARE ALL PFRs AGAINST THIS UNIT CLOSED?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

HAVE ALL WAIVERS AND ECRs BEEN APPROVED AND ARE THEY INCORPORATED?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

TEST AUTHORIZED BY

COGNIZANT ENGINEER	DATE	TECHNICAL MGR./INSTR MRG./PI PREP REP	DATE	ENVIRONMENTAL REQUIREMENTS ENG.	DATE
R Kimble	3/14/05	Martin Hue	3/15/05	Scott Hughes	3/16/05

SUMMARY SECTION

TEST AGENCY (IF MULTIPLE, ATTACH SUMMARY AND TEST DATES)	TEST INITIATION DATE	ACCUMULATED OPERATING HOURS PRIOR TO FIRST ENVIRONMENTAL TEST
JPL Building 144	03/17/05	
SERIAL NUMBERS ACTUALLY TESTED	TEST TERMINATION DATE	OPERATING HOURS DURING ENVIRONMENTAL EXPOSURE

TEST DESCRIPTION

VIBRATION	ACOUSTIC	PYROSHOCK SHOCK	THERMAL VACUUM	TEMPERATURE ATMOSPHERE	OTHER
AXES: X Y Z SINE VIBRATION ☐ ☐ ☐ RANDOM VIBRATION ☒ ☐ ☐	☐	AXES: X Y Z ☐ ☐ ☐ SHOCKS/AXIS:	☒ PRESSURE: <1E-5 mbar, 290K to 7K NO OF CYCLES: 2	NO OF CYCLES:	☐ ____

EMC	COND. SUSC.	COND. EMIS.	ISOLATION	TEMP. LEVEL (°c) AND ACCUMULATED DURATION (HRS.)
☐ ESD	☐ RAD. SUSC.	☐ RAD. EMIS.	☐ MAGNETICS	HOT: ____°c, ____h COLD: ____°c, ____h HOT: ____°c, ____h COLD: ____°c, ____h

WERE THERE ANY PFRs GENERATED DURING ENVIRONMENTAL TESTS? ☐ YES ☑ NO (IF NO, ATTACH EXCEPTIONS LIST)	LIST PFR NOS. / BRIEF EXPLANATION
ARE THE POST ENVIRONMENTAL DAMAGE INSPECTIONS COMPLETE? ☑ YES ☐ NO (IF YES, ATTACH A COPY OF THE INSPECTION REPORTS. IF NO, ATTACH EXPLANATION)	LIST PFR NOS. / BRIEF EXPLANATION
WERE ALL PLANNED TESTS/LEVELS/DURATIONS ACHIEVED? ☑ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST)	LIST PFR NOS. / BRIEF EXPLANATION

☐ TESTS HAVE NOT BEEN SUCCESSFULLY COMPLETED. SEE THE ATTACHED SUMMARY FOR ACTIONS THAT NEED TO BE TAKEN.

COGNIZANT ENGINEER	DATE	TECHNICAL MGR./INSTR MRG./PI PREP REP	DATE	ENVIRONMENTAL REQUIREMENTS ENG.	DATE

HARDWARE HAS SUCCESSFULLY COMPLETED THE ENVIRONMENTAL TESTS LISTED ON THIS FORM OR REMAINING ACTIONS HAVE BEEN TAKEN, INCLUDING RETEST.

COGNIZANT ENGINEER	DATE	TECHNICAL MGR./INSTR MRG./PI PREP REP	DATE	ENVIRONMENTAL REQUIREMENTS ENG.	DATE
R Kimble	5/5/05	Martin Hue	6/3/05	[illegible]	5-23-05

OTHER AUTHORIZATION PROVISIONS AND EXPLANATIONS

is a 1-axis cold vibration test (100 K) done on the BDA. The test will be done with the BDA unit mounted inside a cold vibration facility. 3 force transducers will be mounted in the BDA load path in order to measure the BDA response. After the vibration test, 2 thermal cycles will be completed in a vacuum environment from 290K to 7K.

ENVIRONMENTAL TES JTHORIZATION AND SUMMARY (ETAS)
ENVIRONMENTAL TEST SUMMARY

HARDWARE	S/N	ETAS	TEST ENVIRONMENT LEVELS & DURATION	DATE TEST PERFORMED	TEST AGENCY	PASS/ FAIL	COMMENTS
BDA (10209800)	16	39	**LATERAL** 2 minute Random Vibe +3dB/octave 20-100Hz 0.06 g^2/Hz 100-138.5 Hz +36dB/octave 138.5-170 Hz 0.7 g^2/Hz 170-200 Hz -48dB/octave 200-220 Hz .1 g^2/Hz 220-300 Hz -9 dB/octave 300-2000 Hz Total Input: 8.0 Grms Spectrum to be notched in order to get 15 g's response RMS **LONGITUDINAL (not done on this unit)** 2 minute Random Vibe +3dB/octave 20-100Hz 0.08g^2/Hz 100-400Hz -12dB/octave 400-2000Hz Total Input: 6.2 Grms Spectrum to be notched in order to get 15 g's response RMS Each axis1/4 g sine sweep 20-2000 Hz each axisT ~ 100 K 2 Thermal cycles from 290K to 7K				

Sine

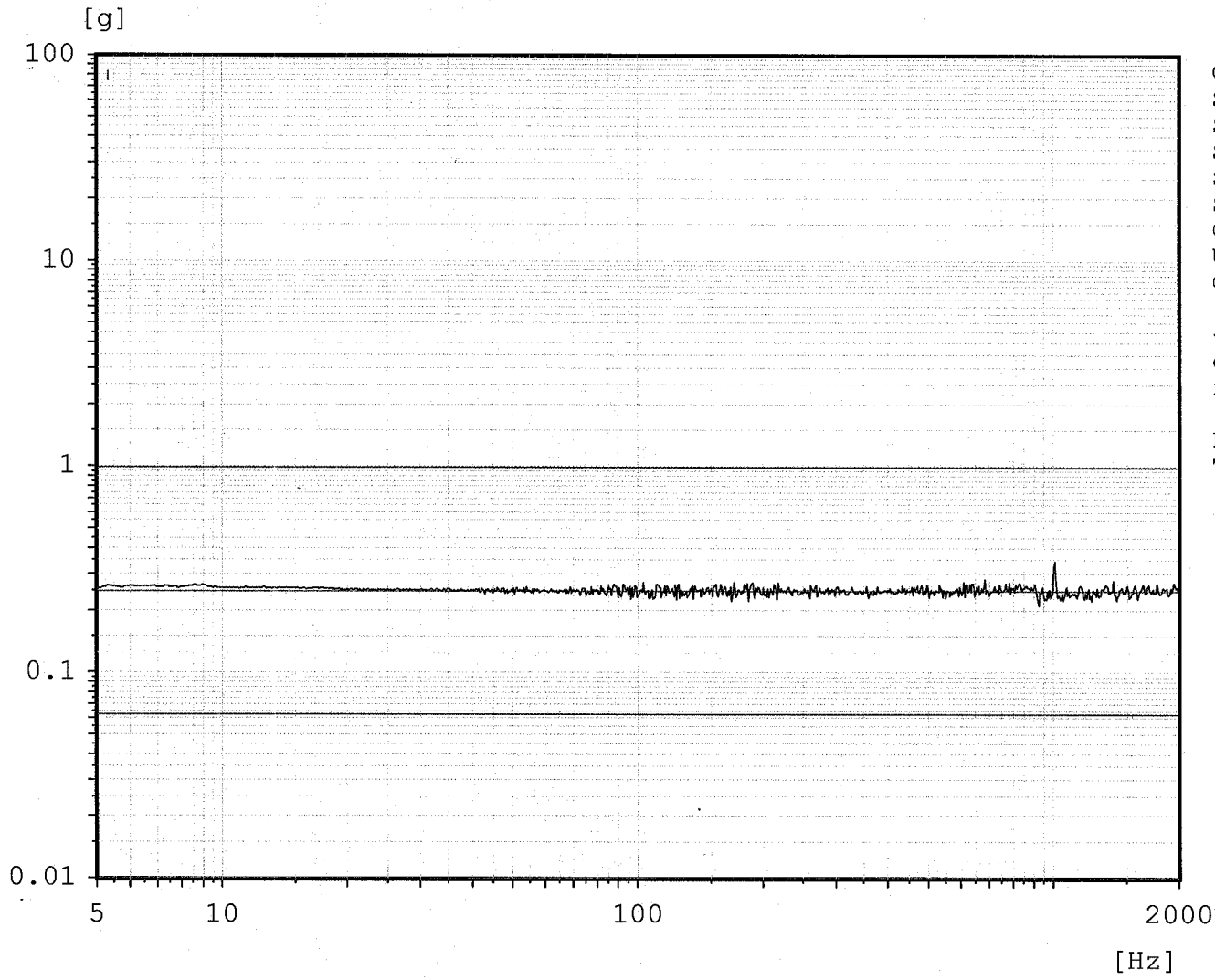
101714, Run # 3, X axis

SPIRE BDA

P/N 10209800-, S/N : 016

Control channel

Before Shake, Cold



Chan.type: X
Sweep type: logarithmic
Sweeps done: 1
Sweeps req.: 1
Sweep direct.: up
Sweep rate: 4.00 Oct/min
Contr.strat.: Maximum
Unit: g
Contr.strat.: Closed loop

-- Testing time --
elapsed: 000:02:09
remaining: 000:00:00

Date: 03-17-05
Time: 11:04:39

964#2/Amp #1/ M+P #2

C:\VcpNT\Daten\m+p\SPIRE\BDA\101714 run 3 xax.rsn

Sine

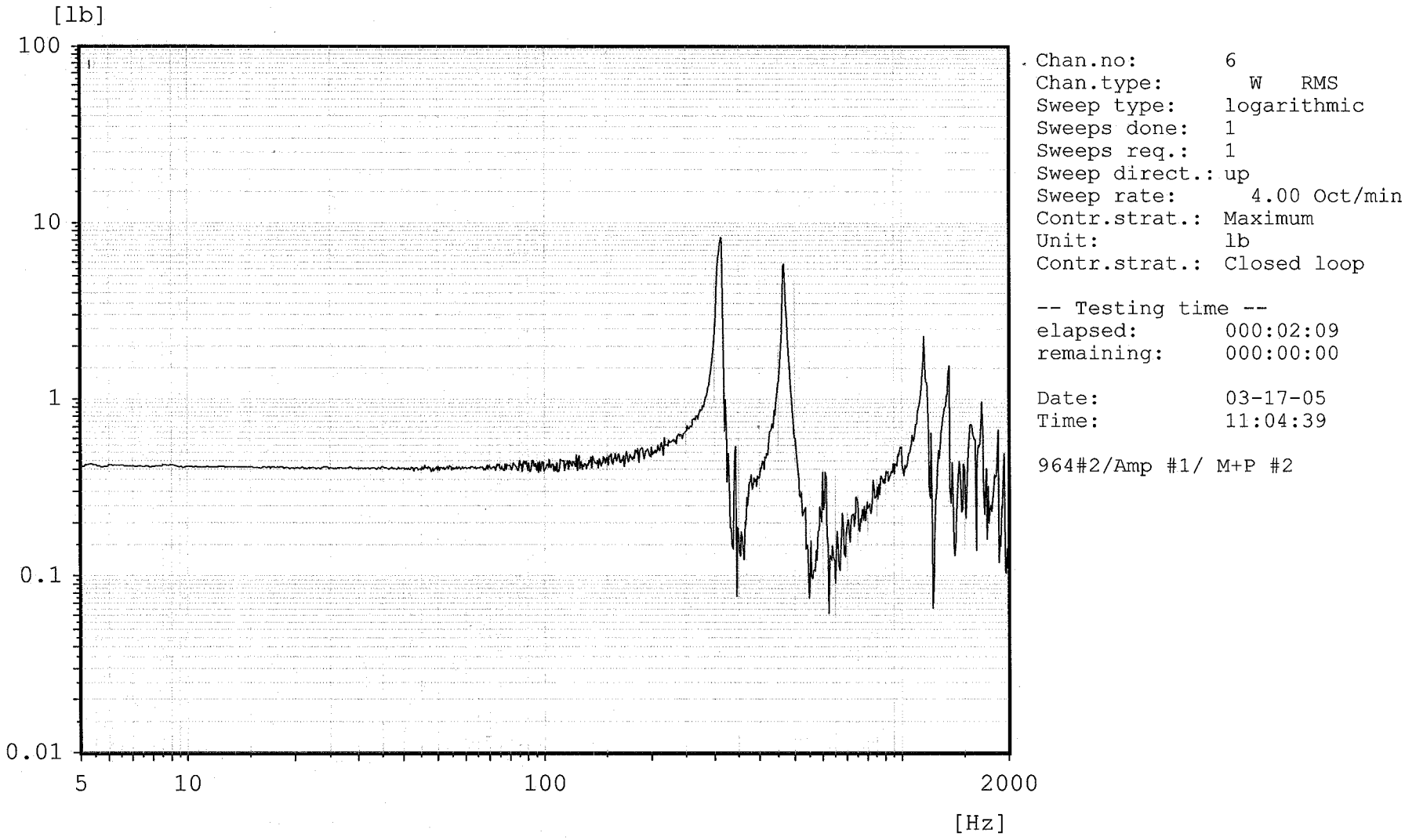
101714, Run # 3, X axis

SPIRE BDA

P/N 10209800-, S/N : 016

Force Sum X

Before Shake, Cold



Chan.no:	6
Chan.type:	W RMS
Sweep type:	logarithmic
Sweeps done:	1
Sweeps req.:	1
Sweep direct.:	up
Sweep rate:	4.00 Oct/min
Contr.strat.:	Maximum
Unit:	lb
Contr.strat.:	Closed loop
-- Testing time --	
elapsed:	000:02:09
remaining:	000:00:00
Date:	03-17-05
Time:	11:04:39

964#2/Amp #1/ M+P #2

C:\VcpNT\Daten\m+p\SPIRE\BDA\101714 run 3 xax.rsn

Sine

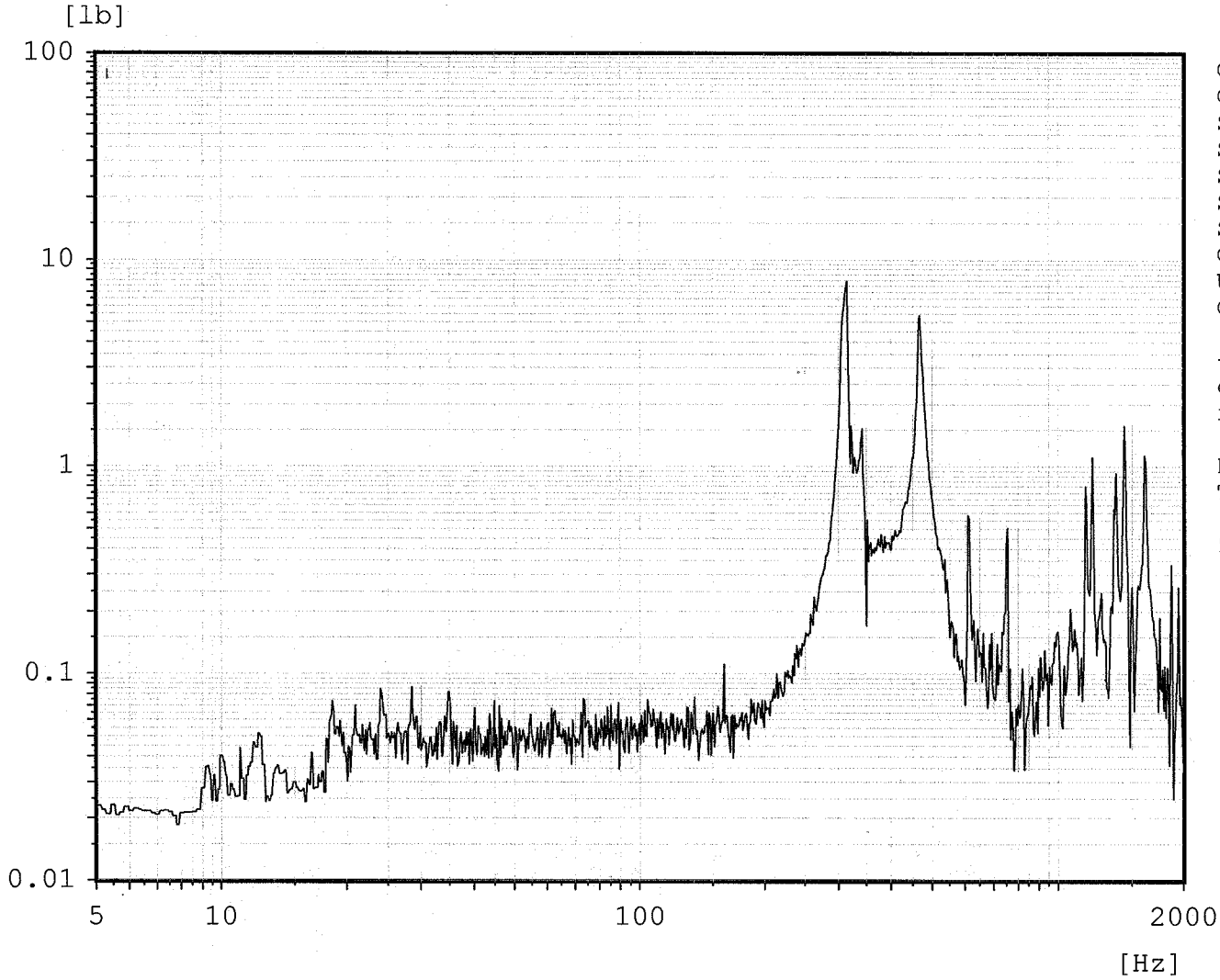
101714, Run # 3, X axis

SPIRE BDA

P/N 10209800-, S/N : 016

Force Sum Y

Before Shake, Cold



Chan.no:	7
Chan.type:	W RMS
Sweep type:	logarithmic
Sweeps done:	1
Sweeps req.:	1
Sweep direct.:	up
Sweep rate:	4.00 Oct/min
Contr.strat.:	Maximum
Unit:	lb
Contr.strat.:	Closed loop

-- Testing time --

elapsed:	000:02:09
remaining:	000:00:00

Date:	03-17-05
Time:	11:04:39

964#2/Amp #1/ M+P #2

C:\VcpNT\Daten\m+p\SPIRE\BDA\101714 run 3 xax.rsn

Sine

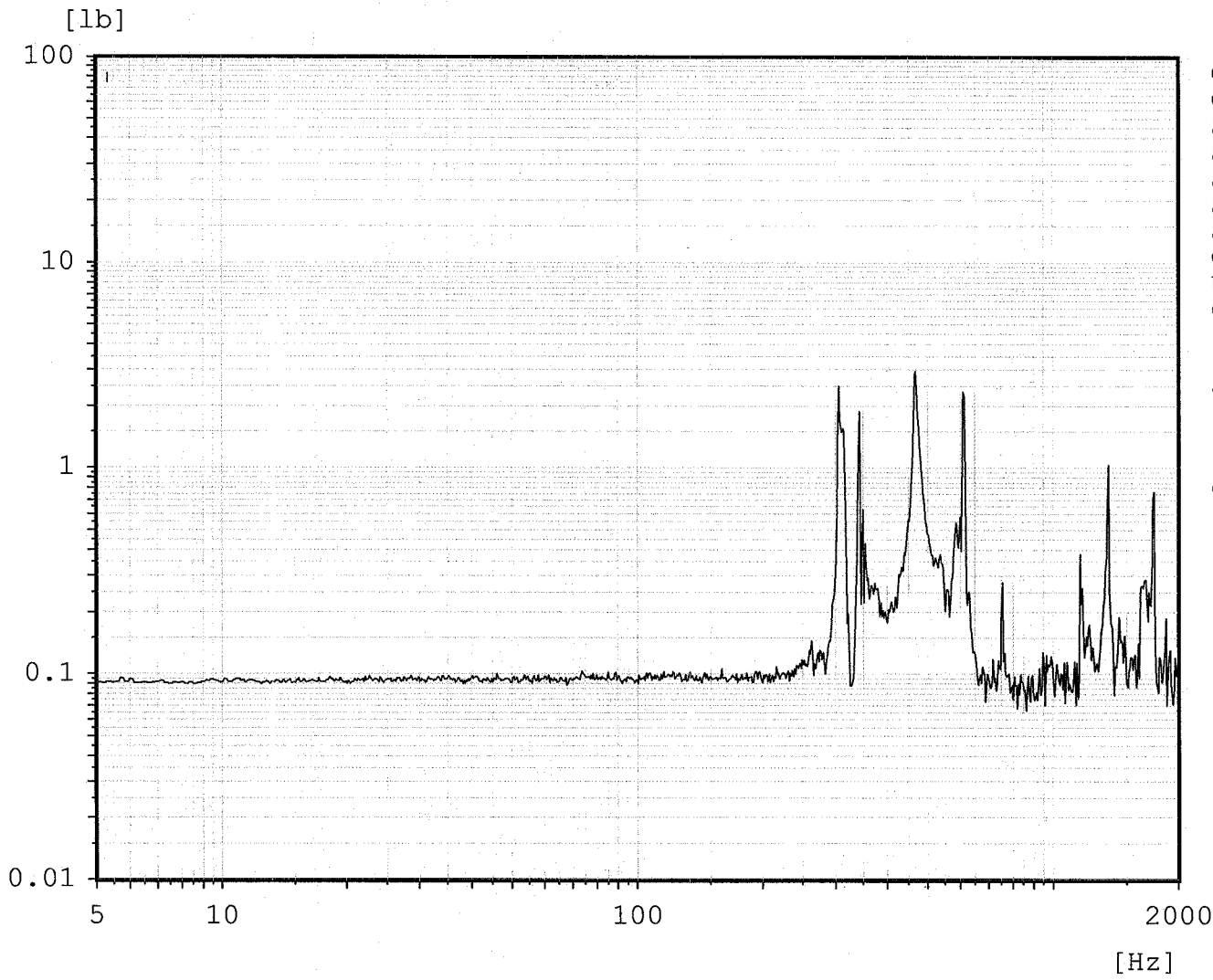
101714, Run # 3, X axis

SPIRE BDA

P/N 10209800-, S/N : 016

Force Sum Z

Before Shake, Cold



Chan.no:	8
Chan.type:	W RMS
Sweep type:	logarithmic
Sweeps done:	1
Sweeps req.:	1
Sweep direct.:	up
Sweep rate:	4.00 Oct/min
Contr.strat.:	Maximum
Unit:	lb
Contr.strat.:	Closed loop

-- Testing time --

elapsed:	000:02:09
remaining:	000:00:00

Date:	03-17-05
Time:	11:04:39

964#2/Amp #1/ M+P #2

C:\VcpNT\Daten\m+p\SPIRE\BDA\101714 run 3 xax.rsn

Random

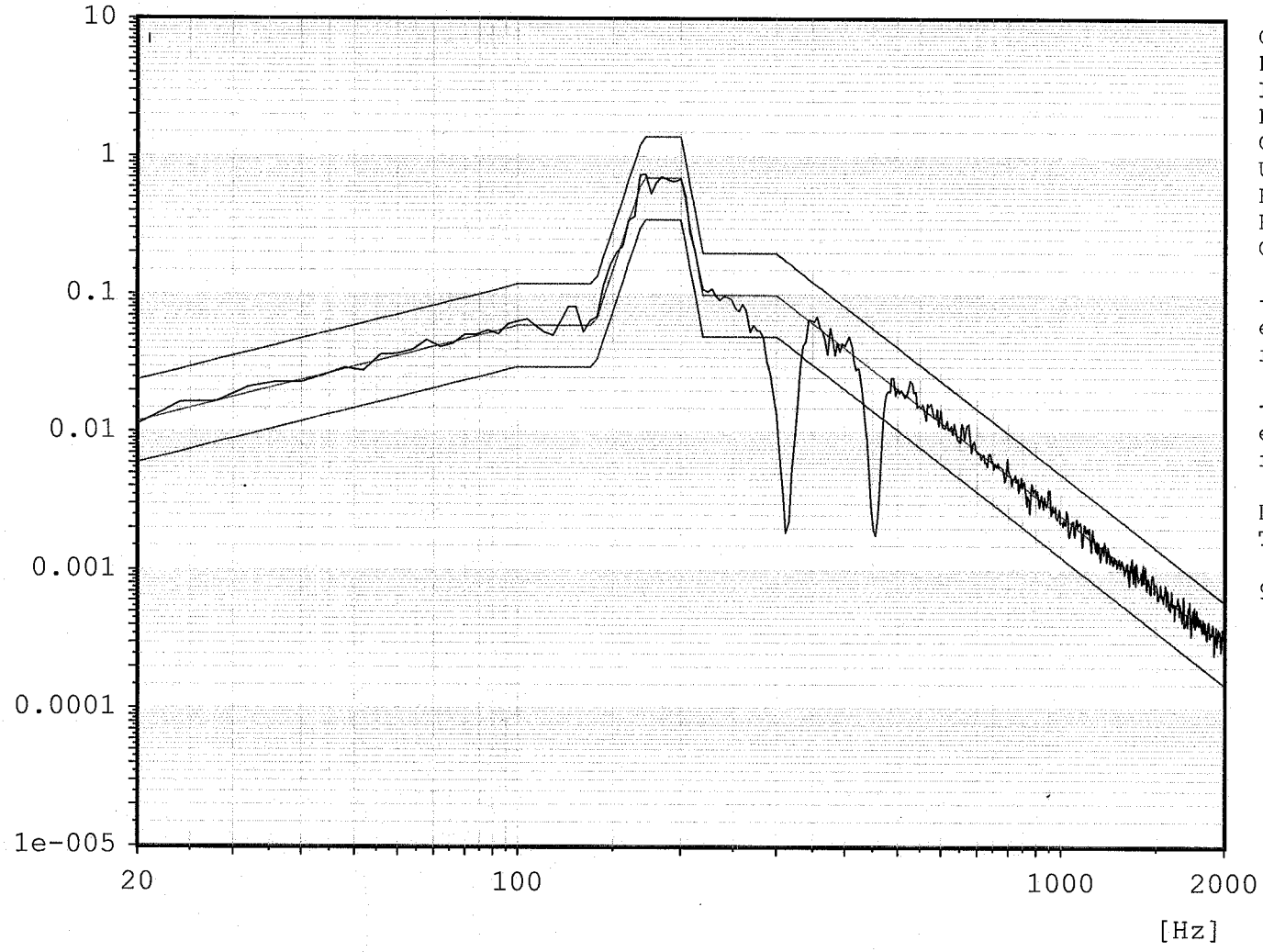
101714, Run # 6, X axis

SPIRE BDA

P/N 10209800-, S/N : 016

Control channel

0dB, Cold



Chan.type:	X
DOF:	180
Level:	0.0 dB
Resolution:	4 Hz
Contr.strat.:	Maximum
Unit:	g²/Hz
RMS (act.):	7.57 g
RMS (req.):	7.945 g
Contr.strat.:	Closed loop
-- Time on act. level --	
elapsed:	000:02:00
remaining:	000:00:00
-- Time total --	
elapsed:	000:03:12
remaining:	000:00:-1
Date:	03-17-05
Time:	11:36:03

964#2/ Amp#1/ M+P#2

C:\VcpNT\Daten\m+p\SPIRE\BDA\101714 run 6 xax.rrn

Random

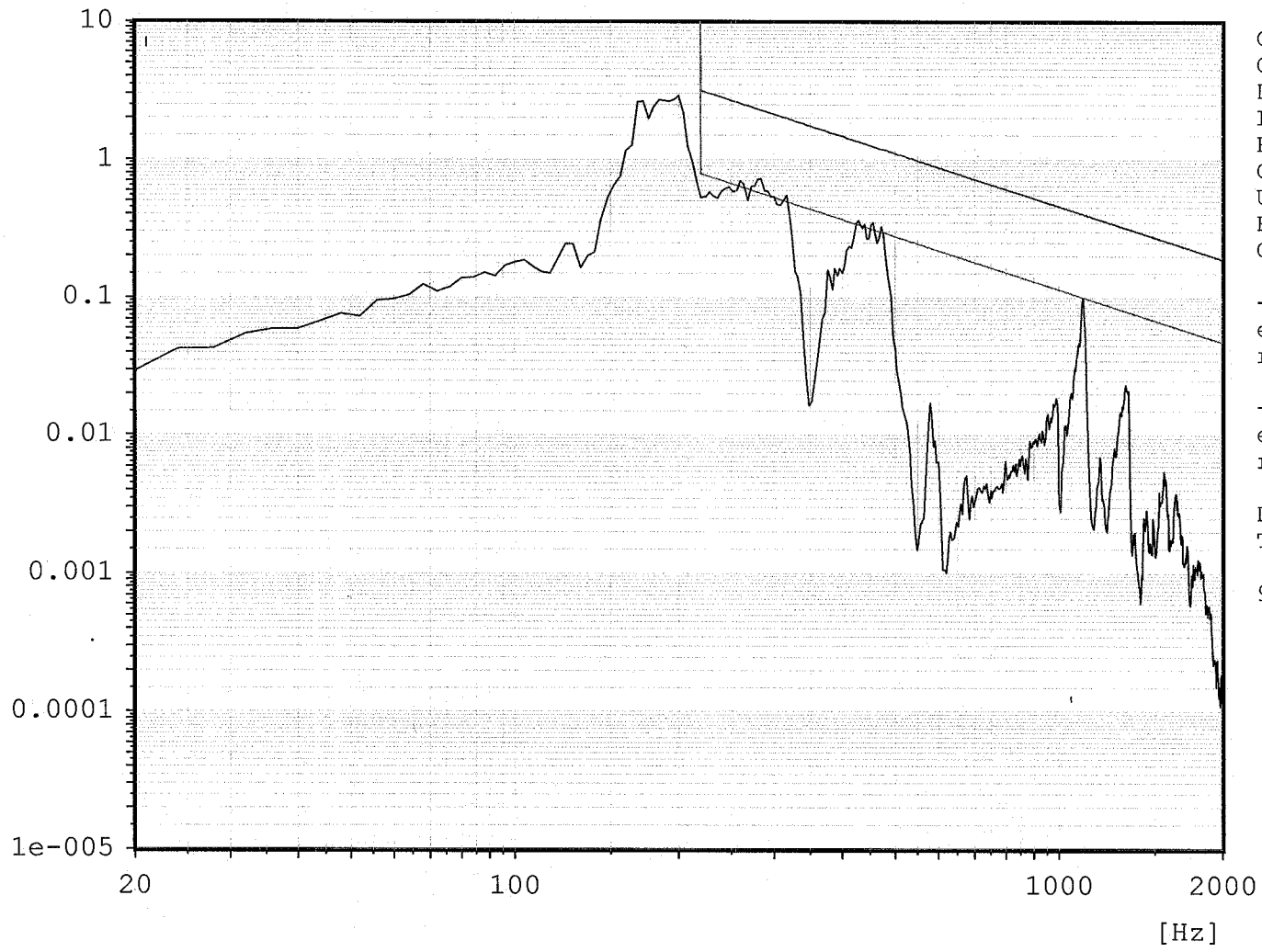
101714, Run # 6, X axis

SPIRE BDA

P/N 10209800-, S/N : 016

Force Sum X

0dB, Cold



Chan.no:	6
Chan.type:	W
DOF:	90
Level:	0.0 dB
Resolution:	4 Hz
Contr.strat.:	Maximum
Unit:	lb²/Hz
RMS (act.):	15.94 lb
Contr.strat.:	Closed loop

-- Time on act. level --

elapsed:	000:02:00
remaining:	000:00:00

-- Time total --

elapsed:	000:03:12
remaining:	000:00:-1

Date:	03-17-05
Time:	11:36:03

964#2/ Amp#1/ M+P#2

C:\VcpNT\Daten\m+p\SPIRE\BDA\101714 run 6 xax.rrn

Random

101714, Run # 6, X axis

SPIRE BDA

P/N 10209800-, S/N : 016

Force Sum Y

0dB, Cold

Chan.no:	7
Chan.type:	W
DOF:	90
Level:	0.0 dB
Resolution:	4 Hz
Contr.strat.:	Maximum
Unit:	lb²/Hz
RMS (act.):	7.819 lb
Contr.strat.:	Closed loop

-- Time on act. level --

elapsed:	000:02:00
remaining:	000:00:00

-- Time total --

elapsed:	000:03:12
remaining:	000:00:-1

Date:	03-17-05
Time:	11:36:03

964#2/ Amp#1/ M+P#2

C:\VcpNT\Daten\m+p\SPIRE\BDA\101714 run 6 xax.rrn

Random

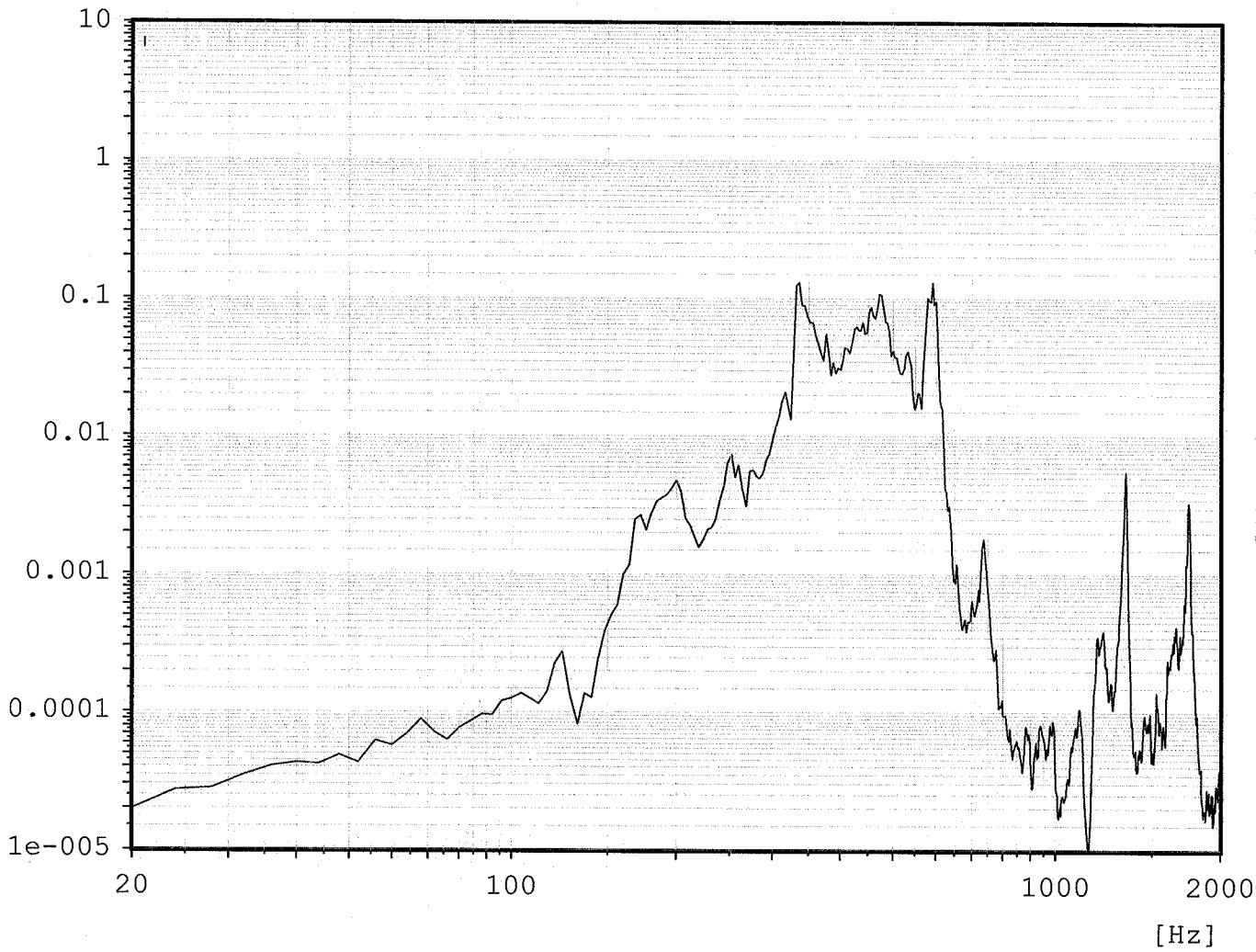
101714, Run # 6, X axis

SPIRE BDA

P/N 10209800-, S/N : 016

Force Sum Z

0dB, Cold



Chan.no:	8
Chan.type:	W
DOF:	90
Level:	0.0 dB
Resolution:	4 Hz
Contr.strat.:	Maximum
Unit:	lb²/Hz
RMS (act.):	4.225 lb
Contr.strat.:	Closed loop
-- Time on act. level --	
elapsed:	000:02:00
remaining:	000:00:00
-- Time total --	
elapsed:	000:03:12
remaining:	000:00:-1
Date:	03-17-05
Time:	11:36:03

964#2/ Amp#1/ M+P#2

C:\VcpNT\Daten\m+p\SPIRE\BDA\101714 run 6 xax.rrn

Sine

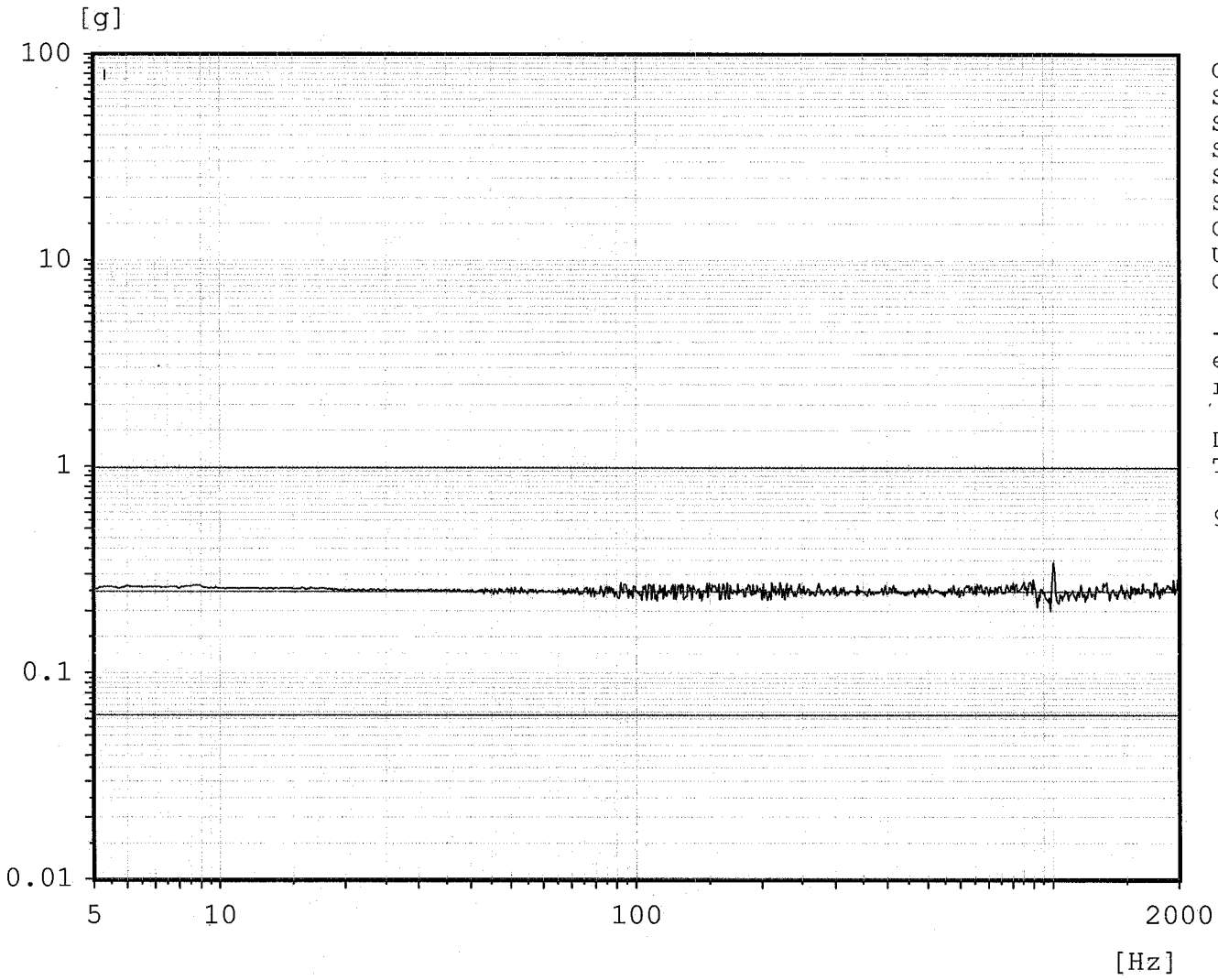
101714, Run # 8, X axis

SPIRE BDA

P/N 10209800-, S/N : 016

Control channel

After Shake, Cold



Chan.type:	X
Sweep type:	logarithmic
Sweeps done:	1
Sweeps req.:	1
Sweep direct.:	up
Sweep rate:	4.00 Oct/min
Contr.strat.:	Maximum
Unit:	g
Contr.strat.:	Closed loop

-- Testing time --

elapsed:	000:02:09
remaining:	000:00:00
Date:	03-17-05
Time:	11:52:08

964#2/Amp #1/ M+P #2

C:\VcpNT\Daten\m+p\SPIRE\BDA\101714 run 8 xax.rsn

Sine

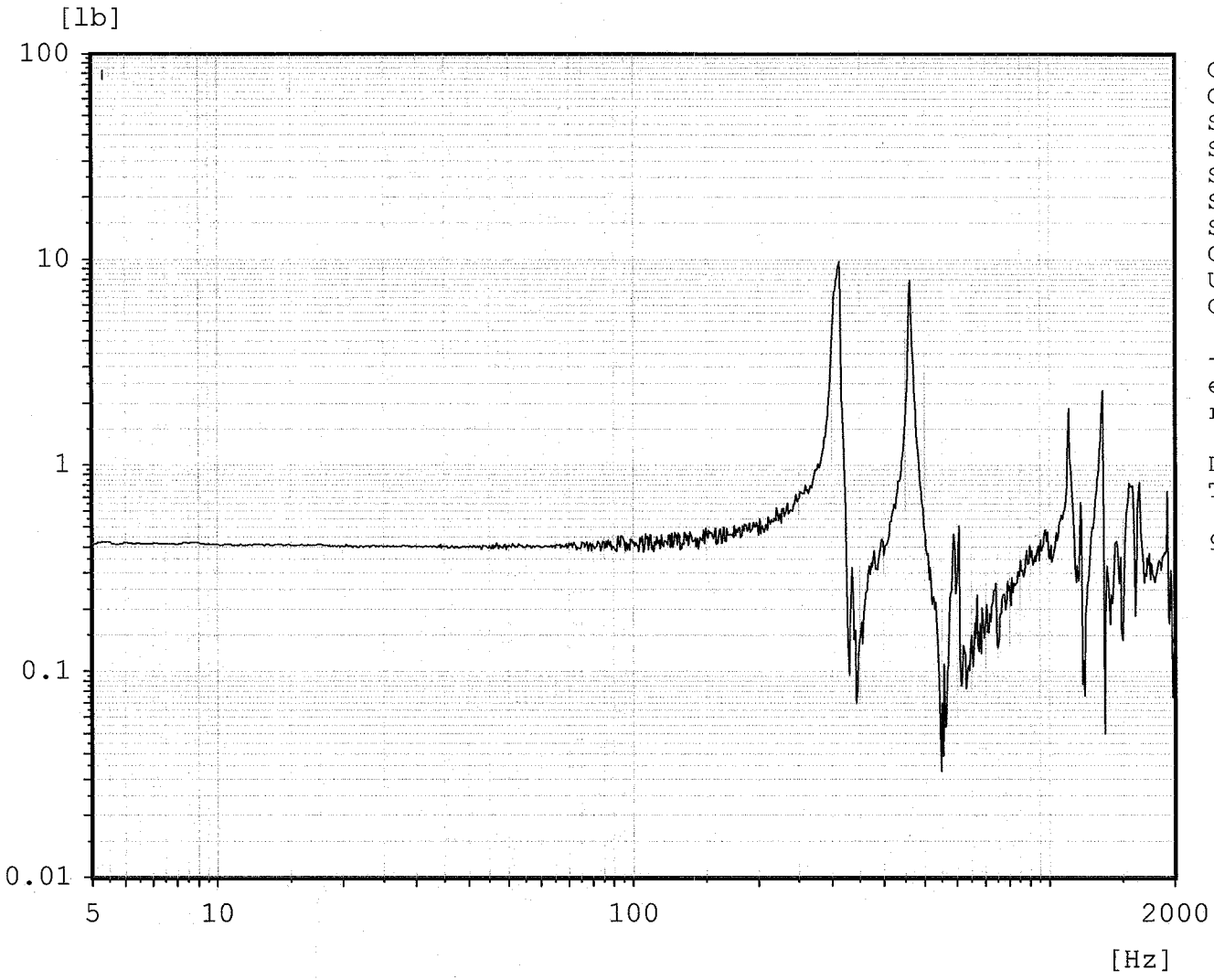
101714, Run # 8, X axis

SPIRE BDA

P/N 10209800-, S/N : 016

Force Sum X

After Shake, Cold



Chan.no:	6
Chan.type:	W RMS
Sweep type:	logarithmic
Sweeps done:	1
Sweeps req.:	1
Sweep direct.:	up
Sweep rate:	4.00 Oct/min
Contr.strat.:	Maximum
Unit:	lb
Contr.strat.:	Closed loop

-- Testing time --

elapsed:	000:02:09
remaining:	000:00:00

Date:	03-17-05
Time:	11:52:08

964#2/Amp #1/ M+P #2

C:\VcpNT\Daten\m+p\SPIRE\BDA\101714 run 8 xax.rsn

Sine

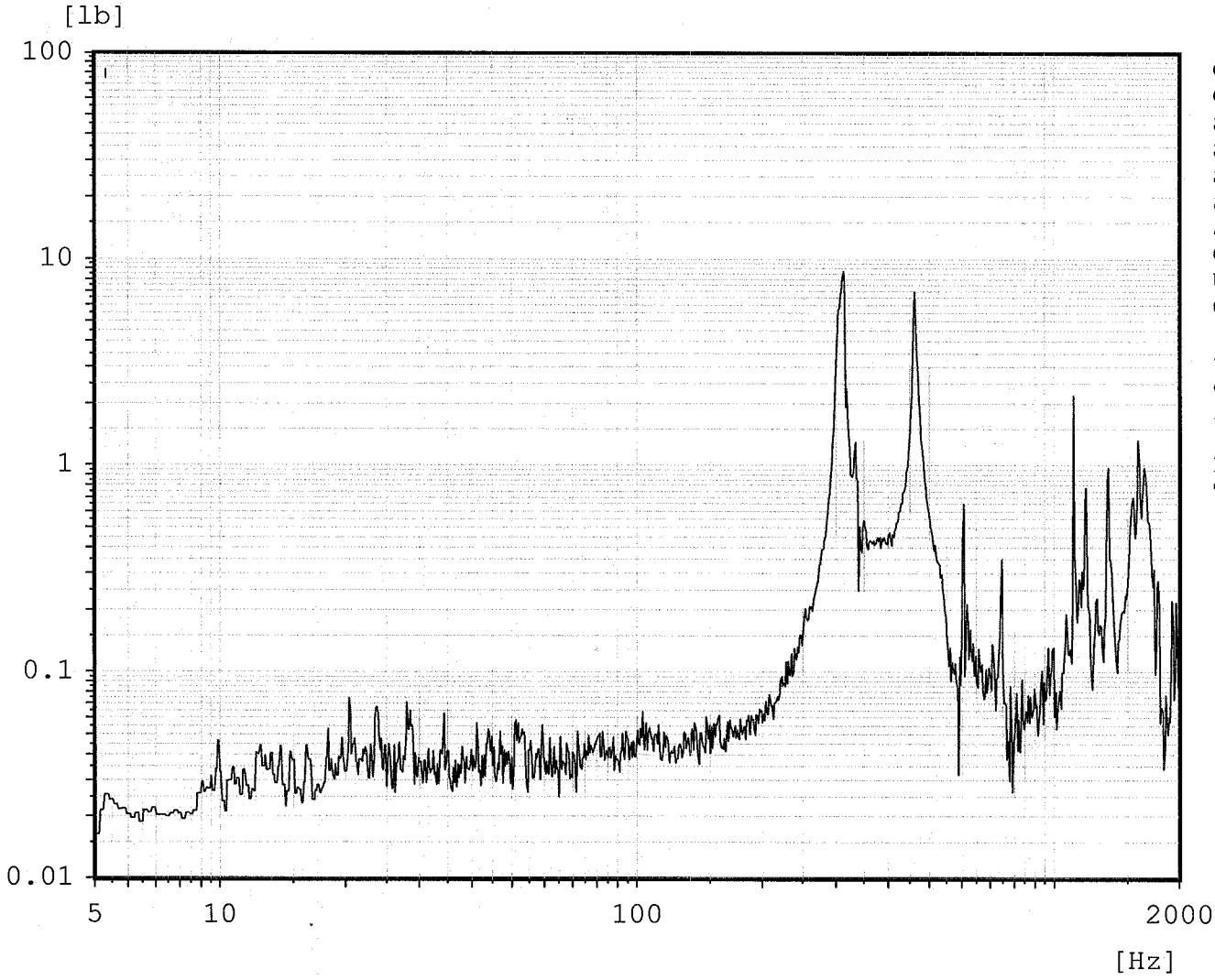
101714, Run # 8, X axis

SPIRE BDA

P/N 10209800-, S/N : 016

Force Sum Y

After Shake, Cold



Chan.no:	7
Chan.type:	W RMS
Sweep type:	logarithmic
Sweeps done:	1
Sweeps req.:	1
Sweep direct.:	up
Sweep rate:	4.00 Oct/min
Contr.strat.:	Maximum
Unit:	lb
Contr.strat.:	Closed loop

-- Testing time --

elapsed:	000:02:09
remaining:	000:00:00

Date:	03-17-05
Time:	11:52:08

964#2/Amp #1/ M+P #2

C:\VcpNT\Daten\m+p\SPIRE\BDA\101714 run 8 xax.rsn

Sine

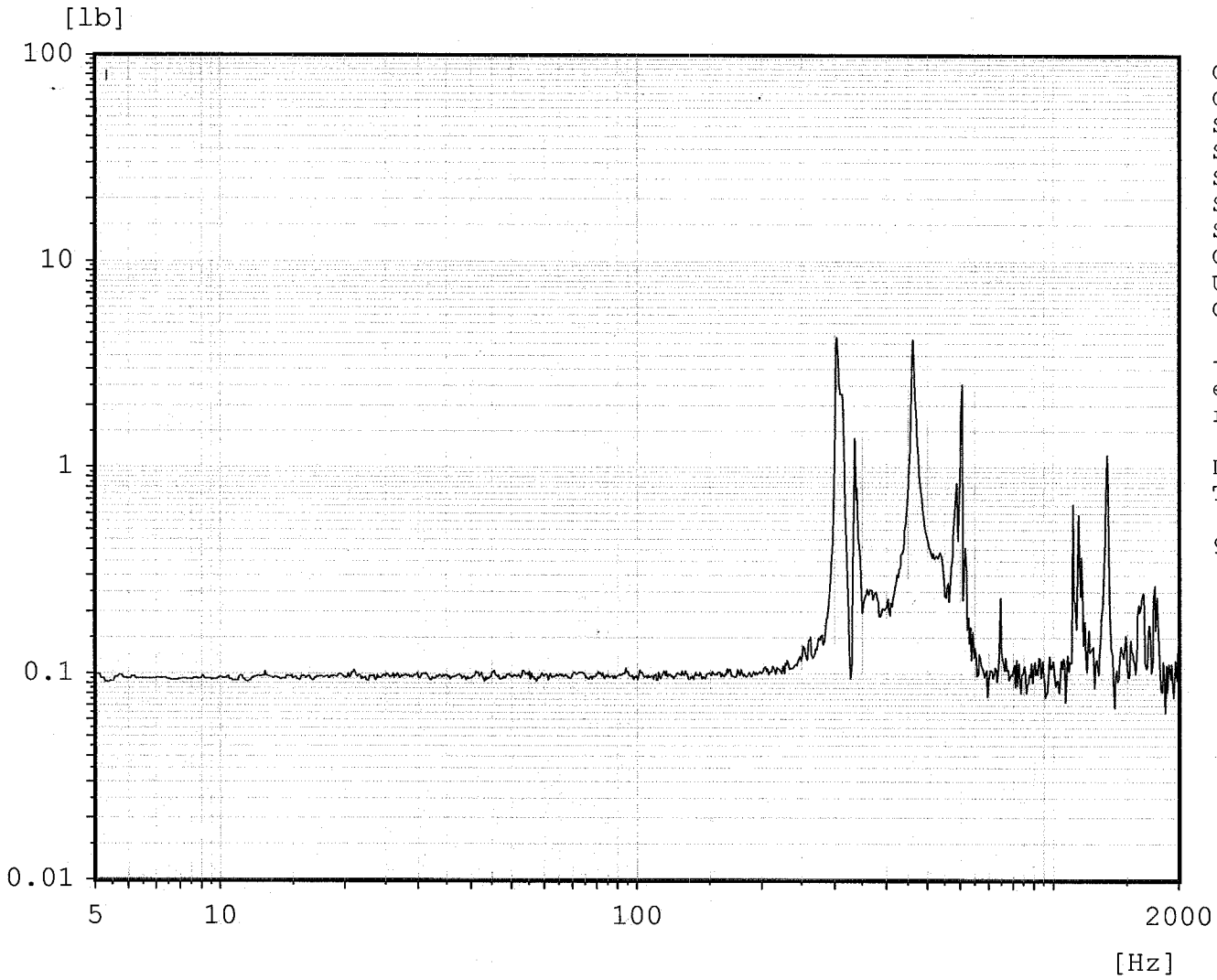
101714, Run # 8, X axis

SPIRE BDA

P/N 10209800-, S/N : 016

Force Sum Z

After Shake, Cold



Chan.no:	8
Chan.type:	W RMS
Sweep type:	logarithmic
Sweeps done:	1
Sweeps req.:	1
Sweep direct.:	up
Sweep rate:	4.00 Oct/min
Contr.strat.:	Maximum
Unit:	lb
Contr.strat.:	Closed loop

-- Testing time --

elapsed:	000:02:09
remaining:	000:00:00

Date:	03-17-05
Time:	11:52:08

964#2/Amp #1/ M+P #2

C:\VcpNT\Daten\m+p\SPIRE\BDA\101714 run 8 xax.rsn

PERFORMANCE VERIFICATION MATRIX - FS SSW BDA - 10209800-5 S/N 016

BDA Performance

Item	D. Value	Min Perf	Measured Median	Unit	Reference	Note
Number of bad optical pixels	= 4	= 9	4		BDA-PER-01	C3,D3,D4,D5 noisy
(NEPphoton/NEPtotal)^2 (derived)	> 0.71	> 0.59	0.738		BDA-PER-02	at 30 mV bias
Optical efficiency*	> 0.7		0.88		BDA-PER-05	
Detector time constant	< 4.2	< 8	2.3	ms	BDA-PER-07	at 28 mV bias
Vmax***	< 17***		11.1	mV	BDA-DRCU-22	bolos only
Calibration uniformity**	> 0.99	> 0.99	N/M		BDA-PER-08	
Cross-talk (n-n)**	< 0.01	< 0.05	N/M		BDA-PER-09	
Cross-talk (non n-n)**	< 0.001	< 0.001	N/M		BDA-PER-09	
1/f knee frequency	< 30	< 100	81.5	mHz	BDA-PER-10	at 21.2 mV bias
Average conducted heat load from 1.7 K	< 1.6	< 3.0	< 2.1	uW	BDA-TEC-06	

BDA Design Values (at 300 mK)

Item	Target	Measured Median	Unit	Reference	Note
R0	180.0	113.1	Ohms	BDA-SSSD	
Delta	41.8	41.8	K	BDA-SSSD	
R300	24.0	15.3	MOhms	BDA-SSSD	
G300	170.0	211.1	pW/K	BDA-SSSD	
Beta	1.50	1.46		BDA-SSSD	
C300	1.00	0.57	pJ/K	BDA-SSSD	
Rlr	10.0	8.4	MOhms	BDA-SSSD	room temp
Dark Sdc	4.1	3.1	e8 V/W	BDA-SSSD	at 21.2 mV bias
Dark NEP (model), incl 9 nV/rtHz amp. noise		5.7	e-17 W/rtHz		at 21.2 mV bias
Dark NEP (1 Hz), incl 9 nV/rtHz amp. noise	5.6	5.4	e-17 W/rtHz	derived	at 21.2 mV bias
Dark NEP (0.1 Hz), incl 9 nV/rtHz amp. noise	5.6	8.1	e-17 W/rtHz	derived	at 21.2 mV bias
Vmax	10.3	9.1	mVrms	BDA-SSSD	SSSD value in error
BDA temperature rise from 1.7 K	< 10	< 8.6	mK	BDA-HCO-1	
BDA thermal time constant	~ 100	115	s	BDA-HCO-2	

*assumes νlower = 1.02 νcutoff

**not tested

***Other channels saturate as follows:

T1 - 40.5 mVrms bias at 300 mK

T2 - 36.1 mVrms bias at 300 mK

R1 - 76.1 mVrms bias

Problem Channels

			Pixel functional at			
	Pixel	**Diagnosis**	**300 K**	**4 K**	**0.3 K**	**Notes**
	C3	Very noisy	Yes	Yes	Yes	No BoDAC noisy history, likely in the BDA, considered bad
	D3	Very noisy	Yes	Yes	Yes	No BoDAC noisy history, likely in the BDA, considered bad
	D4	Very noisy	Yes	Yes	Yes	No BoDAC noisy history, likely in the BDA, considered bad
	D5	Very noisy	Yes	Yes	Yes	No BoDAC noisy history, likely in the BDA, considered bad
	A4	BoDAC dead	Yes	Yes	N/M	
	D6	No Opt Eff data	Yes	Yes	Yes	Opt Eff setup was changed and this is one dead BoDAC pixel
	E1	Excess noise at 0.1 Hz	Yes	Yes	Yes	Likely microphonics from BoDAC cable
	F3	Excess noise at 0.1 Hz	Yes	Yes	Yes	Likely microphonics from BoDAC cable
	F2	Excess noise at 0.1 Hz	Yes	Yes	Yes	Likely microphonics from BoDAC cable
	F1	Excess noise at 0.1 Hz	Yes	Yes	Yes	Likely microphonics from BoDAC cable
	B1	Excess noise at 0.1 Hz	Yes	Yes	Yes	Likely microphonics from BoDAC cable
	F4	Excess noise at 0.1 Hz	Yes	Yes	Yes	Likely microphonics from BoDAC cable
	D1	Excess noise at 0.1 Hz	Yes	Yes	Yes	Likely microphonics from BoDAC cable
	DK1	responds to stray photons	Yes	Yes	Yes	signal about 3x that of optical pixels, due to gap with feedhorns
	DK2	responds to stray photons	Yes	Yes	Yes	signal about 3x that of optical pixels, due to gap with feedhorns
		In general, the noise at .1 Hz data is measured with thermal control, and tends to have higher 1/f knee				
		Whereas the 1/f knee was measured without noise control				

Pixel Performance

Item	DV	MP								
BDA connector			J05	J05	J05	J05	J05	J05	J05	J05
BDA pins			1,26	2,27	3,28	4,29	5,30	6,31	7,32	8,33
BoDAC Connector			4	4	4	4	4	4	4	4
Channel ID			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Detector ID			R1	A4	A3	A2	A1	DK1	B3	B2
BDA Pixel Operability			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BoDAC channel Operability	N/A	N/A	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Noisy BoDAC channel	N/A	N/A	No	No	No	No	No	No	No	No
(NEPphoton/NEPtotal)^2 (derived)	> 0.71	> 0.59	N/A	N/M	0.72	0.72	0.72	N/A	0.76	0.75
Optical efficiency*	> 0.7	> 0.70	N/M	N/M	1.10	0.95	1.02	N/A	0.84	0.84
Detector time constant	< 4.2	< 14	N/M	N/M	2.30	2.22	2.34	2.16	2.41	2.30
Calibration uniformity**	> 0.99	> 0.99	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cross-talk (n-n)**	< 0.01	< 0.05	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cross-talk (non n-n)**	< 0.001	< 0.001	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1/f knee frequency***	< 30	< 100	N/M	N/M	114	99	85	27	91	66

Pixel Design Values

Item	Target								
R0	180.0	4.85E+06	N/M	94.32	101.71	97.24	108.70	139.37	130.05
Delta	41.8	0.00	N/M	41.34	41.46	41.66	41.55	42.82	42.24
G300	170	N/M	N/M	210.94	209.24	213.42	216.84	207.76	207.94
Beta	1.5	N/M	N/M	1.48	1.47	1.47	1.45	1.46	1.47
C300	1.00	N/A	N/M	0.57	0.55	0.59	0.54	0.56	0.55
Gamma	1 (fixed)	N/A	1.0	1.0	1.0	1.0	1.0	1.0	1.0
R300	24.1	4.9	N/M	11.8	13.0	12.8	14.0	21.5	18.5
Rlr+	10.0	8.5	8.63	8.41	8.48	8.74	8.61	8.52	8.8
Rlr-	10.0	8.36	8.44	8.36	8.56	8.38	8.48	8.59	8.48
Dark Sdc	2.2	N/A	N/M	2.8	2.9	2.9	3.0	3.5	3.3
Dark NEP (model), incl 9 nV/rtHz amp. noise		N/A	N/M	5.8	5.7	5.8	5.8	5.4	5.5
Dark NEP (1 Hz), incl 9 nV/rtHz amp. noise	5.6	N/A	N/M	5.59	5.13	5.79	6.13	5.10	5.20
Dark NEP (0.1 Hz), incl 9 nV/rtHz amp. noise	5.6	N/A	N/M	7.78	7.69	9.02	8.74	6.71	7.44
Vmax	11.4	N/M	N/M	8.1	8.4	8.4	8.9	10.7	10.0

*assumes νlower = 1.02 νcutoff

**not tested

***note 1/f knee data may not appear consistent with NEP(0.1 Hz)/NEP(1 Hz), as the data set and processing are different

Pixel Performance											
Item											
BDA connector	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05	J05
BDA pins	9,34	10,35	11,36	12,37	13,38	14,39	15,40	16,41	17,42	18,43	19,44
BoDAC Connector	4	4	4	4	4	4	4	4	4	4	4
Channel ID	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Detector ID	B1	C3	C2	C1	D3	D2	D1	E3	E2	E1	F3
BDA Pixel Operability	Yes	Noisy	Yes	Yes	Noisy	Yes	Yes	Yes	Yes	Yes	Yes
BoDAC channel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noisy BoDAC channel	Yes at 0.1	No	No	No	No	No	Yes at 0.1	No	No	Yes at 0.1	Yes at 0.1
(NEPphoton/NEPtotal)^2 (derived)	0.73	0.75	0.74	0.72	0.73	0.72	0.74	0.74	0.77	0.72	0.74
Optical efficiency*	0.84	0.82	0.86	0.85	0.88	0.92	0.89	0.84	0.77	0.90	0.83
Detector time constant	2.44	3.16	2.18	2.30	2.35	2.23	2.16	2.21	2.35	2.17	2.45
Calibration uniformity**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cross-talk (n-n)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cross-talk (non n-n)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1/f knee frequency***	103	494	97	109	494	101	36	34	18	88	79
Pixel Design Values											
Item											
R0	103.80	120.55	116.50	100.25	103.47	97.25	122.81	111.84	310.82	107.44	111.27
Delta	41.58	42.08	41.89	41.78	41.90	41.54	42.11	42.09	38.72	41.08	42.17
G300	212.32	207.56	211.29	220.29	208.79	218.25	237.50	215.05	163.16	215.45	206.70
Beta	1.47	1.47	1.45	1.46	1.43	1.47	1.48	1.45	1.66	1.44	1.46
C300	0.61	0.76	0.53	0.59	0.58	0.57	0.58	0.55	0.43	0.55	0.59
Gamma	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
R300	13.5	16.8	15.8	13.4	14.0	12.5	17.2	15.6	26.7	13.0	15.7
Rlr+	8.6	8.72	8.84	8.2	8.68	8.65	8.7	8.64	8.92	8.68	8.84
Rlr-	8.44	8.64	8.56	8.41	8.64	8.56	8.41	8.44	8.04	8.68	8.44
Dark Sdc	2.9	3.2	3.1	2.9	3.5	2.8	3.0	3.1	4.0	2.9	3.2
Dark NEP (model), incl 9 nV/rtHz amp. noise	5.8	5.5	5.6	5.9	5.7	5.9	6.0	5.7	4.8	5.8	5.6
Dark NEP (1 Hz), incl 9 nV/rtHz amp. noise	5.64	115.98	5.11	5.81	20.28	5.59	7.53	5.15	5.12	5.43	4.92
Dark NEP (0.1 Hz), incl 9 nV/rtHz amp. noise	10.64	40.67	7.95	8.59	56.07	9.00	10.18	8.01	6.01	11.82	10.77
Vmax	8.6	9.5	9.3	8.7	8.7	8.4	10.3	9.3	11.1	8.6	9.1
*assumes νlower = 1.02 νcutoff											
**not tested											
***note 1/f knee data may not appear consistent											
with NEP(0.1 Hz)/NEP(1 Hz), as the data set and											
processing are different											

Pixel Performance											
Item											
BDA connector	J05	J05	J05	J05	J05	J06	J06	J06	J06	J06	J06
BDA pins	20,45	21,46	22,47	23,48	24,49	7,32	8,33	9,34	10,35	11,36	12,37
BoDAC Connector	4	4	4	4	4	1	1	1	1	1	1
Channel ID	**20**	**21**	**22**	**23**	**24**	**7**	**8**	**9**	**10**	**11**	**12**
Detector ID	F2	F1	G1	T1	G2	G3	G4	DK2	F5	F4	E6
BDA Pixel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BoDAC channel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noisy BoDAC channel	Yes at 0.1	Yes at 0.1	No	No	No	No	No	Yes	No	Yes at 0.1	No
(NEPphoton/NEPtotal)^2 (derived)	0.73	0.74	0.74	N/A	0.74	0.73	0.74	N/A	0.75	0.75	0.73
Optical efficiency*	0.87	0.89	0.92	N/M	0.82	0.90	0.99	N/A	0.90	0.83	0.89
Detector time constant	2.28	2.30	2.32	N/M	2.48	2.32	2.04	2.43	2.26	3.36	2.34
Calibration uniformity**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cross-talk (n-n)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cross-talk (non n-n)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1/f knee frequency***	79	57	46	18	18	85	54	73	77	63	66
Pixel Design Values											
Item											
R0	104.81	113.94	114.72	128.43	113.07	122.45	117.77	114.29	132.86	211.30	108.77
Delta	41.59	42.21	41.81	39.59	41.86	41.26	42.09	40.32	42.30	39.60	41.80
G300	208.13	212.41	204.59	N/M	207.73	213.42	217.86	211.04	211.91	197.60	215.59
Beta	1.47	1.45	1.45	N/M	1.45	1.46	1.44	1.40	1.43	1.49	1.44
C300	0.56	0.56	0.55	N/M	0.60	0.58	0.51	0.60	0.54	0.75	0.59
Gamma	1.0	1.0	1.0	N/A	1.0	1.0	1.0	1.0	1.0	1.0	1.0
R300	13.6	16.1	15.4	12.5	15.3	15.2	16.4	12.4	19.1	20.6	14.5
Rlr+	8.61	8.84	8.72	8.6	8.84	8.03	8.48	8.01	8.08	8.48	8
Rlr-	8.29	8.53	8.72	8.68	8.44	8.2	8.25	8.16	8.28	8.14	8.17
Dark Sdc	3.0	3.1	3.2	N/A	3.1	3.0	3.1	2.8	3.3	3.4	3.0
Dark NEP (model), incl 9 nV/rtHz amp. noise	5.7	5.6	5.5	N/A	5.6	5.7	5.7	5.8	5.5	5.4	5.7
Dark NEP (1 Hz), incl 9 nV/rtHz amp. noise	6.83	5.40	5.54	N/A	5.35	5.97	5.76	8.78	5.38	5.71	5.72
Dark NEP (0.1 Hz), incl 9 nV/rtHz amp. noise	15.00	10.89	9.41	N/A	7.17	9.94	8.69	8.19	8.48	10.00	7.95
Vmax	8.6	9.4	9.0	N/M	9.1	9.2	9.6	8.3	10.2	10.5	9.0
*assumes νlower = 1.02 νcutoff											
**not tested											
***note 1/f knee data may not appear consistent											
with NEP(0.1 Hz)/NEP(1 Hz), as the data set and											
processing are different											

Pixel Performance											
Item											
BDA connector	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06	J06
BDA pins	13,38	14,39	15,40	16,41	17,42	18,43	19,44	20,45	21,46	22,47	23,48
BoDAC Connector	1	1	1	1	1	1	1	1	1	1	1
Channel ID	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
Detector ID	E5	E4	D7	D6	D5	D4	C6	C5	C4	B5	B4
BDA Pixel Operability	Yes	Yes	Yes	Yes	Noisy	Noisy	Yes	Yes	Yes	Yes	Yes
BoDAC channel Operability	Yes	Yes	Yes	No opt e	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noisy BoDAC channel	No	No	No	No	No	No	No	No	No	No	No
(NEPphoton/NEPtotal)^2 (derived)	0.75	0.74	0.74	N/M	N/M	0.74	0.74	0.74	0.75	0.74	0.73
Optical efficiency*	0.84	0.92	0.99	N/M	0.81	0.90	0.93	0.87	0.84	0.86	0.90
Detector time constant	2.13	2.49	2.29	2.87	2.63	2.14	2.21	2.34	2.22	2.18	2.24
Calibration uniformity**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cross-talk (n-n)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cross-talk (non n-n)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1/f knee frequency***	81	115	82	94	< 30	322	93	90	69	70	156
Pixel Design Values											
Item											
R0	132.82	109.21	111.59	113.09	105.20	112.77	113.59	108.63	122.36	115.33	100.70
Delta	42.27	42.00	42.16	41.97	41.56	42.12	42.20	42.11	42.34	41.78	41.81
G300	209.71	206.33	209.74	211.15	208.01	204.53	223.08	208.09	212.79	219.11	214.83
Beta	1.44	1.45	1.45	1.42	1.43	1.47	1.46	1.45	1.46	1.46	1.48
C300	0.51	0.60	0.56	0.70	0.64	0.51	0.57	0.57	0.54	0.55	0.56
Gamma	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
R300	19.0	15.0	15.7	15.5	13.6	15.8	16.1	15.2	17.7	15.4	13.5
Rlr+	8	8.06	8.07	8.04	8.12	8.28	8.13	8.12	8.12	8.64	8.29
Rlr-	8.18	8.16	8.19	8.26	8.19	8.28	8.24	8.24	8.28	8.29	8.3
Dark Sdc	3.3	3.1	3.1	3.1	3.0	3.2	3.0	3.1	3.2	3.0	2.9
Dark NEP (model), incl 9 nV/rtHz amp. noise	5.5	5.6	5.6	5.6	5.7	5.5	5.8	5.6	5.6	5.8	5.8
Dark NEP (1 Hz), incl 9 nV/rtHz amp. noise	5.43	5.38	5.41	5.58	14.02	10.39	5.43	5.51	5.25	6.05	5.41
Dark NEP (0.1 Hz), incl 9 nV/rtHz amp. noise	7.56	7.92	8.00	8.15	15.29	25.67	8.83	8.73	8.04	9.52	9.44
Vmax	10.1	8.9	9.2	9.2	8.6	9.1	9.6	9.0	9.8	9.3	8.7
*assumes νlower = 1.02 νcutoff											
**not tested											
***note 1/f knee data may not appear consistent											
with NEP(0.1 Hz)/NEP(1 Hz), as the data set and											
processing are different											

Pixel Performance				
Item		**Unit**	**Reference**	**Note**
BDA connector	J06			
BDA pins	24,49			
BoDAC Connector	1			
Channel ID	**24**			
Detector ID	T2			
BDA Pixel Operability	Yes			
BoDAC channel Operability	Yes			
Noisy BoDAC channel	No			
(NEPphoton/NEPtotal)^2 (derived)	N/A		BDA-PER-02	at 30 mV bias
Optical efficiency*	N/M		BDA-PER-05	
Detector time constant	N/M	ms	BDA-PER-07	at 28 mV bias
Calibration uniformity**	N/A		BDA-PER-08	
Cross-talk (n-n)**	N/A		BDA-PER-09	
Cross-talk (non n-n)**	N/A		BDA-PER-09	
1/f knee frequency***	N/A	mHz	BDA-PER-10	at 21.2 mV bias
Pixel Design Values				
Item		**Unit**	**Reference**	**Note**
R0	141.09	Ohms	BDA-SSSD	
Delta	40.05	K	BDA-SSSD	
G300	N/M	pW/K	BDA-SSSD	
Beta	N/M		BDA-SSSD	
C300	N/M	pJ/K	BDA-SSSD	
Gamma	1.0			
R300	14.7	MOhms	BDA-SSSD	
Rlr+	8.2	MOhms	BDA-SSSD	room temp
Rlr-	8.32	MOhms	BDA-SSSD	room temp
Dark Sdc	N/A	e8 V/W	BDA-SSSD	at 21.2 mV bias
Dark NEP (model), incl 9 nV/rtHz amp. noise	N/A			
Dark NEP (1 Hz), incl 9 nV/rtHz amp. noise	N/A	e-17 W/rtHz	derived	at 21.2 mV bias
Dark NEP (0.1 Hz), incl 9 nV/rtHz amp. noise	N/A	e-17 W/rtHz	derived	at 21.2 mV bias
Vmax	N/M	mVrms	BDA-DRCU-22	
*assumes νlower = 1.02 νcutoff				
**not tested				
***note 1/f knee data may not appear consistent				
with NEP(0.1 Hz)/NEP(1 Hz), as the data set and				
processing are different				

Symbol	Units	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
T0	K	0.3	Base Temperature				Note: Corrected for sqrt(2) demodulation factor							
Vn	nV/rtHz	9	Amplifier Voltage Noise				corrected for ETF in Johnson and load resistor terms							
Q	pW	0	Absorbed Power Onto Bolometer				assumes only first harmonic of amplifier, Johnson, and LR propagates							
NEP_{photon}	1e-17 W/rtHz	0.00	Noise in Absorbed Optical Power				added 2 more iterations of the recursion solver							
Vbias	mV	20	Bias Across Bolometer & Load Resistors				added variable gain to scale measured noise							
Gain		81000					NEPs checked with standard spreadsheet							
Detector ID		**Target**	**R1**	**A4**	**A3**	**A2**	**A1**	**DK1**	**B3**	**B2**	**B1**	**C3**	**C2**	**C1**
Pthermal	pW	4.882	N/A	#VALUE!	5.147	5.193	5.148	5.312	5.749	5.562	5.256	5.424	5.345	5.427
Pelec+Q	pW	4.882	N/A	#VALUE!	5.147	5.193	5.148	5.312	5.749	5.562	5.256	5.424	5.345	5.427
Tbolo	K	0.32688	N/A	#VALUE!	0.32307	0.32345	0.32283	0.32319	0.32601	0.32517	0.32339	0.32463	0.32390	0.32330
T/T0		1.090	N/A	#VALUE!	1.077	1.078	1.076	1.077	1.087	1.084	1.078	1.082	1.080	1.078
Rbolo	Ω	1.47E+07	5.07E+06	#VALUE!	7.71E+06	8.40E+06	8.35E+06	9.13E+06	1.32E+07	1.16E+07	8.72E+06	1.06E+07	1.01E+07	8.67E+06
Vbolo	mV	8.46	4.62	#VALUE!	6.30	6.61	6.55	6.96	8.72	8.03	6.77	7.59	7.36	6.86
Ibolo	nA	0.58	0.91	#VALUE!	0.82	0.79	0.79	0.76	0.66	0.69	0.78	0.72	0.73	0.79
A		-5.65	N/A	#VALUE!	-5.66	-5.66	-5.68	-5.67	-5.73	-5.70	-5.67	-5.69	-5.69	-5.68
C	pJ/K	1.09	N/A	#VALUE!	0.62	0.59	0.63	0.59	0.61	0.59	0.65	0.82	0.57	0.64
G	pW/K	193.4	N/A	#VALUE!	235.4	233.8	237.8	241.5	234.5	234.1	237.2	233.1	236.1	245.8
Z/R		0.392	1.000	#VALUE!	0.446	0.440	0.448	0.443	0.398	0.412	0.440	0.420	0.431	0.441
τ	ms	5.281	N/A	#VALUE!	2.301	2.226	2.345	2.168	2.463	2.336	2.450	3.193	2.193	2.313
Sdc	V/W	4.09E+08	N/A	#VALUE!	2.81E+08	2.93E+08	2.88E+08	2.95E+08	3.49E+08	3.32E+08	2.94E+08	3.22E+08	3.13E+08	2.87E+08
$NEP_{johnson}$	1e-17 W/rtHz	2.294	N/A	#VALUE!	2.858	2.803	2.844	2.819	2.491	2.597	2.806	2.654	2.719	2.844
NEP_{phonon}	1e-17 W/rtHz	3.147	N/A	#VALUE!	3.465	3.454	3.482	3.511	3.466	3.461	3.479	3.452	3.474	3.541
NEP_{load}	1e-17 W/rtHz	1.882	N/A	#VALUE!	1.868	1.896	1.914	1.985	2.101	2.043	1.933	1.994	1.996	1.979
NEP_{amp}	1e-17 W/rtHz	2.199	N/A	#VALUE!	3.202	3.076	3.122	3.050	2.576	2.707	3.060	2.791	2.877	3.131
NEP_{det}	1e-17 W/rtHz	4.852	N/A	#VALUE!	5.823	5.731	5.799	5.789	5.410	5.497	5.751	5.543	5.632	5.861
DQE		0.000	N/A	#VALUE!	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Vn(det)	nV/rtHz	19.9	12.13	#VALUE!	16.4	16.8	16.7	17.1	18.9	18.3	16.9	17.9	17.6	16.8
Vn(total)	nV/rtHz	19.9	12.1	#VALUE!	16.4	16.8	16.7	17.1	18.9	18.3	16.9	17.9	17.6	16.8
Vn(measured) at 1Hz (300mK)			11.50	7.63	15.70	15.00	16.70	18.10	17.80	17.30	16.60	374.00	16.00	16.70
NEP(measured) at 1Hz (300mK0			N/A	#VALUE!	5.59	5.13	5.79	6.13	5.10	5.20	5.64	115.98	5.11	5.81
Vn(measured) at 0.1Hz (300mK)			12.90	8.02	21.85	22.50	26.00	25.80	23.46	24.72	31.30	131.15	24.87	24.70
NEP(measured) at 0.1Hz (300mK)			N/A	#VALUE!	7.78	7.69	9.02	8.74	6.71	7.44	10.64	40.67	7.95	8.59
Vn(meas) 1Hz (TC at 300mK)			13.30	7.63	15.70	15.00	16.70	18.10	17.80	17.30	16.60	374.00	16.00	16.70
Vn(meas) 1 Hz (No T/C)			11.5	7.65	21	20.4	22.9	21.6	24.9	23	21.7	696	22.5	23.1
Vn(meas) 0.1 Hz (No T/C)			12.9	8.02	41.6	40.5	40.9	27.2	41.6	35.1	36.7	3210	40.8	55.8
Vn (meas) at 0.1Hz (TC at 300mK)					21.85	23.52	31.28	28.03	23.46	24.72	51.03	131.15	24.87	24.70
Vn (meas) at 0.1Hz (TC at 300mK)					24.60	22.50	26.00	25.80	31.30	27.80	31.30	1920.00	32.80	29.70

Symbol	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
T0															
Vn															
Q															
NEP_{photon}															
Vbias															
Gain															
Detector ID	**D3**	**D2**	**D1**	**E3**	**E2**	**E1**	**F3**	**F2**	**F1**	**G1**	**T1**	**G2**	**G3**	**G4**	**DK2**
Pthermal	5.206	5.102	5.600	5.452	5.874	5.098	5.367	5.314	5.385	5.279	N/A	5.335	5.744	5.652	5.461
Pelec+Q	5.206	5.102	5.600	5.452	5.874	5.098	5.367	5.314	5.385	5.279	N/A	5.335	5.744	5.652	5.461
Tbolo	0.32359	0.32216	0.32233	0.32395	0.33294	0.32244	0.32449	0.32409	0.32395	0.32435	N/A	0.32424	0.32533	0.32449	0.32447
T/T0	1.079	1.074	1.074	1.080	1.110	1.075	1.082	1.080	1.080	1.081	N/A	1.081	1.084	1.082	1.082
Rbolo	9.05E+06	8.30E+06	1.13E+07	9.98E+06	1.50E+07	8.57E+06	9.94E+06	8.72E+06	1.03E+07	9.78E+06	N/A	9.73E+06	9.53E+06	1.04E+07	7.93E+06
Vbolo	6.86	6.51	7.95	7.38	9.39	6.61	7.30	6.81	7.46	7.18	N/A	7.20	7.40	7.67	6.58
Ibolo	0.76	0.78	0.70	0.74	0.63	0.77	0.73	0.78	0.72	0.73	N/A	0.74	0.78	0.74	0.83
A	-5.69	-5.68	-5.71	-5.70	-5.39	-5.64	-5.70	-5.66	-5.71	-5.68	N/A	-5.68	-5.63	-5.69	-5.57
C	0.62	0.61	0.62	0.59	0.48	0.59	0.64	0.60	0.61	0.60	N/A	0.65	0.62	0.55	0.65
G	232.7	242.3	264.1	240.4	193.9	239.1	231.7	233.2	237.5	229.2	N/A	232.6	240.3	243.9	235.4
Z/R	0.435	0.459	0.454	0.430	0.342	0.456	0.422	0.430	0.429	0.425	N/A	0.427	0.415	0.422	0.430
τ	2.378	2.233	2.176	2.228	2.409	2.176	2.473	2.288	2.317	2.340	N/A	2.496	2.347	2.061	2.445
Sdc	3.03E+08	2.83E+08	2.99E+08	3.08E+08	4.04E+08	2.88E+08	3.17E+08	2.99E+08	3.15E+08	3.16E+08	N/A	3.12E+08	3.03E+08	3.11E+08	2.83E+08
$NEP_{johnson}$	2.754	2.900	2.860	2.734	2.181	2.876	2.674	2.759	2.706	2.685	N/A	2.704	2.719	2.709	2.821
NEP_{phonon}	3.448	3.513	3.668	3.505	3.155	3.492	3.442	3.451	3.483	3.423	N/A	3.448	3.507	3.532	3.473
NEP_{load}	1.917	1.943	2.242	2.011	1.947	1.949	1.951	1.907	2.008	1.934	N/A	1.952	2.001	2.054	1.899
NEP_{amp}	2.968	3.184	3.014	2.918	2.228	3.130	2.841	3.014	2.857	2.851	N/A	2.883	2.969	2.896	3.175
NEP_{det}	5.653	5.888	5.978	5.685	4.844	5.836	5.557	5.678	5.626	5.549	N/A	5.596	5.702	5.694	5.805
DQE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	N/A	0.000	0.000	0.000	0.000
Vn(det)	17.1	16.6	17.9	17.5	19.6	16.8	17.6	17.0	17.7	17.5	N/A	17.5	17.3	17.7	16.5
Vn(total)	17.1	16.6	17.9	17.5	19.6	16.8	17.6	17.0	17.7	17.5	N/A	17.5	17.3	17.7	16.5
Vn(measured) at	61.50	15.80	22.50	15.90	20.70	15.60	15.60	20.40	17.00	17.50	16.80	16.70	18.10	17.90	24.90
NEP(measured)	20.28	5.59	7.53	5.15	5.12	5.43	4.92	6.83	5.40	5.54	N/A	5.35	5.97	5.76	8.78
Vn(measured) at	170.04	25.43	30.40	24.72	24.30	34.00	34.10	44.80	34.30	29.70	20.70	22.40	30.12	27.00	23.21
NEP(measured)	56.07	9.00	10.18	8.01	6.01	11.82	10.77	15.00	10.89	9.41	N/A	7.17	9.94	8.69	8.19
Vn(meas) 1Hz (T	61.50	15.80	22.50	15.90	20.70	15.60	15.60	20.40	17.00	17.50	16.80	16.70	18.10	17.90	24.90
Vn(meas) 1 Hz (I	129	22.1	28.7	21.2	23.4	20.9	21.9	27.7	22.2	21.8	22.4	21.3	26.3	23.2	59.5
Vn(meas) 0.1 Hz	1510	55.5	30.4	26	24.3	39.5	36	55.5	34.3	29.7	25.1	26.4	56.3	33.3	190
Vn (meas) at 0.1I	170.04	25.43	32.90	24.72	45.31	36.53	35.51	54.83	51.53	43.08	22.19	25.21	30.12	33.47	23.21
Vn (meas) at 0.1I	742.00	26.30	30.90	25.40	43.80	34.00	34.10	44.80	41.50	39.00	20.70	22.40	30.60	27.00	58.30

Symbol	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value		Value
T0															
Vn															
Q															
NEP_{photon}															
Vbias															
Gain															
Detector ID	**F5**	**F4**	**E6**	**E5**	**E4**	**D7**	**D6**	**D5**	**D4**	**C6**	**C5**	**C4**	**B5**	**B4**	**T2**
Pthermal	5.943	5.898	5.711	6.007	5.709	5.761	5.732	5.536	5.636	5.779	5.672	5.853	5.501	5.434	N/A
Pelec+Q	5.943	5.898	5.711	6.007	5.709	5.761	5.732	5.536	5.636	5.779	5.672	5.853	5.501	5.434	N/A
Tbolo	0.32637	0.32789	0.32497	0.32688	0.32601	0.32583	0.32558	0.32509	0.32589	0.32444	0.32564	0.32585	0.32372	0.32387	N/A
T/T0	1.088	1.093	1.083	1.090	1.087	1.086	1.085	1.084	1.086	1.081	1.085	1.086	1.079	1.080	N/A
Rbolo	1.17E+07	1.25E+07	9.16E+06	1.15E+07	9.28E+06	9.72E+06	9.65E+06	8.56E+06	9.76E+06	1.02E+07	9.43E+06	1.09E+07	9.90E+06	8.66E+06	N/A
Vbolo	8.34	8.59	7.23	8.32	7.28	7.48	7.44	6.89	7.42	7.68	7.31	8.00	7.38	6.86	N/A
Ibolo	0.71	0.69	0.79	0.72	0.78	0.77	0.77	0.80	0.76	0.75	0.78	0.73	0.75	0.79	N/A
A	-5.69	-5.49	-5.67	-5.69	-5.68	-5.69	-5.68	-5.65	-5.68	-5.70	-5.69	-5.70	-5.68	-5.68	N/A
C	0.59	0.82	0.64	0.56	0.65	0.61	0.75	0.69	0.55	0.61	0.62	0.59	0.59	0.61	N/A
G	239.0	225.5	241.9	237.3	232.8	236.5	237.2	233.4	231.0	250.1	234.5	240.2	244.8	240.6	N/A
Z/R	0.395	0.391	0.417	0.389	0.402	0.403	0.407	0.416	0.403	0.422	0.406	0.402	0.434	0.432	N/A
τ	2.308	3.426	2.370	2.181	2.518	2.317	2.869	2.633	2.164	2.242	2.372	2.256	2.196	2.251	N/A
Sdc	3.31E+08	3.43E+08	2.99E+08	3.32E+08	3.10E+08	3.12E+08	3.10E+08	2.98E+08	3.17E+08	3.04E+08	3.10E+08	3.22E+08	3.03E+08	2.92E+08	N/A
$NEP_{johnson}$	2.558	2.503	2.737	2.539	2.650	2.650	2.669	2.727	2.626	2.741	2.662	2.613	2.774	2.797	N/A
NEP_{phonon}	3.502	3.402	3.519	3.490	3.454	3.481	3.488	3.457	3.439	3.575	3.465	3.507	3.536	3.504	N/A
NEP_{load}	2.073	2.078	1.980	2.054	1.923	1.966	1.971	1.898	1.935	2.080	1.940	2.046	2.042	1.945	N/A
NEP_{amp}	2.720	2.624	3.011	2.714	2.901	2.882	2.904	3.019	2.835	2.962	2.900	2.795	2.975	3.079	N/A
NEP_{det}	5.524	5.389	5.732	5.497	5.574	5.595	5.622	5.666	5.523	5.779	5.592	5.579	5.764	5.777	N/A
DQE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	N/A
Vn(det)	18.3	18.5	17.1	18.2	17.3	17.5	17.4	16.9	17.5	17.6	17.4	18.0	17.4	16.9	N/A
Vn(total)	18.3	18.5	17.1	18.2	17.3	17.5	17.4	16.9	17.5	17.6	17.4	18.0	17.4	16.9	N/A
Vn(measured) at	17.80	19.60	17.10	18.00	16.70	16.90	17.30	41.80	33.00	16.50	17.10	16.90	18.30	15.80	17.90
NEP(measured)	5.38	5.71	5.72	5.43	5.38	5.41	5.58	14.02	10.39	5.43	5.51	5.25	6.05	5.41	N/A
Vn(measured) at	28.06	34.30	23.77	25.08	24.57	24.99	25.25	45.58	81.50	26.83	27.10	25.90	28.80	27.60	21.30
NEP(measured)	8.48	10.00	7.95	7.56	7.92	8.00	8.15	15.29	25.67	8.83	8.73	8.04	9.52	9.44	N/A
Vn(meas) 1Hz (T	17.80	19.60	17.10	18.00	16.70	16.90	17.30	41.80	42.10	16.50	17.10	16.90	18.30	15.80	17.90
Vn(meas) 1 Hz (I	24.8	23.9	20.4	24	22.9	22.9	22.3	62.5	33	22.4	22	23.8	25.5	23.5	23.9
Vn(meas) 0.1 Hz	40.2	34.3	28.3	42.1	53.1	41.4	39.5	66.9	148	38.8	39.4	35.3	41.1	63.2	26.1
Vn (meas) at 0.1I	28.06	46.22	23.77	25.08	24.57	24.99	25.25	45.58	348.73	26.83	30.67	27.62	32.32	31.75	25.12
Vn (meas) at 0.1I	33.10	55.90	29.90	44.40	29.00	28.20	28.00	50.80	81.50	32.70	27.10	25.90	28.80	27.60	21.30

Symbol	Equation (or Comments)	
T0		
Vn		
Q		
NEP_{photon}		
Vbias		
Gain		
Detector ID		
Pthermal	Power as function of Temperature	$P_{thermal} = [G300/(1+\beta)][T/0.3]^{\beta}$T evaluated from To to Tb
Pelec+Q	Electrical + Absorbed Power	$P_e + Q = [V_{bias}/(2R_L + R_B)]^2 R_B + Q$
Tbolo	Bolometer Temperature	Solve for Tb using Newtonian recursion such that $P_{thermal} = P_e + Q$
T/T0		T/To = Tbolo/To
Rbolo	Bolometer Resistance	$Rbolo = (Ro)\exp[(\Delta/Tb)^{1/2}]$
Vbolo	Voltage across Bolometer	$Vbolo = [Vbias/(2R_L + R_B)]R_B$
Ibolo	Current through Bolometer	$Ibolo = Vbias/(2R_L + R_B)$
A		$A = (T/R)(dR/dT) = -(1/2)[(\Delta/Tb)^{1/2}]$
C	Dynamic Heat Capacity	$C = C300[(T/0.3)^{\gamma}]$
G	Dynamic Thermal Conductance	$G = G300[(T/0.3)^{\beta}]$
Z/R		$Z/R = (I/V)(dV/dI) = [-1 - GTb/(P_eA)] / [1 - GTb/(P_eA)]$
τ	Electrical Time Constant	$\tau = [C/2G][(Z/R + 1)(1 + 2R_L/R_B)] / [Z/R + 2R_L/R_B]$
Sdc	Electrical Responsivity at 0 Hz	$Sdc = (1/2)[R_B/P_e]^{1/2} [1 - Z/R] / [1 + (Z/R)(R_B/2R_L)$
$NEP_{johnson}$	Johnson Noise Prior to Demodulation	$NEP_{johnson} = [(4k(Tb)^3G^2)/(P_eA^2)]^{1/2}$
NEP_{phonon}	Phonon Noise Prior to Demodulation	$=\{[(4kTo^2G)(\beta+1)((T/To)^{2\beta+3}-1)]/[(2\beta+3)(T/To)^{\beta}((T/To)^{\beta+1}-1)]\}^{1/2}$
NEP_{load}	Johnson Noise from R_L Prior to Demod.	$NEP_{load} = [4kTo/2R_L]^{1/2} \lvert 2(Z/R)R_B Ibolo/[(Z/R) - 1]\rvert$
NEP_{amp}	Amplifier Noise Prior to Demodulation	$NEP_{amp} = Vn / Sdc$
NEP_{det}	Detector Noise after Demodulation	$NEP_{det} = [2NEP_{john}^2+NEP_{phon}^2+2NEP_{load}^2+2NEP_{amp}^2]^{1/2}$
DQE	BLIP Figure-of-Merit for Detector	$DQE = NEP_{photon}^2 / (NEP_{photon}^2 + NEP_{det}^2)$
Vn(det)	Voltage Noise of Detector After Demod.	$Vn(det) = NEP_{det}Sdc$
Vn(total)	Total Noise after Demodulation	$Vn(total) = [NEP_{det}^2 + NEP_{photon}^2]^{1/2}Sdc$
Vn(measured) at		
NEP(measured)		
Vn(measured) at		
NEP(measured)		
Vn(meas) 1Hz (T		
Vn(meas) 1 Hz (I		
Vn(meas) 0.1 Hz		
Vn (meas) at 0.1I		
Vn (meas) at 0.1I		

Symbol	Units	Value	Value	Value	Value	Value	Value	Value	Value	Value
T0	K	0.3	Base Temperature				Note: Corrected for sqrt(2) demodulation factor			
Vn	nV/rtHz	10	Amplifier Voltage Noise				corrected for ETF in Johnson and load resistor te			
Q	pW	10.8	Absorbed Power Onto Bolometer				assumes only first harmonic of amplifier, Johnsor			
NEP_{photon}	1e-17 W/rtHz	13.60	Noise in Absorbed Optical Power				added 2 more iterations of the recursion solver			
Vbias	mV	30	Bias Across Bolometer & Load Resistors				added variable gain to scale measured noise			
Gain		80000					NEPs checked with standard spreadsheet			
Detector ID		**Target**	**R1**	**A4**	**A3**	**A2**	**A1**	**DK1**	**B3**	**B2**
Pthermal	pW	18.594	N/A	#VALUE!	18.453	18.625	18.568	19.027	20.517	19.843
Pelec+Q	pW	18.594	N/A	#VALUE!	18.453	18.625	18.568	19.027	20.517	19.843
Tbolo	K	0.38875	N/A	#VALUE!	0.37358	0.37477	0.37331	0.37404	0.38182	0.37935
T/T0		1.296	N/A	#VALUE!	1.245	1.249	1.244	1.247	1.273	1.265
Rbolo	Ω	5.74E+06	5.07E+06	#VALUE!	3.49E+06	3.76E+06	3.76E+06	4.11E+06	5.54E+06	4.98E+06
Vbolo	mV	6.69	6.94	#VALUE!	5.17	5.43	5.41	5.81	7.34	6.71
Ibolo	nA	1.17	1.37	#VALUE!	1.48	1.44	1.44	1.42	1.32	1.35
A		-5.18	N/A	#VALUE!	-5.26	-5.26	-5.28	-5.27	-5.29	-5.28
C	pJ/K	1.30	N/A	#VALUE!	0.72	0.68	0.73	0.68	0.71	0.69
G	pW/K	250.8	N/A	#VALUE!	292.1	290.4	294.5	298.5	295.3	293.8
Z/R		0.414	1.000	#VALUE!	0.461	0.451	0.456	0.441	0.373	0.400
τ	ms	4.202	N/A	#VALUE!	1.972	1.893	1.999	1.833	1.960	1.900
Sdc	V/W	2.25E+08	N/A	#VALUE!	1.66E+08	1.73E+08	1.72E+08	1.79E+08	2.11E+08	1.99E+08
$NEP_{johnson}$	1e-17 W/rtHz	3.837	N/A	#VALUE!	4.229	4.177	4.199	4.154	3.868	3.975
NEP_{phonon}	1e-17 W/rtHz	3.797	N/A	#VALUE!	4.034	4.029	4.051	4.085	4.096	4.072
NEP_{load}	1e-17 W/rtHz	1.805	N/A	#VALUE!	1.729	1.756	1.765	1.824	1.950	1.897
NEP_{amp}	1e-17 W/rtHz	4.450	N/A	#VALUE!	6.021	5.779	5.816	5.595	4.739	5.014
NEP_{det}	1e-17 W/rtHz	7.225	N/A	#VALUE!	8.567	8.376	8.425	8.281	7.616	7.818
DQE		0.780	N/A	#VALUE!	0.716	0.725	0.723	0.730	0.761	0.752
Vn(det)	nV/rtHz	16.2	12.89	#VALUE!	14.2	14.5	14.5	14.8	16.1	15.6
Vn(total)	nV/rtHz	34.6	12.9	#VALUE!	26.7	27.6	27.5	28.5	32.9	31.3

Symbol	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
T0												
Vn	rms											
Q	, and LR propagates											
NEP_{photon}												
Vbias												
Gain												
Detector ID	**B1**	**C3**	**C2**	**C1**	**D3**	**D2**	**D1**	**E3**	**E2**	**E1**	**F3**	**F2**
Pthermal	18.819	19.393	19.194	19.187	18.719	18.529	20.153	19.401	20.947	18.548	19.148	18.879
Pelec+Q	18.819	19.393	19.194	19.187	18.719	18.529	20.153	19.401	20.947	18.548	19.148	18.879
Tbolo	0.37448	0.37797	0.37626	0.37346	0.37556	0.37182	0.37170	0.37580	0.39927	0.37286	0.37750	0.37601
T/T0	1.248	1.260	1.254	1.245	1.252	1.239	1.239	1.253	1.331	1.243	1.258	1.253
Rbolo	3.91E+06	4.61E+06	4.45E+06	3.93E+06	4.00E+06	3.79E+06	5.15E+06	4.42E+06	5.88E+06	3.89E+06	4.33E+06	3.87E+06
Vbolo	5.60	6.29	6.11	5.74	5.63	5.41	6.94	6.16	7.73	5.49	6.01	5.59
Ibolo	1.43	1.37	1.37	1.46	1.41	1.43	1.35	1.40	1.31	1.41	1.39	1.44
A	-5.27	-5.28	-5.28	-5.29	-5.28	-5.28	-5.32	-5.29	-4.92	-5.25	-5.28	-5.26
C	0.76	0.95	0.66	0.74	0.72	0.71	0.71	0.69	0.58	0.68	0.74	0.70
G	294.4	291.4	293.5	303.5	288.0	299.0	326.2	298.2	261.9	294.9	288.9	290.1
Z/R	0.446	0.417	0.428	0.437	0.442	0.463	0.418	0.422	0.353	0.460	0.424	0.439
τ	2.074	2.636	1.830	1.955	2.018	1.910	1.793	1.857	1.788	1.862	2.061	1.933
Sdc	1.75E+08	1.92E+08	1.88E+08	1.75E+08	1.80E+08	1.71E+08	1.92E+08	1.87E+08	2.19E+08	1.73E+08	1.88E+08	1.76E+08
$NEP_{johnson}$	4.167	4.030	4.074	4.172	4.114	4.234	4.119	4.076	3.855	4.216	4.050	4.137
NEP_{phonon}	4.056	4.050	4.060	4.115	4.022	4.077	4.255	4.091	3.903	4.057	4.033	4.033
NEP_{load}	1.787	1.850	1.841	1.819	1.767	1.784	2.030	1.852	1.968	1.789	1.808	1.769
NEP_{amp}	5.698	5.202	5.320	5.730	5.561	5.860	5.213	5.360	4.560	5.770	5.332	5.671
NEP_{det}	8.335	7.945	8.049	8.395	8.194	8.490	8.146	8.094	7.400	8.410	8.023	8.286
DQE	0.727	0.746	0.741	0.724	0.734	0.720	0.736	0.738	0.772	0.723	0.742	0.729
Vn(det)	14.6	15.3	15.1	14.7	14.7	14.5	15.6	15.1	16.2	14.6	15.0	14.6
Vn(total)	28.0	30.3	29.7	27.9	28.6	27.4	30.4	29.5	34.0	27.7	29.6	28.1

Symbol	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
T0												
Vn												
Q												
NEP_{photon}												
Vbias												
Gain												
Detector ID	**F1**	**G1**	**T1**	**G2**	**G3**	**G4**	**DK2**	**F5**	**F4**	**E6**	**E5**	**E4**
Pthermal	19.304	18.948	N/A	19.072	19.894	19.887	19.053	20.658	20.733	19.748	20.737	19.669
Pelec+Q	19.304	18.948	N/A	19.072	19.894	19.887	19.053	20.658	20.733	19.748	20.737	19.669
Tbolo	0.37628	0.37750	N/A	0.37694	0.37785	0.37668	0.37631	0.38119	0.38583	0.37688	0.38208	0.37947
T/T0	1.254	1.258	N/A	1.256	1.259	1.256	1.254	1.271	1.286	1.256	1.274	1.265
Rbolo	4.53E+06	4.27E+06	N/A	4.27E+06	4.23E+06	4.59E+06	3.58E+06	5.00E+06	5.31E+06	4.07E+06	4.91E+06	4.05E+06
Vbolo	6.21	5.90	N/A	5.94	6.20	6.46	5.43	7.02	7.26	6.04	6.99	5.99
Ibolo	1.37	1.38	N/A	1.39	1.47	1.41	1.52	1.40	1.37	1.48	1.42	1.48
A	-5.30	-5.26	N/A	-5.27	-5.22	-5.29	-5.18	-5.27	-5.07	-5.27	-5.26	-5.26
C	0.70	0.69	N/A	0.75	0.73	0.64	0.76	0.69	0.97	0.74	0.65	0.76
G	295.2	285.8	N/A	289.4	299.2	302.2	289.5	298.4	287.3	299.5	297.1	290.1
Z/R	0.423	0.431	N/A	0.429	0.408	0.407	0.437	0.373	0.376	0.411	0.370	0.405
τ	1.927	1.959	N/A	2.089	1.945	1.705	2.096	1.862	2.722	1.979	1.755	2.093
Sdc	1.90E+08	1.86E+08	N/A	1.85E+08	1.82E+08	1.90E+08	1.69E+08	2.00E+08	2.04E+08	1.80E+08	1.99E+08	1.83E+08
$NEP_{johnson}$	4.057	4.070	N/A	4.076	4.085	4.041	4.175	3.922	3.955	4.084	3.918	4.035
NEP_{phonon}	4.072	4.011	N/A	4.035	4.104	4.124	4.041	4.119	4.053	4.106	4.113	4.051
NEP_{load}	1.850	1.794	N/A	1.807	1.858	1.889	1.753	1.923	1.971	1.829	1.913	1.792
NEP_{amp}	5.272	5.373	N/A	5.394	5.482	5.272	5.916	4.994	4.909	5.554	5.018	5.476
NEP_{det}	8.016	8.046	N/A	8.078	8.188	8.043	8.475	7.809	7.749	8.230	7.817	8.117
DQE	0.742	0.741	N/A	0.739	0.734	0.741	0.720	0.752	0.755	0.732	0.752	0.737
Vn(det)	15.2	15.0	N/A	15.0	14.9	15.3	14.3	15.6	15.8	14.8	15.6	14.8
Vn(total)	29.9	29.4	N/A	29.3	29.0	30.0	27.1	31.4	31.9	28.6	31.3	28.9

Symbol	Value	Value	Value	Value	Value	Value	Value	Value		Value
T0										
Vn										
Q										
NEP_{photon}										
Vbias										
Gain										
Detector ID	**D7**	**D6**	**D5**	**D4**	**C6**	**C5**	**C4**	**B5**	**B4**	**T2**
Pthermal	19.883	N/M	N/M	19.610	20.151	19.644	20.336	19.534	19.150	N/A
Pelec+Q	19.883	N/M	N/M	19.610	20.151	19.644	20.336	19.534	19.150	N/A
Tbolo	0.37908	N/M	N/M	0.37968	0.37583	0.37878	0.37953	0.37499	0.37481	N/A
T/T0	1.264	N/M	N/M	1.266	1.253	1.263	1.265	1.250	1.249	N/A
Rbolo	4.24E+06	N/M	N/M	4.23E+06	4.54E+06	4.12E+06	4.73E+06	4.43E+06	3.89E+06	N/A
Vbolo	6.21	N/M	N/M	6.11	6.52	6.04	6.72	6.22	5.70	N/A
Ibolo	1.46	N/M	N/M	1.44	1.43	1.46	1.42	1.40	1.46	N/A
A	-5.27	N/M	N/M	-5.27	-5.30	-5.27	-5.28	-5.28	-5.28	N/A
C	0.71	N/M	N/M	0.65	0.71	0.72	0.69	0.69	0.70	N/A
G	294.6	N/M	N/M	289.2	309.9	292.1	300.2	303.3	298.6	N/A
Z/R	0.400	N/M	N/M	0.406	0.403	0.407	0.387	0.423	0.435	N/A
τ	1.914	N/M	N/M	1.787	1.848	1.970	1.834	1.830	1.896	N/A
Sdc	1.86E+08	N/M	N/M	1.86E+08	1.87E+08	1.84E+08	1.94E+08	1.85E+08	1.75E+08	N/A
$NEP_{johnson}$	4.023	N/M	N/M	4.022	4.061	4.039	3.978	4.105	4.151	N/A
NEP_{phonon}	4.080	N/M	N/M	4.042	4.169	4.061	4.119	4.121	4.085	N/A
NEP_{load}	1.828	N/M	N/M	1.807	1.912	1.805	1.900	1.877	1.799	N/A
NEP_{amp}	5.383	N/M	N/M	5.362	5.344	5.447	5.149	5.410	5.711	N/A
NEP_{det}	8.072	N/M	N/M	8.033	8.130	8.108	7.931	8.162	8.353	N/A
DQE	0.740	N/M	N/M	0.741	0.737	0.738	0.746	0.735	0.726	N/A
Vn(det)	15.0	N/M	N/M	15.0	15.2	14.9	15.4	15.1	14.6	N/A
Vn(total)	29.4	N/M	N/M	29.5	29.6	29.1	30.6	29.3	27.9	N/A

Symbol	Equation (or Comments)	
T0		
Vn		
Q		
NEP_{photon}		
Vbias		
Gain		
Detector ID		
Pthermal	Power as function of Temperature	$P_{thermal} = [G300/(1+\beta)][T/0.3]^{\beta}T$ evaluated from To to Tb
Pelec+Q	Electrical + Absorbed Power	$P_e + Q = [V_{bias}/(2R_L + R_B)]^2R_B + Q$
Tbolo	Bolometer Temperature	Solve for Tb using Newtonian recursion such that $P_{thermal} = P_e + Q$
T/T0		T/To = Tbolo/To
Rbolo	Bolometer Resistance	$Rbolo = (Ro)\exp[(\Delta/Tb)^{1/2}]$
Vbolo	Voltage across Bolometer	$Vbolo = [Vbias/(2R_L + R_B)]R_B$
Ibolo	Current through Bolometer	$Ibolo = Vbias/(2R_L + R_B)$
A		$A = (T/R)(dR/dT) = -(1/2)[(\Delta/Tb)^{1/2}]$
C	Dynamic Heat Capacity	$C = C300[(T/0.3)^{\gamma}]$
G	Dynamic Thermal Conductance	$G = G300[(T/0.3)^{\beta}]$
Z/R		$Z/R = (I/V)(dV/dI) = [-1 - GTb/(P_eA)] / [1 - GTb/(P_eA)]$
τ	Electrical Time Constant	$\tau = [C/2G][(Z/R + 1)(1 + 2R_L/R_B)] / [Z/R + 2R_L/R_B]$
Sdc	Electrical Responsivity at 0 Hz	$Sdc = (1/2)[R_B/P_e]^{1/2} [1 - Z/R] / [1 + (Z/R)(R_B/2R_L)$
$NEP_{johnson}$	Johnson Noise Prior to Demodulation	$NEP_{johnson} = [(4k(Tb)^3G^2)/(P_eA^2)]^{1/2}$
NEP_{phonon}	Phonon Noise Prior to Demodulation	$=\{[(4kTo^2G)(\beta+1)((T/To)^{2\beta+3}-1)]/[(2\beta+3)(T/To)^{\beta}((T/To)^{\beta+1}-1)]\}^{1/2}$
NEP_{load}	Johnson Noise from R_L Prior to Demod.	$NEP_{load} = [4kTo/2R_L]^{1/2} \lvert 2(Z/R)R_B Ibolo/[(Z/R) - 1]\rvert$
NEP_{amp}	Amplifier Noise Prior to Demodulation	$NEP_{amp} = Vn / Sdc$
NEP_{det}	Detector Noise after Demodulation	$NEP_{det} = [2NEP_{john}^2+NEP_{phon}^2+2NEP_{load}^2+2NEP_{amp}^2]^{1/2}$
DQE	BLIP Figure-of-Merit for Detector	$DQE = NEP_{photon}^2 / (NEP_{photon}^2 + NEP_{det}^2)$
Vn(det)	Voltage Noise of Detector After Demod.	$Vn(det) = NEP_{det}Sdc$
Vn(total)	Total Noise after Demodulation	$Vn(total) = [NEP_{det}^2 + NEP_{photon}^2]^{1/2}Sdc$

Version	**Issue Date**	**Sheet**	**Changes from Previous Version**
SSW 10			
		Mather dark & optical	Change NEP(Johnson) to remove the effect of electrothermal feedback
			Change NEP(Load) to remove the effect of electrothermal feedback
			Remove sqrt(2) demodulation factor from NEP(total)
			Insert variable BoDAC gain and correct for sqrt(2) reduction in dark NEPs
			Add two more recursions in thermal balance to calculate Tbolo
			Fix N/A to mean not applicable, N/M to mean not measured
			Fix borders
		Pixel	Add NEP(model) derived from physical parameters and Mather model
			Fix N/A to mean not applicable, N/M to mean not measured
		BDA	Reoptimize bias for DQE
			Add NEP(model) median
			Exclude noisy pixels from NEP and 1/f medians
		Problem Channels	New spreadsheet added to summarize issues
		Version notes	New spreadsheet added to track changes

EIDP Coverpage For QM PLW BDA

Unit Identfication								
Name	:	QM PLW BDA						
Part #	:	10209800 -8						
S/N	:	#007						

Environmemtal Testing	Axes Tested	Temperature	Duration or Number of Cycles	Pass/Fail	Requirement	Source	Waiver #
Random Vibration Test	X, Y, Z	100 K	2 min per axis	P	X, Y, Z at 90 K 1 min per axis	SSSD Sec # 3.4	HR-SP-JPL-RFW-006
High Level Sine Vibe Test	None	NA	NA	NA	X, Y, Z at 90 K	SSSD Sec # 3.4	HR-SP-JPL-RFW-005
Bakeout	NA	80 C	5 days as part of the assembly procedures	P	None (other than as part of the assembly procedure)	D-20549	
Thermal Cycles	NA	RoomT to ~ < 10 K	27	P	Min15 from RmT to < 77 K	D-20549	

Other Testing	Frequency (Hz)	Note		Minimum Performance	Source	Waiver #
Lowest Resonant Frequency (X-axis)	283 Hz	Cold		> 200 Hz (Goal: >250 Hz)	SSSD Sec # 3.1.3	NA
Lowest Resonant Frequency (Y-axis)	281 Hz	Cold		> 200 Hz (Goal: >250 Hz)	SSSD Sec # 3.1.3	NA
Lowest Resonant Frequency (Z-axis)	276 Hz	Cold		> 200 Hz (Goal: >250 Hz)	SSSD Sec # 3.1.3	NA

Metrology Measurements were performed before and after the Vibration Test and the Thermal Cycles

	Motion in X/Y	Motion in Z		Meets Goal ?	Performance Goal	Source	Waiver #
Maximum motion due to Random Vibration Test 1st axis (X)	21 μm	40 μm		Y	125 μm in X/Y and 500 μm in Z	SSSD Sec # 3.1.1	NA
Maximum motion due to Random Vibration Test 2nd axis (Y)	22 μm	8.6 μm		Y	125 μm in X/Y and 500 μm in Z	SSSD Sec # 3.1.1	NA
Maximum motion due to Random Vibration Test 3rd axis (Z)	9.5 μm	11 μm		Y	125 μm in X/Y and 500 μm in Z	SSSD Sec # 3.1.1	NA
Cumulative Maximum motion	34 μm	56 μm		Y	125 μm in X/Y and 500 μm in Z	SSSD Sec # 3.1.1	NA

Cold Continuity Measurements : In Process

				Pass/Fail	Requirement	Source	Waiver #
Cold Continuity Test (1st Thermal Cycle)				P	None	NA	NA
Cold Continuity Test (2nd Thermal Cycle)				P	None	NA	NA

ENVIRONMENTAL TEST AUTHORIZATION AND SUMMARY (ETAS)

AUTHORIZATION SECTION

PROJECT	LOG NO.
Herschel	HS013

SYSTEM/ASSEMBLY TITLE	DATE ISSUED
SPIRE Qual BDA S/N007	7/23/2003

REFERENCE DESIGNATION NUMBER	PART NO. (IF MULTIPLE, ATTACH LIST)	REV.	SERIAL NO.
	10209800-8		007

HARDWARE TYPE
☒ EM QUAL ☐ FLIGHT ☐ FLIGHT SPARE ☐ OTHER

PRE-ENVIRONMENTAL INSPECTION REPORT NUMBER (ATTACH IR)

WIRING HARNESS	PART NO.	REV.	SERIAL NO.
☐ EM QUAL ☐ FLIGHT ☐ EM ☐ SE			

TEST DESCRIPTION (CHECK ALL APPLICABLE)
☒ SINE VIBRATION ☐ PYROSHOCK ☐ ACOUSTIC ☐ EMC ☐ OTHER _____
☒ RANDOM VIBRATION ☐ THERMAL VAC. ☐ THERMAL ATMOSPHERE

TYPE OF TEST
☐ QUALIFICATION ☐ FLIGHT ACCEPTANCE
☐ PROTO FLIGHT ☐ RETEST

WILL ALL TESTS/LEVES/DURATIONS REQUIRED BY THE PROJECT DOCUMENTS BE PERFORMED ON THIS UNIT?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) ENTER PROJ. DOC. NO. AND REV. ____

HAS THE UNIT PASSED ALL PRE-ENVIRONMENTAL FUNCTIONAL TESTS?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

HAVE ALL DESIGN ANALYSES BEEN COMPLETED AND REQUIRED CHANGES BEEN IMPLEMENTED?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

IS THE TEST ARTICLE IDENTICAL TO OTHER FLIGHT UNITS?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

ARE ALL PFRs AGAINST THIS UNIT CLOSED?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

HAVE ALL WAIVERS AND ECRs BEEN APPROVED AND ARE THEY INCORPORATED?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

TEST AUTHORIZED BY

COGNIZANT ENGINEER	DATE	TECHNICAL MGR./INSTR MRG./PI PREP REP	DATE	ENVIRONMENTAL REQUIREMENTS ENG.	DATE
[signature]	7/25/03	[signature]	7-25-03	[signature]	7/28/03

SUMMARY SECTION

TEST AGENCY (IF MULTIPLE, ATTACH SUMMARY AND TEST DATES)	TEST INITIATION DATE	ACCUMULATED OPERATING HOURS PRIOR TO FIRST ENVIRONMENTAL TEST
JPL Building 144	07/30/03	
SERIAL NUMBERS ACTUALLY TESTED	TEST TERMINATION DATE	OPERATING HOURS DURING ENVIRONMENTAL EXPOSURE
S/N 007	8/7/03	

TEST DESCRIPTION

VIBRATION	ACOUSTIC	PYROSHOCK SHOCK	☐ THERMAL VACUUM	☐ TEMPERATURE ATMOSPHERE	☐ OTHER
AXES: X Y Z		AXES: X Y Z	PRESSURE:		
SINE VIBRATION ☒ ☒ ☒	☐	☐ ☐ ☐			
RANDOM VIBRATION ☒ ☒ ☒		SHOCKS/AXIS:	NO OF CYCLES:	NO OF CYCLES:	____

EMC	☐ COND. SUSC.	☐ COND. EMIS.	☐ ISOLATION	TEMP. LEVEL (°c) AND ACCUMULATED DURATION (HRS.)
☐ ESD	☐ RAD. SUSC.	☐ RAD. EMIS.	☐ MAGNETICS	HOT: _____°c, _____h COLD: _____°c, _____h
				HOT: _____°c, _____h COLD: _____°c, _____h

WERE THERE ANY PFRs GENERATED DURING ENVIRONMENTAL TESTS? ☐ YES ☒ NO (IF NO, ATTACH EXCEPTIONS LIST)	LIST PFR NOS. / BRIEF EXPLANATION
ARE THE POST ENVIRONMENTAL DAMAGE INSPECTIONS COMPLETE? ☒ YES ☐ NO (IF YES, ATTACH A COPY OF THE INSPECTION REPORTS. IF NO, ATTACH EXPLANATION)	LIST PFR NOS. / BRIEF EXPLANATION
WERE ALL PLANNED TESTS/LEVELS/DURATIONS ACHIEVED? ☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST)	LIST PFR NOS. / BRIEF EXPLANATION

☐ TESTS HAVE NOT BEEN SUCCESSFULLY COMPLETED. SEE THE ATTACHED SUMMARY FOR ACTIONS THAT NEED TO BE TAKEN.

COGNIZANT ENGINEER	DATE	TECHNICAL MGR./INSTR MRG./PI PREP REP	DATE	ENVIRONMENTAL REQUIREMENTS ENG.	DATE

☒ HARDWARE HAS SUCCESSFULLY COMPLETED THE ENVIRONMENTAL TESTS LISTED ON THIS FORM OR REMAINING ACTIONS HAVE BEEN TAKEN, INCLUDING RETEST.

COGNIZANT ENGINEER	DATE	TECHNICAL MGR./INSTR MRG./PI PREP REP	DATE	ENVIRONMENTAL REQUIREMENTS ENG.	DATE
[signature]	2/18/04	[signature]	3/17/05	[signature]	2-18-04

OTHER AUTHORIZATION PROVISIONS AND EXPLANATIONS

This is a cold vibration test (<110 K) done on the Qual BDA. The unit is identical to the flight design. Response accelerometers will be mounted onto the suspended mass and force transducers will be mounted under the interface fixture in order to provide redundant response measurements. This test will be a cold 3-axis test with metrology before, in between, and after each axis.

ENVIRONMENTAL TEST AUTHORIZATION AND SUMMARY (ETAS)
ENVIRONMENTAL TEST SUMMARY

HARDWARE	S/N	ETAS	TEST ENVIRONMENT LEVELS & DURATION	DATE TEST PERFORMED	TEST AGENCY	PASS/ FAIL	COMMENTS
Qual BDA (10209800-8)	7	HSO13	**LATERAL** 2 minute Random Vibe +3dB/octave 20-100Hz 0.06 g^2/Hz 100-138.5 Hz +36dB/octave 138.5-170 Hz 0.7 g^2/Hz 170-200 Hz -48dB/octave 200-220 Hz .1 g^2/Hz 220-300 Hz -9 dB/octave 300-2000 Hz Total Input: 8.0 Grms Spectrum to be notched in order to get 15 g's response RMS **LONGITUDINAL** 2 minute Random Vibe +3dB/octave 20-100Hz 0.08g^2/Hz 100-400Hz -12dB/octave 400-2000Hz Total Input: 6.2 Grms Spectrum to be notched in order to get 15 g's response RMS Each axis1/4 g sine sweep 20-2000 Hz each axisT ~ 100 K				

ENVIRONMENTAL TEST AUTHORIZATION AND SUMMARY (ETAS)

AUTHORIZATION SECTION

PROJECT	LOG NO.
Herschel	HS017

SYSTEM/ASSEMBLY TITLE	DATE ISSUED
S[illegible] Qual BDA SN007	9/2/2003

REFERENCE DESIGNATION NUMBER	PART NO. (IF MULTIPLE, ATTACH LIST)	REV.	SERIAL NO.
	10209800		007

HARDWARE TYPE
☒ EM QUAL ☐ FLIGHT ☐ FLIGHT SPARE ☐ OTHER

PRE-ENVIRONMENTAL INSPECTION REPORT NUMBER (ATTACH IR)

WIRING HARNESS	PART NO.	REV.	SERIAL NO.
☐ EM QUAL ☐ FLIGHT ☐ EM ☐ SE			

TEST DESCRIPTION (CHECK ALL APPLICABLE)
☐ SINE VIBRATION ☐ PYROSHOCK ☐ ACOUSTIC ☐ EMC ☐ OTHER _____
☐ RANDOM VIBRATION ☒ THERMAL VAC. ☐ THERMAL ATMOSPHERE

TYPE OF TEST
☒ QUALIFICATION ☐ FLIGHT ACCEPTANCE
☐ PROTO FLIGHT ☐ RETEST

WILL ALL TESTS/LEVES/DURATIONS REQUIRED BY THE PROJECT DOCUMENTS BE PERFORMED ON THIS UNIT?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) ENTER PROJ. DOC. NO. AND REV. ____

HAS THE UNIT PASSED ALL PRE-ENVIRONMENTAL FUNCTIONAL TESTS?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

HAVE ALL DESIGN ANALYSES BEEN COMPLETED AND REQUIRED CHANGES BEEN IMPLEMENTED?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

IS THE TEST ARTICLE IDENTICAL TO OTHER FLIGHT UNITS?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

ARE ALL PFRs AGAINST THIS UNIT CLOSED?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

HAVE ALL WAIVERS AND ECRs BEEN APPROVED AND ARE THEY INCORPORATED?
☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION

TEST AUTHORIZED BY

COGNIZANT ENGINEER	DATE	TECHNICAL MGR./INSTR MRG./PI PREP REP	DATE	ENVIRONMENTAL REQUIREMENTS ENG.	DATE
[signature]	10/9/03	[signature]	10-16-03	[signature]	10/9/03

SUMMARY SECTION

TEST AGENCY (IF MULTIPLE, ATTACH SUMMARY AND TEST DATES)	TEST INITIATION DATE	ACCUMULATED OPERATING HOURS PRIOR TO FIRST ENVIRONMENTAL TEST
JPL Building 183	9/2/03	
SERIAL NUMBERS ACTUALLY TESTED	TEST TERMINATION DATE	OPERATING HOURS DURING ENVIRONMENTAL EXPOSURE
	11/11/03	

TEST DESCRIPTION

VIBRATION	ACOUSTIC	PYROSHOCK SHOCK	☒ THERMAL VACUUM	☐ TEMPERATURE ATMOSPHERE	☐ OTHER
AXES: X Y Z		AXES: X Y Z	PRESSURE: <1E-5 mbar, 290K to 7K		
SINE VIBRATION ☐ ☐ ☐	☐			NO OF CYCLES:	____
RANDOM VIBRATION ☐ ☐ ☐		SHOCKS/AXIS:	NO OF CYCLES: 27		

EMC	COND. SUSC.	COND. EMIS.	ISOLATION	TEMP. LEVEL (°c) AND ACCUMULATED DURATION (HRS.)
☐ ESD	☐ RAD. SUSC.	☐ RAD. EMIS.	☐ MAGNETICS	HOT: ____°c, ____h COLD: ____°c, ____h
				HOT: ____°c, ____h COLD: ____°c, ____h

WERE THERE ANY PFRs GENERATED DURING ENVIRONMENTAL TESTS? ☐ YES ☒ NO (IF NO, ATTACH EXCEPTIONS LIST)	LIST PFR NOS. / BRIEF EXPLANATION
ARE THE POST ENVIRONMENTAL DAMAGE INSPECTIONS COMPLETE? ☒ YES ☐ NO (IF YES, ATTACH A COPY OF THE INSPECTION REPORTS. IF NO, ATTACH EXPLANATION)	LIST PFR NOS. / BRIEF EXPLANATION
WERE ALL PLANNED TESTS/LEVELS/DURATIONS ACHIEVED? ☒ YES ☐ NO (IF NO, ATTACH EXCEPTIONS LIST)	LIST PFR NOS. / BRIEF EXPLANATION

☐ TESTS HAVE NOT BEEN SUCCESSFULLY COMPLETED. SEE THE ATTACHED SUMMARY FOR ACTIONS THAT NEED TO BE TAKEN.

COGNIZANT ENGINEER	DATE	TECHNICAL MGR./INSTR MRG./PI PREP REP	DATE	ENVIRONMENTAL REQUIREMENTS ENG.	DATE

☒ HARDWARE HAS SUCCESSFULLY COMPLETED THE ENVIRONMENTAL TESTS LISTED ON THIS FORM OR REMAINING ACTIONS HAVE BEEN TAKEN, INCLUDING RETEST.

COGNIZANT ENGINEER	DATE	TECHNICAL MGR./INSTR MRG./PI PREP REP	DATE	ENVIRONMENTAL REQUIREMENTS ENG.	DATE
[signature]	2/18/04	[signature]	3/17/05	[signature]	2-18-04

OTHER AUTHORIZATION PROVISIONS AND EXPLANATIONS

1. .mal cycles will be performed on the BDA SN7 in order to fully qualify the design for flight.

ENVIRONMENTAL TEST AUTHORIZATION AND SUMMARY (ETAS)
ENVIRONMENTAL TEST SUMMARY

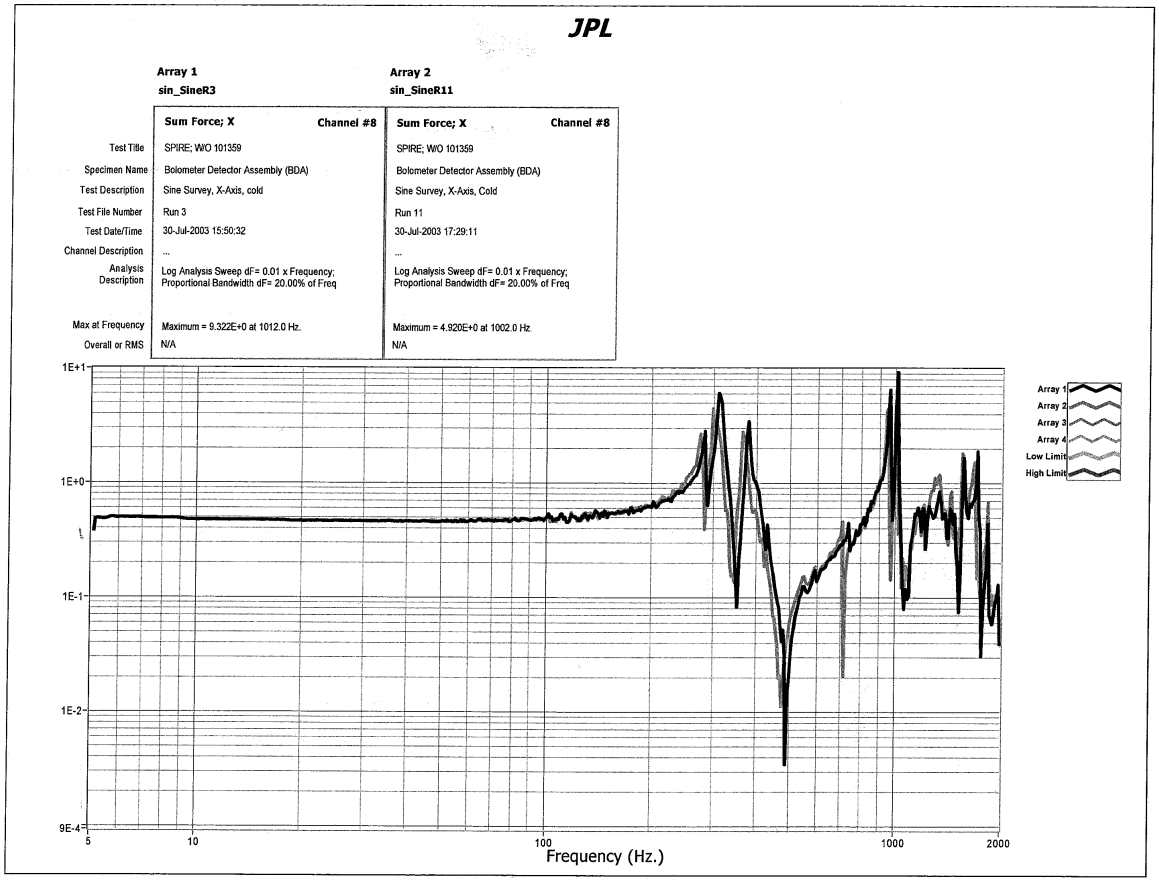
HARDWARE	S/N	ETAS	TEST ENVIRONMENT LEVELS & DURATION	DATE TEST PERFORMED	TEST AGENCY	PASS/ FAIL	COMMENTS
Qual BDA (10209800)	7	HSO17	27 Thermal cycles from 290K to 7K				

QM BDA Random Vibration Test

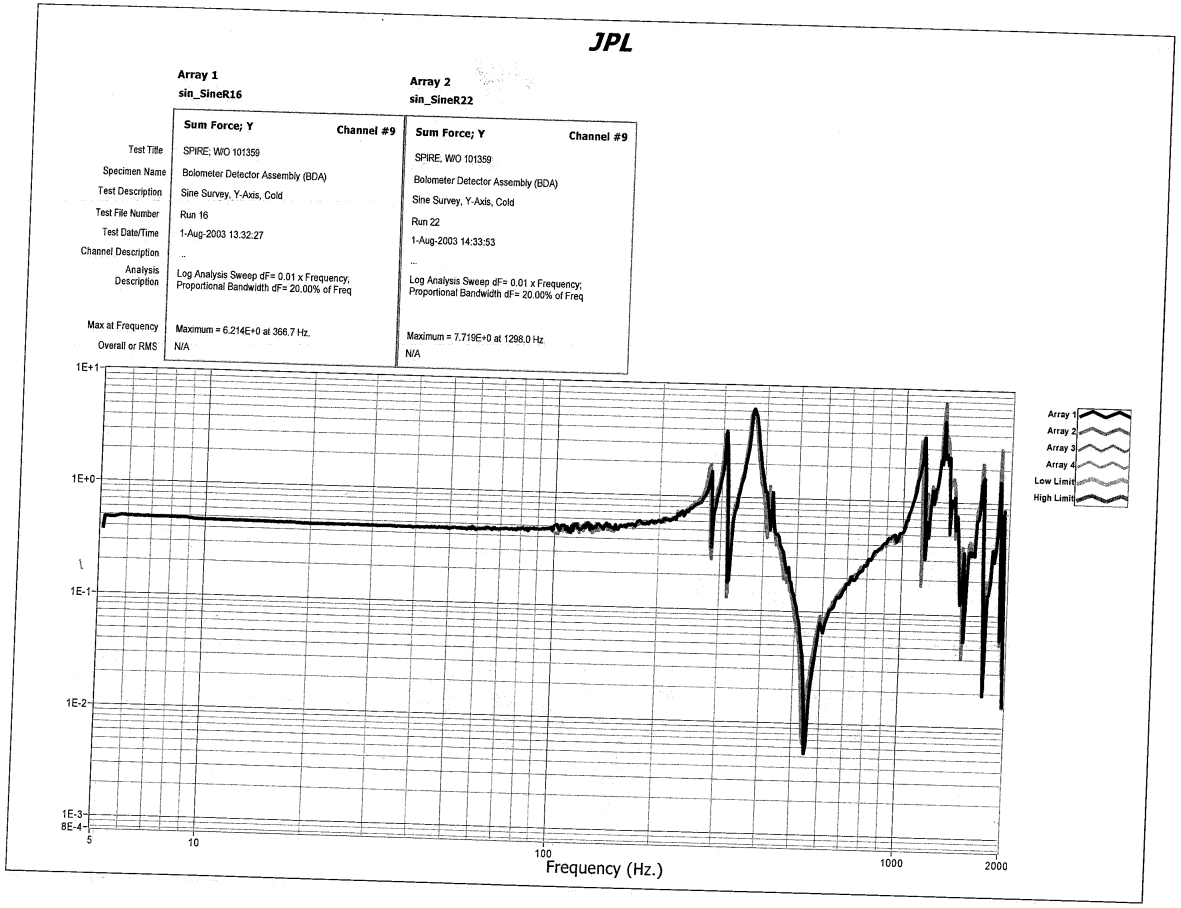
P/N 10209800-8

S/N 007

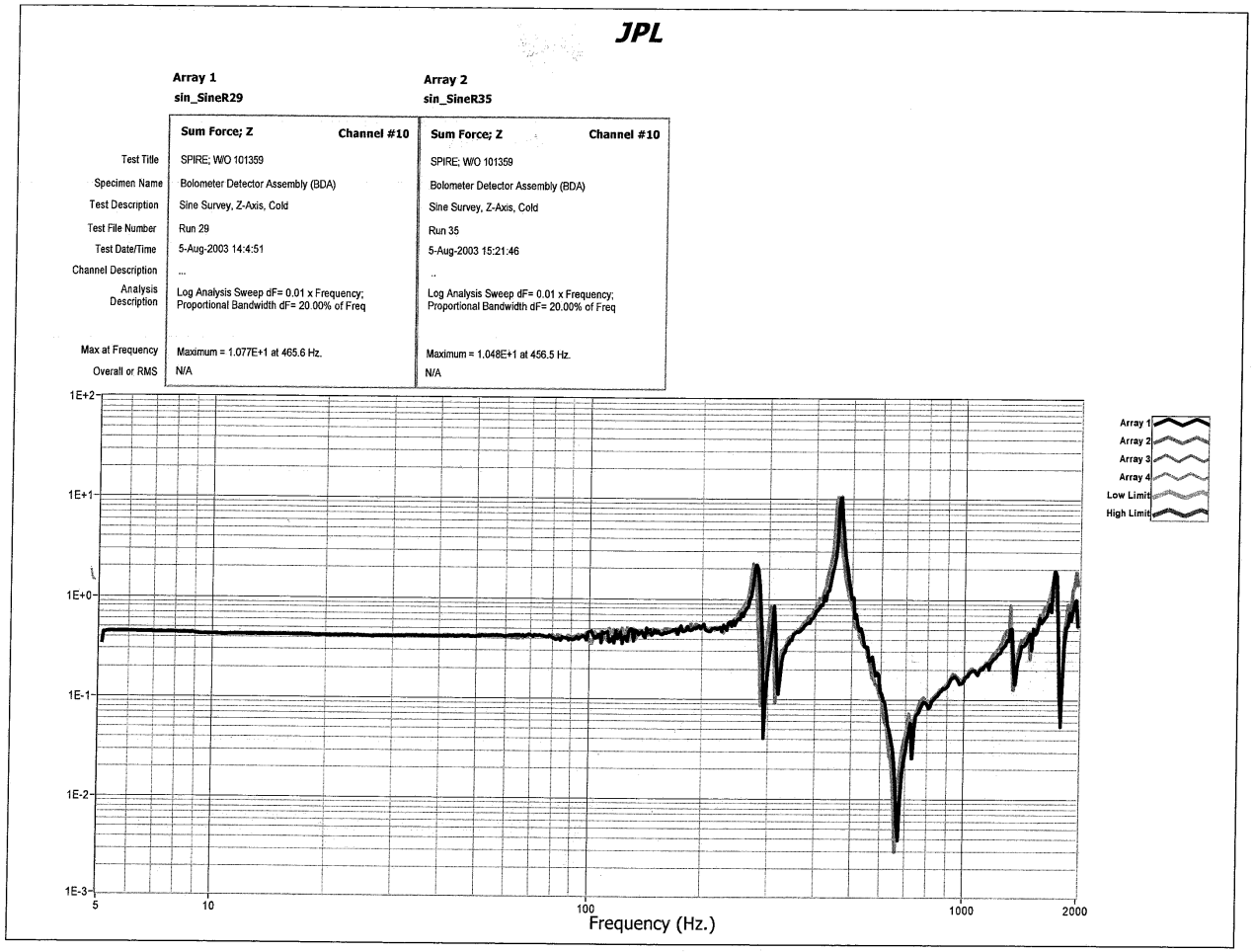
X-axis Shake, Cold, Sine Surveys (Before and After 0 dB Random Vibe)



Y-axis Shake, Cold, Sine Surveys (Before and After 0 dB Random Vibe)



Z-axis Shake, Cold, Sine Surveys (Before and After 0 dB Random Vibe)



Hardware ID FS SSW BDA, 10209800-5 S/N 016

Date	Time	AIDS	Power	Mate	Demate	Transport	Notes
							Assembly Process Connector Mates
28-Aug-2003		240226		J05	J05		kapton cable sub-assembly test
9-Feb-2004		240839		J06	J06		kapton cable sub-assembly test
26-Feb-2004		241700		J05,J06	J05,J06		kapton cable post-installation test
2-Mar-2004		241700		J05,J06	J05,J06		load resistor test
8-Mar-2005		241700		J05,J06	J05,J06		detector test
9-Mar-2005		241700		J05,J06	J05,J06		detector test, after feedhorn installation
							Assembly Complete
10-Mar-2005		245004	x	J05,J06	J05,J06		assembly complete electical test (pre-bakeout)
10-Mar-2005		245004				x	103 -> MDL -> 103, for optical metrology
11-Mar-2005		245004					Temporary Filter installation
11-Mar-2005		245004					epoxy cure bake 1.5hrs, 66C, ambient pressure.
11-Mar-2005		245004				x	103 -> bld 158 for Vacuum Bakeout (80C, 24 hrs, 10E-5 torr)
14-Mar-2005		245004				x	bld 158 -> 103 for final filter install, staking
14-Mar-2005		245004				x	bld 103 -> 170 -> 103 for metrology
15-Mar-2005		245004				x	103 -> 183 delivery to environmental test
15-Mar-2005		245004	x	J05,J06	J05,J06		post-bakeout, pre-shake electrical test
15-Mar-2005		245037					Install into Shake facility
17-Mar-2005		245037				x	183->144
17-Mar-2005		245037					pump out, go cold, complete 2 min 90K shake
17-Mar-2005		245037					warm overnight
18-Mar-2005		245037					complete warm low-level shake
18-Mar-2005		245037				x	144->183 for removal from shake fixture
18-Mar-2005		245037				x	183->170->183 for metrology
18-Mar-2005		245094		J05,J06			Install into Cold Alignment Facility for TS1, J05, J06
18-Mar-2005		245094	x				Take continuity data
18-Mar-2005		245094					pump out
18-Mar-2005		245094					Cooler on
21-Mar-2005		245094	x				Take continuity data

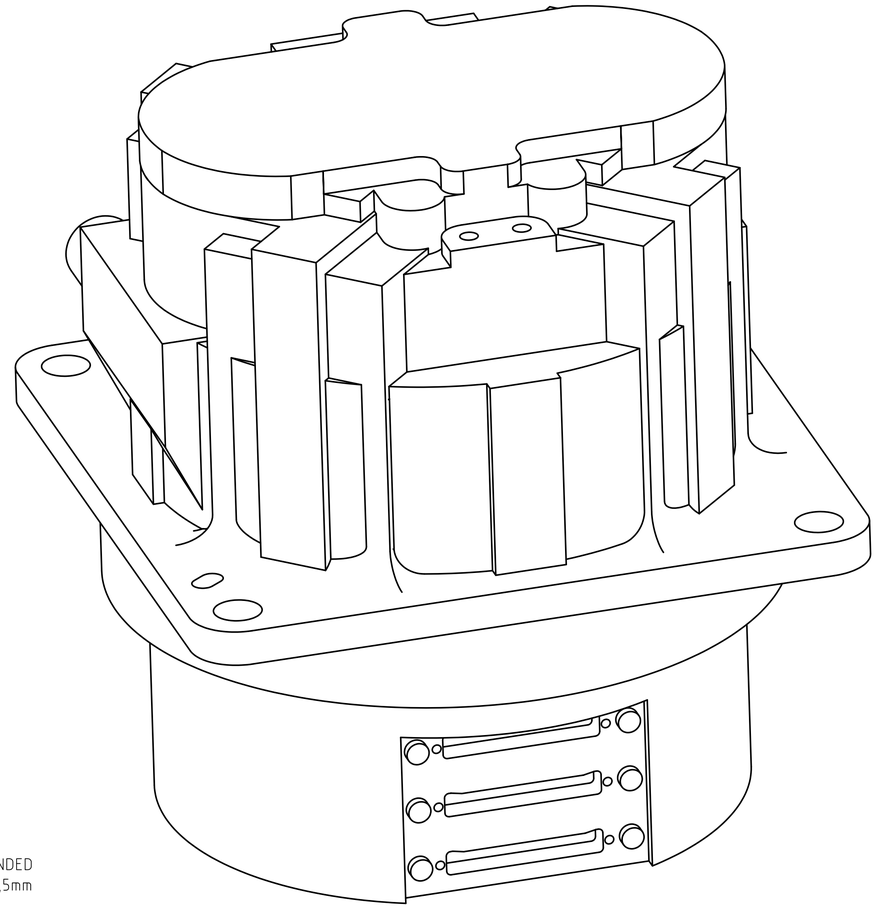
Hardware ID FS SSW BDA, 10209800-5 S/N 016

Date	Time	AIDS	Power	Mate	Demate	Transport	Notes
21-Mar-2005		245094					Cooler off
22-Mar-2005		245094	x				Take continuity data
22-Mar-2005		245094			J05,J06		Remove from Cold Alignment Facility
22-Mar-2005		245094				x	183->170->183 for metrology
22-Mar-2005		245095		J05,J06			Install into Cold Alignment Facility for TS2, J05, J06
23-Mar-2005		245095	x				Take continuity data
22-Mar-2005		245095					pump out
23-Mar-2005		245095					Cooler on
24-Mar-2005		245095	x				Take continuity data
24-Mar-2005		245095					Cooler off
28-Mar-2005		245095	x				Take continuity data
28-Mar-2005		245095			J05,J06		Remove from Cold Alignment Facility
28-Mar-2005		245095				x	183->170->103 for metrology, drybox storage
12-Apr-2005		245259				x	103 -> 183 delivery to performance test
12-Apr-2005		245259		J05,J06			Installation into BODAC
12-Apr-2005		245259					pump out, cooldown
interim		245259	x				performance testing
6-May-2005		245259					finish warmup, vent
6-May-2005		245259					pump out, cooldown
interim		245259	x				performance testing
16-May-2005		245351					finish warmup, vent
16-May-2005		245351			J05,J06		Removal from BODAC
16-May-2005		245351				x	183 -> 103 for drybox storage
16-Jun-2005		245613				x	103 -> 183 delivery to performance test
16-Jun-2005		245613		J05,J06			2nd Installation into BODAC
16-Jun-2005		245613					pump out, cooldown
interim		245613	x				performance testing
30-Jun-2005		245782					finish warmup, vent
30-Jun-2005		245782			J05,J06		Removal from BODAC

Hardware ID FS SSW BDA, 10209800-5 S/N 016

Date	Time	AIDS	Power	Mate	Demate	Transport	Notes
30-Jun-2005		245782				x	183 -> 103 for drybox storage
13-Jul-2005		245747				x	103->170->103 for metrology, return to drybox storage

REVISIONS														
LTR	ZONE	DESCRIPTION	CODE	DWN	CHK	STRUCT	MATL	THRM CONT	PEM		ENGR	DSGN SUPV	DATA MGT	RELEASE DATE
A		INITIAL RELEASE	CODE B	SEE TITLE BLOCK									RTN	12/7/01
B		UPDATED: MASS & CG'S, FILTER SHAPE,VOLUME NEED AROUND CAPSTANS, CONN. POSITIONS. REMOVED MODES AND MASS PARTICIPATION; ROTATED PIXEL MAP 180°.	B	DJC	MAW				MIH		MAW		RGB	09/08/04
C		INCORPORATED ECR HR-SP-JPL-ECR-003; CHANGED FOCUS FOR -2 &-3; CHANGED DP TO DK	B											



GENERAL VIEW
REFERENCE ONLY

9. ALL DIMENSIONS SHOWN FOR THE 300mK STAGE ARE FOR THE NOMINAL SUSPENDED POSITION. THE SUSPENDED UNIT MAY BE SHIFTED FROM NOMINAL POSITION ±0,5mm IN ANY AXIS.

8. ONLY PIXELS, DOWEL PIN HOLES, AND SLOTS VISIBLE. ALL OTHER FEATURES OMITTED FOR CLARITY.

7. FOR PHOTOMETER AND SPECTROMETER SUBSYSTEM INTERFACE DATA AND LAYOUT CONFIGURATION, SEE SHEETS 5-7.

6. DIMENSIONS IN {} ARE CALCULATED FOR OPERATING TEMPERATURE AND ARE PROVIDED FOR REFRENCE ONLY. ALL OTHED DIMENSIONS ARE BASED ON AN ASSEMBLY TEMPERATURE OF 20° C.

5. INDICATES CONNECTOR POSITION. CONNECTORS INSTALLED ARE NANONIC STM 051 M6SN.

4. REFER TO TABLES ON SHEETS 5, 6, AND 7 FOR DIFFERENCES BETWEEN DETECTOR ARRAYS.

3. ASSEMBLY REFERENCE DESIGNATOR, TITLE, PART NUMBER, REVISION LETTER, AND SERIAL NUMBER TO APPEAR AS SHOWN IN THIS AREA.

2. THIS IS THE INTERFACE CONTROL DRAWING FOR THE BOLOMETER DETECTOR ARRAY, JPL PART NUMBER 10209800. JPL DRAWING NUMBER 10209800 SHALL CONTAIN THE FOLLOWING NOTE: THIS ASSEMBLY MEETS THE INTERFACE REQUIREMENTS OF JPL INTERFACE CONTROL DRAWING 10209721.

1. THIS TECHNICAL DATA IS EXPORT CONTROLLED UNDER U.S. LAW AND IS BEING TRANSFERRED BY JPL TO PPARC PURSUANT TO THE NASA / PPARC LETTER OF AGREEMENT WHICH ENTERED INTO FORCE ON DECEMBER 2, 1999. THIS TECHNICAL DATA IS TRANSFERRED TO PPARC FOR USE EXCLUSIVELY ON THE NASA/PPARC SPIRE ON FIRST COOPERATIVE PROJECT, MAY NOT BE USED FOR ANY OTHER PURPOSE, AND SHALL NOT BE RE-TRANSFERRED OR DISCLOSED TO ANY OTHER PARTY WITHOUT THE PRIOR WRITTEN APPROVAL OF NASA.

NOTES: UNLESS OTHERWISE SPECIFIED

INTERFACE DRAWING

QTY REQD	ITEM NO	REF DES	CAGE NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL OR NOTE	ZONE

PARTS LIST

MATERIAL

METRIC

THIRD ANGLE PROJECTION

SPIRE

NEXT ASSEMBLY | USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MILLIMETERS

LINEAR TOLERANCES:

0-6	± 0.1
OVER 6-30	± 0.2
OVER 30-120	± 0.3
OVER 120-315	± 0.5
OVER 315-1000	± 0.8
OVER 1000	± 1.2

ANGULAR TOLERANCES:
± 0.5°

MACHINE FINISH (MICROMETERS) 3.2

DO NOT SCALE DRAWING
INTERPRET DWG PER ASME Y14.100M

CONTRACT NO 1244858

APPD _____ DATE _____

DWN	D CRUMB	11/9/01
CHK	B BURDICK	11/14/01
STRUCT	K BROWNING	11/19/01
MATL	M KNOPP	11/19/01
THRM CONT		
MSSL	A. J. COKER	11/7/01
PEM	G. LILENTHAL	12/13/01
ENGR	L. HUSTED	11/19/01
DSGN SUPV		

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CA 91109

RELEASED THROUGH EDMG

BOLOMETER DETECTOR ARRAY, SPIRE

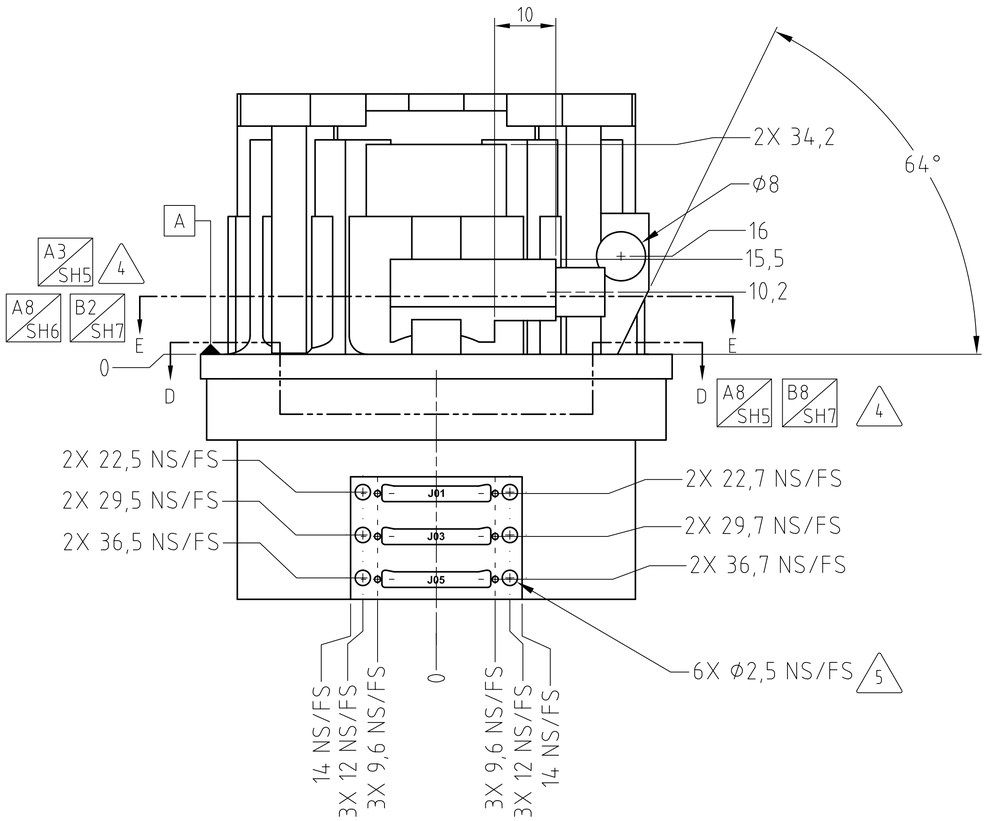
SIZE	CAGE NO		REV
A1	23835	10209721	C

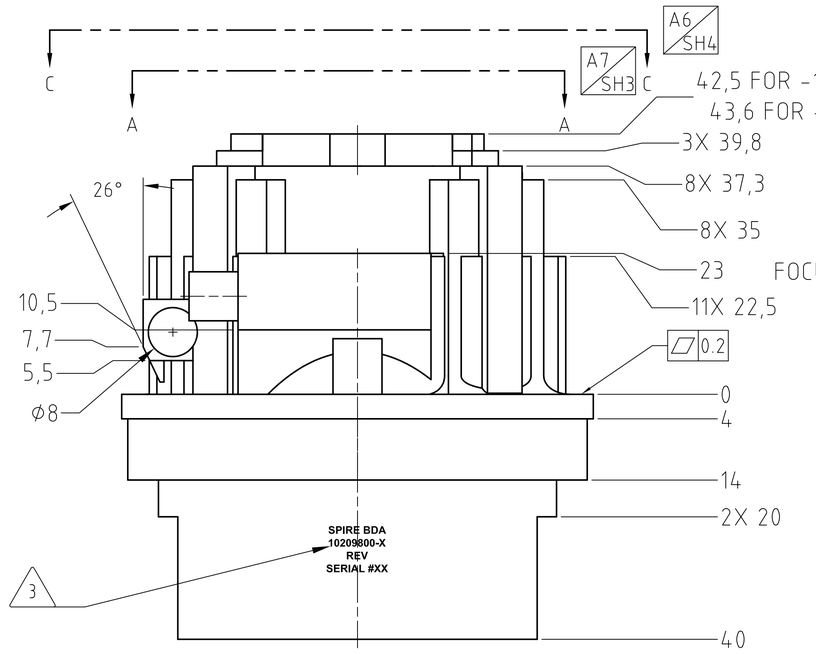
SCALE NONE | UNCLASSIFIED | SHEET 1 OF 7

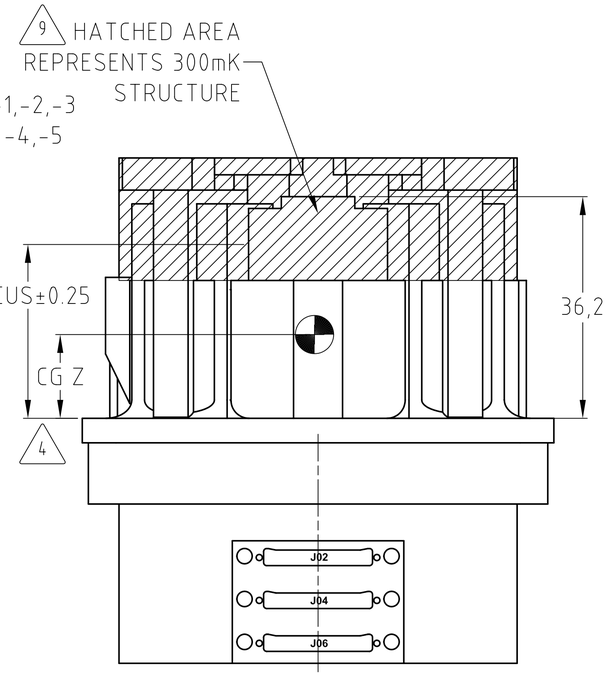
REV 2/00

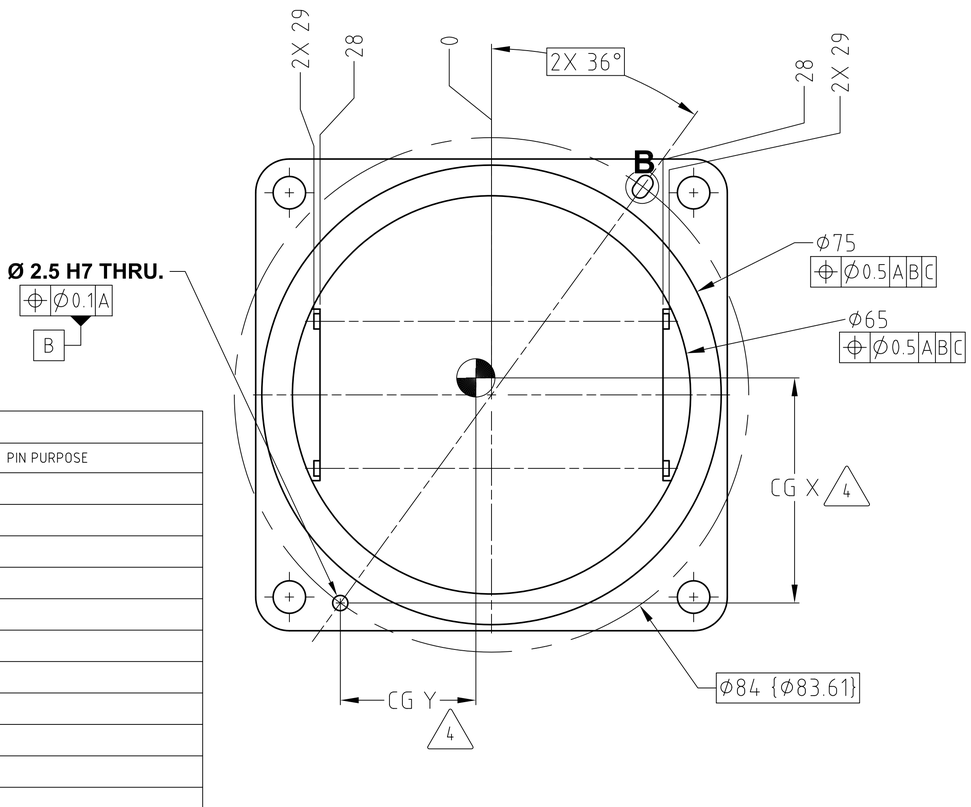
AutoCAD GENERATED

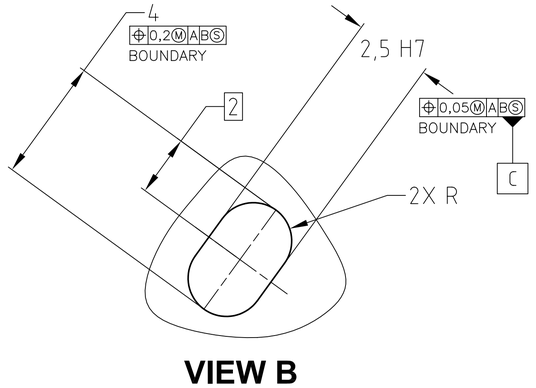
10209721











VIEW B
SCALE: 10:1

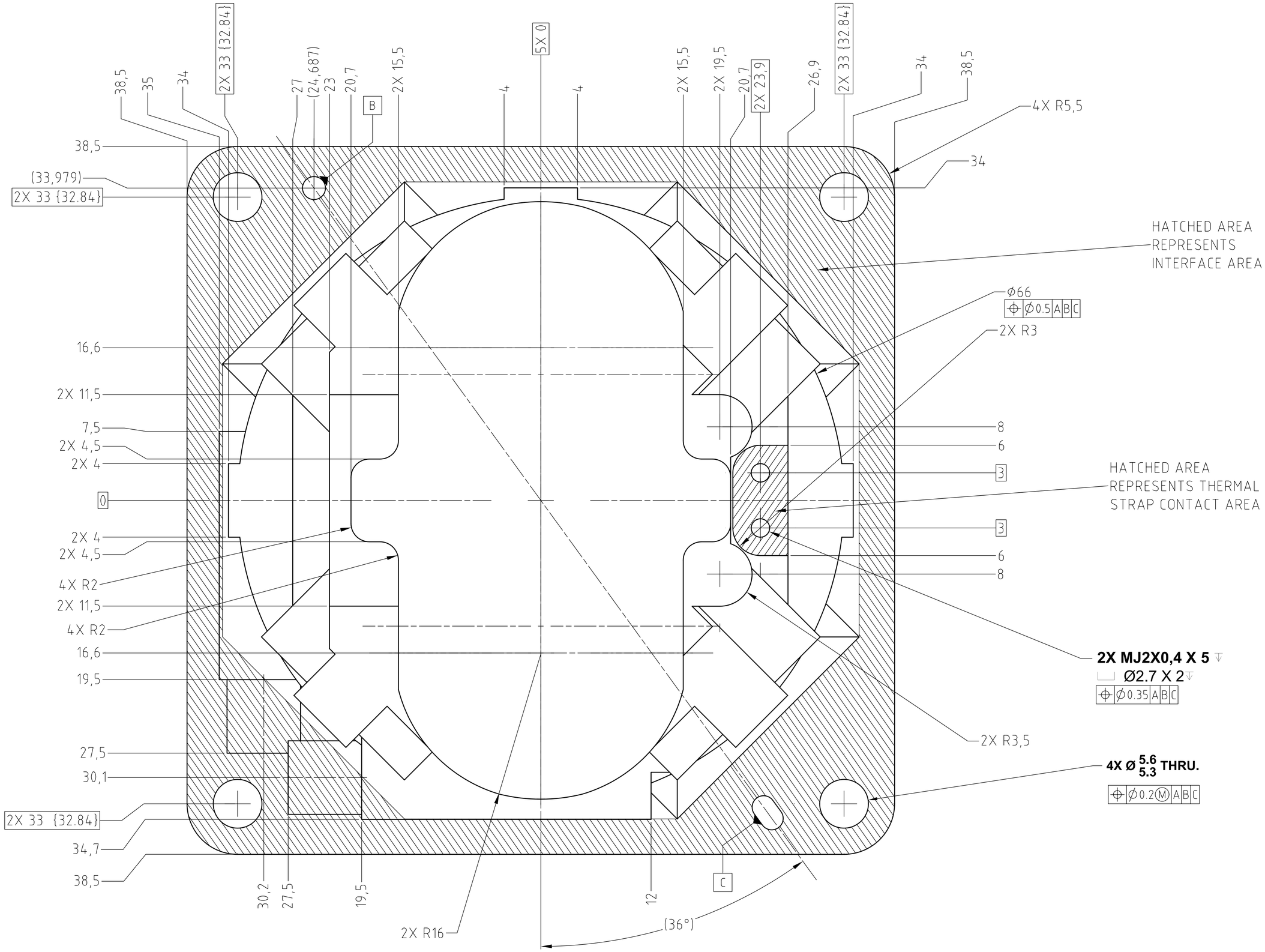
ALL CONNECTORS					
PIN #	PIN PURPOSE	PIN #	PIN PURPOSE	PIN #	PIN PURPOSE
1	SIGNAL A+	18	SIGNAL T+	35	SIGNAL J-
2	SIGNAL B+	19	SIGNAL U+	36	SIGNAL K-
3	SIGNAL C+	20	SIGNAL V+	37	SIGNAL L-
4	SIGNAL D+	21	SIGNAL W+	38	SIGNAL M-
5	SIGNAL E+	22	SIGNAL X+	39	SIGNAL N-
6	SIGNAL F+	23	SIGNAL Y+	40	SIGNAL P-
7	SIGNAL G+	24	SIGNAL Z+	41	SIGNAL R-
8	SIGNAL H+	25	SIGNAL BIAS V+	42	SIGNAL S-
9	SIGNAL I+	26	SIGNAL A-	43	SIGNAL T-
10	SIGNAL J+	27	SIGNAL B-	44	SIGNAL U-
11	SIGNAL K+	28	SIGNAL C-	45	SIGNAL V-
12	SIGNAL L+	29	SIGNAL D-	46	SIGNAL W-
13	SIGNAL M+	30	SIGNAL E-	47	SIGNAL X-
14	SIGNAL N+	31	SIGNAL F-	48	SIGNAL Y-
15	SIGNAL P+	32	SIGNAL G-	49	SIGNAL Z-
16	SIGNAL R+	33	SIGNAL H-	50	SIGNAL BIAS V-
17	SIGNAL S+	34	SIGNAL I-	51	SIGNAL BIAS GND

SIZE	CAGE NO		REV
A1	23835	10209721	C
SCALE 2:1	UNCLASSIFIED	SHEET 2 OF 7	

REV 2/00

10209721

AutoCAD GENERATED



VIEW A-A

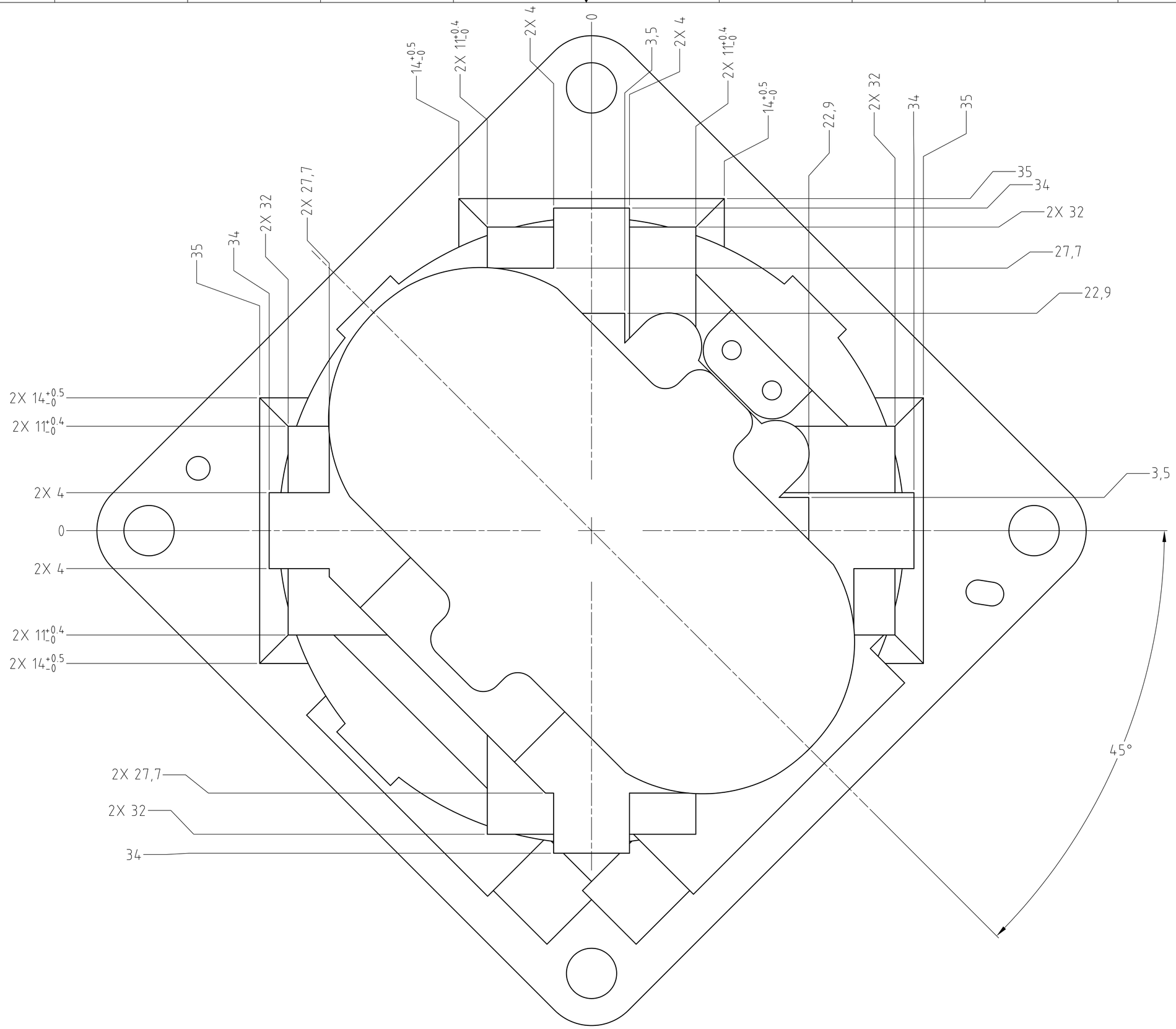
H4/SH2

SIZE	CAGE NO		REV
A1	23835	10209721	C
SCALE 2:1	UNCLASSIFIED	SHEET 3 OF 7	

REV 2/00

AutoCAD GENERATED

10209721



VIEW C-C ROTATED 45° CCW H4/SH2

SIZE	CAGE NO		REV
A1	23835	10209721	C
SCALE 2:1	UNCLASSIFIED	SHEET 4 OF 7	

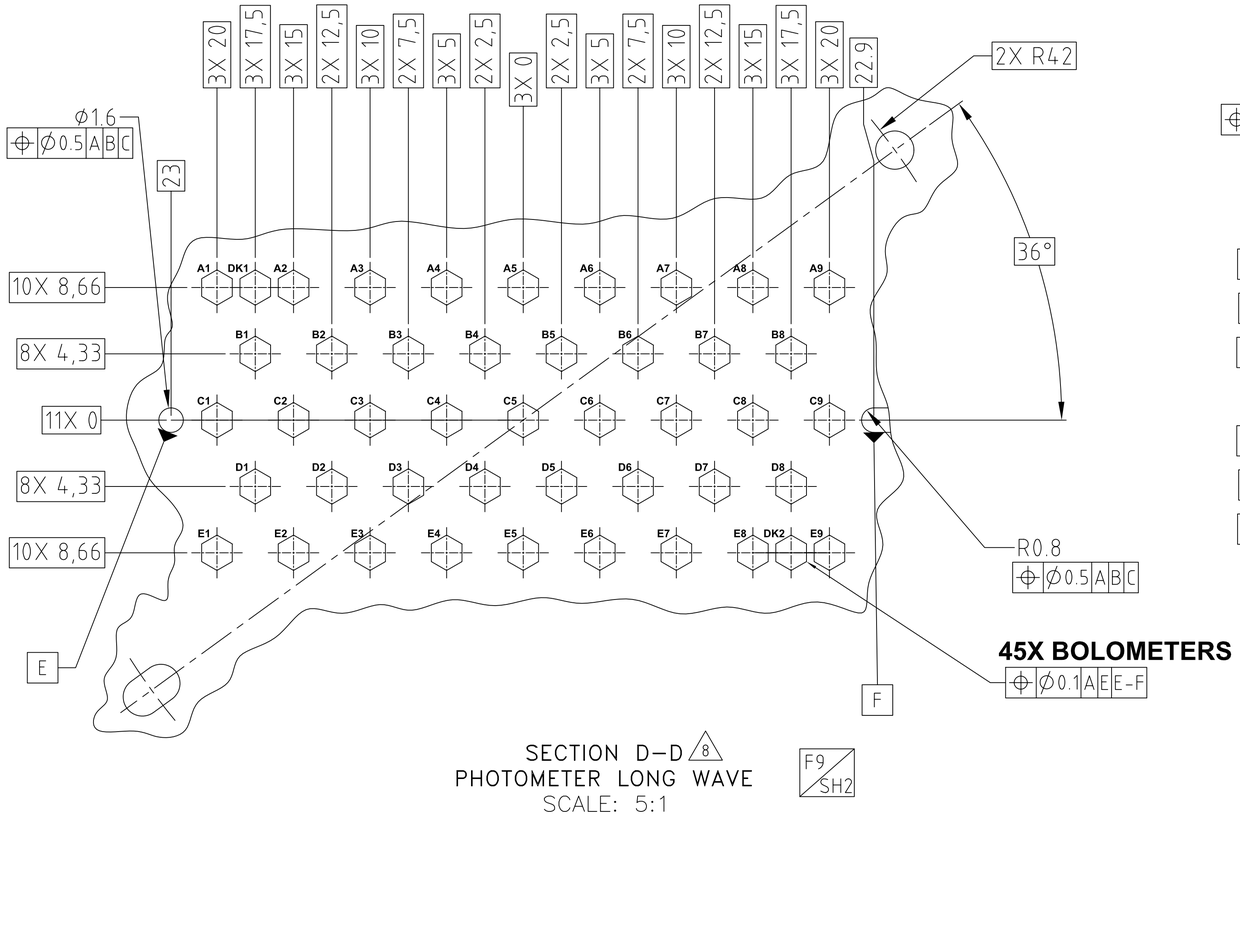
REV 2/00

AutoCAD GENERATED

10209721

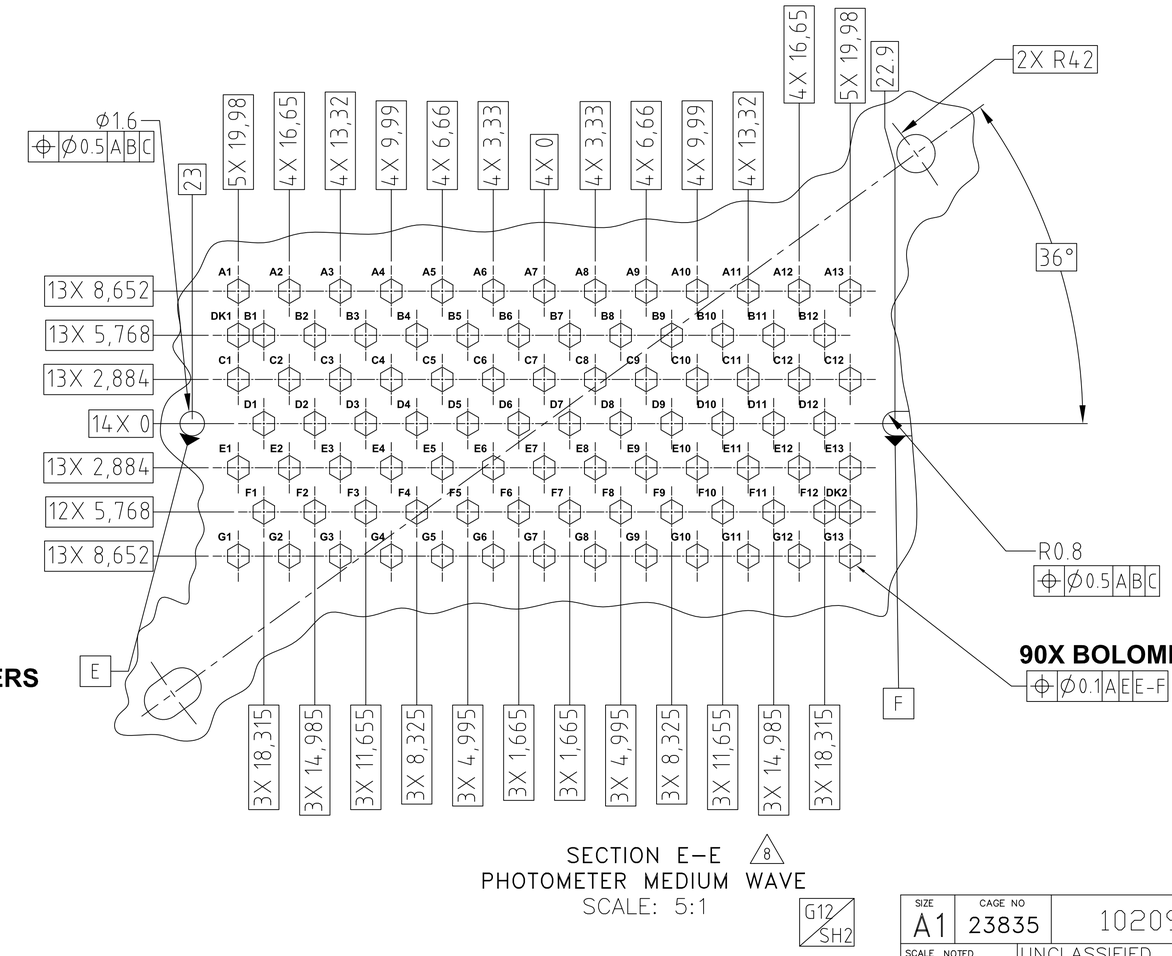
SUBSYSTEM INTERFACE DATA						
UNIT: P/LW						
NUMBER: 10209800-1						
FOCUS: 32.8						
CONNECTOR POSITIONS USED: J05, J06						
MECHANICAL CHARACTERISTICS						
MASS: 632 g						
C.O.G. LOCATION W.R.T. LOCATION HOLE:	X	34.4	Y	24.3	Z	6
MOMENT OF INERTIA:	I_x	772 Kg*mm^2	I_y	1,145 Kg*mm^2	I_z	1,423 Kg*mm^2
MECHANICAL INTERFACE MATERIAL: 7075 AL						
SURFACE FINISH DESCRIPTION: CHEM FILM GOLD						
TOTAL CONTACT AREA: 1783 mm^2						
R.M.S. ROUGHNESS OF CONTACT AREA: 3.2 uM						
THERMAL STRAP INTERFACE MATERIAL: CU 99.999% PURE						
THERMAL STRAP SURFACE FINISH DESCRIPTION: GOLD PLATED						
THERMAL STRAP CONTACT AREA: 57.5 mm^2						
THERMAL STRAP R.M.S. ROUGHNESS OF CONTACT AREA: 3.2 uM						

SUBSYSTEM INTERFACE DATA						
UNIT: P/MW						
NUMBER: 10209800-2						
FOCUS: 32.2						
CONNECTOR POSITIONS USED: J01, J02, J03, J04						
MECHANICAL CHARACTERISTICS						
MASS: 632 g						
C.O.G. LOCATION W.R.T. LOCATION HOLE:	X	34.4	Y	24.3	Z	8.5
MOMENT OF INERTIA:	I_x	764 Kg*mm^2	I_y	1,152 Kg*mm^2	I_z	1,428 Kg*mm^2
MECHANICAL INTERFACE MATERIAL: 7075 AL						
SURFACE FINISH DESCRIPTION: CHEM FILM GOLD						
TOTAL CONTACT AREA: 1783 mm^2						
R.M.S. ROUGHNESS OF CONTACT AREA: 3.2 uM						
THERMAL STRAP INTERFACE MATERIAL: CU 99.999% PURE						
THERMAL STRAP SURFACE FINISH DESCRIPTION: GOLD PLATED						
THERMAL STRAP CONTACT AREA: 57.5 mm^2						
THERMAL STRAP R.M.S. ROUGHNESS OF CONTACT AREA: 3.2 uM						



SECTION D-D (8)
PHOTOMETER LONG WAVE
SCALE: 5:1

F9 / SH2



SECTION E-E (8)
PHOTOMETER MEDIUM WAVE
SCALE: 5:1

G12 / SH2

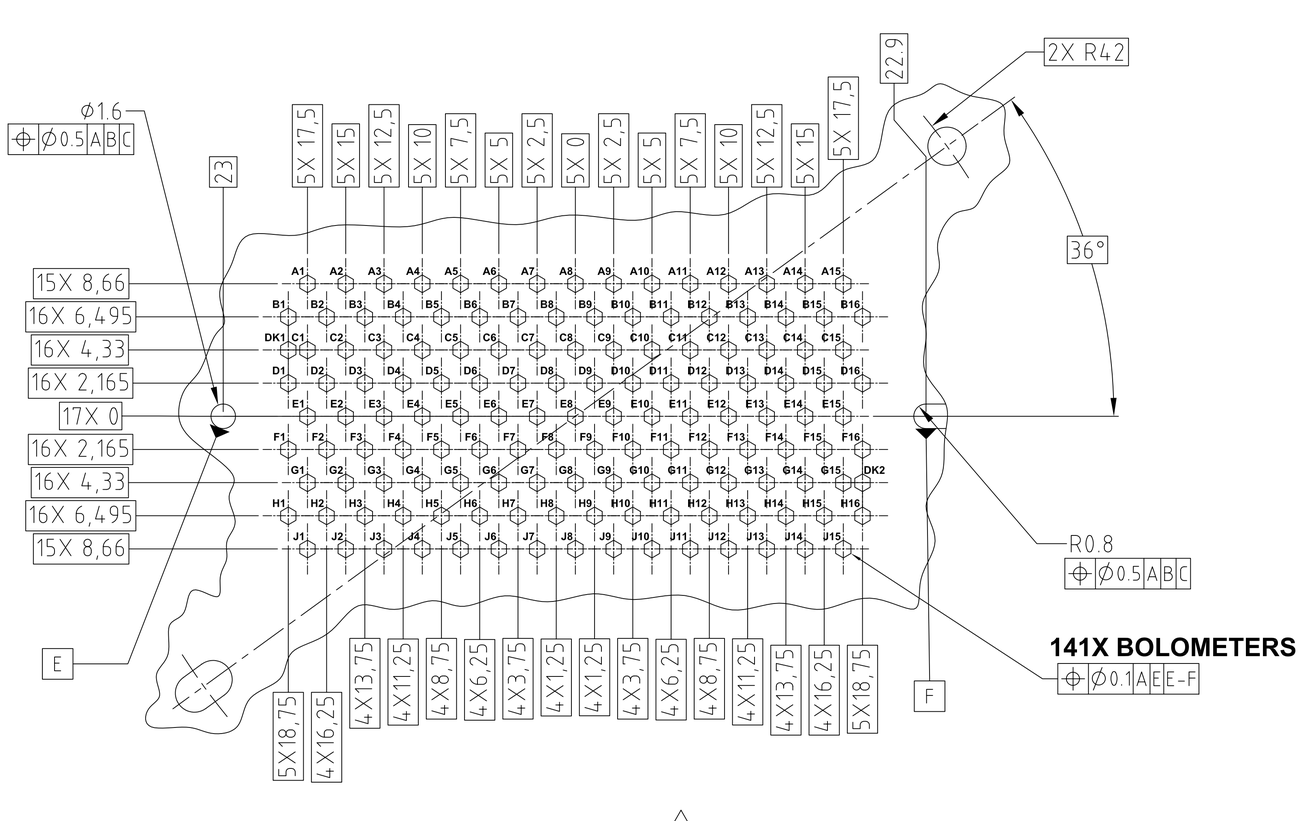
SIZE	CAGE NO		REV
A1	23835	10209721	C
SCALE NOTED	UNCLASSIFIED	SHEET 5 OF 7	

REV 2/00

AutoCAD GENERATED

A1 10209721

SUBSYSTEM INTERFACE DATA						
UNIT: P/SW						
NUMBER: 10209800-3						
FOCUS: 23.8						
CONNECTOR POSITIONS USED: J01, J02, J03, J04, J05, J06						
MECHANICAL CHARACTERISTICS						
MASS: 600 g						
C.O.G. LOCATION W.R.T. LOCATION HOLE:	X	34.5	Y	24.3	Z	6.5
MOMENT OF INERTIA:	I_x	712 Kg*mm^2	I_y	1,074 Kg*mm^2	I_z	1,364 Kg*mm^2
MECHANICAL INTERFACE MATERIAL: 7075 AL						
SURFACE FINISH DESCRIPTION: CHEM FILM GOLD						
TOTAL CONTACT AREA: 1783 mm^2						
R.M.S. ROUGHNESS OF CONTACT AREA: 3.2 uM						
THERMAL STRAP INTERFACE MATERIAL: CU 99.999% PURE						
THERMAL STRAP SURFACE FINISH DESCRIPTION: GOLD PLATED						
THERMAL STRAP CONTACT AREA: 57.5 mm^2						
THERMAL STRAP R.M.S. ROUGHNESS OF CONTACT AREA: 3.2 uM						



SECTION E-E ⚠8
PHOTOMETER SHORT WAVE
SCALE: 5:1

G12/SH2

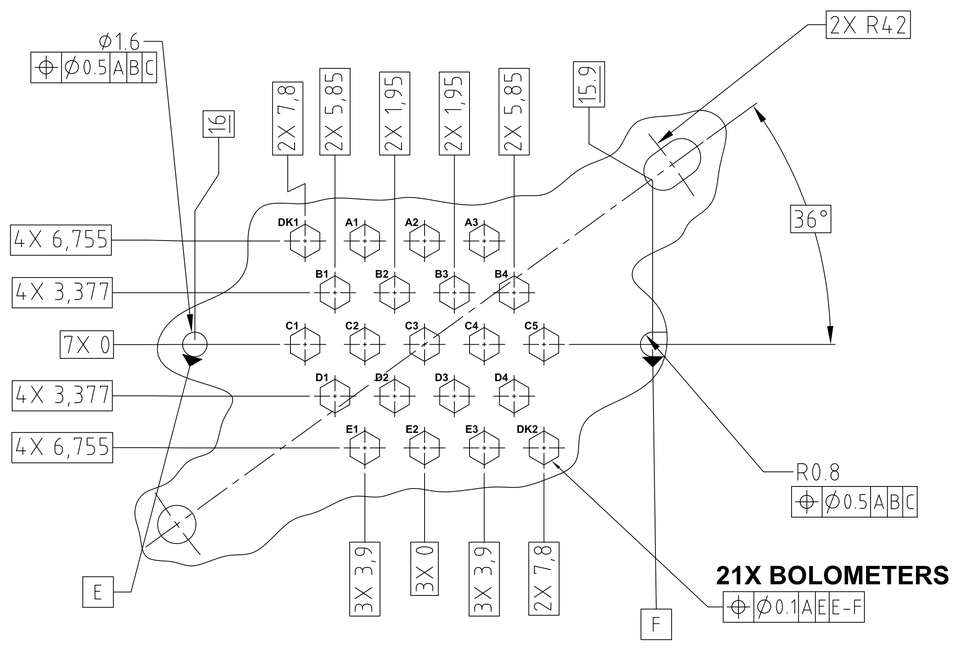
SIZE	CAGE NO		REV
A1	23835	10209721	C
SCALE NOTED	UNCLASSIFIED	SHEETS OF 7	

10209721 A1

AutoCAD GENERATED

REV 2/00

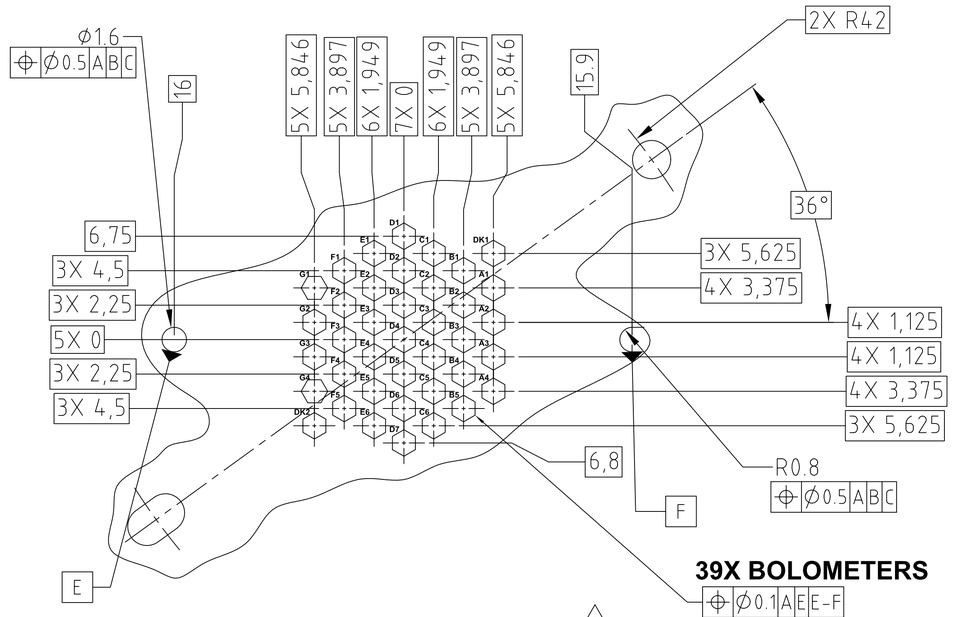
SUBSYSTEM INTERFACE DATA						
UNIT: S/LW						
NUMBER: 10209800-4						
FOCUS: 36.9						
CONNECTOR POSITIONS USED: J05						
MECHANICAL CHARACTERISTICS						
MASS: 550 g						
C.O.G. LOCATION W.R.T. LOCATION HOLE:	X	34.5	Y	24.1	Z	4.4
MOMENT OF INERTIA:	I_x	665 Kg*mm^2	I_y	990 Kg*mm^2	I_z	1,239 Kg*mm^2
MECHANICAL INTERFACE MATERIAL: 7075 AL						
SURFACE FINISH DESCRIPTION: CHEM FILM GOLD						
TOTAL CONTACT AREA: 1783 mm^2						
R.M.S. ROUGHNESS OF CONTACT AREA: 3.2 uM						
THERMAL STRAP INTERFACE MATERIAL: CU 99.999% PURE						
THERMAL STRAP SURFACE FINISH DESCRIPTION: GOLD PLATED						
THERMAL STRAP CONTACT AREA: 57.5 mm^2						
THERMAL STRAP R.M.S. ROUGHNESS OF CONTACT AREA: 3.2 uM						



SECTION D-D △8
SPECTROMETER LONG WAVE
SCALE: 5:1

F9 / SH2

SUBSYSTEM INTERFACE DATA						
UNIT: S.SW						
NUMBER: 10209800-5						
FOCUS: 26.7						
CONNECTOR POSITIONS USED: J05, J06						
MECHANICAL CHARACTERISTICS						
MASS: 510 g						
C.O.G. LOCATION W.R.T. LOCATION HOLE:	X	34.6	Y	24.2	Z	6
MOMENT OF INERTIA:	I_x	628 Kg*mm^2	I_y	936 Kg*mm^2	I_z	1,189 Kg*mm^2
MECHANICAL INTERFACE MATERIAL: 7075 AL						
SURFACE FINISH DESCRIPTION: CHEM FILM GOLD						
TOTAL CONTACT AREA: 1783 mm^2						
R.M.S. ROUGHNESS OF CONTACT AREA: 3.2 uM						
THERMAL STRAP INTERFACE MATERIAL: CU 99.999% PURE						
THERMAL STRAP SURFACE FINISH DESCRIPTION: GOLD PLATED						
THERMAL STRAP CONTACT AREA: 57.5 mm^2						
THERMAL STRAP R.M.S. ROUGHNESS OF CONTACT AREA: 3.2 uM						



SECTION E-E △8
SPECTROMETER SHORT WAVE
SCALE: 5:1

G12 / SH2

SIZE	CAGE NO		REV
A1	23835	10209721	C
SCALE 5:1	UNCLASSIFIED	SHEET 7 OF 7	

AutoCAD GENERATED

REV 2/00

LTR	ZONE	DESCRIPTION		DATE	APPROVED
A		INITIAL RELEASE	C	SEE TITLE BLOCK RGB	3/18/03
B		INCORPORATED ECR 102651	D	DJC MAW RGB	07/12/04
C		INCORPORATED RAL ECR HR-SP-JPL-ECR-005	B		

ARRAY DEFINITION	10209800−1 P/LW		10209800−2 P/MW				10209800−3 P/SW						10209800−4 S/LW	10209800−5 S/SW	
BDA CONNECTOR	J05	J06	J01	J02	J03	J04	J01	J02	J03	J04	J05	J06	J05	J05	J06
PIXEL MAP A	R1	E1	A7	E7	A13	R1	D6	F12	R1	E1	D11	G5	R1	R1	–
B	A8	E2	A6	D7	T1	G1	B6	J11	D16	F1	A10	H6	T1	A4	–
C	A7	E3	B6	F7	B12	T2	C5	E12	T1	T2	E10	J6	C1	A3	–
D	A6	E4	C7	E8	C13	E1	A5	H12	B16	H1	C10	F6	DK1	A2	–
E	A9	D1	A5	G8	A12	D1	E5	G12	C15	G1	B10	G6	B1	A1	–
F	C9	D2	B5	F8	D12	F1	B5	F13	A15	J1	D10	H7	D1	DK1	–
G	B8	D3	C6	E9	C12	E2	D5	E13	D15	H2	A9	F7	E1	B3	G3
H	B7	D4	D6	G9	B11	G2	C4	J12	B15	F2	E9	J7	A1	B2	G4
I	C7	C1	B4	D9	A11	F2	A4	H13	C14	J2	C9	G7	C2	B1	DK2
J	B5	C3	C5	F9	E13	G3	D4	G13	D14	G2	B9	H8	D2	C3	F5
K	B6	C5	D4	E10	D11	E3	B4	F14	A14	H3	D9	F8	B2	C2	F4
L	A5	T2	A4	G10	C11	D3	C3	E14	A13	J3	A8	G8	E2	C1	E6
M	T1	E5	C4	F10	B10	F3	B3	J13	B14	E2	C8	J8	A2	D3	E5
N	B4	C6	B3	E11	A10	G4	A3	H14	C13	F3	E8	F9	C3	D2	E4
P	C4	C8	C3	G11	D10	E4	A2	G14	B13	G3	D8	H9	D3	D1	D7
R	B3	D5	B2	F11	B9	F4	D3	J14	D13	H4	B8	G9	B3	E3	D6
S	C2	D6	D2	E12	C10	E5	C2	F15	A12	J4	C7	J9	E3	E2	D5
T	B2	D7	A3	G12	C9	D5	B2	H15	C12	E3	E7	F10	C4	E1	D4
U	B1	D8	A2	F12	A9	F5	D2	J15	D12	F4	A7	H10	DK2	F3	C6
V	A3	E7	C2	G13	B8	G5	A1	G15	B12	G4	D7	G10	D4	F2	C5
W	A4	E6	B1	DK2	A8	E6	C1	H16	E11	H5	B7	F11	C5	F1	C4
X	A1	E8	A1	T/C	D8	G6	B1	DK2	A11	E4	C6	J10	B4	G1	B5
Y	DK1	DK2	DK1	T/C	C8	F6	DK1	F16	C11	J5	E6	H11	A3	T1	B4
Z	A2	E9	C1	T/C	B7	G7	D1	E15	B11	F5	A6	G11	T2	G2	T2
JFET INTERFACE AA	HSJFP07 J14	HSJFP08 J16	HSJFP11 J22	HSJFP12 J24	HSJFP09 J18	HSJFP10 J20	HSJFP03 J06	HSJFP04 J08	HSJFP01 J02	HSJFP02 J04	HSJFP05 J10	HSJFP06 J12	HSJFS03 J06	HSJFS01 J02	HSJFS02 J04
BB	HSJFP07 J13	HSJFP08 J15	HSJFP11 J21	HSJFP12 J23	HSJFP09 J17	HSJFP10 J19	HSJFP03 J05	HSJFP04 J07	HSJFP01 J01	HSJFP02 J03	HSJFP05 J09	HSJFP06 J11	HSJFS03 J05	HSJFS01 J01	HSJFS02 J03
CC	HSJFP07 J35	HSJFP08 J36	HSJFP11 J39	HSJFP12 J40	HSJFP09 J37	HSJFP10 J38	HSJFP03 J31	HSJFP04 J32	HSJFP01 J29	HSJFP02 J30	HSJFP05 J33	HSJFP06 J34	HSJFS03 J13	HSJFS01 J11	HSJFS02 J12
DD	HSJFP07 J47	HSJFP08 J48	HSJFP11 J51	HSJFP12 J52	HSJFP09 J49	HSJFP10 J50	HSJFP03 J43	HSJFP04 J44	HSJFP01 J41	HSJFP02 J42	HSJFP05 J45	HSJFP06 J46	HSJFS03 J17	HSJFS01 J15	HSJFS02 J16
FPU HARNESS	7	8	11	12	9	10	3	4	1	2	5	6	15	13	14
CRYO HARNESS	6	6	4	4	5	5	8	8	9	9	7	7	1	2	2

7. INFORMATION IN THIS DOCUMENT IS ALSO CONTAINED IN THE HARNESS DEFINITION DOCUMENT, RAL DOCUMENT SPIRE–RAL–PRJ–000608. IN AREAS WHERE THERE ARE CONFLICTS, THE HARNESS DEFINITION DOCUMENT TAKES PRECEDENCE.

6. ESD PROTECTION RESISTORS ARE 7 TIMES THE SOURCE RESISTOR.

5. GROUND WIRE TO BE TERMINATED AT INSTRUMENT INTEGRATION. WIRE WILL HAVE A MINIMUM LENGTH OF 150MM.

4. UNLESS OTHERWISE NOTED, ⏚ IS JFET CHASSIS GROUND.

3. JFET MEMBRANE HEATER IS 0.0204 TIMES THE SOURCE RESISTOR.

2. ALL RESISTORS HAVE A TOLERANCE OF ±40%.

1. THIS TECHNICAL DATA IS EXPORT CONTROLLED UNDER U.S. LAW AND IS BEING TRANSFERRED BY JPL TO PPARC PURSUANT TO THE NASA / PPARC LETTER OF AGREEMENT WHICH ENTERED INTO FORCE ON DECEMBER 2, 1999. THIS TECHNICAL DATA IS TRANSFERRED TO PPARC FOR USE EXCLUSIVELY ON THE NASA/PPARC SPIRE ON FIRST COOPERATIVE PROJECT, MAY NOT BE USED FOR ANY OTHER PURPOSE, AND SHALL NOT BE RE–TRANSFERRED OR DISCLOSED TO ANY OTHER PARTY WITHOUT THE PRIOR WRITTEN APPROVAL OF NASA.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	ITEM NO	REF DES	CAGE NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL OR NOTE	ZONE

PARTS LIST

MATERIAL

METRIC

THIRD ANGLE PROJECTION

NEXT ASSEMBLY: SPIRE — USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS

LINEAR TOLERANCES:

0–6	± 0.1
OVER 6–30	± 0.2
OVER 30–120	± 0.3
OVER 120–315	± 0.5
OVER 315–1000	± 0.8
OVER 1000	± 1.2

ANGULAR TOLERANCES: ± 0.5°

MACHINE FINISH (MICROMETERS) 3.2

DO NOT SCALE DRAWING

INTERPRET DWG PER ANSI Y14.100M

CONTRACT NO 1244858

APPD ______ DATE ______

DWN	D CRUMB	2/26/03
CHK	J BOCK	3/17/03
STRUCT		
MATL	D GRIFFIN	2/11/03
THRM CONT	B SWINYARD	2/11/03
RAL	J DELDERFIELD	2/10/03
PEM	G LILIENTHAL	3/17/03
ENGR	L HUSTED	2/26/03
DSGN SUPV		

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CA 91109
RELEASED THROUGH EDMG

WIRING SCHEMATIC, SPIRE

SIZE A1X3 — CAGE NO 23835 — 10209725 — REV C

SCALE NONE — UNCLASSIFIED — SHEET 1 OF 1

AutoCAD GENERATED

REV 2/00

FRAME 1 of 2 — CAGE NO 23835 — DRAWING NUMBER 10209725 — REV C — SH NO 1

SPIRE MIUL Cover Page

MIUL = Material Identification & Utilization List
Declared Materials List's and Processes List are not included in this HRCR

Materials and Processes List

SPIRE

JPL D-25725

REV B
1/05/04

Reviewed by: _____
M. Knopp M&P Engineer

SPIRE Assembly Array/Backshort Assembly Traveller
Revised by A Turner 3-2-2005

AIDS: 244985

Device #	SSW 4.1	SSW BS 4.1
Date	4-Mar-05	
Collected by	A Turner	

Device Thickness Measurements

Zero at	Measure at	Meas (mm)
1	1	0.0000
1	2	-0.9970
1	3	-1.0030
1	4	-1.0030
1	5	0.0010
1	6	-0.9955
1	7	-1.0010
1	8	-1.0030
1	9	-1.0035
1	10	-1.0030
1	11	-0.9955
1	12	-1.0010
1	13	-1.0030
1	14	-1.0030
1	15	-1.0030
1	16	0.0010
1	17	-0.9980
1	18	-1.0020
1	19	-1.0025
1	20	0.0005

Targets	mm	tol (mm)
Stack thick	1.0060	0.0215
NTD chip	0.0250	0.0100
BS dist	0.069	0.007

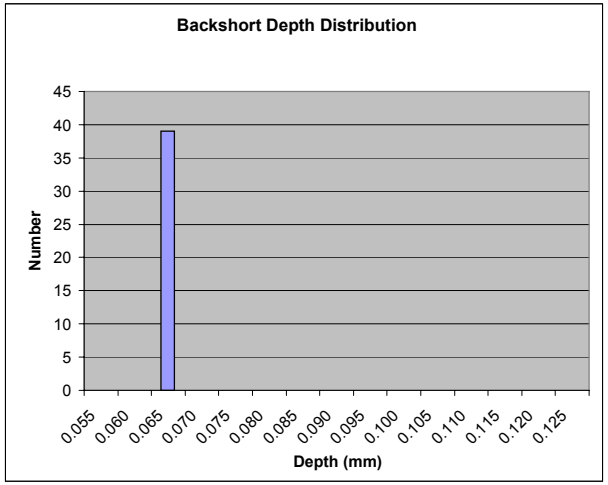
Stack Thickness (mm)	
Average	1.0011
max	1.0035
min	0.9955
p-p	0.0080
Backshort Thickness(mm)	
Average	0.9359
max	0.9370
min	0.9345
p-p	0.0025
Backshort Distance (mm)	
Average	0.0680
max	0.0655
min	0.0695
p-p	0.0040
NTD Chip Thickness(mm)	
Average	0.0305
max	0.0265
min	0.0345
p-p	0.0080

Height measurements of Backshort to Detector to NTD chip

a= BS height
b= to web
c= NTD height

Pillar Height Measurements

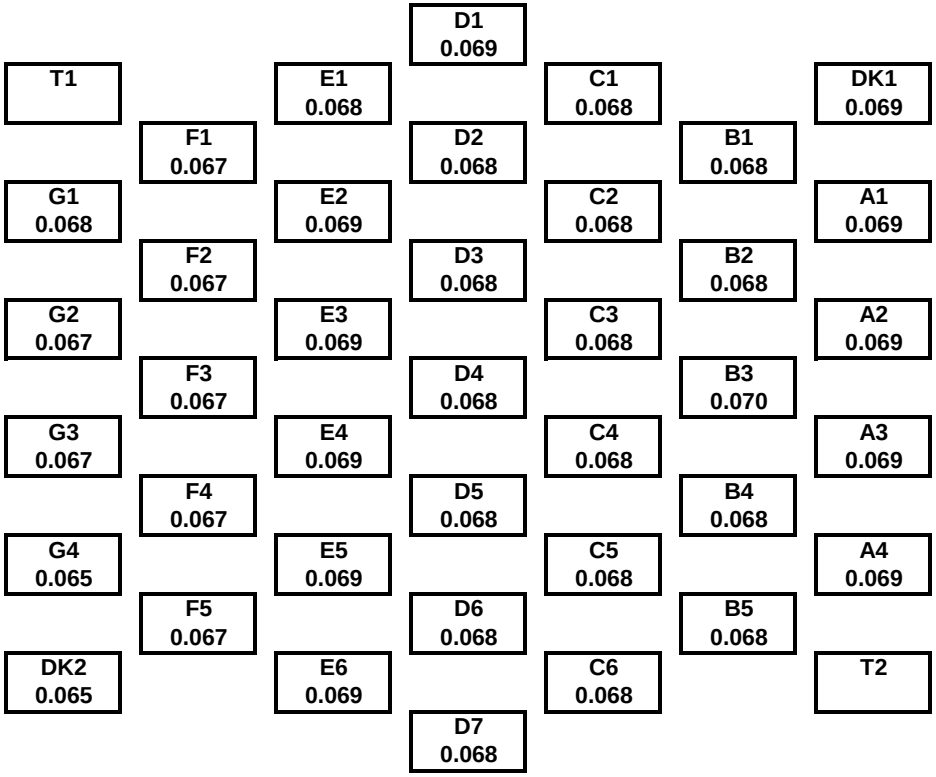
Zero at	Row	Pixel	a (mm)	b(mm)	c(mm)	NTD chip (mm)	BS dist (mm)
1	T	1		-1.0020	-1.0295	0.0275	
1	G	1	-0.9345	-1.0020	-1.0305	0.0285	0.0675
1	G	2	-0.9345	-1.0015	-1.0310	0.0295	0.0670
1	G	3	-0.9345	-1.0015	-1.0335	0.0320	0.0670
1	G	4	-0.9350	-1.0005	-1.0310	0.0305	0.0655
1	DK	2	-0.9355	-1.0010	-1.0335	0.0325	0.0655
1	F	1	-0.9355	-1.0025	-1.0325	0.0300	0.0670
1	F	2	-0.9355	-1.0030	-1.0360	0.0330	0.0675
1	F	3	-0.9355	-1.0025	-1.0330	0.0305	0.0670
1	F	4	-0.9355	-1.0025	-1.0290	0.0265	0.0670
1	F	5	-0.9355	-1.0020	-1.0300	0.0280	0.0665
1	E	1	-0.9355	-1.0035	-1.0345	0.0310	0.0680
1	E	2	-0.9355	-1.0040	-1.0345	0.0305	0.0685
1	E	3	-0.9350	-1.0035	-1.0340	0.0305	0.0685
1	E	4	-0.9350	-1.0035	-1.0340	0.0305	0.0685
1	E	5	-0.9350	-1.0035	-1.0310	0.0275	0.0685
1	E	6	-0.9350	-1.0035	-1.0345	0.0310	0.0685
1	D	1	-0.9360	-1.0050	-1.0335	0.0285	0.0690
1	D	2	-0.9360	-1.0045	-1.0390	0.0345	0.0685
1	D	3	-0.9360	-1.0045	-1.0360	0.0315	0.0685
1	D	4	-0.9360	-1.0045	-1.0355	0.0310	0.0685
1	D	5	-0.9360	-1.0040	-1.0370	0.0330	0.0680
1	D	6	-0.9360	-1.0040	-1.0335	0.0295	0.0680
1	D	7	-0.9360	-1.0035	-1.0335	0.0300	0.0675
1	C	1	-0.9365	-1.0050	-1.0380	0.0330	0.0685
1	C	2	-0.9365	-1.0050	-1.0355	0.0305	0.0685
1	C	3	-0.9365	-1.0050	-1.0340	0.0290	0.0685
1	C	4	-0.9365	-1.0050	-1.0335	0.0285	0.0685
1	C	5	-0.9365	-1.0045	-1.0360	0.0315	0.0680
1	C	6	-0.9365	-1.0045	-1.0340	0.0295	0.0680
1	B	1	-0.9365	-1.0050	-1.0385	0.0335	0.0685
1	B	2	-0.9365	-1.0050	-1.0330	0.0280	0.0685
1	B	3	-0.9365	-1.0060	-1.0325	0.0265	0.0695
1	B	4	-0.9365	-1.0045	-1.0385	0.0340	0.0680
1	B	5	-0.9365	-1.0045	-1.0340	0.0295	0.0680
1	DK	1	-0.9370	-1.0055	-1.0380	0.0325	0.0685
1	A	1	-0.9370	-1.0060	-1.0395	0.0335	0.0690
1	A	2	-0.9370	-1.0060	-1.0390	0.0330	0.0690
1	A	3	-0.9370	-1.0055	-1.0390	0.0335	0.0685
1	A	4	-0.9370	-1.0055	-1.0350	0.0295	0.0685
1	T	2		-1.0045	-1.0320	0.0275	



SPIRE Assembly Array/Backshort Assembly Traveller
Revised by A Turner 3-2-2005

SSW Backshort Distance Map (in mm)

Device	SSW 4.1
BS	SSW BS 4.1
DATE	4-Mar-05
By	A Turner
AIDS	244985



Stack Thickness (mm)	
Average	1.0011
max	1.0035
min	0.9955
p-p	0.0080
Backshort Thickness(mm)	
Average	0.9359
max	0.9370
min	0.9345
p-p	0.0025
Backshort Distance (mm)	
Average	0.0680
max	0.0655
min	0.0695
p-p	0.0040
NTD Chip Thickness(mm)	
Average	0.0305
max	0.0265
min	0.0345
p-p	0.0080

BS dist criteria (mm)	
low	0.062
high	0.076

Detector Front Short Gap

FH- SSW SN02 after rework was completed 3/8/05

	xaxis						
yaxis	0.000	-6.250	-12.500	-18.750	-25.000	-31.250	-37.500
0.000	0.000	-0.002	-0.001	-0.002	-0.002	-0.002	-0.001
-4.467	0.001	0.002	0.008	-1.898	0.007	0.005	0.005
-8.933	0.007	0.007	-1.894	-1.899	-1.900	0.005	0.005
-13.400	0.008	0.008	-1.898	-1.900	-1.901	0.007	0.007
-17.867	0.006	0.008	-1.898	-1.901	-1.900	0.007	0.006
-22.333	0.001	0.004	0.008	-1.901	0.008	0.002	0.002
-26.800	-0.002	-0.002	0.001	0.001	0.003	-0.003	-0.001

Numbers in red indicate x coordinate landed measurement on a hole and the true measurement was taken at this number location instead

Slope Corrected

	xaxis						
yaxis	0.000	-6.250	-12.500	-18.750	-25.000	-31.250	-37.500
0.000	0.000	-0.002	-0.001	-0.001	-0.001	-0.001	0.000
-4.467	0.001	0.002	0.008	-1.897	0.008	0.006	0.006
-8.933	0.007	0.007	-1.893	-1.898	-1.898	0.006	0.007
-13.400	0.009	0.009	-1.896	-1.899	-1.899	0.008	0.008
-17.867	0.007	0.009	-1.896	-1.900	-1.898	0.009	0.008
-22.333	0.002	0.005	0.010	-1.899	0.010	0.004	0.004
-26.800	0.000	0.000	0.003	0.003	0.005	0.000	0.002

ave =	-1.898
max =	-1.893
min =	-1.900
p-p =	0.007

CP-26 SN02 + SSW 4.1 and SSW BS 4.1

	xaxis						
yaxis	0.000	-6.250	-12.500	-18.750	-25.000	-31.250	-37.500
0.000	0.000	2.572	2.562	2.557	2.557	2.559	0.000
4.467	n/a	2.002	2.000	1.998	2.000	2.000	n/a
8.933	n/a	n/a	1.998	1.996	1.999	n/a	n/a
13.400	n/a	n/a	1.997	1.996	1.998	n/a	n/a
17.867	n/a	n/a	1.996	1.994	1.996	n/a	n/a
22.333	n/a	2.001	1.996	1.994	1.994	1.995	n/a
26.800	-0.002	2.544	2.546	2.548	2.551	2.552	-0.002

z2-j06

Slope Corrected

	xaxis						
yaxis	0.000	-6.250	-12.500	-18.750	-25.000	-31.250	-37.500
0.000	0.000	2.572	2.562	2.557	2.557	2.559	0.000
4.467		2.002	2.000	1.998	2.000	2.000	
8.933			1.999	1.996	1.999		
13.400			1.998	1.997	1.999		
17.867			1.997	1.995	1.997		
22.333		2.002	1.998	1.996	1.996	1.996	
26.800	0.000	2.546	2.548	2.550	2.553	2.554	0.000

avg	1.998
max	2.002
min	1.995
p-p	0.007

DATE **3/9/2005**

Frontshort Estimated

GAP

yaxis	0.000	-6.250	-12.500	-18.750	-25.000	-31.250	-37.500
0.000	0.000						0.000
-4.467	0.001			0.101			0.006
-8.933			0.106	0.098	0.101		
-13.400			0.101	0.098	0.099		
-17.867			0.101	0.096	0.099		
-22.333	0.002			0.097			0.004
-26.800	0.000						0.002

ave =	0.100
max =	0.106
min =	0.096
p-p=	0.010

Coverplate SN	**10209826-1 SN02**
Feedhorn SN	**SSW SN02**
Detector SN	**SSW 4.1**
Backshort SN	**SSW BS 4.1**
FS	**0.096**
FS Tol	**0.033**
BS	**0.069**
BS Tol	**0.007**

Legend
AG = Measured Assembly gap
FS= Desired Front short gap
D/B = Desired Detector/Backshort Array Stack Height
BS= Desired Backshort gap
D= Detector Wafer thickness
B= Desired Backshort Wafer thickness
BE = Desired Backshort Etch Depth

CMI *Advancing Ultra-Precision Manufacturing*

Custom Microwave Inc.
940 Boston Avenue
Longmont, CO 80501

CERTIFICATE OF COMPLIANCE

JPL	1248788
CUSTOMER	PURCHASE ORDER NUMBER
3981	10209853 REV X5
INVOICE NUMBER	PART NUMBER(S)
P8645-02	1 EA.
LOT NUMBER(S)/SERIAL	QUANTITY

Custom Microwave, Inc. certifies that all materials and processes used in the manufacturing of supplied parts conforms in all respects to the above mentioned purchase order, specification and/or drawing requirements and that documents are on file to substantiate this and are available for examination. Custom Microwave, Inc. further certifies that no parts supplied against this purchase order contain mercury or have come in contact with mercury or mercury compounds nor do they contain beryllium or beryllium compounds except beryllium copper.

Authorized Signature Quality Assurance Manager	1/27/04 Date

CMI CAGE CODE: 5Y549

MATERIALS:

COPPER C101 HOUSING: RM#997
BRASS WIRE RM# 1200
SN96 SOLDER: RM#1294

PROCESSES:

COPPER ELECTROFORM CMI COPPER # 3
GOLD PLATE PER MIL-G-45204, TYPE 3, CLASS 1, GRADE A

NCR# 13049

CMI *Advancing Ultra-Precision Manufacturing*

Custom Microwave Inc.
940 Boston Avenue
Longmont, CO 80501

NON CONFORMANCE REPORT

1. NCR #:	2. Pg. 1 of
13049	1

3. PART #:	REV.	4. PART DESCRIPTION:	5. PROJ. # :	6. CUSTOMER:
10209853	X5	FEEDHORN S/SW	P8645	JPL

7. SERIAL # OR BATCH #	8. VENDOR NAME	9. VEND CERT#	10. VEND P.O #	11. VEND #
-02				

8. DETAILS OF NON CONFORMANCE

12. ITEM #	13. DESCRIPTION Dwg Zone, Spec. Para, Ser. no.	14. DISCREPANCY	15. TEAM #	16. QTY	17. DEFECT CODE
1	G-10, Ø 2.155/2.145	2.1579 - 2.1737 (SEE REPORT)	7	1	OSD
2	E-11, SURFACE FINISH 0.2mm	DENT IN SURFACE	4	1	OSD
3	E-4, Ø .188-.193	.1862-.1965 (SEE REPORT)	7	1	OSD
	Ⓜ .04 A B B-D	.0540 MAX (SEE REPORT)	7	1	OSD

18. ORIGINATOR: (PRINT & SIGN)	DATE:	19. OPERATION DETECTED AT:	20. WORK AREA DETECTED AT:
TROY GEORGE Troy L. George	1-26-04	175	INSPECTION

21. ITEM #	22. OPER #	23. DISPOSITION	24. STAMP/ SIGN
1,2,3		REQUEST USE AS IS	

25. RTV Qty:	26. SCRAP Qty :	27. REWORK Qty:	28. STANDARD REPAIR Qty:	29. USE AS IS Qty :	30. REPAIR Qty :

31. CLASSIFICATION	32. CUSTOMER APPROVAL REQUIRED	33. CORRECTIVE ACTION REQUIRED
CRITICAL ☐ MAJOR ☐ MINOR ☐	YES ☒ NO ☐	YES ☐ NO ☐

34. Project Leader :	DATE :	35. Customer Approval:	DATE :	36. Quality Assurance :	DATE
Dc Dagg	1/26/04			Troy L. George	1-26-04

37. CAUSE :
1. LARGE DIAMETERS ARE SIZED BY HAND, VERY DIFFICULT TO CONTROL SIZE.
2. AIR NOZZLE TIP BROKE OFF OF AIR GUN AND HIT FINISHED SURFACE.
3. TIGHT MANUFACTURING REQUIREMENTS. TRUE POSITION GOT WORSE DURING REWORK FROM NCR 12294

38. CAR#:	39. ACTIONEE :	40. ASSIGNED DATE:

41. CORRECTIVE ACTION :
Part is acceptable for use as is.
Mark Wahl

42. EFFECTIVITY DATE/ (Lot#/S/N)

43. DATE COMPLETED :	44. APPROVED BY:	45. CACODE#:

FORM 0001

CUSTOMER	SHIP DATE	GROSS WEIGHT	QUOTE		PACKING LIST
19698	11/21/00 SHP	86	18-757538-3	OF 3	
BILL TO:	WORK ORDER	**	ORDER DATE	TEST RESULTS	
CUSTOM MICROWAVE INC	331844		11/17/00 ORD		

DELIVERY DATE	SHIP BRANCH	SELL BRANCH	WORK ORDER
11/27/00 DEL	03-CLE	18-STL	331844

SHIP TO

CUSTOM MICROWAVE INC 01
[illegible]40 BOSTON AVENUE
LONGMONT CO 80501

THYSSEN
COPPER AND BRASS SALES
AIN PLASTICS
TMX

5755 GRANT AVENUE
CLEVELAND OH 44105-5635

CUSTOMER P.O. NUMBER	TERRITORY	ENTRY ID
11725	03	04JDF

BUYER	INSIDE SALES
MIKE	04JDF JOHN D. FITZPATRICK

BUYER TELEPHONE	INSIDE SALES TELEPHONE
(303) 651-0707	(847) 490-9870 239

SHIP VIA	SHIPPING STATUS		
INTERNAL	COMPLETE	PARTIAL	CANCEL
	X		

TO CUSTOMER	FOB
COMMON/FRT-	ORIG
BILL OF LADING	FREIGHT STATUS
	PPD

CUSTOMER SIGNATURE: DATE:

QUANTITY	ORDERED	SHIPPED
INVENTORY	69.92 LB	70.00
BILLING	1.00 PC	1.00
WAREHOUSE	1.00 PC	

PART DESCRIPTION 185966-9

CR COPPER PLATE C11000
1-1/2 CUT
SAW 12" (+.063,-0) X 12" (+.063,-0)
Test Results Attn to: QA Department.

RR 997

PACKED WITH OTHER GOODS

FINISHED GOODS LOCATION

FULL	SCRAP	FILLED BY	PACKED BY	Q/A AUDIT
		GIL		

CUSTOMER RECEIVING HOURS | MAXIMUM SKID WEIGHT

LOADING INSTRUCTIONS | MAXIMUM BUNDLE WEIGHT

Rack Location: Avail 2516
Product Code: 0303

BOXES	BARS	CASES	CUSHP	PKGS	SKIDS	BDLS	TUBES	CTNS	FLAT	COILS
					1					

SPECIAL INSTRUCTIONS

INSPECTION RECORD														

TEST RESULTS -----
CERTIFICATE OF COMPLIANCE
We hereby certify that mercury or any of its compounds are not used in the processing and distribution of our products. We hereby certify that the material above complies with the following specifications:
ASTM-B152-97A

T33565	1.00	PC	REVERECOP	0862732	00288201
TAG NUMBER	QUANTITY	UNIT	VENDOR	VENDOR PO	HEAT/LOT

GARY W. STAMM - General Manager: CLEVELAND PRINTED 11/17/00 12:50 AM CONTROL NO 00073

REVERE COPPER PRODUCTS, INC.

ADDRESS INQUIRY
CATHY ST.THOMAS
ONE REVERE PARK
ROME, NY 13440-5561

WANTED

REVERE

DPT 11

PAGE 1

REVERE NO. 74450

CUSTOMER DATE	CUSTOMER ORDER NUMBER
04/18/2000	862732

CUSTOMER CODE	DIV	SALESMAN	IND. CODE	CL	KS	TAX	TO
148035004	RM	21		3	1		0

****
* CERTIFICATE OF TEST *
****

SOLD TO
TMX/COPPER AND BRASS SALES
ATTN: ACCOUNTS PAYABLE
400 RENAISSANCE CENTER - SUITE 1700
DETROIT MI 48243

SHIP TO
TMX/COPPER AND BRASS SALES
5755 GRANT AVENUE
CLEVELAND OH 44105

02772 REVERE C11000 CR CU PLATE
TO ASTM B-152

1.500" X 36.5" X 144.5"

NET WEIGHT - 7727 CUST PART# -

The goods described herein were produced in compliance with all applicable requirements of sections 6, 7 and 12 of the Fair Labor Standards Act, as amended, and of regulations and orders of the United States Department of Labor issued under section 14 thereof.

FOB MILL PREPAID
VIA
MARK * 185966-9

ITEM NO.	DESCRIPTION	QTY. ORD.	CASE NO.	NO. OF PCS.	GROSS WT.	TARE	NET WT.	HEAT NO.
	CHEMICAL ANALYSIS							

HEAT#/LOT CU
00287001 99.98%
00288201 99.99%
CU INCLUDES- +Ag

997

PHYSICAL ANALYSIS

HEAT#/LOT	HARDNESS RF	TENSILE KSI	COND %IACS
00287001	79	34.5	98.5
00288201	80	33.5	98.3

Date 11.21.00
Customer CUSTOM MICROWAVE
These Tests Are For Material Shipped On
Your Order 11725
From Copper And Brass Sales, Inc.
INV/WO 931844
WGT PCS
CC:

WE CERTIFY THAT THE FOREGOING RESULTS ARE CORRECT AND THAT THIS MATERIAL HAS BEEN PROCESSED, INSPECTED, AND TESTED IN COMPLIANCE WITH THE REQUIREMENTS OF YOUR PURCHASE ORDER AND SPECIFICATIONS. THIS MATERIAL HAS NOT COME IN CONTACT WITH FREE MERCURY DURING THE MANUFACTURING PROCESS.

RORY MONTGOMERY LABORATORY MANAGER

PART/COMP CODE

SIGNATURE ON FILE

PACKING LIST

SHIPPER

EDM Supplies, Inc.
9806 Everest Street
Downey, CA 90242-3199
Phone: 562-803-6563
Fax: 562-803-4281

Sales Order Number 250913
Shipper Number 2
Ship Date 06/28/02
Page 1

S 103884
O CUSTOM MICROWAVE
L 940 BOSTON AVE
D LONGMONT CO 80501

T
O

B 103884
I CUSTOM MICROWAVE
L 940 BOSTON AVE
L LONGMONT CO 80501

T
O

FOB: DOWNEY Terms: NET 30 Freight: PREPAID AND ADD

Customer's PO: 12557 Resale No:

LI#	Order/Qty	UM	Part/Description	Units/Pkg	Ship Qty	Lot Number
1	10	EA	C22-023 .023 DIA. X 12 PBR Rm 1200		5	0
2	10	EA	C22-024 .024 DIA. X 12 PBR Rm 1201		10	0
5	10	EA	C22-027 Rm 1204 .027 DIA. X 12 PBR *****CERTIFICATIONS***** WE HEREBY CERTIFY THIS MATERIAL TO BE PRECISION BRASS ROD, ALLOY 260 SIGNED: Lisa Andreau ORDERED BY DAN JONGSMA		4	0

Ship Via: UPS GRND PPB Waybill No:

SHIP TO: CUSTOM MICROWAVE
940 BOSTON AVE
LONGMONT CO 80501

EIS Phoenix
1524 West 14th Street Suite 104
TEMPE AZ 85281
USA

Cust. Phone: 3036510707

Packing List # 3325511
Page: 1 / 1

Sold To: CUSTOM MICROWAVE
940 BOSTON AVENUE
LONGMONT CO 80501
USA

Ship To: CUSTOM MICROWAVE
940 BOSTON AVENUE
LONGMONT CO 80501
USA

RM-1294

Date: 06/13/03 11:40:35
Print: 06/13/03 11:40:35
Sales Order #: 16511107

CUSTOMER ORDER NO. 13019						
PACKING LIST NO. 3325511	ORDER DATE 06/13/03	CUST NO. 10498	SALESMAN Sales Rep: Robin Griffo Phone #6023253996	ORDERED BY	PCS.	WT.
SHIP VIA FRT PPD & CHG			SHIP DATE 06/13/03	SALESMAN 364	PICKED BY	DATE

CATALOG	DESCRIPTION / COLOR: / PUT UP:	U/M	QUANTITY ORDERED	QUANTITY SHIPPED	QUANTITY BACK ORDERED
NOTE: ITEMS NOT BACKORDERED OR SHIPPED FROM ANOTHER EIS LOCATION DO NOT SHIP WITHOUT CERTIFICATE OF ANALYSIS					
SMS63M.031 23068	96.3/AG3.7, SOLID WIRE, .031 DIA, 1 LB	LB	2.00	2	0.00
	MUST HAVE CERTIFICATE OF ANALYSIS WITH SHIPMENT!!				
	CERTIFICATE OF COMPLIANCE				
MATERIALS INCLUDED IN THIS SHIPMENT ARE THOSE SPECIFIED ON THE PURCHASE ORDER. ALL SPECIFICATIONS AND PROPERTIES OF THE MATERIAL ARE DETERMINED BY THE MANUFACTURER.					
Authorized Signature / Title: Scott Keith / Shipping					
Lot/Batch Number (MFR DATE) or MFG Shelf Date	Shelf Life	Date of Exp			
311910	5/8/03	indefinite	N/A		
	/ /				/ /

THIS SALE IS SUBJECT TO ALL CONDITIONS AND PROVISIONS APPEARING ON THE REVERSE HEREOF

NORTHROP GRUMMAN
Component Technologies

Kester

RM-1294

Northrop Grumman Corporation
Kester
515 E. Touhy Avenue
Des Plaines, Illinois 60018

Telephone: (847) 297-1600
Fax: (847) 390-9338

CERTIFICATE OF ANALYSIS

ORDER NUMBER:: N/A
CUSTOMER PO:: N/A
LOT NUMBER: 311910

PRODUCT: Sn96.3Ag3.7 Solid Wire

TEST	UNITS	RESULT	MIN SPEC	MAX SPEC
Tin	wt%	BALANCE	Balance	Balance
Lead	wt%	0.0342		0.200
Antimony	wt%	0.0215		0.500
Copper	wt%	0.0044		0.080
Gold	wt%	0.0001		0.050
Aluminum	wt%	0.0001		0.005
Cadmium	wt%	0.0001		0.002
Zinc	wt%	0.0004		0.003
Silver	wt%	3.66	3.50	3.90
Bismuth	wt%	0.0023		0.100
Arsenic	wt%	0.0020		0.030
Iron	wt%	0.0021		0.020
Indium	wt%	0.0040		0.100
Nickel	wt%	0.0002		0.010

We certify that this product conforms to all product specification requirements.
The inspection and test data is indicated above.

This document is computer generated and does not require a signature

CMI Quality Assurance Inspection Plan

Checked By: T.A.
Date: 4-25-03
DC Stamp: CM DC
MAP # MP13105
Rev. 0

Proj #	P8645	Description	Feedhorn Block, 10209853, Final Assembly	Part #	10209853	Rev.	X5
Customer	JPL	Total Quantity	48	Serial Numbers		MIL STD -105 LEVEL II SINGLE C=100% M= 1.5 AQL A= 4.0 AQL	

Item #	Characteristic	Seq # No.	Dwg Zone	AQL	Insp Gage Number	Actual/Range	Qty Insp	Qty Acc	Qty Rej	Cert Oper Stamp Date	Insp Stamp Date
5	Record Proj #, S/N's, QTY on QAIP	50		C							
	CMI dwg # 17964										
10	Ø.375±.005 THRU	~~50~~ 28	B3	C		ACCEPT	2	2	0		CMI 6 9-27-03
15	Ø.688+.000/-.005 ⌖ Ø.004 X-Y-Z	~~50~~ 28	C4	C		.68813 .68800 .00017 .00116					CMI 6 9-27-03
20	1.339+.000/-.008	~~50~~ 28	E2	C		1.336 - 1.337					
25	1.772±.010	~~50~~ 28	C1	C		1.7735 - 1.773					
30	4X R.354±.008	~~50~~ 28	B1	C		.353 - .356					
35	.7423	~~50~~ 28	E5	C		.74321 - .74314					
40	▱ .0002	~~50~~ 28	E6	C		RECORDED .00015 .0002					
45	R.020±.004	~~50~~ 28	D4	C		.024					
50	.1973	~~50~~ 28	B5	C		RECORDED .19735 - .1975					
55	// .0002 X	~~50~~ 28	E6	C		RECORDED .00015 .0002					
	CMI dwg # 17963										
60	.1420	50	D3	C		ACCEPT	48	48	0		9 IMD 9-9-03
65	.9426	65	D5	C		RECORDED	47	47	0		6 9-10-03

CMI Quality Assurance Inspection Plan

Checked By: / Date:	DC Stamp	MAP #	Rev.
	CM DC	MP13105	0

Proj #		Description	Feedhorn Block, 10209853, Final Assembly	Part #	10209853	Rev.	X5
Customer	JPL	Total Quantity		Serial Numbers		MIL STD -105 LEVEL II SINGLE C=100% M= 1.5 AQL A= 4.0 AQL	

Item #	Characteristic	Seq # No.	Dwg Zone	AQL	Insp Gage Number	Actual/Range	Qty Insp	Qty Acc	Qty Rej	Cert Oper Stamp Date	Insp Stamp Date
	JPL dwg # 10209853										
70	⌖ Ø0,04 X-Y-Z	100	D4	C		ACCEPT SEE REPORTS .0319 MAX	37	37	0		CMI DL 10-8-03
75	◎ 0,015 E	100	G10	C		.015 MAX SEE REPORT NCR 12280 SCRAP-7 PARTS	48	41	7 (5)		CMI DL 9-16-03
	CMI dwg # 18135										
80	⌓Ø.020 X Y Z All around	118	D4	C		SEE REPORT	1	1	0		CMI DL 10-8-03
85	.7373 +/- .007 PER CUSTOMER DRAWING DL 10-8-03	118	E5	C		.7328	1	1	0		↓
90	.1913	118	B6	C		.1926 ACCEPT PER ONE TIME ONLY REDLINE	1	1	0		↓
	JPL dwg # 10209853										
95	inspect assembly for aluminum, stains, and debris DL	~~155~~ 175		C							
100	4X R9	175	D10	C		9.0128 - 8.9604	1	1	0		CMI DL 10-29-03
105	NS/FS ⌓Ø0,5 A B D All around	175	B11	C		.2024 MAX	↓	↓	↓		CMI DL 11-19-03
110	38,5	175	C11	C		38.546					
115	6,5	175	C10	C		6.4099					↓
120	// 0,05 A	175	F10	C		~~DL 11-19-03~~ ~~.0089~~ .0089					
125	23,611±0,2 (4 corners)	175	E11	C		23.5031					

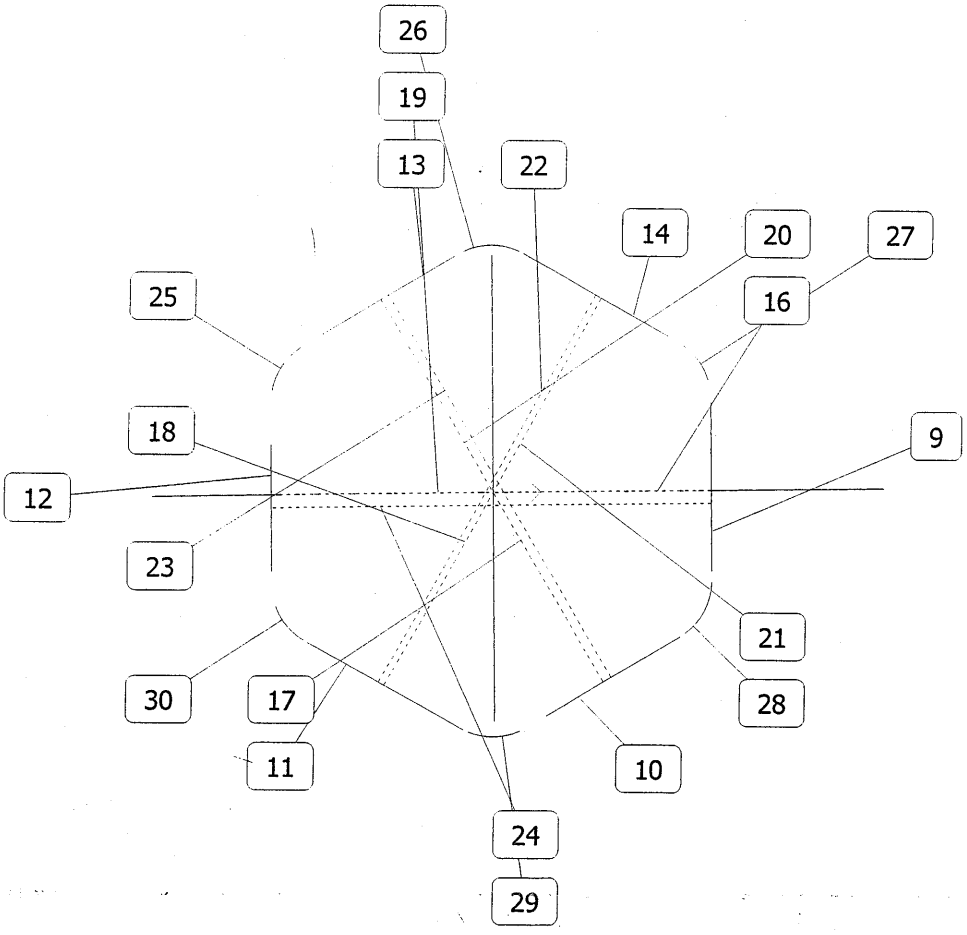
CMI Quality Assurance Inspection Plan

Checked By: Date: | DC Stamp: CMI DC | MAP # MP13105 | Rev. 0

Proj #		Description	Feedhorn Block, 10209853, Final Assembly	Part #	10209853	Rev.	X5
Customer	JPL	Total Quantity		Serial Numbers		MIL STD -105 LEVEL II SINGLE C=100% M= 1.5 AQL A= 4.0 AQL	

Item #	Characteristic	Seq # No.	Dwg Zone	AQL	Insp Gage Number	Actual/Range	Qty Insp	Qty Acc	Qty Rej	Cert Oper Stamp Date	Insp Stamp Date
130	//,003 A	175	E10	C		.003 EXCLUDING DAMAGE 20 POINT TO 25 POINTS	1	1	0		DLL 11-19-03
135	2X 17+0/-0,2	175	C10	C		16.964 16,904					
140	2X R0,5 all around	175	E9	C		.45 - .50					
145	3	175	E8	C		2.9944					
150	1,884+0,02/-0 18 boss points, 18 land points	175	E8	C		1.9031					
155	▱ 0,003	175	E8	C		.003 DATUM AREA 20 POINTS					
160	37X Ø2,155/2,145 ◎ 0,015 E	175	G10	C		2.1726 - 2.1564 NCR 13049 NCR12294 .015 SEE PREVIOUS REPORTS	1	⊘1	DLL 1-27-04 X0		8 DLL 11-19-03
165	Ø0,193/0,188 ⌖ Ø0,04 X Y Z	175	E4	C	DLL 1-26-04	SEE REPORT NCR 13049 .0540 MAX ~~.0424 MAX~~ NCR12294	1	⊘1	DLL 1-27-04 X0		8 DLL 11-19-03
170	37X 0,2 surface finish	175	E6	C		NCR 13049 SURFACE DAMAGE NCR12294	1	⊘1	X0 DLL 1-27-04		8 DLL 11-19-03
175	4X Ø2,25/2 THRU ⌖ Ø0,05 Ⓜ X Y Z	175	D12	C		2.1255 - 2.1299 .0149 MAX	1	1	0		CMI 6 DLL 11-19-03
180	2X Ø3,2/3,12 THRU ⌵ Ø3,85/3,6 X 90° M3,5 X 0,35-6H ⌖ Ø0,35 X Y Z	175	H12	C		3.1822 3.1851 .0339 MAX					
185	Ø1,61/1,6 THRU	175	C10	C		1.6002					
190	1,6+0,01/-0 ⌖0,1 A B C	175	E1	C		1.6012 .006					

Ø.020 SEQ 118



Program: Untitled
Units: in, dec deg

Date: Wed Oct 08 2003 Time: 09:25:52

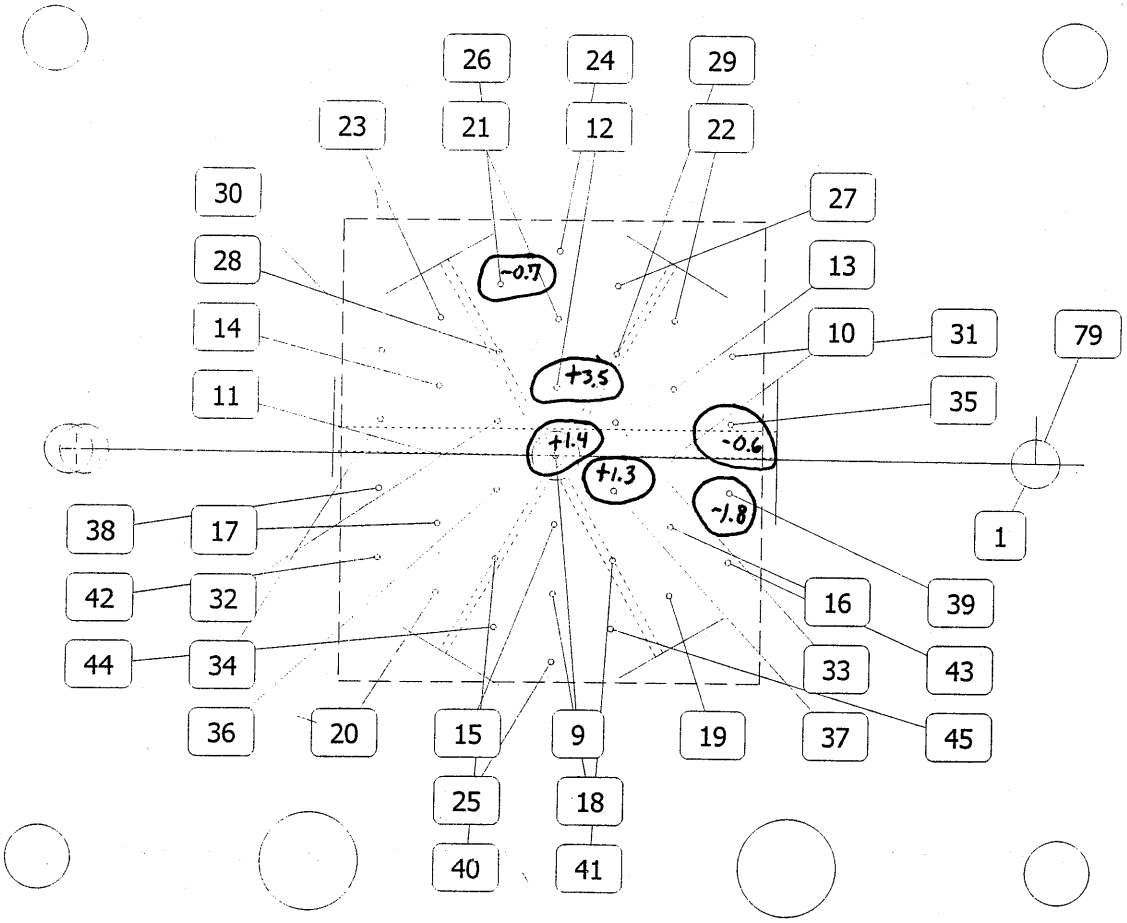
Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Distance 16	[System 8]					
Distance XY	0.29092	0.28545	0.02000	0.02000	0.00547	
Distance 17	[System 8]					
Distance XY	0.29082	0.28545	0.02000	0.02000	0.00537	
Distance 18	[System 8]					
Distance XY	0.29196	0.28545	0.02000	0.02000	0.00651	
Distance 19	[System 8]					
Distance XY	0.29340	0.28545	0.02000	0.02000	0.00795	
Distance 20	[System 8]					
Distance XY	0.29369	0.28545	0.02000	0.02000	0.00824	
Distance 21	[System 8]					
Distance XY	0.29244	0.28545	0.02000	0.02000	0.00699	
Distance 22	[System 8]					
Distance XY	0.58441	0.57090	0.02000	0.02000	0.01351	
Distance 23	[System 8]					
Distance XY	0.58449	0.57090	0.02000	0.02000	0.01359	
Distance 24	[System 8]					
Distance XY	0.58433	0.57090	0.02000	0.02000	0.01343	
Arc 25	[System 8]					
Radius	0.08683	0.08850	0.02000	0.02000	-0.00168	
Arc 26	[System 8]					
Radius	0.08764	0.08850	0.02000	0.02000	-0.00087	
Arc 27	[System 8]					
Radius	0.08847	0.08850	0.02000	0.02000	-0.00004	
Arc 28	[System 8]					
Radius	0.08610	0.08850	0.02000	0.02000	-0.00241	
Arc 29	[System 8]					
Radius	0.08818	0.08850	0.02000	0.02000	-0.00032	
Arc 30	[System 8]					
Radius	0.08352	0.08850	0.02000	0.02000	-0.00498	

ACTUAL SIZE & LOCATION

AFTER REWORK

01/05/04

853 S/N -02



Program: Feedhorn block 37 final inspect with datums high maDate: Mon Jan 05 2004 Time: 12:41:47
Units: mm, dec deg

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 1	[MCS]					
Center X	284.8601	273.0275			11.8326	
Center Y	145.3033	127.3063			17.9970	
Diameter	1.6078	1.6000	0.0100	0.0000	0.0078	
System 8	[System 6]					
Origin X	0.0000	0.0000			0.0000	
Origin Y	0.0000	0.0000			0.0000	
Circle 79	[System 8]					
Center X	-0.0000	0.0099			-0.0099	
Center Y	-0.0000	0.0071			-0.0071	
Diameter	1.6078	1.6000	0.0100	0.0000	0.0078	
Circle 9	[System 8]					
Center X	-16.0578	-16.0464			-0.0114	
Center Y	0.0047	0.0000			0.0047	
Diameter	0.1944	0.1880	0.0050	0.0000	0.0064	0.0014
Circularity	0.0028					
TP RFS	0.0247		0.0400			
Circle 10	[System 8]					
Center X	-12.1457	-12.1380			-0.0077	
Center Y	-0.0099	0.0000			-0.0099	
Diameter	0.1891	0.1880	0.0050	0.0000	0.0011	
Circularity	0.0022					
TP RFS	0.0251		0.0400			
Circle 11	[System 8]					
Center X	-19.9675	-19.9548			-0.0127	
Center Y	-0.0039	0.0000			-0.0039	
Diameter	0.1894	0.1880	0.0050	0.0000	0.0014	
Circularity	0.0022					
TP RFS	0.0265		0.0400			
Circle 12	[System 8]					
Center X	-16.0656	-16.0464			-0.0192	
Center Y	2.2595	2.2565			0.0030	
Diameter	0.1965	0.1880	0.0050	0.0000	0.0085	0.0035
Circularity	0.0030					
TP RFS	0.0389		0.0400			
Circle 13	[System 8]					
Center X	-12.1384	-12.1380			-0.0004	
Center Y	2.2648	2.2565			0.0083	
Diameter	0.1897	0.1880	0.0050	0.0000	0.0017	
Circularity	0.0019					
TP RFS	0.0166		0.0400			
Circle 14	[System 8]					
Center X	-19.9731	-19.9548			-0.0183	
Center Y	2.2561	2.2565			-0.0004	
Diameter	0.1901	0.1880	0.0050	0.0000	0.0021	
Circularity	0.0030					
TP RFS	0.0367		0.0400			
Circle 15	[System 8]					
Center X	-16.0595	-16.0464			-0.0131	
Center Y	-2.2542	-2.2565			0.0023	
Diameter	0.1888	0.1880	0.0050	0.0000	0.0008	
Circularity	0.0012					
TP RFS	0.0266		0.0400			

Program: Feedhorn block 37 final inspect with datums high maDate: Mon Jan 05 2004 Time: 12:41:47
Units: mm, dec deg

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 16	[System 8]					
Center X	-12.1520	-12.1380			-0.0140	
Center Y	-2.2792	-2.2565			-0.0227	
Diameter	0.1899	0.1880	0.0050	0.0000	0.0019	
Circularity	0.0012					
TP RFS	0.0534		0.0400			0.0134
Circle 17	[System 8]					
Center X	-19.9526	-19.9548			0.0022	
Center Y	-2.2615	-2.2565			-0.0050	
Diameter	0.1902	0.1880	0.0050	0.0000	0.0022	
Circularity	0.0022					
TP RFS	0.0109		0.0400			
Circle 18	[System 8]					
Center X	-16.0646	-16.0464			-0.0182	
Center Y	-4.5322	-4.5130			-0.0192	
Diameter	0.1887	0.1880	0.0050	0.0000	0.0007	
Circularity	0.0014					
TP RFS	0.0529		0.0400			0.0129
Circle 19	[System 8]					
Center X	-12.1431	-12.1380			-0.0051	
Center Y	-4.5313	-4.5130			-0.0183	
Diameter	0.1910	0.1880	0.0050	0.0000	0.0030	
Circularity	0.0013					
TP RFS	0.0379		0.0400			
Circle 20	[System 8]					
Center X	-19.9678	-19.9548			-0.0130	
Center Y	-4.5326	-4.5130			-0.0196	
Diameter	0.1904	0.1880	0.0050	0.0000	0.0024	
Circularity	0.0035					
TP RFS	0.0470		0.0400			0.0070
Circle 21	[System 8]					
Center X	-16.0575	-16.0464			-0.0111	
Center Y	4.5201	4.5130			0.0071	
Diameter	0.1928	0.1880	0.0050	0.0000	0.0048	
Circularity	0.0029					
TP RFS	0.0264		0.0400			
Circle 22	[System 8]					
Center X	-12.1509	-12.1380			-0.0129	
Center Y	4.5196	4.5130			0.0066	
Diameter	0.1904	0.1880	0.0050	0.0000	0.0024	
Circularity	0.0014					
TP RFS	0.0291		0.0400			
Circle 23	[System 8]					
Center X	-19.9676	-19.9548			-0.0128	
Center Y	4.5165	4.5130			0.0035	
Diameter	0.1882	0.1880	0.0050	0.0000	0.0002	
Circularity	0.0029					
TP RFS	0.0265		0.0400			
Circle 24	[System 8]					
Center X	-16.0561	-16.0464			-0.0097	
Center Y	6.7712	6.7695			0.0017	
Diameter	0.1928	0.1880	0.0050	0.0000	0.0048	
Circularity	0.0027					
TP RFS	0.0196		0.0400			

Program: Feedhorn block 37 final inspect with datums high maDate: Mon Jan 05 2004 Time: 12:41:47
Units: mm, dec deg

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 25	[System 8]					
Center X	-16.0602	-16.0464			-0.0138	
Center Y	-6.7883	-6.7695			-0.0188	
Diameter	0.1920	0.1880	0.0050	0.0000	0.0040	
Circularity	0.0016					
TP RFS	0.0466		0.0400			0.0066
Circle 26	[System 8]					
Center X	-18.0172	-18.0006			-0.0166	
Center Y	5.6478	5.6413			0.0065	
Diameter	0.1873	0.1880	0.0050	0.0000	-0.0007	-0.0007
Circularity	0.0018					
TP RFS	0.0357		0.0400			
Circle 27	[System 8]					
Center X	-14.1040	-14.0922			-0.0118	
Center Y	5.6440	5.6413			0.0027	
Diameter	0.1913	0.1880	0.0050	0.0000	0.0033	
Circularity	0.0034					
TP RFS	0.0242		0.0400			
Circle 28	[System 8]					
Center X	-18.0193	-18.0006			-0.0187	
Center Y	3.3956	3.3848			0.0108	
Diameter	0.1907	0.1880	0.0050	0.0000	0.0027	
Circularity	0.0034					
TP RFS	0.0431		0.0400			0.0031
Circle 29	[System 8]					
Center X	-14.1018	-14.0922			-0.0096	
Center Y	3.3919	3.3848			0.0071	
Diameter	0.1894	0.1880	0.0050	0.0000	0.0014	
Circularity	0.0018					
TP RFS	0.0240		0.0400			
Circle 30	[System 8]					
Center X	-21.9165	-21.9090			-0.0075	
Center Y	3.3936	3.3848			0.0088	
Diameter	0.1904	0.1880	0.0050	0.0000	0.0024	
Circularity	0.0016					
TP RFS	0.0230		0.0400			
Circle 31	[System 8]					
Center X	-10.1901	-10.1838			-0.0063	
Center Y	3.3897	3.3848			0.0049	
Diameter	0.1902	0.1880	0.0050	0.0000	0.0022	
Circularity	0.0028					
TP RFS	0.0159		0.0400			
Circle 32	[System 8]					
Center X	-18.0183	-18.0006			-0.0177	
Center Y	1.1276	1.1283			-0.0007	
Diameter	0.1901	0.1880	0.0050	0.0000	0.0021	
Circularity	0.0021					
TP RFS	0.0355		0.0400			
Circle 33	[System 8]					
Center X	-14.0990	-14.0922			-0.0068	
Center Y	1.1270	1.1283			-0.0013	
Diameter	0.1910	0.1880	0.0050	0.0000	0.0030	
Circularity	0.0017					
TP RFS	0.0139		0.0400			

Program: Feedhorn block 37 final inspect with datums high maDate: Mon Jan 05 2004 Time: 12:41:47
Units: mm, dec deg

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 34	[System 8]					
Center X	-21.9048	-21.9090			0.0042	
Center Y	1.1273	1.1283			-0.0010	
Diameter	0.1900	0.1880	0.0050	0.0000	0.0020	
Circularity	0.0023					
TP RFS	0.0086		0.0400			
Circle 35	[System 8]					
Center X	-10.1904	-10.1838			-0.0066	
Center Y	1.1318	1.1283			0.0035	
Diameter	0.1874	0.1880	0.0050	0.0000	-0.0006	-0.0006
Circularity	0.0012					
TP RFS	0.0150		0.0400			
Circle 36	[System 8]					
Center X	-18.0016	-18.0006			-0.0010	
Center Y	-1.1321	-1.1282			-0.0039	
Diameter	0.1910	0.1880	0.0050	0.0000	0.0030	
Circularity	0.0016					
TP RFS	0.0081		0.0400			
Circle 37	[System 8]					
Center X	-14.1085	-14.0922			-0.0163	
Center Y	-1.1325	-1.1282			-0.0043	
Diameter	0.1943	0.1880	0.0050	0.0000	0.0063	0.0013
Circularity	0.0030					
TP RFS	0.0337		0.0400			
Circle 38	[System 8]					
Center X	-21.9183	-21.9090			-0.0093	
Center Y	-1.1397	-1.1282			-0.0115	
Diameter	0.1929	0.1880	0.0050	0.0000	0.0049	
Circularity	0.0019					
TP RFS	0.0295		0.0400			
Circle 39	[System 8]					
Center X	-10.1943	-10.1838			-0.0105	
Center Y	-1.1385	-1.1282			-0.0103	
Diameter	0.1862	0.1880	0.0050	0.0000	-0.0018	-0.0018
Circularity	0.0011					
TP RFS	0.0295		0.0400			
Circle 40	[System 8]					
Center X	-18.0129	-18.0006			-0.0123	
Center Y	-3.3996	-3.3847			-0.0149	
Diameter	0.1895	0.1880	0.0050	0.0000	0.0015	
Circularity	0.0036					
TP RFS	0.0386		0.0400			
Circle 41	[System 8]					
Center X	-14.0962	-14.0922			-0.0040	
Center Y	-3.4035	-3.3847			-0.0188	
Diameter	0.1896	0.1880	0.0050	0.0000	0.0016	
Circularity	0.0020					
TP RFS	0.0385		0.0400			
Circle 42	[System 8]					
Center X	-21.9218	-21.9090			-0.0128	
Center Y	-3.4003	-3.3847			-0.0156	
Diameter	0.1915	0.1880	0.0050	0.0000	0.0035	
Circularity	0.0025					
TP RFS	0.0403		0.0400			0.0003

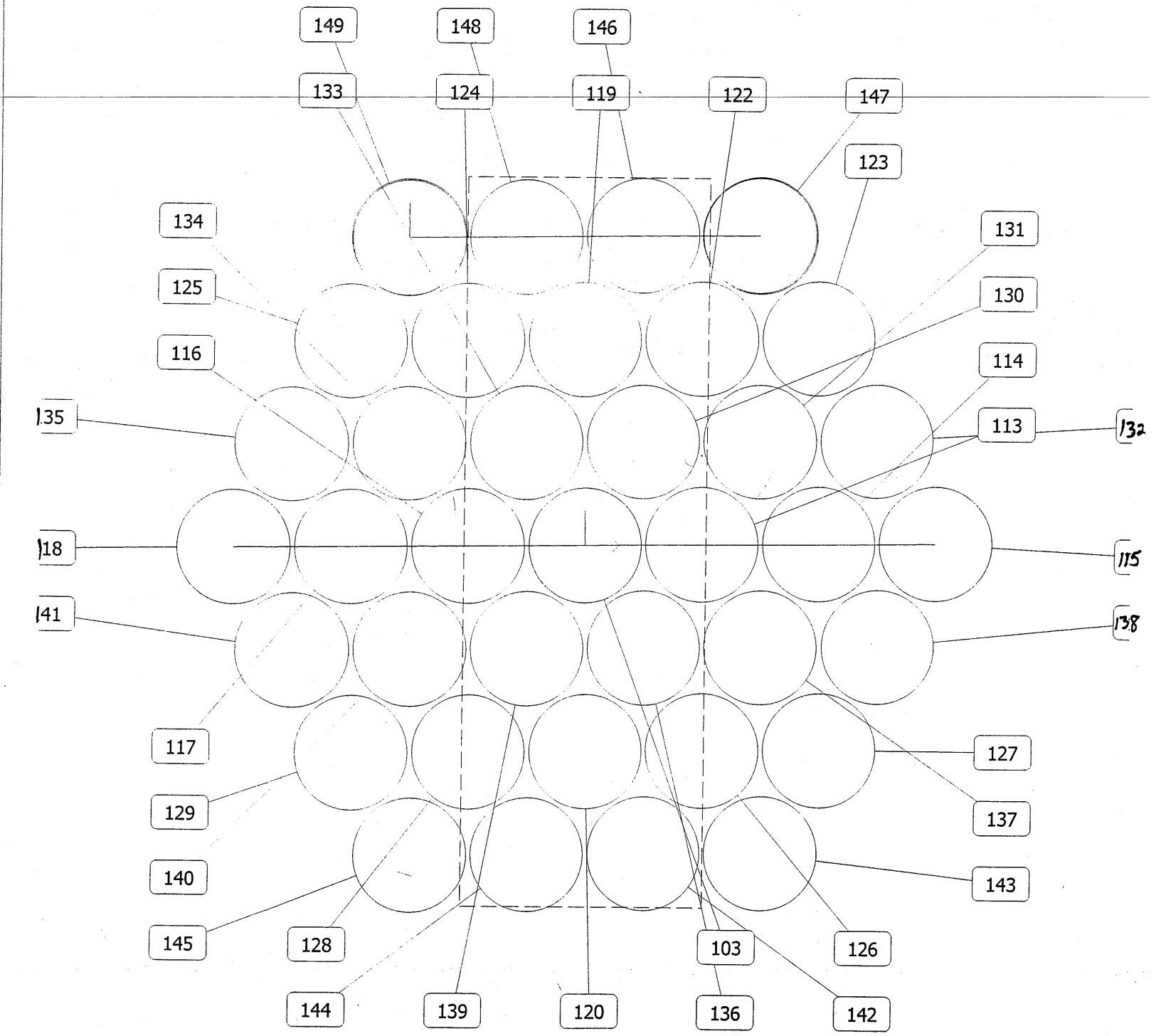
Program: Feedhorn block 37 final inspect with datums high maDate: Mon Jan 05 2004 Time: 12:41:47
Units: mm, dec deg

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 43	[System 8]					
Center X	-10.1899	-10.1838			-0.0061	
Center Y	-3.4110	-3.3847			-0.0263	
Diameter	0.1915	0.1880	0.0050	0.0000	0.0035	
Circularity	0.0048					
TP RFS	0.0540		0.0400			0.0140
Circle 44	[System 8]					
Center X	-18.0128	-18.0006			-0.0122	
Center Y	-5.6559	-5.6412			-0.0147	
Diameter	0.1890	0.1880	0.0050	0.0000	0.0010	
Circularity	0.0017					
TP RFS	0.0383		0.0400			
Circle 45	[System 8]					
Center X	-14.1101	-14.0922			-0.0179	
Center Y	-5.6629	-5.6412			-0.0217	
Diameter	0.1899	0.1880	0.0050	0.0000	0.0019	
Circularity	0.0019					
TP RFS	0.0563		0.0400			0.0163
Circle 49	[System 8]					
Center X	-7.9940	-8.0000			0.0060	
Center Y	-13.5037	-13.5000			-0.0037	
Diameter	3.2873	3.2860			0.0013	
TP RFS	0.0142		0.3500			
Circle 50	[System 8]					
Center X	-23.9904	-24.0000			0.0096	
Center Y	-13.5047	-13.5000			-0.0047	
Diameter	3.2851	3.2840			0.0011	
TP RFS	0.0214		0.3500			
Circle 51	[System 8]					
Center X	-32.9898	-33.0000			0.0102	
Center Y	-13.5020	-13.5000			-0.0020	
Diameter	2.1399	2.0000	0.2500	0.0000	0.1399	
TP RFS	0.0207		0.0500			
Circle 52	[System 8]					
Center X	-32.9907	-33.0000			0.0093	
Center Y	13.5043	13.5000			0.0043	
Diameter	2.1404	2.0000	0.2500	0.0000	0.1404	
TP RFS	0.0204		0.0500			
Circle 55	[System 8]					
Center X	1.0087	1.0000			0.0087	
Center Y	-13.4990	-13.5000			0.0010	
Diameter	2.1379	2.0000	0.2500	0.0000	0.1379	
TP RFS	0.0176		0.0500			
Circle 56	[System 8]					
Center X	1.0116	1.0000			0.0116	
Center Y	13.5028	13.5000			0.0028	
Diameter	2.1398	2.0000	0.2500	0.0000	0.1398	
TP RFS	0.0239		0.0500			
Distance 64	[System 8]					
Distance XY	7.4285	7.2500	0.5000	0.0000	0.1785	
Distance 65	[System 8]					
Distance XY	7.4124	7.2500	0.5000	0.0000	0.1624	
Distance 66	[System 8]					
Distance XY	7.4418	7.2500	0.5000	0.0000	0.1918	
Distance 67	[System 8]					
Distance XY	7.4518	7.2500	0.5000	0.0000	0.2018	

Program: Feedhorn block 37 final inspect with datums high maDate: Mon Jan 05 2004 Time: 12:41:47
Units: mm, dec deg

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Distance 68	[System 8]					
Distance XY	7.4304	7.2500	0.5000	0.0000	0.1804	
Distance 69	[System 8]					
Distance XY	7.4363	7.2500	0.5000	0.0000	0.1863	
Distance 70	[System 8]					
Distance XY	14.8785	14.5000	1.0000	0.0000	0.3785	
Distance 71	[System 8]					
Distance XY	14.8810	14.5000	1.0000	0.0000	0.3810	
Distance 72	[System 8]					
Distance XY	14.8319	14.5000	1.0000	0.0000	0.3319	
Line 73	[System 8]					
Location Y	-16.9629	-17.0000	0.2000	0.0000	0.0371	
Line 74	[System 8]					
Location Y	16.9226	17.0000	0.0000	0.2000	-0.0774	
Circle 75	[System 8]					
Center X	-32.2521	-32.2507			-0.0014	
Center Y	0.0000	0.0000			0.0000	
Diameter	1.6045	1.6000	0.0100	0.0000	0.0045	
Point 77	[System 8]					
Location X	-31.9981	-32.0000			0.0019	
Location Y	0.0008	0.0000			0.0008	
TP RFS	0.0040		0.1000			
Distance 78	[System 8]					
Distance X	0.5078	0.5000	0.1000	0.1000	0.0078	

FINAL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FINAL LARGE

Program: Feedhorn block 37 large hole side final 3.iwp Date: Thu Nov 20 2003 Time: 08:44:16
Units: mm, dec deg

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 103	[System 102]					
Center X	0.0009	0.0000			0.0009	
Center Y	-0.0029	0.0000			-0.0029	
Diameter	2.1658	2.1500	0.0050	0.0050	0.0158	0.0108
TP RFS	0.0060		0.0400			
Circle 113	[System 102]					
Center X	2.2507	2.2565			-0.0058	
Center Y	0.0039	0.0000			0.0039	
Diameter	2.1614	2.1500	0.0050	0.0050	0.0114	0.0064
TP RFS	0.0140		0.0400			
Circle 114	[System 102]					
Center X	4.5004	4.5130			-0.0126	
Center Y	0.0077	-0.0000			0.0077	
Diameter	2.1612	2.1500	0.0050	0.0050	0.0112	0.0062
TP RFS	0.0295		0.0400			
Circle 115	[System 102]					
Center X	6.7480	6.7695			-0.0215	
Center Y	0.0000	0.0000			0.0000	
Diameter	2.1584	2.1500	0.0050	0.0050	0.0084	0.0034
TP RFS	0.0430		0.0400			0.0030
Circle 116	[System 102]					
Center X	-2.2519	-2.2565			0.0046	
Center Y	-0.0038	-0.0000			-0.0038	
Diameter	2.1676	2.1500	0.0050	0.0050	0.0176	0.0126
TP RFS	0.0120		0.0400			
Circle 117	[System 102]					
Center X	-4.5032	-4.5130			0.0098	
Center Y	-0.0032	0.0000			-0.0032	
Diameter	2.1602	2.1500	0.0050	0.0050	0.0102	0.0052
TP RFS	0.0207		0.0400			
Circle 118	[System 102]					
Center X	-6.7481	-6.7695			0.0214	
Center Y	-0.0000	0.0000			-0.0000	
Diameter	2.1572	2.1500	0.0050	0.0050	0.0072	0.0022
TP RFS	0.0429		0.0400			0.0029
Circle 119	[System 102]					
Center X	-0.0038	0.0000			-0.0038	
Center Y	3.9027	3.9084			-0.0057	
Diameter	2.1688	2.1500	0.0050	0.0050	0.0188	0.0138
TP RFS	0.0138		0.0400			
Circle 120	[System 102]					
Center X	0.0021	0.0000			0.0021	
Center Y	-3.9054	-3.9084			0.0030	
Diameter	2.1638	2.1500	0.0050	0.0050	0.0138	0.0088
TP RFS	0.0074		0.0400			
Circle 122	[System 102]					
Center X	2.2521	2.2565			-0.0044	
Center Y	3.9050	3.9084			-0.0034	
Diameter	2.1661	2.1500	0.0050	0.0050	0.0161	0.0111
TP RFS	0.0112		0.0400			
Circle 123	[System 102]					
Center X	4.4979	4.5130			-0.0151	
Center Y	3.9101	3.9084			0.0017	
Diameter	2.1603	2.1500	0.0050	0.0050	0.0103	0.0053
TP RFS	0.0304		0.0400			

Program: Feedhorn block 37 large hole side final 3.iwp Date: Thu Nov 20 2003 Time: 08:44:16
Units: mm, dec deg

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 124	[System 102]					
Center X	-2.2545	-2.2565			0.0020	
Center Y	3.8985	3.9084			-0.0099	
Diameter	2.1658	2.1500	0.0050	0.0050	0.0158	0.0108
TP RFS	0.0201		0.0400			
Circle 125	[System 102]					
Center X	-4.5061	-4.5130			0.0069	
Center Y	3.8995	3.9084			-0.0089	
Diameter	2.1615	2.1500	0.0050	0.0050	0.0115	0.0065
TP RFS	0.0226		0.0400			
Circle 126	[System 102]					
Center X	2.2511	2.2565			-0.0054	
Center Y	-3.9008	-3.9084			0.0076	
Diameter	2.1706	2.1500	0.0050	0.0050	0.0206	0.0156
TP RFS	0.0187		0.0400			
Circle 127	[System 102]					
Center X	4.5043	4.5130			-0.0087	
Center Y	-3.9009	-3.9084			0.0075	
Diameter	2.1643	2.1500	0.0050	0.0050	0.0143	0.0093
TP RFS	0.0230		0.0400			
Circle 128	[System 102]					
Center X	-2.2502	-2.2565			0.0063	
Center Y	-3.9030	-3.9084			0.0054	
Diameter	2.1627	2.1500	0.0050	0.0050	0.0127	0.0077
TP RFS	0.0167		0.0400			
Circle 129	[System 102]					
Center X	-4.5064	-4.5130			0.0066	
Center Y	-3.9037	-3.9084			0.0047	
Diameter	2.1694	2.1500	0.0050	0.0050	0.0194	0.0144
TP RFS	0.0162		0.0400			
Circle 130	[System 102]					
Center X	1.1246	1.1283			-0.0037	
Center Y	1.9539	1.9542			-0.0003	
Diameter	2.1641	2.1500	0.0050	0.0050	0.0141	0.0091
TP RFS	0.0075		0.0400			
Circle 131	[System 102]					
Center X	3.3740	3.3848			-0.0108	
Center Y	1.9517	1.9542			-0.0025	
Diameter	2.1644	2.1500	0.0050	0.0050	0.0144	0.0094
TP RFS	0.0223		0.0400			
Circle 132	[System 102]					
Center X	5.6215	5.6413			-0.0198	
Center Y	1.9540	1.9542			-0.0002	
Diameter	2.1602	2.1500	0.0050	0.0050	0.0102	0.0052
TP RFS	0.0397		0.0400			
Circle 133	[System 102]					
Center X	-1.1266	-1.1282			0.0016	
Center Y	1.9507	1.9542			-0.0035	
Diameter	2.1668	2.1500	0.0050	0.0050	0.0168	0.0118
TP RFS	0.0077		0.0400			
Circle 134	[System 102]					
Center X	-3.3807	-3.3847			0.0040	
Center Y	1.9488	1.9542			-0.0054	
Diameter	2.1604	2.1500	0.0050	0.0050	0.0104	0.0054
TP RFS	0.0135		0.0400			

Program: Feedhorn block 37 large hole side final 3.iwp Date: Thu Nov 20 2003 Time: 08:44:16
Units: mm, dec deg

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 135	[System 102]					
Center X	-5.6344	-5.6412			0.0068	
Center Y	1.9472	1.9542			-0.0070	
Diameter	2.1682	2.1500	0.0050	0.0050	0.0182	0.0132
TP RFS	0.0195		0.0400			
Circle 136	[System 102]					
Center X	1.1295	1.1283			0.0012	
Center Y	-1.9484	-1.9542			0.0058	
Diameter	2.1688	2.1500	0.0050	0.0050	0.0188	0.0138
TP RFS	0.0118		0.0400			
Circle 137	[System 102]					
Center X	3.3741	3.3848			-0.0107	
Center Y	-1.9454	-1.9542			0.0088	
Diameter	2.1612	2.1500	0.0050	0.0050	0.0112	0.0062
TP RFS	0.0276		0.0400			
Circle 138	[System 102]					
Center X	5.6321	5.6413			-0.0092	
Center Y	-1.9479	-1.9542			0.0063	
Diameter	2.1610	2.1500	0.0050	0.0050	0.0110	0.0060
TP RFS	0.0223		0.0400			
Circle 139	[System 102]					
Center X	-1.1235	-1.1282			0.0047	
Center Y	-1.9504	-1.9542			0.0038	
Diameter	2.1711	2.1500	0.0050	0.0050	0.0211	0.0161
TP RFS	0.0121		0.0400			
Circle 140	[System 102]					
Center X	-3.3767	-3.3847			0.0080	
Center Y	-1.9507	-1.9542			0.0035	
Diameter	2.1714	2.1500	0.0050	0.0050	0.0214	0.0164
TP RFS	0.0174		0.0400			
Circle 141	[System 102]					
Center X	-5.6306	-5.6412			0.0106	
Center Y	-1.9523	-1.9542			0.0019	
Diameter	2.1705	2.1500	0.0050	0.0050	0.0205	0.0155
TP RFS	0.0214		0.0400			
Circle 142	[System 102]					
Center X	1.1283	1.1283			-0.0000	
Center Y	-5.8461	-5.8626			0.0165	
Diameter	2.1654	2.1500	0.0050	0.0050	0.0154	0.0104
TP RFS	0.0330		0.0400			
Circle 143	[System 102]					
Center X	3.3785	3.3848			-0.0063	
Center Y	-5.8485	-5.8626			0.0141	
Diameter	2.1679	2.1500	0.0050	0.0050	0.0179	0.0129
TP RFS	0.0308		0.0400			
Circle 144	[System 102]					
Center X	-1.1258	-1.1282			0.0024	
Center Y	-5.8535	-5.8626			0.0091	
Diameter	2.1657	2.1500	0.0050	0.0050	0.0157	0.0107
TP RFS	0.0188		0.0400			
Circle 145	[System 102]					
Center X	-3.3778	-3.3847			0.0069	
Center Y	-5.8537	-5.8626			0.0089	
Diameter	2.1740	2.1500	0.0050	0.0050	0.0240	0.0190
TP RFS	0.0226		0.0400			

Program: Feedhorn block 37 large hole side final 3.iwp Date: Thu Nov 20 2003 Time: 08:44:16
Units: mm, dec deg

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 146	[System 102]					
Center X	1.1207	1.1283			-0.0076	
Center Y	5.8630	5.8626			0.0004	
Diameter	2.1681	2.1500	0.0050	0.0050	0.0181	0.0131
TP RFS	0.0152		0.0400			
Circle 147	[System 102]					
Center X	3.3716	3.3848			-0.0132	
Center Y	5.8602	5.8626			-0.0024	
Diameter	2.1682	2.1500	0.0050	0.0050	0.0182	0.0132
TP RFS	0.0268		0.0400			
Circle 148	[System 102]					
Center X	-1.1323	-1.1282			-0.0041	
Center Y	5.8492	5.8626			-0.0134	
Diameter	2.1659	2.1500	0.0050	0.0050	0.0159	0.0109
TP RFS	0.0280		0.0400			
Circle 149	[System 102]					
Center X	-3.3829	-3.3847			0.0018	
Center Y	5.8463	5.8626			-0.0163	
Diameter	2.1722	2.1500	0.0050	0.0050	0.0222	0.0172
TP RFS	0.0329		0.0400			

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2) .0080
3) .0049
4) .0015
5) .0055
6) .0145
7) .0021
8) .0025
9) .0045
10) .0136
11) .0133
12) .0093
13) .0081
14) .0085
15) .0113
16) .015
17) .0107
18) .0143
19) .0031
20) .0148
21) .0071
22) .0069
23) .0109
24) .0030
25) .0089
26) .0140
27) .0113
28) .0089
29) .0150
30) .0056
31) .0146
32) .0012
33) .0060
34) .0144
35) .0143
36) .0094
37) .0114
38) .0054

End Item Data Package (EIDP)

SPIRE - 300mK SSW Filters - Flight Spare

SPIRE Ref.: SPIRE-UCF-
Cardiff Ref.: HSO-CDF-EIDP-058
Issue 1.0
27 February 2004

Prepared by: Peter Hargrave

Approved by: Carole Tucker

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Change Record

Issue	Section	Date	Changes
1.0		20/02/04	First Issue

Table of contents

Section	Contents	Req.	Comments
1	Shipping Documents	X	
2	Transportation, Packing, Handling & Integration Procedures	X	
3	Certificate of Conformance / Delivery Review Board MoM Ai-Lists	X	
4	Qualification Status List / Test Matrix	X	
5	Top Level Drawings (inc. Family Tree)	X	
6	Interface Drawings	X	
7	Functional, Block & Mechanical Drawings	X	
8	Electrical Circuit Drawings		
9	As Built Parts List	X	
10	Serialised Components List		
11	List of Waivers		
12	Copies of Waivers		
13	Operational Manual		
14	Historical Record	X	
15	Logbook / Diary of Events	X	
16	Operating Time / Cycle Record	X	
17	Connector Mating Record		
18	Age Sensitive Items Record		
19	Pressure Vessel History / Test Record		
20	Calibration Data Record	X	
21	Temporary Installation Record	X	
22	Open Work / Deferred Work / Open Tests	X	
23	List of Non-Conformance Reports	X	
24	Copies of Non-Conformance Reports	X	
25	Test Reports	X	
26	Proof Load Certificates		
27	Reference List of EIDP's		

	(Lower Level / Associated)		
28	Mass Records / Power Budget	**X**	
29	Cleanliness Statement	**X**	
30	Other Useful Information	**X**	

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SECTION 01 - Shipping Documents

Mark Weilert
M/S 79-24
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena CA 91109-8099
USA

Instructions to FedEx – Important!
At LAX, please handover to:-
Packair Airfreight Inc.
5510 West 104 St.
Los Angeles,
CA 90045
USA

Power of Attorney – Roger Bacher
Telephone Number – (310) 342-6051

SECTION 02 - Transportation, Packing, Handling & Integration Procedures

This package contains flight hardware.
To be opened only by authorised SPIRE personnel in clean room conditions.
Do not touch filter surface.
Handle only by Aluminium frame.
To be integrated to SPIRE flight spare SSW BDA according to JPL procedure.

Hand over to JPL Cognisant Engineer – Mark Weilert

Mark Weilert
M/S 79-24
Jet Propulsion Laboratory
4800 Oak Grove Dr.
Pasadena Ca 91109-8099

Mark.A.Weilert@jpl.nasa.gov
office: (818) 354-5060
fax: (818) 393-4878

SECTION 03 - Certificate of Conformance

Cardiff University Astronomy Instrumentation Group hereby certifies that the following equipment,	
Spacecraft / Project:	**Herschel**
Instrument:	**SPIRE**
Model:	**Flight Spare**
Subsystem:	**300mK SSW filter stack**
Serial No:	**FILT-FS-220**
As described in this End Item Data Package: **HSO-CDF-EIDP-058**	
Complies with the requirements set out in: **SPIRE-RAL-PRJ-000034**	

Responsible Authority		***Signature***
Cardiff Filter Management	Prof P.A.R.Ade	
	Dr C.E.Tucker	
Cardiff Product Assurance	Dr I.Walker	
Cardiff SPIRE Management	Dr P.Hargrave	

SECTION 04 - Qualification Status List / Compliance Matrix

Test	Status	Test Institute
	FS-SSW FILT-FS-220	
Spectral behaviour - Near-band transmission	Tested at component level. Compliant.	UWC
Spectral behaviour - out-of-band blocking, at ?<15μm	Open test. Off-cuts to be tested once facility commissioned	UWC
Dimension and tolerances to specification	Compliant	UWC
Filter flatness	Compliant. Requirement applies only to lens component.	UWC
Inspection for surface defects	Passed	UWC
Mass	Compliant	
Thermal cycling (5 cycles 300K-77K-300K)	Passed	UWC
Cold vibration	Not tested	RAL
Environmental condition - Vacuum $3x10^{-1}$mBar	Passed	UWC
Differential pressure (a pumping-out rate of 10mBar/sec)	Passed	UWC
Pre-bake out (not exceeding 80°C)	Passed	UWC
Outgassing	Test not performed. All materials used within ESA / NASA specifications	
Cleanliness checks, by visual inspection.	Passed	UWC
Degradation due to high energy radiation.	Not tested	

SECTION 05 - Top Level Drawings (Inc. Family Tree)

TOP LEVEL DRAWING LIST

Drawing No.	Title
FILT-CQM/PFM-200-03.001	300mK Filter Assembly

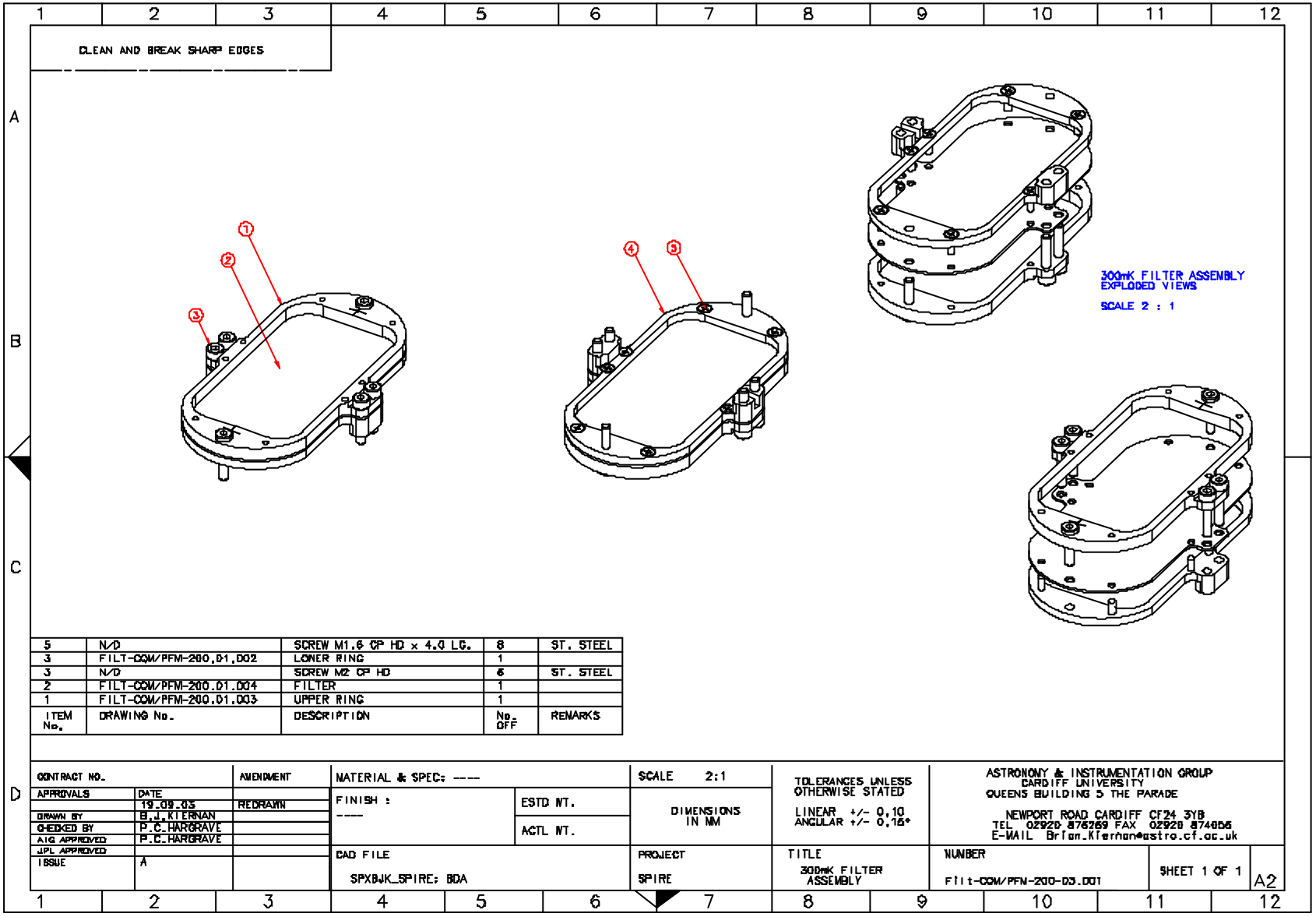

Figure 1 300mK filter stack assembly

SECTION 06 - Interface Drawings

INTERFACE DRAWING LIST

Drawing No.	Title
FILT-CQM/PFM-200	300mK Filter ICD

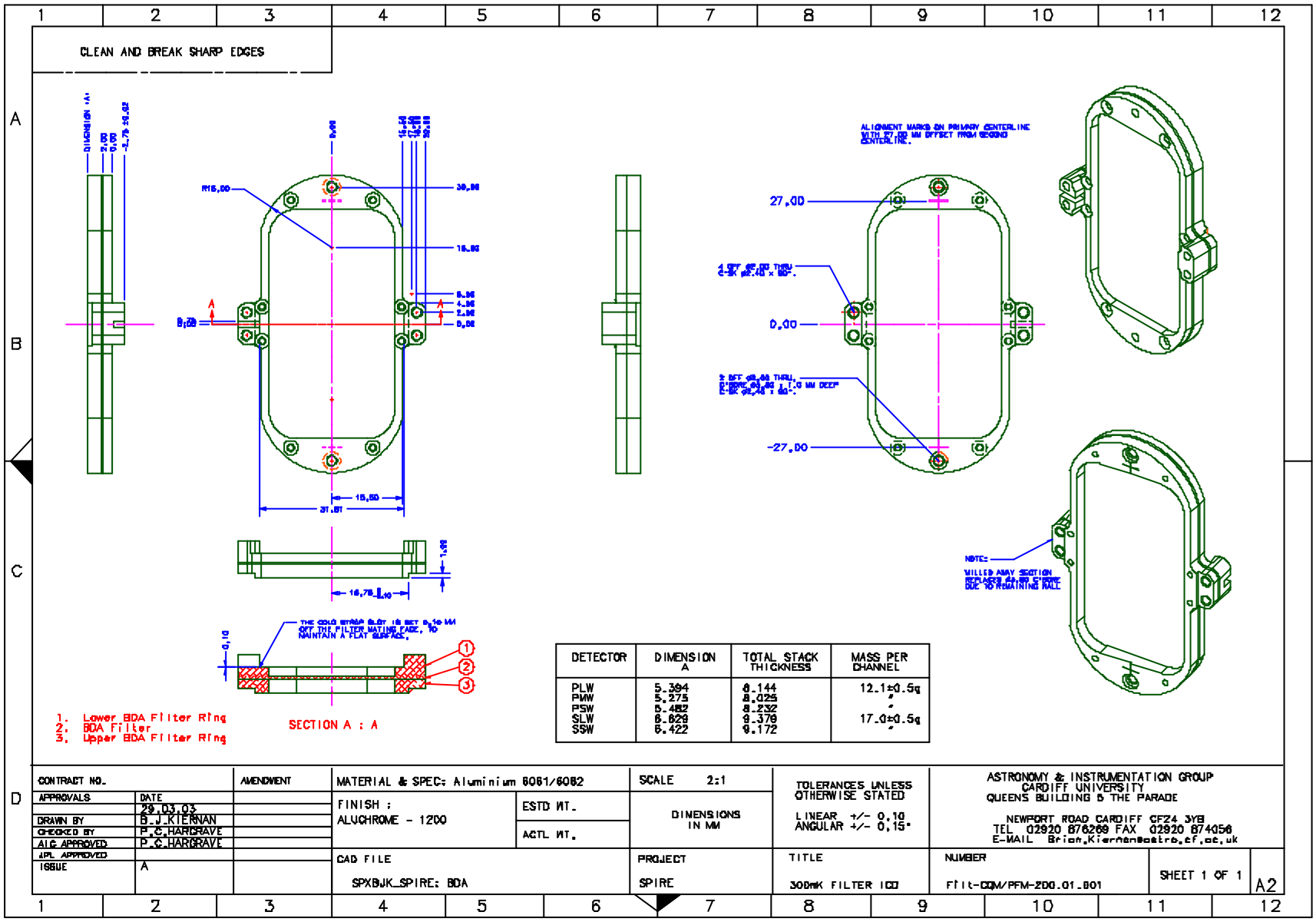

Figure 2 Interface drawing for 300mK filters

SECTION 07 - Functional, Block & Mechanical Drawings

Component drawings are given in this section. Also shown, for illustration purposes, are details of the mounting of the HDPE lens for each filter stack assembly.

FUNCTIONAL & BLOCK DRAWING LIST

Drawing No.	Title

MECHANICAL COMPONENT DRAWING LIST

Drawing No.	Title
FILT-CQM/PFM-200-01-004	300mK Filter
FILT-CQM/PFM-200-01-003	300mK Filter Upper Ring
FILT-CQM/PFM-200-01-002	300mK Filter Lower Ring
FILT-CQM/PFM-200-02-001	300mK Spectrometer Lens

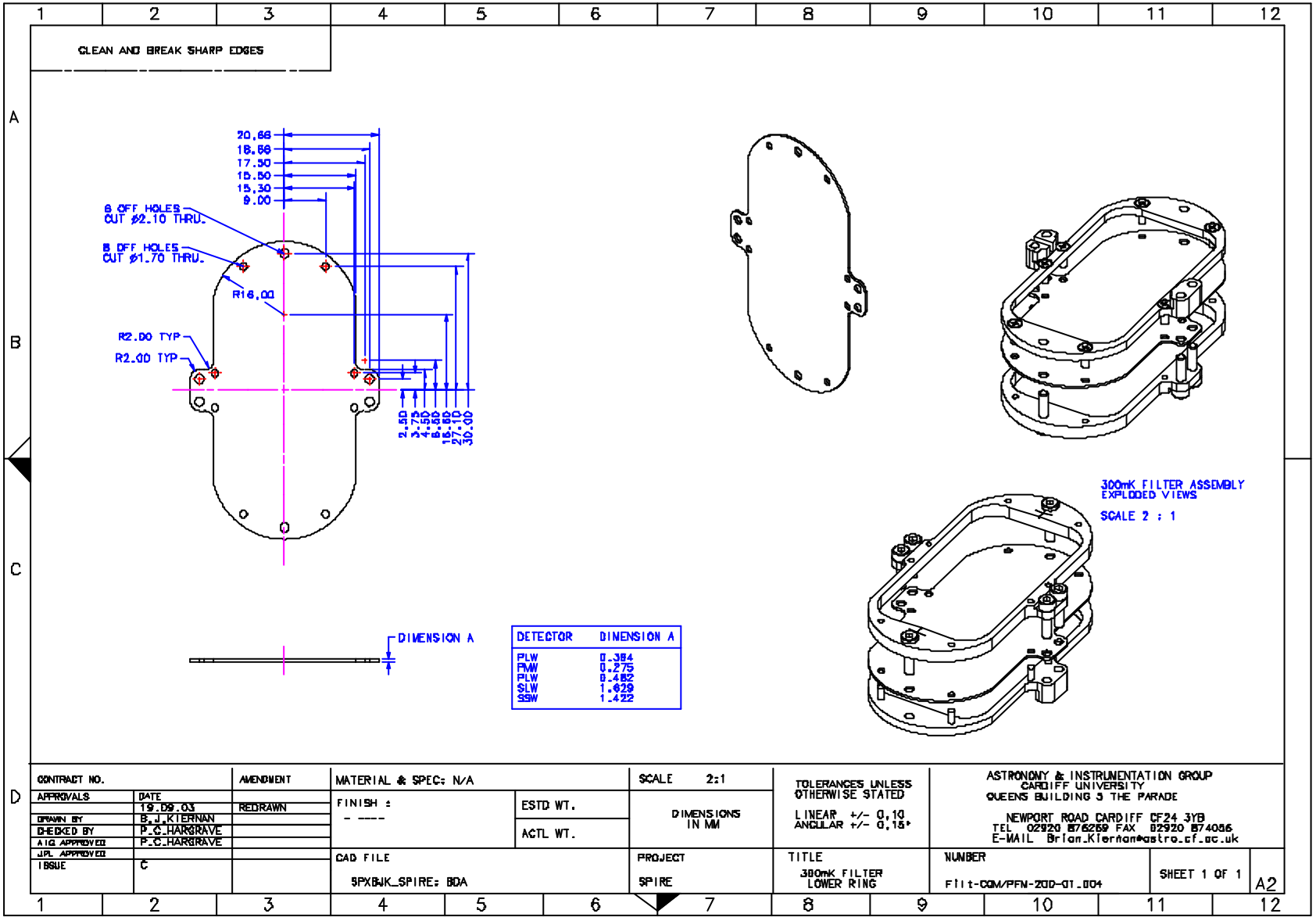

Figure 3 300mK Filter

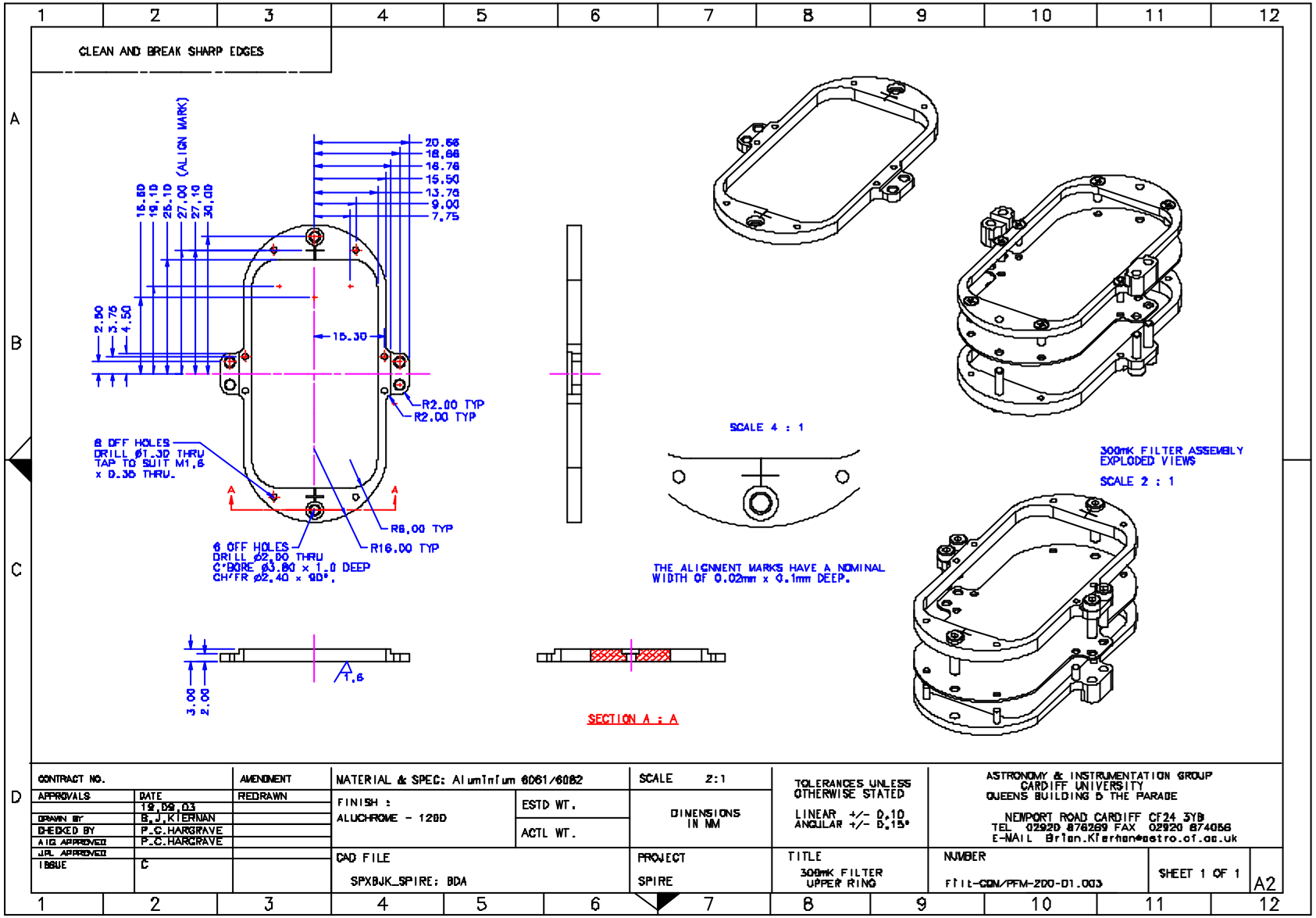

Figure 4 300mK Filter Upper Ring

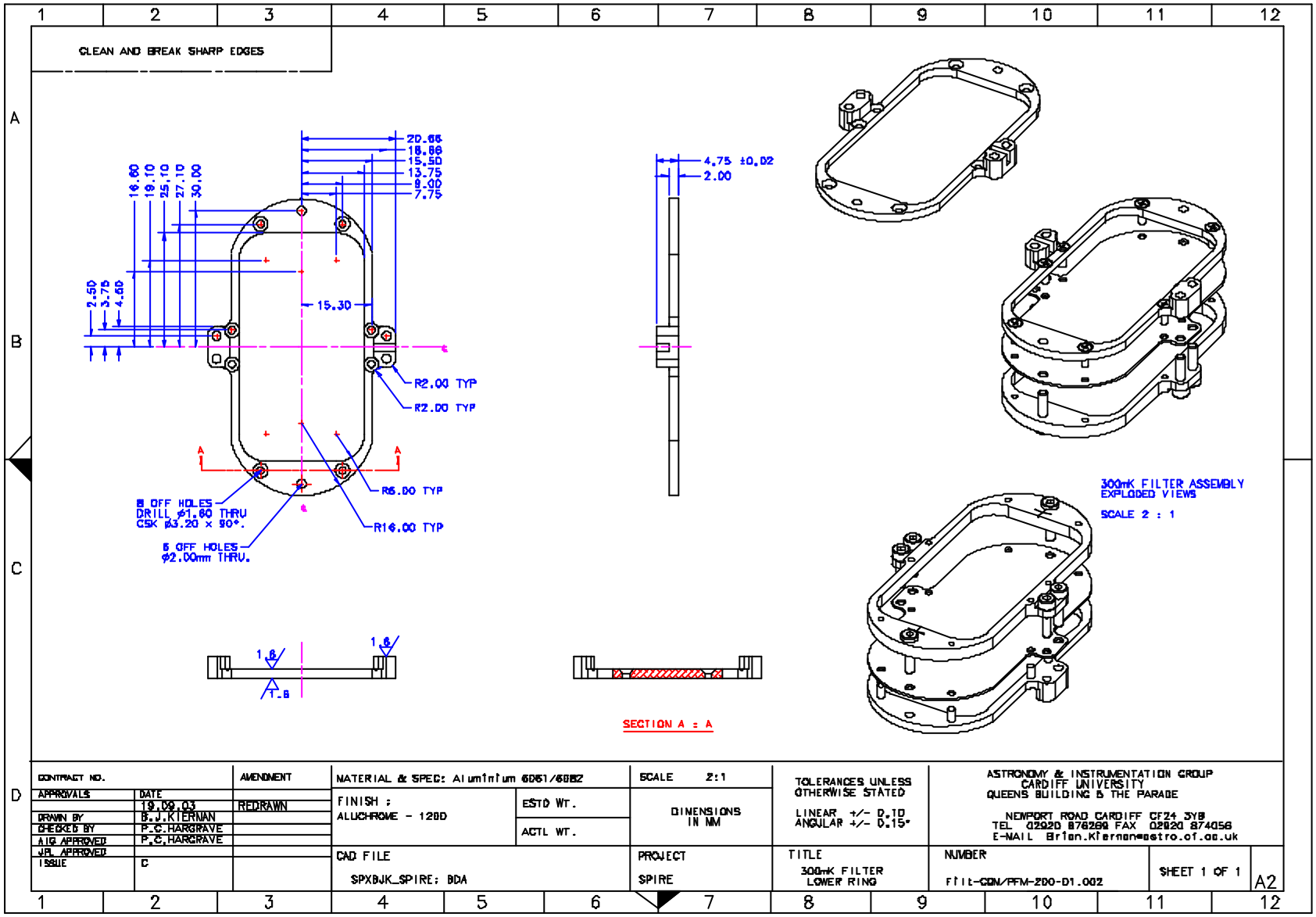

Figure 5 300mK Filter Lower Ring

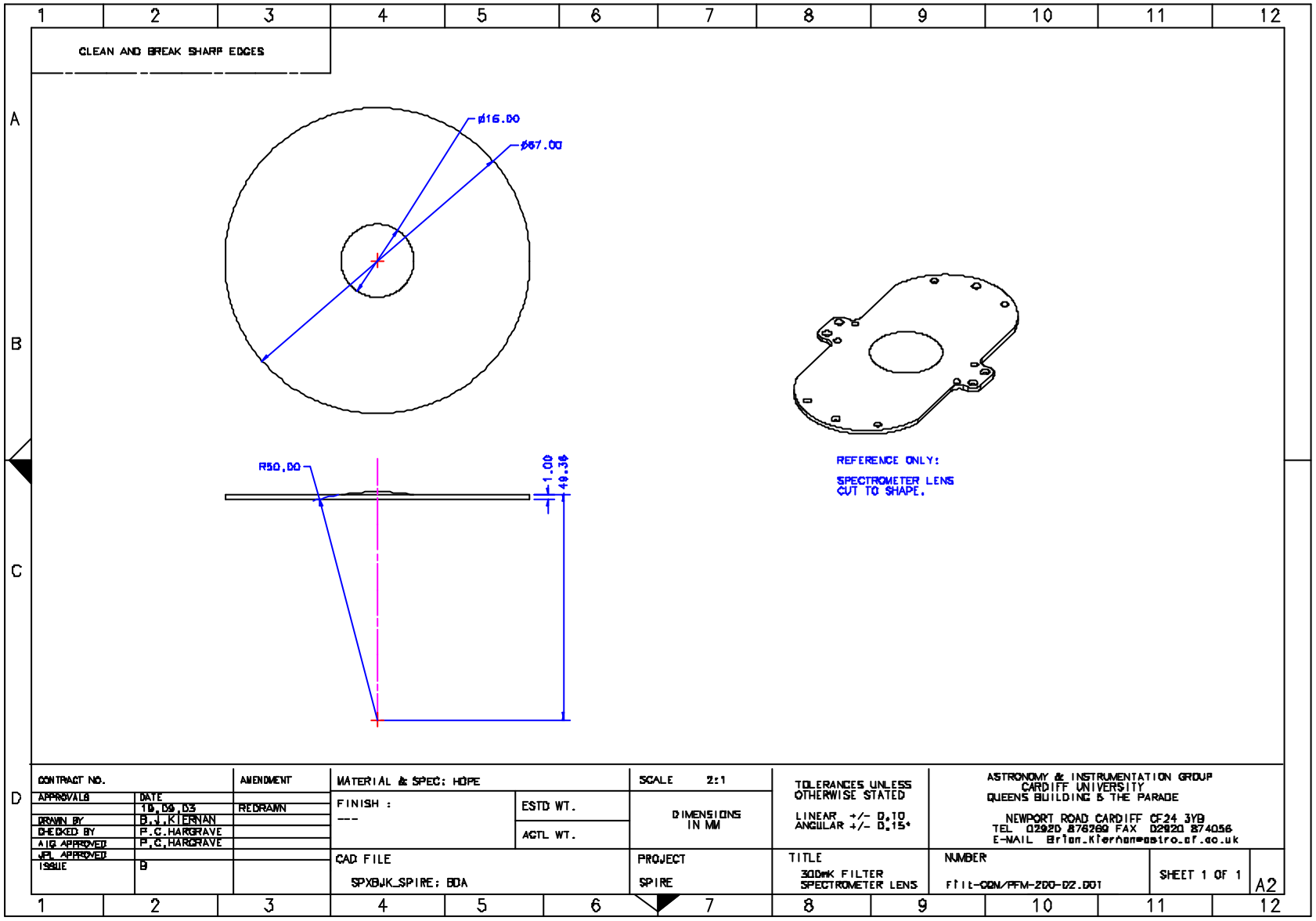

Figure 6 300mK Spectrometer lens

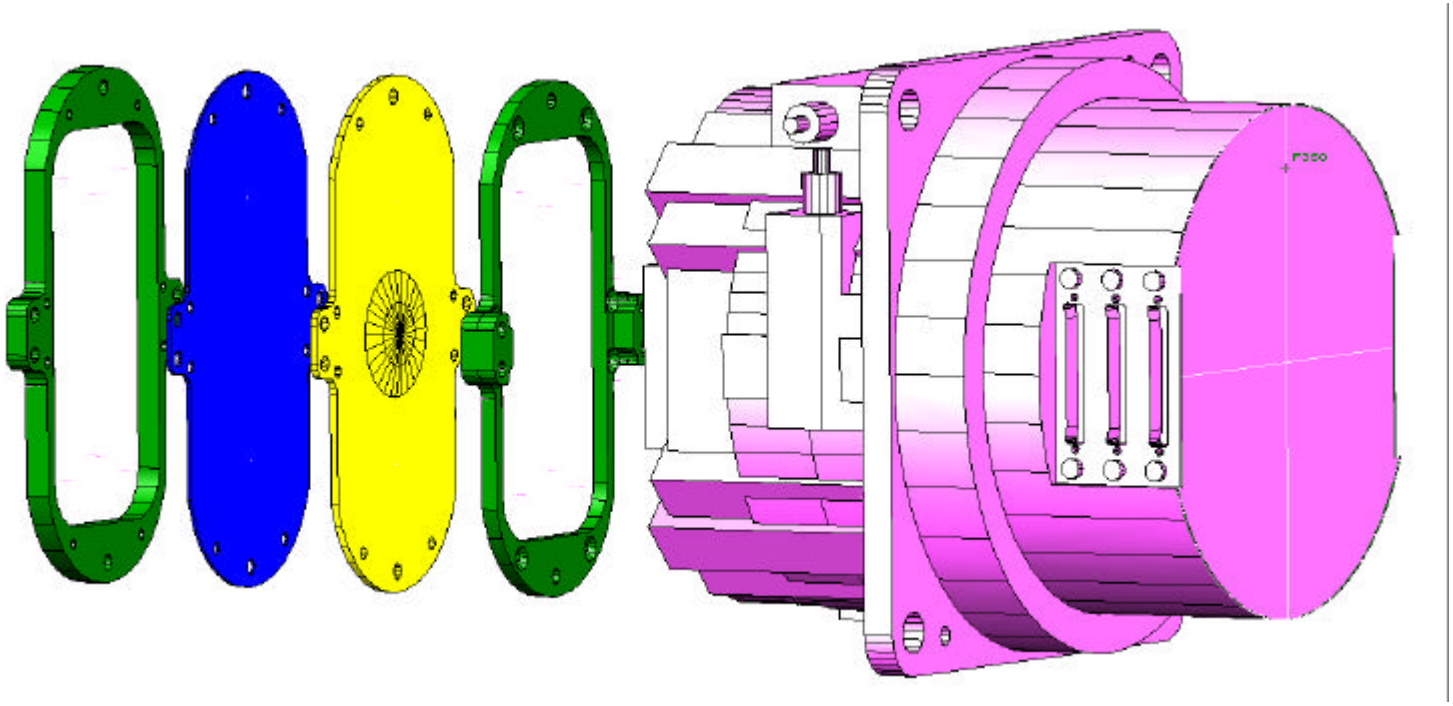

Figure 7 Location of spectrometer lens in 300-mK filter stack. Note that the SSW filter assembly has two filters and one lens in the stack.

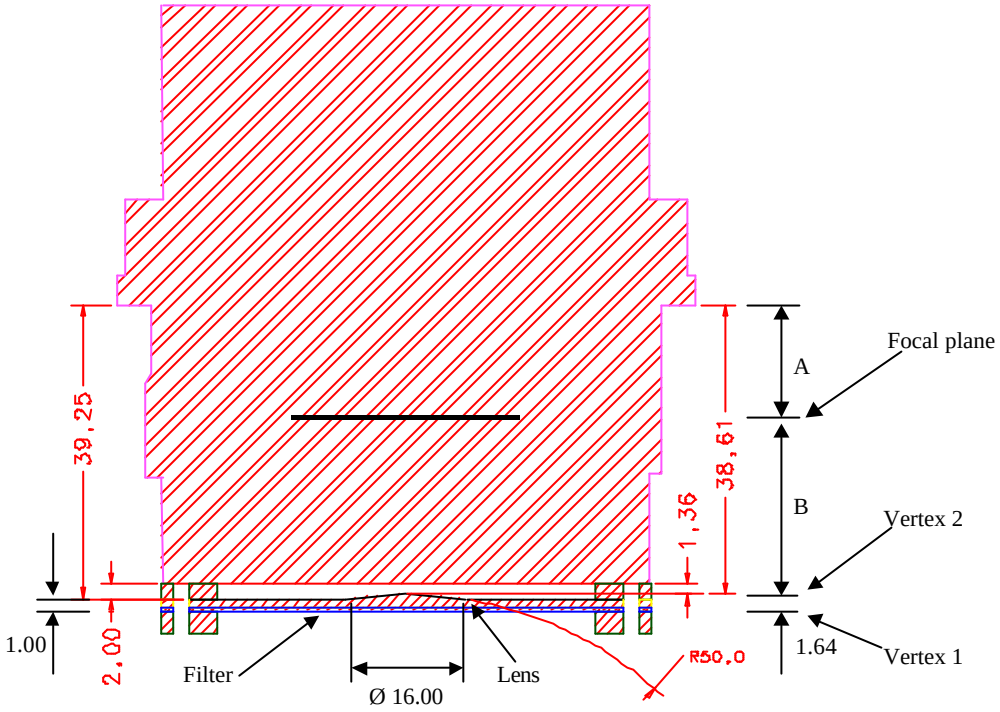

Figure 8 Dimensions of spectrometer lens – filter – detector assembly.

Table 1 Position of lens vertex and focal plane wrt detector mounting flange

	SLW	**SSW**
A (cf JPL ICD 9 Nov 2001)	36.9	26.7
B = 38.61 - A	1.71	11.91

SECTION 09 - As Built Configuration Items Status List

Item	Reference	Location	Notes
Filter drawings and manufacturing files		\\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_documents\ Filters\Drawings\300MK-filter-CQM-PFM.doc	
Material certificates of conformance		Available at Cardiff for inspection	
FILT-FS-220 Spectroscopic test data SSW-FS assembly		\\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_documents\ Issued\ Data\FILT-FS-220_FS_SSW_assembly_February2004.xls	
FILT-FS-223 Spectroscopic test data SSW-FS lens material		\\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_documents\ Issued\ Data\FILT-PFM-223_SSW_HDPE_October2003.xls	
FILT-FS-224 Spectroscopic test data SSW-FS SFIL4S		\\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_documents\ Issued\ Data\FILT-PFM-224_SSW_SFIL4S_October2003.xls \\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_documents\ Issued\ Data\FILT-FS-224_FS_SSW_SFIL4S_February2004.xls	Flight model and flight spare filters were cut from the same substrate material. The pre-cutting data for this component is held in the PFM file.
FILT-FS-225 Spectroscopic test data SLW-FS SFIL5S		\\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_documents\ Issued\ Data\FILT-PFM-225_SSW_SFIL5S_October2003.xls \\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_documents\ Issued\ Data\FILT-FS-225_FS_SSW_SFIL5S_February2004.xls	Flight model and flight spare filters were cut from the same substrate material. The pre-cutting data for this component is held in the PFM file.

Part number	Description	Details
FILT-FS-220	***FS SSW FILTER ASSEMBLY***	
FILT-FS-221	SSW PFM lower filter ring	Aluminium-6082 – Aluchrom 1200 coated
FILT-FS-222	SSW-PFM upper filter ring	Aluminium-6082 – Aluchrom 1200 coated
FILT-FS-223	SSW PFM lens	HDPE lens
FILT-FS-224	SFIL4S – PFM – B679 filter	60cm^{-1} LPE blocking filter
FILT-FS-225	SFIL5S – PFM – B650 filter	52.6cm^{-1} LPE band defining edge filter

SECTION 11 - List of Waivers

SECTION 12 - Copies of Waivers

SECTION 13 - Operations Manual

SECTION 14 - Historical Record

The following table contains *brief* historical details of the manufacture, assembly and testing of the FS 300mK spectrometer filter set, including the levels of environmental cleanliness.
A *full* historical record of every stage of manufacture for each individual grid integral to the final mounted filter is traceable at UWC, in both hard copy log-book format and on a Microsoft Access database.

SSW-FS Lens

Date	Action	UWC Test reference
13/08/02	HDPE material purchased from Goodfellow Cambridge LTD	Cat.# ET327980, order ref. LS241088/S K
16/10/02	Lens blanks embossed by Cardiff MEC centre, School of Engineering	Inspection report Q2217
06/08/03	Lens cut to size	Process HC1
06/08/03	SSW-FS lens thermally shocked 5 times between 77K and 350K	
06/08/03	SSW-FS lens cleaned & baked for 12 Hrs at 350K	
24/02/04	SSW-FS lens mounted in PFM-SLW stack	
24/02/04	FS-SSW stack final clean, 12Hr bake-out	
27/02/04	FS-SSW shipped to JPL	

Filter SFIL5S

Date	Action	UWC Test reference
4/7/03	Filter B650 manufactured in class 1000 clean room	
8/7/03	Filter B650 spectroscopically tested in the range 10-145cm-1	S2676r7
9/7/03	Filter B650 spectroscopically tested in the range 3-40cm-1	T0118r7
24/7/03	Filter B650 thermally cycled 2 x [300K-77K-300K)	
9/9/03	Filter B650 repressed	
10/9/03	Filter B650 spectroscopically tested in the range 3-40cm-1	T0174r12
11/9/03	Filter B650 spectroscopically tested in the range 15-140cm-1	T0175r7
16/02/04	Filter B650 cut to SFIL4S drawing	Process MC1
17/02/04	SFIL5S spectroscopically tested for uniformity in the range10-145cm-1 – Three locations over area	T0272r16, T0272r19, T0272r22
24/02/04	SFIL5S mounted into 300mK SSW-FS filter assembly	

Filter SFIL4S

Date	Action	UWC Test reference
8/8/03	Filter B679 manufactured in class 1000 clean room	
11/8/03	Filter B679 spectroscopically tested in the range10-145cm-1	T0150r7
11/8/03	Filter B679 thermally cycled 5 x [300K-77K-300K)	Therm0031
11/8/03	Filter B679 spectroscopically tested in the range 3-40cm-1	T0150r13
16/02/04	Filter B679 cut to SFIL5S drawing	
17/02/04	SFIL4S spectroscopically tested for uniformity in the range10-145cm-1	T0272r7, T0272r10, T0272r13
24/02/04	SFIL4S mounted into 300mK SSW-FS filter assembly	

SSW FS filter stack assembly

Date	Action	UWC Test reference
24/02/04	Filters B650, B679 and lens mounted into SSW-FS assembly.	
24/02/04	SSW-FS filter stack measured on clean room CMM	
24/02/04	SSW-FS filter stack thermally shocked 2 times between 77K and 350K while mounted on invar BDA replica	
25/02/04	SSW-FS filter stack re-measured on clean room CMM	
26/02/04	SSW-FS stack assembly spectroscopically tested for uniformity in the range10-145cm-1	S2683r4, S2683r7
26/02/04	Final cleaning, followed by 8Hr bakeout (350K)	
27/02/04	FS-SSW assembly shipped to JPL	

SECTION 15 - Logbook / Diary of Events

Not provided – available from subsystem provider upon request.

SECTION 16 - Operating Time / Cycle Record

SECTION 20 - Calibration Data Record

The recommended total stack transmission for the FS SSW channel to be used for calibration purposes is indicated in this section.

Important notes on these data:-

- It was not possible to measure the transmission of the stack assembly through the central area of the filter stack, due to the presence of the lens. The lens would change the FTS beam and make background measurements impossible. Therefore the data shown in Figure 9 are only indicative of the transmission through the central section with the lens.

- For the SSW stack, the data shown in Figure 9 were calculated as follows:-
    - Measure the filter transmissions individually
    - Measure the HDPE lens material transmission through the 1.0mm thick planar areas
    - Combine these data to calculate the total transmission of the stack (shown in red)
    - Measure the transmission of the stack, either side of the lens to verify the calculated transmission

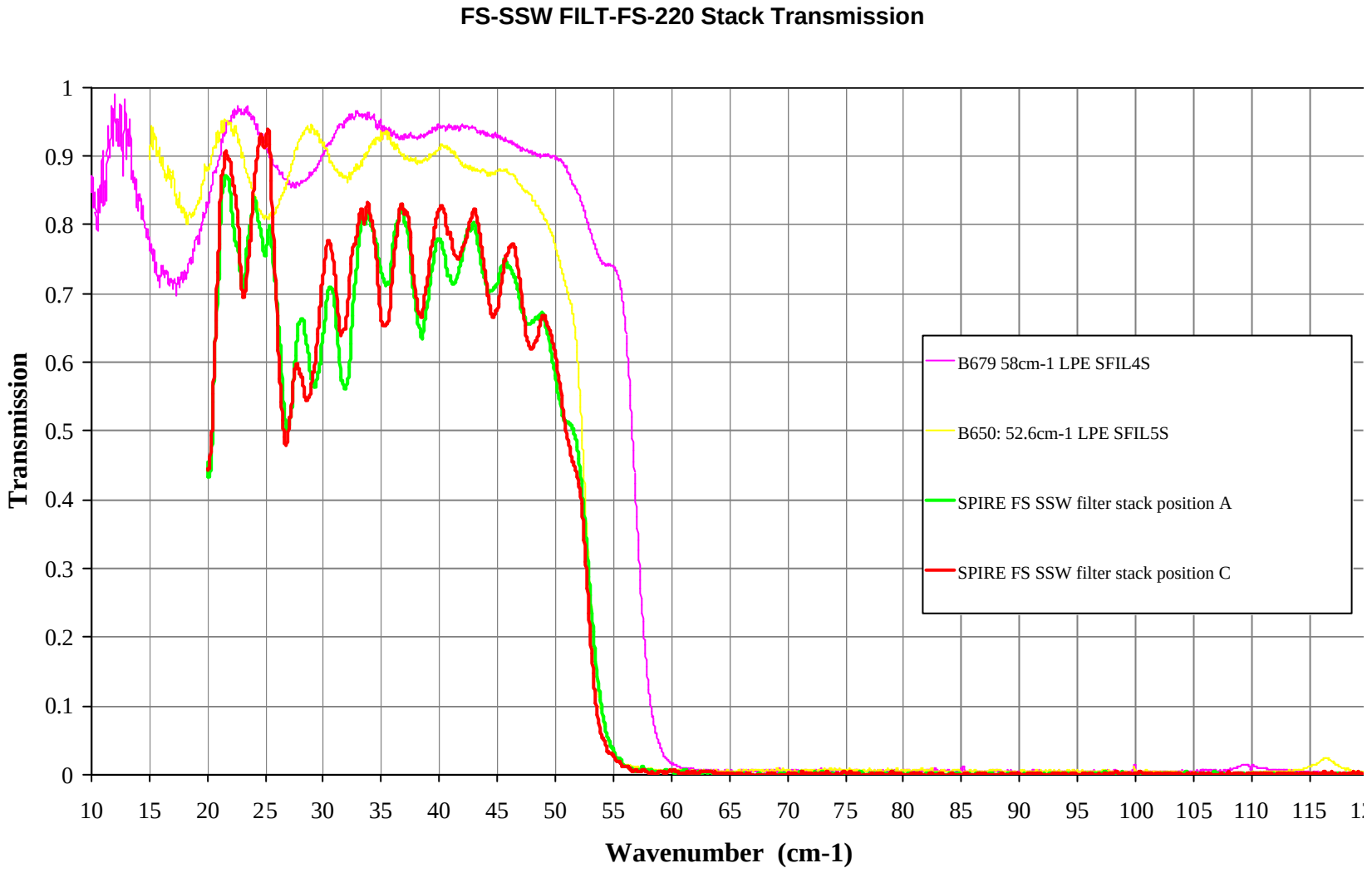

Figure 9 Spectroscopic data for FS-SSW stack. The total stack transmission is shown by the red and green traces.

SECTION 21 - Temporary Installation Record

SECTION 22 - Open Work / Deferred Work / Open Tests

SECTION 23 - List of Non-Conformance Reports

SECTION 24 - Copies of Non-Conformance Reports

SECTION 25 - Test Reports

The filter module underwent the following series of qualification tests:-

a) Post-manufacture spectroscopic measurements of the filter material
b) Thermal shocks of the filter material. This consists of between five cycles of:-
    - Plunge filter material at room temperature into bath of liquid nitrogen and leave for 2 minutes
    - Remove filter material from LN_2 and place in oven at 353K for 10 minutes
c) Visual inspection
d) Post-thermal shock spectroscopic measurements
e) Cutting to size
f) Visual inspection
g) Spectroscopic measurements of filter material at three points over the filter area
h) Second thermal shock cycle – repeat of step (b)
i) Visual inspection under microscope
j) Spectroscopic measurements of filter material at three points over the filter area
k) Mounting filter material in clamp assembly
l) Spectroscopic measurements of mounted assembly
m) Thermal shocks of filter assembly – repeat step (b)
n) Final spectroscopic measurements of filter assembly – 3 points over filter area

Spectroscopic tests – index

Spectroscopic tests were carried out according to standard UWC FTS procedures. Refer to historical record for index.

Spectroscopic test details

- Uniformity checks:-
    - Filter components were checked for uniformity at three points along the filters long axis - at the centre of the filter, and at two points along the long axis, 16mm either side of the central point.
    - The FTS geometric beam footprint was approximately 7mm diameter.
    - The SSW stack transmission was measured at the two 16mm off-set points, but not through the centre point, for reasons discussed earlier (section 20)

FS-SFIL4S

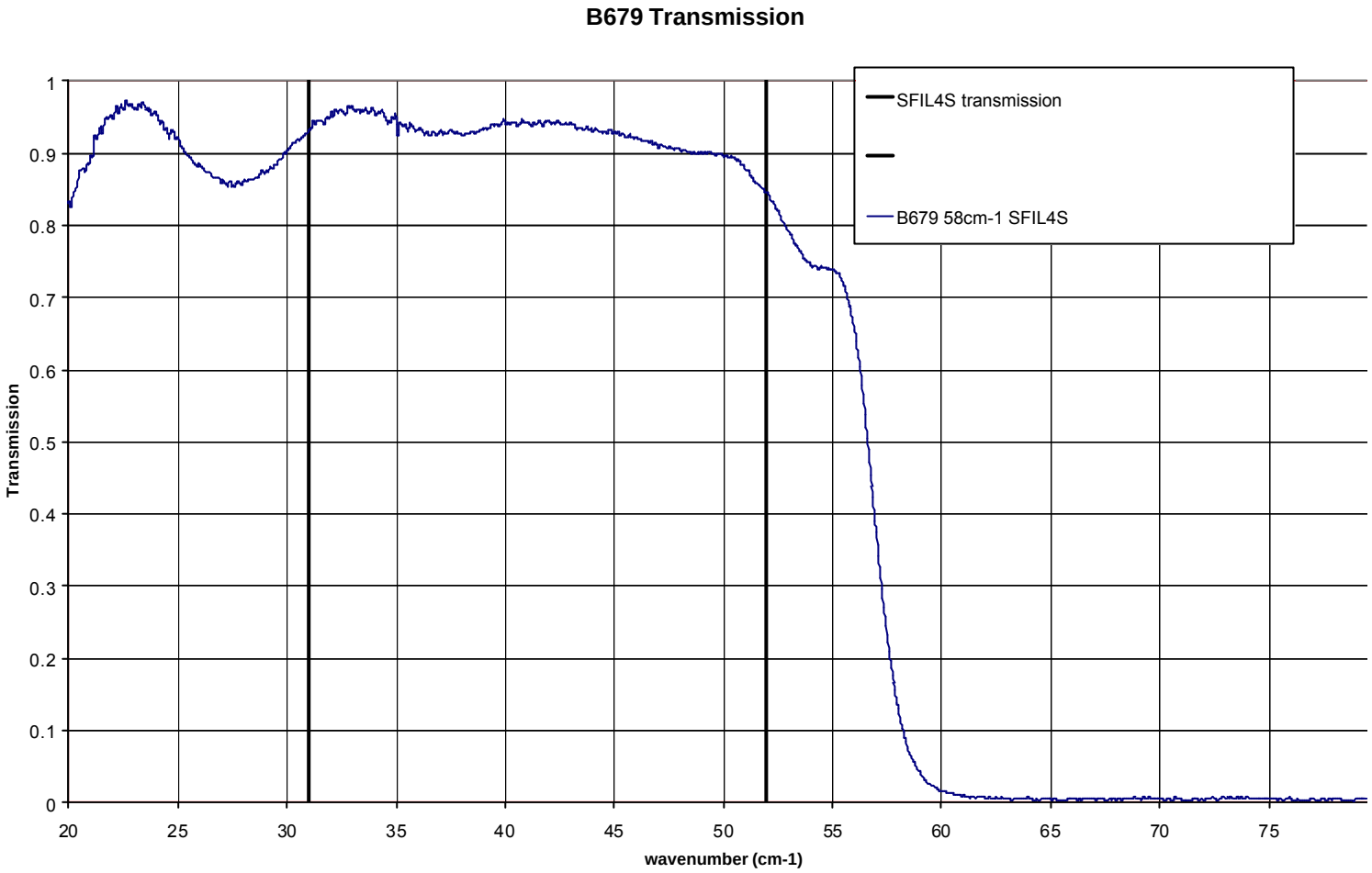

Figure 10 B679 SFIL4S FILT-FS-224 pre-thermal shocking

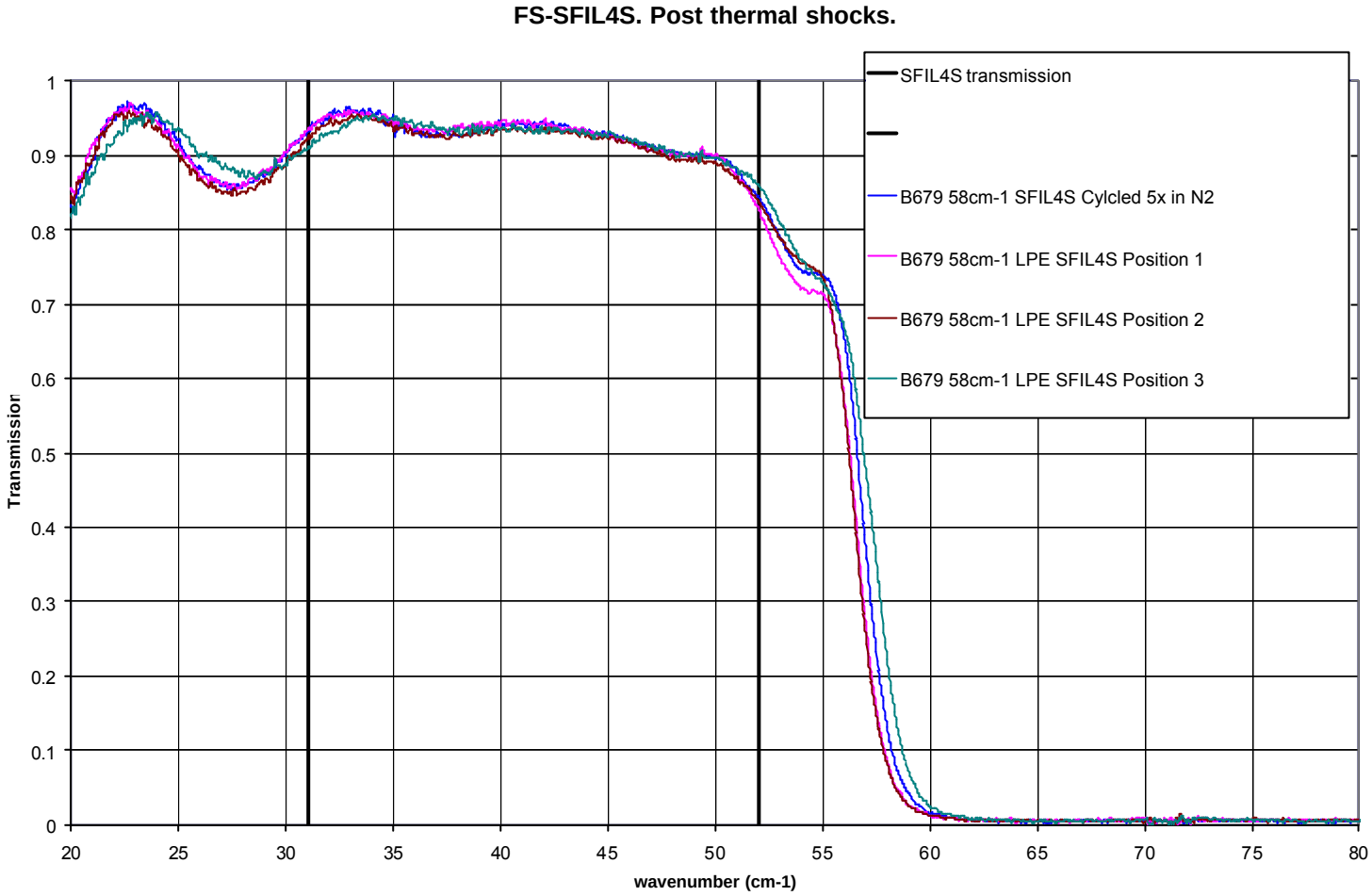

Figure 11 B679 SFIL4S FILT-FS-224 post-thermal shocking, and uniformity data

FS-SFIL5S

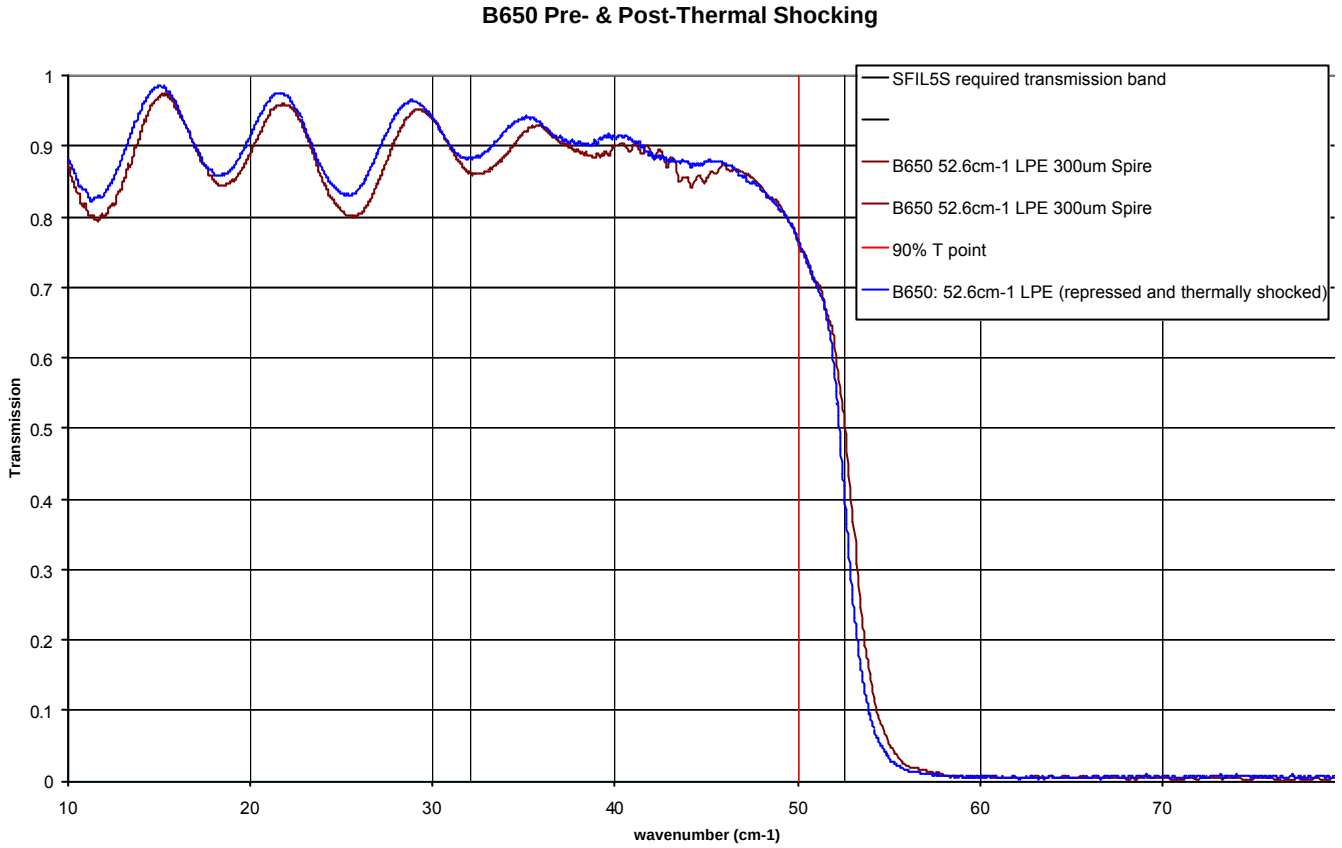

Figure 12 B650 SFIL5S FILT-FS-225 pre- and post-thermal shocking data

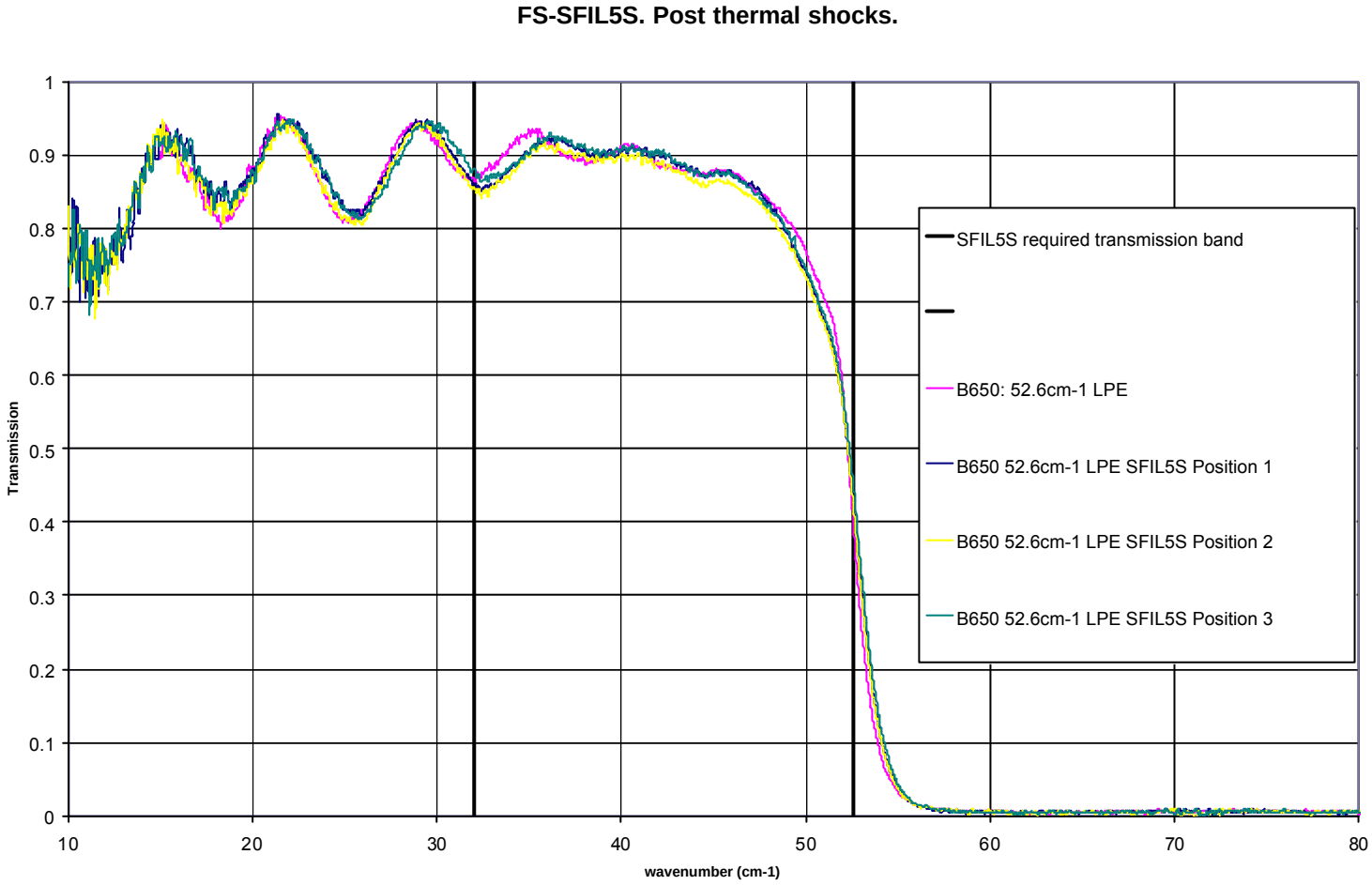

Figure 13 B650 SFIL5S FILT-FS-225 uniformity data

FS-SSW Lens

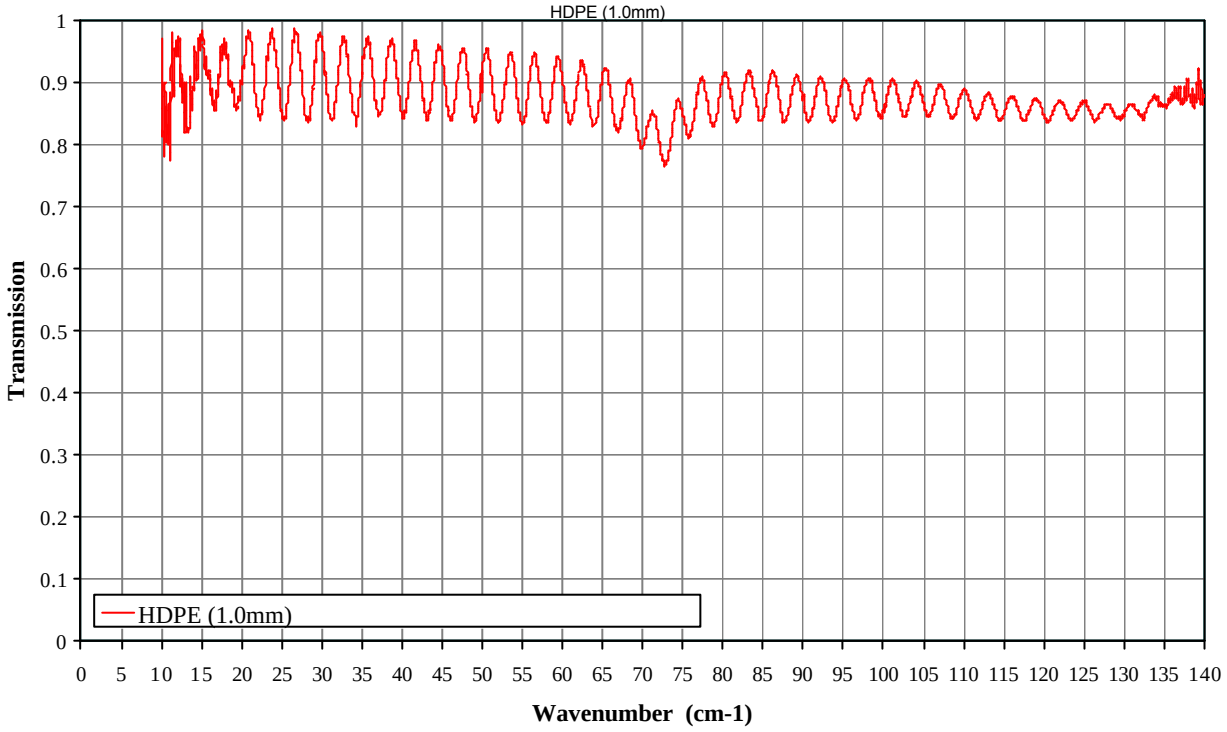

Figure 14 Transmission of 1.0mm thick planar section of PFM-SSW lens

FS-SSW Filter Stack Assembly

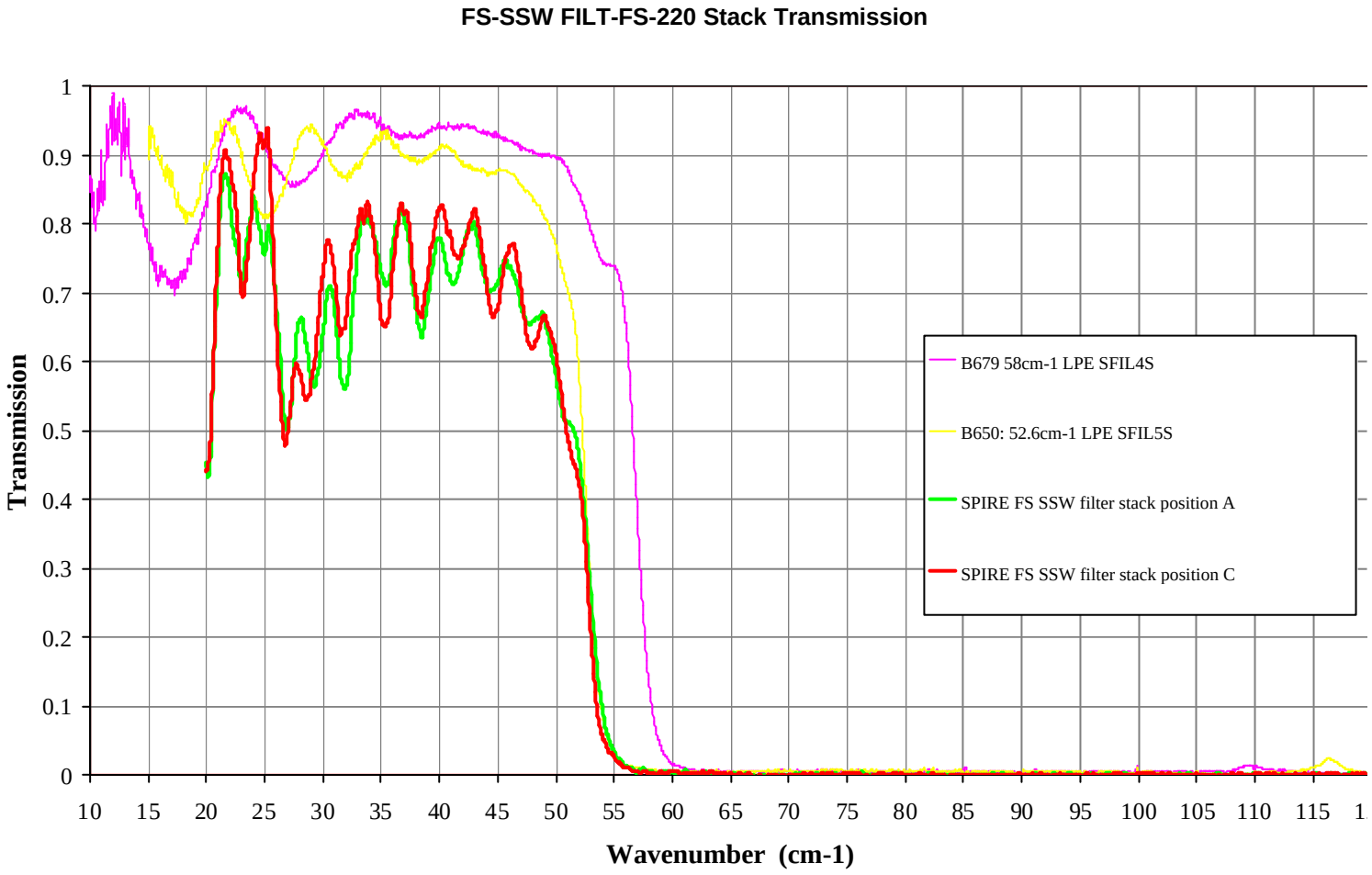

Figure 15 Transmission of assembled SSW filter stack, including lens. Spectra were measured only on the planar sections of HDPE either side of the lens.

FS-SSW Metrology Report

The SSW assembly was measured on the coordinate measuring machine in the Herschel-Planck clean room at Cardiff. The metrology points indicated below were measured both before and after the final sequence of three 350K – 77K thermal shock cycles.

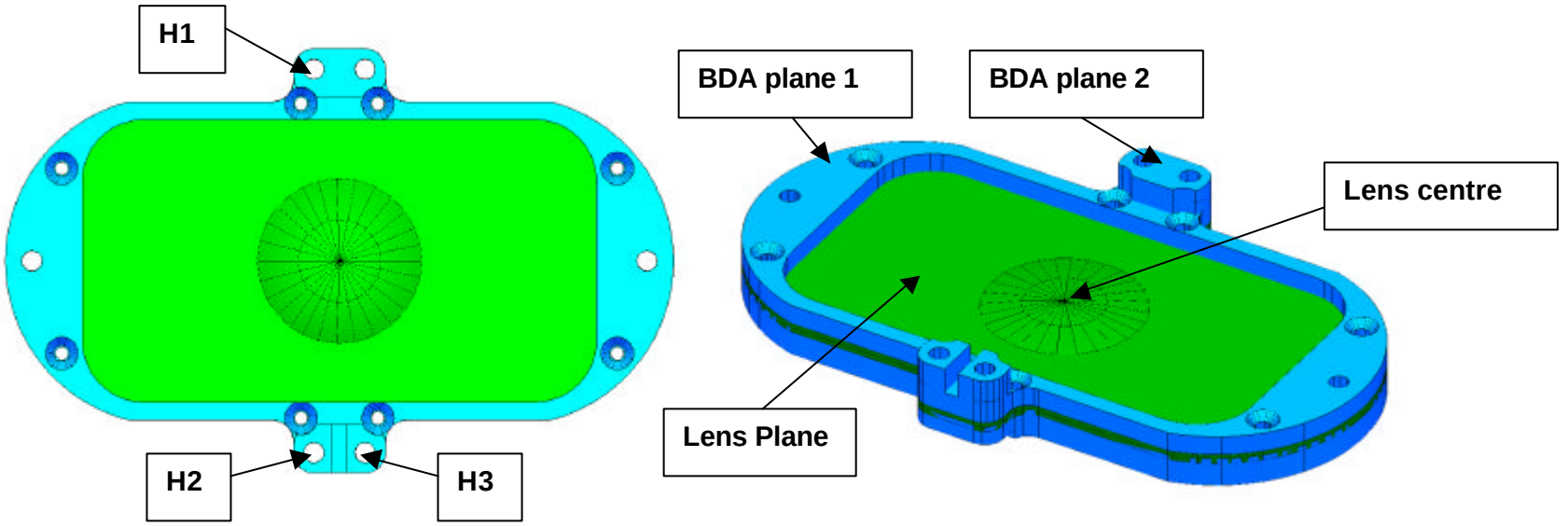

Table 2 Metrology results for SSW assembly

Distance (mm)	Before thermal shocks	After thermal shocks
H1 – H2	37.244	37.250
H2 – H3	4.999	4.999
BDA plane 1 – BDA plane 2	2.002	2.002
BDA plane 1 – lens plane	-2.003	-2.004
BDA plane 1 – lens centre	-1.446	-1.445

The specifications for the distance of the lens apex (centre) to BDA plane 1 are 1.36±0.1 mm (LAM.LOOM.SPIRE.NOT.2002.001-2 – tolerance not stated in document, but confirmed verbally).

SECTION 27 - Reference List of EIDP's

Associated

Title (Listed in alphabetical order)	ID (Serial No.)	Acronym	Document No.	Issue	Date
SSW BDA FS EIDP					

Lower Level

Title (Listed in alphabetical order)	ID (Serial No.)	Acronym	Document No.	Issue	Date

SECTION 28 - Mass Records

Assembly	Final measured mass
FILT-FS-220 – FS-SSW assembly	10.959 ± 0.002 g

SECTION 29 - Cleanliness Statement

SECTION 30 - Other Useful Information

SECTION 31 - DPL/DML etc

SECTION 32 – List of Appendices/Attachments

Appendix #	Title (Listed in alphabetical order)	Document No.	Issue	Date	Notes